PROPOSED ACTION MAINTENANCE OF CRITICAL COMPONENTS ON MACHINE CENTRIFUGAL PUMP USING METHOD FAILURE MODE EFFECT AND CRITICALITY ANALYSIS (FMECA) IN PDAM TIRTAWENING BANDUNG CITY

Shandy Nurdianto, Gabriel Sianturi
Program Studi Teknik Industri, Universitas Komputer Indonesia, Bandung
Jl. Dipatiukur No. 112-116 40132, Telp (022) 2504119, Fax (022) 2533754

ABSTRAK

PDAM company engaged in water supply and sewage treatment . During the company made the process of distributing clean water , there are times when the machine is damaged . So that the machine can not operate properly . If this is allowed , which is often damaged components likely to experience sudden damage to the engine or on other components because these components are less maintenance . Thus the need for a method of treatment that is effective and efficient to address the damage caused to the machine or pump .

This research was conducted in PDAM TIRTAWENING BANDUNG . Issues raised in this study was not done of the optimal treatment method by the company such as the lack of preventive care in the maintenance or maintenance performed . Available treatments only component replacement process only. This will impact on the machine to be easily damaged and reduced performance of the machine being used .

This study uses Failure Mode Effects and Criticality Analysis (FMECA) . This study aims to identify the damage caused to the machine , look for the causes and consequences caused by the breakdown of components , dam identify adverse effects that would occur if the machine is damaged . In this study, conducted in accordance of the procedures used method .

From research conducted in PDAM TIRTAWENING , using FMECA can be seen that the priority of critical components in the maintenance action , namely Shaft (shaft) , Impeller , Shaft Sleeve , and Bearings . The damage suffered by the four components are worn , broken , cracked , and erosion . From the research company is expected to know the damage to the engine and able to take action to better treatments .

Keywords: *Maintenance*, FMECA (*Failure Mode, Effect and Criticality Analysis*)

I. Preliminary

A. Background

Water is one of the main supporting element dibutukan by humans in order to survive . It is inevitable that water is used in every aspect of human life , such as to meet the household needs , the needs of irrigation in agriculture and farming, animal husbandry and fishery needs , industry requirements and so forth.
Availability of clean water is dependent on the water resources contained within a region . Indonesia is geographically a tropical country with abundant resources , however, despite having abundant water resources , utilization should be carried out effectively and efficiently.

Regional Water Company (PDAM) is a company engaged in the field of water supply and sewage treatment . The history of the establishment of PDAM Bandung started since the Dutch colonial era in Indonesia . Formation of PDAM Bandung as the Regional Owned Enterprises (enterprises) based regulation (Perda) in Bandung City . The city that was originally designed for 200,000 inhabitants it is now inhabited by more than 2 (two) million because there was steady influx of migrants from the region around Bandung . In the Topographic Bandung is a basin formed from ancient lake Bandung . Bandung Basin, which covers 2,283 km ^{2} it is composed of two administrative regions , namely Regency Bandung and Bandung. Growing population and high urbanization have caused the city to the high density of population of 10 899 inhabitants per km ^{2} and aligned with it followed an increase in demand for housing with support facilities including clean water and waste water

PDAM role in terms of acquisition , processing and distribution of clean water and waste water to the public . The pattern of distribution of water carried by PDAM Bandung in three ways . First by direct distribution to consumers in vulnerable areas , namely water tank with water fleet , both by way of distribution through terminals and tap water for the population in general have not been able to assume a customer of clean water.

The third way is through a system of pipelines connected to homes and operated through gravitational pressure .

During the company made the process of distribution of water , there are times when the machine or pump that is in the company suffered damage resulting from engine components frequent or continuous damage that can cause water capacity is reduced and the cessation of the distribution process , or the absence of distribution for the citizens . So that the machine can not operate properly . Until now the company is still doing maintenance on any machine with a standard way of working alone or still do the treatment by waiting a component in a machine was damaged only and the absence of regular maintenance . If this is allowed , which is often damaged components likely to experience sudden damage to the engine or on other components because these components are less prioritized or less optimal treatment is done by the company.

