Maintenance management improvement based on reliability centered maintenance II in energy generating industries

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Maintenance management improvement based on reliability centered maintenance II in energy generating industries

M L Singgih[1] **, Y Prasetyawan**[1] **,Sutikno**[2]**, D Hartanto**[1]**, F R Kurniawan**[1] **,W T Wicaksana**[1]

[1] Industrial Engineering Department, Institut Teknologi Sepuluh Nopember
[2] Mechanical Engineering Department, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia
moseslsinggih@gmail.com, yudhaprase@gmail.com, sutikno.its@gmail.com, dody_hartanto@ie.its.ac.id, kurniawanrindy@gmail.com, winahyutyas@gmail.com

Abstract: The *X* power plant is one of an electric company subsidiaries. Engaged in providing electricity for the certain regions. In general, the type of treatment from *X* power plant is short and long term maintenance. The application of these two systems helps *X* power plant to maintain the machines. The author argues that the type of maintenance from *X* power plant is not or is not yet optimal, the author wants to test whether reliability centered maintenance II treatment method can be applied in *X* power plant so that the efficiency and maintenance of the machine is in accordance with their individual needs. After implementing the RCM II information worksheet and RCM II decision worksheet, it is found that the existing maintenance management system in *X* power plant can be. Several incompatibility are detected, and should be matched with the corresponding maintenance method. For further research, the author recommend that the object of research are broadened so that the RCM II method can be used on other energy generating industries.
Keywords: Reliability Centered Maintenance II, RCM II information worksheet, RCM II decision worksheet, Maintenance Management

1. Introduction

In this part, the research background, problem formulation, and research objective will be shown.

1.1 Research Background

The availability of electricity supply is one of the important needs in society. Electricity development is an alternative that can be done to guarantee the availability of electricity. This will ensure the availability of electric energy supply so the eletricity will be in sufficient quantities, of good quality and prices that can be reached by the wider community. A sufficient amount means that existing supply can accommodate the needs of the wider community. While good quality means the community will be guaranteed to receive the supply as it should and prices that do not burden the public. The main objective of this eletric energy development focuses on improving the welfare and prosperity of the community fairly and equitably and realizing sustainable development.

Existing data shows that the existing electrification ratio increases continuously every year. For example, in 2013 with a target of 76.8%, it experienced an increase of 3.71% so that the realization in

2013 was 80.51%. Likewise in 2014 with a target of 80%, an increase of 3.45% also happen so that the realization was 84.35%. The data shows that the electrification ratio has increased positively.
Compared to the ASEAN countries, the electrification ratio of Indonesia with 84,35% in 2015 is far behind. All the ASEAN countries has been able to get electrification ratio above 98%. Based on this condition, the Indonesian government through *national employment general plan* (RKUN) target to reach electrification ratio of 97.35% in 2019. To support this target, a 35.000 MW electrical program is designed.

The 35.000 MW electricity program is one of the RUKN programs. The program then carry out the construction of new plants from Sumatra to Papua. In addition to building new plants, there are other alterations, namely maintaining and carrying out maintenance on existing plants. The purpose of doing maintenance is to maintain national electricity needs. Existing programs certainly have very expensive costs. The program that is carried out must still pay attention to the fact that there are maintenance costs attached to it. The maintenance costs arise from maintenance for old and new electrical energy providers. If the problem is not taken care of, there will be overrun costs. To prevent the occurrence of large costs, appropriate treatment methods are needed. Proper maintenance according to the type of treatment will reduce costs so that efficiency is created which is certainly very profitable for the industry.

1.2 Problem Formulation

Based on the finding above, the problem that will be solved in this research is how to improve and maintain the maintenance management activity in the energy generating industries using reliability centered maintenance II method.

1.3 Research Objective

Based on the problem formulation, the objective for the research are (1) to identify functions, malfunctions, causes of malfunctions, and the impact of failures of components, facilities and tools found in energy-producing industries and make RCM II information worksheet, (2) to determine the most appropriate maintenance activities for each energy-producing industry using RCM II Decision Worksheet, and (3) Determine the appropriate maintenance activity interval for the components, facilities and tools found in the energy-producing industry

2. Methods

In this part, first the research procedure will be discused. Then the method of collecting data will be presented. After that an example of te result from data collection will be presented. This includes FMEA, RCM II information worksheet, RCM II decision worksheet.

