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# Maintenance Prevention on Coal Fired Power Plant Boiler

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**Abstract:- Today the need for electrical energy is inseparable from human life, almost all human life needs to use electricity. Starting from household needs, workplace needs, almost entirely using electricity because electricity is energy that is easily transformed into other energy. Electricity can be used for applications that require small to large energy. Therefore, the reliability and availability of electricity will be maintained to ensure that no activity is constrained due to the absence of electricity. With maintenance prevention, we can minimalize breakdown time, keep the machine efficiency, machine availability, and machine reliability with implementing maintenance prevention the breakdown of the machine can anticipate and we can plan to doing maintenance.**

***Keywords***:- *PowerPlant, Boiler, Thermal Power, Maintenance Prevention.*

## I. INTRODUCTION

Electricity is a useful form of human life and an important factor in supporting the development of the area. As more and more people, the economic growth and development of the industrial sector led to the need for greater electricity. This is happening in major cities and in rural areas so that electricity supply is optimally and freely available. Electricity demand is increasing year by year and the lack of development of new power plants in Indonesia leads to an energy crisis.

Today the government is entrusting the private sector to participate in running electricity, especially for remote areas. Thermal energy is indispensable for investors as it has a relatively quick point compared to other electrical energy management methods. The thermal power commonly used in Indonesia is heating the water so that it becomes a high-pressure steam that will make the turbine generator blades produce electricity that we can use.

In operation, the machine used to heat water is called Boiler.In a simple a boiler may be defined as a closed vessel in which steam is produced from water by combustion of fuel(Kumar, Kumar, & Sharma, 2014). Steam boilers are closed vessels that contain water and will be heated so that certain pressures and temperatures can rotate the steam turbine. Because the heating process can be used to rotate the turbine requires a considerable time from 2-3 hours to a capacity below 100MW, so the failures in the Boiler operation are maintained so that the reliability of the electric power system remains optimistic.

The failure mode and effect analysis is used to identify and analyzed: (1) all failure mode of different parts of the boiler system machine, (2) effects of this failure mode on the boiler system and (3) how to circumvent the failure and/or moderate the effect of the failed boiler system. FMEA is a step by step tactic to identifying all possible failure throughout the processes. “Effect Analysis” denotes to studying the consequences of those failures (Rakesh, Jos, & Mathew, 2013).

FMEA provides a methodology for documenting phenomena occurring phenomenon based on the root of the problem to assist in the ongoing improvement process. This is a systematic approach to analysis, definition, budgeting, and risk assessment in boiler engine operations. In this case, we use FMEA in analyzing the main causes of failure of the gas oil boiler system.

FMEA discipline was developed not from manufacture process but from the United States Military. Military Procedure MIL-P-1629, titled Procedures for Performing a Failure Mode, Effects and Criticality Analysis, dated November 9, 1949. FMEA is a Formal Design Methodology in the 1960s by the aerospace industry, with obvious reliability and safety requirements(Sharma & Srivastava, 2016).

Preventive maintenance is a means of maintaining the reliability and availability of boiler engines performance. Provides everything that will happen to the machine and predicts damage from anomalies that occur. Predict damage and create operating standards to maintain engine reliability and performance.

## II. LITERATURE REVIEW

Maintenance is normally perceived to have a poorer rate of return than any other major budget item. Yet, most companies can reduce maintenance costs by at least one-third, and improve the level of productivity, by giving maintenance the management priority it requires (Ahuja & Khamba, 2008).

Maintenance prevention teams work to improve equipment performance through improved equipment design. The maintenance function works with the engineering department during the early stages of equipment design. This allows the team to design and install equipment that is easy to maintain and operate (Swanson, 2001).

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The goal of maintenance prevention (MP) is to reduce maintenance costs and deterioration losses in new equipment by considering past maintenance data and the latest technology when designing for higher reliability, maintainability, operability, flexibility, safety, and other requirements (Kirby, 2013).