Based on the above issues , so that the number of water distribution is not reduced as a component in the engine is damaged , it needs a method of treatment that can be done by the company. FMECA (Failure Mode Effects and Criticality Analysis) is an excellent method in helping companies because with this method the company can identify the type of damage of the engine components , find the causes and potential consequences thereof. By using the method FMECA companies can regularly perform component maintenance procedures , so that damage to the system or the engine suddenly can soon be overcome . Therefore , we propose alternative measures of treatment on components, and lift it into an object of research thesis entitled " Proposed Measures Treatment In Critical Components Engineering Centrifugal Pump with Method Using Failure Mode Effects and Criticality Analysis (FMECA) on taps TIRTAWENING".

The formulation of the problem in this research are: The problems that exist in the company not yet optimal treatments performed at the company's engine components . Maintenance of the company only replacement of components alone or waiting for the damage occurred in the components , which can result in water distribution process halted or reduced water capacity . And the problems will be solved is " How to optimize maintenance actions on components that were damaged by the method FMECA

The purpose of this research are:

1. Identify the machinery and components which have the highest critical level .
2. Identify the causes and types of damage of components on a machine that is deemed most often damaged .
3. Providing care measures proposed are effective and efficient for companies with a method FMECA

Limitation of problem in this research are:

1. Research conducted in water conservancy engineering section .
2. Types of machines studied were centrifugal pumps .
3. In this study , the method used is FMECA .
4. In the implementation of the implementation is not done in the field, research is limited to the submission of the proposal only.

II. Study of literature

A. *Failure Mode Effect and Criticality Analysis*

This type of damage , effects and criticality analysis (FMECA) is a systematic design techniques to identify and invest potentially system (product / process) is bad , is in line with the methodology for testing steps in which the system damage can occur . Potential effects of system performance and security of the damage and other serious effects . FMECA is composed of two different analyzes , the type of damage and impact analysis (FMEA) , all of which extended to analyze the type of critical damage , called criticality analysis (CA) . Above another real advantage from the action identifiers or change of eliminating or reducing the chance of damage .

FMECA also improve the knowledge of the system and improve supplies into the expected behavior , the output of FMECA done at the right time from the invaluable input to improve the cost effective preventive maintenance program and the work focused on the control plan .

FMECA begins with the conceptual stage and preparation , when the design of the system is analyzed from a functional perspective . To maximize effectiveness , however, the analysis needs to enhance any additional information is available for an analysis , it also reflects all the design changes and their impact on the overall system . Besides, and in addition , gain or benefit more apparent with FMECA , it can make an important contribution to the feasibility study preparation phase system throughout the design and depiction of functional problems .

The steps of the implementation of the FMECA , including :

1. The depiction of system requirements (Product / Process) .
2. Compliance functional analysis .
3. Meeting the needs allocation .
4. Identify the type of damage .
5. Determining the cause of the damage .
6. Determine the effects of damage
7. Assess the ugliness of damage , frequency of occurrence of these types of failures , and the probability of detection based on the conditions below .

A. Bad Effect	Level
Minor / Very low; Not Giving reason that expectations of a complementary nature as it has a lot of effect on system performance . Customers may not accept failure .	1 2
***Low*/ Rendah**; The poor state of low to cause the destruction of nature , only to neglect the customer disturbance . Customers may be just a little look at the ugliness on the system performance ..	3 4
Moderate / Medium ; The cause of the damage is customer dissatisfaction . Customers create inconvenience / disruption to damage the customer will see the ugliness in the sub - system performance .	5 6
***High*/ Tinggi**; Means higher customer dissatisfaction to damage such a system can not be operated , how not , the security system is breached or failed to fulfill something in accordance with government regulations.	7 8
***Very high*/ Sangat tinggi**; The poor state when the type of damage that could potentially affect the safety function of the system or the cause of the failure to fulfill something accordance with government regulations.	9 10

