

**MODIFICATIONS IN COAL PULVERISERS  
TO INCREASE AVAILABILITY OF COAL FIRED BOILERS  
(3 x 35 TPH - RUSSIAN MAKE)  
- A Case Study**

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In Russian design of 12 MW Captive Power Plant, three Water tube Pulverized Coal Fired Boilers are provided. Each Boiler is equipped with two Coal Pulverizers (Hammer Mill). There is no provision of stand by Mill. For 100% steam generation, both mills are to be kept in running condition.

If any mill comes under break down due to any reason, Steam generation reduces by 50% & oil consumption increases considerably to maintain Boiler stability. Hammer Mills are the back bone of Thermal Power Plant. Due to ageing, frequent Coal leakages were observed from Coal Pulverizers (Hammer Mills). Also, wearing of Rotors at bearing area, at Air Sealing plates & inner plates in Hammer Mill was frequent. Due to these failures in Hammer Mills, the availability of Boiler has become less, resulting in poor power generation.

To overcome these problems, it was considered to renovate & to modify Hammer Mills. In order to increase the availability of the Hammer Mills, Hard Facing of Hammers were done to increase Hammers life, replaceable sleeves system in two halves system were provided on Rotor & at Air Sealing location. Inner plates with wear resistant material were totally replaced. Introduced Ceralin Bends in place of Thick Steel bends in Pulverized coal distribution pipe lines. Application of Ceramic Putty on worn out portion of ROTOR in place of Welding Technology.

Stoppers were provided to restrict coal entry in bearings to avoid temperature rise. Modification done in Air Sealing plates. Introduced two woolen felts filling system in place of single felt system to avoid pulverized coal leakage from Hammer Mills. Use of Heat Resistant grease especially in summer.

With the above renovation & modification in Hammer Mills, the availability of the Boiler increased considerably, ultimately increase in Power Generation.

## **1. Introduction:**

In Russian design of 12 MW Captive Power Plant, three Water tube Pulverized Coal Fired Boilers are provided. Each boiler of 35 t / hr capacity, working pressure 40 kg/cm<sup>2</sup> and working temperature 440 °C. Main fuel is pulverized coal having average calorific value of 3320 kcal/kg supported with residual fuel oil. Each boiler is equipped with 2 hammer mills each of 6 t/hr capacity. There is one Czechoslovakia make 12 MW Turbine – Generator set. Due to ageing frequent breakdown were occurring in Hammer Mills which was ultimately affecting the power generation due to non availability of boilers.

In view of this, all the 6 numbers Coal Pulverizes were renovated with necessary modifications successfully during 1987 to 1989.

## **2. Need for Renovation & Modification:**

In view of Power shortage, Government has directed to add several thousand Megawatts of thermal capacity by renovation & modernization prior to 2012 & has also estimated an investment of Rs.75000 crores for renovation & modernization.

For enhancing capacity, many countries are carrying out Renovation of their old Thermal Power Plants based on old Pulverized coal firing Technology through making major modification including replacement of oil burner with new design efficient oil Burners.

India has world's fourth-largest coal reserves. The Geological Survey of India estimates that there is 111.88 billion tons of coal in India, we use 56 million tons of coal every year and this figure will rise to 195 million tons by the turn of the century.

## **3. Present and Future Power Requirement:**

At present India has an installed capacity of 1, 47965.41 MW as on 31.03.2009. According to CEA, the total capacity addition planned for the ongoing Eleventh Five-Year Plan period, 2007-12 is 78,780 MW. This includes the addition of 3380 MW of nuclear power, 59,693 MW of thermal power & 15,627 MW of hydro power. The country will need a capacity addition of 4, 15,000 MW in next 10 years and between 800,000 MW to 950,000 MW by 2030 to achieve the targeted growth of over eight percent annually. This would imply substantial increase in annual oil imports which could be around 300 to 400 million tons and coal imports that could touch 800 million tons annually.

