

CONFIRMATION

I admit that have read this work and in my opinion this work was adequate from scope aspect and quality to award in purpose Bachelor of Mechanical Engineering (Automotive)

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MAINTENANCE STRATEGY DEVELOPMENT (MSD) USING RELIABILITY
CENTERED MAINTENANCE IN A POWER PLANT: A HOLISTIC STUDY

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This report is submitted to
Faculty of Mechanical Engineering
Universiti Teknikal Malaysia Melaka (UTeM)
In partial fulfillment of conditions for
Bachelor of Mechanical Engineering (automotive) investiture

Fakulti Kejuruteraan Mekanikal
Universiti Teknikal Malaysia Melaka

April 2009

DECLARATION

“I hereby, declare this thesis entitled Maintenance Strategy Development(MSD) Using Reliability Centered Maintenance :A Holistic Study is the results of my own research except as cited in the reference”

Signature :

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Date : 9 April 2009

To My Beloved Mother,
Pn Hajah Nahorai Bt Nayan

And My Beloved Father,
Hj Abd Halim B Hj Abd Wahab

ACKNOWLEDGEMENT

I would like to take this opportunity to thank god because with his blessed, I have finished whole of my final year project. By this change I would like to express my deepest gratitude to Mr Ahmand Fuad B Ab Ghani for his kind effort in guide me to perform project procedure and lending his hand for supporting in my project accomplishment.

I'm also want to give my thankful greeting for Mr Suzaimi B Safei, Section head of Training department in giving cooperation to assist in achieving my project. The other appreciation also favor to TJSB mechanical department, operation and management staff for great welcoming my project to be conduct at their workplaces.

Lastly, unforgettable my fellow friends, housemates and whoever involved in the project whether direct or indirectly are expressed with billion of thank you.

ABSTRACT

The project is about to performed holistic study for reliability centered maintenance, RCM to achieved better maintenance strategies with cost and time effective. Reliability Centered Maintenance is a process used to determine what must be done to ensure that the equipment fulfils its intended function in its operating context, given the technical characteristics of failure of the equipment.

A systematic and analytical method for deciding what preventive maintenance (PM) requirement should be done on any machine or any asset and identify the need to take other actions that are warranted to ensure safe and cost effective operations of a system.

ABSTRAK

Projek ini adalah berdasarkan pembelajaran yang menyeluruh ke atas konsep penyelenggaraan berasaskan kebolehpercayaan,RCM dalam mencapai strategi penyelenggaraan yang berkesan dengan kos yang rendah. Penyelenggaraan berasaskan kebolehpercayaan,RCM adalah proses yang menentukan aktiviti yang perlu dilakukan terhadap aset supaya fungsi operasinya berterusan, dengan diberi ciri kerosakan aset tersebut.

Langkah-langkah yang sistematik dan bersifat analisis serta tindakan lain perlu dilakukan terhadap mesin atau aset lain untuk memastikan keselamatan dan keberkesanan sistem operasi. Langkah-langkah ini diperlukan untuk menentukan keperluan kepada penyelenggaraan pencegahan(PM) dan jenis penyelenggaraan yang diperlukan.

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LIST OF SYMBOLS

NO	SYMBOL	REPRESENTS	PAGES
1	A_o	Operational availability	8
2	A_i	Inherent availability	8
3	e	base of the natural logarithm (2.718281828)	12
4	λ	failure rate	12
5	θ	MTBF	12
6	t	Time	12

NOMENCLATURE

RCM	Reliability centered maintenance
TJSB	Teknik Janakuasa Sdn Bhd
LPP	Lumut Power Plant
FMEA	Failure Mode and Effect Analysis
FCA	Failure Characteristic Analysis
RCA	Root Cause Analysis
HPFW	High Pressure Feedwater Pump
PM	Preventive Maintenance
HP	High Pressure
MTBF	Mean time between failures

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CHAPTER 1

INTRODUCTION

1.1 Maintenance and RCM

From the engineering viewpoint, there are two elements of management for any physical asset. It must be maintained and from time to time it may also need to be modified. The major dictionaries define maintain as cause to continue (oxford) or keep in an existing state (Webster). This suggests that maintenance means preserving something. On the other hand, they agree that to modify something means to change it in some way. Maintenance define as ensuring physical assets continue to do what their users want them to do in context of operating function and this leads to definition of reliability-centered which is a process used to determine the maintenance requirements of any physical asset in its operating context.

