SKRIPSI – ME4841

ANALISA KEANDALAN DAN KETERSEDIAAN PADA SISTEM *PULVERIZER* DI SEBUAH PEMBANGKIT LISTRIK

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Surabaya
2019

BACHELOR THESIS & COLLOQUIUM – ME4841

RELIABILITY AND AVAILABILITY ANALYSIS ON POWER PLANT PULVERIZER SYSTEM

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APPROVAL SHEET

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(MOM)
Program Study of Bachelor Engineering (S-1) of Department Marine Engineering
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JULY 12th, 2019

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ANALISA KEANDALAN DAN KETERSEDIAAN PADA SISTEM PULVERIZER DI SEBUAH *POWER PLANT*

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Abstrak

Pulverizer merupakan bagian yang sangat penting dalam proses pembakaran batu bara di pembangkit listrik tenaga uap. Pulverizer menentukan apakah proses selanjutnya dapat terjadi atau tidak. Sistem pulverizer membutuhkan keandalan tingkat sistem yang tinggi sehingga penghancuran batu bara dapat dilakukan dan dapat melanjutkan proses pembakaran. Dalam beberapa penelitian yang telah dilakukan tentang keandalan sistem pulverizer di beberapa pembangkit listrik di Indonesia memiliki nilai keandalan rendah. Beberapa penelitian dilakukan oleh Ratna Wulansari pada tahun 2006 dengan studi kasus di PT. PJBUP Paiton, Budiharjo pada tahun 2016 dengan studi kasus di PT. DSS Serang dan Slamet ryadi pada 2007 di PT. YTL Jawa Timur.

Maka dari itu penulis mengambil inisiatif untuk melakukan penelitian tentang keandalan dan ketersediaan sistem pulverizer di PT. PJB UBJOM Pacitan. Keandalan menjadi sesuatu yang penting karena secara langsung mempengaruhi kinerja suatu sistem, sehingga peningkatan keandalan harus dilakukan melalui strategi keandalan. Ada dua cara untuk meningkatkan nilai keandalan sistem, salah satunya dapat dilakukan dengan memberikan redundansi pada sistem (Artana & Dinariyana, 2013). Teknik ini berguna untuk komponen pendukung, yaitu dengan menyediakan atau menempatkan unit cadangan secara paralel. Metode yang digunakan dalam penelitian ini adalah menggunakan simulasi dengan bantuan Weibull ++ dan perangkat lunak Blocksim untuk mendapatkan nilai keandalan dan ketersediaan pada tingkat sistem. Data utama yang dibutuhkan adalah TTF dan TTR dari masing-masing pulverizer pada sistem. Kemudian data diuji untuk mengetahui distribusi yang tepat untuk data tersebut. Kemudian hitung parameter distribusi. Parameter akan digunakan untuk menghitung keandalan dan ketersediaan perangkat lunak yang akan digunakan. Hasil dari penelitian ini berupa perbandingan nilai keandalan dan ketersediaan antara sistem pulverizer yang ada sekarang dengan sistem yang ditawarkan. Hasil perbandingan menunjukkan lebih optimal bila sistem terdapat 6 pulverizer. Dimana 4 pulverizer operasi dan 2 lainnya dalam kondisi standby. Pemilihan dilakukan berdasarkan perbandingan cost operasi pada masing-masing sistem.

Key words – Reliability, Availability, Pulverizer, Distribution test, simulation *Weibull++*, and *Blocksim.*

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RELIABILITY AND AVAILABILITY ANALYSIS ON POWER PLANT PULVERIZER SYSTEM

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Abstract

Pulverizer plays a very vital role in the coal firing process at steam power plant. Pulverizer determines whether the next process can take place or not. The pulverizer system requires high system level reliability so that pulverizing coal can be carried out and can continue the firing process. In several studies that have been conducted on the reliability of pulverizer system in several power plants in Indonesia have a low reliability value. Several researches are conducted by Ratna Wulansari in 2006 with study case at PT. PJBUP Paiton, Budiharjo in 2016 with study case at PT. DSS Serang and Slamet ryadi in 2007 at PT. YTL East Java.

So from that the author took the initiative to conduct research on the reliability and the availability of the pulverizer system at the PT. PJB UBJOM Pacitan. Reliability becomes something important because it directly affects the performance of a system, so that increased reliability must continue to be carried out through a reliability strategy. There are two ways to improve the value of system reliability, one of which can be done by providing redundancy to the system (Artana & Dinariyana, 2013). This technique is useful for supporting components, namely by providing or placing a backup unit in parallel. The methods used in this research are using simulation with the help of Weibull ++ and Blocksim software to obtain reliability and availability number at the system level. The main data needed is the *TTF* and *TTR* of each pulverizer on the system. Then the the data is tested to find out the right distribution for the data. Then calculate the parameter of the distribution. The parameter will be used to calculate the reliability and availability of the software that will be used. The results of this study are a comparison of the value of reliability and availability between the current pulverizer system and the system offered. The comparison results show more optimal if there are 6 pulverizers. Where are the 4 operating pulverizers and 2 others in standby. The selection is based on the comparison of operating costs for each system.

Key words – Reliability, Availability, Pulverizer, Distribution test, simulation *Weibull++*, and *Blocksim.*

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PREFACE

Praise be to God Almighty, for His blessings, the authors can finish “Final Project Proposal” of reports in accordance with a predetermined time. The authors hope this report can be useful for readers and writers so that they can understand what considerations are used as a reference in making statements about the final project research and data collecting in a particular power plant company. In the preparation of this thesis there are many obstacles that the author faces but ultimately can pass through, because of the help of various parties. For this reason, the author expresses his gratitude to:

1. Ir. Dwi Priyanta, M.SE., as lecturer supervising the subjects of Bachelor Thesis that has taken the time to give guidance and direction in every assistance.
2. Nurhadi Siswantoro, ST., MT., as lecturer supervising the subjects of Bachelor Thesis that has taken the time to give guidance and direction in every assistance.
3. The author’s parent and sisters, for prayers and support so that this report is completed.
4. Mr. Hendro Kukuh as an engineer in PJB UBJOM Pacitan, who helps the data support for this final project so this report can be completed.
5. Mr. Nindar as an human resources department, who allowed me to get this all data for this final project so this report can be completed.
6. Rizky Agung Sukandar who always helps me in operating the software in the office so this final project be completed.
7. Oktavialdi and Puguh who helped me accompany the data collection process in Pacitan.
8. Fauzan Hawari helped me by lending his car so that I could collect the data I needed.

The author hopes that by writing of the Final Project Proposal can be useful and provide information to the reader. Because of the limitations of author, constructive criticisms and suggestions are indispensable for perfection in this report.

Surabaya, July 12th 2019

Fadhillah Muttaqien

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CHAPTER I
INTRODUCTION

1.1. Background

In Indonesia, the type of power plant that has the largest capacity as electricity producer in Indonesia is the Steam Power Plant (*PLTU*). According to data in 2016, the capacity of *PLTU* installed in Indonesia is 16,779.00 MW[1]. So that the *PLTU* becomes a very important part in meeting electricity needs in Indonesia.

In the process of electricity production in the *PLTU*, of course, it requires energy for the process. The energy used in this power plant comes from coal. The process of providing coal fuel in a power plant is usually called a coal handling / coal firing system. The process that is categorized as this begins in the coal process that just enters the ship and then is placed in an area called the coal pile through a stacking process. Stacking is the process of moving coal from barges to coal piles. Reclaiming process is needed, where in this process the coal is moved from the coal pile to the coal silo. Coal is dredged and moved from coal piles using a stacker and the reclaimer is then transported by a conveyor to the coal silo. After being accommodated in coal silos, the coal will be forwarded to the coal feeder to regulate the amount of coal needed in the manufacturing process. Then after from the coalfeeder, coal is sent to the pulverizer to be mashed so that it can facilitate the buying process. The next process is carried out with the help of the Primary Air Fan, Coal will be forwarded to the furnace through a pipe. Then the coal is used as fuel to heat the boiler.

In the coal handling system / coal firing system there is a pulverizer subsystem which is a very important component in the Steam Power Plant. Pulverizer plays a very vital role in the coal firing process. The quality of the pulverized coal will determine the burning process later. This pulverizer also determines whether the next process can take place or not. If the Pulverizer is not operating, the company cannot produce electricity in accordance with the desired target, and the worst impact is the electricity can not be supplied to the consumer and the company's income is reduced. Of course the pulverizer system requires high system level reliability so that pulverizing coal can be carried out and can continue the firing process.

In several studies that have been conducted on the reliability of the pulverizer system in several power plants in Indonesia, both component level and system level have a low reliability value. So that if the value of reliability value is low, it can cause the system to stop operating. In the research conducted at PT. PJB UP Paiton by Ratna Wulansari in 2006, examined the reliability of the pulverizer system. In the pulverizer system PT.PJB UP Paiton there are 5 pulverizer units. The minimum number of pulverizers that must operate in one system is 3 units and 2 other pulverizer units are in standby condition. In fact, in the case of a system that has 2 standby units, the pulverizer system is still often down or stopped operating. Then the reliability of the pulverizer system is analyzed and the results are that using 5 pulverizer units the reliability value is $R(t) = 0{,}035$ dengan $t = 365\ days$ (Wulansari, 2006).

[1] Statistik Ketenagalistrikan Kementrian Energi dan Sumber Daya Mineral tahun 2016

In addition, in another study conducted at PT. DSS Serang by Budiharjo in 2016, the level of availability of the Roller Mill system was investigated. In the roller mill system PT. DSS Serang there are 3 roller mill units. In the condition of reality on this system, the pulverizer often experiences failure damage to its components so that the system goes down. Then analyzed from the system the value of the operational availability of the system reached 86.92% (Budiharjo & Ikatrinasari, 2018). These results are then optimized from proper preventive maintenance scheduling so as to increase the value of system reliability.

Then in the research conducted at PT. YTL East Java by slamet ryadi in 2007 the reliability of the pulverizer components was examined. In this *PLTU*, pulverizer component failure often occurs outside of the standard maintenance time that has been determined by the company. That is the preventive maintainment time planned every 3500 hours. This was then analyzed for the reliability of the components of the pulverizer. Obtained the three most critical components of the pulverizer are; scrapper, grinding roll, spring. With each reliability value is 0.3822, 0.351, 0.0360 (Ryadi, et al., 2007). Those value of the reliability is very low when referred to the company's standards. If the constituent components have a low value of reliability, damage will often occur which can cause the pulverizer to stop operating, then if the pulverizer component together with other pulverizers then allows the system to stop anyway.

There is still more research on the reliability of the pulverizer which indicates that frequent failures occur outside the time determined by each power plant. But the authors only attach a few of the results of the study.

Here the author realizes that the pulverizer system is a very important part of the PLTU and also realizes that many studies show that the reliability of the components and the pulverizer system is quite low so that the pulverizer is often failed and causes the pulverizer system to stop operating.

So from that the author took the initiative to conduct research on the reliability of the pulverizer system at the PT. PJB UBJOM Pacitan. At this plant has 5 pulverizer units in each boiler. With 4 pulverizer units in operating conditions and 1 pulverizer unit in standby. Reliability becomes something important because it directly affects the performance of a system, so that increased reliability must continue to be carried out through a reliability strategy. There are two ways to improve the value of system reliability, one of which can be done by providing redundancy to the system (Artana & Dinariyana, 2013). This technique is useful for supporting components, namely by providing or placing a backup unit in parallel.

In this study, the system reliability that will be analyzed is PLTU PJB UBJOM Pacitan. Then if the *PLTU* has a low pulverizer system reliability, the researchers will increase its reliability by adding the number of standby pulverizers. so that the reliability value can met to the reliability standards of PT. PJB UBJOM Pacitan. This reliability and availability analysis will use a simulation method with Blocksim software. Of course, this addition will be analyzed by comparison of investment, maintenance costs, costs of losses when the system is shutdown. This analyzed will be compared between the system has not been modified and the system has been added or modified. So that this research can be used as one of the basic considerations for redesigning the pulverizer system which has relatively high availability and reliability values and allows for the application of a redundancy system especially on the pulverizer system.

1.2. Statement of Problem

The problem of this research are:

1. How to determine the distribution test and parameter selection of pulverizer failure data and repair data?
2. How is the value of reliability of each pulverizers on the system owned by PT. PJB UBJOM Pacitan?
3. How is the value of reliability and availability of the pulverizer system owned by PT. PJB UBJOM Pacitan?
4. How many additional components are needed to get the reliability value that has been determined by PT. PJB UBJOM Pacitan?
5. How to analyze the economic aspect of adding components to achieve the reliability of the system?

1.3. Research Limitation

The limitation of this research are:

1. The object that will be analyze is limited on pulverizer system at PT. PJB UBJOM Pacitan Unit 1
2. The analysis carried out is only limited to reliability and availability at the level of the pulverizer system.
3. Economic analysis carried out is only limited to the analysis of investment costs, maintenance costs, and costs when the system is shut down.
4. Reliability and availability analysis is carried out in a simulation.

1.4. Research Objectives

The Objectives of this Research are:

1. To determine the parameters from the distribution fit test of the failure and repair data.
2. To know the reliability of the pulverizer components at PT. PJB UBJOM Pacitan
3. To know the reliability value of the pulverizer system at PT. PJB UBJOM Pacitan
4. To know the amount of components numver that will added for increasing the reliability number.
5. To know the economical assesment of increasing the reliability value by increasing the number of componenets.

1.5. Research Beenefits

The results of this study can be used by PT. PJB UBJOM Pacitan to find out the value of the reliability and availability of the system that it has. In addition, this research can also be used as an option for companies to improve the reliability of the pulverizer system if needed.

CHAPTER II
LITERATURE STUDY

2.1. Overview

One of the plants that supply electricity in Indonesia is PT. PJB UBJOM Pacitan. The plant located in Pacitan is a steam power plant. This PLTU can produce 2x315 MW. In the process of electricity production requires energy for the process. The energy used in the power plant comes from fuel derived from coal. The process of supplying coal fuel at the PLTU is usually called a coal firing system. The process categorized in the coal firing system begins in the coal process that just enters the ship and then is placed in an area called coal pile through a stacking process. Stacking is the process of transferring coal from barges to coal pile. Next is the reclaiming process, where in this process the coal is moved from the coal pile to the coal silo. Coal is dredged and removed from the coal pile using a stacker and the recliner is then transported by a conveyor to the coal silo. After being accommodated in the coal silo, the coal will be forwarded to the coal feeder to regulate the amount of coal that is needed in the process. Then after the coal feeder, the coal is sent to the pulverizer to be mashed. So that the firing process can burn the coal easier. After the pulverizing process is complete, the pulverized coal sent to the burner with the help of primary air fan. There are 4 coal burners at each corner of the furnace for the same elevation and pulverizer.

In the Pacitan generation unit, there are 5 Pulverizer units used for the refining process. In the boiler there are 5 coal burner elevations (elevations A, B, C, D and E). While coarse coals are dropped again into the pulverizer to be mashed again. In this process, dirt and foreign objects are often found that are not needed in the process of combustion of impurities that will not be able to pass through classfier so that it falls down along with the coarse remnants of coal leading to spillage reject.

In general, the PLTU uses fluid of steam water that circulates in a closed cycle. Closed cycle means using fluid repeatedly. Figure 2.1 is an illustration of the process at the PLTU in general. The process is as follows:

1. Water is loaded into the boiler until it fills up the entire area of the heat transfer surface. In this water boiler it is heated with hot gas as a result of combustion of fuel with air so that it turns into steam.
2. Steam produced by boilers with a certain pressure and temperature is directed to rotate the turbine to produce a mechanical power in the form of rotation.
3. The generator that is connected directly to the turbine will rotate producing electrical energy as a result of the rotation of the magnetic.
4. Steam turbine output entered into the condenser to be cooled with a cooler. So that it can turn back into water. Condensate water from steam condensation is used again. Thus this cycle takes place continuously and repeatedly.

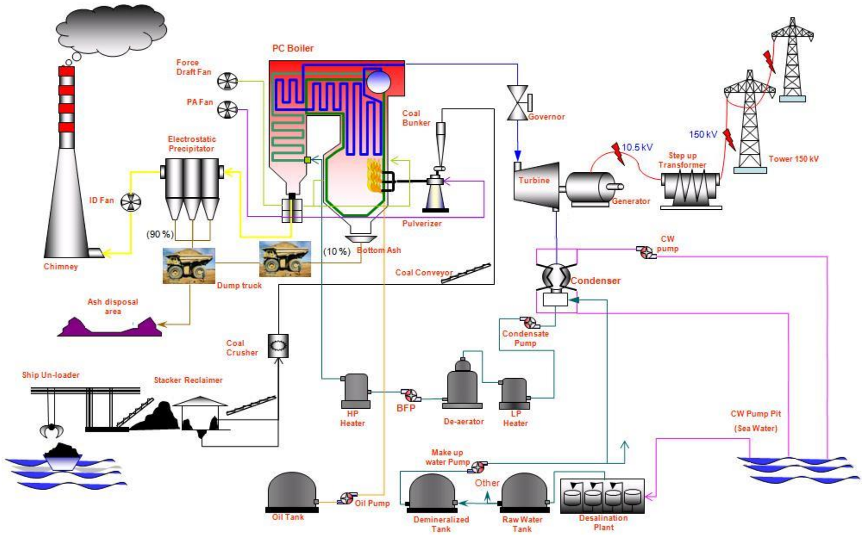

Figure 2.1. Cycle of The Power Plant Process In PLTU UBJOM Pacitan[2]

In the Coal firing system, there is a pulverizer which is a very important component in the Steam Power Plant. Pulverizer plays a very vital role in the coal firing process. The quality of the pulverized coal will determine the burning process later. In Figure 2.2. illustrated the relationship between pulverizer systems and other systems. This pulverizer also determines whether the next process can take place or not. If the Pulverizer is not operating, the company cannot produce electricity in accordance with the desired target and then the power plant can not channeling electricity to the recipient and resulting in reduced income to the company.

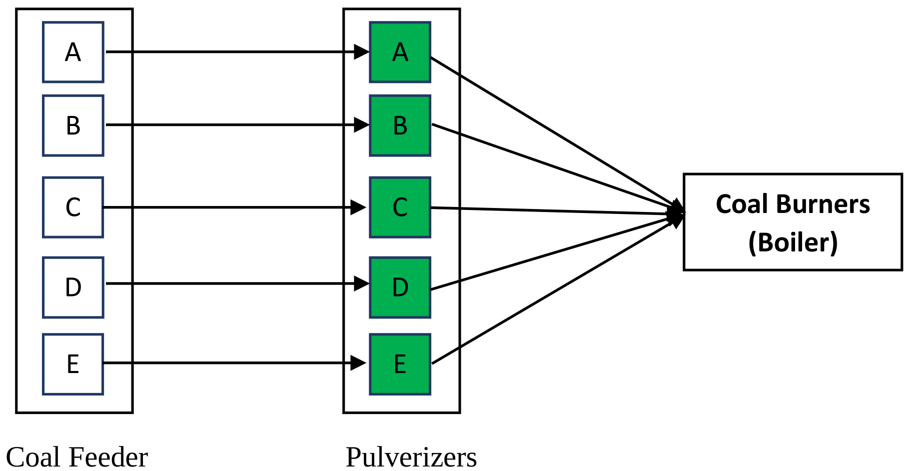

Figure 2.2. Process Flow Diagram of Pulverizer System[3]

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[2] PT. PJB UBJOM Pacitan

[3] Master Thesis Rakhmat Hidayat Teknik Mesin FTI-ITS

As in the research entitled "Calculation of the optimum number of standby pulverizer with the Reliability and Basic Risk Method at PT. PJB Unit Pembangkit Paiton" (Wulansari, 2006) examined the number of pulverizers that are optimal in the subsystem to minimize the operational risk of PT. PJB UP Paiton I. The background of this research is the high failure frequences of the pulverizer in the boiler coal firing system. PT. PJB UP Paiton has 5 pulverizer units. The minimum amount of pulverizer that must operate in one system is as many as 3 units and 2 other pulverizer units are used for standby systems. Nevertheless, the pulverizer subsystem is still experiencing failure due to the number of less than 3 units. Therefore it is necessary to analyze the reliability of the pulverizer. So that it can be used to determine the number of pulverizers that can guarantee the generating system can operate continuously in supplying electricity.

The result of this study found that the reliability system using pulverizer units was R(t)= 0,035 with t = 365 days obtained from the montecarlo simulation which was assisted by Reliasoft software. With a very low reliability value, the calculation of the optimal number of pulverizers to obtain high reliability values with low risk is carried out. Where the value of this risk is a loss in the form of cost. After calculating the simulation results, the optimal number of components is 8 pulverizers with system reliability values R (t) = 1 with a total cost of Rp.1,150,066,727 / year. Along with the addition of the number of puverizers the total cost of risk is getting smaller due to better system reliability. Risk in this case is an impact in cost of downtime when the failure occured.

In another study from entitled "Optimization of maintenance time intervals for reliability values for the effectiveness of the pulveriser system at PT. YTL Jawa Timur " (Ryadi, et al., 2007) determined the value of reliability at the shutdown system with various criteria set. The eligibility criteria for replacement are determined by components in priority and a comparison of the shut down system results from the analysis that has been applied. The background of this research is the frequently appeared breakdown signal of pulverizer system in the control room engineer. This signal appears outside of the component maintenance time which planned every 3500 hours (PM3500). The reality in the field is that there are components that are damaged outside the schedule, this is what will be analyzed for the redetermination maintenance intervals. The results of these calculations are based on the value of reliability of the components and how to optimize them. The 3 main critical components that have the lowest reliability and can cause the pulverizer fail. Thare are scrapper, Grinding roll, and Spring. The reliability value of each of the critical components for time (3500 hours) is as follows:

Table2.1. The Reliability of each Critical Components

Components	Time (Hour)	Reliability
Scrapper	3500	0,3822
Grinding Roll	3500	0,351
Spring	3500	0,0360

In the other research with the entitled "Improvement of Roller Mill Reliability with Root Cause Analysis and Preventive Maintanance Approach" (Budiharjo & Ikatrinasari, 2018), the most critical components will be analyzed which can affect the failure of the coal mill system.

Based on operational data in 2015 there have been 64 times failure to roller mill spare parts - Boiler PT. DSS Serang with 946.67 hours of repairs. This research was conducted with the aim of improving the reliability of the Roller Mill system. Searching for the root cause of the problem using cause and effect diagram method and root cause analysis, and the actions with a preventive maintenance approach. The data from Roller Mill operational availability before Preventive Maintenance are as follows:

Based on previous studies regarding the reliability of pulverizers in several power plants in Indonesia are very low, So from that the author took the initiative to conduct research on the reliability of the pulverizer system on the other steam power plant that is PT. PJB UBJOM Pacitan. Where in this pulverizer system, to pulverize the coal, 5 pulverizers are needed on each boiler. With 4 pulverizers in the system in the operation condition and the other is standby.

Reliability becomes something important because it directly affects the performance of a system, improving can be done with several strategies. There are 2 models of reliability techniques (Heizer & Render, 2011) :

1. Increased component by component. Component reliability is a design problem or specification regarding the responsibility of the engineering design department. However, users can play a role in improving components with research studies on improving quality factors.
2. Provides redundancy. This technique is useful for supporting a component, namely by providing or placing a standby unit in parallel.

In this research, system reliability will be analyzed. Then if the PLTU has a low system reliability, then it will increase its reliability by adding the number of standby pulverizers. So that the reliability value can met to the reliability standards of PT. PJB UBJOM Pacitan. Also this addition will be analyzed the comparison of investment between the current system with the system that will be modified. So, this research can be used as one of the basic considerations for redesigning the system components which have relatively high reliability and availability values and allow for the implementation of a redundancy system especially on the pulverizer system.

2.2. Pulverizer

In the PLTU (Steam Power Plant) system, the coal pulveriser mill plays an important role in achieving efficient combustion in the furnace (combustion chamber). Coal from the coal yard, before it can be used for combustion in the furnace must pass a certain process in the coal pulveriser mill, including:

a. Softened (grinded) takes place in the bowl in the coal pulveriser mill. The coal from the coal inlet pipe will immediately fall in the middle of the bowl. By moving the bowl round, the coal will be directed to the edge so that it

can be softened by a roll grinder. The purpose of this grinding process is to get small coal to accelerate the combustion process in the furnace.
b. Dryed. When the primary air enters the coal pulveriser mill through the vane-wheel, the turbulence of the primary air will be able to lift the coal particles upward towards the separation area. At present, primary air with high temperatures will function as a coal dryer in the coal pulveriser mill.
c. Classified. Coal in the form of small particles, will be classified by the classifier based on the desired fineness, that is 75 ~ 80% of the 200 mesh escaped coal particles. The following is a picture of the pulverizer's outer appearance

Figure 2.3 Pulverizer[4]

2.2.1. Type of Pulverizer

Each factory has a way to determine the type of mill pulverizer. When viewed from the rotation the mill pulverizer is divided into three, namely: High Speed Mill pulverizer, Medium Speed Mill pulverizer, Low Speed Mill pulverizer. The pulverizer mill used at the Pacitan PLTU is a type of Medium Speed Mill pulverizer. Most mill pulverizer types are marked with letters and numbers, B & W 89G for Babcock & Wilcox products, while ABB CE factory is HP 963 type. For HP 963 it means: 96 is Bowl size = 96 inches, while 3 is the number of grinding rolls .

[4] Report of Onthe Job Training PT. PJB UBJOM Pacitan

2.2.2. Work principle

The start-up pulverizer starts by turning on the pulverizer drive motor then opening all valves on the primary air duct so that the primary air from the Primary Air Heater flows into the pulverizer. Primary air is supplied by Prymary Air Fan (PAF). After the primary air flow reaches a steady state and the desired temperature, the air seal is flowed by opening the Seal Air Valve. The air seal is supplied by the Sealing Air Fann (SAF). The sealing air function is to prevent coal powder from coming out of the pulverizer and preventing coal powder from polluting the lubricating oil on grinding roll assemblies. Sealing air pressure is slightly higher than primary air pressure.

After the primary air and seal air work properly, the coal feeder is turned on so that the coal enters the pulverizer and the grinding process begins. Classifier openings are set at around 50-60% so that the softness of the coal powder which is channeled to the burner through the Coal Pipe is 200 mesh. Raw coal enters the coal bunker into the pulverizer through a coal feeder that regulates the amount of coal that is based on weight (Gravimetric). The coal falls on the rotating grinder table crushed by the roller into powdered coal. The hot primary air that enters the pulverizer brings powdered coal to the coal burner through the classifier and falls back to the grinding table.

The primary air enters the pulverizer through the cavity (throat) with sufficient speed to bring the pulverizer fuel to the coal burner. Heavy objects or foreign objects mixed with coal such as pieces of iron, pyrite, stones etc. will be thrown out of the grinding table through the throat, swept by the pyrite plow to the pyrite hopper.

The pulverizer system is also equipped with a water seal, which is the sealing air system that serves to provide sealing air at three locations, namely air seal in the yoke, roll wheel and coal feeder (FDR Motor). The water seal on the roll wheel functions to provide sealing on the side of the roll wheel bearing so that the dust / granules of coal do not enter, so that it does not pollute the bearing lubricant on the roll wheel. While in yoke, the water seal functions as a seal between the outside air and the pulverizer room, so that the air in the pulverizer does not come out or leak through the yoke gap or the gearbox. The water seal also supplies the coal feeder to provide positive pressure from the coal feeder to the pulverizer. To prevent hot air from being loaded with coal dust from the pulverizer it flows up to the coal feeder, where it is feared there could be an explosion in the bunker due to the intensity of hot air meeting with coal dust. The design of seal air systems for pulverizers and coal feeders is supplied from one Seal Air Fan (SAF).

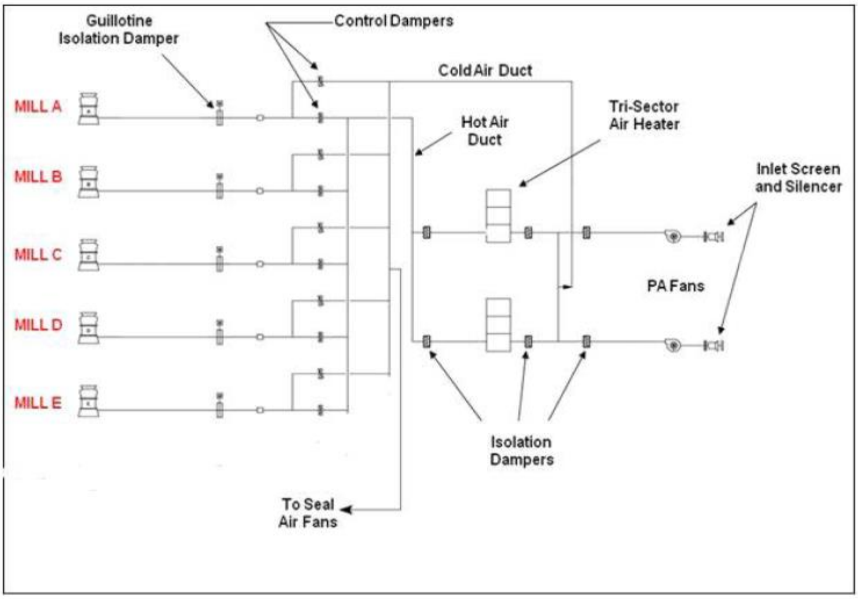

Figure 2.4 Air Supply System to Pulverizer[5]

Under normal conditions primary air serves to transport and maintain the coal output temperature of the pulverizer is constant 66oC. Setting the amount of primary air flow will be adjusted to the amount of coal flow into the pulverizer by adjusting the opening of the flow damper, while maintaining the output of coal powder from the pulverizer by regulating the hot damper and cold damper.

At the start pulverizer, the initial stage that must be fulfilled is to open the PA dumper and set a minimum PA of 40 t / h, at this stage cold dampers (cold PA air) still open 100% and gradually the hot dumper will control the coal output temperature by 66 C. Under normal operating conditions the magnitude of the primary air flow will adjust to the amount of coal flow into the pulverizer, while the coal output temperature of the pulverizer is maintained at 66 C according to the type of coal used by the PLTU Pacitan.

2.2.3. Main Pulverizer Components

The main parts of the pulverizer can generally be divided into three parts, namely the gearbox, the bottom housing, the middle house intermediate housing, and the top house top housing. Figure 2.5. shows a picture and location of the components in the mill pulverizer along with an explanation of its function.

1. Gearbox

   The gearbox on the pulverizer functions to change the rotation, from the desired high rotation speed. The gearbox is located below (bottom housing), the gearbox on the pulverizer is the main function for turning the yoke and grinding ring.