India currently imports over 70 percent of its crude oil requirement, which is around 114 million tons. In the case of coal, though India has large reserves, the quality is not so good due to high ash content. Over next 25 years an estimated Rs 60,000 billions is required to provide electricity to consumers at affordable cost. Government has targeted for providing electricity in all villages by 2012 by decentralized distributed generation options.

#### 4. Specification of Boiler & Auxiliaries:

All the three Russian Make Water Tube Boilers are equipped with 2 nos. Hammer Mills, 2nos. Raw coal Feeders, 2nos. coal bunkers, 1 no. each I D & F. D Fan in each Boiler. Details of some equipments & accessories are given below:

**A. Number of pulverized coal fired Russian Boilers : 3 Nos.**

- a. Capacity of each Boiler : 35 t / hr
- b. Working pressure : 40 kg/cm<sup>2</sup>
- c. Working temperature : 440 °C
- d. Furnace volume : 179 m<sup>3</sup>
- e. Radiating heating surface and each Boiler : 176 m<sup>2</sup>
- f. Total heat input for generating rated parameters : 26 to 28 million kcal/hr

**B. Number of hammer mills per boiler : 2 Nos.**

- Capacity of hammer mill : 6 t / hr

**C. Raw Coal Feeder : 2 Nos. in each boiler**

- Capacity : 2.3 to 15.2 t / hr.

**D. I D Fan**

- Capacity : 78000 m<sup>3</sup> / hr
- Head : 270 mm WC
- RPM : 730

**E. F D Fan**

- Capacity : 41500 m<sup>3</sup> / hr
- Head : 430 mm WC
- RPM : 730

## 5. Problematic Area in Coal Pulverizer (Hammer Mills):

Each boiler is equipped with 2 hammer mills. There are no standby mills in the boiler, hence it is essential to run both the hammer mills simultaneously for generation of full capacity of required steam. The following locations / areas were identified due to which Hammer mills come under breakdown frequently resulting in generation obstruction.

- a. **Hammer Mill Rotor:** The length of rotor is 3.4 m and its maximum diameter is 250 mm. There are 11 disc of diameter 440 mm each of 90 mm thickness, 18 mm thick disc and 45 mm thick disc (one number each) on either side of the rotor. 72 hammers of manganese steel each of 9.9 kgs of equal weight to avoid vibrations, are fitted with the help of holders on these discs for pulverizing the coal. Coal pulverization takes place in enclosed chamber. The pulverized coal is sent to boiler furnace for burning through coal distributor pipe with the help of air pressure received from F D Fan. Leakage of powdered coal from Hammer Mill is protected by woolen felt fitted on air sealing plates on either side. Two numbers heavy duty Spherical Roller Bearings SKF No 22334CK are provided on either side of the rotor for smooth running of the rotor.
- b. **Hammer Mills:** Erosion occurs at 4 locations in the bearing ends and 4 locations at air sealing plates at either side of Rotor. After coal leakages, surrounding area becomes heavily polluted. Two guide discs are provided (45 mm thick and 18 mm thick disc) on either side of the rotor to prevent axial dispersion of powdered coal from hammer mill enclosed chamber. These discs get eroded due to passage of time and need replacement once in 2 months. Its replacement is time consuming process since it requires shifting of Motor for removal of rotor coupling, bearings along with pedestal and air sealing plates.
- c. **Problem of Temperature rise in Hammer Mill Bearing :**
  - Due to worn out of woolen felt, fitted on either side of Bearing, Coal powder entered in bearing & gets mixed up with grease, thus bearing temperature rises & ultimately mill has to stop for cooling of Bearing. Woolen felts are replaced.
  - Bearings are water cooled. In summer season bearing temperature increases & it requires special care & additional source is required to cool bearing.
- d. **Coal Burners & Oil Burners:**
  - Each Boiler is equipped with 4nos Coal Burners, 2 nos each on either side & Oil Burners are fitted concentric to Coal Burners.
  - Frequent cleaning of oil burner nozzle attracts for modification in Oil Burner.

