“Fuel Management & Efficiency Improvement at DTPS for Sustainable Growth”

Vijay Dali
AVP (Operations ) Dahanu TPS

Anirudha Asawa
DGM (Operations )Dahanu TPS
Dahanu Thermal Power Station
Flow of Presentation

- Company Profile
- DTPS at Glance
- Initial Experience with Indian Raw Coal Firing
- Criteria for Coal Blending
- Adoption of imported coal at DTPS
- Operational Observation
- Coal Logistics (Indian and Imported)
- Blending Mechanism
- Practices with blended coal
- Boiler Performance with Blended Coal
- Innovative Maintenance Practices
- Energy Monitoring System
- Conclusion
R-Infra Emerged as Winner and Voted one of the India's 10 Most Admired Companies
DTPS at a Glance

Commercial Operation
- Commercially Operating Since 1995-96
- Catering Power to Commercial Capital Mumbai

Environmental Performance
- Best Environmentally Performing Power Plant
- Dahanu Operating in Eco Sensitive Zone and following Stringent Environmental Norms

Awards & Recognition
- Winner of More than 100 National & International Awards

System Approach
- DTPS is also certified for QMS, EMS, OHSAS, ISMS and SA

Performance
- More than 100% PLF Achieved for Last Consecutive 6 years & Overall 8 times since 2003-04
DTPS at a Glance

DTPS Geographical location

Well connected by Western Railway & National Highway No. 8

At a distance of 128 Kms from Mumbai

Surrounded by two natural Creeks - Savata and Dandi

Surya Dam nearby – 32 kms
Land (hectares)

Total land: 821.58
Land for Plant: 351.58
Land for Ash disposal: 370.00
Land for Colony: 100.00
About Dahanu TPS

The setting up of the Plant was approved in 1989 for 2 x 250 MW capacity.

First Synchronization
Unit – I - January 1995
Unit – II - March 1995

Station Commercial operation
- July 1995/Jan 1996

Till date Running Hours
Unit – I - 1.38 lacs
Unit – II - 1.35 lacs
1998 Quality Management System ISO 9001
1999 Environment Management System ISO 14001
2000 RAMCO ERP Package implementation
2001 ISO upgradation
2002 Optic Ground wire (OPGW) & Backbone data highway
2003 SAP & Employee self service implementation
2004 British Safety Council Audit
2005 Benchmarking in CII
2005 Six Sigma Drive I
2005 HR Mercer study
2006 Occupational Health and Safety Assessment Studies OHSAS 18001
2006 Knowledge Management
2006 Six Sigma Drive II
2007 Social Accountability SA 8000
2008 Integrated Management System (ISO 9001, ISO 14001, OHSAS 18001)
2008 Information Security Management System ISO 27001
2009 SAP ECC - In place of RAMCO
2010 Ramkrishna Bajaj National Quality Award
Initial Experience with Indian Raw Coal

Overall performance of power plant was adversely effected due to increase in coal consumption and variation in parameters like GCV, Ash content by using Raw coal.

Following were the problems with Raw Coal:

1. Not able to achieve Full load
2. Reduction in reliability and availability of units with increase in failure of boiler pressure parts and coal mills
3. High Auxiliary power consumption
4. High Ash
5. Poor Flame intensity & stability
6. Variation in Steam parameters
Operational Observations Raw Coal Firing

- Flame quality is not good at upper furnace elevation
- Flame color is blackish or pinkish in shade
- Wide variation in Boiler parameters observed
- Water wall and LRSB operation more, Continuous spray required for controlling MS temperature
- Poor combustion and unstable flame condition at partial load
- More ash deposition observed in Boiler during shut down
- Faster erosion at the coal burner
Operational Observations Raw Coal Firing

- Mill classifier outlet temperatures were maintaining on higher side
- To control High Mill outlet temperature, mill Hot / cold air dampers kept in auto and modulating as per temperature
- Frequent ball (Grinding Media) top up required & ball loading on higher side
- Wear and tear of mill liners and balls on higher side
- PA header pressure set point was maintained higher than designed
- High Boiler exit flue gas temp (APH Outlet)
- Increase in ESP loading due to high Ash content
Criteria for Coal Blending

- Grindability
  - Heating Value
- Moisture
- Ash content & Composition
  - Volatile Matter
Grindability

HGI is the measure of coal hardness

- Higher the HGI value softer (Easy to Pulverize) is the coal
- HGI of coal generally varies from 45-100
- HGI is more sensitive to coal moisture content.
- The constituent coals in the blend behave as separate coals in the pulverizer rather than as a homogeneous blend.
- HGI values are not generally additive for coal blends.
- The grindability of coals with substantially different HGI values cannot be improved by blending.
- Selective grinding of coal in pulverizes takes place, softer coal grinds first and fed to the furnace while harder retain for more time
Heating Value

The heating value is generally additive for blends. Blending a certain amount of a lower / higher heating value coal maybe possible before capacity restraints are reached.

Erroneous blending may affect the

- Capacity of the furnace
- Coal and ash handling systems
- Burners

*The GCV of blended coal should be nearer to the design valve*
Moisture

Moisture content is generally additive for blends.

Increased moisture content affects

- Coal handling and storage (coal flow properties)
- Pulveriser capacity
- Lowers thermal efficiency of boiler (energy loss due to the latent heat of vaporisation)
- Increases the flue gas volume flow rate - effect on fans, air preheater and pollution control equipment.
Volatile Matter

Volatile matter affects the following

- Pulveriser inlet/outlet temperature and required fineness
- Burner settings
- Ignition
- Flame shape and stability
- Burnout and carbon content of fly ash
ASH content & Composition

Ash content affects the following:

- Ash handling systems & ESP Performance
- Pulverisers (abrasion)
- Soot blowing intervals (slagging and fouling propensity, erosion)
- Unburnt carbon in ash
- Flame stability
Adoption of Imported Coal in DTPS

- DTPS has two units of 250 MW each using coal as primary fuel.

- The allotted quota of raw coal is not adequate, as there is a huge gap between demand and supply of indigenous coal.

- Shortfalls in domestic coal supply.

- Progressive degradation in coal quality.
Adoption of Imported Coal in DTPS

- DTPS started importing coal since 1998-99, to bridge the shortfall and to maintain the reliability of the plant.

- Blending with good quality imported coal helps in reduction of ash content and improvement in GCV of as-fired coal.

- Improves combustion, flame stability and heat release rate by a fuel that burns substantially as a gaseous mixture when combusted.
Adoption of Imported Coal in DTPS

1. Loading factor improved & PLF achieved more than 100% consistently
2. Failure of equipments in CHP & AHP reduced
3. Plant Reliability and availability improved by reduction in tube leakages, equipment break down
4. Environmental parameters improved
5. Aux. power reduced
6. Loading factor improved & PLF achieved more than 100% consistently
7. Overall performance improved

Commercial operations
F-grade Coal

Indian raw coal + Imported coal

1995-96 1st Phase 1999 2nd Phase 2001 3rd Phase 2006

Wash coal + various grades of imported coal

LCV coal is generally used as a partial substitute of Indian wash coal due to acute shortage of washed coal. The same level of performance is maintained.
Operational Observations Blend Coal Firing

- Increase in Volatile matter due to blending, increases the Combustion efficiency.
- High volatile matter decrease the coal consumption but due to lean mixture explosion in pulverizes may occur.
- Restricting Volatile matter within safe limit by blending appropriate coal can prevent explosion in pulverizes.

Flame at all elevation is bright with red colour and also stability is good.

Flame instability aspects such as furnace pressure fluctuations or weakening of scanner signals were not experienced, as the imported coal was having a higher volatile matter.

While firing blended coal furnace found to be bright and stable near firing zone.
Operational Observations Blend Coal Firing

Bright Furnace bottom there by indicating less unburnt carbon and complete combustion.

During the blended firing, the water wall deposits were easily removable. blended firing has not resulted in any hard deposits that are difficult to remove

The Gas temperature trend along horizontal and second pass indicate that blended firing has not affected the heat absorption in Reheater, LTSH and economizer

blended firing resulted in lesser super heater spray than with firing Indian coal alone indicating better furnace heat absorption.

Acid Dew Point was observed to be similar to Indian coal. Hence, blended firing is not likely to pose problems with respect to Acid Dew Point and cold end corrosion.