Reliability Centered Maintenance (RCM) is the process that is used to determine the most effective approach of maintenance. It involves identifying actions that, when taken, will reduce the probability of failure and which are the most cost effective. It seeks the optimal mix of Condition-Based Actions, Time- or Cycle-Based actions, or a Run-to-Failure approach, as shown in Figure 1. The principal features of each strategy are shown below their block in Figure 1. RCM is an ongoing process that gathers data from operating systems performance and uses this data to improve design and future maintenance. These maintenance strategies, rather than being applied independently, are

integrated to take advantage of their respective strengths in order to optimize facility and equipment operability and efficiency while minimizing life-cycle costs(Source: NASA.(2000)).

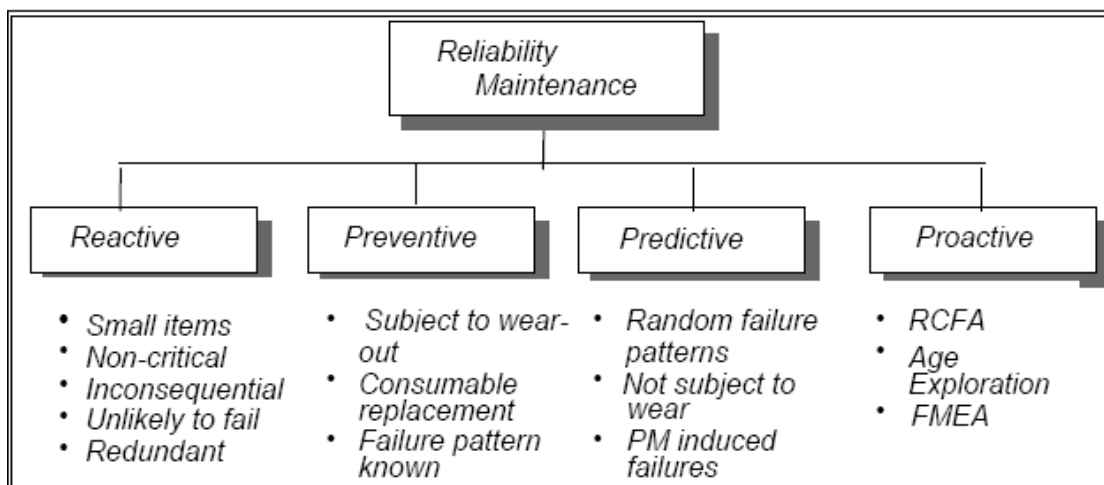


Figure 1.1 Component of an RCM program (source: NASA, 2000)

From approximately 1960 until the late 1980s, Preventive Maintenance (PM) was the most advanced technique used by progressive facilities maintenance organizations. PM is based on two principles - 1) a strong correlation exists between equipment age and failure rate, and 2) individual component and equipment probability of failure can be determined statistically, and therefore, parts can be replaced or rebuilt prior to failure. PM assumes that failure probabilities can be determined statistically for individual machines and components and parts or adjustments can be replaced or performed in time to preclude failure. For example, a common practice in the past was to replace or renew bearings after some number of operating hours based on the assumption that bearing failure rate increases with time in service. This has proven to be ineffective. (Source: NASA. (2000). *Reliability Centered Maintenance Guide for Facilities and Collateral Equipment*)

1.2 Problem statement

Reliability refers to the consistency of a measure. A test is considered reliable if we get the same result repeatedly. For example, if a test is designed to measure a trait (such as introversion), then each time the test is administered to a subject, the results should be approximately the same

In the power plant there are a lot of maintenance strategy and most of the plant operator use conventional and reactive maintenance. So the study carried out to modify existance conventional maintenance and come out with better strategic maintenance.

