
MAINTENANCE STRATEGY REVIEW (MSR) BASED ON ISO 14224:2016 IN INDONESIA OIL AND NATURAL GAS COMPANIES

Maintenance Strategy Review (MSR) Berdasarkan ISO 14224:2016 di Perusahaan Minyak dan Gas Indonesia

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Abstract

The oil and gas industry is vital for Indonesia, and the safety and effectiveness of work in processing and exploring the oil and gas that operate in Indonesia must comply with existing regulations. This safety and effectiveness are inseparable from how the company maintains the assets and instruments used at the oil and gas production and exploration site. Maintenance of pipes and instruments for production is one of the company's most vital assets. In addition to having appropriate productivity, pipes and instruments must be maintained optimally so that maintenance costs do not exceed the value of the oil and gas production. This study's research subject is a natural gas refinery from an oil and gas company operating in the Madura Strait, East Java, Indonesia. The object of research limited to the company's piping system (pipeline system). This study uses a quantitative assessment using the calculated Mean Time Before Failure (MTBF) method and a qualitative assessment using the asset maintenance standard to reveals how the maintenance cycle that has been implemented can be optimized. The author carried out a criticality assessment using Maintenance Strategy Review (MSR) to calculate the risk level of asset. This study found that 78 assets must be maintained in their maintenance cycle, two cash assets must be reduced in their maintenance cycle, and seven assets can be extended for their maintenance cycle. The two assets that need to be reduced in maintenance cycles are the shutdown valve asset that goes to the temporary pig receiver and the shutdown valve that goes to the HP flare header. An asset that can be extended its maintenance cycle is a transmitter for flow indicators.

Kata kunci: maintenance strategy, oil and natural gas, Madura Strait.

Abstrak

Industri minyak dan gas bumi merupakan industri yang vital bagi negara Indonesia, keselamatan dan keefektifan pekerjaan dalam mengolah minyak dan gas bumi yang beroperasi di Indonesia harus sesuai dengan regulasi yang ada. Keselamatan dan keefektifan ini tidak luput dari bagaimana perusahaan tersebut memelihara alat dan instrumen yang digunakan pada situs produksi dan eksplorasi minyak dan gas bumi tersebut. Pemeliharaan pipa dan instrumen untuk produksi merupakan salah satu aset vital bagi perusahaan. Selain harus memiliki produktivitas yang sesuai, pipa dan instrument harus dipelihara secara optimal agar biaya pemeliharaan tidak melebihi dari nilai produksi minyak dan gas bumi tersebut. Dalam penelitian ini, yang menjadi subjek penelitian adalah kilang gas bumi dari salah satu perusahaan minyak dan gas bumi yang beroperasi di Selat Madura, Jawa Timur, Indonesia. Objek penelitian ini terbatas pada sistem perpipaan perusahaan (pipelines system). Studi ini menggunakan penilaian kuantitatif dengan metode perhitungan Mean Time Between Failure (MTBF) dan penilaian kualitatif dengan menggunakan standar pemeliharaan aset untuk mengungkap bagaimana siklus pemeliharaan yang sudah diterapkan dapat dioptimalkan. Penulis melakukan penilaian kritis menggunakan Maintenance Strategy Review (MSR) untuk menghitung tingkat risiko aset. Studi ini menemukan bahwa 78 aset harus dipertahankan dalam siklus pemeliharannya, dua aset kas harus dikurangi dalam siklus pemeliharannya, dan tujuh aset dapat diperpanjang untuk siklus pemeliharannya. Dua aset yang perlu dikurangi dalam siklus perawatan adalah aset shutdown valve yang menuju ke pig receiver sementara dan shutdown valve yang menuju ke HP flare header. Aset yang dapat diperpanjang siklus pemeliharannya adalah pemancar untuk indikator aliran.

Kata kunci: strategi pemeliharaan, minyak dan gas alam, Selat Madura.

1. INTRODUCTION

The organizations operating in the charity sector play a critical role in society. However, most of these resources are found in Indonesia, a country with enormous potential for natural resources ranging from biodiversity, forests, and seas to oil and natural gas. The possibility of these natural resources must be appropriately utilized to be able to make Indonesia a developed country and be useful for its people. Utilization of this potential can be done through the processes of exploration and production of oil and gas. Oil and gas are natural resources stored beneath the earth's surface. Oil and gas stored in these pores are called reservoirs.