In general NOx emissions reduce on blended firing
## Operational Observations Blend Coal Firing

- Mill classifier outlet temperatures are maintaining normal while Hot air damper 100% opened and cold air damper remain closed.
- Hot PA header pressure set point reduced nearer to design value.
- Total coal flow reduced.
- Due to reduction in Coal Flow, requirement of combustion air reduced because of which fan loading also reduced.
- Coal Mill balls loading reduced.
- Due to reduction in coal flow & Ball loading Mill loading decreased.
- Mill changeover & maintenance reduced.
Operational Observations Blend Coal Firing

- Frequency of Mill balls top up reduced and life of liners and balls increased.
- Lower erosion at the coal burner and Flue gas path & boiler tubes due to low ash.
- O&M cost reduced.
- ESP loading decreased due to low ash content.
- Loading factor improved consistently.
- Failure of equipments in CHP & AHP reduced.
- Plant Reliability and availability improved by reduction in tube leakages, equipment break down.
- Environmental parameters improved.
Coal Logistics : Domestic

Transportation

Spectrum Washery

80% Yield WC

Transportation, Loading up to Railway siding

Rail Freight

Mines to Dahanu ~ 1400 Kms

Dipika Mines, Korba

Coal Logistics : Domestic

Transportation

Spectrum Washery

80% Yield WC

Transportation, Loading up to Railway siding

Rail Freight

Mines to Dahanu ~ 1400 Kms

Dipika Mines, Korba
Coal Logistics : Imported

Loading Point, Freigh & Insurance

Dahanu High Sea

Barges

Maximum 1000MT capacity

12 Kms

Mines

Dahanu Stockyard

Transportation (from Jetty to Coal Stockyard)

DTPS Jetty

Coal Logistics : Imported

Confidential
Coal Flow Diagram
Blending Mechanism

Two different grades of coal are mixed uniformly in predetermined proportion for achieving desired calorific value. Blending of coal is done on conveyor and as per requirement.

Two / three different grades of Coal are lifted from separate locations. Lifting rates / flow is predetermined and is monitored through Belt Scale by the operator as well as from Control room.

These different grades of coal are fed on a single conveyor (three locations) There are minimum two transfer points where these three grades of coal get mixed uniformly (due to free fall of about 8-10 meter) before being fed to bunker. During bunkering, there is another free fall of coal. The process itself ensures proper blending of two/three coal.
Precautions during Blending of Coal

- In case of any stream selection, feeding of ‘A’-grade coal has to be started last, only after feeding of Indian coal has been started and normalized.

- In the event of stoppage in any of the stream, it has to be ensured that feeding from the other stream has also been stopped.

- The proportion/feeding of different grades of coal shall be closely monitored from the belt scales provided in CHP Control Room.

- The coal flow for different grades of coal for various ratios maintained, considering total coal flow as design capacity of CHP.

- MCV and HCV cannot be fired simultaneously.
Practices with Blended coal

- Soot blower Operations to overcome Low Main steam & Reheater temperatures

  . Initially during Blended Coal firing Main stream & Reheater temperature were maintaining on lower side.
  . To maintain the Reheater temperature burner tilt remaining continuously at +30° due to which main steam temperature started maintaining on higher side which required higher spray.
  . To maintain required MS & RH temperature frequency of WWSB & LRSB operation was more.
Soot blower operation Optimization

The original design of soot blowing systems for most existing plants consists of blowing cycles based on time or the intuition of the boiler operator. Often soot blowing was done on a once a day or once a shift basis, regardless of actual plant parameters.

Effects of Traditional Approach

- Timed based approach typically results in over cleaning
- Excessive use of steam is an economic penalty for this type of operation
- Results in the around 80% variation in the main-steam & re-heat temperatures
- High furnace exit flue gas temperature
- Lower efficiency
- Erosion of tubes
√ A scheduler software is prepared in house.
√ With the entry of the key attributes the schedule of the next six days is what operator can see on the software screen.
√ It manages the task of scheduling Water Wall & Long Retractable soot blowing so that the operators do not have to focus on this activity and manually initiate the sequences.
√ Blowing the right regions at the appropriate times has also reduced boiler exit gas concerns, which often resulted in over blowing already clean areas.
Reheater Temperature maintained by operating Burner Tilt in AUTO mode.

Availability of Long Retractable soot blowers ensures the cleanliness of heat transfer surfaces to improve Heat pick up from Flue Gas.

Regular preventive maintenance of burner tilts and Secondary air control dampers carried out to have desired effects of the boiler cleaning through soot blowers operations. After regular soot slowing and scheduling, deposition reduced to considerable extent.