**e. Coal Distributor Pipe lines:**

- There are four pulverized coal pipe lines for each coal burners having Bends. These Bends gets eroded due to erosion & leakages start in due course, Resulting stoppages of mill for repair. Coal pollution starts & it requires immediate site cleaning. Its classifier requires time to time setting for proper size pulverized coal flow for better combustion in Boiler Furnace.
- Ceralin Bends were fitted in place of steel bends for longer life.

**f. Design of Coal Bunker:**

- Each Boiler has two coal Bunkers one each for each Hammer mill having 26 Hrs coal storage capacity. During rainy season, coal sticks on Walls, which requires time to time Bunker cleaning..

**6. Remedial Action taken to increase availability of the Hammer Mills for**

**Increasing steam generation by various modifications in Hammer Mills:**

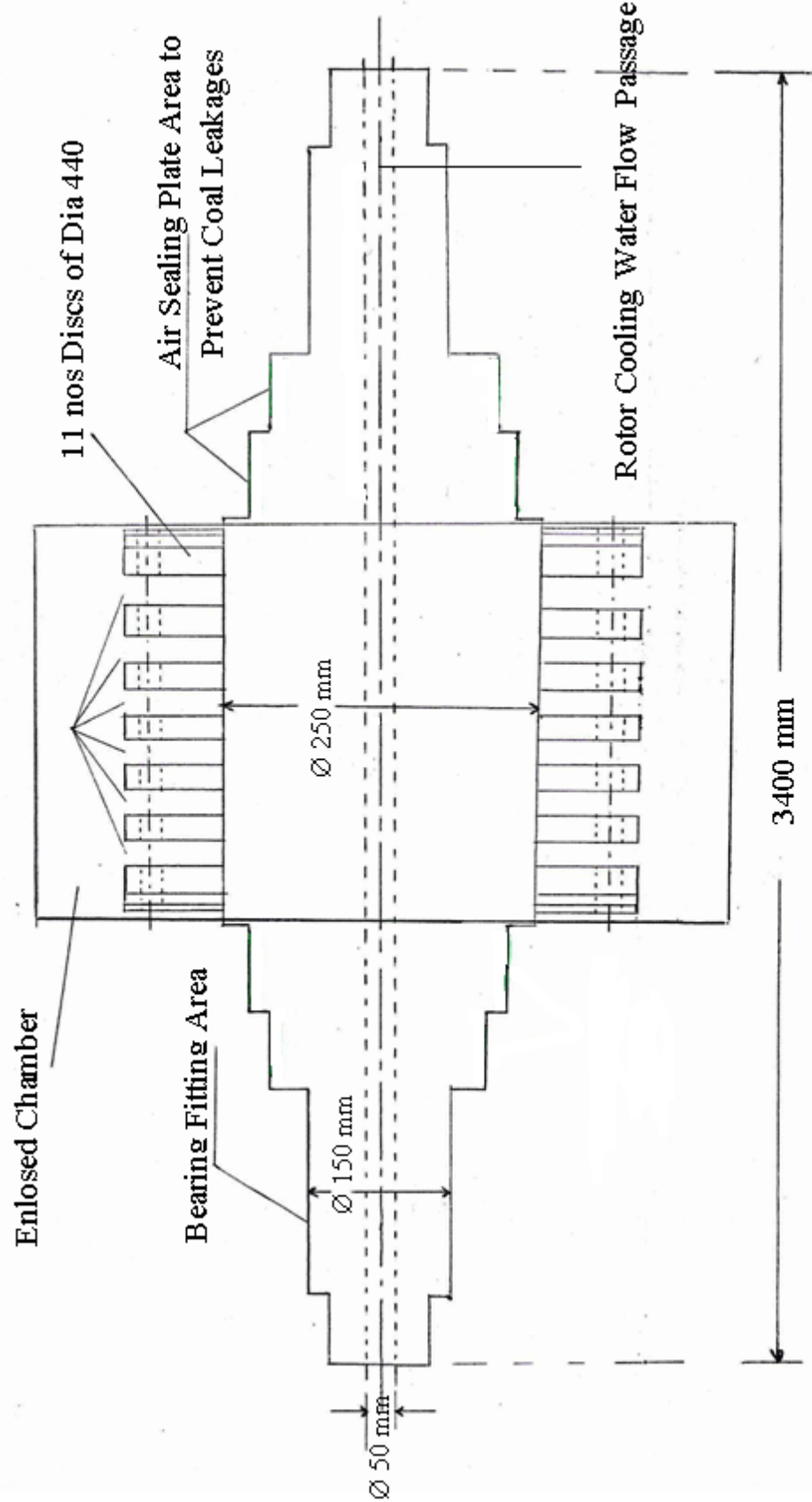
- A. Developed technology to reduce breakdown time in hammer mills. Introduced Sleeve System in two halves at Air sealing plates area on Mill rotor where Rotor has worn out up to 5 mm deep & on bearing fitted area on either side of rotor.
- B. Introduction of additional groove on both sides of Air Sealing plates to fit double woolen felts to avoid coal leakages from Mills.
- C. Replacement of Inner mill lining time to time to avoid coal leakages from mill body.
- D. Hard facing of Hammers to increase Hammers life.
- E. Application of hard facing Putty on worn out portion of mill rotor.
- F. Time to time acid cleaning of rotor water cooling line in ROTOR.
- G. Application of heat resistant Grease in Heavy duty Mill Bearing in summer.
- H. Timely replacement of grease of mill bearing.
- I. Timely setting of Classifiers.
- J. To maintain inside mill body temperature as per manual specially in summer to avoid rise in mill bearing temperature.
- K. Application of Ceralin bends for pulverized coal pipe bends to avoid coal erosion.
- L. Interconnection of pulverized coal fuel lines from one mill to mill of stand by mill to reduce breakdown time of mills.
- M. Timely cleaning of coal bunkers.
- N. Proper selection of material.

## **7. Conclusions / Results:**

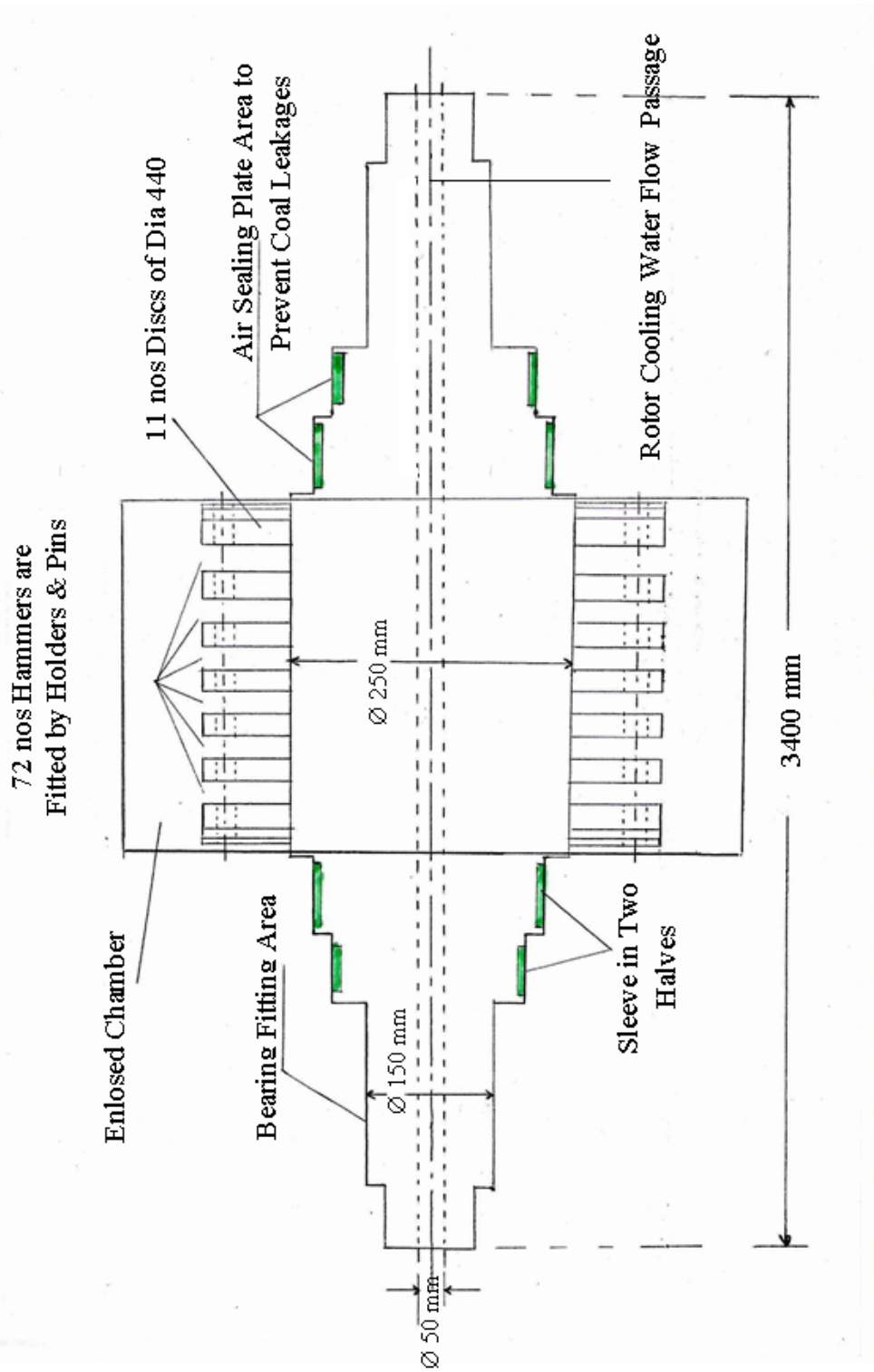
- a. After renovation & various modifications in Hammer Mills, the availability of the boiler has increased considerably.
- b. Breakdown reduced to minimum.
- c. Reduction in maintenance expenditure.
- d. Specific oil and coal consumption reduced.
- e. Power generation increased.
- f. Cost of power generation reduced.
- g. Fugitive emissions in Hammer Mill area have been reduced.

**ROTOR OF COAL PULVERISER**

72 nos Hammers are  
Fitted by Holders & Pins



ROTOR OF COAL PULVERISER



TEJ BAHADUR is a BSc, B.E. (Mechanical) – 1972, Dayal Bagh Engineering College, Agra and has worked with M/S Modi's 10 MW captive power plant in boiler maintenance area at Harduaganj, Kasimpur, Aligarh for 2 years.

He is working for **33 Yrs.** at M/S Bharat Heavy Electricals Ltd, Haridwar in various capacities. **22 years experience in Operation and Maintenance of 12 MW Captive Thermal Power Plant as Head of TPS** at BHEL, Haridwar from September 76' to May 98' including liaison activities with Directorate of Boilers of Uttar Pradesh & Uttarakhand. Got fabricated & Erected Economizer coils, Super heater coils, Air Pre heater Blocks and Headers. **4 years** experience in maintaining Unique & Sophisticated Manufacturing machines of Turbines & their components up to 500 MW capacity.

**4 years** experience in maintaining 112 nos. EOT Cranes up to 150 tons capacity, Maintenance of electrical Arc Furnaces up to 2 MW capacity, Spares procurement worth Rs. 3.5 Crores annually for various machines and dealing with various vendors, Works Contract Management (Dealt with 110 Nos. Contractors Electrical, Mechanical & Civil Works).

At present working in PCRI, BHEL, Haridwar since July 2005. Having experience of Environment Impact Assessment (EIA) studies for setting up of various Thermal Power Plants up to 660 MW capacity and monitoring of Air, Noise and Water Quality of various industries and Thermal Power Stations.

#### **Achievements & Awards:**

1. Recipient of **National Vishwa Karma Award** from Ministry of Labour, Govt. Of India for manufacturing Boiler's components with in-house effort with huge saving in money value.
2. Received more than 30 times appreciation certificates from BHEL Management for various technical development Activities.
3. Represented Meerut University in Cricket. Had been **Cricket Captain** of Engineering College, Agra & BHEL Haridwar.