The product is the main result of a production process, with a system consisting of inputs, operating procedures, and outputs. Products from the oil and gas industry are highly dependent on the productivity and production costs of their exploration and production activities. In this aspect, the maintenance of pipes and instruments for production is one of the company's vital assets. In addition to having appropriate productivity, pipes and instruments must be maintained optimally so as not to exceed the value of the oil and gas production. Because the oil and gas industry is vital for Indonesia, the safety and effectiveness of work processing oil and gas operations in Indonesia must comply with existing regulations.

The British Standard Glossary 3811: 1993 defines maintenance as combining all technical and administrative measures, including control measures, as maintaining or restoring an item to a state where it can perform its intended function (BSI, 1993). Oil and gas companies require analysis related to the maintenance contained in the pipes and instruments (piping and instruments) used in the field to minimize the risk of work accidents and keep oil and gas production and processing costs minimal. This maintenance analysis is helpful as a company investment for the production process for a certain period. The research can be used to determine which assets need to be focused on for maintenance and how to maintain the strategy. Preventive maintenance and scheduling are interrelated because well-scheduled maintenance will reduce the possibility of downtime for assets used in production (Nurcahyo et al., 2016).

This study's research subject is a natural gas refinery from an oil and gas company operating in the Madura Strait. The company has three offshore locations in the Madura Strait: one production site and two exploration sites with limitations on the scope of piping and instruments.

A combination of quantitative and qualitative methods was chosen in this study (Rahayu et al., 2019). This study uses a quantitative assessment using the calculated Mean Time Before Failure (MTBF) method and a qualitative assessment using the asset maintenance standard used by oil and gas companies. This study uses tools to review maintenance strategies to reduce the risk of pipeline failure, analyze their effects, and develop responses through the Maintenance Strategy Review (MSR) method. This study reveals how the maintenance cycle that has been implemented can be optimized by considering the MTBF value.

2. LITERATURE REVIEW

Maintenance is a series of activities to keep the facility in the same condition as at its initial installation to continue working according to its production capacity (Mann & Mikesell, 1976). While the purpose of maintenance is to extend the useful life, ensure the optimum availability of equipment used for production, ensure operational readiness, and ensure the safety of people who use it (Corder, 1992).

Maintenance management aims to optimize maintenance performance by increasing the availability of a system or equipment through planning, organizing, managing human resources, and evaluating (Wireman, 2005). Meanwhile, asset management is a science and art to guide wealth management which includes planning asset requirements, obtaining inventory, legal auditing, assessing, operating, maintaining, renewing or deleting, to transferring assets effectively and efficiently. The purpose of asset management is to assist companies in making the right decisions so that assets can be managed effectively and efficiently (Sugiama, 2013).

Information on reliability and performance is often of particular interest in the design, operation, and maintenance of oil and gas industry equipment, especially for safety-critical systems. To aid decision-making in this industry, it is common and sometimes difficult to collect and analyze information on the root causes of failures that have occurred in similar systems in the past. The international standard ISO 14224 provides key guidance on obtaining quality equipment failure information for decision-making in the oil and gas industry, including specific guidance on data collection concepts and how to record and classify the cause of the error (Selvik & Bellamy, 2020).

Machinery and equipment components in the offshore industry are regularly inspected and replaced based on time-based maintenance

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methods. Time-based maintenance is better than emergency maintenance after equipment failure. Time-based preventive maintenance is a great way to keep equipment in the offshore industry in good working order, but this maintenance doesn't guarantee that equipment will succeed. Condition-based maintenance (CBM) can assess equipment degradation behavior and apply predictions and appropriate maintenance actions. Integrated ICT systems are introduced and implemented in offshore industrial operating systems. Equipment maintenance information systems, such as computerized maintenance management systems (CMMS), have been used in nuclear and land power plants. CMMS is the application of information about maintenance activities in an organization. CMMS can perform computerized processing of facility management task information to efficiently manage maintenance tasks and evaluate the performance results of maintenance activities. (Hwang et al., 2018).

