

**ANALYSIS OF PREVENTIVE MAINTENANCE FOR PROCESSING PLANT  
( GASSIFICATION PROCESS UNIT )**

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**JUNE 2015**

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**Laporan ini dikemukakan sebagai  
memenuhi sebahagian daripada syarat penganugerahan  
Ijazah Sarjana Muda Kejuruteraan Mekanikal (Loji & Penyenggaraan)**

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**JUNE 2015**

## DECLARATION

“I hereby declare that the work in this report is my own except for summaries and quotations which have been duly acknowledged.”

Signature : .....

Author : .....

Date : .....

## SUPERVISOR DECLARATION

“I hereby declare that I have read this thesis and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Plant & Maintenance)”

Signature : .....

Supervisor : .....

Date : .....

## **DEDICATION**

I dedicate this research to all lecturers, my family and friends

## ABSTRACT

Preventive maintenance defined as a philosophy, a skill of management series in how to manage the plant operation to be more efficient in terms of cost and times. The purposes of this research is to find the value of preventive maintenance performance that consists of a several activities, according to standard operation of a particular components. The method that will be use is Weibull method, which by this method, the shape parameter and characteristic life can be evaluate to find the failure and reliability distribution in a period of specific time and economic analysis.

The scope of this research are only for terms in preventive maintenance; types of preventive activities, number of labors, inventory / spare parts, failures and any related terms for preventive maintenance. The terms of cost in labors and inventory for economic analysis will have two parameters as to be comparison, the first one is maintenance cost without optimization and the other one is maintenance cost with maintenance optimization. The result of these two parameters are depends on the characteristic life factors ( $\eta$ ) and mean time between failure ( MTBF ).

The result of this research will shows all the evaluation for beta shape parameter,  $\beta$  and eta characteristic life,  $\eta$  for each of the components in the particular plant. Then both of the parameters will determine the factors needed in terms to find the optimized time line for preventive maintenance and leads to economic analysis after the optimization. Lastly, the conclusion will discuss the overall results and the relationship between all of the comparison, the shape factors, characteristic life and optimized maintenance cost.

## ABSTRAK

'Preventive maintenance' ataupun penyelenggaraan pencegahan, adalah boleh dikatakan sebagai falsafah yang berkaitan dengan teknik dan pentadbiran operasi loji, unruk menjadikannya lebih efektif daripada segi masa dan kos. Penyelenggaraan ini terdiri daripada beberapa aktiviti yang merujuk kepada satu piawaian yang telah ditetapkan. Loji pemprosesan bergantung kepada kebolehpayaan sesuatu mesin untuk berfungsi dengan baik, dimana jika pengeluaran diberhentikan, ianya akan mempengaruhi keseluruhan loji tersebut. Daripada tesis ini, *process flow diagram* akan memberi gambaran secara keseluruhan aktiviti ini, dimana unit yang digunakan ialah unit-1000, iaitu unit klasifikasi gas. Komponen mesin pada proses loji ini adalah ssangat penting dimana setiap komponen diklasifikasikan sebagai kategori kritikal ataupun sebaliknya. FMEA digunakan untuk memberi garis panduan dalam penyelenggaraan yang akan dilakukan. Data yang diperoleh akan dianalisis dengan menggunakan teknik-teknik tertentu dimana dengan menganalisa data tersebut, setiap komponen yang terlibat dapat dikaitkan dengan parameter tertentu contohnya seperti menggunakan OEE, MTBF dan CMMS, kecekapan sesuatu mesin itu boleh ditentukan dan dianalisa dengan lebih cekap.