2.1 Research Procedure

The procedure of conducting the research is pictured in the figure 1 below:

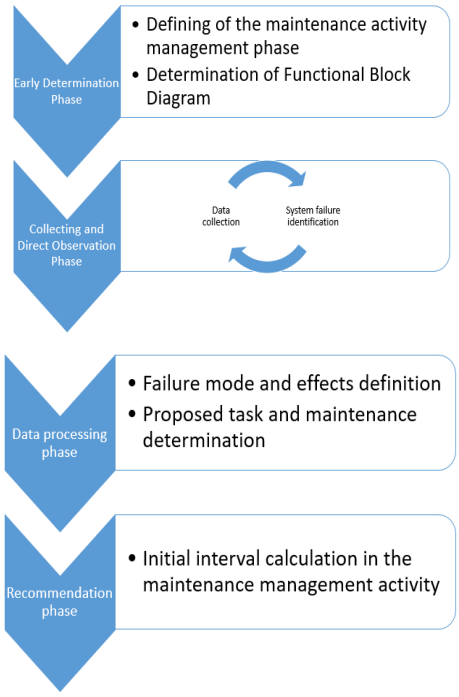

Figure 1 Research Procedure

The research begins with the initial determination phase. The initial determination phase includes defining maintenance management activities. Defining is done specifically for maintenance management activities in the energy industry. After the maintenance management activities have been defined, then the construction of functional block diagrams is carried out. In this diagram an explanation of the relationship between the functions of a part of a system, and other parts of a system will be given. After that, it will proceed with the stage of direct collection and observation. This stage is a cycle of data collection and identifying system failures. The cyclic nature is because the activity is carried out on every object observed and each activity adds data collected. System failure identification will focus on identifying the functions of existing systems in the energy industry. The function that has been defined is then used and analyzed to determine the failure that will occur.

The next stage is the data processing stage. The data processing stage consists of defining failure modules and their effects as well as determining proposed tasks and maintenance activities. Defining failure mode will be based on the function defined in the previous stage. After that, the proposed task and technical maintenance will be carried out based on RCM II.

The final stage of this study is the preparation of an improvement in the efficiency of care management by calculating the initial interval. The calculation is carried out based on RCM II and has recommendations for carrying out appropriate maintenance activities both in terms of method, time and cost for each facility.

3. Result and Discussion

In this part, the result of the data collection will be presented. The, RCM II information worksheet, and RCM II decision worksheet will be shown and discussed. At the end of the part, ther will be a thorough discussion about the finding.

3.1 RCM II Information Worksheet

Reliability centered maintenance II information worksheet is the development result from the FMEA of the observation object. FMEA aims to identify the flow of a failure may happened in product or process,

and then estimate the risk that may happen. The result from FMEA can be categorized into function, function failure, failure mode, and failure effect.

In the function part, the function of the machine in the observation object will be explained. In the function failure part, the possibility of failure while the machine is operating is explained. In the failure mode part, after the possibility of failure is listed, the possible cause of the function failure will be listed. The failure mode can be obtained from the failure record in the observation object and through interview with the supervisor and the field operator. The last part, the failure effect contain the possible impact of the failure mode. After the FMEA identification is finished, the result will be described into the RCM II information worksheet.

The research conducted in *X* power plant involved 31 different machines. In this part an example of the RCM II information worksheet will be presented in table 1

3.2 RCM II Decision Worksheet

RCM II decision worksheet is the next phase after the FMEA or the RCM II information worksheet is done. Decision worksheet is a summary of every question listed in the RCM II decision diagram. The RCM II decision diagram is presented in figure 2. There are some condition that become the main attention of the decision worksheet, those are the hidden failure, safety, environment, and operational. The result of the decision worksheet will be the a list of proposed task that contains scheduled on condition, scheduled restoration task, schedule discard task and finding failure.

The RCM II decision worksheet will identify all 31 machines observed in *X* power plant. An example of RCM II decision worksheet will be presented in table 2. The result or the proposed task will determine the best time for each machine to be maintained by related department.

Table 1 An example of RCM II information worksheet in superheater machine

RCM II Information Worksheet		Sistem : UNIT PEMBANGKIT LISTRIK TENAGA UAP		*Unit 4 UP Gresik*		
				1	*SUPERHEATER*	
Function		*Function Failure*		*Failure Mode*		*Failure Effect*
1	Transform saturated steam to super heated steam that is exhausted from the high pressure steam drum	1	Fail to transform saturated steam to super heated steam in the primary superheated, secondary superheated, and final superheated part.	1	Cracked drain inlet primary superheated boiler pipe	Cracked pipe caused by corrosion and unable to withstand the heat when the combustion process is on. If the pipe is cracked can cause shutdown and trip.
				2	Leaked secondary superheated inlet header drain valve	Super heated steam formation process cannot be done properly and may cause shutdown
				3	Leaked final superheater inlet header valve	Super heated steam formation process cannot be done properly and may cause shutdown
				4	Obsolete and degrading pipes	Corrotion and deposit happen because overload of several compound into the pipes, which are Na, Mg, Cl. The pipes become easily broken. Aside from that the mixing of the compound and the superheated steam can cause trip.