In several studies related to the maintenance of the offshore industry, Arthur, N. and Dunn (2001) applied optimization with the CBM approach for large reciprocating compressors in offshore installations. Caselitz, P. and Giehardt (2002) undertake hardware and software solution development, but also prototype testing, integration of failure prediction, and maintenance and repair planning techniques on offshore wind converters. They also compared the results of the lifecycle cost (LCC) of various strategies with the condition monitoring system (CMS) strategy. Migueláñez and Lane (2010) conducted a comprehensive study of sensor events and measurements across offshore turbine systems and subsystems. Telford et al. (2011) reviewed the literature on the development and application of CBM in the offshore oil and gas industry. Nurcahyo et al. (2019) determine key process areas in the oil and gas industry using the capability maturity model (CMM), Delphi method, and analytical hierarchy process (AHP) in maintenance planning.

Condition – Based Maintenance (CBM), or Predictive Maintenance, is the most suitable maintenance method to be implemented in the industry (Nurcahyo et al., 2018). One of the strategies for implementing the maintenance program at this oil and gas company is to conduct a Maintenance Strategy Review (MSR). This evaluation will be carried out on the maintenance strategy assigned to several tools and instruments to ensure that every input and notification from this implementation is used to optimize the strategy. Reviewing and monitoring

the effects of the maintenance work assigned to it needs to be done. The relationship between maintenance and developing a long-term maintenance strategy is significant for stakeholders at every company level (Jasiulewicz-Kaczmarek, 2013). The beginning of the Reliability Centered Maintenance (RCM) phase is the MSR. RCM is an ideal offering to be applied in power plants in Indonesia (Dachyar et al., 2018).

MSR is a continuous improvement effort. The author creates a framework based on three main phases: scoping, study, and implementation to perform MSR. The scoping phase is carried out to determine the scope of the MSR. The results of the scoping will be a list of objects of observation. This scoping will be carried out by conducting an asset register. The asset list compiled in an information management system (MIS) provides the correct basis for a successful solution (English et al., 2022). MSR can also lengthen the time it takes to conduct training. Training is essential to improving the effectiveness of maintenance performance. The right training program increases maintenance performance. (Fatoni & Nurcahyo, 2018).

The international standard ISO 14224:2016 provides key guidance on obtaining quality equipment failure information for decision-making in the oil and gas industry, including specific guidance on data collection concepts and how to record and classify the cause of the error. Standardization of data gathering procedures improves information interchange between parties such as plants, owners, manufacturers, and contractors. This International Standard specifies the requirements that any reliability and maintenance (RM) data system, whether in-house or commercially available, must meet when intended for RM data sharing. There are examples, rules, and principles for exchanging and combining such RM data. This International Standard also includes a framework and guidance for developing performance targets and requirements for equipment dependability and availability (Selvik & Bellamy, 2020).

Therefore, assets registered will follow the ISO 14224 standard, and assets registered as objects must follow a standardized hierarchy. The second study is the implementation and analysis of MSR. The result will be a list of recommendations. This is done by critically evaluating each tool and instrument and then analyzing each component. Third, this implementation is implemented to realize the recommendations concluded in the previous phase. Each recommendation will be

implemented and transferred to the appropriate system, such as a maintenance change request for the maintenance master data in the CMMS (Selvik & Bellamy, 2020).

A computerized maintenance management system (CMMS) is a software package that stores information about maintenance operations in a computer database developed at the dawn of computing and mathematical systems. Since then, CMMS development has progressed as technology and requirements became readily available. Therefore, in the near future, CMMS can support the management of related maintenance activities efficiently and effectively. Technical information, economic information, and historical information about equipment and operating facilities are essential to achieve efficient maintenance management. Maintenance management can be defined as a variety of exercises that define maintenance objectives, methodologies, and obligations and carry them out in the following ways: CMMS, a software package that stores information in a computer database, contains information about an organization's maintenance operations. This software helps maintenance managers optimize activities and make informed decisions (Mohd Noor et al., 2021).