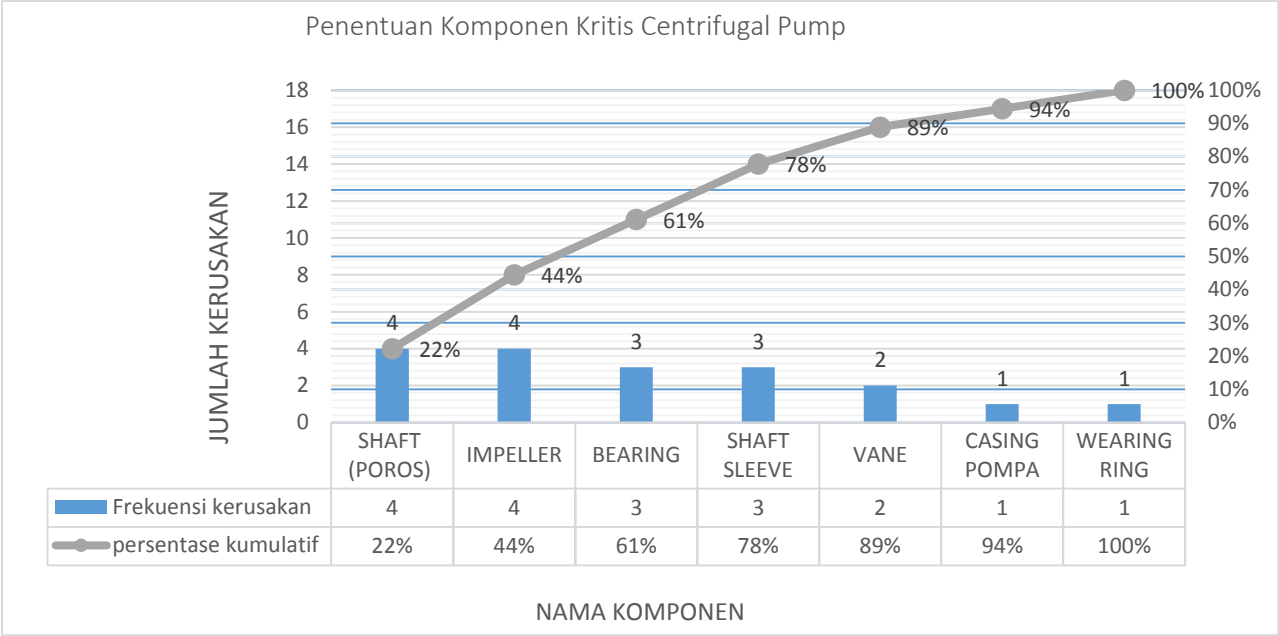
B. Activity Frequency of Failure	Level	Probability Damage
***Remote*/ Sangat rendah**; Damage unwelcome	1	<1 in 10^6
***Low*/ Rendah**; Relatively less damage	2 3	1 in 20.000 1 in 4.000
***Moderate*/ Sedang**; damage occasionally	4 5 6	1 in 1.000 1 in 400 1 in 80
***High*/ Tinggi**; Repeat damage	7 8	1 in 40 1 in 20
***Very high*/ Sangat tinggi**; The damage can hardly be ignored / left.	9 10	1 in 8 1 in 2

C. Detection Probability	Level
***Very high*/ Sangat tinggi**; Design verification and control process flows almost detect the type of potential damage for sure	1 2
***High*/ Tinggi**; DV or PCs now have an excellent opportunity to detect the type of damage potential	3 4
***Moderate*/ Sedang**; DV or PCs can now detect the type of damage potential .	5 6
***Low*/ Rendah**; DV or PCs today do not like / choose the type of damage potential .	7 8
Very low; DV or PCs now probably will not detect the type Potential damages .	9
Absolute certainty of nondetection; The absolute certainty of not detecting DV or PCs now can not detect the type of damage potential .	10