[5] Report of Onthe Job Training PT. PJB UBJOM Pacitan

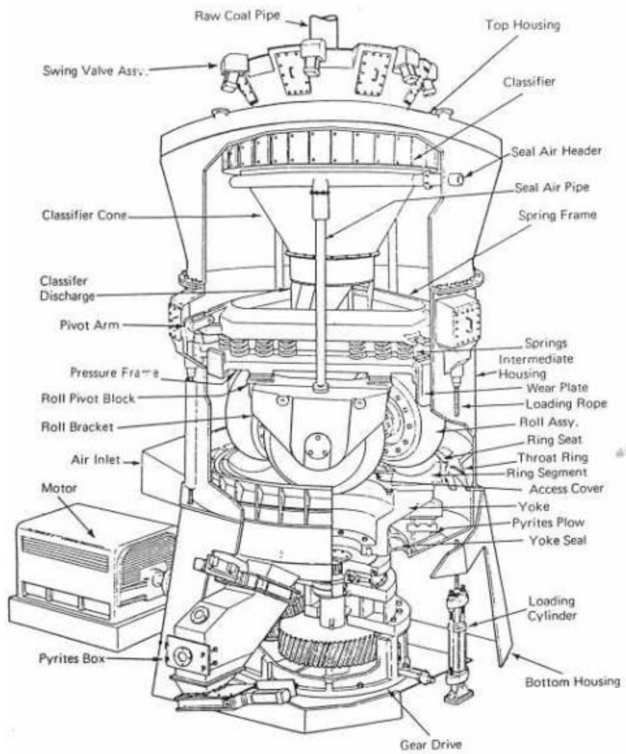

Figure 2.5. Pulverizer[6]

2. Bottom Housing
- The primary air inlet is a cylindrical space below the throat ring. Primary air entering through the throat ring transports fine coal, another function is to circulate coal and dry coal.
- Cylinder loading functions to adjust spring. In the Pulverizer tire pressure on the grinding ring is obtained from the screw spring pressure installed between the spring frame and the preassure frame namely spring or spring. The length of this spring is maintained in the operating area in order to obtain adequate grinding pressure.
- Innerting Header is a wet steam steam pipe that enters the mill which functions to clean the pulverizer from fine coal which pollutes the pulverizer.
3. Intermediate housing

   The intermediate housing is the center of the pulverizer. At the intermediate housing there is a door that can be opened during the maintenance process.
- Seal air pipe Is a pipe where the air flows seal.
- Seal air header is the main air collector.

[6] Report of Onthe Job Training PT. PJB UBJOM Pacitan

- Grinding ring is made of wear-resistant material, GRS functions as a table or tire stand and rotates with a yoke that is below it.
- Spring air function is to put pressure on the tire.

4. Top Housing

- Classifier functions to separate the coarse coal powder (coal finesses) from the smooth one, wherein the smooth one goes directly to the combustion chamber and the coarse one falls down again.
- Raw coal inlet pipe is where the place of the coal enters the pulverizer by being dropped from the middle part of the classifier. This allows coal to fall straight into the middle of the cone cover.
- The air header seal is located on the inner wall of the top pulverizer in the middle between the bottom of the louver section classifier and the bottom of the house over the pulverizer. This water header seal supplies air seal to three tires. The perapat air pressure here is kept constant at 635 mmHg higher than the grinding zone.

2.3. Comparasion and Proposed Method

In this section will be explained and compared between two methods. There are Markov Modelling (Analyticall Method) and Reliability Block Diagram (RBD) Simulation using software. The general explanation between this method explained below:

- Markov modeling is one technique that is able to accommodate time improvements into the evaluation of system reliability (Artana & Dinariyana, 2013). This markov method can be applied to discrete systems or continuous systems. Discrete system is a system that changes state (state) can be observed /occur discretely. Whereas a continuous system is a system where changes in conditions and system behavior occur continuously. In general, this method describes each probability of the condition/state of a system along with its transition. Then calculate the probability of each of these states using mathematical equations. Then the sum of the probability values is the value of its availability.
- RBD Simulation. One of the digital simulation is Reliabilitiy Block Diagram simulation. RBD is a graphical representation of a system describing the function of the system and shows the logical interconnections of components needed to fulfill this function (Garðarsdóttir, 2014). A thorough understanding of how the components function and how these functions affect the system operation is necessary before analyzing reliability of any system. RBD is useful for gaining this understanding and identifying the types and levels of data and other information needed for further quantitative reliability analysis. The system level RBD model is established as a function of the components

(the blocks in the diagram). Having the life distributions for the components, i.e. the individual reliabilities, reliability metrics of interest can be obtained for the whole system based on the reliabilities of the components. The commercial BlockSim software is for establishing and running the RBD model, i.e. for accepting the models of all components and for undertaking all computations and simulations that are based on these models.

2.3.1. Input Process Comparasion

The process markov modell is the failure rate and repair rate which will be used to determine the probability of each stat. So that later you can find out the value of availability of the system. But the character that must be possessed by a system so that this system can be modeled using the markov approach is if the system or component in the system has a distribution with a constant failure rate (Priyanta, 2000). The probability distribution function that has a constant failure rate is an exponential distribution.

The use of input in the simulation is the same. Use parameters that have passed the distribution testing stage and have chosen the right parameters according to the existing data distribution. So that the use of this simulation does not limit the system or components that have a certain distribution. In the simulation we can add other inputs besides time to failure and time to repair, it can also input the scheduled maintanance, so that we can get more accurate availability values.

2.3.2. Data Process Comparasion

The process of using this RBD simulation method is very easy. In general, to get the value of system reliability only requires two stages, namely (Wang, et al., 2004). Construct the reliabiliity model and analyze that model. After describing the system design, you can then analyze reliability first by inputting the parameters obtained from the distribution test using *Weibull ++* software on each block on the system that has been drawn. Then enter the system parameters. The advantages of this model are:

- easily model large, repairable systems
- no restrictions on the failure, repair, and other time distributions in the system
- dependent relations between the failure, repair, and other events easily accounted for
- easy to construct, understand, modify, and incorporate
- any system additions
- all reliability indexes are obtainable
- both long-term and short term solutions easily obtained.

So, the consideration in choosing this method is because the reliability assessment by means of analytical methods or mathematical methods will be very complicated when applied to this case. Because this object of this research can be categorized as a system complex, for example, a system with redundancy, standby, and k-out-of-n structures. The system will be more complex if there is a repairable component in the system (Garðarsdóttir, 2014). The use of analytical methods will be very intense and even tends to be sullit and impossible to solve (Garðarsdóttir, 2014).

Solution one of the mathematical methods described above is the Markov chain. In the process of evaluating the reliability of a system, it requires many long stages. Among other things is the making of state diagrams, determining failure and repair rates, determining transition between states, making matrix, making equations of the probability of each state and the last is calculating system reliability from these equations.

In this study the markov method will be very long if used. Because in this case an assessment of the reliability of the system at the current plant will be carried out. then it will be optimized by adding the number of standby systems if the system reliability is currently below the standard. So that in this study it is possible to do reliability analysis many times.

For example, if markov analysis is used in this study. So the possibility of the state of the system owned by the current pulverizer system with 5 components is 32 states. Where the number of states is 2 (Baghela, 2012). With n is the number of components in the system and 2 is the number of conditions that might occur ie operation and failure condition. With a very large number of states and components on a repairable type system. Then the existing equation to calculate the probability in each state will be very much and very difficult to be solved. Likewise the magnitude of the matrix.

If the reliability of the current system has been obtained and has a low reliability, it needs to be optimized by adding the number of standby systems. This means that reliability assessment is needed again with the number of components being 6 pieces. So the number of states to be analyzed becomes 64. In the second reliability assessment, it will be more complicated because it has a larger number of states. That is the analysis so far if the reliability of the system has not reached the standard value. So that the RBD simulation method uses software analysis to be used.

2.4. The Concept of Reliability

Reliability is defined as the ability of a component or system to carry out functions that are needed in the environment and certain operational conditions for a predetermined period of time. Reliability is one aspect that can affect the success of the production process. Reliability becomes very important because it will affect maintenance costs and also affect the profitability of the company. In general there are two methods used to evaluate the reliability of a system, namely:

a. Quantitative method
   Quantitative method is a method of analysis carried out in mathematical calculations. This method can be done through obtaining maintenance data.
b. Qualitative analysis
   Qualitative methods are methods of analyzing quality of a mode and the impact of failure. These are several qualitative methods, such as, Failure Mode and Effects Analysis (FMEA), Failure Mode, Effects Criticality Analysis (FMECA). Fault Tree Analysis (FTA) etc.

2.4.1. Random Variable

In analyzing the reliability of a system, it will not be separated from the availability of data to be processed. The value of the reliability of a component will depend on time. For this reason, reliability analysis will be related to the probability distribution with time as a random variable.

Random variable is a value or parameter that will be measured in data processing. In order for probability theory to be applied, the event or values must be random to time. Parameters of events to be measured, for example, time to failure and time to repair, are variables that randomly randomize time or space. This random variable is defined discretely and continuously. (Billiton & Allan, 1992).

2.4.2. Distribution Test

Distribution test is used to test a set of failure time and repair time of a component. So that the distribution of these components will be known. With the help of *Weibull ++* software, the most appropriate distribution of time to failure and time to repair is done by using three types of distribution tests, namely:

a. Avarage Goodness of Fit (AvGOF)

To analyze the suitability of the data, a goodness of fit test can be used between the frequency distribution of the observations and the expected frequency distribution. The Goodness of fit test is based on the *Kolmogorov-Smrnov* test, which assumes that the distribution of the variables being tested is continuous and the sample is taken from a simple population.

The *AvGOF* value is obtained from the *Kolmogorov-Smirnov (KS)* test by comparing the empirical distribution of data with certain toritis distributions hypothesized. In principle, if the value of *KS* is smaller, the equation for calculating the parameters *KS* is better:

$$Dn = \max|Sn(t) - Q(t)| \quad (2.1)$$

With,

$S_n(t)$ = The cumulative fraction of the number of data failures of observation results at *(t)* to total *(t)* observations

$Q(t)$ = The cumulative fraction of the number of failures results from the calculation of the expected type of distribution at *(t)* for the total *(t)* calculation

The hypothesis are:

H_0 = Data follows a certain continuous distribution

H_1 = Data follows another continuous distribution

If $Dn < D_{critical}$ then H_0 fails to be rejected, with $D_{critical}$ can be obtained from the *KS test table* that available in the statistics book. In *Weibull++* software, the value of *AvGOF* is the difference between the actual data values and the data generated from the reference distribution owned by *Weibull++* software. So that, the smaller *AvGOF* the better the distribution compared to the others.

b. *Avarage of Plot (AvPlot)*

AvPlot is based on the *normalized index* of the plot fit test. The test results are shown in the *AvPlot index* which is the normalization of the coefficient correlation *(ρ')*, the correlation coefficient value is $-1 \leq \rho' \leq 1$, if the absolute value is close to 1, it will get better. In the *Weibull++* software the value is *AvPlot index* is obtained by normalizing the correlation coefficient above. The provisions used are if the smaller the *AvPlot* value, then the tested distribution will be better than the others.

c. *Likelihood Function Ratio (LKV)*

LKV is a method for determining the type of distribution of a data by comparing the similarities of two models. This test is based on the *likelihood ratio*, which illustrates how many times there is a data to the character of a model. The *likelihood ratio* is measured based on its logarithmic value so it is often called the *log-likelihood ratio.*

The three of those distribution test is used as consideration in making decisions to determine the distribution to be chosen. in processing data in weibull ++ software, ratings are made based on the weighting of each of the three distribution tests. Weighting results that have the lowest value of the distribution indicate the best distribution for data between the time of failure and the length of time for repairs.

2.4.3. Lifetime distributions

Depending on component characteristics, the failure rate as a function of time can be decreasing, constant, increasing or a combination of those. Figure 2.4 shows the so called "Bathtub" curve, which is a useful when explaining these basic concepts of reliability engineering (Garðarsdóttir, 2014). Some distributions tend to better represent life data and are most commonly called lifetime distributions. There exist a number of lifetime distributions, the following are the most widely used for this purpose:

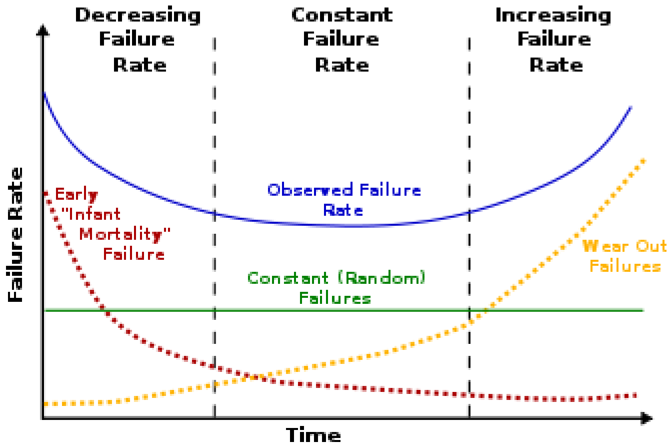

Figure 2.6 Bathub Curve[7]

2.4.3.1. Normal Distribution

Normal distribution is used to describe the effect of time increase when we can specify the time between damage and uncertainty. This distribution is also used to describe dependence on time. Normal distribution has the following formula:

- Probability Density Function (PDF)

$$f(t) = \frac{1}{\sigma\sqrt{2\pi}} exp\left[-\frac{1}{2}\frac{(t-\mu)^2}{\sigma^2}\right] \quad (2.2)$$

Where μ is the mean of the times to failure, σ is the standard deviation and t is a variable representing time.

- Cumulative Distribution Function (CDF)

$$F(t) = \frac{1}{\sigma\sqrt{2\pi}} \int_{-\infty}^{t} e^{\left[-\frac{1}{2}\frac{(t-\mu)^2}{\sigma^2}\right]} dt \quad (2.3)$$

Where μ is the mean of the times to failure, σ is the standard deviation and t is a variable representing time.

[7] Wikipedia.com

- Mean Time To Failure (MTTF)

$$MTTF = \mu \quad (2.4)$$

Where μ is the mean of the times to failure.

- Reliability Function

$$R(t) = \int_t^{\infty} f(t) = \int_t^{\infty} \frac{1}{\sigma\sqrt{2\pi}} exp\left[-\frac{1}{2}\frac{(t-\mu)^2}{\sigma^2}\right] dt \quad (2.5)$$

Where μ is the mean of the times to failure, σ is the standard deviation and *t* is a variable representing time.

2.4.3.2. Exponensial Distribution

The constant damage rate model for a system operating continuously leads to an exponential distribution, with the following formula:

- Probability Density Function (PDF)

$$f(t) = \lambda e^{-\lambda t} \quad (2.6)$$

Where λ is the failure rate and t is a variable represnting time.

- Reliability Function

$$R(t) = e^{-\lambda t} \quad (2.7)$$

Where λ is the failure rate and t is a variable represnting time.

- Cumulatif Density Function (CDF)

$$F(t) = 1 - R(t) \quad (2.8)$$

- Failure Rate Function

$$\lambda(t) = \frac{f(t)}{R(t)} = \lambda \quad (2.9)$$

Where λ is the failure rate and t is a variable represnting time.

- Mean Time To Failure

$$MTTF = \int_0^{\infty} R(t)dt = \frac{1}{\lambda} \quad (2.10)$$

Where λ is the failure rate and t is a variable represnting time.

2.4.3.3. Lognormal Distribution

Lognormal distribution is the distribution that represent the variance failure distribution.

- Probability Density Function

$$f(t) = \frac{1}{\sigma\sqrt{2\pi}} exp\left[-\frac{1}{2}\frac{(t-\mu)^2}{\sigma^2}\right] \quad (2.11)$$

Where μ is the mean of the times to failure, σ is the standard deviation and *t* is a variable representing time.

- Reliability Function

$$R(t) = \int_t^\infty f(t) \quad (2.12)$$

2.4.3.4. Weibull Distribution 2-Parameters

This distribution is used to in reliability calculation. With the variance of the parameters in weibull distribution, forms of failure behavior can be more easily modeled. The functions of the weibull distribution are as follows:

- Probability Density Function

$$f(t) = \frac{\beta}{\eta}\left(\frac{t}{\eta}\right)^{\alpha-1} exp\left[-\left(\frac{t}{\eta}\right)^{\alpha}\right] \quad (2.13)$$

Where β is the shape parameter, η is the scale parameter and t is a variable representing time.

- Cumulatife Distribution Function

$$F(t) = 1 - exp\left[-\left(\frac{t}{\beta}\right)^{\alpha}\right] \quad (2.14)$$

Where β is the shape parameter, η is the scale parameter and t is a variable representing time.

- Reliabililty Function

$$R(t) = exp\left[-\left(\frac{t}{\alpha}\right)^{\beta}\right] \quad (2.15)$$

- Mean Time To Failure

$$MTTF = \int_0^\infty R(t)dt = \beta T\left(1 + \frac{1}{\alpha}\right) \quad (2.16)$$

Dimana, $T(n) = \int_0^\infty x^{n-1} e^{-x} dx$

2.4.3.5. Weibull Distribution 3-Parameters

- Probability Density Function

$$f(t) = \frac{\beta}{\eta}\left(\frac{t-\gamma}{\eta}\right)^{\beta-1} exp\left[-\left(\frac{t-\gamma}{\eta}\right)^{\beta}\right] \quad (2.17)$$

- Reliabililty Function

$$R(t) = 1 - F(t) = \exp\left[-\left(\frac{t-\gamma}{\eta}\right)^{\beta}\right] \quad (2.18)$$

Where β is the shape parameter, η is the scale parameter, γ is location parameter and t is a variable representing time.

2.4.4. Reliability Block Diagram

To evaluate the quantitative reliability of a system the first thing to do is modelling the system into a block of reliability diagrams (Billiton & Allan, 1992). Reliability block diagram is a graphical description of the relationship of the components in the fuel system. To make a reliability block diagram of a system, between the physical form of the system and the block diagram model, does not have to be the same. This reliability block diagram basically consists of a series and parallel arrangement.

2.4.4.1. Series System Model

All components in the system are said to be as if all components must work to make the system successful or only one failure is needed to make the system fail. The block diagram of the three components of the first, second and subsequent series is shown in the following figure:

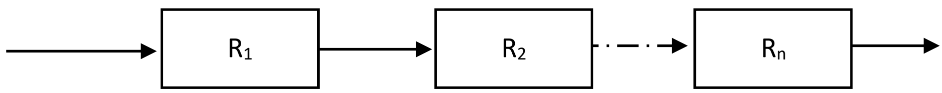

Figure 2.7. Seri System Model

To calculate the reliability value of a system that is smashed in series, you can use the equation (Ebeling, 1997):

$$Rs(t) = \prod_{i=1}^{n} Ri(t) \quad (2.20)$$

2.4.4.2. Parallel System

All components in the system are said to be parallel if all the working components make the system a different success, or there is more than one failure needed to make the system fail. Block diagram of the first, second and next three parallel components shown in the figure below.

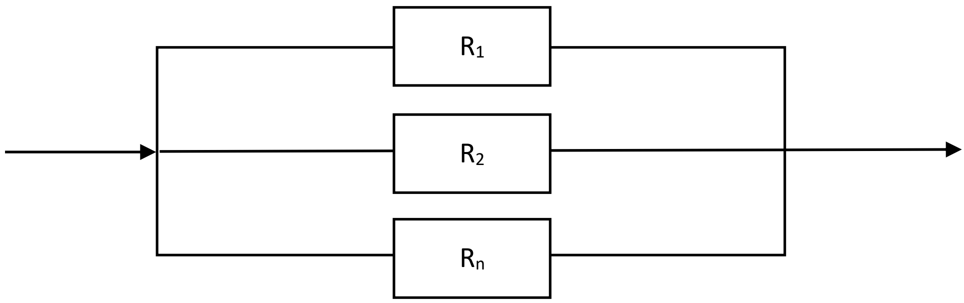

Figure 2.8. Parallel System Model

To calculate the reliability value of a system that is smashed in Parallel, you can use the equation (Ebeling, 1997)

$$Rs(t) = 1 - \prod_{i=1}^{n}[1 - Ri(t)] \quad (2.20)$$

2.5. Availability

If one considers both reliability (probability that the item will not fail) and maintainability (the probability that the item is successfully restored after failure), then an additional metric is needed for the probability that the component/system is operational at a given time, (i.e., has not failed or it has been restored after failure). This metric is availability.

Availability is a performance criterion for repairable systems that accounts for both the reliability and maintainability properties of a component or system. It is defined as the probability that the system is operating properly when it is requested for use. That is, availability is the probability that a system is not failed or undergoing a repair action when it needs to be used. The next table illustrates the relationship between reliability, maintainability and availability.

Reliability	Maintainability	Availability
↔ Constant	↓ Decreases	↓ Decreases
↔ Constant	↑ Increases	↑ Increases
↑ Increases	↔ Constant	↑ Increases
↓ Decreases	↔ Constant	↓ Decreases

Figure 2.9. Relationship between Reliability and availability[8]

[8] Reliawiki.com

The definition of availability is somewhat flexible and is largely based on what types of downtimes one chooses to consider in the analysis. As a result, there are a number of different classifications of availability, such as:

2.5.1. Instantaneous or Point Availability, $A(t)$

Instantaneous (or point) availability is the probability that a system (or component) will be operational (up and running) at any random time, t. This is very similar to the reliability function in that it gives a probability that a system will function at the given time, t. Unlike reliability, the instantaneous availability measure incorporates maintainability information. At any given time, t, the system will be operational if the following conditions are met :
The ite functioned properly from 0 to t with probability $R(t)$ or it functioned properlu since the last repair at time u, 0 < u < t, with probability :

$$\int_0^t R(t-u)m(u)du \qquad (2.21)$$

With $m(u)$being the renewal density function of the system.
Then the point availability is the summatioin of these two probabilities, or :

$$A(t) = R(t) + \int_0^t R(t-u)m(u)du \qquad (2.22)$$

With $m(u)$being the renewal density function of the system.

2.5.2. Avarage Uptime Availability (or Mean Availability), $\bar{A}\ (t)$

The mean availability is the proportion of time during a mission or time period taht the system is available for use. It repsents the mean value of the instantaneous function vover the period (0,T) and is fiven by :

$$\bar{A}\ (t) = \frac{1}{t}\int_0^t A(u)du \qquad (2.23)$$

2.5.3. Steady State Availability, $A(\infty)$

The steady state availability of the system is the limit of the instantaneous availability function as time approaches infinity or :

$$A(\infty) = \lim_{t\to\infty} A(t) \qquad (2.24)$$

In other words, one can think of the steady state availability as a stabilizing point where the system's availability is a constant value. However, one has to be very careful in using the steady state availability as the sole metric for some systems, especially system that do not need regular maintanance. The following figure shows graphically steady state availability

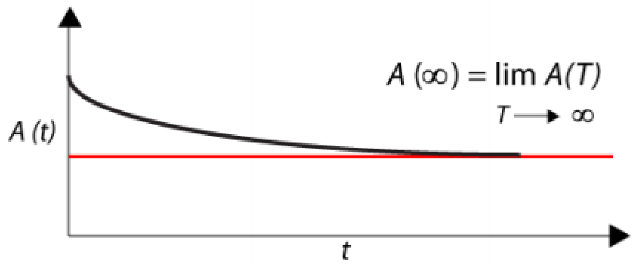

Figure2.10 Steady State Availability[9]

2.5.4. Inherent Availability, *At*

Inherent availability is the steady state availability when considering only the corrective downtime of the system. For a single component, this can be computed by :

$$At = \frac{MTTF}{MTTF+MTTR} \tag{2.25}$$

This gets slightly more complicated for a system. To do this one needs to look at the mean time between failures, or $MTBF$, and compute this as follows :

$$At = \frac{MTBF}{MTBF+MTTR} \tag{2.26}$$

This may look simple. However, one should keep in mind that until the steady state is reached, the $MTBF$ may be a function of time (e.g., a degrading system), thus the above formulation should be used cautiously. Furthermore, it is important to note that the $MTBF$ defined here is different from the $MTTF$ (or more precisely for a repairable system, $MTTF$, mean time to first failure).

2.5.5. Achieved Availability, A_A

Achieved availability is very similar to inherent availability with the exception that preventive maintenance (PM) downtimes are also included. Specifically, it is the steady state availability when considering corrective and preventive downtime of the system. It can be computed by looking at the mean time between maintenance actions, $MTBM$ and the mean maintenance downtime, $\bar{M}$ or:

$$A = \frac{MTBM}{MTBM+\bar{M}} \tag{2.27}$$

2.5.6. Operational Availability, A_O

Operational availability is a measure of the average availability over a period of time and it includes all experienced sources of downtime, such as administrative

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[9] Reliawiki.com

downtime, logistic downtime, etc. Operational availability is the ratio of the system uptime and total time. Mathematically, it is given by:

$$Ao = \frac{Uptime}{Operating\ Cycle} \tag{2.28}$$

Where the operating cycle is the overall time period of operation being investigated and uptime is the total time the system was functioning during the operating cycle. When there is no specified logistic downtime or preventive maintenance, the above equation returns the Mean Availability of the system. The previous availability definitions are a priori estimations based on models of the system failure and downtime distributions.

2.6. Economic Assesment

In economic analysis which will be the basis of comparison between the existing and modifeid systems, there are 3 costs that need to be taken into account. Namely investment costs, failure costs and preventive maintenance costs. Investment costs are the costs needed to add 1 pulverizer to the system. Where this fee will be included in the calculation of the modified pulverizer system. Failure costs (Cf) are costs incurred as a result of failure to non-estimated components resulting in loss of company revenue. This fee consists of spare parts costs, costs of losing income and labor costs which are calculated as follows:

C_f = [(Labor Cost x Repair Time) + (Corrective Maintanance Time x Material Cost)] + Shutdown cost (IDR)

Planned maintenance costs (C_p) represent costs incurred due to planned scheduled maintenance of the company. In this calculation, the maintenance costs intended are labor costs and material costs. The following are the formulas used to calculate preventive costs.

C_p = [(Labor Cost x Repair Time) + (Preventive Maintance Time x Material Cost)]

After calculating these aspects from each system, then a comparison will be made. The most optimal system will be chosen, namely the system that has the least total cost.

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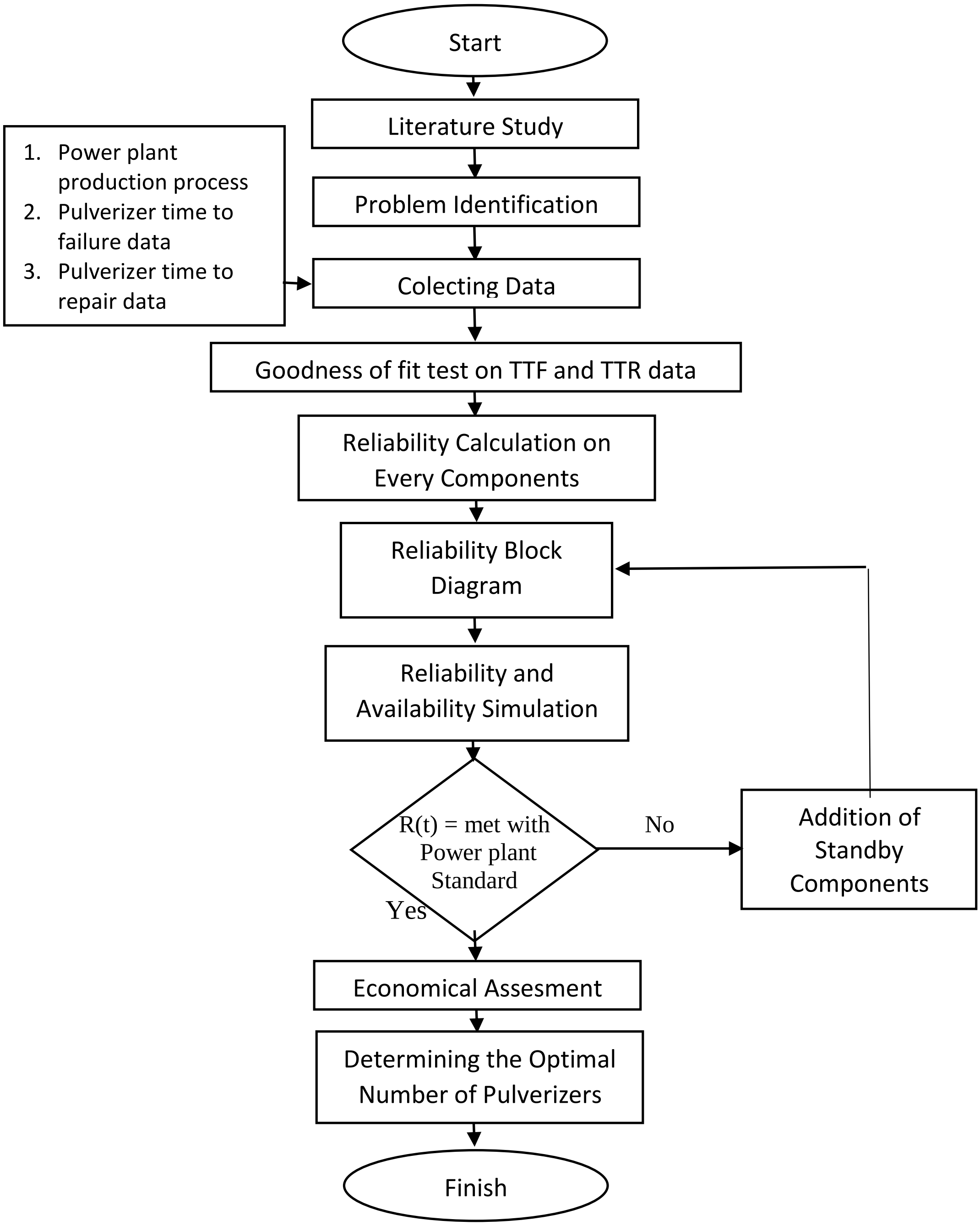
BAB III
METHODOLOGY

3.1. Flowchart Methodology

The following is an overview of the steps in conducting this research:



3.2. Problem Identification

In the first process in this study the author has an interest in fields related to power plants as well as in the science of reliability. The author found a problem from several previous studies which stated that the reliability of the system and the pulverizer component were fairly low. Especially in Indonesian steam power plant. The pulverizer component often fails when outside the schedule of repairs. The high failure rate at the level of the pulverizer component can affect the reliability of the pulverizer system. So, the worst effect is the system will go down or stop operation. Then the pulverizer cannot supply fuel to the furnace at the PLTU. If the PLTU fail to operate, this will be very detrimental for the company and the recipient of electricity distribution both for the community and industry. So the author initiated to carry out research on the analysis of the reliability and availability of the pulverizer system at the Pacitan PLTU.

3.3. Literature Study

Literatur Study is the step when the author learn the teoritical study from any literature that related to this research. The source of this reaserch are from journal, Science Website, book, and others. In this step, the study are related to reliability, availability analysis.

3.4. Colecting Data

This step will help the author to finish the research by collecting data from the company. The data that needed in this research are P&ID system, historical data of time to failure and time to repair. These data can help the author finish the calculation process.

3.5. Goodness of fit test on TTF and TTR data

Goodness - of - fit test is used to test a set of failure time and repair time components so that the distribution of these components will be known. The method used to carry out the test is *Avarage Good Fitness (AvGOF), Avarage of Plot (AvPlot), Likelihood Function Ration (LKV)*. Determination of the distribution of this data will be determined with the help of *Weibull ++* software.

3.6. Reliability Calculation on Every Components

After knowing the data distribution of failures and repairs, the next is the calculation of reliability on each component in the pulverizer system. Determination of reliability can be done by manual calculation by entering the parameters obtained from the results of testing the previous distribution into the formula listed in Chapter II. Because of the aim of this research is analysis system reliability, it will require a type of distribution and parameters for each component to be used as input. So that the highest value of reliability will be defined as a reference.