Mean Time Between Failures (MTBF) is the average tool uptime between failures that occur. MTBF can be applied to tools that have repairable properties. MTBF is based on assumptions and definitions of failure, and this attention to detail is essential for correctly interpreting MTBF values (Torell & Avelar, 2004). This paper defines failure as all notifications regarding oddities at production or exploration sites reported to the CMMS. So all notifications about the tool will be counted as failures. Communication and coordination of e-maintenance planning and maintenance work plans are priority key process areas (Nurchahyo et al., 2019).

Oreda is a project organization that includes 7-11 oil and gas companies as members that have been operating for more than 35 years. Oreda provides a comprehensive data bank collected on equipment at the oil and gas companies that are members of Oreda. Oreda also has a forum for exchanging and developing reliable methods and knowledge in the oil and gas industry's production of ISO standards and APIs. Oreda is the birthplace of the ISO 14224, ISO 20815, and ISO TR 12489 standards. Oreda provides a handbook for non-member companies with selected data drawn from a combination of data from oil and gas companies operating worldwide. The edition used in the research is Oreda's 2009 publication (Hameed et al., 2011).

3. METHODOLOGY

The data used in this study was obtained from failure notifications from platforms in the Madura Strait. This failure notification will then become the basis for calculating the historical MTBF of the tool or instrument. The data is limited only to the last year. The tools and instruments are limited to the pipeline system or piping, and instruments. A flowchart for the discussion is shown in Figure 1. The stages of data analysis are:

- a. Registering assets to be observed as objects using an asset register
- b. Registering assets into function location on the C-MMS system
- c. Conduct a criticality assessment to eliminate assets that have a low critical level
- d. Looking for a pre-assigned maintenance strategy with related assets
- e. The analysis uses historical MTBF data and Oreda
- f. Recommendations, interpret the results obtained from MSR and provide input.

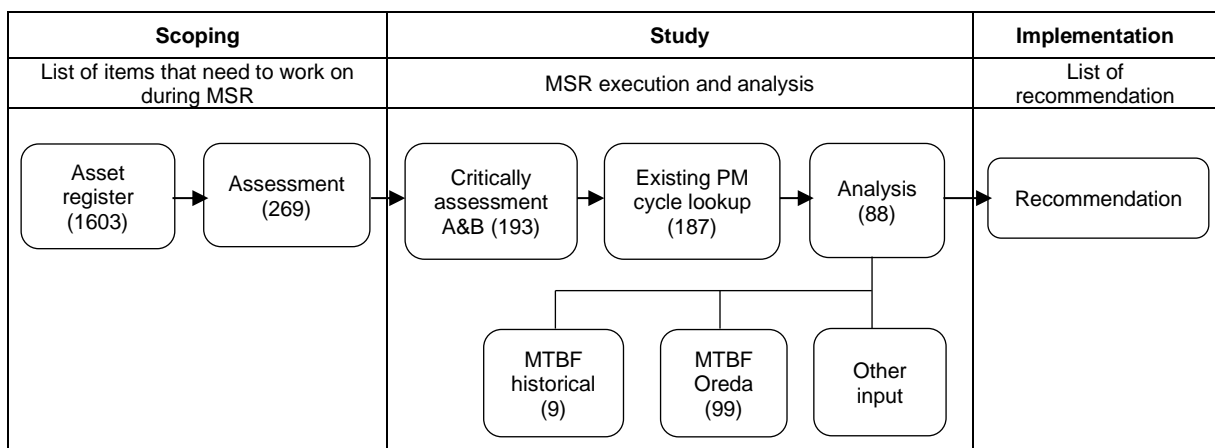


Figure 1 Research Flow Chart.

4. RESULT AND DISCUSSION

The initial stage of this research is to identify asset registration on Piping and Instrument Drawing (P&ID) at exploration sites and production sites. Identification data for the two study locations are described in Table 1.

Table 1 Registration Results for Both Locations.

No	Location	Assets
1	Exploration Site	1,506
2	Production Site	97
Total		1603

After registering 1,603 assets for the two assets site that will become research objects, the author performs a criticality assessment to calculate the risk level of each asset. According to (Godfrey & Halcrow, 1996), the risk value is the multiplication of the tendency or frequency with the risk consequences. The likelihood is the chance of a loss in the number of events per year. Consequences are the amount of losses caused by the occurrence of an event expressed in monetary terms. Assets that will be continued in the analysis process are assets with critical levels A and B following the indicators in Table 2. The risk value of this asset will then be the selection of which asset has a higher critical level (A), medium (B), and low (C). In this study, MSR only focuses on assets with an increased risk of being critical assets (A) and medium (B).