SADC operation is done manually by keeping Aux air damper constant and Fuel air Damper are kept 50% opened at working elevations for proper combustion. By doing the SADC operation in specific manner Wind box to Furnace DP is maintaining @ 100 MMWC.
Performance with Blended Coal

**Reduction in Coal Consumption**: Specific coal consumption reduced by 10%

**Reduction in Ash Generation**: Ash generation reduced by 10%. This gives benefits in reduction in auxiliary power consumption for ash handling plant. Deashing frequency reduced.

**Reduction in maintenance of Ash handling equipment**: Reduction in ash generation has resulted in lesser erosion of ash handling equipment. This has resulted in improved reliability and availability of ash handling equipment.

**Reduction in Boiler Auxiliary Loading**: Since Average GCV of coal has improved, less amount of coal is required for achieving full load (260 MW). Mills loading and ID, FD & PA fans loading reduced substantially.
Performance with Blended Coal

**Reduction in maintenance of Boiler pressure parts:** As there is less ash generation in Boiler, tube leakage due to ash erosion and flue gas erosion has reduced.

**Reduction in ESP loading:** Due to reduction in coal consumption & % ash content, ESP loading has reduced and its performance improved.

**Improvement in Environmental performance:** Daily average value of TPM maintained at 50% less than design value

**Reduction in APH flue gas outlet temperature:** APH flue gas outlet temperature reduced by around 10 °C
Performance with Blended Coal

**Heat Rate improved:** Due to reduction in boiler losses, Heat rate improved

**Reduction in DM water consumption:** Due to use of blended coal frequency of soot blowing has reduced substantially

**Reduction in Excess Air:** Excess air reduced by 20% of design value resulting decrease in Boiler auxiliary power consumption. As the VM is higher in blend coal the combustion quality has improved.

**Increase in Generation:** Due to reduction in coal consumption and stable heat value generation has stabilized. Improvement in availability and reduced loading of equipments helped to enhance the loading factor.

**Increase in Boiler efficiency:** Dry flue gas loss and unburnt carbon losses reduced, resulting in increased Boiler efficiency.
Blended coal firing

- Firing blended Coal improves operational efficiency by improving Loading of Units, Turbine Heat Rate, Boiler Efficiency, Auxiliary Power Consumption and Reduce maintenance cost.

- While firing blended coal furnace was found to be bright and stable near firing zone. Furnace bottom was also bright there by indicating less unburnt carbon and complete combustion. Unburnt analysis of bottom and fly ash indicated value within acceptable limits.

- Heat pick up of MS & RH were observed to be stable without much variation and without RH spray.
Blended coal firing

- During Boiler shutdown, furnace is found to be very clean without any deposits.
- Temperature of FG at various furnace zones were observed to be stable without much variation and were near design values.
- There were no instances of mill fire when Blended coal was fired.
- Blended coal firing did not lead to any choking in APH.
- There was no clinkering in the furnace during operation with Blended coal.
Innovative Maintenance Approach

- Modular Maintenance concept
- "PROMT" Priority on Managing Performance Trends maintenance
- Innovative Maintenance Approach
- Efficiency Based Maintenance Concept

Energy Monitoring System
Modular Maintenance Concept

- A maintenance procedure that allows the replacement of major assemblies in a minimum amount of time and expenditure is called “module” (e.g. HP turbine module, CW debris filter, Primary & Secondary fans rotor, Boiler feed pump cartridge)

BFP Cartridge

HP Turbine Module
PROMT Maintenance Concept

- "PROMT" - Priority on Managing Performance Trends maintenance (e.g. wise Flue gas duct leakages, HP heaters performance)

Flue Gas duct leakages

HP Heaters parting plate leakages
Efficiency based O&M

- Along with preventive and predictive maintenance, scheduled equipment changeovers focus is shifted to Efficiency based O&M

- Equipments where standby are available, less power consuming or more efficient kept in service most of the time.

- Reasons for lower efficiency are find out and maintenance is planned accordingly.