3.7. Reliability Block Diagram

Before analyzing the reliability of a system, the first thing to do is to model the system into a block of reliability diagrams (Billiton & Allan, 1992). Block reliability diagram is a graphical description of the relationship of the components in the pulverizer system. This block diagram of reliability diagram basically consists of a series and parallel arrangement or a combination of series and parallel arrangement. This stage of the completion process is assisted by Blocksim Software.

3.8 Reliability and Availability Simulation

To get the value of reliability and availability, a simulation using the software blocksim will be carried out. By doing input parameters from failure distribution and repair distribution that have been obtained on each block that has been made before. This input parameter is useful as a reference for the existing system track record for future simulation.

3.9 Addition of Standby Components

After obtaining the reliability and availability values on the pulverizer system, the results of these values can be compared with the minimum standard of reliability or availability value of the power plant at certain time intervals. If the system reliability or availability is still below the standard set by the power plant, a number of new standby pulverizers will be added to the system. Then after that a reliability and availability assessment will be carried out again.

3.10 Economical Analysis

When the new system has reached the reliability or availability standards that are owned by the power plant, then the next step is an economic assessment. Economical analysis will be conducted in both existing system and new system. The cost to be calculation will be carried out based on the maintenance costs, investment costs in new pulverizer, losses costs when the system is shut down.

3.11. Determining the Optimal Number of Pulverizers

This process is the last process in this research. This stage will determine the selection of the optimal number of pulverizers based on the lowest cost level by comparing the existing system costs and new system costs.

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CHAPTER IV
DATA ANALYSIS AND DISCUSSION

4.1. Pulverizer System

Pulverizer system is the object that will be analyzed in this research. In the Coal fuel firing system, there is pulverizer system which is a very important component in the Steam Power Plant. Pulverizer plays a very vital role in the coal firing process. The quality of the pulverized coal will determine the burning process later. In Figure 4.1. illustrated the relationship between pulverizer systems and other systems. This pulverizer also determines whether the next process can take place or not. The pulverizer system consists of 5 pulverizers (factories) in each unit. Where in the picture circled below is a pulverizer system. This system consists of 4 pulverizers which are always operating and 1 in standby. Where the standby pulverizer functions as a component that keeps the pulverizer system operating. In order for the system to continue to run, the 4 pulverizers must be operated simultaneously. The pulverizer system gets a coal supply to be crushed from the coal feeder system. Which will then be continued through 4 output pipes in each pulverizer and will be burned at 4 burners located at each corner of the boiler.

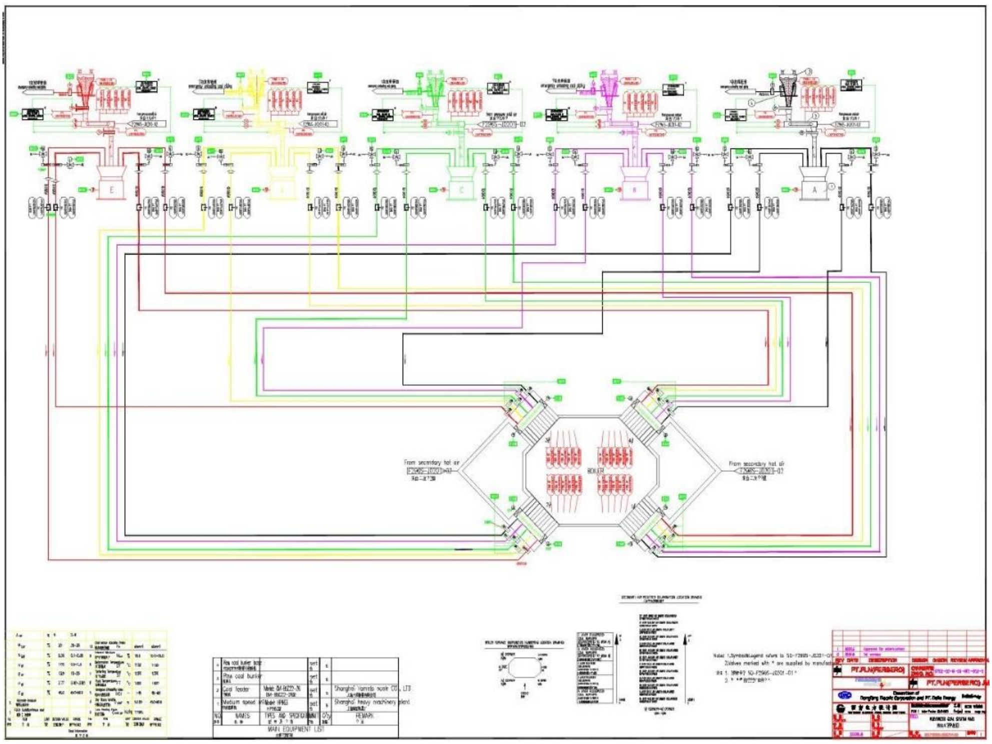

Figure 4.1. P&ID of Pulverizer System[10]

[10] Source : PT. PJB UBJOM Pacitan Data

4.1.1. Pulverizer A Reliability Analysis

After the operational log is collected from PT. PJB UBJOM Pacitan, then the next step is calculating TTF (Time To Failure) number. Before calculating the TTF, the first step is knowing the what kind of the failure that make the pulverizer is down. Because the data provided is not equipped with data information of pulverizer down causes. Then a questionnaire is made that lists all types of failures found in the operational log pulverizer. Furthermore, it is given to PJB UBJOM Pacitan engineer, so the type of failure that causes the pulverizer down can be known. The questionnaire is attached at the end of the report. The following is the TTF of Pulverizer A from 2013-2019.

Table 4.1. Time To Failure of Pulverizer A

Data No.	TTF (Hour)	Mill Part
1.	3981	Drain Innerting Mill
2.	9433	Mil Abnormal Sound
3.	1624	Pyrite Mill
4.	257	VaneWheel
5.	7369	Mil Abnormal Sound
6.	272	Scrapper
7.	4461	Scrapper
8.	8545	Pyrite Mill
9.	5349	Sealing Air Mill
10.	586	Orifice
11.	1599	Mill Trip

After TTF data is obtained, then the distribution test can be done according to the existing data. Determining the best type of distribution is based on the three test parameters, that are *Avarage Good Fitness (AvGOF), Avarage of Plot (AvPlot), dan Likelihood Function Ration (LKV).* Determination of the distribution type is done with the help of *Weibull++* software. the steps are as follows:

1. The TTF of pulverizer that that has been obtained, inputted to the Weibull software for testing.
2. The *Weibull++* program will do three tests, namely *AvGOF*, *AvPlot, and LKV.* Each of which has its own function in determining distribution.

3. The result of program running process are the ranking of the calculation result of each test parameter. So that the type of distribution can be selected . The following are ther results of running program.

Table 4.2. Distribution Determination of Pulverizer A

Distribution	*AvGOF*	*AvPlot*	*LKV*	Ranking
1P-Exponential	0.69746722	5.989528473	-102.108	2
2P-Exponential	6.626211795	8.013789883	-101.382	4
Normal	7.26361726	5.083614343	-104.562	5
Lognormal	10.33245179	6.513978193	-103.061	6
2P-Weibull	0.976222787	5.384844767	-102.337	3
3P-Weibull	0.00685855	4.589022505	-102.998	1

From the above data we can see that the 3*P-Weibull* distribution is ranked first in the distribution ranking. Therefore we choose the *3P-Weibull* distribution as a reliability distribution.

The next step is to determine the parameters of the 3*P-Weibull* distribution to find out the reliability value of Pulverizer A. *Weibull++* software is used to find parameters from the *3P-Weibull* distribution. The parameters obtained are

β = 1.057263

η= 4816.71168

γ = -383.8575

With the distribution and parameters that have been determined with the help of the Weibull ++ program, then it is included in the following reliability equation (2.18) 3*P-Weibull* disribution.

$$R(t) = 1 - F(t) = \exp\left[-\left(\frac{t-(-383.8575)}{4816.71168}\right)^{1.057263}\right]$$

Table 4.3. Reliability of Pulverizer A

Time (t)	Reliability R(t)

720	0.810073
1440	0.698954
2160	0.600992
2880	0.515470
3600	0.441248
4320	0.377100
5040	0.321830
5760	0.274328
6480	0.233586
7200	0.198702
7920	0.168878
8760	0.139550
17520 (2 years)	0.018183

From Table 4.3 we can conclude that the reliability of pulverizer is decreasing from the first month to the second year. if we see it in a year the reliability of the pulverizer component is 0.139550. With the failure rate 0.000228/Hr which is means in the first year there are 1.99 times of failures. And in the second year operations the reliability is 0.018183. With the failure rate 0.000237/Hr which is means in the seecond year operations there are 2.0 times of failure. Where mean time to failure of pulverizer A is 4328 Hr.

These results if we reffer to the data that is owned is already quite representative. Where the failure that occurred in 2013 was 1 time, in 2014 there were 0 times, 2015 amounted to 3 times, 2016 there were 3 times, 2017 was 1 time of failure, 2018 there were 2 times of failure and 2019 still have no failure occured. So if it is matched with the number of failures obtained from the value of the failure rates, it is appropriate. Where the failure was caused most by scrapper and pyrite mill. If you see the results of the failure rate in the first and second years having a number of failures that are not much different, namely 1.99 and 2.0, it can be concluded that the pulverizer A can have entered the useful period in the bathup curve or also called the constant failure rate.

In the Figure 4.2 is a graph that illustrates the reliability of the pulverizer component from the first year to the second year. Then in Figure 4.3 is a graph that illustrates the reliability of the first year to the second year.

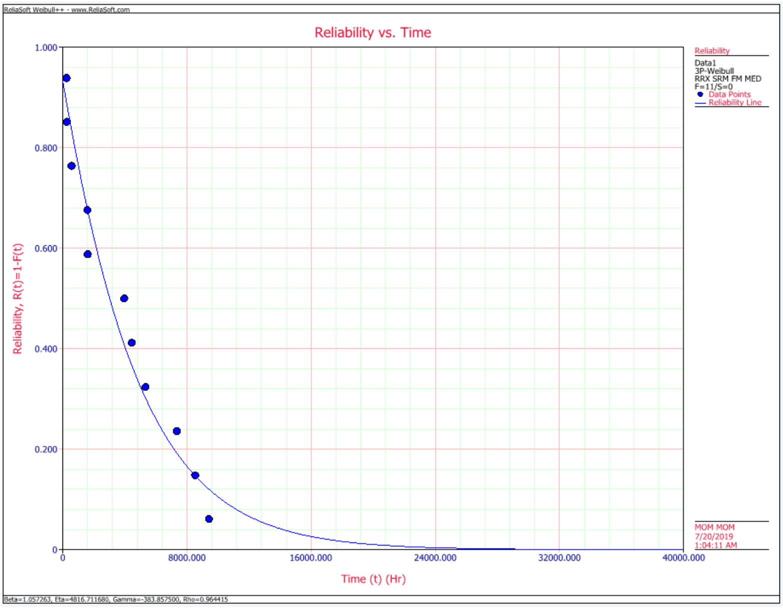

Figure 4.2. Reliability vs Time Graphics

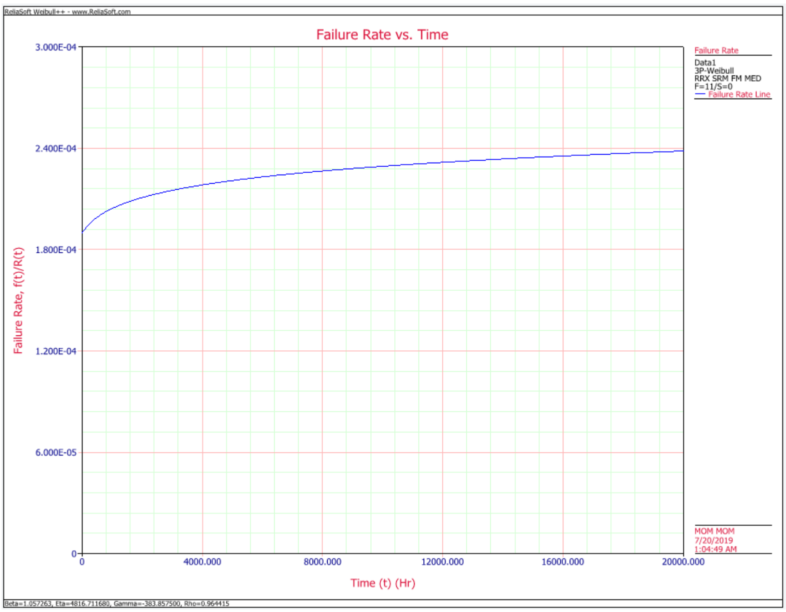

Figure 4.3. Failure rates Graphics of Pulverizer A.

4.1.2. Pulverizer B Reliability Analysis

After the operational log is collected from PT. PJB UBJOM Pacitan, then the next step is calculating TTF (Time To Failure) number. Before calculating the TTF, the first step is knowing the what kind of the failure that make the pulverizer is down.

Because the data provided is not equipped with data information of pulverizer down causes. Then a questionnaire is made that lists all types of failures found in the operational log pulverizer. Furthermore, it is given to PJB UBJOM Pacitan engineer, so the type of failure that causes the pulverizer down can be known. . The questionnaire is attached at the end of the report. The following is the TTF of Pulverizer B from 2013-2019.

Table 4.4. Time To Failure Data of Pulverizer B

Data No.	TTF (Hour)	Mill Part
1.	3385	Mill High Ampere
2.	9184	Mil Abnormal Sound
3.	7291	Motor Bearing
4.	6041	Deflector Mill
5.	1865	Scrapper
6.	1896	Lube Oil
7.	38	Scrapper
8.	711	Pyrite Mill
9.	364	Lube Oil
10.	12138	Spring Grinding
11.	437	Orifice
12.	13	Mil Abnormal Sound
13.	3314	Lube Oil
14.	171	Bowl and Scrapper

After TTF data is obtained, then the distribution test can be done according to the existing data. Determining the best type of distribution is based on the three test parameters, that are *Avarage Good Fitness (AvGOF), Avarage of Plot (AvPlot), dan Likelihood Function Ration (LKV).* Determination of the distribution type is done with the help of *Weibull++* software. the steps are as follows:

1. The TTF of pulverizer that that has been obtained, inputted to the Weibull software for testing.
2. The Weibull++ program will do three tests, namely *AvGOF, AvPlot, and LKV*. Each of which has its own function in determining distribution.

3. The result of program running process are the ranking of the calculation result of each test parameter. So that the type of distribution can be selected . The following are ther results of running program.

Table 4.5. Distribution Determination of Pulverizer B

Distribution	*AvGOF*	*AvPlot*	*LKV*	Ranking
1P-Exponential	60.20187792	9.868693283	-127.79538	6
2P-Exponential	4.266387608	4.528877698	-130.8701	3
Normal	31.35652109	8.954098918	-135.01287	5
Lognormal	7.611452976	5.14868803	-127.02321	4
2P-Weibull	0.024004219	2.915665733	-125.94422	1
3P-Weibull	0.025768186	2.937214098	-125.90758	2

From the above data we can see that the *2P-Weibull* distribution is ranked first in the distribution ranking. Therefore we choose the normal distribution as a reliability distribution.

The next step is to determine the parameters of the *2P-Weibull* distribution to find out the reliability value of Pulverizer B. *Weibull++* software is used to find parameters from the *2P-Weibull* distribution. The parameters obtained are

β = 0.556015

η = 2739.632922

With the distribution and parameters that have been determined with the help of the Weibull ++ program, then it is included in the following reliability equation (2.15) of *2P-Weibull* distribution.

$$R(t) = exp\left[-\left(\frac{t}{2739.632922}\right)^{0.556015}\right]$$

Table 4.6. Reliability of Pulverizer B

Time (t)	Reliability R(t)
720	0.621465

1440	0.496913
2160	0.416367
2880	0.357660
3600	0.312238
4320	0.275774
5040	0.245747
5760	0.220552
6480	0.199104
7200	0.180631
7920	0.164568
8760	0.148309
17520 (2 years)	0.060457

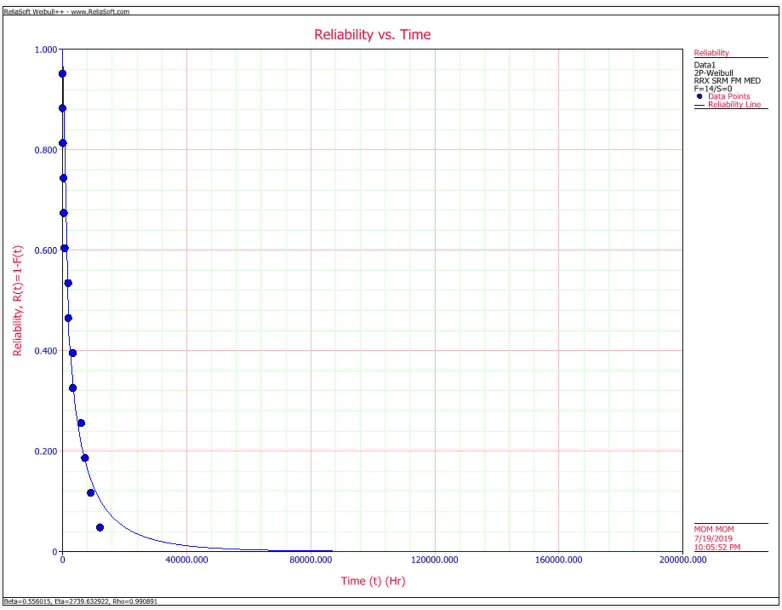

Figure 4.4 Reliability vs Time Graphics of Pulverizer B

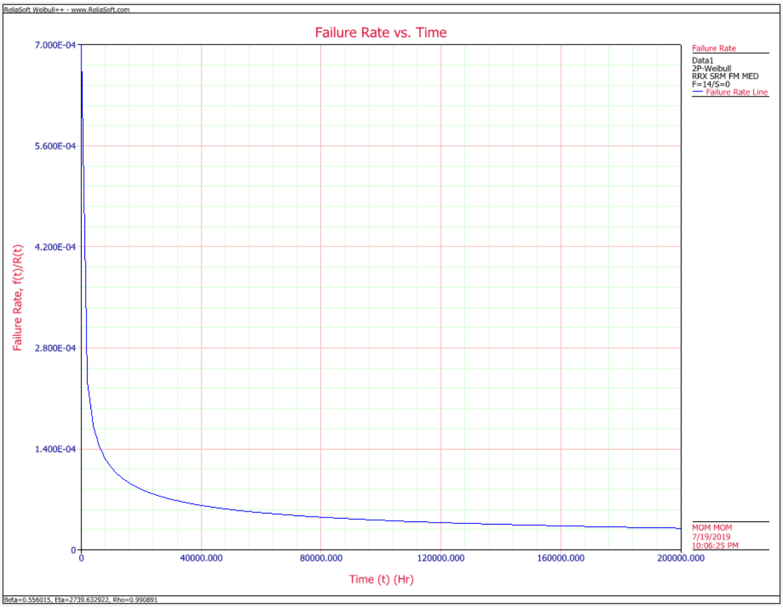

Figure 4.5. Failure Rates Graphics of Pulverizer B

From Table 4.6 we can conclude that the reliability of pulverizer is decreasing very significantly from the first month to the second year. if we see it in a year the reliability of the pulverizer component is 0.148309. With the failure rate 0.000121/Hr which is means in the first year there are 1 times of failures. And in the second year operations the reliability is 0.060457. With the failure

4.1.3. Pulverizer C Reliability Analysis

After the operational log is collected from PT. PJB UBJOM Pacitan, then the next step is calculating TTF (Time To Failure) number. Before calculating the TTF, the first step is knowing the what kind of the failure that make the pulverizer is down. Because the data provided is not equipped with data information of pulverizer down causes. Then a questionnaire is made that lists all types of failures found in the operational log pulverizer. Furthermore, it is given to PJB UBJOM Pacitan engineer, so the type of failure that causes the pulverizer down can be known. The questionnaire is attached at the end of the report. The following is the TTF of Pulverizer C from 2013-2019.

Table 4.7 Time To Failure Data of Pulverizer C

Data No.	TTF (Hour)	Mill Part
1.	11132	Pyrite Mill
2.	15932	Pyrite Mill

3.	2351	Pyrite Mill
4.	619	Flanges Mill
5.	606	Explosive Door Mill
6.	124	Pyrite Mill
7.	256	Pyrite Mill
8.	2924	Pyrite Mill
9.	3808	Pyrite Mill
10.	3876	Pyrite Mill

After TTF data is obtained, then the distribution test can be done according to the existing data. Determining the best type of distribution is based on the three test parameters, that are *Avarage Good Fitness (AvGOF), Avarage of Plot (AvPlot), dan Likelihood Function Ration (LKV).* Determination of the distribution type is done with the help of *Weibull++* software. the steps are as follows:

1. The TTF of pulverizer that that has been obtained, inputted to the Weibull software for testing.
2. The Weibull++ program will do three tests, namely *AvGOF, AvPlot, and LKV.* Each of which has its own function in determining distribution.
3. The result of program running process are the ranking of the calculation result of each test parameter. So that the type of distribution can be selected . The following are ther results of running program.

Table 4.8. Distribution Determination of Pulverizer C

Distribution	*AvGOF*	*AvPlot*	*LKV*	Ranking
1P-Exponential	46.23034863	11.562104	-93.6	5
2P-Exponential	9.470302854	6.69566963	-96.5	4
Normal	57.46183374	11.5030331	-99.3	6
Lognormal	0.348684229	4.73109023	-92.9	3
2P-Weibull	0.036370164	4.30298095	-92.8	2
3P-Weibull	0.002706996	3.70128892	-92.1	1

From the above data we can see that the *3P-Weibull* distribution is ranked first in the distribution ranking. Therefore we choose the *3P-Weibull* distribution as a reliability distribution. The next step is to determine the parameters of the 3*P*-

Weibull distribution to find out the reliability value of Pulverizer C. *Weibull++* software is used to find parameters from the *3P-Weibull* distribution. The parameters obtained are

β = 0.57335

η = 3410.462479

γ = 91.52

With the distribution and parameters that have been determined with the help of the Weibull ++ program, then it is included in the following reliability equation (2.18) of *3P-Weibull* distribution.

$$R(t) = 1 - F(t) = \exp\left[-\left(\frac{t-(91.52)}{3410.462479}\right)^{0.57335}\right]$$

Table 4.9. Reliability of Pulverizer C

Time (t)	Reliability R(t)
720	0.684412
1440	0.555752
2160	0.472017
2880	0.410258
3600	0.361903
4320	0.322650
5040	0.289992
5760	0.262325
6480	0.238561
7200	0.217921
7920	0.199832
8760	0.181375
17520 (2 years)	0.078244

From Table 4.9 we can conclude that the reliability of pulverizer is decreasing very significantly from the first month to the second year. if we see it in a year the reliability of the pulverizer component is 0.181375. With the failure rate 0.000113/Hr which is means in the first year there are 0.98 times of failures. And in the second year operations the reliability is 0.078244. With the failure rate 0.000084/Hr which is means in the seecond year operations there are 1.4 times of failure. Where mean time to failure of pulverizer C is 5550 Hr.

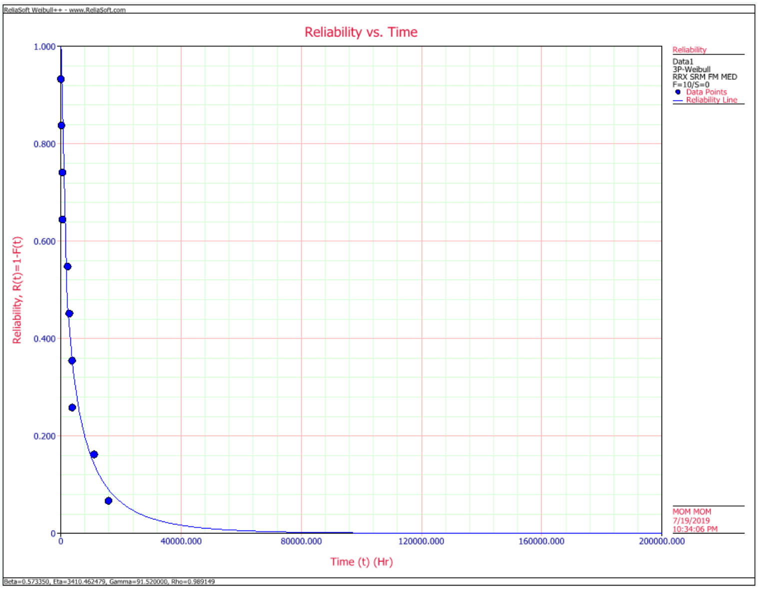

Figure 4.6. Reliability vs Time Graphics of Pulverizer C

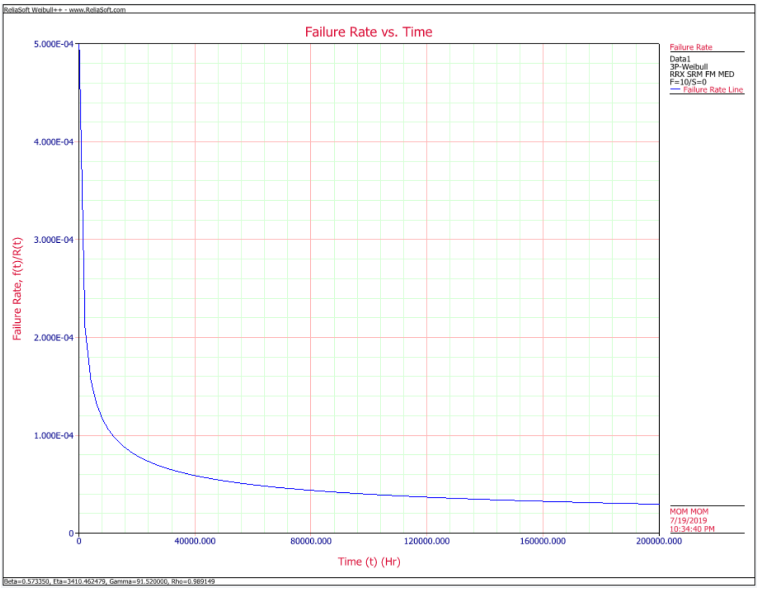

Figure 4.7 Failure Rates Graphics of Pulverizer C

These results if we reffer to the data that is owned is already quite representative. Where the failure that occurred in 2013 was 0 time, in 2014 there were 1 times, 2015 amounted to 0 times, 2016 there were 3 times, 2017 was 4 time of failure, 2018 there were 2 times of failure and 2019 there were 0 times of failure. With the value of the failure rate decreasing from the first year to the second year shows that the pulverizer is still in the area of "infant mortality" on the bathup curve. Where the failure was caused most by scrapper and pyrite mill. In the Figure 4.6 is a graph that illustrates the reliability of the pulverizer component from the first year to the second year. Then in Figure 4.7 is a graph that illustrates the failure rates of the pulverizer C.

4.1.4. Pulverizer D Reliability Analysis

After the operational log is collected from PT. PJB UBJOM Pacitan, then the next step is calculating TTF (Time To Failure) number. Before calculating the TTF, the first step is knowing the what kind of the failure that make the pulverizer is down. Because the data provided is not equipped with data information of pulverizer down causes. Then a questionnaire is made that lists all types of failures found in the operational log pulverizer. Furthermore, it is given to PJB UBJOM Pacitan engineer, so the type of failure that causes the pulverizer down can be known. The questionnaire is attached at the end of the report. The following is the TTF of Pulverizer D from 2013-2019.

Table 4.10. Time To Failure Data of Pulverizer D

Data No.	TTF (Hour)	Mill Part
1.	3213	Inspeksi Mill
2.	7385	Manhole Mill
3.	65	Mil Abnormal Sound
4.	7960	Mill
5.	112	Mil Abnormal Sound
6.	1700	Mil Abnormal Sound
7.	5032	Pyrite Mill
8.	2540	Mainhole Mill
9.	429	Pyrite Mill
10.	302	Mil Abnormal Sound
11.	8339	Pyrite Mill

12.	235	Pyrite Mill
13.	5208	Inlet Sealing Air
14.	961	Ampere Hunting
15.	2279	Vanewheel
16.	90	Pyrite Mill
17	523	Pyrite Mill
18.	331	Lube Oil

After TTF data is obtained, then the distribution test can be done according to the existing data. Determining the best type of distribution is based on the three test parameters, that are *Avarage Good Fitness (AvGOF), Avarage of Plot (AvPlot), dan Likelihood Function Ration (LKV).* Determination of the distribution type is done with the help of *Weibull++* software. the steps are as follows:

1. The TTF of pulverizer that that has been obtained, inputted to the Weibull software for testing.
2. The Weibull++ program will do three tests, namely *AvGOF, AvPlot, and LKV*. Each of which has its own function in determining distribution.
3. The result of program running process are the ranking of the calculation result of each test parameter. So that the type of distribution can be selected . The following are ther results of running program.