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## ABBREVIATION

<b>PM</b>	Preventive maintenance
<b>MTBF</b>	Mean time between failure
<b>FMEA</b>	Failure mode effect analysis
<b>MTTR</b>	Mean time to repair
<b>MTTF</b>	Mean time to failure
<b>MTBM</b>	Mean time between maintenance
$\eta$	Characteristic life
$\beta$	Shape factor
<b>R (t)</b>	Reliability function
<b>F (t)</b>	Failure distribution function
<b>H (t)</b>	Hazard function
<b>TPM</b>	Total productivity maintenance
<b>RCM</b>	Reliability centered maintenance
<b>TPM</b>	Total productive maintenance
<b>TQM</b>	Total quality management
<b>OEE</b>	Overall equipment effectiveness
<b>Qty.</b>	Quantity

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 INTRODUCTION**

Since decades ago, the history of preventive maintenance already begun, whereabouts the revolution of industry in Europe and America. Preventive maintenance is an activity that need to secure the reliability of a components or a machine in a period of time. Maintenance can be divided into a few types of major activity ; predictive maintenance ( PDM ), root cause analysis ( RCA ), preventive maintenance ( PM ) and condition based maintenance ( CBM ). Today's maintenance challenges consists of many factors; the more of the technologies developed each days, the more complicated the machines it can be. Hence, the maintenance activities could be need more advance tools or devices, in order to ease the maintenance work that need to be done, and of course, value of money is the first priority that will be considered. Initially, the keys of maintenance works are the combination of a particular skills in terms of process management, material handling, technical skills and specific knowledge about the machines. However, the maintenance activity must be executed in a manner way; as to

comply with the safety of the public and the machines, welfare and health to the society and environment. The goal of the maintenance in process plant is to develop a new technique or a concept so that we can adapt the maintenance activity without interfering any of the process, even the whole equipment changed over times, the subsequence of the maintenance activity are still the same. Therefore, this research is about to on how can we reduce the cost at all manners in terms of all the preventive maintenance activities and to manage the cost effectiveness. The evaluation in this research is based on gasification unit-1000, a raw syngas production processing plants. The process flow diagram of gasification unit-1000 can be refer to the appendices. The equipment consists of different unit which it continuously supply the product to another unit.

## **1.2 OBJECTIVES**

There are a few main objectives of this research by the title; analysis of preventive maintenance planning for process plant. The objectives are to analysis the preventive maintenance plan and schedule of a process plant (gasification process unit), to study the effectiveness of a preventive maintenance planning and scheduling of a process plant in terms of it's failure rate, availability, reliability and maintenance cost. As an add on, the performance parameters can be relate to labor work and inventory (spare parts) cost optimization as well. Also, the other objectives are to estimate the total costs and economic losses incurred within the maintenance planning time horizon, by studying the graphs of the investment of the maintenance cost, tracking and predicting matters related in terms of the graph's fluctuation.

## **1.3 PROBLEM STATEMENTS**

Problem statement in this project may vary but generally the problems arose subjectively due to cost planning and controlling. Preventive maintenance activities consumed a lot of financial related base. These included the skill labor cost, advance

calibration equipment, special tools, production downtime, future expand and any other related consequences.

To maintain / reduce the loss of productivity, a time based scheduling and proper planning maintenance time consumption management were the preliminary challenges to build up an effective strategize maintenance management planning. By using a right preventive maintenance planning methods, the failure mode of each the equipment failure can be predicted before it happened and also to control the unnecessary inventory / spare parts / labor cost from flowing out.

#### **1.4 SCOPE**

- Total outflow cost are bounded only the PM cost (labor cost and inventory cost).
- To analysis the effect of preventive maintenance performance analysis been done by normal PM methods by using weibull analysis method method.
- The performance of preventive maintenance measured from the availability, reliability and failure distribution.
- Economic losses by the process plant estimated due to the equipment failures.

#### **1.5 SUMMARY**

As a conclusion, the impact of the preventive maintenance activities for process plant specifically plays an important role for the whole process and productivity. In either way, the maintenance programs and activities will influenced the fluctuation of the company's welfare. Operational and capital expenditure were the bases of the plant's total cost control. Hence, to achieved the cost planning and management scheduled, it needs to have a proper maintenance activities and Moreover, preventive maintenance planning were the essentials of the equipment in terms to reduce the failure