IMPLEMENTATION OF RELIABILITY CENTERED MAINTENANCE (RCM) IN PERTAMINA HULU ENERGY SUBHOLDING UPSTREAM (PHE SHU) THROUGH PERTAMINA RELIABILITY DATA (PAREDA) DATABASE & APPLICATION DEVELOPMENT

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Abstract
As part of the integrated efforts that need to be made to achieve the target of becoming a world-class energy company, PHE SHU needs to carry out a series of strategic initiative programs related to the implementation of RCM which need to be carried out in several field including all Regions, Zones, Work Areas and Assets. In the context of implementing RCM at PHE SHU, management has carried out a series of massive and simultaneous activities during 2022-2023 period, both debriefing several workshops & socialization of RCM understanding, issuing task forces and director's orders, conducting site visits & field implementation pilot projects in the onshore area (GTC SKG Subang Field) as well as offshore area (GTG X-Ray Jatibarang Field), performing sharing sessions/focus group discussion, review maturity level assessment, initiate various continuous improvement and its replication to other fields, as well as database development and created Pertamina Reliability Data (PAREDA) applications.

Keywords: RCM, PHE SHU, PAREDA.

1. INTRODUCTION
RCM is a corporate-level maintenance strategy designed to optimize maintenance programs by establishing safe minimum levels of equipment upkeep. RCM emphasizes matching individual assets with the maintenance techniques most likely to deliver cost-effective outcomes. One of the key objectives of the RCM analysis is to develop a maintenance schedule that would ensure that reliability of a system is enhanced. In essence a maintenance task would be implemented prior to the failure occurring. RCM is just one component of an overall Integrated Asset Management Process. By utilizing the RCM process, we can increase safety performance, reduce maintenance costs, improve the effectiveness of your operations, boost machine uptime, and gain a greater understanding of the level of risk. Among the crucial risks is the potential for unplanned shutdown which can cause loss of production. If unplanned shutdown events continue, it can have an impact on the company's reputation and the trust of both shareholders and stakeholders.

https://mechta.ub.ac.id/
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With the availability of a database of data reliability that can be used as a reference in a comprehensive analysis for decision making for operational, maintenance and efforts to increase the reliability of the equipment itself. So that it is possible to carry out more comprehensive analyzes such as Failure Mode & Effect Analysis (FMEA), Reliability Centered Maintenance (RCM), Root Cause Failure Analysis (RCFA) and other analysis tools in improving equipment reliability through improving strategies and planning in Maintenance & Reliability (M&R) management. In addition to increasing equipment reliability, an increase in overall maintenance cost efficiency will also be achieved.

2. RCM METHODOLOGY

In practice, there are several steps of RCM methodology which will be carried out with the following scope including system selection, system boundary, system description and functional block diagram, system function and functional failure, failure mode and effect analysis (FMEA), logic tree analysis (LTA), task selection and task interval. The scope area of RCM are as follows:

- PM : Preventive Maintenance  
- CbM : Condition Based Maintenance  
- PdM : Predictive Maintenance  
- RCFA : Root Cause Failure Analysis  
- FMEA : Failure Mode and Effect Analysis

![Figure 1. RCM Scope Area](image)

The primary advantage of Weibull analysis is the ability to provide reasonably accurate analysis and Failure forecasts with extremely small samples. The two defining parameters of the Weibull line are the shape parameter, beta(β), and the characteristic life, eta (η).

\[ F(t) = 1 - e^{\left(\frac{t - \gamma}{\eta}\right)^\beta} \]  
\[ R(t) = e^{\left(\frac{t - \gamma}{\eta}\right)^\beta} \]  

Beta is related to the physics of the failure, and eta is the typical time to failure in Weibull analysis. Eta and beta are useful in predicting failure time and optimizing maintenance intervals to plan maintenance strategic such as PM, CbM and PdM.
Figure 2. PF Curve

Figure above describes the PF curve of a Gas Turbine equipment which has a life time (eta) of 32000 hours and beta 2. The PF curve can be used as a basis for planning Maintenance.

Figure 3. Site Survey SKG Subang Field

2.1 Systematic & Structure

RCM is a systematic and structured approach in planning maintenance strategies to increase the reliability and availability of equipment. RCM is based on the understanding that every piece of equipment has potential failures that must be identified and dealt with appropriately in order to maintain optimal performance and minimize the risk of failures that can cause losses. It involves a series of analysis and decision-making steps that focus on the reliability and maintenance aspects of equipment. This approach emphasizes identifying potential failures and determining the most effective maintenance strategy to prevent or reduce those risks. RCM aims to allocate resources efficiently by prioritizing maintenance actions based on the impact of failure on safety, the environment and operational performance. The RCM process generally involves the following steps:

1. Identification of System Functions: Understand the function and performance of the system or equipment to be analyzed.
2. Identification of Failure Modes: Identify all possible failure modes that can occur in a system or equipment
3. Failure Impact Analysis: Analyze the safety, environmental, operational, and financial consequences of each failure mode.
4. Determination of Treatment Strategy: Determine the most appropriate maintenance strategy to prevent or reduce the risk of failure, based on analysis of the impact of failure and other considerations.
5. Treatment Plan Development: Develop a detailed treatment plan, including the required treatment schedule, methods, and procedures.
6. Implementation and Evaluation: Carry out the maintenance strategy that has been determined, and carry out continuous monitoring and evaluation to ensure its effectiveness.

Implementing RCM can improve maintenance efficiency, optimize resource use, reduce unnecessary maintenance costs, improve system reliability, and extend equipment life. RCM can also help achieve higher safety goals through identifying risks and implementing appropriate countermeasures.

As for the implementation of RCM requires several specific policies including:

**Wellness asset Monitoring Policy:**
Establishes routine monitoring requirements for equipment that is the focus of the RCM. This can include monitoring of operational parameters, performance measurement and other monitoring methods. This policy should cover the frequency of monitoring, the methods used, and responses to monitoring results that are suspicious or outside the normal range.

**Routine Inspection Policy:**

![Figure 2. RCM Stages](image-url)
Defines the types of inspections that need to be performed regularly to detect potential failures. This policy should include specific checklists, inspection intervals, inspection methods used, and actions to be taken based on inspection findings.

**Predictive Maintenance Policy:**
Establishes policies and procedures for carrying out predictive maintenance, such as oil analysis, spectral analysis, thermography, or non-destructive inspections. This policy should cover the type of predictive maintenance used, the intervals it performs, the interpretation of results, and the actions taken based on the findings.

**Maintenance Planning and Scheduling Policy:**
Defines procedures for planning and scheduling maintenance activities based on RCM findings. This policy should cover planning methods, job submission processes, resource allocation, and coordination with operations teams to minimize impact on production.

**Change Management Policy:**
Defines policies to manage changes related to maintenance recommended through the RCM process. This policy should include procedures for evaluating, approving and implementing changes, as well as effective communication to all relevant parties.

**Failure Reporting and Analysis Policy:**
Defines procedures for reporting and analysis of failures that occur despite maintenance actions in accordance with the RCM. This policy should cover actions taken to prevent similar failures in the future and the organization's learning process from such failures.

**Training and Development Policy:**
Establishes policies for the training and development of personnel involved in RCM implementation. This policy should include identifying training needs, planning training, and evaluating training success.

**RCM Evaluation and Improvement Policy:**
Establishes a policy to carry out periodic evaluations of RCM implementation and continuous efforts to improve its effectiveness. This policy should include performance metrics to measure, process evaluation, and implement corrective actions.

If recommendations from monitoring, assessment and evaluation results require a new development project, then the process will refer to the Maintenance & Reliability Management System (MRMS) while still considering follow-up recommendations during production engineering activities and production operations.

### 2.2 RCM Document

<table>
<thead>
<tr>
<th>No</th>
<th>Document Type</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>System piping &amp; instrumentation diagram (P&amp;ID)</td>
<td>Source of system-equipment configuration design information</td>
</tr>
<tr>
<td>2</td>
<td>System schematic and/or block diagram</td>
<td>A visual display diagram of how the system works</td>
</tr>
<tr>
<td>3</td>
<td>Equipment history (Breakdown, Planned maintenance, Corrective)</td>
<td>List of failure logs and all maintenance actions that have occurred at the plant</td>
</tr>
<tr>
<td>4</td>
<td>Equipment vendor manual</td>
<td>Information on the design and operation of the equipment for use</td>
</tr>
<tr>
<td>5</td>
<td>System operation manuals</td>
<td>A list of details about how the system functions, how it relates to other systems, and what operational...</td>
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</table>
2.3 RCM Category & Classification
Currently, RCM is the most favorable method for developing failure management policies with the aim of sustaining the functional performance of our physical assets. Despite its name, it goes well beyond maintenance to include operational, engineering, procedural, process, and training outcomes. It can touch on many aspects of our businesses if we use physical assets and these days, just about everyone does.\(^1\)

Referring to the categories and classifications of the asset life cycle sourced from ISO 55001, it can be understood that the implementation of RCM must have started from the design phase to operation & maintenance (green highlight), as clearly seen in the flow diagram in Figure 4.

3. RESULTS AND DISCUSSION
Pertamina Hulu Energi Subholding Upstream (PHE SHU) is one of subsidiary entity of PT Pertamina (Persero) group. It has specific uniquely compared to other PT Pertamina (Persero) subsidiaries. Apart from being in charge of managing a portfolio of more than 53 domestic and 5 overseas subsidiaries, 6 joint ventures and affiliates, PHE SHU also manages
and supervise operations in 48 domestic upstream oil and gas working areas and 3 overseas working areas. In an effort to supply oil and natural gas to meet domestic needs, PHE SHU is obliged to improve and ensure that oil and natural gas production operations can run reliably and efficiently. With a large and diverse number of assets, one of the databases needed is reliability data from tools/equipment to become the basis for analysis in an effort to ensure reliable equipment that supports the availability of production units/systems in accordance with the operating context and targets that have been set.

Data collection is an investment. Data standardization, when combined with enhanced data management systems that allow electronic collection and transfer of data, can result in improved quality of data for reliability and maintenance. A cost-effective way of optimizing data requirements is through industry co-operation. To make it possible to collect, exchange and analyzed data based on common viewpoints, a standard is required. Standardization of data collection practices facilitates the exchange of information between relevant parties e.g. plants, owners, manufacturers and contractors throughout the world.

Pertamina Reliability Data (PAREDA) was built as a supporting application for the RCM database standardization at PHE SHU in the form of web applications and apps that allow it to be used anywhere, from anywhere and at any time without being constrained by remote areas and work area limitations.

4. CONCLUSION

In the petroleum, petrochemical and natural gas industries, great attention is being paid to safety, availability, reliability and maintainability of equipment. The industry annual cost of equipment unavailability is very large, although many plant owners have improved the availability of their operating facilities by addressing this challenge. A stronger emphasis has recently been put on cost-effective design and maintenance for new plants and existing installations among more industrial parties. In this respect, data on failures, failure mechanisms and maintenance related to these industrial facilities and its operations have become more important. It is necessary that this information is used by and communicated between, the various parties and its disciplines, within the same company or between companies. Various analysis methodologies are used to estimate the risk of hazards to people and environment, or to analyze plant or system performance. For such analyses to be effective and decisive, equipment reliability and maintenance data are vital.

These analyses require a clear understanding of the equipment’s technical characteristics, its operating and environmental conditions, its potential failures and its maintenance activities. It can be necessary to have data covering several years of operation before sufficient data have been accumulated to give confident analysis results and relevant decision support. It is necessary, therefore, to view data collection as a long-term activity, planned and executed with appropriate goals in mind. At the same time, clarity as to the causes of failures is key to prioritizing and implementing corrective actions that result in sustainable improvements in availability, leading to improved profitability and safety.

Apart from strengthening the asset management aspect through the stages of the RCM process, conducting debriefing and outreach, real case field studies, and preparing guidelines, database creation through develop PAREDA also needs to be carried out to obtain integrated and comprehensive RCM implementation results.
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REFERENCES