Table 4.11. Distribution Determination of Pulverizer D

Distribution	*AvGOF*	*AvPlot*	*LKV*	Ranking
1P-Exponential	83.71338245	9.854961327	-159.635	6
2P-Exponential	23.20999153	5.59489808	-162.537	4
Normal	52.46076073	9.711352179	-168.674	5
Lognormal	1.268157683	4.842232087	-158.54	2
2P-Weibull	5.159273636	5.400118144	-158.22	3
3P-Weibull	0.017422457	3.242995943	-156.336	1

From the above data we can see that the *3P-Weibull* distribution is ranked first in the distribution ranking. Therefore we choose the *3P-Weibull* distribution as a reliability distribution. The next step is to determine the parameters of the *3P-Weibull* distribution to find out the reliability value of Pulverizer D. *Weibull++*

software is used to find parameters from the *3P-Weibull* distribution. The parameters obtained are

β = 0.545085

η = 2015.565586

γ = 59.9

With the distribution and parameters that have been determined with the help of the Weibull ++ program, then it is included in the following reliability equation (2.15) of *3P-Weibull* distribution.

$$R(t) = 1 - F(t) = \exp\left[-\left(\frac{t-(59.9)}{2015.565586}\right)^{0.545085}\right]$$

Table 4.12. Reliability of Pulverizer D

Time (t)	Reliability R(t)
720	0.580312
1440	0.443318
2160	0.359642
2880	0.300920
3600	0.256822
4320	0.222303
5040	0.194502
5760	0.171637
6480	0.152525
7200	0.136341
7920	0.122490
8760	0.108695
17520 (2 years)	0.039002

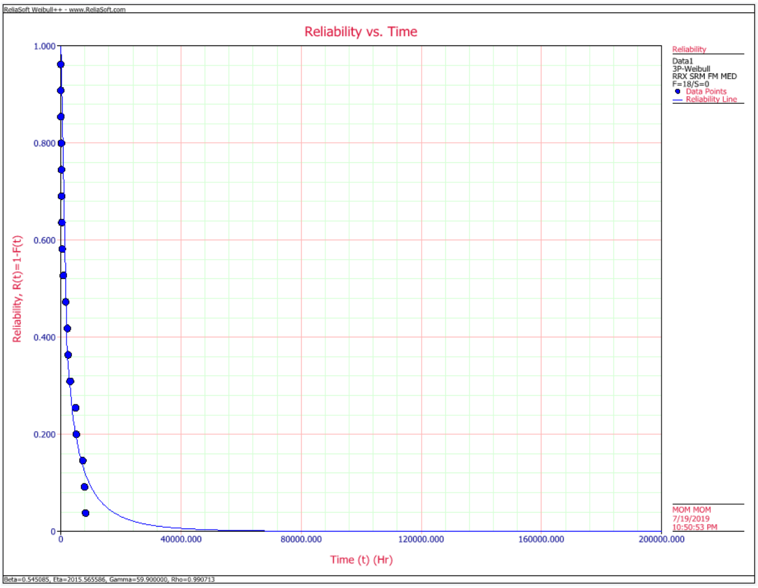

Figure 4.8 Reliability vs Time Graphics of Pulverizer D

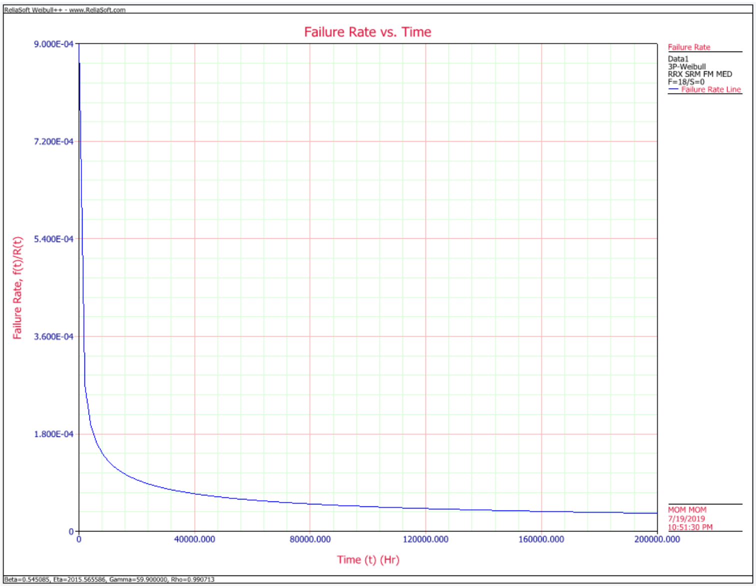

Figure 4.9. Failure Rates Graphics of Pulverizer D

From Table 4.12 we can conclude that the reliability of pulverizer is decreasing very significantly from the first month to the second year. if we see it in a year the reliability of the pulverizer component is 0.108695. With the failure rate 0.000139/Hr which is means in the first year there are 1.2 times of failures. And in the second year operations the reliability is 0.039002. With the failure rate

0.000101/Hr which is means in the seecond year operations there are 1.7 times of failure. Where mean time to failure of pulverizer D is 3539.510301 Hr. These results if we reffer to the data that is owned is already quite representative. Where the failure that occurred in 2013 was 1 time, in 2014 there were 2 times, 2015 amounted to 3 times, 2016 there were 4 times, 2017 was 2 time of failure, 2018 there were 2 times of failure and 2019 there were 4 times of failure. With the value of the failure rate decreasing from the first year to the second year shows that the pulverizer is still in the area of "infant mortality" on the bathup curve. Where the failure was caused most by pyrite mill. In the Figure 4.8 is a graph that illustrates the reliability of the pulverizer component from the year to year. Then in Figure 4.9 is a graph that illustrates the failure rates of the pulverizer D.

4.1.5. Pulverizer E Reliability Analysis

After the operational log is collected from PT. PJB UBJOM Pacitan, then the next step is calculating TTF (Time To Failure) number. Before calculating the TTF, the first step is knowing the what kind of the failure that make the pulverizer is down. Because the data provided is not equipped with data information of pulverizer down causes. Then a questionnaire is made that lists all types of failures found in the operational log pulverizer. Furthermore, it is given to PJB UBJOM Pacitan engineer, so the type of failure that causes the pulverizer down can be known. The questionnaire is attached at the end of the report. The following is the TTF of Pulverizer E from 2013-2019.

Table 4.13. Time To Failure Data of Pulverizer E

Data No.	TTF (Hour)	Mill Part
1.	3213	Repair Mill
2.	643	Pyrite Mill
3.	11154	Orifice
4.	2994	Mill High Ampere
5.	1002	Pyrite Mill
6.	10292	Pyrite Mill
7.	1267	Pyrite Mill
8.	7678	Scrapper
9.	115	Body Mill
10.	8188	Pyrite Mill
11.	2028	Scrapper

12.	1437	Body Mill

After TTF data is obtained, then the distribution test can be done according to the existing data. Determining the best type of distribution is based on the three test parameters, that are *Avarage Good Fitness (AvGOF), Avarage of Plot (AvPlot), dan Likelihood Function Ration (LKV).* Determination of the distribution type is done with the help of *Weibull++* software. the steps are as follows:

1. The TTF of pulverizer that that has been obtained, inputted to the Weibull software for testing.
2. The Weibull++ program will do three tests, namely *AvGOF, AvPlot, and LKV.* Each of which has its own function in determining distribution.
3. The result of program running process are the ranking of the calculation result of each test parameter. So that the type of distribution can be selected . The following are the results of running program.

Table 4.14. Distribution Determination of Pulverizer E

Distribution	*AvGOF*	*AvPlot*	*LKV*	Ranking
1P-Exponential	0.622696	5.8221	-112.0519285	5
2P-Exponential	0.61227	5.2951	-112.2888469	4
Normal	42.38911	9.5089	-116.0677397	6
Lognormal	0.149568	4.0283	-112.8713099	2
2P-Weibull	0.254947	4.1668	-112.1986762	1
3P-Weibull	0.266481	4.4145	-112.3970683	3

From the above data we can see that the*2P-Weibull* distribution is ranked first in the distribution ranking. Therefore we choose the *2P-Weibull* distribution as a reliability distribution.

The next step is to determine the parameters of the*2P-Weibull* distribution to find out the reliability value of Pulverizer E. *Weibull++* software is used to find parameters from the *2P-Weibull* distribution. The parameters obtained are

β = 0.858656

η = 4216.614848

With the distribution and parameters that have been determined with the help of the Weibull ++ program, then it is included in the following reliability equation (2.12) of *2P-Weibull* distribution.

$$R(t) = exp\left[-\left(\frac{t}{4216.614848}\right)^{0.858656}\right]$$

Table 4.15. Reliability of Pulverizer E

Time (t)	Reliability R(t)
720	0.803150
1440	0.671990
2160	0.569466
2880	0.486350
3600	0.417672
4320	0.360228
5040	0.311763
5760	0.270601
6480	0.235458
7200	0.205325
7920	0.179394
8760	0.153582
17520 (2 years)	0.033462

From Table 4.15 we can conclude that the reliability of pulverizer is decreasing very significantly from the first month to the second year. if we see it in a year the reliability of the pulverizer component is 0.153582. With the failure rate 0.000184/Hr which is means in the first year there are 1.6 times of failures. And in the second year operations the reliability is 0.033462. With the failure rate 0.000167/Hr. which is means in the seecond year operations there are 1.4 times of failure. Where mean time to failure of pulverizer D is 4558.8 Hr. These results if we reffer to the data that is owned is already quite representative. Where the failure that occurred in 2013 was 2 time, in 2014 there no failure, 2015 amounted to 3 times, 2016 there were 2 times, 2017 was 2 time of failure, 2018 there were 1 times of failure and 2019 there were 2 times of failure. With the value of the failure rate decreasing from the first year to the second year shows that the pulverizer is still in the area of "infant mortality" on the bathup curve. Where the failure was caused most by pyrite mill. In the Figure 4.10 is a graph that illustrates the reliability of the pulverizer component from the year to year. Then in Figure 4.11 is a graph that illustrates the failure rates of the pulverizer E. And in the Figure 4.12 Shows the reliability graphics for all the pulverizer.

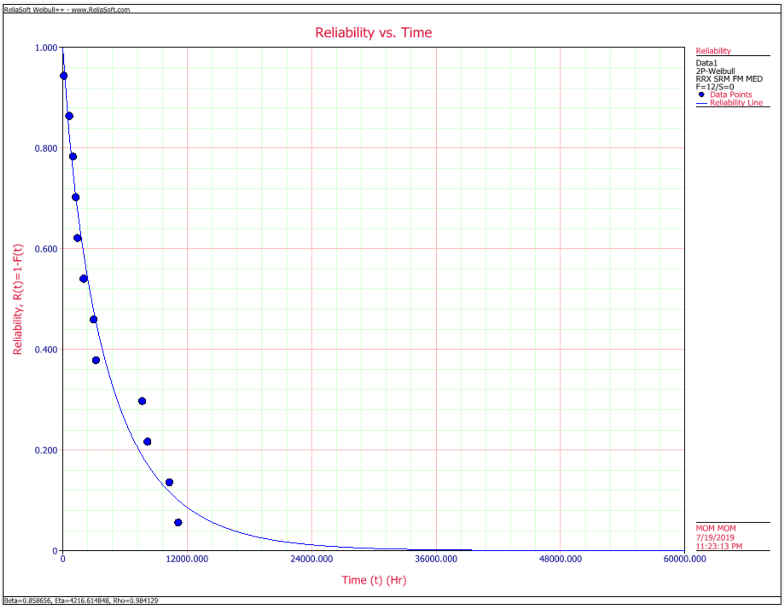

Figure 4.10 Reliability vs Time Graphics of Pulverizer E

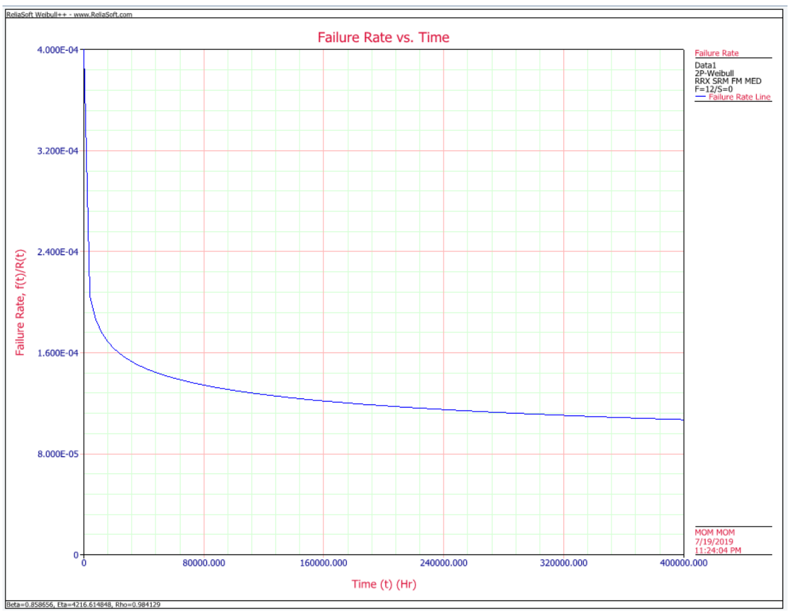

Figure 4.11 Failure Rates Graphics of Pulverizer E

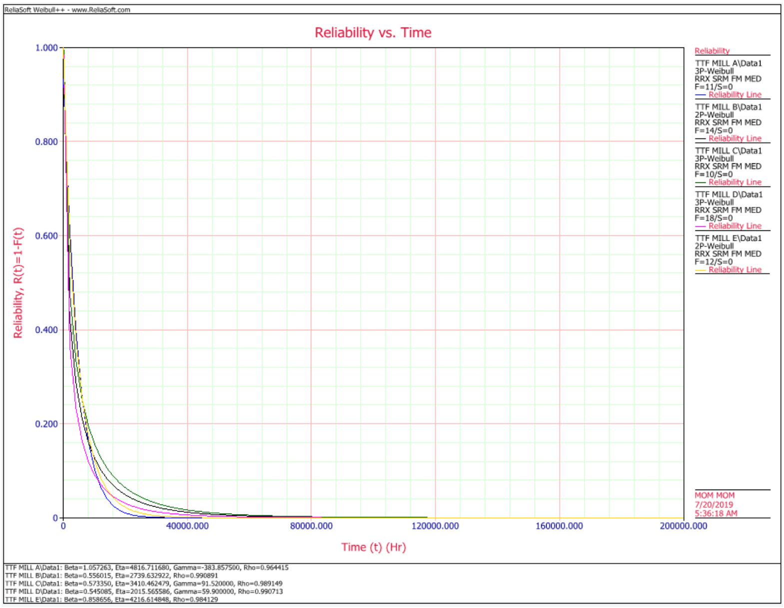

Figure 4.12 Reliability vs Time Graphics of All Pulverizer

4.2. Reliability and Availability Analysis of Pulverizer System

4.2.1. Time to Repair Distribution Test

After calculating the TTF value and getting the reliability value for each pulverizer, the next step is to calculate the reliability and availability values at the system level. To calculate the reliability value at the system level, parameters from the distribution of each pulverizer failure are needed. The data is in the previous sub-chapter.

To calculate the availability value at the system level there is data needed as input. The main data needed is to enter the value of TTR (Time to Repair) from the corrective maintanance and preventive maintanance. The input data is needed because to find availability value requires time where the pulverizer is down or in other words called downtime. TTR data from Corrective Maintenance and Preventive Maintenance have represented the downtime data. The following are TTR Corrective Maintanance and Preventive Maintanance from each pulverizer.

Table 4.16. TTR of Pulverizer A

No.	TTR Corrective Maintanance	TTR Preventive Maintanance
1	415	73
2	23	66

3	7	79
4	7	74
5	2504	28
6	75	32
7	432	2
8	2	144
9	86	1
10	8	288
11	10	1
12	-	8
13	-	144
14	-	265
15	-	144

After the data from TTR Corrective Maintanance (CM), and TTR Preventive Maintanance (PM) are ready. Next is to do a distribution test and look for parameters. The method that used in this stage is exactly the same as the one used to find TTF in the previous chapter. Determination of the type of distribution is done with the help of *Weibull ++* software as well. The following are the results of running the program.

Table 4.17. Distribution Determination of TTR CM Pulverizer A

Distribution	*AvGOF*	*AvPlot*	*LKV*	Ranking
1P-Exponential	99.72594	28.1929	-75.64068068	6
2P-Exponential	86.62371	14.7471	-83.1077453	4
Normal	88.59226	17.4347	-88.62809136	5
Lognormal	2.621101	5.58823	-64.72722565	2
2P-Weibull	13.79965	8.04504	-66.33920178	3
3P-Weibull	0.491023	5.22068	-63.03461544	1

Table 4.18. Distribution Determination of TTR PM Pulverizer A

Distribution	*AvGOF*	*AvPlot*	*LKV*	Ranking
1P-Exponential	87.53998438	14.06692146	-150.2217579	6
2P-Exponential	87.22120832	7.85129645	-158.4514277	3
Normal	93.92988356	12.61167965	-167.1818964	5
Lognormal	33.79384953	5.435055804	-146.0802279	4
2P-Weibull	0.592128807	3.394661018	-144.0171257	1
3P-Weibull	1.215109238	3.406649006	-144.0281172	3

From the above data we can see that the 3P-Weibull distribution is ranked first in the distribution ranking both of TTR CM and PM are. Therefore we choose the 3P-Weibull distribution as a TTR distribution.

The next step is to determine the parameters of the 3P-Weibull distribution to find out the availability of the pulverizer system. *Weibull++* software is used to find parameters from the 3P-Weibull distribution. The following are the summary of parameters from all pulverizer:

Table 4.19. Distribution Parameters of TTR Corrective Maintanance

Pulverizer	Distribution	Parameters		
		β / mean	*η / std dev*	*γ*
Mill A	3P-Weibull	0.381598	107.424415	1.925
Mill B	2P-Weibull	0.815108	285.586002	-
Mill C	Normal	231.900031	212.280852	-
Mill D	3P-Weibull	0.72858	217.450136	0.465
Mill E	3P-Weibull	0.291672	28.514079	3.97

Table 4.20. Distribution Parameters of TTR Preventive Maintanance

Pulverizer	Distribution	Parameters		
		β	*η*	*γ*
Mill A	3P-Weibull	0.860678	98.903456	-5.9625
Mill B	3P-Weibull	0.89183	171.959708	-6.625

Mill C	2P-Weibull	0.704819	75.282185	-
Mill D	2P-Weibull	0.680843	95.49846	-
Mill E	2P-Weibull	0.682808	98.047335	-

4.2.2. Pulverizer System Reliability and Availability Analysis

Next is to do a simulation with the help of BlockSim software to get the reliability and availability value on the system. The following are the steps of operating the software blocksim to find the desired value.

4.2.2.1. Constructing Reliability Block Diagram (RBD)

First, in the operation of software blocksim is to make RBD (Reliability Block Diagram). Reliability Block Diagram (RBD) is a method for analyzing system reliability and availability using system block diagrams. The following is Reliabilty Block Diagram of pulverizer system.

The pulverizer system is part of a fuel firing system or it can be said to be a sub-system of a fuel firing system. This pulverizer system is located between the coal feeder and burner in the boiler. Where the pulverizer system is sent coal from the coal feeder then from the pulverizer it is sent to the burner system. Coal feeder on the block diagram illustrated in figure 4.13 represented by a block called start and the burner is represented by the name of the finish. Therefore the coal feeder and burners systems are arranged in series with the pulverizer system. In this study the main focus is the analysis of the pulverizer system, so it is assumed that the coal feeder and burner will always operate or the reliability is 1.

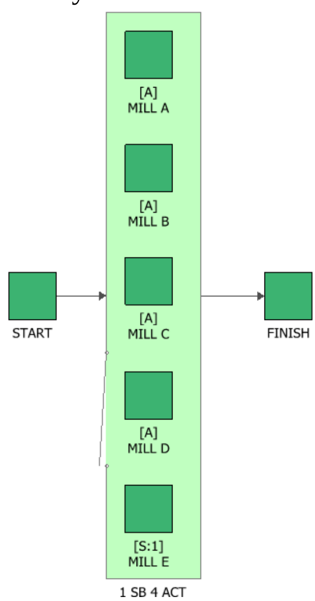

Figure 4.13. Reliability Block Diagram of Pulverizer System

In this block diagram it is illustrated that there are 4 pulverizers which are stated with operating conditions (Mill A, B, C, & D) and where 1 other pulverizer is on standby (Mill E). In the system, it is set where the pulverizer system is declared operating when the pulverizer that operates is 4. In the pulverizer system that is arranged in standby it is assumed that the switching process takes place perfectly.

4.2.2.2. Filling the simulation parameters for each component

The parameters that are filled in are types from time to failure distribution, repair distribution from corrective maintanance and repair distribution from preventive maintanance that we have gotten at the previous chapter. The process of filling in the parameters is filled until all parameters for each block needed for the simulation are completely filled. In Figure 4.8 is the filling of parameters in one component block.

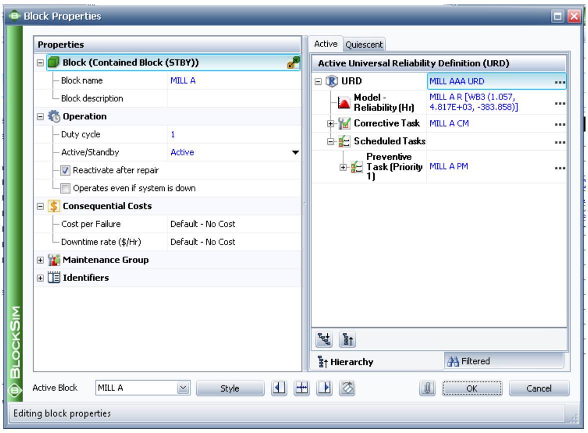

Figure4.14. Block Properties of Pulverizer A

The option reliability model is where the time to failure distribution parameter is filled. Then the corrective option is a place where time to repair distribution corrective maintenance is filled. Also in preventive tasks where the time to repair distribution preventive task parameters are loaded in. Then the current age of the pulverizer is 5.85 years.

4.2.2.3. Filling the simulation parameters for system

The next step is to fill the simulation parameters in the system. To get the desired simulation results, the simulation parameters for the system must be filled first. The simulation parameters that must be filled are simulation end time, compute point availability, and number of simulation. End time is loaded based on the time when the pulverizer operates until the pulverizer overhauls for 2 years. In order for the simulation to produce accurate results, the simulation to obtain availability values needs to be done repeatedly and the expected index availability results are the average values of all simulation results. 3000 simulations carried out to get one availability index value are enough to get a valid result. The following is the simulation parameters for the system.

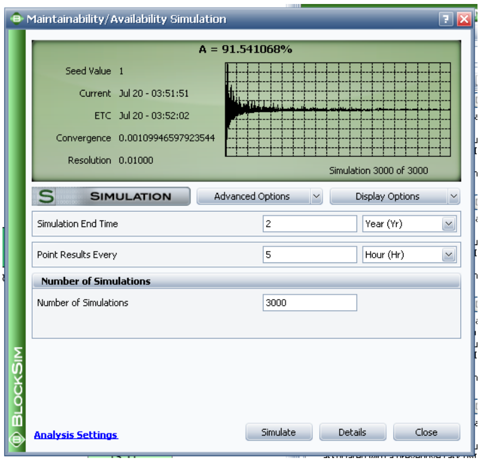

Figure 4.15 Availability Simulation Parameter Input

4.2.2.4. Reliability and Availability Simulation Result

After all the required parameters have been inputted then we can see the simulation results. The following Table 4.21, 4.22 and 4.33 are the results of the pulverizer system simulation that has been carried out.

Mean availability in the Table 4.21. explain about the number due to all downing events, which can be thought of as the operational availability. It is the ratio of the system uptime divided by the total simulation time (total time). The mean availability of this system is 0.915411.

Then the mean availability (w/o PM, OC & Inspection) is the mean availability due to failure events only and it is 0.949987 for this example. No preventive maintenance actions or inspections were defined for this system. Downtimes caused by PM and inspections are not included in this result.

Then point availability is the probability that the system is up at time t, which is 2 years (17520 Hours). In this case the point availability at 17520 hour would be the times the system was up at 17520 hour divided by the number of simulations. So, this point availability is 0.922667 or 2373,9 out of the 3000 simulations the system was up at 17520 hours.

In the table below also stated the value of reliability, which is the probability that the system has not failed by time. This is similar to point availability with the major exception that it only looks at the probability that the system did not have a single failure. Other (non-failure) downing events are ignored. During the simulation, a special counter again must be used. This counter is increased by one (once in each simulation) if the system has had at least one failure up to 17520 hours. Thus, the reliability at 17520 would be the number of times the system did not fail up to 17520 divided by the number of simulations. For this example, this is 0.062 because the system success 186 times out of the 3000 simulations until the end time of operation

(17520 hr). It means there must be a failure in each simulation of the system in 2 years.

From this simulation result, we also can know the total downtime of this pulverizer system which is 1482 hours out of 17520 operation hours. We can also find out the amount of downtime caused by the type of maintanance. Where PM causes system down for 605 hours. And CM for 876.

Table 4.21. Availability Simulation Result

System Overview	
Mean Availability (All Events)	0.915411
Std Deviations (Mean Availability)	0.070235
Mean Availability (w/o PM, OC & Inspection)	0.949987
Point Availability (All Events) at 17520	0.922667
Reliability (17520)	0.062
Uptime (Hr)	16037.995165
CM Downtime (Hr)	876.219359
PM Downtime (Hr)	605.785476
Total Downtime (Hr)	1482.004835
MTTFF (Hr):	4729.033071
MTBF (Total Time) (Hr):	2921.46073

In this following table are explained the result of simulation on every block. One of this collomn explained about the expected number of failures. This is the average number of system failures. The system failures (not downing events) for all simulations are counted and then averaged. For this case, the expected number of the system failures for one run is 6,3 times.

Table 4.22. Block Summary 1

Block Name	**Mean Av. (All Events)**	**Mean Av. (w/o PM, OC &Insp)**	**Expected Number of Failures**	**Block Downtime (Hr)**
1 SB 4 ACT	0.915411	0.949987	6.385333	1482.004835
MILL A	0.902855	0.924287	3.717667	1701.984569
MILL B	0.876135	0.903407	5.364333	2170.116395
MILL C	0.918367	0.938392	4.444667	1430.207142

MILL D	0.884723	0.904451	6.352333	2019.654073
MILL E	0.953867	0.983969	1.128	808.242625

Table 4.23. Block Summary 2

Block Name	Number of CMs	CM Downtime (Hr)	Number of PMs	PM Downtime (Hr)
1 SB 4 ACT	0	0	5.990667	605.785476
MILL A	3.717667	1326.487464	3.725333	375.497105
MILL B	5.364333	1692.309932	2.771	477.806463
MILL C	4.444667	1079.367874	3.75533	350.839268
MILL D	6.352333	1674.023031	2.838	345.631042
MILL E	1.128	280.860314	4.280333	527.382311

From the simulation results, it can be said that the value of the system availability is still very high. With a 91% value in operating conditions and 9% indicating the system time is down or 1482 hours downtime from 17520 hours operation. The causes of corrective maintenance and preventive maintenance with a value of 876 hours and 605 hours, respectively. This large value occurs because the system experiences failure as many as 6 times during 2 years of operations with different lengths of time. Figure 4.16 shows the graphics system failures from year to year. Figure 4.17 illustrates the graph of reliability and availability of time.

System failure will occur if at least 2 mills fail simultaneously. Figure 4.18 illustrates the plotting of events in the block and mill system. Here we can get information where the causes of system failure occur. For example, the first failure was caused by the simultaneous preventive occurrence of the entire mill. The second failure caused by preventive maintenance carried out at Mill C and then failure at Mill E. Then the third system failure occurred when Mill A was doing a long enough corrective maintenance and then a failure occurred at Mill E. The fourth system failure was caused by the occurrence of corrective maintenance on mill A and failure at Mill E and then followed by preventive maintenance carried out by Mill D and B. Likewise with the fifth system failure still caused by the length of corrective maintenance carried out at Mill A and failure at Mill B and then followed by preventive maintenance at Mill C. The last system failure was caused by the failure of Mill A and Mill D simultaneously and then followed by preventive at Mill C.

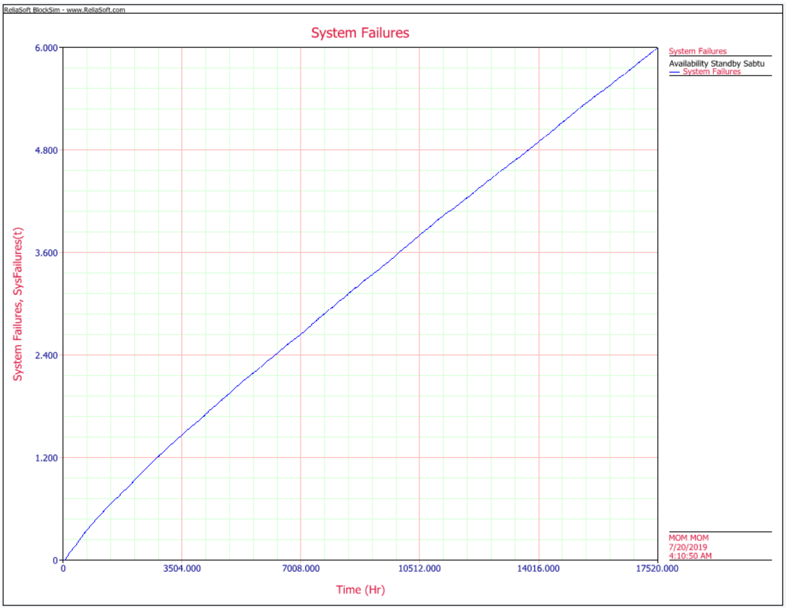

Figure 4.16 System Failures

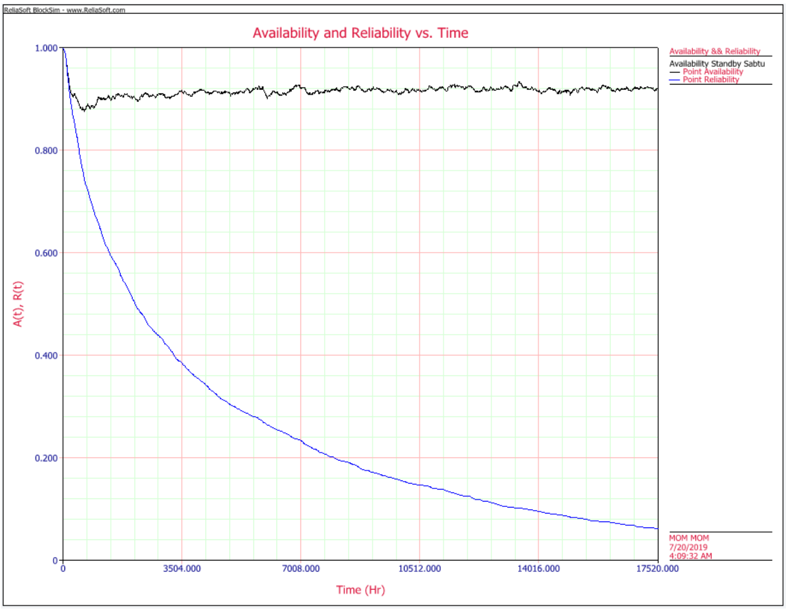

Figure 4.17 Reliability and Availability vs Time

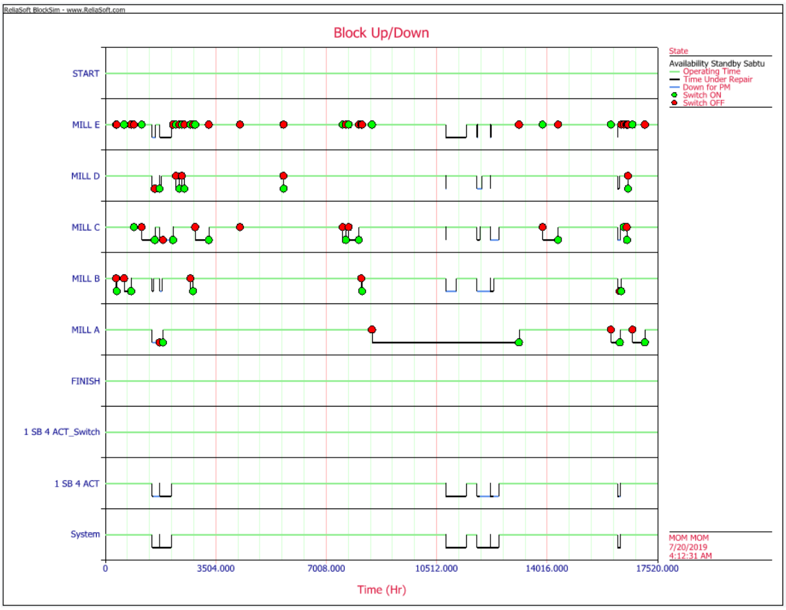

Figure 4.18 Block Up/Down Plotting

Accordance with the initial problem, is the pulverizser system circuit owned by PT. PJB UBJOM Pacitan with 4 pulverizers operating and 1 standby is in accordance with the specified standard or not. So that when the pulverizer system does not meet the specified standards, optimization will be carried out with the addition of redundancies as offered at the beginning of the study. Because the standard value needed is not obtained, which is based on availability and reliability values, the researcher continues to simulate again with the addition of 1 standby pulverizer. So the next simulation will be analyzed with a system consisting of 4 operating pulverizers and 2 standby pulveizer. Then a comparison will be made between the existing system and the modified one in terms of cost. So that the selection can be done among the most optimal.