Failure mode and effect analysis (FMEA) is an engineering technique used to eliminate potential failures, problems and errors in the system and determine their effects on the operation of the product. It could be a design, manufacturing process and services of products before it reaches to the customers. The analysis of the evolution may take two courses of action (Kumar et al., 2014).

FMEA is to develop, evaluate and enhance the design development and testing methodologies to achieve the elimination of failures and thus obtain world-class competitive products. The main advantages of using FMEA methods are: Reduction of Costs, with a critical impact on warranty returns; Reduction of the Time needed from the project phase to the market launch and Improvement of the Quality and Reliability of the products, while increasing the safety of their operation (Sharma & Srivastava, 2016).

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The failure mechanism of tube boiler is identified due to the short-term overheating as result of the localized flue gas flow following massive clinker formations in primary super heater region of the boiler (Pratama & Hardi, 2018).

Cracks in the boiler are due to the buildup of crusted ash but are not immediately cleaned so there will be a dramatic temperature difference between the furnace and one side that has a crust stockpile, thus causing cracking (Hare, Rasul, & Moazzem, 2010).

Maintenance is normally perceived to have a poorer rate of return than any other major budget item. Yet, most companies can reduce maintenance costs by at least one-third, and improve the level of productivity, by giving maintenance the management priority it requires. That priority must span all levels of an organization's management structure to develop an understanding at each level of the significance maintenance can have upon the success or failure of organization objectives (Ahuja & Khamba, 2008).

Criticality analysis is a tool used to evaluate how equipment failures impact organizational performance in order to systematically rank plant assets for the purpose of work prioritization, material classification, PM / PdM development and reliability improvement initiatives (Afefy, 2010).

Boiler design will affect reboot speed when failure occurs. Good boiler designs will have several levels of reinforcement so that when the source fails, other sources will help to reboot the system quickly. Hopefully with this system the reliability of the system will always be maintained and the amount of electrical disturbance will be avoided (Zeng et al., 2014).

The concept of maintenance is wide ranging. It covers malfunction correction, preventive and continuous maintenance, inspections and monitoring. Neglected maintenance routines may cause harm to people, to the process equipment and to the environment. Shutdown periods district heat producing power plants are usually scheduled for the summer season when the steam demand seasonally drops at its lowest, but in pulp and paper industry sector the demand is to operate as long as possible between the shutdowns (Sevtsenko, 2011) .

Good air conditioners of electric motor unit units and instruments are recommended. It is also a designer job to design a heat-resistant system, since the boiler system will have a high temperature. When the machine has a temperature specification close to the operating temperature then the equipment should be supplemented with additional cooling which will help distribute heat from the system to the coolant. it is expected that the cooling performance of the engine will be more robust and reliability will be maintained (Apriliasari & Ichsan, 2013) .

The tube boiler has a high damage point if it is not treated properly, since the boiler temperature change needs to be arranged in such a way that the expansion and decay of the boiler tube material can also be adjusted. With drastic changes in constant and repeated temperatures will cause cracks in the boiler tube (Epelbaum, Hanson, & Seitz, 2010).

The oxidation prevailing in the boiler tube will also make the tube boiler become fragile and easily cracked. so the treatment uses chemicals that make the water quality enter the oxygen-free boiler, the silica that can settle on the wall of the boiler, the iron will interfere with the instrument and improve the conductivity in the boiler feed water (Meier et al., 2010).

The internal corrosion of boiler pressure parts (water tube) mainly has four forms: steam corrosion, oxygen corrosion, corrosion and corrosion under the scale. Case one is steam corrosion. Steam surface metal at higher than 400 degree Celsius iron contact with steam to form Fe3O4 film, this is the steam corrosion. Case two is oxygen corrosion. The boiler feed water and oxygen in the process of electrochemical corrosion of the cathode polarization so we must eliminate the oxygen from the system with chemical treatment, electrochemical etching speed, the higher the temperature, the corrosion is block. Preventive measures: feed water deaerator, control water content; control the coal economizer tubes of water speed of not less than 0.3m/s, to prevent air bubbles trapped in the pipe wall. Case three is alkali corrosion. When the temperature is high, accelerated electrochemical corrosion, the higher the temperature, the

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greater the more strongly alkaline, corrosion (Luo & Zhang, 2013).

Most of the power plants are designed by the energetic performance criteria based on the first law of thermodynamics only. The real useful energy loss cannot be justified by the first law of thermodynamics, because it does not differentiate between the quality and quantity of energy (Anjali & Kalivarathan, 2015).

The air preheater are more important of boiler auxiliary. The air preheater improves performance of the plant due to more heat transfer to incoming cold air for combustion. Cleaning of plugging or fouling reduce power consumption, unit heat rate and coal consumption. Overall performance and profit of power plant hence increase (Sheikh & Agarwal, 2017).

One of the most powerful methods available for measuring the reliability of products or process is FMEA. Probably the greatest criticism of the FMEA has been its limited use in improving designs (Ambekar, Edlabadkar, & Shrouty, 2013).

## III. METHODS

To implement the Maintenance Prevention (MP) we must build the solid team for planning and be executing the action.MP should be performed for capital projects, redesign or modification of current assets, equipment installation and commissioning, and replacement parts and components planning(Swanson, 2001).

TPM uses the Overall Equipment Effectiveness (OEE) and Maintenance prevention serves to see the entire boiler condition. Currently the company is doing a reduction for higher efficiency (Kholil, Maulidina, & Rimawan, 2016).

To determine the precautionary care parameters must first be aware of root problems that exist in the machine, such as instruments that have critical functions but also fragile in operation.

Boilers are the main heat transfer units in a power plant, though there are other heat transfer units associated with power plants, but unwanted deposits like slagging and fouling occurred mainly in boilers(Hare et al., 2010).

Advantages of pressure in the system and drastically changing pressure will cause system instability and the risk of damage to the components of the boiler, especially on the tool and the water wall (Tomašková, 1929). so much more pressure settings are required to be accommodated by the safety valve that will soon be opened when there is a greater pressure as the sudden release to the load causes the steam flow to the turbine to be drastically reduced by the government. Better in termination of load should be followed by operator maneuver so more pressure will be avoided.