- Coal mill O&M is based on the output and quality of the pulverised coal.
Energy Monitoring System

- FGD: Process parameter
- PCR-1: Process parameter
- PCR-2: Process parameter
- Compressor Room: Process parameter
- 6.6 KV Swgr U-1
- 6.6 KV Swgr U-2

Continual Improvement

Total 161 New meters installed (HT)
### Energy Monitoring System

#### Daily "Energy" Deviation Report

<table>
<thead>
<tr>
<th>HT Auxiliaries</th>
<th>Average as on Date (2011-12)</th>
<th>Base Value</th>
<th>Operating Value</th>
<th>Operation Control</th>
<th>Maintenence Control</th>
<th>Running Hrs</th>
<th>Actual</th>
<th>Deviation w. r. to Base Value</th>
<th>Sp. Power Consumption</th>
<th>HT Aux (%) w. r. to Aux. Power (%)</th>
<th>HT Aux (%) w. r. to Generation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIT</td>
<td>Kw</td>
<td>kw</td>
<td>kw</td>
<td>kw</td>
<td>kw</td>
<td>Hrs</td>
<td>Kw</td>
<td>Kw</td>
<td>Kw</td>
<td>Kw / TN</td>
<td></td>
</tr>
<tr>
<td>BFP - 1A</td>
<td>6967</td>
<td>7100</td>
<td>&gt;7100 - 7350</td>
<td>&gt;7350 - 7450</td>
<td>&gt;7450</td>
<td>24.0</td>
<td>6998</td>
<td>-102</td>
<td>8.86</td>
<td>15.59</td>
<td>1.34</td>
</tr>
<tr>
<td>BFP - 1B</td>
<td>7074</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.0</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>BFP - 2A</td>
<td>7034</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.0</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>BFP - 2B</td>
<td>7209</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24.0</td>
<td>7241</td>
<td>141</td>
<td>9.21</td>
<td>16.14</td>
<td>1.38</td>
</tr>
<tr>
<td>CEP-1A</td>
<td>516</td>
<td>500</td>
<td>&gt;500 - 595</td>
<td>&gt;595 - 620</td>
<td>&gt;620</td>
<td>24.0</td>
<td>441</td>
<td>-59</td>
<td>0.69</td>
<td>0.98</td>
<td>0.08</td>
</tr>
<tr>
<td>CEP-1B</td>
<td>440</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.0</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>CEP-2A</td>
<td>438</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24.0</td>
<td>433</td>
<td>-67</td>
<td>0.70</td>
<td>0.96</td>
<td>0.08</td>
</tr>
<tr>
<td>CEP-2B</td>
<td>538</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.0</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>ECW - 1A</td>
<td>298</td>
<td>305</td>
<td>&gt;305 - 330</td>
<td>&gt;330 - 355</td>
<td>&gt;355</td>
<td>7.9</td>
<td>296</td>
<td>-9</td>
<td>0.23</td>
<td>0.22</td>
<td>0.02</td>
</tr>
<tr>
<td>ECW - 1B</td>
<td>308</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24.0</td>
<td>305</td>
<td>0</td>
<td>0.23</td>
<td>0.68</td>
<td>0.06</td>
</tr>
<tr>
<td>ECW - 1C</td>
<td>307</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.1</td>
<td>304</td>
<td>-1</td>
<td>0.23</td>
<td>0.45</td>
<td>0.04</td>
</tr>
<tr>
<td>ECW - 2A</td>
<td>318</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11.9</td>
<td>316</td>
<td>11</td>
<td>0.24</td>
<td>0.35</td>
<td>0.03</td>
</tr>
<tr>
<td>ECW - 2B</td>
<td>307</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24.0</td>
<td>304</td>
<td>-1</td>
<td>0.23</td>
<td>0.68</td>
<td>0.06</td>
</tr>
<tr>
<td>ECW - 2C</td>
<td>304</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.1</td>
<td>303</td>
<td>-2</td>
<td>0.23</td>
<td>0.34</td>
<td>0.03</td>
</tr>
<tr>
<td><strong>TURBINE TOTAL (Kw)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16942</td>
<td>-88</td>
<td>36.40</td>
<td>3.12</td>
<td></td>
</tr>
</tbody>
</table>

---

*Confidential*
Many Awards to DTPS

1st ISO 50001 EnMS certificate to DTPS in world

1st Rank Performance Awards From GOI

8th time Continues National Level Energy Efficiency Award By CII

DTPS only plant from India in platts power

4th time Continues State Level Energy Efficiency Award to DTPS by GOM
Awards & Recognition

Received more than 100 National and International awards in the category of:

- Performance
- Environment
- Safety
- Corporate social responsibility
Thank You