Table 2 An example of RCM II decision worksheet in superheater machine

RCM II Decision Worksheet			System : ELECTRIC STEAM POWER PLANT											
			Sub System : SUPERHEATER											
Information Reference			Consequences Evaluation				H1	H2	H3	Default Task			Proposed Task	Can be Done by
							S1	S2	S3					
							O1	O2	O3					
F	FF	FM	H	S	O	N	N1	N2	N3	H4	H5	S4		
1	1	1	N	N	N	Y	N	N	Y	Y			Do Scheduled Discard task by replacing inlet drain primary superheated pipe. Also by doing finding failure task by checking the material composition by using spectrometer as a predictive maintenance effort	Engineering mechanic
		2	Y	N	N	N	N	Y	N	Y			Do Scheduled Restoration Task by fixing the inler header drain valve in the secondary superheated by closing leaked plug. Do finding falure buy checking the condition of the valve.	Engineering mechanic
		3	Y	N	N	N	N	Y	N	Y			Do Scheduled Restoration Task by fixing the inler header drain valve in the final superheated by closing the leaked plug. Do finding failure activity by checking the valve condition.	Engineering mechanic
		4	Y	N	Y	N	N	Y	N	N			Do scheduled restoration task by cleaning using cathodic protection	Har Mekanik, Engineering

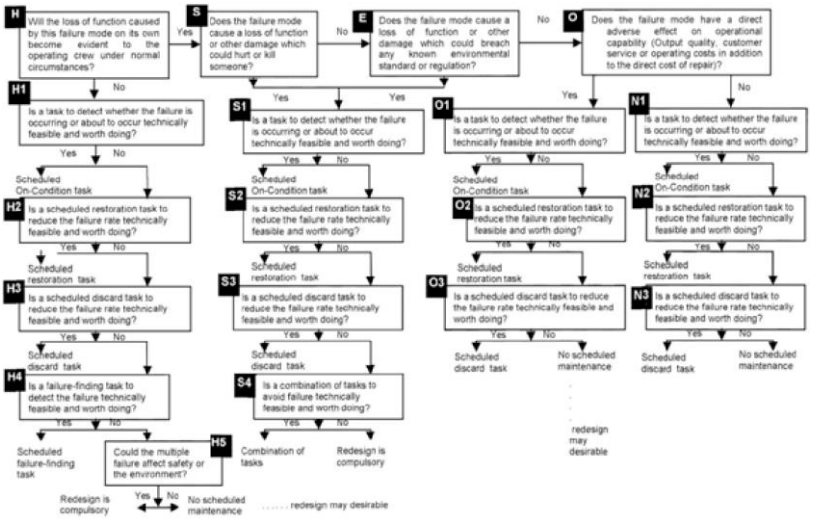

Figure 2 RCM II decision diagram

3.3 Discussion

The work flow of making the RCM II information worksheet and then the RCM II decision worksheet is done on whole 31 machine in the *X* power plant. The 31 machine are related in the machines that functioned in the rankine cycle in the power plant from the boiler to the

condensor. From the RCM II information worksheet developed, the failure modes are identified. The failure modes in the heating related machines are mostly about the potency of leaking and unpurified compund mixed in the burner chamber. The RCM II decision worksheet for the machines mostly recommend a finding failure activity such as checking the leak potency in the pipes. It is highly critical to keep the heating related machines functioning due to shutdown possibility if the machines are broken down.

Meanwhile, in the aerator and condensing related machines, the potensial failure modes are related to corrotion and leaking in the cooling pipes. The corrotion may happen becuase of the altering temperature happen in the condensing related machines. While the leaking may happen because of the corrotion weaken the pipes structure. One of the main propsed task is by scheduling a regular calibrating task in the display unit so that the displayed condition are accurate. This will lead to early prevention of leaking caused by extreme temperature change.

4. Conclusion

Based on the fiding in the result and the discussion above, the conclusion for this research are:

- The result from FMEA identification of the machines shows that there are a few improvement that can be made because in the existing condition is not yet affordable
- The result from the identification of information worksheet indicates that there are a few machines that is assigned maintenance activity not compatible with the machines. Through RCM II, a suitable maintenance activity has been proposed so that the maintenance activity can be improved

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