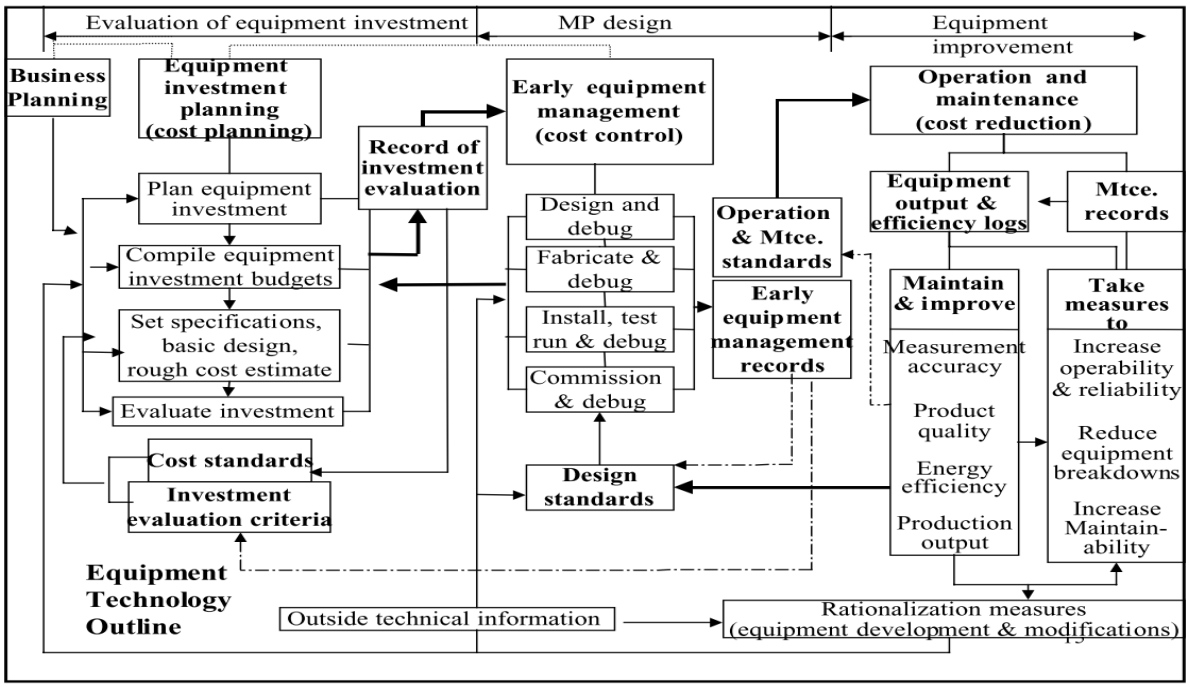


Fig 1:- Maintenance Prevention flow diagram (Swanson, 2001).

From Fig. 1 we can see the maintenance prevention design is part of all system in business, in relation to business planning in the future and after implementing preventive maintenance is expected to cost production and maintenance be reduced. Optimize equipment efficiency and reduce disability levels.

So in implementing preventive maintenance, there will be assessments related to what has been implemented. The PDCA system will be useful to accommodate it.

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Maintenance prevention performance will always be maintained and continue to evolve to maintain its business quality (reliability, availability, and efficiency of boiler engines).

Annual shutdown inspections include all the most urgent areas at that time such as: boiler water wall, boiler tube, instrument, nozzle, etc. Special attention should be paid for especially equipment for the areas that are expected to be problematic. In case worn parts were found during inspections, repairing actions are planned beforehand for the next year's shutdown or in planned shutdown in every month. In case, the wear has already gone too far and malfunction is expected to appear in the near future, correcting actions must be performed within the prevailing time and resources. In this case the main focus is to keep the boiler running until the next possible shutdown (Sevtsenko, 2011).But it is better if there is a possibility of damage in the same place still exists. Maintenance personnel have provided spare parts to take care of when the damages happen again.

## IV. RESULT AND DISCUSSION

Coal boilers have critical component components that should always be maintained and maintained, and should be replaced periodically to maintain their reliability. To support it, good planning and backed by compact teams will help boost the boiler engine.

All maintenance personnel have the ability to analyze damage from the boiler machine, thus predicting the components that need to be replaced. The creation of a work plan and action plan for improvement is also needed to facilitate the work system. So if the field is not confused about what to do, and be systematically working to shorten the working hours.

Maintenance prevention models are created during the design process to know the system's critical point points and facilitate future maintenance. Preventive care is also regularly reviewed to obtain optimum results to follow with how the current engine behavior.

| No. | Planed Action | Equipment | Risk of Operation |
|---|---|---|---|
| 1 | Clean and Nozzle Check | Coal Nozzle | If there is a blockage in the coal nozzle will cause the operation, check that the nozzle diameter is still in accordance with the standard or needs to be replaced. |
| 2 | Check Water Wall, and Water tube area | Boiler furnace, boiler | The water walls and water tubes in the boilers have a critical point in their operations so they must always be maintained. Cleaned from all crusts outside and also always checked silica locally inside to maintain system reliability. |
| 3 | Check quality of Feed Water. Iron, silica, conductivity, pH | Water Treatment | The boiler feed water source has a special specification that must always be met to maintain the quality of the boiler so that damage to the operation of the tubes and boilers overlap will be minimized. |
| 4 | Check Instrument And Calibration if Needed | Instrument | The instrument in the boiler should always be in good condition to minimize damage. Check and re-calibrate shall always be performed to ensure the accuracy of the instrument. |

Table 1:- Planning on maintenance coal boiler

## V. CONCLUSION

Focus of maintenance and reliability improvement is on the boiler system. But did not rule out also to always monitor the other items for the entire system maintained its reliability. Implementation maintenance prevention will lead to free maintenance. It is hoped that in its operations can be avoided the existence of damage and problems due to the design process. As a continuation of the maintenance prevention, the TPM system has been widely identified in the manufacturing process. This proactive maintenance strategy contributing to improved manufacturing performance highlighted by various researchers.

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