1.3 Objectives

Objective of the project is to study Reliability Centered Maintenance(RCM) in order to improve conventional maintenance strategy exist in power plant through industrial survey, case study and may involve simulation. The project carried out to established new maintenance strategies which more effective and efficient which at the same time can provide higher process availability and reduce man hours and risk of hazards to facilities. Through this project managers will be able to develop and update a preventive maintenance (PM) program for their facilities that is based on the reliability characteristics of equipment and components and cost. Such a PM program will help to achieve the highest possible level of facility availability at the minimum cost.

1.4 Scope of project

The project will cover RCM methodology with supporting Failure Mode and Effect Analysis (FMEA), Failure Characteristics Analysis (FCA), Maintenance Management System,(MMS) which improve conventional reactive maintenance to achieve optimum performance and plant availability.

1.5 The reliability-centered maintenance concept

Prior to the development of the RCM methodology, it was widely believed that everything had a "right" time for some form of preventive maintenance (PM), usually replacement or overhaul. A widespread belief among many maintenance personnel was that by replacing parts of a product or overhauling the product (or reparable portions thereof), that the frequency of failures during operation could be reduced.

Despite this previous commonly held view, the results seemed to tell a different story. In far too many instances, PM seemed to have no beneficial effects. Indeed, in many cases, PM actually made things worse by providing more opportunity for maintenance-induced failures.

1.5.1 Airline study.

When the airline companies in the United States observed that PM did not always reduce the probability of failure and that some items did not seem to benefit in any way from PM, they formed a task force with the Federal Aviation Administration (FAA) to study the subject of preventive maintenance. The results of the study confirmed that PM was effective only for items having a certain pattern of failures. The study also concluded that PM should be necessary only when required to assure safe operation. Otherwise, the

decision to do or not to do PM should be based on economics. (Source :Department of Army United States of America. ((2006).Washington. DC).

1.5.2 RCM approach.

The RCM approach provides a logical way of determining if PM makes sense for a given item and, if so, selecting the appropriate type of PM. The approach is based on the following precepts.

- i. *The objective of maintenance is to preserve an item's function(s).* RCM seeks to preserve system or equipment function, not just operability for operability's sake. Redundancy improves functional reliability but increases life cycle cost in terms of procurement and life cycle cost.
- ii. *RCM focuses on the end system.* RCM is more concerned on maintaining system function than individual component function.
- iii. *Reliability is the basis for decisions.* The failure characteristics of the item in question must be understood to determine the efficiency of preventive maintenance. RCM is not overly concerned with simple failure rate; it seeks to know the conditional probability of failure at specific ages (the probability that failure will occur in each given operating age bracket).
- iv. *RCM is driven first by safety and then economics.* Safety must always be preserved. When safety is not an issue, preventive maintenance must be justified on economic grounds.
- v. *RCM acknowledges design limitations.* Maintenance cannot improve the inherent reliability – it is dictated by design. Maintenance, at best, can sustain the design level of reliability over the life of an item.

vi. *RCM is a continuing process.* The difference between the perceived and actual design life and failure characteristics is addressed through age (or life) exploration.

1.5.3 RCM concept.

The RCM concept has completely changed the way in which PM is viewed. It is now a widely accepted fact that not all items benefit from PM. Moreover, even when PM would be effective, it is often less expensive (in all senses of that word) to allow an item to "run to failure" rather than to do PM. In the succeeding discussions, the RCM concept will be examined in more detail.

CHAPTER 2

LITERATURE REVIEW

Literature review is a method to gather all the information about the project and details of information will be analyze and studied to identify this project disadvantages and advantages. Project study such information searching through internet, industrial references, journal, database and other research paper are examples of literature review material used in this process. The project information studied for literature review based on:

2.1 Availability.

Availability is defined as the instantaneous probability that a system or component will be available to perform its intended mission or function when called upon to do so at any point in time. It can be measured in one of several ways.

2.1.1 Operational availability (Ao).

Another equation for availability directly uses parameters related to the reliability and maintainability characteristics of the item as well as the support system. Equation (1) reflects this measure