Table 2 Risk Matrix for Criticality Assessment.

Consequence	Risk Matrix			
5 Extreme	5 B	10 A	15 A	20 A
4 Major	4 B	8 B	12 A	16 A
3 Moderate	3 C	6 B	9 B	12 A
2 Minor	2 C	4 B	6 B	8 B
1 Slight	1 C	2 C	3 C	4 B
Likelihood	1 Very unlikely	2 Unlikely	3 Possible	4 Likely

The results of the criticality assessment show that 151 assets have a higher critical level

(A) and 247 assets that have a medium critical level as described in Table 3. After registering the assets on two sites and it was found that there were 398 assets with high and medium critical levels. The author then created a function location registered in the C-MMS system, which was adjusted to the registered necessary level, the previously registered maintenance cycle, observation MTBF value, Oreda MTBF value, and recommendations.

Table 3 Registration Results for Both Locations.

No	Critical Level	Total assets
1	A	151
2	B	247
Total		398

After reviewing the maintenance strategy associated with the function located on the C-MMS and looking at the current maintenance cycle, the authors compared the MTBF data from the notification system. They combined it with international standard Oreda data. It was found that 78 assets must be maintained in their maintenance cycle, two cash assets must be reduced in their maintenance cycle, and seven assets can be extended for their maintenance cycle. The two assets that need to be reduced in maintenance cycles are the shutdown valve asset that goes to the temporary pig receiver and the shutdown valve that goes to the HP flare header, which is reduced to PM 6M because the MTBF failure notification history data shows the number 7.99 per month. An asset that can be extended its maintenance cycle is a transmitter for flow indicators. According to Oreda and Carotek, standard maintenance is carried out every two years to reduce the instrument's workload.

An offshore industry maintenance is a complex and challenging topic. The maintenance scheduler must consider the availability of various resources (e.g., service vessels, spare parts, and maintenance technicians) to minimize production disruptions. The scheduling procedure must be done on a rolling horizon, with the maintenance plan reacting promptly to changing weather and sea environment circumstances (Shafiee, 2015). Industry must have a long-term maintenance strategy in place to handle the changing circumstances of its facilities. The maintenance method must be changed regularly to keep up with changing circumstances of the facilities in the surrounding environment (Setyoko et al., 2022).

Maintenance logistics management is a critical duty. Failure to provide effective maintenance logistics owing to a shortage of spare parts, a lack of transportation, or insufficient people can have a negative impact on wind farm availability, reducing power output and profitability. As a result, well-organized repair logistics are required not only to decrease operational costs but also to assure the continuation of the oil and gas production process (Shafiee, 2015).

5. CONCLUSION

As a result, the asset register, which is then grouped based on the critical level of the item, obtained as many as 398 assets, which are then analyzed for the maintenance cycle that has been registered in C-MMS for later analysis according to the MTBF value observed compared to the Oreda MTBF to be able to define whether these assets can be extended, shortened, or maintained at their current maintenance cycle. It obtained as many as 78 assets that can be maintained in its maintenance cycle, two assets that must be reduced in its maintenance cycle, and seven assets that can be extended in its maintenance cycle. By doing a maintenance strategy review, the company can save money and reduce the workload required to maintain these assets without reducing production performance.

Based on the discussion at the conclusion, the author can provide suggestions for oil and gas companies that are the subject of reducing the maintenance cycle for two assets, namely the shutdown valve tool that goes to the temporary pig receiver and the shutdown valve that goes to the flare header, down to preventive maintenance because there is a historical MTBF that shows a value of \$7.99 per month. Extend the maintenance cycle for seven assets, namely transmitters for flow indicators. Because according to Oreda and advice from a Carotek maintenance consulting company, extending the maintenance cycle to 2Y, or every two years, can reduce the instrument's workload. The flow indicator transmitter's probability of asset failure for three years is 13.14%. Last, maintain maintenance cycles for the other 78 assets.

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