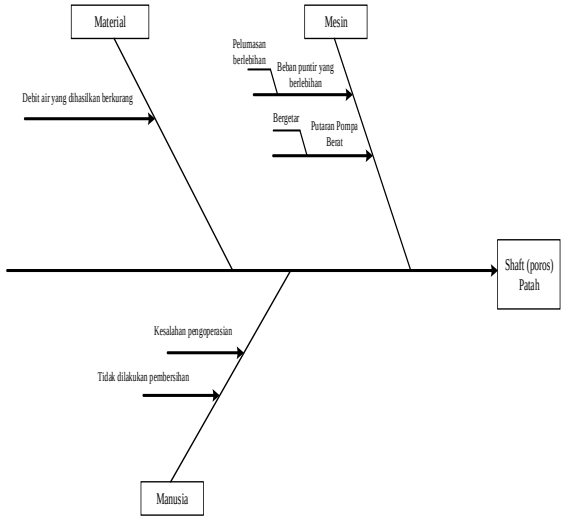
III. results and Discussion

A. Determination of the most critical components

Based on the frequency of damage incurred during the years in getting the four components that are considered often damaged , presented in Pareto diagram below.



The next step is to determine the type of damage that is obtained at each critical component . The damage that occurs in this shaft component that could lead to a broken component . After the critical component is determined the causes of damage, which is described in the fishbone diagram below.



The next step is to determine the effect of the evils that occur in a system where critical components are damaged . In determining the effect of the failure of a system , we must first know the damage these components . Failures in components in its function will certainly impact was bad enough for the overall functioning of the engine system , partial damage engine components would make the engine stops or can not operate.

Next is judging ugliness Type of Damage , Assessing Damage Frequency and Detection Assessing Probability of each critical component . Those values seen by the list of values and categories are listed in Table 1. After getting these values , we then determine the value of the RPN by multiplying these values on each of the critical components.

Tabel 2. *Risk Priority Number (RPN) For Each Critical Components*

Component name	Against Ugliness Process	Frequency of Failure	Detection Probability	RPN
Shaft	8	9	7	504
Impeller	8	9	7	504
Shaft Sleeve	8	9	5	360
Bearing	8	9	5	360

The results are then presented in a table FMECA , which includes the overall results obtained during the processing of the data . In addition to these results , in this table is also shown responses and alternative control measures were carried out on these critical components.

From these results , we can be sure that the critical component that the first priority is the Shaft and Impeller because such components have the effect of ugliness value and high damage frequency . And RPN high

IV. Conclusion

The company did not care regardless of the condition of the state of the company. The company establishes treatment where existing facilities must be in accordance with the needs of the maintenance activities , if the facility is inadequate then the care system will not be performing well . This will result in the lack of reliability of the components of the pump From the data processing and analysis , it can be concluded as follows :

• By doing this research as well as data processing that has been done , then the machine components centrifugal pump is in critical condition , the component Shaft , Impeller , Shaft Sleeve , and Bearings . Determination of critical engine components is based on the results of the comparison with the Pareto diagram . Can be seen from the frequency of occurrence of the damage as much as four times the component Shaft and Impeller , 3 times on components and Shaft Sleeve Bearings in an interval of 1 year .Dari hasil penentuan faktor sebab-akibat kerusakan (*fishbone*), didapat faktor yang berpengaruh terhadap kerusakan komponen yang mengakibatkan komponen rusak adalah faktor mesin, manusia, dan material

• Based on the results of the calculation of the RPN (Risk Priority Number) , which occupies a critical component of care measures are a priority in Shaft and impeller which has a value of RPN 504 , while component and Shaft Sleeve Bearing has a value of RPN 360

Daftar Pustaka

1. Blanchard, Benjamin S. (1994), *Maintainability*. Dinesh Verma, Elmer L. Peterson.
2. Andriyana, Soeh (2009), *Usulan Sistem Perawatan Terhadap komponen Kritis Lokomotif dengan Menggunakan Metode FMECA*, Teknik Industri UNIKOM,Bandung.
3. Sandika, San San (2013), *Usulan Tindakan Perawatan Mesin Pengolahan Air Minum dengan Menggunakan Metode FMECA*, Teknik Industri UNIKOM, Bandung.
4. Onny. (2011). *Mechanical*. Retrieved May 30, 2016, from http;//www.artikel-teknologi.com/bagian-bagian-pompa-sentrifugal/
5. Arsip Humas PDAM TIRTAWENING

Biodata

Penulis 1
Nama : Shandy Nurdianto
Email :shandynurdianto33@gmail.com
No. Tlp: 085721300202

Penulis 1
Nama : Gabriel Sianturi
Email :
No. Tlp: