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IMPROVEMENT IN RELIABILITY AND EFFICIENCY IN BALL TUBE MILLS

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Abstract

In the era of availability based tariff (ABT) & tough competition in power sector and intention of Government to provide round the clock uninterrupted power to the consumers of the state at most competitive rates, it is becoming inevitable to achieve improvement in availability and cost reduction at the same time, though both these goals appear against each other.

In line with such challenges, this paper on “Improvement in Reliability & Efficiency of BBD Mills at PTPS is of utmost significance, under this initiative at Panipat Thermal Power Station (PTPS), factor responsible for reliability improvement and efficiency improvement in Ball Tube Mills are identified and categorized to improve mill availability. Based upon these factors criticality of the factors may be identified and commercial availability may be enhanced through proper diagnosis, corrective actions & best O&M practices.

Introduction:

Reliability analysis is an innate aspect of power plant design and plays considerable role throughout the plant operation in terms of expenses (operating and maintenance) and optimal maintenance scheduling of its equipments. Reliability may be defined as the ability of an equipment, component, product, system, etc., to function under designated operating state of affairs for a specified period of time or number of cycles [1]. In literature both qualitative and quantitative methods for assessing the reliability of complex systems are available. The most commonly used qualitative methods are Fault Tree Analysis [2], Effects and Criticality Analysis [3], Failure Modes and Effects Analysis [4], Root Cause Failure Analysis [5], Fish Bone Analysis [6], Event Tree Analysis [7], and Predictive Failure Analysis [8]. Block diagram analysis [9], Markov chain, and Monte Carlo simulation [10] are some of the quantitative methods of reliability analysis available in literature. The two-state Markov model is the mainly used outage model in power system reliability analysis [11].

Etiet. al. [12] integrated reliability and risk analysis for maintenance policies of a thermal power plant. Need to integrate RAMS (reliability, availability, maintainability and supportability) centered maintenance along with risk analysis was stressed. Although results expected or obtained with the application of those concepts were not explained. A staircase function was introduced by Ji et. al. [13] to approximate the aging failure rate in power systems and a component renewal process outage model for a time-varying failure rate was proposed. Markov method was used by Haghifam and Manbachi [13] to model reliability, availability and mean-time-to-failure indices of combined heat and power (CHP) systems based on interactions between electricity-generation, fuel-distribution and heat-generation subsystems. Carpanetoet. al. [14] carried out Monte Carlo simulation for identifying long, medium and short term time frames by incorporating uncertainty at large-scale and small-scale for cogeneration system. Small-scale uncertainty relevant to both short-term and medium-term time frames was addressed through probabilistic models and Monte Carlo simulations [15].

Mohan et. al. [2] calculated RTRI (real time reliability index) for a SPP (steam power plant) using graph theory. Tang [16] proposed a new method based on the combination of graph theory and Boolean function for assessing reliability of mechanical systems. Garg et al. [5] developed a graph theoretical model to compare various technical and economical features of wind, hydro and thermal power plants. Performance analysis of coal based steam power plant boiler was carried out by Mohan et al. [3] using graph theory and step-by-step methodology for the evaluation was also proposed.

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1. System Description and Mathematical Modeling

In the present work ball tube mills reliability is discussed and analysed. Ball tube mills are low speed horizontal mills used in coal fired Thermal Power Station for pulverizing the coal. In BBD mills, primary air has dual function to perform. The line diagram of thecoal pulverization ball mill used in coal power plant is as shown in Figure 1. It is used as drying & transporting media for coal and regulates mill output also. In order to avoid excess sweeping of coal from mill only part of the primary air directly proportional to the boiler load demand is passed through mill. Further to ensure and maintain sufficient velocity of pulverized fuel and to avoid setting in PF pipes an additional quantity of primary air is fed into the pipe known as bypass air.

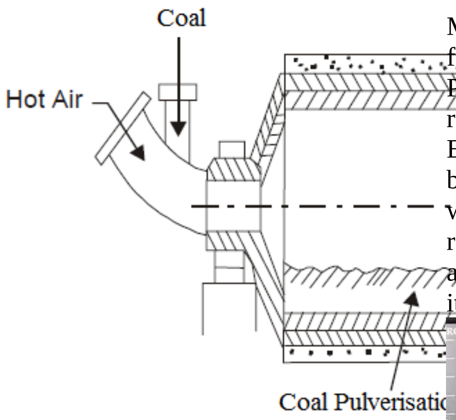

Figure1. Line diagram representing coal pulverization ball mill used in coal power plant

There are total nine numbers BBD mills installed in three Units of Panipat Thermal Power Station. Each Unit is having three mills. Ball tube mills model BBD-4772 are installed in Unit-7 & 8 with coal crushing capacity as 75.9 Tons/Hour for design coal at ball load of 80 tons. A lot of problems are faced with these mills during initial years but now the things have improved a lot with best Operation & Maintenance practices adopted at PTPS and with continuous improvements/ modifications made at plant level based upon our experience.Real time flow diagram of BBD mill is as represented in Figure 2. In Figure 3 real time flow diagram of BBD mill with measurable parameters is represented with different parameters.

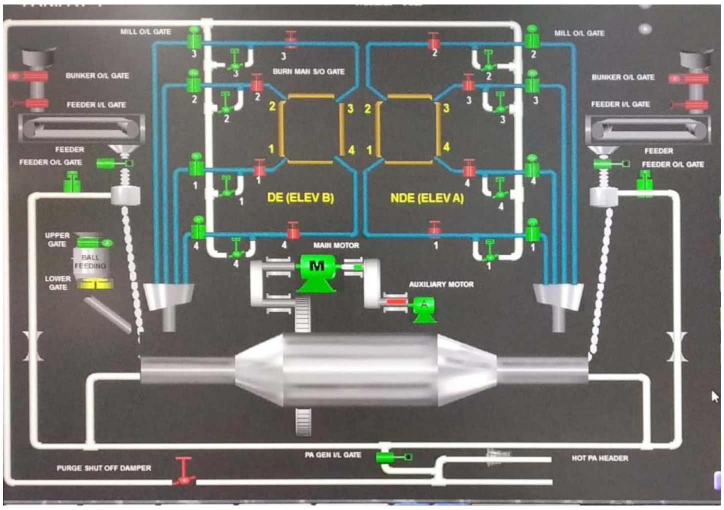

Figure 2. Flow diagram representing the flow of coal in power plant

Milling system is one of the most critical system for reliable power generation in Thermal Power Plants, hence utmost importance was given to review all critical events related to these mills. Every incident of mill tripping/ failure/outage has been critically reviewed. There were occasions when only some sub system of mills tripped resulting into tripping of the Unit. With proper analysis, continuous efforts and positive approach, it is possible to achieve very high availability.

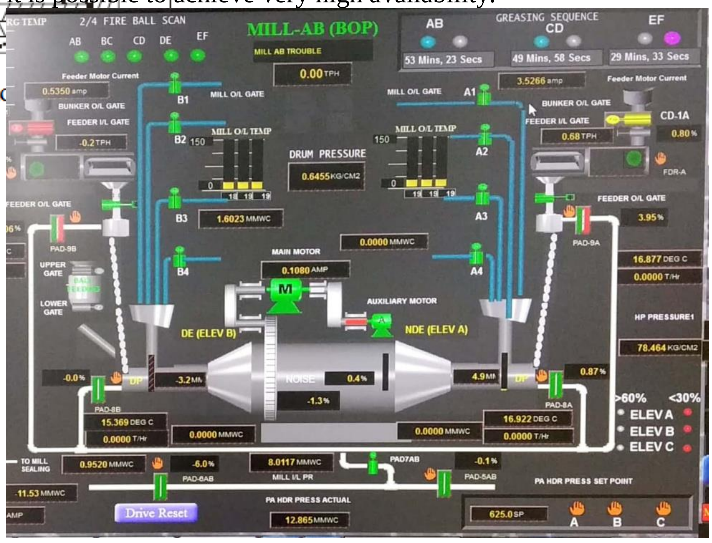

Figure 3. Flow diagram with different measurable parameters of coal in power plant

In the present work problems experienced in the operation and maintenance of

Six major problems experienced in BBD mills are:

i. Screw conveyor ribbon failure
ii. Failure of connecting rods
iii. One end operation of mill
iv. Fire in standby Coal Feeders
v. Mill Explosion and fire
vi. Greasing sequence of Girth Gear

All of the parameters are interdependent and their interdependence is as shown in Figure 4.

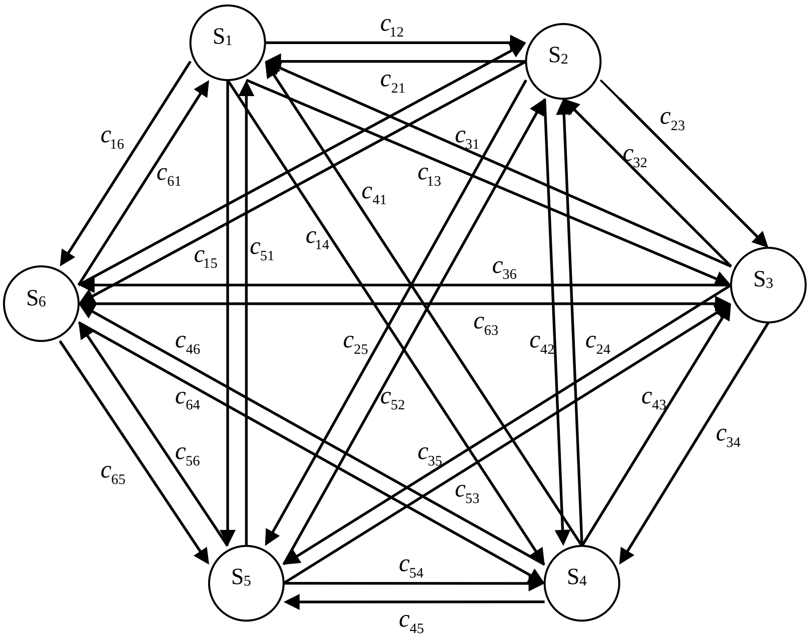

Figure 3. Flow diagram representing the interdependence of different parameters

2. Results and Discussion

It is evident that root cause of above incidents is failure of screw conveyor ribbons mostly due to entrapment of foreign material, which further damages the connecting rods and mill has to be run with one end operation for a certain period of time until the breakage of connecting rods is confirmed and finally the mill is stopped. With one end operation, probability of fire incident increases. The mill has to be taken on PTW for a long duration and sometimes causes need of secondary fuel oil support increasing the cost of generation. If necessary steps are not taken to improve the system, the mill availability gets drastically reduced and the Unit operation comes at stake.

To control these breakdowns, the situation demands some additional checks & to follow best preventive maintenance practices as prevention is better than cure.

Our preventive maintenance schedules are categorized as monthly preventive maintenance schedule & quarterly preventive maintenance schedule which cover:

- Inspection of mills internals e.g. connecting rods, ribbons, liner screw conveyors.
- Cleaning of classifiers and refusal ducts.
- Lubrication of bearings & couplings.
- Inspection of feeders, main reducers, seal air fans etc.
- Charging of grinding media balls at regular intervals.

Possibility of providing zero speed sensor on DCS to indicate screw conveyor rotation is being studied. A conveyor stop alarm needs to be provided in Control Room which can alert the Desk Engineer to stop the feeder at the earliest in case drive bars fail.

Availability improvement of mills is vital for meeting scheduled generation targets. With proper diagnosis & by taking remedial measures and taking right action at right time, the mill breakdowns can be minimized and our initiatives for improvement in reliability and efficiency have brought fruitful results.

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Nomenclature

B - Broyer (Name of Inventor)
B - Boulet (Frech word for Balls)
D - Direct Firing
47 - Diameter of shell is 4.7 meter
72 - Length of shell