4.2.3. Reliability and Availability Analysis of Modified System

In this sub-chapter, a pulverizer system simulation will be carried out if using 4 pulverizers under operating conditions and 2 under standby conditions. At this stage have the same steps as the previous sub-chapter. However, filling the reliability parameters, corrective maintanance and preventive maintenance in the new pulverizer standby will be equated with the parameters possessed by the pulverizer C. This was chosen because the C pulverizer has a reliability value that is somewhat better than the others. In the system, there is a new standyby pulverizer that will be represented by a block that has an F. The following is reliability block diagram that will be simulated.

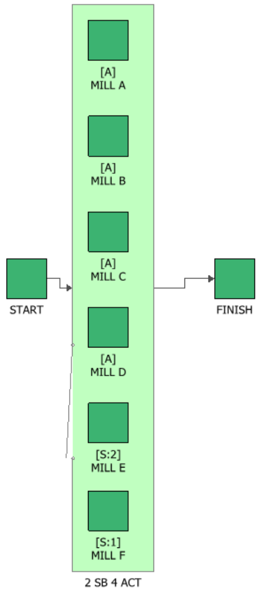

Figure 4.19. Reliability Block Diagram of Modified Pulverizer System.

After making a reliability block diagram and filling in all parameters of the blocks, the following are the simulation results obtained with simulation time is 2 years and the number of simulations is 3000.

Table 4.24 Simulation Result

System Overview	
Mean Availability (All Events)	0.99049
Std Deviations (Mean Availability)	0.01882
Mean Availability (w/o PM, OC & Inspection)	0.99455
Point Availability (All Events) at 17520	0.991
Reliability (17520)	0.58366
Expected Number of Failures	0.94833
Uptime (Hr)	17353.3
CM Downtime (Hr)	95.4862
PM Downtime (Hr)	71.1264
Total Downtime (Hr)	166.612
MTTFF (Hr):	30505.7
MTBF (Total Time) (Hr):	18474.5

Table 4.25 Block Summary

Block Name	Mean Av. (All Events)	Mean Av. (w/o PM, OC &Insp)	Expected Number of Failures	Block Downtime (Hr)
1 SB 4 ACT	0.99049	0.99455	1.066	166.61
MILL A	0.921089	0.92349	3.780	1382.5
MILL B	0.912952	0.91638	4.752	1525.0
MILL C	0.941518	0.94421	4.001	1024.6
MILL D	0.910274	0.91283	5.873	1572.0
MILL E	0.988686	0.99305	0.484	198.21
MILL F	0.980245	0.98318	1.215	346.11

Table 4.26 Block Summary

Block Name	Number of CMs	CM Downtime (Hr)	Number of PMs	PM Downtime (Hr)
1 SB 4 ACT	0	0	1.014	71.126
MILL A	3.78	1340.39	0.423	42.125
MILL B	4.75	1464.99	0.331	60.091
MILL C	4.00	977.444	0.494	47.167
MILL D	5.87	1527.08	0.344	44.926
MILL E	0.48	121.770	0.608	76.446
MILL F	1.21	294.666	0.516	51.443

If we see the simulation results of the system with 2 standby and 4 operations, the mean availability value is 0.99 where the system experiences a downtime of 166 hours and has an operating time of 17353 hours. Where this value is derived from uptime divided by the total operating time. This value only represents when the system has downtime in some simulations. We can see where the number of systems experienced success and did not fail even one time. Here is defined as the point availability where the value is 0.991. This value of 0.991 means that 2973 system simulations were up during 17520 hours of operation. And 27 simulations prove that the system is down. Then from 27 simulations that are calculated to get the mean availability above. Likewise the mean availability without preventive maintanance is obtained.

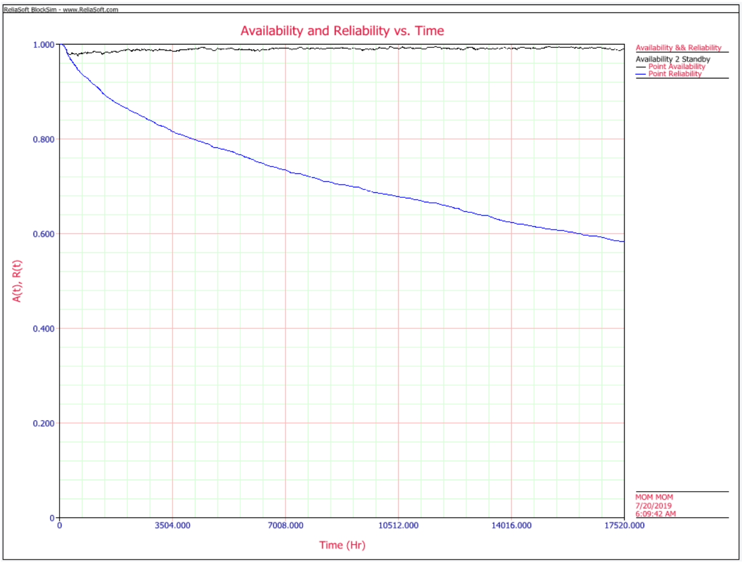

Figure 4.20 Availability and Reliability vs Time

Then next is the value of reliability, which is the probability that the system has not failed by time. This is the major exception with the exception that it only looks at the probability that the system does not have a single failure. Other (non-failure) downing events are ignored. In this cases, the reliability at 17520 would be the number of times the system did not fail to 17520 divided by the number of simulations. For this example, this is 0.583 because the system success 1749 times out of the 3000 simulations until the end time of operation (17520 hr). The figure 4.20 is a graph of reliability and availability of time.

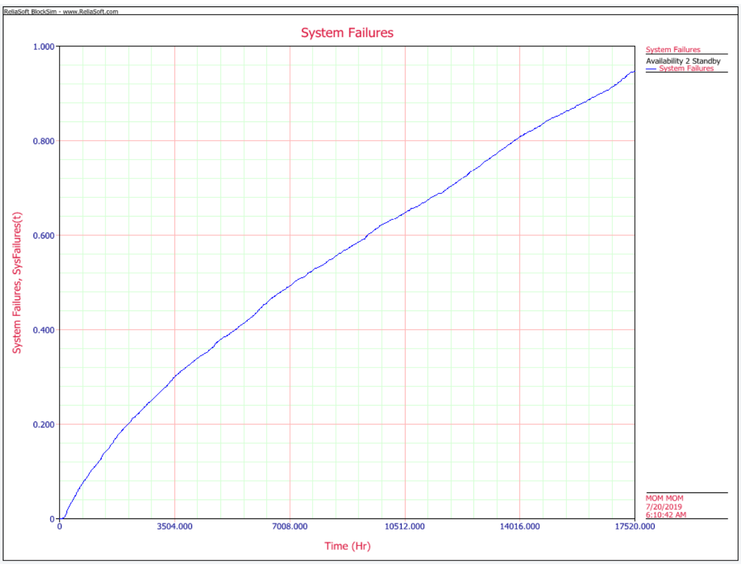

Figure 4.21 System Failures Graphic

Next the expected number of failure from this simulation result is 0.94 times. This value is the average of all number of system failures. In this case 0.94 times, which implies that a total of 2844 system failures are over 3000 simulations. Thus, the expected number of system failure for one run is 0.94. Figure 4.21 explains where the graph of system failure that occurred from the first time the operation until the last time the operation was 17520 hours.

System failure will occur if at least 2 mills fail simultaneously. In figure 4.22 a plotting of events on the block and mill system is illustrated. Here we can get very important information where we can find out what is happening to the system we have. The plotting diagram shown is only an illustration of the last simulation. In this plot it was shown that the system did not down for 2 years running. This is because the system has a 2 mill standard that manages to fail from the other mill. For example, where the 2 main miles experience the same downtime and then successfully covered by the standby mill. That happened at 2100 at the time of operation where Mill C went down so Mill F managed to replace its operation. Then it was not long before Mill D experienced a failure when Mill C experienced corrective maintenance, but it was successfully replaced by Mill E. In the results of this simulation it was shown that there were no 3 mills experiencing a downward downturn. So that there are no failures that occur in the system.

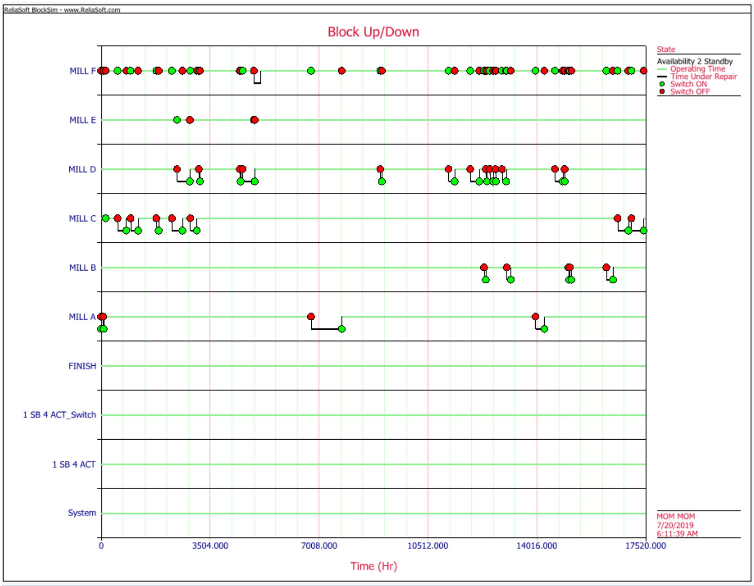

Figure 4.22 Block Up/Down

4.2.4. Economical Analysis

In economic analysis which will be the basis of comparison between the existing and modifeid systems, there are 3 costs that need to be taken into account. Namely investment costs, failure costs and preventive maintenance costs. Investment costs are the costs needed to add 1 pulverizer to the system. Where this fee will be included in the calculation of the modified pulverizer system. Failure costs (Cf) are costs incurred as a result of failure to non-estimated components resulting in loss of company revenue. This fee consists of spare parts costs, costs of losing income and labor costs which are calculated as follows:

C_f = [(Labor Cost x Repair Time) + (Corrective Maintanance Time x Material Cost)] + Shutdown cost (IDR)

Preventive maintenance costs represent costs incurred due to planned scheduled maintenance of the company. In this calculation the maintenance costs intended are maintenance costs that cause downtime only, so the cost of losing income is also included in the calculation here:

Planned maintenance costs represent costs incurred due to planned scheduled maintenance of the company. In this calculation, the maintenance costs intended are labor costs and material costs. The following are the formulas used to calculate preventive costs.

C_p = [(Labor Cost x Repair Time) + (Preventive Maintance Time x Material Cost)]

4.2.4.1. Cost Analysis on The Existing Pulverizer System

The costs required to perform calculations by the existing pulverizer system are as follows.

- Labor cost
  The labor needed to carry out maintenance on the pulverizer requires 2 people. The cost required to pay each person's salary is 75,000 IDR / Hour. So for 1 hour repair requires 150,000 IDR.
- Loss of income
  To get the value of lost income due to the system failure there are some data needed. First, the selling price of electricity produced by PT. PJJ UBJOM Pacitan is 844 IDR / kwh. Then we need to know also the production of electricity produced by the PLTU. However, because it cannot be obtained, it is assumed that the amount of electricity produced with the same capacity power plant is 1976 Gwh in a year.
- Material Cost
  This fee is obtained from the data provided by PT. PJB UBJOM Pacitan. However, this fee is not specific given from every material because it cannot be given to the public. So that the data obtained in the form of material expenditure data for a year for corrective maintenance. So that it is assumed that each corrective maintenance will require a material cost of IDR 23,000,000. The following table are the result of the calculations.

Table 4.27 Corrective Maintance Cost of Existing System

CORRECTIVE MAINTANANCE COST (Existing System)					
MILL	Number of CM	CM Downtime	Labor Cost	Material Cost	CM Total Cost
MILL A	3	1326	150000	23000000	Rp267.900.000
MILL B	5	1692	150000	23000000	Rp368.800.000
MILL C	4	1079	150000	23000000	Rp253.850.000
MILL D	6	1674	150000	23000000	Rp389.100.000
MILL E	1	280	150000	23000000	Rp65.000.000
Total Cost (C_f)					Rp1.344.650.000

Table 4.28 Preventive Maintance Cost of Existing System

PREVENTIVE MAINTANANCE COST (Existing System)					
MILL	Number of PM	PM Downtime	Labor Cost	Material Cost	PM Total Cost
MILL A	3	375	150000	23000000	Rp125.250.000
MILL B	2	477	150000	23000000	Rp117.550.000
MILL C	3	350	150000	23000000	Rp121.500.000
MILL D	2	345	150000	23000000	Rp97.750.000
MILL E	4	527	150000	23000000	Rp171.050.000
TOTAL (C_p)					Rp633.100.000

Table 4.29 Loss of Income of Existing System

Loss of Income of Existing System				
Downtime (Hour)	System Downtime (2year)	Rp/Kwh	Kwh/2 year	Total Cost
1482	0,084589041	844	3.952.000.000	Rp282.145.731.507

4.2.4.2. Cost Analysis on the Modified Pulverizer System

The costs required to perform calculations by the existing pulverizer system are as follows.

- Labor cost

The labor needed to carry out maintenance on the pulverizer requires 2 people. The cost required to pay each person's salary is 75,000 IDR / Hour. So for 1 hour repair requires 150,000 IDR.

- Pulverizer Investment
  In this calculation, investment cost is needed to make a pulverizer purchase. In accordance with the data provided by PT. PJB UBJOM, the cost of purchasing a pulverizer is 2.444.318.255 IDR
- Loss of income
  To get the value of lost income due to the system failure there are some data needed. First, the selling price of electricity produced by PT. PJB UBJOM Pacitan is 844 IDR / kwh. Then we need to know also the production of electricity produced by the PLTU. However, because it cannot be obtained, it is assumed that the amount of electricity produced with the same capacity power plant is 1976 Gwh in a year.
- Material Cost
  This fee is obtained from the data provided by PT. PJB UBJOM Pacitan. However, this fee is not specific given from every material because it cannot be given to the public. So that the data obtained in the form of material expenditure data for a year for corrective maintenance. So that it is assumed that each corrective maintenance will require a material cost of IDR 23,000,000. The following table are the result of the calculations.

Table 4.30 Corrective Maintance Cost of Modified System

CORRECTIVE MAINTANANCE COST (Modified System)					
MILL	Number of CM	CM Downtime	Labor Cost	Material Cost	CM Total Cost
MILL A	3	1340	150000	23000000	Rp270.000.000
MILL B	4	1464	150000	23000000	Rp311.600.000
MILL C	4	977	150000	23000000	Rp238.550.000
MILL D	5	1527	150000	23000000	Rp344.050.000
MILL E	0,48	121	150000	23000000	Rp29.190.000
MILL F	1	294	150000	23000000	Rp67.100.000
Total Cost (C_f)					Rp1.344.650.000

Table 4.31 Preventive Maintance Cost of Modified System

Preventive Maintanance Cost (Modified System)					
MILL	Number of PM	PM Downtime	Labor Cost	Material Cost	PM Total Cost
MILL A	0,4	42,1	150000	23000000	Rp15.518.750
MILL B	0,3	60,1	150000	23000000	Rp15.913.650
MILL C	0,4	47,2	150000	23000000	Rp16.275.050
MILL D	0,3	44,9	150000	23000000	Rp13.638.900
MILL E	0,6	76,4	150000	23000000	Rp25.266.900
MILL F	0,5	51,4	150000	23000000	Rp19.216.450
TOTAL (C_p)					Rp1.344.650.000

Table 4.32 Loss of Income of Modified System

Loss of Income of Modified System				
Downtime (Hour)	System Downtime (2year)	Rp/Kwh	Kwh/2 year	Total Losses
166,6	0,009509132	844	3.952.000.000	Rp31.717.597.078

4.2.5. Determining The Optimal Pulverizer System

After calculating the availability and cost analysis values on the current system and the modified system, then this chapter will compare the most optimal system in terms of cost. If we compare a system that has 1 standby or is called an existing system, it has a 1482 hour downtime with a availability value of 0.91. The value of this considerable downtime in the operation of 2 years of operation caused a loss of Rp.283,490,381,507. Where the value of this loss is due to the loss of income caused by the powerplant which stopped operating for 1482 hours. Then shutdown costs are also due to repairs that must be made due to failure of each pulverizer. Then preventive costs contained in the existing system amounted to Rp.633,100,000. But this preventive value does not significantly affect the total cost incurred by the existing system. The biggest loss is due to the considerable downtime. So the total cost of the system using 1 standby are Rp284,123,481,507.

Then the calculation is carried out where after the system has been modified into 4 pulverizers under operating conditions and 2 in standby conditions there is a drastic change in the downtime that occurs on the system, namely 166 hours. This low downtime value makes the loss becomes much smaller, namely Rp. 32,978,087,078. with preventive measures carried out on 6 pulverizers, the value of expenditure on preventive maintenance is Rp105,829,700. so the total cost that must be paid for the modified system is Rp 35,528,235,033. In accordance with the solution proposed at the beginning of the study, optimization of the existing system can be carried out. So, the system recommended to be applied in PT. PJB UBJOM Pacitan is a system with the addition of 1 more standby pulverizer. Because it has a total cost that is much smaller than what is now. So that makes the pulverizer system experience fewer downs.

Table 4.33 Costs Comparasion

System	Existing System	Modified System
DownTime	1482	166,6
Shutdown Cost	Rp283.490.381.507	Rp32.978.087.078
Investment	-	Rp2.444.318.255
Preventice Cost	Rp633.100.000	Rp105.829.700
Total Cost	Rp284.123.481.507	Rp35.528.235.033

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CHAPTER V
CONCLUSION

5.1. Conclusion

Based on research on reliability and availability analysis on the power plant pulverizer system in PT. PJB UBJOM Pacitan can be concluded that:

1. Distribution of Time to Failure (TTF) and Time to Repair both Corrective Maintanance (TTR CM) and Preventive maintanane (TTR PM) of pulverizer owned by PT. PJB UBJOM Pacitan Unit 1 are shown in the tables below. The type of distribution and parameters obtained in the table below will determine the value of reliability in the next stage.

Distribution Parameters of TTF

Pulverizer	Distribution	Parameters				
		β	η	γ	σ	μ
Mill A	3P-Weibull	1.05	4816.71	-383.85	-	-
Mill B	3P-Weibull	0.57	3410.46	91.52	-	-
Mill C	3P-Weibull	0.54	2015.5	59.9	-	-
Mill D	2P-Weibull	0.85	4216.6	-	-	-
Mill E	Lognormal	-	-	-	1.14	6.60

Distribution Parameters of TTR Corrective Maintanance

Pulverizer	Distribution	Parameters				
		β	η	γ	σ	μ
Mill A	3P-Weibull	0.3815	107.424	1.925	-	-
Mill B	2P-Weibull	0.8151	285.586	-	-	-
Mill C	Normal	-	-	-	231.90	212.280
Mill D	3P-Weibull	0.7285	217.450	0.465	-	-
Mill E	3P-Weibull	0.2916	28.514	3.97	-	-

Distribution Parameters of TTR Preventive Maintanance

Pulverizer	Distribution	Parameters		
		β	η	γ

Mill A	2P-Weibull	0.860678	98.903456	-5.9625
Mill B	2P-Weibull	0.89183	171.959708	-6.625
Mill C	3P-Weibull	0.704819	75.282185	-
Mill D	3P-Weibull	0.680843	95.49846	-
Mill E	2P-Weibull	0.682808	98.047335	-

2. The reliability value of each pulverizer owned by PT. PJB UBJOM Pacitan Unit 1 are showns in the tables bellow. The reliability values for each of these pulverizers show different values. However, it can be concluded that the decline in the reliability value occurs but not significantly until the end of the second year.

Reliability of Pulverizers on PT. PJB UBJOM Pacitan Unit 1

Pulverizer	Reliability R(t)	
	t = 8760 hr (1 year)	*t = 17520 (2 years)*
Mill A	0.139550	0.018183
Mill B	0.148309	0.060457
Mill C	0.181375	0.078244
Mill D	0.108695	0.039002
Mill E	0.153582	0.033462

3. The results of the simulation carried out on the pulverizer system with a series of 4 pulverizers under operating conditions and 1 pulverizer in standby conditions with simulation time of 17520 hours and number of simulation are 3000 times, are:
   a. The value of system availability from the simulation shows a number that is not too large, which is 91% in operating conditions. And 9% indicates the system time is down. Where when the system is down, there are 2 pulverizers that experience simultaneous downtime. In the results of the system simulation, it shows that the system will experience a downtime of 1482 hours from 17520 hours of operation. The biggest cause of the system down was caused by corrective maintanance which was carried out for quite a long time. With a time of 876 hours. The down time caused by preventive maintenance is 605 hours.

b. The reliability of the pulverizer system shows a small numbers. Where the value of reliability is 0.062. in the simulation results, the system has failed 6 times in 2 years of operation. This is also due to the reliability of each pulverizer that is not too large so that each pulverizer experiences considerable failure in 2 years of operation. With Mill A, B, C, D and E each experienced 3.7, 5.3, 4.4, 6.3 and 1.1 failures. The Mean Time To First Failure of the system owned is 4729 hours.

4. Accordance with the initial problem, is the pulverizser system circuit owned by PT. PJB UBJOM Pacitan with 4 pulverizers operating and 1 standby is in accordance with the specified standard or not. So that when the pulverizer system does not meet the specified standards, optimization will be carried out with the addition of redundancies as offered at the beginning of the study. Because the standard value needed is not obtained, which is based on availability and reliability values, the researcher continues to simulate again with the addition of 1 standby pulverizer. So the next simulation will be analyzed with a system consisting of 4 operating pulverizers and 2 standby pulveizer. Then a comparison will be made between the existing system and the modified one in terms of cost. So that the selection can be done among the most optimal.
5. From the results of the research conducted, it can be said that a system with 2 standby is more optimal compared to a system that has 1 standby. This is because the availability value is far greater than 1 standby. So the cost is also much smaller. So, the system recommended to be applied in PT. PJB UBJOM Pacitan is a system with the addition of 1 standby pulverizer. Because it has a total cost that is much smaller than what is now. So that makes the pulverizer system experience fewer downs.

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HASIL REKAP DATA OPERATIONAL LOG BERDASARKAN JENIS KERUSAKAN PADA TAHUN 2013

Berdasarkan Operational Log selama tahun 2013 Unit #1 Terdapat bayak kerusakan yang terjadi dan kegiatan perbaikan yang dilakukan, sehingga dapat disimpulkan data jenis kegagalan dan maintanan yang sama seperti dibawah ini. Adapun untuk melanjutkan penelitian ini, peneliti perlu mengetahui dari jenis-jenis kegagalan dan perbaikan apa saja yang menyebabkan pulverizer mengalami kondisi berhenti beroperasi (down). Responden dapat memberikan jawaban (YA, untuk menjawab Bahwa jenis tersebut menyebabkan pulverizer berhenti beroperasi) dan (Tidak , untuk sebaliknya)

No.	Description	Asset Description	Owner Group	Wo Priority	Work Type	Ya	Tidak
1	**MILL PM 28D**	MEDIUM SPEED MILL #1E			PM		V
2	**OUTLET MILL B CORNER 2**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL B TO CORNER NO.2 LAYER BURNER D PNEUMATIC VALVE - SOLENOID VALVE		URGENT	NC	V	
3	**KEBOCORAN UDARA PADA SOLENOID OUTLET MILL**	MEDIUM SPEED MILL #1B SYSTEM	I&CU	NORMAL	CM		V
4	**MOV CONTROL VALVE HOT DAMPER MILL OPEN AUTO**	MEDIUM SPEED MILL #1E - INLET HOT AIR MOTORIZED CONTROL VALVE		NORMAL	CM	V	
5	**LEAKAGE PADA TEMPERATURE TRANSMITTER MILL**	MEDIUM SPEED MILL #1A		NORMAL	CM		V
6	**PEMBUKAAN HOT DAMPER MILL TIDAK STABIL**	MEDIUM SPEED MILL #1E - INLET HOT AIR MOTORIZED CONTROL VALVE		NORMAL	CM	V	
7	**MILL AMPERE TINGGI**	MEDIUM SPEED MILL #1B		NORMAL	CM	V	
8	**REPAIR DAN INSPEKSI MILL**	MEDIUM SPEED MILL #1D			CM	V	
9	**PERBAIKAN DAN REPAIR MILL**	MEDIUM SPEED MILL #1E			CM	V	
10	**PRESSURE INDIKATOR OUTLET LUBE OIL MILL TIDAK ADA**	MEDIUM SPEED MILL #1B - LUBE OIL STATION - OUTLET OIL PRESSURE INDICATOR NO.1		NORMAL	CM	V	
11	**PNEUMATIC VALVE HOT AIR MILL**	MEDIUM SPEED MILL #1C - INLET HOT AIR SYSTEM		NORMAL	CM	V	
12	**INDIKASI CURRENT PADA MILL SEAL AIR FAN ERROR**	SEALING AIR FAN #1A SYSTEM		NORMAL	CM		V
13	**INDIKASI DRAIN INNERTING MILL BUNTU (manual valve sdh full open, tapi tdk ada aliran)**	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL A - INLET PNEUMATIC VALVE		NORMAL	CM	V	
14	**INDIKASI TRAFO PYRITE MILL TERBAKAKR**	MEDIUM SPEED MILL #1E - PYRITE HOPPER - OUTLET VALVE		NORMAL	CM		V
15	**INDIKASI LEAKAGE PADA MILL**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL C TO CORNER NO.1 LAYER BURNER C - FLOW TRANSMITTER		NORMAL	CM	V	
16	**FLAME DETECTOR CORNER 2 LAYER B TIDAK TERDETEKSI**	MAIN BURNER #1 - FLAME DETECTOR INTENSITY CORNER NO.2 LAYER BURNER B		NORMAL	CM		V
17	**TIDAK ADA FEEDBACK PADA COAL FEEDER MILL**	COAL FEEDER SYSTEM #1C		NORMAL	CM		V
18	**LEAKAGE DI NIPPLE SOLENOID PADA HOT DAMPER MILL**	MEDIUM SPEED MILL #1D - INLET HOT AIR PNEUMATIC CONTROL DAMPER		NORMAL	CM	V	
19	**INDIKASI LINE PYRITE MILL TERSUMBAT MATERIAL**	MEDIUM SPEED MILL #1C - PYRITE HOPPER - INLET PNEUMATIC VALVE		NORMAL	CM		V
20	**Mill AIR DAMPER BEARING AUS**	COAL FEEDER #1C - SEALING AIR DAMPER		NORMAL	CM	V	
21	**Mill INLET COAL GATE TIDAK BISA OPEN/CLOSE**	COAL FEEDER #1D - LOCAL CONTROL CABINET		NORMAL	CM	V	
22	**Mill BURNER INLET VALVE CONTROL OPEN FAULT**	VAPOR / EXHAUST GAS #1 - INLET CORNER NO.4 LAYER BURNER A - MOTORIZEDD VALVE		NORMAL	CM	V	

HASIL REKAP DATA OPERATIONAL LOG BERDASARKAN JENIS KERUSAKAN PADA TAHUN 2014

Berdasarkan Operational Log selama tahun 2014 Unit #1 Terdapat bayak kerusakan yang terjadi dan kegiatan perbaikan yang dilakukan, sehingga dapat disimpulkan data jenis kegagalan dan maintanan yang sama seperti dibawah ini. Adapun untuk melanjutkan penelitian ini, peneliti perlu mengetahui dari jenis-jenis kegagalan dan perbaikan apa saja yang menyebabkan pulverizer mengalami kondisi berhenti beroperasi (down). Responden dapat memberikan jawaban (YA, untuk menjawab Bahwa jenis tersebut menyebabkan pulverizer berhenti beroperasi) dan (Tidak , untuk sebaliknya)

No.	Description	Asset Description	Owner Group	Wo Priority	Work Type	Ya	Tidak
1	KEBOCORAN PADA LINE UDARA COMPRESOR SHUT OFF DAMPER HOT AIR	MEDIUM SPEED MILL #1E - INLET HOT AIR PNEUMATIC CONTROL DAMPER	I&CU		CM	V	
2	PERBAIKAN MEKANIK TUAS HOT AIR DAMPER MILL LEPAS	MEDIUM SPEED MILL #1D - INLET HOT AIR PNEUMATIC CONTROL DAMPER	MECHU1		CM		V
3	PENGECEKAN MOTOR MILL	MEDIUM SPEED MILL #1E	ELECU		PM		V
4	PM PEKERJAAN MEKANIK MILL - 28D	MEDIUM SPEED MILL #1A	MECHU1		PM	V	
5	LEAKAGE PADA TEMPERATURE TRANSMITTER MILL	MEDIUM SPEED MILL #1E	I&CU		PM		V
6	Mill 1D - MSM D OUTLET HIGH	MEDIUM SPEED MILL #1D - OUTLET CARBON MONO OXIDE CONTENT CONTROL CABINET	I&CU		CM		V
7	MEDIUM SPEED MILL MECHANIC INSPECTION	MEDIUM SPEED MILL #1E	MECHU1		PM	V	
8	VALVE PYRITE MILL TIDAK BISA FULL OPEN	MEDIUM SPEED MILL #1E - PYRITE HOPPER - OUTLET SOLENOID VALVE	I&CU		CM		V
9	MIX DAMPER MILL HANYA OPEN/TERBUKA 15%	MEDIUM SPEED MILL #1D - MIXED AIR MOTORIZED CONTROL VALVE	I&CU		CM	V	
10	MEDIUM SPEED MILL INSTRUMENT INSPECTION	MEDIUM SPEED MILL #1E	I&CU		PM		V
11	MIXER DAMPER MEDIUM SPEED MILL FEEDBACKNYA TIDAK SESUAI DENGAN COMMAND	MEDIUM SPEED MILL #1D	I&CU	URGENT	CM		V
12	CONTROL VALVE HOT AIR MILL OPEN FAULT	MEDIUM SPEED MILL #1D - INLET HOT AIR MOTORIZED CONTROL VALVE	I&CU	NORMAL	CM		V
13	INLET DANOUTLET PYRITE MILL TIDAK BISA FULL OPEN DAN FULL CLOSE	MEDIUM SPEED MILL #1E - PYRITE HOPPER - INLET SOLENOID VALVE	I&CU	NORMAL	CM		V
14	LEAKAGE DI FLANGE SISI BAWAH DAN ATAS LINE MIX AIR MILL	MEDIUM SPEED MILL #1C - MIXED AIR MOTORIZED CONTROL VALVE	MECHU1	NORMAL	CM	V	
15	MEDIUM SPEED MILL ELECTRIC INSPECTION	MEDIUM SPEED MILL #1E	ELECU		PM		V
16	MILL PM 28D	MEDIUM SPEED MILL #1A	MECHU1		PM		V
17	MEDIUM SPEED MILL MECHANIC INSPECTION	MEDIUM SPEED MILL #1E	MECHU1		PM	V	
18	Mill - VALVE MIX AIR MILL APABILA DI BUKA/OPEN LEBIH DARI 70% MAKA FLOW UDARA TURUN	MEDIUM SPEED MILL #1C - INLET HOT AIR PNEUMATIC CONTROL DAMPER	I&CU	URGENT	CM	V	
19	FILTER/STRAINER LUBE OIL KOTOR	MEDIUM SPEED MILL #1E	MECHU1	NORMAL	PM		V
20	PERBAIKAN MEKANIK - FILTER/STRAINER LUBE OIL KOTOR	MEDIUM SPEED MILL #1E	MECHU1		PM		V
21	PRESSURE INDIKATOR OUTLET LUBE OIL MILL TIDAK ADA	MEDIUM SPEED MILL #1B - LUBE OIL STATION - OUTLET OIL PRESSURE INDICATOR NO.1	I&CU		CM		V
22	HOT DAMPER MILL FAULT	MEDIUM SPEED MILL #1A - INLET HOT AIR MOTORIZED CONTROL VALVE	I&CU	URGENT	CM	V	
23	INLET SHUT OFF DAMPER MILL FAULT	MEDIUM SPEED MILL #1A - INLET HOT AIR PNEUMATIC CONTROL DAMPER	I&CU	URGENT	CM	V	
24	SUPPLY UDARA PNEUMATIC OUTLET MILL BOCOR	MEDIUM SPEED MILL #1A	I&CU	URGENT	CM	V	
25	PENGECEKAN SENSOR TEMPERATURE OUTLET MILL	MEDIUM SPEED MILL #1E - OUTLET TEMPERATURE SENSING ELEMENT NO.1	I&CU	NORMAL	PM		V
26	PIPA SUPPLY MIX AIR TO MILL BOCOR	MEDIUM SPEED MILL #1C - INLET HOT AIR DUCT	MECHU1	URGENT	CM		V
27	FLOW, TEMP, DAN PRESSURE MILL TIDAK MAU NAIK (dcs dan lokal open 70%)	MEDIUM SPEED MILL #1E - INLET HOT AIR PNEUMATIC CONTROL DAMPER	I&CU	URGENT	CM		V
28	OUTLET MILL BOCOR PADA FLANGES	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL A TO CORNER NO.1 LAYER BURNER E - PNEUMATIC GATE VALVE	MECHU1	NORMAL	PM	V	
29	INDIKASI TUAS MOV CONTROLL VALVE HOT DAMPER MILL LEPAS	MEDIUM SPEED MILL #1A - INLET HOT AIR MOTORIZED CONTROL VALVE	I&CU	NORMAL	CM		V
30	LEAKAGE MANUAL VALVE DRAIN INERTING MILL	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL E - SOLENOID VALVE	MECHU1	NORMAL	CM	V	
31	JASA PEMBONGKARAN DAN PERBAIKAN GRINDING ROLL MILL	MEDIUM SPEED MILL #1E		NORMAL	PAM	V	
32	CLEANING COAL MILL	MEDIUM SPEED MILL #1C SYSTEM		NORMAL	PM	V	
33	LINK STEM COLD DAMPER MILL KENDOR	MEDIUM SPEED MILL #1E - INLET COLD AIR PNEUMATIC GATE DAMPER	MECHU1	EMERGENCY	CM	V	
34	PIN ENGSEL MOV COOL AIR DAMPER MILL bengkong	MEDIUM SPEED MILL #1E - INLET COLD AIR MOTORIZED DAMPER		NORMAL	CM	V	
35	FLEXIBLE JOINT APH B YANG MENUJU HOT AIR DAMPER MILL BOCOR	AIR PREHEATER #1B - OUTLET PRIMARY AIR DUCT	MECHU1	URGENT	CM	V	
36	PURIFIER LUBE OIL MILL KOTOR	MEDIUM SPEED MILL #1A - LUBE OIL STATION PUMP	MECHU1	URGENT	PDM		V
37	LEAKAGE PADA MANNHOLE MILL	MEDIUM SPEED MILL #1D	MECHU1	NORMAL	CM	V	

38	SUARA NOISE PADA MILL (Indikasi scapper lepas)	MEDIUM SPEED MILL #1D	MECHU1	NORMAL	CM	V	
39	MOV COLD DAMPER MILL PENUNJUKANNYA TIDAK SESUAI DI DCS DAN DI LOCALNYA	MEDIUM SPEED MILL #1E - INLET COLD AIR MOTORIZED DAMPER	I&CU	NORMAL	CM	V	
40	PEBEDAAN PEMBACAAN TEMPERATURE LUBE OIL MILL ANATARA LOKAL DAN DCS	MEDIUM SPEED MILL #1D - LUBE OIL STATION - OUTLET TEMPERATURE SENSING ELEMENT	I&CU	NORMAL	CM		V
41	PDM - VIBRASI PADA LUBE OIL PUMP MILL	MEDIUM SPEED MILL #1C - LUBE OIL STATION PUMP	MECHU1		PDM		V
42	LEAKAGE PADA FLANGES LINE INLET MILL	MEDIUM SPEED MILL #1A - INLET DUCT	MECHU1	NORMAL	CM	V	
43	INLET PYRITE HOPPER MILL BUNTU TERGANJAL PLAT	MEDIUM SPEED MILL #1C - PYRITE HOPPER - INLET PNEUMATIC VALVE	MECHU1	URGENT	CM	V	
44	JASA PURIFIER LUBE OIL MILL	MEDIUM SPEED MILL #1E		NORMAL	PDM		V
45	INLET MILL PRIMARY AIR BOCOR	MEDIUM SPEED MILL #1B SYSTEM	MECHU1	NORMAL	CM	V	
46	PNEUMATC VALVE INERTING MILL TIDAK BISA OPEN DARI DCS DAN LOCAL	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL D - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM	V	
47	MILL FLANGE DRAIN FIRE FIGHTING BOCOR	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL D - INLET PIPE	MECHU1	NORMAL	CM	V	
48	INTERNAL CHECK MILL	MEDIUM SPEED MILL #1D	MECHU1	NORMAL	PAM	V	
49	MODUL MOV HOT AIR MILL RUSAK	MEDIUM SPEED MILL #1C - INLET HOT AIR SYSTEM	I&CU	URGENT	CM	V	
50	LEAKAGE HOT AIR MILL PADA ARE SHUT OFF DAMPER	MEDIUM SPEED MILL #1A - INLET HOT AIR PNEUMATIC CONTROL DAMPER	MECHU1	URGENT	CM	V	
51	LEAKAGE MIXING AIR MILL PADA AREA DUCT	MEDIUM SPEED MILL #1A - MIXED AIR MOTORIZED CONTROL VALVE	MECHU1	NORMAL	CM	V	
52	MILL AIR MIXED DAMPER FAULT	MEDIUM SPEED MILL #1C - MIXED AIR MOTORIZED CONTROL VALVE	I&CU	URGENT	CM	V	
53	FLOW TRANSMITTER MILL BERMASALAH	MEDIUM SPEED MILL #1A - AIR FLOW TRANSMITTER NO.2	I&CU	URGENT	CM		V
54	PERBAIKAN VANWHEEL MILL	MEDIUM SPEED MILL #1D	MECHU1	URGENT	PAM	V	
55	SCRAPER PYRITE PATAH & LEPAS	MEDIUM SPEED MILL #1D		URGENT	CM	V	
56	AIR FLOW MILL RENDAH	MEDIUM SPEED MILL #1A	MECHU1	URGENT	CM	V	
57	FIRE FIGHTING STEAM - MEDIUM SPEED MILL OPEN FAULT	FIRE FIGHTING STEAM #1 - OUTLET DEAERATOR TANK TO MEDIUM SPEED MILL - PNEUMATIC VALVE	I&CU	NORMAL	CM		V
58	HOT DAMPER MILL LEAK THROUGH	MEDIUM SPEED MILL #1A - INLET HOT AIR MOTORIZED CONTROL VALVE	MECHU1	NORMAL	CM	V	
59	TUAS PENGGERAK LIMIT SWITCH INLET PYRITE MILL PATAH	MEDIUM SPEED MILL #1B - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM		V
60	ECP: MODIFIKASI PENAMBAHAN LINE & VALVE BYPASS INNERTING MILL	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL B - INLET PIPE	MECHU1	NORMAL	EJ	V	

HASIL REKAP DATA OPERATIONAL LOG BERDASARKAN JENIS KERUSAKAN PADA TAHUN 2015

Berdasarkan Operational Log selama tahun 2015 Unit #1 Terdapat bayak kerusakan yang terjadi dan kegiatan perbaikan yang dilakukan, sehingga dapat disimpulkan data jenis kegagalan dan maintanan yang sama seperti dibawah ini. Adapun untuk melanjutkan penelitian ini, peneliti perlu mengetahui dari jenis-jenis kegagalan dan perbaikan apa saja yang menyebabkan pulverizer mengalami kondisi berhenti beroperasi (down). Responden dapat memberikan jawaban (YA, untuk menjawab Bahwa jenis tersebut menyebabkan pulverizer berhenti beroperasi) dan (Tidak , untuk sebaliknya)

No.	Description	Asset Description	Owner Group	Wo Priority	Work Type	Ya	Tidak
1	MILL HOT DAMPER VALVE TUAS LEPAS	MEDIUM SPEED MILL #1E - INLET HOT AIR PNEUMATIC CONTROL DAMPER	MECHU1	URGENT	CM		v
2	ECP: CABLE COATING AREA MILL	MEDIUM SPEED MILL SYSTEM #1	ELECU	NORMAL	EJ		v
3	ECP: MODIFIKASI PENAMBAHAN LINE & VALVE BYPASS IINNERTING MILL	SAC TO BOILER HOUSE - OUTLET PIPE		NORMAL	EJ	v	
4	TUAS PYRITE MILL PATAH	MEDIUM SPEED MILL #1D SYSTEM	MECHU1	NORMAL	CM		v
5	HIDRANT AREA MILL LEAKTHROUGH	MEDIUM SPEED MILL #1B SYSTEM	MECHU1	NORMAL	CM		v
6	MILL - PM 28D	MEDIUM SPEED MILL #1A	ELECU		PM		v
7	LEAKAGE PADA OUTLET MILL	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL B TO CORNER NO.2 LAYER BURNER D - PNEUMATIC GATE VALVE	MECHU1	NORMAL	CM		v
8	DAMPER OUTLET MILL TIDAK BISA DIOPERASIKAN DARI DCS	SAC TO COAL SAMPLING MEDIUM SPEED MILL #1A - OUTLET VALVE NO.4	I&CU	NORMAL	CM	v	
9	TUAS HOT DAMPER MILL BAUT KENDUR (tidak ada karet penahan).	MEDIUM SPEED MILL #1C - INLET COLD AIR MOTORIZED DAMPER	MECHU1	NORMAL	CM		v
10	MILL SUARA ABNORMAL	MEDIUM SPEED MILL #1A SYSTEM	MECHU1	NORMAL	CM	v	
11	MILL OUTLET PYRITE TUAS TIDAK ADA	MEDIUM SPEED MILL #1E - PYRITE HOPPER - OUTLET SOLENOID VALVE	I&CU	NORMAL	CM		v
12	TUAS LIMIT SWITCH INLET PYRITE MILL PUTUS	MEDIUM SPEED MILL #1D - PYRITE HOPPER - INLET SOLENOID VALVE	I&CU	NORMAL	CM		v
13	OUTLET VALVE PYRITE MILL TIDAK BISA DIOPEN	MEDIUM SPEED MILL #1E - PYRITE HOPPER - OUTLET VALVE	I&CU	NORMAL	CM		v
14	DITEMUKAN PECAHAN MATERIAL MILL KELUAR DARI PYRITE HOPPER	MEDIUM SPEED MILL #1E SYSTEM	MECHU1	NORMAL	PAM		v
15	SHUT OFF HOT AIR DAMPER MILL CLOSE FAULT	MEDIUM SPEED MILL #1E - INLET HOT AIR PNEUMATIC CONTROL DAMPER	I&CU	URGENT	CM	v	
16	PERMINTAAN VALVE DRAIN INNERTING MILL	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL - INLET PIPE	MECHU1	URGENT	PAM	v	
17	INTERNAL CHECK MILL	MEDIUM SPEED MILL #1D	MECHU1	NORMAL	PAM	v	
18	KALIBRASI COAL FEEDER MILL	COAL FEEDER #1D - CONTROL WEIGHT NO.1	I&CU	NORMAL	PAM	v	
19	PERBAIKAN SOLENOID INLET VALVE PYRITE MILL	MEDIUM SPEED MILL #1B - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU		PAM		v
20	PENGGANTIAN RUBBER COUPLING DAN REALLIGNMENT LUBE OIL PUMP MILL	MEDIUM SPEED MILL #1A - LUBE OIL STATION PUMP	MECHU1	URGENT	PDM	v	
21	HOUSE BEARING HOT DAMPER MILL RETAK	MEDIUM SPEED MILL #1D - INLET HOT AIR PNEUMATIC CONTROL DAMPER	MECHU1	NORMAL	CM	v	
22	TUTUP EMERGENCY PUSH BUTTON MILL TIDAK ADA	MEDIUM SPEED MILL #1A		NORMAL	CM		v
23	ORIFICE GATE VALVE OUTLET MILL LEAKAGE	MEDIUM SPEED MILL #1E	MECHU1	URGENT	CM	v	
24	SELONOID SHUT OFF DAMPER MILL RUSAK	MEDIUM SPEED MILL #1E	I&CU	URGENT	CM	v	
25	MATERIAL PYRITE MILL BANYAK, (mohon internal check)	MEDIUM SPEED MILL #1A SYSTEM	MECHU1	NORMAL	CM	v	
26	JASA REPAIR GRINDING ROLL MILL B,C DAN D DAN OIL SEAL MILL UNIT 1	MEDIUM SPEED MILL SYSTEM #1			PAM	v	
27	LUBE OIL PUMP MILL 1D SUARA KASAR	MEDIUM SPEED MILL #1D	MECHU1	NORMAL	PDM		v
28	VANEWHEEL MILL PATAH	MEDIUM SPEED MILL #1A	MECHU1	URGENT	CM	v	
29	GLAND PACKING PADA FLANGES INLET PYRITE MILL BOCOR	MEDIUM SPEED MILL #1E - PYRITE HOPPER - INLET PNEUMATIC VALVE	MECHU1	NORMAL	CM		v
30	MEDIUM SPEED MILL FIRE FIGHTING VALVE TIDAK BISA DIOPERASIKAN	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL C - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM		v
31	MEDIUM SPEED MILL SHUTOFF HOT DAMPER OPEN FAULT	MEDIUM SPEED MILL #1C - INLET HOT AIR PNEUMATIC CONTROL DAMPER	I&CU	NORMAL	CM	v	
32	MEDIUM SPEED MILL PRESSURE UDARA LOW ALARM, SEDANGKAN BUKAAN HOT DAN COOL DAMPER LEBIH BE	MEDIUM SPEED MILL #1A	I&CU	NORMAL	CM	v	
33	HOT DAMPER MILL TIDAK AKTUAL (CCR dan lokal tidak sesuai)	MEDIUM SPEED MILL #1D - INLET HOT AIR MOTORIZED CONTROL VALVE	I&CU	NORMAL	CM		v
34	BOILER - MEDIUM SPEED MILL INSTRUMENT SIMPLE INSPECTION	MEDIUM SPEED MILL SYSTEM #1			OH	v	
35	MEDIUM SPEED MILL ELECTRIC SIMPLE INSPECTION	MEDIUM SPEED MILL SYSTEM #1			OH	v	
36	MEDIUM SPEED MILL MECHANIC SIMPLE INSPECTION	MEDIUM SPEED MILL SYSTEM #1		NORMAL	OH	v	
37	OUTLET MILL CLOSE FAULT/SELENOID RUSAK	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL D TO CORNER NO.1 LAYER BURNER B - PNEUMATIC GATE VALVE	I&CU	NORMAL	CM		v

38	**FIRE FIGHTING MILL TIDAK BISA OPEN**	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL B - INLET PNEUMATIC VALVE	MECHU1	NORMAL	CM		v
39	**LUBE OIL SSTATION MILL, PRESSURE INDIKATOR INLET LEBIH KECIL DARI OUTLET**	MEDIUM SPEED MILL #1D SYSTEM		NORMAL	CM		v
40	**AIR FLOW MIX MILL RENDAH**	MEDIUM SPEED MILL #1C - AIR FLOW TRANSMITTER		NORMAL	CM		v
41	**PERBAIKAN MOTOR CLEANOUT CONVEYOR FEEDER MILL**	COAL FEEDER SYSTEM #1		NORMAL	PAM	v	
42	**TRANSMITER LEVEL BUNKER MILL MASALAH**	COAL BUNKER #1A - LOWER BIN LEVEL SIGNAL NO.1	I&CU	NORMAL	CM		v
43	**Mill CV INLET HOT AIR FB FAULT DI DCS**	MEDIUM SPEED MILL #1B - INLET HOT AIR DUCT	I&CU	NORMAL	CM	v	
44	**TUAS INLET PYRITE MILL TIDAK ADA**	MEDIUM SPEED MILL #1E - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM		v
45	**INNERTING MILL TIDAK BISA OPEN**	MEDIUM SPEED MILL #1B SYSTEM	I&CU	NORMAL	CM	v	
46	**MOV HOT AIR DAMPER MILL MUNCUL ALARM**	MEDIUM SPEED MILL #1E - INLET HOT AIR PNEUMATIC CONTROL DAMPER	I&CU	URGENT	CM		v
47	**PENORMALAN SHUT OFF DAMPER MILL**	MEDIUM SPEED MILL #1A - INLET HOT AIR PNEUMATIC CONTROL DAMPER	MECHU1	NORMAL	PAM	v	
48	**REKOMENDASI HASIL PENGUKURAN VIBRASI MEDIUM SPEED MILL - LUBE OIL STATION PUMP**	MEDIUM SPEED MILL #1C - LUBE OIL STATION PUMP		NORMAL	PDM	v	
49	**PENGGANTIAN VALVE DRAIN INERTING MILL**	MEDIUM SPEED MILL #1D SYSTEM	MECHU1	NORMAL	PAM		v
50	**VALVE DRAIN PIPA INNERTING STEAM MILL LEAKTHROUGH**	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL C - INLET PIPE	MECHU1	NORMAL	CM		v
51	**INVERTER COUNTER FEEDER MILL TIDAK TERBACA**	COAL FEEDER SYSTEM #1D	I&CU	URGENT	CM		v
52	**PERBAIKAN SOLENOID INLET VALVE PYRITE MILL**	MEDIUM SPEED MILL #1B - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	NORMAL	PAM	v	
53	**MILL AMPERE LEBIH TINGGI DIBANDING MILL YG LAIN HARAP DILAKUKAN INTERNAL CHECK**	MEDIUM SPEED MILL #1E - MOTOR STATOR COIL V - TEMPERATURE SENSING ELEMENT NO.1	MECHU1	NORMAL	CM	v	
54	**KEBOCORAN SERBUK BATU BARA DI FLANGES OUTLET MILL**	COAL FEEDER #1A - OUTLET COAL MOTORIZEDD GATE	MECHU1	NORMAL	CM		v
55	**CONTROL VALVE MIX AIR MILL FAULT**	MEDIUM SPEED MILL #1C	I&CU	NORMAL	CM	v	
56	**LIMIT SWITCH OUTLET PYRITE MILL ERROR**	MEDIUM SPEED MILL #1E - PYRITE HOPPER - OUTLET SOLENOID VALVE	I&CU	NORMAL	CM		v
57	**MILL MOTOR FRONT BEARING SUARA ABNORMAL DI LOKAL**	MEDIUM SPEED MILL #1B		NORMAL	CM	v	
58	**TUAS HOT DAMPER MILL MASALAH (Dilokal tuas engsel lengkap,minta calibrasi CV)**	MEDIUM SPEED MILL #1C - INLET HOT AIR MOTORIZED CONTROL VALVE	I&CU	URGENT	CM		v
59	**LINE SUPPLY UDARA INSTRUMENT MENUJU REGULATOR SHUTOFF DAMPER MILL LEPAS**	MEDIUM SPEED MILL #1B - INLET HOT AIR PNEUMATIC CONTROL DAMPER	I&CU	NORMAL	CM	v	
60	**JASA REPAIR HARD FACING GRINDING ROLL MILL**	MEDIUM SPEED MILL #1B SYSTEM			PAM	v	
61	**BUKAAN HOT DAMPER MILL TIDAK SESUAI**	MEDIUM SPEED MILL #1C - INLET HOT AIR MOTORIZED CONTROL VALVE	I&CU	NORMAL	CM	v	
62	**MILL D UNIT 1**	MEDIUM SPEED MILL #1D	MECHU1	NORMAL	CM	v	
63	**OUTLET PYRITE MILL TIDAK BISA DIOPERASIKAN DARI PANEL LOKAL**	MEDIUM SPEED MILL #1E - PYRITE HOPPER - OUTLET VALVE	I&CU	NORMAL	CM		
64	**MSM PYRITE BATUBARA ABNORMAL (mohon internal check mill)**	MEDIUM SPEED MILL #1D	MECHU1	URGENT	CM		v
65	**LINE UDARA INSTRUMENT UNTUK FLUSHING DI AREA MILL BELUM ADA (MODIFIKASI ENGINEERING)**	MEDIUM SPEED MILL #1C SYSTEM		NORMAL	EJ	v	
66	**KABEL PANEL LAMPU PUTUS DI AREA MILL**	MEDIUM SPEED MILL #1E SYSTEM	ELECU	NORMAL	CM		v
67	**LINE INLET PYRITE MILL PESOK**	MEDIUM SPEED MILL #1E - PYRITE HOPPER - INLET SOLENOID VALVE	MECHU1	NORMAL	CM		v
68	**PERMINTAAN PIN BOLT INCLUDE NUT FOR COUPLING MOTOR MILL 1B**	MEDIUM SPEED MILL #1B SYSTEM	MECHU1	NORMAL	PAM		v
69	**PERBAIKAN NIPLE GREASE PADA BEARING MOTOR CWP DAN MILL UNIT 1 UNTUK KEPERLUAN SI**	PT PLN (PERSERO) PEMBANGKITAN LONTAR PACITAN AREA COMMON	ELECU	URGENT	PAM	v	
70	**KABEL SELENOID OUTLET PYRITE MILL LEPAS**	MEDIUM SPEED MILL #1E - PYRITE HOPPER - OUTLET SOLENOID VALVE	I&CU	NORMAL	CM	v	
71	**PENGGANTIAN BEARING SISI DE MILL**	MEDIUM SPEED MILL #1B SYSTEM	MECHU1	NORMAL	PAM	v	
72	**PENGGANTIAN INNERPART MILL**	MEDIUM SPEED MILL #1D	MECHU1	OUTAGE	PAM	v	
73	**PENGGANTIAN BEARING MOTOR MILL**	MEDIUM SPEED MILL #1A		OUTAGE	PDM	v	
74	**PERBAIKAN PADA OUTLET PYRITE MILL (BENGKOK)**	MEDIUM SPEED MILL #1E - PYRITE HOPPER - OUTLET VALVE	MECHU1	NORMAL	OH		v
75	**SEALING AIR FAN SERING DROP KETIKA 5 MILL RUNNING**	SEALING AIR FAN #1A SYSTEM	MECHU1	OUTAGE	PAM	v	
76	**JASA PENGGANTIAN TABLE MILL**	MEDIUM SPEED MILL #1C SYSTEM	MECHU1	OUTAGE	PAM	v	
77	**LUBE OIL MILL A,B,C,D & E TUAS BERAT SAAT DI MANUFER**	MEDIUM SPEED MILL #1A - LUBE OIL STATION - HEATER NO.1	I&CU	OUTAGE	PAM	v	
78	**PERMINTTAN MATERIAL LEM ANTI WEAR LINER UNTUK MILL**	MEDIUM SPEED MILL #1C SYSTEM	MECHU1	URGENT	PAM	v	
79	**BAUT COPLE STAM MILL HOT DAMPER LEPAS**	MEDIUM SPEED MILL #1C - INLET HOT AIR MOTORIZED CONTROL VALVE	MECHU1	NORMAL	CM		v
80	**TETESAN AIR SISI STAMP MANUAL VALVE INNERTING MILL**	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL C - INLET PNEUMATIC VALVE	MECHU1	NORMAL	CM		v

81	**KEBOCORAN PADA LAYER D2 DARI MILL 1B**	MEDIUM SPEED MILL #1B - INLET COLD AIR SYSTEM	MECHU1	NORMAL	WR	v	
82	**REGRESSING HOT AIR DAMPER DAN MIX AIR DAMPER MILL**	MILL AIR SYSTEM, CARRIER AIR SYSTEM - PAF #1 - OUTLET INTERCONNECTING DUCTING SYSTEM	MECHU1	NORMAL	PAM		v
83	**REGREASSING HOT AIR DAN MIX AIR DAMPER MILL**	PRIMARY HOT AIR HEADER DUCT #1 SYSTEM	MECHU1	NORMAL	PAM		v
84	**OUTLET VALVE PYRITE MILL TIDAK BISA CLOSE (Swicth Ubnormal)**	MEDIUM SPEED MILL #1C - PYRITE HOPPER - OUTLET VALVE	I&CU	NORMAL	CM		v
85	**LEAKAGE PADA CORNER B1, B2 dan B3 (mill-1D)**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL D TO CORNER NO.4 LAYER BURNER B - FLOW TRANSMITTER	MECHU1	NORMAL	CM	v	
86	**PERBAIKAN DOUBLE BEAM HOIST CRANE MILL**	COAL BUNKER BAY UNIT 1 - MOTOR HOIST NO.1		NORMAL	CM		v
87	**HANGER LINER INNERTING MILL PUTUS**	MEDIUM SPEED MILL #1D	MECHU1	NORMAL	CM		v
88	**OUTLET MILL TIDAK BISA OPEN DARI CCR**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL D TO CORNER NO.1 LAYER BURNER B - PNEUMATIC GATE VALVE	I&CU	NORMAL	CM	v	
89	**KEBOCORAN PADA LINE MIX AIR DAMPER MENUJU MILL**	MEDIUM SPEED MILL #1B	MECHU1	NORMAL	CM	v	
90	**PAM " FLUSHING LUBE OIL MILL"**	MEDIUM SPEED MILL #1E - LUBE OIL STATION PUMP	MECHU1	NORMAL	PAM	v	
91	**BEARING TUAS HOT DAMPER MILL PECAH**	MEDIUM SPEED MILL #1A - INLET HOT AIR PNEUMATIC CONTROL DAMPER	MECHU1	NORMAL	OH	v	
92	**LEAKAGE PADA INLET MILL**	MEDIUM SPEED MILL #1A - INLET DUCT	MECHU1	NORMAL	CM	v	
93	**KEBOCORAN LINE PRESSURE INDIKATOR PADA LUBE OIL MILL**	MEDIUM SPEED MILL #1A	I&CU	NORMAL	CM		v
94	**NOISE PADA MILL DAN DITEMUIKAN PATAHAN KOMPONEN MILL & BAUT SAAT PYRITE**	MEDIUM SPEED MILL #1D	MECHU1	NORMAL	CM	v	
95	**Turbin Unit 1 – Lampu pada breaker 6 KV Mill 1D mati**	6 KV UNIT SECTION 1B - CIRCUIT BREAKER FOR #1D MEDIUM SPEED MILL CIRCUIT BREAKER		NORMAL	RTF		v
96	**PERMINTAAN SCRAPPER MILL #2 (SI)**	MEDIUM SPEED MILL #2D SYSTEM		OUTAGE	PAM		v
97	**NILAI AIR FLOW MILL KURANG AKURAT**	MEDIUM SPEED MILL SYSTEM #1	I&CU	NORMAL	CM		v
98	**ECP : PEMBUATAN SARANA SAMPLING BATUBARA PADA MILL**	MEDIUM SPEED MILL #1E	MECHU1	NORMAL	OH		v
99	**Civil - GREATING AREA MILL BANYAK YANG RUSAK**	PT PLN (PERSERO) PEMBANGKITAN LONTAR PACITAN UNIT 1	CIVILU	NORMAL	ADM		v
100	**LIMIT SWITCH INLET PYRITE MILL BERAT**	MEDIUM SPEED MILL #1E	I&CU	NORMAL	PAM		v
101	**TUAS PENGGERAK LIMIT SWITCH OUTLET PYRITE MILL PATAH**	MEDIUM SPEED MILL #1B	I&CU	NORMAL	PAM		v
102	**PERMINTAAN INTERNAL CHECK PADA MILL**	MEDIUM SPEED MILL #1D	MECHU1	URGENT	PM	v	
103	**HANDLE MANUAL MIX AIR DAMPER MILL TIDAK BISA DIOPERASIKAN KARENA TERBENTUR SUPPOR BEA**	MEDIUM SPEED MILL #1B - MIXED AIR MOTORIZED CONTROL VALVE	MECHU1	NORMAL	CM	v	
104	**BOCOR SERBUK BATU BARA DAN KELUAR PERCIKAN API DI MANHOLE MILL**	MEDIUM SPEED MILL #1D	MECHU1	NORMAL	CM		v
105	**JASA CLEANING AREA COAL FEEDER, COAL MILL DAN NORMALISASI ECONOMIZER HOPPER**	COAL FEEDER SYSTEM #1		OUTAGE	PAM	v	
106	**PAM "INTERNAL CHECK MILL"**	MEDIUM SPEED MILL #1B SYSTEM	MECHU1	NORMAL	PAM	v	
107	**KEBOCORAN SERBUK BATU BARA DI L-BOW OUTLET MILL**	MEDIUM SPEED MILL #1C	MECHU1	NORMAL	CM		v
108	**COLD DAMPER MILL ERROR (dilokal posisi tampilan mati)**	MEDIUM SPEED MILL #1E - INLET COLD AIR MOTORIZED DAMPER	I&CU	NORMAL	CM		v
109	**REGULATOR PNEUMATIC VALVE INNERTING MILL BOCOR**	MEDIUM SPEED MILL #1D	I&CU	NORMAL	CM		v

HASIL REKAP DATA OPERATIONAL LOG BERDASARKAN JENIS KERUSAKAN PADA TAHUN 2016

Berdasarkan Operational Log selama tahun 2016 Unit #1 Terdapat bayak kerusakan yang terjadi dan kegiatan perbaikan yang dilakukan, sehingga dapat disimpulkan data jenis kegagalan dan maintanan yang sama seperti dibawah ini. Adapun untuk melanjutkan penelitian ini, peneliti perlu mengetahui dari jenis-jenis kegagalan dan perbaikan apa saja yang menyebabkan pulverizer mengalami kondisi berhenti beroperasi (down). Responden dapat memberikan jawaban (YA, untuk menjawab Bahwa jenis tersebut menyebabkan pulverizer berhenti beroperasi) dan (Tidak , untuk sebaliknya)

No.	Description	Asset Description	Owner Group	Wo Priority	Work Type	YA	TIDAK
1	**PERBAIKAN – REGULATOR PNEUMATIC VALVE INERTING MILL BOCOR**	MEDIUM SPEED MILL #1D	I&CU		CM	v	
2	**MILL - PM 28D**	MEDIUM SPEED MILL #1A	ELECU	NORMAL	PM		v
3	**MANUAL VALVE INERTING MILL INDIKASI BOCOR**	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL A - INLET PIPE	MECHU1	NORMAL	CM	v	
4	**FILTER /STRAINER LUBE OIL MILL KOTOR**	MEDIUM SPEED MILL #1E	MECHU1	NORMAL	CM		v
5	**KEBOCORAN OLI DI FILTER LUBE OIL MILL**	MEDIUM SPEED MILL #1E - LUBE OIL STATION PUMP	MECHU1	NORMAL	CM		v
6	**PAM "PENGGANTIAN EXPANTION JOINT ALL MILL"**	MEDIUM SPEED MILL #1B - INLET HOT AIR DUCT	MECHU1	NORMAL	PAM	v	
7	**ECP : PEMBUATAN SARAN SAMPLING BATUBARA PADA MILL**	MEDIUM SPEED MILL #1B		NORMAL	OH		v
8	**TUAS HOT AIR DAMPER MILL LEPAS**	MEDIUM SPEED MILL #1E - INLET HOT AIR PNEUMATIC CONTROL DAMPER	MECHU1	NORMAL	CM		v
9	**PAM "INTERNAL CHECK MILL"**	MEDIUM SPEED MILL SYSTEM #1	MECHU1	NORMAL	PAM	v	
10	**PEKERJAAN ELEKTRIK MILL - PM 28D**	MEDIUM SPEED MILL #1A	ELECU	NORMAL	PM	v	
11	**SELENOID PNEUMATIK OUTLET PYRITE MILL BOCOR UDARA INSTRUMENT**	MEDIUM SPEED MILL #1C - PYRITE HOPPER - OUTLET VALVE	I&CU	NORMAL	CM		v
12	**SHUT OFF DAMPER MILL FAULT**	MEDIUM SPEED MILL #1A - INLET HOT AIR PNEUMATIC CONTROL DAMPER	I&CU	URGENT	CM	v	
13	**INDIKASI SUARA KASAR PADA LUBE OIL PUMP MILL**	MEDIUM SPEED MILL #1C - LUBE OIL STATION PUMP	MECHU1	NORMAL	CM		v
14	**INDIKASI SUARA KASAR/NOISE PADA MILL**	MEDIUM SPEED MILL #1A	MECHU1	NORMAL	CM	v	
15	**PEKERJAAN INSTRUMENT MILL - PM 28D**	MEDIUM SPEED MILL #1A	I&CU	NORMAL	PM		v
16	**NAPLE UDARA INSTRUMENT MENUJU OUTLET MILL BOCOR**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL E TO CORNER NO.1 LAYER BURNER A - PNEUMATIC GATE VALVE	I&CU	NORMAL	CM		v
17	**FIRE FIGHTING MILL BOCOR PADA REGULATOR UDARA INSTRUMEN**	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL D - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM		v
18	**FIRE FIGHTING MILL BOCOR PADA NAPLE UDARA INSTRUMEN**	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL A - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM		v
19	**JASA CLEANING MILL DAN CONDENSOR**	BUNKER, FEEDER AND PULVERIZING SYSTEM #1		OUTAGE	PAM	v	
20	**PEMASANGAN AEROFOIL MILL**	MEDIUM SPEED MILL #1C	MECHU1	NORMAL	PAM	v	
21	**PAM "JASA BONGKAR PASANG DAN REPAIR MILL"**	MEDIUM SPEED MILL #1E	MECHU1	NORMAL	OH	v	
22	**PENGGANTIAN FILTER REGULATOR INERTING MILL 1A**	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL A - INLET PIPE	I&CU	NORMAL	PAM	v	
23	**OUTLET MILL TIDAK ADA COVERNYA**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL C TO CORNER NO.1 LAYER BURNER C - PNEUMATIC GATE VALVE	MECHU1	NORMAL	CM		v
24	**TUAS PATAH PADA PYRITE HOPPER - OUTLET SOLENOID VALVE MILL**	MEDIUM SPEED MILL #1B - PYRITE HOPPER - OUTLET SOLENOID VALVE	I&CU	NORMAL	CM		v
25	**PENYETINGAN MOV HOT DAN MIX DAMPER MILL**	MEDIUM SPEED MILL SYSTEM #1	I&CU	NORMAL	PAM	v	
26	**KEBOCORAN PADA OUTLET MILL**	VAPOR / EXHAUST GAS #2 - OUTLET MEDIUM SPEED MILL D TO CORNER NO.1 LAYER BURNER B SYSTEM	MECHU1	NORMAL	CM	v	
27	**PENGGANTIAN BEARING HOT DAMPER MILL 1A-E**	BUNKER, FEEDER AND PULVERIZING SYSTEM #1	MECHU1	OUTAGE	PAM	v	
28	**MEDIUM SPEED MILL 1- INSPEKSI DAN PERBAIKAN BEARING DAMPER MILL**	MEDIUM SPEED MILL SYSTEM #1	MECHU1	NORMAL	PAM	v	
29	**BREAKER MILL POSISI GROUNDING PENUNJUKAN DISPLAY OPEN**	MEDIUM SPEED MILL #1A	ELECU	NORMAL	CM		v
30	**PERBAIKAN BULLRING MILL**	MEDIUM SPEED MILL #1D SYSTEM	MECHU1		PAM	v	
31	**OUTLET PYRITE MILL MENUTUP SENDIRI (CONTROL RUSAK)**	MEDIUM SPEED MILL #1C - PYRITE HOPPER - OUTLET VALVE	I&CU	NORMAL	CM		v
32	**LINE INLET PYRITE MILL "PENYOK"**	MEDIUM SPEED MILL #1D - PYRITE HOPPER - INLET PNEUMATIC VALVE	MECHU1	NORMAL	CM	v	
33	**KEBOCORAN PADA VALVE INERTING MILL**	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL A - INLET PNEUMATIC VALVE	MECHU1	NORMAL	CM	v	
34	**MAIN HOLE MILL KURANG RAPAT**	MEDIUM SPEED MILL #1D SYSTEM	MECHU1	NORMAL	CM	v	
35	**Mill NOISE (suara kasar di ruang scrapper)**	MEDIUM SPEED MILL #1A SYSTEM	MECHU1	NORMAL	CM	v	
36	**LEAKAGE PADA INLET MILL**	MEDIUM SPEED MILL #1A - INLET DUCT	MECHU1	NORMAL	CM	v	
37	**REKOMENDASI HASIL PENGUKURAN VIBRASI MEDIUM SPEED MILL - LUBE OIL STATION PUMP**	MEDIUM SPEED MILL #1D - LUBE OIL STATION PUMP		NORMAL	PDM		v
38	**MATERIAL PYRITE MILL KELUAR BESI**	MEDIUM SPEED MILL #1B SYSTEM	MECHU1	URGENT	CM		v
39	**VALVE OUTLET PYRITE MILL TIDAK FULL CLOSE**	MEDIUM SPEED MILL #1E - PYRITE HOPPER - OUTLET SOLENOID VALVE	I&CU	NORMAL	CM		v
40	**OUTLET VALVE MILL TIDAK BISA CLOSE**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL A TO CORNER NO.1 LAYER BURNER E - PNEUMATIC GATE VALVE	I&CU	NORMAL	CM		v

41	**PEMBACAAN LEVEL BUNKER MILL ERROR (bandul lepas)**	MEDIUM SPEED MILL #1D SYSTEM	I&CU	NORMAL	CM		v
42	**PNEUMATIC VALVE FIRE FIGHTING MILL OPEN FAULT (mekaniknya berat)**	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL E - INLET PNEUMATIC VALVE	MECHU1	NORMAL	CM	v	
43	**INDIKATOR TEMPERATURE OUTLET MILL TIDAK SAMA.**	MEDIUM SPEED MILL #1B - OUTLET TEMPERATURE SENSING ELEMENT NO.1	I&CU	NORMAL	CM		v
44	**MILL KONDISI STOP TAPI MUNCUL VIBRASI**	MEDIUM SPEED MILL #1B SYSTEM	I&CU	NORMAL	CM		v
45	**ADJUSTING ROD DAN DEFLECTOR MILL PATAH(Anjlok)**	MEDIUM SPEED MILL #1B	MECHU1	NORMAL	CM	v	
46	**KEBOCORAN PADA INLET COLD AIR PNEUMATIC GATE DAMPER MENUJU DUCT MILL**	MEDIUM SPEED MILL #1E - INLET COLD AIR PNEUMATIC GATE DAMPER	MECHU1	NORMAL	CM		v
47	**PANEL LOCAL BOX PYRITE MILL ALARM (sisi outlet) TIDAK BISA RESET**	MEDIUM SPEED MILL #1C - PYRITE HOPPER - LOCAL CONTROL BOX	ELECU	NORMAL	CM		v
48	**OUTLET MILL TIDAK DAPAT DIOPERASIKAN DARI DCS (macet)**	MEDIUM SPEED MILL #1D	I&CU	NORMAL	CM		v
49	**PENGGANTIAN REGULATOR OUTLET MILL**	MEDIUM SPEED MILL SYSTEM #1	I&CU	NORMAL	PAM	v	
50	**SINYAL UNTUK INLET DAN OUTLET PYRITE MILL ERROR**	MEDIUM SPEED MILL #1D	I&CU	NORMAL	CM		v
51	**INLET PYRITE MILL TIDAK BISA DIOPEN DARI PANEL LOKAL**	MEDIUM SPEED MILL #1C - PYRITE HOPPER - INLET SOLENOID VALVE	I&CU	NORMAL	CM		v
52	**OUTLET PYRITE MILL TIDAK DAPAT DIOPERASIKAN DARI PANEL LOKAL**	MEDIUM SPEED MILL #1B	I&CU	NORMAL	CM		v
53	**"PAM" PERMINTAAN PART UNTUK MILL (ME)**	MEDIUM SPEED MILL #1A SYSTEM		OUTAGE	PAM		v
54	**HOT DAMPER MILL TIDAK BISA DIOPERASIKAN DARI DCS**	MEDIUM SPEED MILL #1E - INLET HOT AIR MOTORIZED CONTROL VALVE	I&CU	NORMAL	CM		v
55	**SELENOID SLIDE GATE PYRITE MILL RUSAK.**	MEDIUM SPEED MILL #1C - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM		v
56	**MATERIAL PYRITE MILL KELUAR BUNGA API DAN TIDAK HABIS**	MEDIUM SPEED MILL #1C SYSTEM	MECHU1	NORMAL	CM	v	
57	**"PAM" PENGGANTIAN BEARING POMPA LUBE OIL MILL (ME)**	MEDIUM SPEED MILL #1D - LUBE OIL STATION PUMP	MECHU1	OUTAGE	PAM	v	
58	**ECP.COATING CABLE AREA MILL**	MEDIUM SPEED MILL SYSTEM #1	ELECU	NORMAL	EJ		v
59	**MODUL CONTROL VALVE MIXED AIR DAMPER MILL RUSAK**	MEDIUM SPEED MILL #1B - MIXED AIR MOTORIZED CONTROL VALVE	I&CU	NORMAL	CM	v	
60	**TUAS LIMIT SWITCH INLET PYRITE MILL HILANG**	MEDIUM SPEED MILL #1E - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM		v
61	**KEBOCORAN LINE INSTRUMENT UDARA PADA SOLENOID VALVE INLET PYRITE HOPPER MILL**	MEDIUM SPEED MILL #1C - PYRITE HOPPER - INLET SOLENOID VALVE	I&CU	NORMAL	CM		v
62	**DUCT LINE MIX AIR DAMPER MILL BOCOR DAN TERBAKAR**	MEDIUM SPEED MILL #1B - MIXED AIR MOTORIZED CONTROL VALVE	MECHU1	NORMAL	CM	v	
63	**PENUMPUKAN DEBU DI LINE MIX AIR DAMPER MENUJU MILL**	MEDIUM SPEED MILL #1B SYSTEM	CIVILU	ENVIRON MENT	CM	v	
64	**BELT FEEDER MILL TIDAK BERPUTAR SAAT DI START**	COAL FEEDER SYSTEM #1C	MECHU1	NORMAL	CM	v	
65	**LINE INLET PYRITE DAN FLANGES INLET PYRITE MILL BOCOR**	MEDIUM SPEED MILL #1D - PYRITE HOPPER - INLET PNEUMATIC VALVE	MECHU1	NORMAL	CM	v	
66	**BAUT PENGAIT TUAS HOT AIR MILL DAMPER PUTUS**	MEDIUM SPEED MILL #1C - INLET HOT AIR MOTORIZED CONTROL VALVE	MECHU1	NORMAL	CM	v	
67	**INDIKASI HOT DAMPER DAN MIX DAMPER MILL BOCOR**	MEDIUM SPEED MILL #1B - INLET HOT AIR PNEUMATIC CONTROL DAMPER	MECHU1	NORMAL	CM	v	
68	**KEBOCORAN UDARA DI DUCT MIX AIR MILL**	MEDIUM SPEED MILL #1A - INLET DUCT	MECHU1	NORMAL	CM	v	
69	**OUTLET PYRITE MILL BOCOR**	MEDIUM SPEED MILL #1E	MECHU1	NORMAL	CM	v	
70	**ALARM PADA MOV MIX AIR DAMPER MILL**	MEDIUM SPEED MILL #1A - MIXED AIR MOTORIZED CONTROL VALVE	I&CU	URGENT	CM		v
71	**SCRAPPER MILL LEPAS DAN KELUAR DARI PYRITE**	MEDIUM SPEED MILL #1B	MECHU1	NORMAL	CM	v	
72	**KEBOCORAN UDARA PADA PISTONE PNEUMATIC SLIGHT GATE OUTLET PYRITE MILL**	MEDIUM SPEED MILL #1E - PYRITE HOPPER - OUTLET VALVE	I&CU	NORMAL	CM	v	
73	**DITEMUKAN BAGIAN MILL YANG TERLEPAS DI PYRITE MILL**	MEDIUM SPEED MILL #1B	MECHU1	NORMAL	CM	v	
74	**KOPLING MOV HOT DAMPER MILL RUSAK**	MEDIUM SPEED MILL #1C - INLET HOT AIR MOTORIZED CONTROL VALVE	MECHU1	NORMAL	CM	v	
75	**DUCT MIX AIR MILL JEBOL**	MEDIUM SPEED MILL #1C - INLET HOT AIR DUCT	MECHU1	NORMAL	CM	v	
76	**LINE OUTLLET MILL BOCOR SERBUK BATU BARA**	MEDIUM SPEED MILL #1C	MECHU1	NORMAL	CM		v
77	**SR Boiler 1 – TUAS PENGGERAK MOC HOT DAMPER MILL BENGKOK (terhimpit tangga)**	MEDIUM SPEED MILL #1D - INLET HOT AIR PNEUMATIC CONTROL DAMPER	MECHU1	NORMAL	CM	v	
78	**MILL PERLU INTERNAL CHECK, MATERIAL BANYAK & SERING PLUGGING**	MEDIUM SPEED MILL #1D	MECHU1	NORMAL	CM	v	
79	**PENGGANTIAN GEARBOX MILL**	MEDIUM SPEED MILL SYSTEM #1	MECHU1	OUTAGE	PAM	v	
80	**MIX DAMPER MILL INDIKASI DCS BLANK DAN LOCAL TIDAK MENYALAMi**	MEDIUM SPEED MILL #1C - MIXED AIR MOTORIZED CONTROL VALVE	I&CU	NORMAL	CM		v
81	**SOLENOID VALVE PADA PNEUMATIC SLIGHT GATE OUTLET MILL RUSAK**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL D TO CORNER NO.3 LAYER BURNER B - PNEUMATIC GATE VALVE	I&CU	NORMAL	CM	v	
82	**INLET HOOPER PYRITE MILL SULIT DIOPERASIKAN DARI PANEL LOKAL DAN TERDAPAT PERCIKAN b**	MEDIUM SPEED MILL #1C - PYRITE HOPPER - INLET SOLENOID VALVE	MECHU1	NORMAL	CM		v
83	**PENGGANTIAN LIMIT SWITCH OUTLET MILL**	MEDIUM SPEED MILL SYSTEM #1		OUTAGE	PAM	v	
84	**MATERIAL PYRITE MILL BANYAK BATU BARA PADA COAL FLOW NORMAL**	MEDIUM SPEED MILL #1C SYSTEM	MECHU1	NORMAL	CM		v
85	**SR Boiler 1 – flow inlet burner corner A3 (mill E) terdeteksi 0 t/h**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL E TO CORNER NO.3 LAYER BURNER A - FLOW TRANSMITTER	I&CU	NORMAL	CM	v	

91	**DISPLAY MOV MIX AIR DAMPER MATI**	MEDIUM SPEED MILL #1C - MIXED AIR MOTORIZED CONTROL VALVE	I&CU	NORMAL	CM	v	
92	**FLOW OUTLET MILL RENDAH**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL C TO CORNER NO.3 LAYER BURNER C - FLOW TRANSMITTER	I&CU	NORMAL	CM		v
93	**PENGGANTIAN ISOLASI DAMPER MILL1A-E**	MEDIUM SPEED MILL #1A - INLET SEALING AIR DAMPER	MECHU1	OUTAGE	PAM	v	
94	**COVER COOLING MOTOR MILL RUSAK**	MEDIUM SPEED MILL #1D SYSTEM	ELECU	NORMAL	CM		v
95	**ADA KEBOCORAN PADA SELA-SELA MAIN HOLE SCRAPER MILL**	MEDIUM SPEED MILL #1D	MECHU1	NORMAL	CM		v
96	**REGULATOR SHUTOFF DAMPER MILL LEAKAGE**	MEDIUM SPEED MILL #1B - INLET HOT AIR SYSTEM	I&CU	NORMAL	CM		v
97	**KABEL DAN SELANG INSTRUMENT OUTLET VALVE MILL LEPAS**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL E TO CORNER NO.4 LAYER BURNER A - PNEUMATIC GATE VALVE	I&CU	NORMAL	CM	v	
98	**TERDAPAT PERCIKAN API PADA FLANGES MILL**	MEDIUM SPEED MILL #1C	MECHU1	NORMAL	CM	v	
99	**MATERIAL PYRITE MILL BANYAK**	MEDIUM SPEED MILL #1C SYSTEM		URGENT	CM	v	
100	**SCRAPER MILL LEPAS DAN MASIH BERADA DALAM MILL**	MEDIUM SPEED MILL #1A	MECHU1	NORMAL	CM	v	
101	**LINE DRAIN INNERTING (mohon diarahkan ke drainase)**	FIRE FIGHTING STEAM #2 - MEDIUM SPEED MILL A - INLET PIPE	MECHU1	NORMAL	CM		v
102	**LEAKAGE PADA LINE LUBE OIL MENUJU GEAR BOX MILL**	MEDIUM SPEED MILL #1B SYSTEM	MECHU1	NORMAL	CM	v	
103	**SLIDE GATE OUTLET PYRITE MILL HANYA OPEN SETENGAH**	MEDIUM SPEED MILL #1E - PYRITE HOPPER - OUTLET VALVE	I&CU	NORMAL	CM	v	
104	**COVER PENUTUP PUSH BUTTON EMERGENCY TIDAK ADA**	MEDIUM SPEED MILL #1A SYSTEM	ELECU	NORMAL	RTF		v

HASIL REKAP DATA OPERATIONAL LOG BERDASARKAN JENIS KERUSAKAN PADA TAHUN 2017

Berdasarkan Operational Log selama tahun 2017 Unit #1 Terdapat bayak kerusakan yang terjadi dan kegiatan perbaikan yang dilakukan, sehingga dapat disimpulkan data jenis kegagalan dan maintanan yang sama seperti dibawah ini. Adapun untuk melanjutkan penelitian ini, peneliti perlu mengetahui dari jenis-jenis kegagalan dan perbaikan apa saja yang menyebabkan pulverizer mengalami kondisi berhenti beroperasi (down). Responden dapat memberikan jawaban (YA, untuk menjawab Bahwa jenis tersebut menyebabkan pulverizer berhenti beroperasi) dan (Tidak , untuk sebaliknya)

NO.	Description	Asset Description	Owner Group	Wo Priority	Work Type	YA	TIDAK
1	INLET PYRITE MILL BOCOR KELUAR PERCIKAN API	MEDIUM SPEED MILL #1D - PYRITE HOPPER - INLET PNEUMATIC VALVE	MECHU1	NORMAL	CM		v
2	KEBOCORAN PADA OUTLET NO.4 MILL 1C	MEDIUM SPEED MILL #1C SYSTEM	MECHU1	NORMAL	CM	v	
3	PEKERJAAN ELEKTRIK MILL- PM 28D	MEDIUM SPEED MILL #1A	ELECU	NORMAL	PM		v
4	MILL - PM 28D	MEDIUM SPEED MILL #1A	MECHU1	NORMAL	PM		v
5	PENGGANTIAN REGULATOR OUTLET PYRITE MILL	MEDIUM SPEED MILL #1D - PYRITE HOPPER - OUTLET SOLENOID VALVE	I&CU	NORMAL	PAM		v
6	LEAKAGE SERBUK BATU BARA PADA OUTLET FEEDER MILL	MEDIUM SPEED MILL #1E		NORMAL	CM	v	
7	LIMIT SWITCH OPEN OUTLET MILL 1E NO.1 RUSAK	MEDIUM SPEED MILL #1E	I&CU	NORMAL	CM	v	
8	PENGGANTIAN REGULATOR FILTER MILL UNIT 1	MEDIUM SPEED MILL SYSTEM #1	I&CU	NORMAL	PAM	v	
9	PYRITE MILL PLUGGING MATERIAL BESI	MEDIUM SPEED MILL #1C - PYRITE HOPPER - OUTLET VALVE	MECHU1	NORMAL	CM		v
10	SLIDE GATE INLET PYRITE MILL BISA CLOSE SULIT OPEN	MEDIUM SPEED MILL #1C - PYRITE HOPPER - INLET SOLENOID VALVE	MECHU1	NORMAL	CM		v
11	TUAS LIMIT SWITCH CLOSE SLIDE GATE INLET PYRITE MIL HILANG	MEDIUM SPEED MILL #1C - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM	v	
12	PEKERJAAN INSTRUMENT MILL - PM 28D	MEDIUM SPEED MILL #1A	I&CU	NORMAL	PM		v
13	AKSES TANGGA MENUJU OUTLET MILL LAS-LASAN LEPAS	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL E TO CORNER NO.4 LAYER BURNER A - PNEUMATIC GATE VALVE	MECHU1	NORMAL	CM		v
14	MEAN INSPECTION PENORMALAN OUTLET MILL	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL D TO CORNER NO.3 LAYER BURNER B SYSTEM	I&CU	OUTAGE	PAM	v	
15	KEBOCORAN DI LINE MIX AIR MILL	MEDIUM SPEED MILL #1B SYSTEM	MECHU1	NORMAL	CM	v	
16	MIX AIR DAMPER MILL LEAKTHROUGH	MEDIUM SPEED MILL #1B - MIXED AIR MOTORIZED CONTROL VALVE	MECHU1	NORMAL	CM	v	
17	MATERIAL PYRITE MILL BANYAK	MEDIUM SPEED MILL #1B	MECHU1	NORMAL	CM	v	
18	SR Boiler 1 – DUCT AIR (LINE MIX AIR) MILL JEBOL	MEDIUM SPEED MILL #1C - INLET COLD AIR DUCT	MECHU1	NORMAL	CM	v	
19	SR Boiler 1– EXPLOSIVE DOOR MILL JEBOL	MEDIUM SPEED MILL #1C SYSTEM	MECHU1	NORMAL	CM	v	
20	SR Boiler 1 – LEVEL LUBE OIL TANK MSM LOW 30% DISEBABKAN KEBOCORAN OLI DI INLET MILL	MEDIUM SPEED MILL #1B SYSTEM	MECHU1	NORMAL	CM	v	
21	JASA REPAIR VANE WHEEL MILL ME UNIT 1	MEDIUM SPEED MILL SYSTEM #1	MECHU1	OUTAGE	PAM	v	
22	PENORMALAN AEROFOIL MILL #1	MEDIUM SPEED MILL SYSTEM #1	I&CU	OUTAGE	PAM	v	
23	LEAKAGE STEAM DI LINE INNERTING MILL	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL A - SOLENOID VALVE	MECHU1	NORMAL	CM	v	
24	CONTROL VALVE HOT DAMPER MILL TIDAK BISA DIOPERASIKAN DARI DCS	MEDIUM SPEED MILL #1A - INLET HOT AIR PNEUMATIC CONTROL DAMPER	I&CU	NORMAL	CM	v	
25	SR Boiler 1 – MATERIAL MILL "protol" DITEMUKAN SAAT PYRITE MILL	MEDIUM SPEED MILL #1E	MECHU1	NORMAL	CM	v	
26	INERTING MILL OPEN FAULT	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL E - INLET PNEUMATIC VALVE	I&CU	URGENT	CM	v	
27	PENGGANTIAN SEAL PNEUMATIC PYIRTE MILL	MEDIUM SPEED MILL #1E - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	NORMAL	PAM		v
28	MEAN INSPECTION PENGGANTIAN ACTUATOR PNEUMATIC PYRITE MILL	MEDIUM SPEED MILL #1E - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	OUTAGE	PAM	v	
29	PENGGANTIAN BEARING DAMPER MILL	MEDIUM SPEED MILL #1A - INLET COLD AIR MOTORIZED DAMPER	MECHU1	OUTAGE	PAM	v	
30	MEAN INSPECTION COLD AND HOT DAMPER MILL	MEDIUM SPEED MILL #1A - INLET COLD AIR MOTORIZED DAMPER		OUTAGE	OH	v	
31	MEAN INSPECTION SHUT-OFF AIR DAMPER MILL	MEDIUM SPEED MILL #1A - INLET HOT AIR SYSTEM		OUTAGE	OH	v	
32	MEAN INSPECTION MEDIUM SPEED MILL LUBE OIL SYSTEM	MEDIUM SPEED MILL #1A - LUBE OIL STATION PUMP		OUTAGE	OH	v	
33	MEAN INSPECTION MEDIUM SPEED MILL	MEDIUM SPEED MILL #1A		OUTAGE	OH	v	
34	MEAN INSPECTION ELECTRIC MILL	MEDIUM SPEED MILL #1A		OUTAGE	OH	v	
35	MEAN INSPECTION MILL PULVERIZER SYSTEM	MEDIUM SPEED MILL #1A SYSTEM		OUTAGE	OH	v	
36	INDIKATOR CO CONTENT MILL A,B,C,D,E BLANK (ERROR)	MEDIUM SPEED MILL #1A - OUTLET CARBON MONO OXIDE CONTENT CONTROL CABINET	I&CU	NORMAL	CM		v
37	COAL FLOW DI CORNER MILL TIDAK BISA MAKSIMAL (LOW)	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL C TO CORNER NO.3 LAYER BURNER C SYSTEM	I&CU	OUTAGE	OH	v	
38	PENGELASAN KEBOCORAN DUCT HOT AIR MILL	MEDIUM SPEED MILL #1A - INLET HOT AIR DUCT	MECHU1	NORMAL	PAM	v	
39	PEKERJAAN PERBAIKAN DUCTING MILL 1C	MILL AIR SYSTEM, CARRIER AIR SYSTEM - PAF #1 - OUTLET INTERCONNECTING DUCTING SYSTEM	MECHU1	NORMAL	PAM	v	
40	KEBOCORAN UDARA PADA REGULATOR VALVE OUTLET PYRITE MILL	MEDIUM SPEED MILL #1E - PYRITE HOPPER - OUTLET VALVE	I&CU	NORMAL	CM		v

41	**PEKERJAAN CLEANING EQUIPMENT AREA MILL DAN PYRITE**	BUNKER, FEEDER AND PULVERIZING SYSTEM #1		NORMAL	PAM		v
42	**LEAKAGE PADA OUTLET MILL**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL B TO CORNER NO.2 LAYER BURNER D SYSTEM	MECHU1	NORMAL	CM	v	
43	**JASA PENGGANTIAN VANEWHEEL MILL UNIT 1**	MEDIUM SPEED MILL #1A SYSTEM	MECHU1	OUTAGE	PAM	v	
44	**INDIKASI LEAKTHROUGH CV HOT DAMPER MILL**	MEDIUM SPEED MILL #1A - INLET HOT AIR MOTORIZED CONTROL VALVE	MECHU1	NORMAL	CM	v	
45	**SHUT OFF DAMPER MILL TIDAK DAPAT DI CLOSE**	MEDIUM SPEED MILL #1A - INLET HOT AIR PNEUMATIC CONTROL DAMPER	I&CU	NORMAL	CM	v	
46	**BOCOR UDARA INSTRUMENT DI SHAFT SLIDEGATE OUTLET PYRITE MILL**	MEDIUM SPEED MILL #1E - PYRITE HOPPER - OUTLET VALVE	I&CU	NORMAL	CM		v
47	**JASA FABRIKASI PNEUMATIC PYRITE MILL 1A-1E, ME #1**	MEDIUM SPEED MILL #1A - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	OUTAGE	PAM	v	
48	**INDIKASI LEAKTHROUGH PADA COLD DAMPER MILL**	MEDIUM SPEED MILL #1A - PYRITE HOPPER - INLET PNEUMATIC VALVE		NORMAL	CM		v
49	**KACA PANEL PYRITE MILL PECAH**	MEDIUM SPEED MILL #1C - PYRITE HOPPER - LOCAL CONTROL BOX		NORMAL	CM		v
50	**JASA PENGGANTIAN BULLRING MILL SAAT ME UNIT 1**	MEDIUM SPEED MILL #1A SYSTEM	MECHU1	OUTAGE	PAM	v	
51	**PENGGANTIAN SENSOR FLAME DETECTOR MILL 1E SISI A1**	MAIN BURNER #1 - FLAME DETECTOR INTENSITY CORNER NO.3 LAYER BURNER A SYSTEM	I&CU	NORMAL	PAM	v	
52	**BOCOR SEERBUK BATU BARA DI L BOW OUTLET MILL**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL C TO CORNER NO.2 LAYER BURNER C - PNEUMATIC GATE VALVE		NORMAL	CM	v	
53	**PERBAIKAN MOTOR MILL**	MEDIUM SPEED MILL #1D SYSTEM	ELECU	URGENT	PAM	v	
54	**RESETING SISTEM PROTEKSI MILL**	MEDIUM SPEED MILL #1C SYSTEM	ELECU	NORMAL	PAM	v	
55	**TUAS HOT DAMPER MILL PATAH**	MEDIUM SPEED MILL #1B - INLET HOT AIR MOTORIZED CONTROL VALVE	MECHU1	NORMAL	CM		v
56	**PENGGANTIAN SOLENOID OUTLET MILL**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL C TO CORNER NO.3 LAYER BURNER C PIPE	I&CU	NORMAL	PAM	v	
57	**PENGGANTIAN SENSOR VIBRASI MOTOR MILL**	MEDIUM SPEED MILL #1D SYSTEM	I&CU	NORMAL	PAM	v	
58	**PENGGANTIAN SENSOR VIBRASI MOTOR MILL**	MEDIUM SPEED MILL #1D - LUBE OIL STATION PUMP	MECHU1	NORMAL	PDM	v	
59	**CV HOT DAMPER MILL 1A DCS 0% TAPI KONDISI AKTUAL DAMPER DILOKAL OPEN ± 50%**	MEDIUM SPEED MILL #1A - INLET HOT AIR MOTORIZED CONTROL VALVE	I&CU	NORMAL	CM	v	
60	**INTENSITAS FLAME MILL TIDAK STABIL (kadang muncul kadang hilang)**	MAIN BURNER #1 - FLAME DETECTOR INTENSITY CORNER NO.1 LAYER BURNER A	I&CU	URGENT	CM		v
61	**REKOMENDASI HASIL PENGUKURAN VIBRASI MEDIUM SPEED MILL**	MEDIUM SPEED MILL #1E		OUTAGE	PDM		v
62	**COMMAND DAN FEEDBACK CV HOT DAMPER MILL TIDAK SAMA**	MEDIUM SPEED MILL #1D - INLET HOT AIR MOTORIZED CONTROL VALVE	I&CU	OUTAGE	OH		v
63	**TERDAPAT KEBOCORAN PADA INLET PYRITE MILL**	MEDIUM SPEED MILL #1B SYSTEM	MECHU1	NORMAL	CM		v
64	**FLAME DETECTOR NO 3 MILL 1 E TIDAK TERDETEKSI (tidak nyala)**	MAIN BURNER #1 - FLAME DETECTOR INTENSITY CORNER NO.3 LAYER BURNER A	I&CU	URGENT	CM		v
65	**SALAH SATU TEMP OUTLET MILL HUNTING (menyentuh 62 °C)**	MEDIUM SPEED MILL #1B - OUTLET TEMPERATURE SENSING ELEMENT NO.1	I&CU	URGENT	CM		v
66	**LEVEL LUBE OIL MILL LOW**	MEDIUM SPEED MILL #1C - LUBE OIL STATION - HEATER NO.1	MECHU1	NORMAL	CM		v
67	**PEMBUATAN SALURAN AIR DAN DRAINASE UNTUK CLEANING BC6 DAN MILL**	BELT CONVEYOR C-6B	MECHU2	NORMAL	PAM		v
68	**PENAMBAHAN OIL MILL**	MEDIUM SPEED MILL #1C - LUBE OIL STATION PUMP	MECHU1	NORMAL	PAM		v
69	**KEBOCORAN BATUBARA PADA LINE INLET MILL**	COAL FEEDER #1C - OUTLET COAL MOTORIZEDD GATE	MECHU1	NORMAL	CM	v	
70	**PAM-INTERNAL CHECK MILL (DEFLECTOR LINER MILL TERLEPAS)**	MEDIUM SPEED MILL #1B SYSTEM	MECHU1	NORMAL	PAM	v	
71	**EXPLOSION DOOR MILL BOCOR UDARA**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL C TO CORNER NO.1 LAYER BURNER C SYSTEM	MECHU1	NORMAL	CM	v	
72	**PERBAIKAN OUTLET PNEUMATIC MILL**	MEDIUM SPEED MILL #1E	I&CU	NORMAL	PAM	v	
73	**HASIL PYRITE MILL BANYAK MATERIAL BATUBARA HALUS**	MEDIUM SPEED MILL #1C SYSTEM	MECHU1	OUTAGE	CM	v	
74	**SR BOILER 1- LINE PYRITE MILL PESOK**	MEDIUM SPEED MILL #1C	MECHU1	NORMAL	CM	v	
75	**PENGGANTIAN ADJUSTING SHROUD & RING VANE WHEEL MILL**	MEDIUM SPEED MILL #1E	MECHU1	URGENT	PAM	v	
76	**PAM - LOOP TEST RELAY PROTEKSI - CB Mill**	6 KV UNIT SECTION 1B - CIRCUIT BREAKER FOR #1D MEDIUM SPEED MILL CIRCUIT BREAKER	ELECU	NORMAL	PAM	v	
77	**PENGGANTIAN VACUM KONTAK MILL**	PT PLN (PERSERO) PEMBANGKITAN LONTAR PACITAN UNIT 1	ELECU	NORMAL	PAM	v	
78	**PERBAIKAN ELECTRICAL BOX PANEL POWER DAN KONTROL AREA MILL, COAL FEEDER DAN APH INCLUDE MATERIAL**	CONSOLE PANEL #1	ELECU	URGENT	PAM	v	
79	**ADA REMBESAN OIL DI TEMP GAUGE OUTLET LUBE OIL MILL**	MEDIUM SPEED MILL #1D	I&CU	NORMAL	WR		v
80	**PERBAIKAN BREAKAER MILL**	MEDIUM SPEED MILL #1B SYSTEM	ELECU	NORMAL	PAM	v	
81	**MODIFIKASI PEMBUATAN EARLY WARNING SYSTEM MILL**	MEDIUM SPEED MILL SYSTEM #1	ELECU	NORMAL	EJ	v	
82	**FLAME MILL CORNER TIDAK TERDETEKSI**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL B TO CORNER NO.4 LAYER BURNER D - FLOW TRANSMITTER	I&CU	NORMAL	WR		v
83	**AIR FLOW MILL TIDAK TERDETEKSI**	MEDIUM SPEED MILL #1A - AIR FLOW TRANSMITTER NO.1	I&CU	NORMAL	WR		v

82	**FLAME MILL CORNER TIDAK TERDETEKSI**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL B TO CORNER NO.4 LAYER BURNER D - FLOW TRANSMITTER	I&CU	NORMAL	WR		v
83	**AIR FLOW MILL TIDAK TERDETEKSI**	MEDIUM SPEED MILL #1A - AIR FLOW TRANSMITTER NO.1	I&CU	NORMAL	WR		v
84	**LIMIT SWITCH CLOSE INLET PYRITE MILL TIDAK ADA**	MEDIUM SPEED MILL #1D - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	NORMAL	WR		v
85	**AIR FLOW MILL TIDAK ERROR**	MEDIUM SPEED MILL #1A SYSTEM	I&CU	NORMAL	WR	v	
86	**JOINT INSPECTION-PENGECEKAN MILL**	MEDIUM SPEED MILL #1D SYSTEM	MECHU1	NORMAL	PAM	v	
87	**PENGECEKAN RUBBER COUPLING DAN PENGGANTIAN - LUBE OIL PUMP MILL 1C INDIKASI MISALIGNMENT**	MEDIUM SPEED MILL #1C - LUBE OIL STATION PUMP	MECHU1	NORMAL	PDM	v	
88	**PENGUKURAN DIMENSI MOTOR MILL**	MEDIUM SPEED MILL #1D		NORMAL	PAM	v	
89	**SOLENOID SHUT OFF DAMPER MILL TIDAK BISA OPEN**	MEDIUM SPEED MILL #1D - INLET HOT AIR PNEUMATIC CONTROL DAMPER	I&CU	EMERGENCY	EM	v	
90	**SUARA KASAR PADA MILL (NOISE)**	MEDIUM SPEED MILL #1E	MECHU1	NORMAL	WR	v	
91	**KALIBRASI MOV MIX AIR MILL**	MEDIUM SPEED MILL #1E - MIXED AIR MOTORIZED CONTROL VALVE	I&CU	NORMAL	PAM	v	
92	**CV COLD AIR MILL SAAT DI OPEN AIR FLOW TURUN**	MEDIUM SPEED MILL #1E - INLET COLD AIR MOTORIZED DAMPER	I&CU	URGENT	CM		v
93	**RING GASKET FLANGE PYRITE MILL SOBEK**	MEDIUM SPEED MILL #1D	MECHU1	NORMAL	CM	v	
94	**PENGELASAN FLANGE INLET MILL**	MEDIUM SPEED MILL #1C SYSTEM	MECHU1	NORMAL	CM	v	
95	**PERBAIKAN SOBEK PADA EXPANSION JOINT DUCT MIX AIR MILL**	MEDIUM SPEED MILL #1C SYSTEM	MECHU1	NORMAL	CM	v	
96	**PERBAIKAN KEBOCORAN PADA DRAIN OLI GEARBOX MILL**	MEDIUM SPEED MILL #1D	MECHU1	NORMAL	CM		v
97	**LINE SUPPLY UDARA OUTLET PYRITE MILL LEPAS**	MEDIUM SPEED MILL #1D - PYRITE HOPPER - OUTLET SOLENOID VALVE	I&CU	NORMAL	CM	v	
98	**PERBAIKAN KEBOCORAN PADA FLANGE LINE CORNER A1 MILL 1E**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL E TO CORNER NO.1 LAYER BURNER A SYSTEM	MECHU1	NORMAL	CM	v	
99	**TEMPERATURE GEAR BOX PLANETARY BEARING TE 1 MILL 1D DI DCS ERROR**	MEDIUM SPEED MILL #1D - PLANETARY GEAR BOX - BEARING TEMPERATURE SENSING ELEMENT NO.1	I&CU	NORMAL	CM		v
100	**PERBAIKAN LIMIT SWITCH PYRITE MILL 1D SISI CLOSE**	MEDIUM SPEED MILL #1D - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	NORMAL	PAM		v
101	**PENGELASAN PADA TITIK KEBOCORAN BATUBARA INLET MILL**	MEDIUM SPEED MILL #1E	MECHU1	NORMAL	CM	v	
102	**Pengelasan leakage Pada Line Outelt Mill 1C No.3**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL C TO CORNER NO.3 LAYER BURNER C PIPE	MECHU1	NORMAL	CM	v	
103	**Penggantian Isolasi Line Mixed Air Mill 1C yang Rusak**	MEDIUM SPEED MILL #1C - MIXED AIR MOTORIZED CONTROL VALVE	MECHU1	NORMAL	CM		v
104	**OUTLET PYRITE MILL KURANG RAPAT**	MEDIUM SPEED MILL #1D - PYRITE HOPPER - OUTLET VALVE	MECHU1	NORMAL	CM		v
105	**PENGELASAN OUTLET MILL CORNER A1 SETELAH ORIFICE**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL E TO CORNER NO.1 LAYER BURNER A PIPE	MECHU1	NORMAL	CM	v	
106	**PERBAIKAN MILL AREA SCRAPPER**	MEDIUM SPEED MILL #1E - INLET SEALING AIR MOTORIZED DAMPER	MECHU1	NORMAL	CM	v	
107	**PIPA SUPPLY UDARA OUTLET MILL PECAH**	MEDIUM SPEED MILL #1B	I&CU	NORMAL	CM	v	
108	**PERBAIKAN MIX DAMPER MILL FEEDBACK FAULT SAAT DI CLOSE**	MEDIUM SPEED MILL #1B - MIXED AIR MOTORIZED CONTROL VALVE	I&CU	NORMAL	PAM	v	
109	**PENGELASAN BODY MILL**	MEDIUM SPEED MILL #1E - INLET SEALING AIR SYSTEM	MECHU1	NORMAL	CM	v	
110	**PERBAIKAN SLIDE GATE PYRITE MILL TIDAK RAPAT**	MEDIUM SPEED MILL #1D - INLET SEALING AIR SYSTEM	MECHU1	NORMAL	CM		v
111	**PAM-PERBAIKAN TUAS DAMPER HOT AIR MILL**	MEDIUM SPEED MILL #1A - INLET HOT AIR MOTORIZED CONTROL VALVE	MECHU1	NORMAL	PAM	v	
112	**PAM-INTERNAL CHECK MILL**	MEDIUM SPEED MILL #1E	MECHU1	NORMAL	PAM	v	
113	**NEPEL UDARA SLIDE GATE PNEUMATIC OUTLET MIL LEPAS**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL D TO CORNER NO.3 LAYER BURNER B - PNEUMATIC GATE VALVE	I&CU	NORMAL	CM	v	
114	**PENAMBAHAN PACKING – FLANGES COAL PIPE MILL 1A CORNER E3**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL A TO CORNER NO.3 LAYER BURNER E - PNEUMATIC GATE VALVE	MECHU1	NORMAL	CM	v	
115	**MATERIAL PYRITE MILL BATUBARA BANYAK DAN BESAR**	MEDIUM SPEED MILL #1D		URGENT	CM		v
116	**ENAMBAHAN PACKING PACKING GRAPHIT - INDIKASI KEBOCORAN BATUBARA PADA OUTLET MILL 1E no. 2**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL E TO CORNER NO.2 LAYER BURNER A - PNEUMATIC GATE VALVE	MECHU1	NORMAL	CM	v	
117	**PYRITE MILL PLUGGING**	MEDIUM SPEED MILL #1D - INLET SEALING AIR MOTORIZED DAMPER	MECHU1	EMERGENCY	EM	v	
118	**PAM - PERBAIKAN MOV SEALING MILL ALARM FAULT**	MEDIUM SPEED MILL #1D - INLET SEALING AIR MOTORIZED DAMPER	I&CU	NORMAL	PAM		v
119	**OUTLET PYRITE MILL LEAK UDARA SAAT POSISI OPEN**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL B TO CORNER NO.4 LAYER BURNER D PIPE	I&CU	NORMAL	WR		v
120	**REGULATOR PRESSURE PYRITE MILL TERBAKAR**	MEDIUM SPEED MILL #1D - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	URGENT	CM		v
121	**INLET PYRITE MILL TIDAK MENYENTUH LIMIT SWITCH**	MEDIUM SPEED MILL #1A - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM		v
122	**INDIKASI FLAME MILL 1B NO.4 TIDAK MENYALA SAAT OPERASI**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL D TO CORNER NO.4 LAYER BURNER B - PNEUMATIC GATE VALVE	I&CU	NORMAL	CM	v	
123	**KABEL LIMIT SWITCH INLET PYRITE MILL PUTUS**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL D TO CORNER NO.4 LAYER BURNER B PNEUMATIC VALVE - SOLENOID VALVE	I&CU	NORMAL	CM		v
124	**PERBAIKAN LIMIT SWITCH OUTLET PYRITE MILL**	MEDIUM SPEED MILL #1D - PYRITE HOPPER - OUTLET VALVE	I&CU	NORMAL	PAM		v
125	**PERBAIKAN KEBOCORAN UDARA DI FLANGE INLET PYRITE MILL**	MEDIUM SPEED MILL #1C	MECHU1	NORMAL	CM	v	

HASIL REKAP DATA OPERATIONAL LOG BERDASARKAN JENIS KERUSAKAN PADA TAHUN 2018

Berdasarkan Operational Log selama tahun 2018 Unit #1 Terdapat bayak kerusakan yang terjadi dan kegiatan perbaikan yang dilakukan, sehingga dapat disimpulkan data jenis kegagalan dan maintanan yang sama seperti dibawah ini. Adapun untuk melanjutkan penelitian ini, peneliti perlu mengetahui dari jenis-jenis kegagalan dan perbaikan apa saja yang menyebabkan pulverizer mengalami kondisi berhenti beroperasi (down). Responden dapat memberikan jawaban (YA, untuk menjawab Bahwa jenis tersebut menyebabkan pulverizer berhenti beroperasi) dan (Tidak , untuk sebaliknya)

NO.	Description	Asset Description	Owner Group	Wo Priority	Work Type	YA	TIDAK
1	**PEKERJAAN ELEKTRIK MILL PM 28D**	MEDIUM SPEED MILL #1A	ELECU	NORMAL	PM		v
2	**MILL PM 28D**	MEDIUM SPEED MILL #1A	MECHU1	NORMAL	PM		v
3	**PENGGANTIAN COVER PUSH BUTTON MILL**	MEDIUM SPEED MILL SYSTEM #1		NORMAL	PAM		v
4	**TUAS LIMIT SWITCH OUTLET PYRITE MILL HILANG**	MEDIUM SPEED MILL #1C - PYRITE HOPPER - OUTLET VALVE	I&CU	NORMAL	CM		v
5	**OUTLET MILL PADA DCS FEEDBACK FAULT (dilokal sudah open)**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL E TO CORNER NO.1 LAYER BURNER A - PNEUMATIC GATE VALVE	I&CU	NORMAL	CM	v	
6	**KEBOCORAN UDARA DI LINE SUPPLY UDARA REGULATOR OUTLET MILL**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL C TO CORNER NO.1 LAYER BURNER C SYSTEM	I&CU	NORMAL	CM	v	
7	**INDIKASI KEBOCORAN PADA REGULATOR OUTLET PYRITE MILL**	MEDIUM SPEED MILL #1D - PYRITE HOPPER - OUTLET SOLENOID VALVE	I&CU	NORMAL	CM		v
8	**INDIKASI KEBOCORAN PADA REGULATOR OUTLET PYRITE MILL**	MEDIUM SPEED MILL #1C - PYRITE HOPPER - OUTLET SOLENOID VALVE	I&CU	NORMAL	PAM		v
9	**PERBAIKAN FLEXIBLE JOINT MIX AIR MILL KROPOS**	MEDIUM SPEED MILL #1B - MIXED AIR MOTORIZED CONTROL VALVE	MECHU1	NORMAL	CM	v	
10	**BAUT LIMIT SWITCH OUTLET MILL HILANG**	MEDIUM SPEED MILL #1D - PYRITE HOPPER - OUTLET VALVE	I&CU	NORMAL	CM		v
11	**PAM - PENGGANTIAN SOLENOID OUTLET MILL**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL D TO CORNER NO.1 LAYER BURNER B PNEUMATIC VALVE - SOLENOID VALVE	I&CU	NORMAL	PAM	v	
12	**PEKERJAAN INSTRUMENT MILL PM 28D**	MEDIUM SPEED MILL #1A	I&CU	NORMAL	PM		v
13	**OUTLET MILL TIDAK BISA TERTUTUP**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL B TO CORNER NO.1 LAYER BURNER D - PNEUMATIC GATE VALVE	I&CU	NORMAL	CM	v	
14	**JASA PERBAIKAN COAL PIPE INLET MILL DAN ELBOW COAL PIPE OUTLET MILL**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL C TO CORNER NO.4 LAYER BURNER C PIPE	f	NORMAL	PAM	v	
15	**Co CONTINOUS MONITORING SYSTEM MILL KEBOCORAN UDARA INSTRUMENT**	MEDIUM SPEED MILL #1E SYSTEM	I&CU	NORMAL	CM		v
16	**INTERNAL CHECK MILL**	MEDIUM SPEED MILL #1A	MECHU1	NORMAL	PAM	v	
17	**Indikasi :Tuas CV hot damper mill menabrak cor,an**	MEDIUM SPEED MILL #1A - INLET HOT AIR PNEUMATIC CONTROL DAMPER	I&CU	NORMAL	WR		v
18	**Indikasi : Boiler 1 – Tuas CV hot damper mill 1A bengkok**	MEDIUM SPEED MILL #1A - INLET HOT AIR MOTORIZED CONTROL VALVE		URGENT	WR		v
19	**Indikasi : Boiler 1 – Tuas Mix air mill 1B bukaan MOV 70 % mengenai cor,an**	MEDIUM SPEED MILL #1B - MIXED AIR MOTORIZED CONTROL VALVE	MECHU1	NORMAL	WR		v
20	**REKOMENDASI LUBE OIL MILL INDIKASI MISSALIGNMENT**	MEDIUM SPEED MILL #2E - LUBE OIL STATION PUMP	MECHU1	NORMAL	PDM		v
21	**CV mix damper Millbukaan 30% mekanik berat**	MEDIUM SPEED MILL #1C - MIXED AIR MOTORIZED CONTROL VALVE	MECHU1	NORMAL	WR	v	
22	**PEKERJAAN CLEANING MILL**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL E TO CORNER NO.1 LAYER BURNER A SYSTEM	MECHU1	NORMAL	PAM	v	
23	**PAM - PENGGANTIAN MOTOR LUBE OIL MILL 1A**	MEDIUM SPEED MILL #1A - LUBE OIL STATION PUMP		OUTAGE	PAM		v
24	**TUAS LIMIT SWITCH INLET DAN OUTLET PYRITE MILL HILANG**	MEDIUM SPEED MILL #1C - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM		v
25	**SLIDE GATE OUTLET PYRITE MILL TIDAK RAPAT**	MEDIUM SPEED MILL #1D - PYRITE HOPPER - OUTLET VALVE	I&CU	NORMAL	CM		v
26	**SELENOID INLET DAN OUTLET PYRITE MILL LEPAS**	MEDIUM SPEED MILL #1A - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM		v
27	**MOV MIX AIR MILL ALARM "RUNNING DIRICTION ERROR"**	MEDIUM SPEED MILL #1A - MIXED AIR MOTORIZED CONTROL VALVE	I&CU	NORMAL	CM	v	
28	**INERTING MILL TIDAK BISA DIBUKA DARI DCS**	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL E - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM	v	
29	**PENGGANTIAN SWG – Slide Gate Outlet Pyrite Mill**	MEDIUM SPEED MILL #2A - PYRITE HOPPER - OUTLET VALVE	MECHU1	NORMAL	CM	v	
30	**SLIDE GATE INLET PYRITE MILL TIDAK BISA DIBUKA**	MEDIUM SPEED MILL #1A - PYRITE HOPPER - INLET PNEUMATIC VALVE	MECHU1	NORMAL	CM		v
31	**CASING MOTOR MILL RUSAK**	MEDIUM SPEED MILL #1D SYSTEM		NORMAL	CM		v
32	**KEBOCORAN UDARA DI SELENOID SHUT OFF DAMPER MILL**	MEDIUM SPEED MILL #1A - INLET HOT AIR PNEUMATIC CONTROL DAMPER	I&CU	NORMAL	CM	v	
33	**MOV Inlet Cold Air Damper Mill Alarm "Over Closing Valve Protection on Running"**	MEDIUM SPEED MILL #1D - INLET COLD AIR PNEUMATIC GATE DAMPER	I&CU	NORMAL	CM	v	
34	**PAM - CLEANING SENSOR FLAME SCANNER BOILER UNIT 1 (TINY OIL, OIL GUN DAN MILL)**	MAIN BURNER #1 - FLAME DETECTOR INTENSITY CORNER NO.2 LAYER BURNER A SYSTEM	I&CU	NORMAL	PAM		v
35	**PAM - PENGGANTIAN DEFLECTOR LINER DAN AIR THROTLING RING MILL**	MEDIUM SPEED MILL #1D	MECHU1	URGENT	PAM	v	
36	**PENAMBAHAN STATUS EMERGENCY STOP MILL UNIT**	MEDIUM SPEED MILL SYSTEM #1	I&CU	OUTAGE	PAM	v	
37	**LIMIIT SWITCH INLET PYRITE MILL HILANG**	MEDIUM SPEED MILL #1C - PYRITE HOPPER - INLET SOLENOID VALVE	I&CU	NORMAL	CM		v
38	**PENGELASAN OUTLET MILL**	SAC TO COAL SAMPLING MEDIUM SPEED MILL #2E - OUTLET MANUAL VALVE NO.2	MECHU1	NORMAL	PAM	v	
39	**PENGELASAN - KEBOCORAN PADA BODY MILL**	MEDIUM SPEED MILL #1C	MECHU1	NORMAL	CM	v	
40	**Boiler 1 – Flanges Pyrite Mill 1D Kurang Rapat**	MEDIUM SPEED MILL #1D - PYRITE HOPPER - INLET SOLENOID VALVE		NORMAL	CM		v

41	**REPLACE OUTLET MILL DAN CLEAN OUT FEEDER**	MEDIUM SPEED MILL #1A - PYRITE HOPPER - OUTLET VALVE	MECHU1	NORMAL	PAM	V	
42	**PERBAIKAN BREAKER MILL TIDAK BISA REMOTE**	MEDIUM SPEED MILL #1D	ELECU	NORMAL	PAM	V	
43	**PEMASANGAN LINER DAN VANEWHEEL – Mill SUARA LOCAL NOISE**	MEDIUM SPEED MILL #1D	MECHU1	NORMAL	CM	V	
44	**PERBAIKAN MILL - INNER PART MILL LEPAS DAN ADA SUARA ABNORMAL DALAM MILL**	MEDIUM SPEED MILL #1B	MECHU1	NORMAL	CM	V	
45	**SEL TRANSMITTER AIR FLOW MILL ERROR**	MEDIUM SPEED MILL #1E - INLET HOT AIR MOTORIZED CONTROL VALVE	I&CU	NORMAL	CM		V
46	**DUDUKAN MOV HOT AIR MILL TERANGKAT KEATAS**	MEDIUM SPEED MILL #1B - INLET HOT AIR MOTORIZED CONTROL VALVE		NORMAL	CM	V	
47	**PENGELASAN - COVER SPRING GRINDING MILL BOCOR**	MEDIUM SPEED MILL #1B	MECHU1	NORMAL	CM	V	
48	**ECP: MODIFIKASI VALVE INLET MILL**	MEDIUM SPEED MILL #1A SYSTEM		OUTAGE	EJ	V	
49	**PEKERJAAN REPAIR SUPPORT HOT DAMPER DAN MIX DAMPER**	MEDIUM SPEED MILL #1C - INLET HOT AIR MOTORIZED CONTROL VALVE	I&CU	NORMAL	WR	V	
50	**TEMPERATURE OUTLET MILL HUNTING**	MEDIUM SPEED MILL #1E - OUTLET TEMPERATURE SENSING ELEMENT NO.2	I&CU	NORMAL	CM		V
51	**Rekomendasi LOP Mill INDIKASI KERUSAKAN BEARING PADA POMPA DAN MISSALIGNMENT**	MEDIUM SPEED MILL #1C - LUBE OIL STATION PUMP	MECHU1	NORMAL	PDM	V	
52	**PENGECEKAN BEARING DAMPER - HOT DAMPER MILL BERAT DAN TUAS BENGKOK**	MEDIUM SPEED MILL #2D - INLET HOT AIR PNEUMATIC CONTROL DAMPER	MECHU1	NORMAL	CM	V	
53	**PENGGANTIAN LIMIT SWITCH SLIDE GATE DAMPER OUTLETE MILL**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL A TO CORNER NO.1 LAYER BURNER E - PNEUMATIC GATE VALVE	I&CU	OUTAGE	OH	V	
54	**PENGGANTIAN LIMIT SWITCH SLIDE GATE PIRYTE HOPPER MILL**	MEDIUM SPEED MILL #1E - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	OUTAGE	OH		V
55	**PENGECEKAN TUAS MANUAL VALVE SEALIING MILL - TIDAK ADA PENGUNCINYA**	MEDIUM SPEED MILL #1D - INLET SEALING AIR SYSTEM	MECHU1	NORMAL	CM	V	
56	**INERTING MILL TIDAK BISA DIBUKA (OPEN FAULT)**	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL A - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM	V	
57	**PENANGANAN KOBOCORAN TEMPORARY – KEBOCORAN SERBUK BATUBARA DI OUTLET MILL**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL D TO CORNER NO.1 LAYER BURNER B - PNEUMATIC GATE VALVE	MECHU1	NORMAL	CM		V
58	**SR LINE SEALING OUTLET LEPAS**	MEDIUM SPEED MILL #1D		NORMAL	CM	V	
59	**MOV HOT DAMPER MILL ALARM OVER CLOSING PROTECTION FOR RUNNING**	MEDIUM SPEED MILL #1D - INLET HOT AIR MOTORIZED CONTROL VALVE	I&CU	NORMAL	CM	V	
60	**PENGGANTIAN FLEXIBLE HOSE PIPE SA FAN TO MILL**	SEALING AIR FAN #1 - OUTLET DUCT	MECHU1	OUTAGE	PAM	V	
61	**TUAS LIMIT SWITCH INLET PYRITE MILL PATAH**	MEDIUM SPEED MILL #1C - PYRITE HOPPER - INLET SOLENOID VALVE	I&CU	NORMAL	CM		V
62	**CLEANING - PERMINTAAN PENGECEKAN DI ORIFICE MILL**	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL B TO CORNER NO.1 LAYER BURNER D PIPE	MECHU1	NORMAL	CM	V	
63	**PENGECORAN PONDASI – DUDUKAN MOV MIX AIR DAMPER MILL TERANGKAT DAN ROMPAL (MESIN 1 DAN SARANA)**	MEDIUM SPEED MILL #1A - MIXED AIR MOTORIZED CONTROL VALVE	MECHU1	NORMAL	CM	V	
64	**SELENOID OUTLET PYRITE MILL TIDAK BISA OPEN DAN CLOSED DARI LOCAL**	MEDIUM SPEED MILL #1D - PYRITE HOPPER - OUTLET VALVE	I&CU	NORMAL	CM		V
65	**BREAKER PYRITE MILL DI "ON"LANGSUNG TRIP (Panel pyrite dilokal mati)**	MEDIUM SPEED MILL #1A - PYRITE HOPPER - LOCAL CONTROL BOX	I&CU	NORMAL	CM		V
66	**PAM-PENGECEKAN ALL BERING DAMPER MILL**	MEDIUM SPEED MILL #1A - INLET HOT AIR PNEUMATIC CONTROL DAMPER	MECHU1	NORMAL	PAM	V	
67	**PENGGANTIAN STRUCTURE LINNER MILL**	MEDIUM SPEED MILL #1C	MECHU1	NORMAL	PAM	V	
68	**PENGGANTIAN LOCK GRINDING ROLL MILL**	MEDIUM SPEED MILL #1B SYSTEM	MECHU1	NORMAL	PAM	V	
69	**CIVIL - PEMBUATAN PONDASI MOV MIX AIR DAMPER MILL**	MEDIUM SPEED MILL #1A - MIXED AIR MOTORIZED CONTROL VALVE	CIVILU	NORMAL	PAM	V	
70	**PENGGANTIAN CV HOT DAMPER MILL**	MEDIUM SPEED MILL #1A - INLET HOT AIR MOTORIZED CONTROL VALVE		OUTAGE	PAM	V	
71	**PENGGANTIAN PNEUMATIC INERTING MILL**	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL A - INLET PNEUMATIC VALVE		OUTAGE	PAM	V	
72	**PENAMBAHAN SAMPLING PORT PADA TANGKI LUBE OIL MILL**	MEDIUM SPEED MILL SYSTEM #1	MECHU1	NORMAL	PDM	V	
73	**FLAME MILL CORNER TIDAK TERDETEKSI DI DCS**	MEDIUM SPEED MILL #1E - INLET SEALING AIR DAMPER	I&CU	NORMAL	CM	V	
74	**SUARA MILL UBNORMAL TERDAPAT INNERPART YANG LEPAS**	MEDIUM SPEED MILL #1B		URGENT	CM	V	
75	**PERBAIKAN DUDUKAN LIMIT SWITCH OUTLET MILL**	VAPOR / EXHAUST GAS #2 - OUTLET MEDIUM SPEED MILL C TO CORNER NO.4 LAYER BURNER C - PNEUMATIC GATE VALVE	MECHU1	NORMAL	CM	V	
76	**Indikasi : Boiler 1 – Mill 1D ampere hunting perbandingan coal flow dan ampere tidak seimbang**	MEDIUM SPEED MILL #1D	I&CU	NORMAL	CM	V	
77	**INNERTING MILL OPEN FAULT**	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL B - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM	V	
78	**PENGGANTIAN SOLENOID DREDGINE COAL BUNKER MILL**	COAL BUNKER #1C		OUTAGE	PAM	V	
79	**FLAME DETECTOR MILL CORNER TIDAK MENYALA**	VAPOR / EXHAUST GAS #1 - INLET CORNER NO.4 LAYER BURNER B - MOTORIZEDD VALVE	I&CU	NORMAL	CM		V
80	**PENGGANTIAN EXPANTION JOINT MIXED AIR DAMPER MILL 1A-E (ME 2019)**	MEDIUM SPEED MILL #1B			PAM	V	

HASIL REKAP DATA OPERATIONAL LOG BERDASARKAN JENIS KERUSAKAN/PERBAIKAN PADA TAHUN 2019

Berdasarkan Operational Log selama tahun 2019 Unit #1 Terdapat bayak kerusakan yang terjadi dan kegiatan perbaikan yang dilakukan, sehingga dapat disimpulkan data jenis kegagalan dan maintanan yang sama seperti dibawah ini. Adapun untuk melanjutkan penelitian ini, peneliti perlu mengetahui dari jenis-jenis kegagalan dan perbaikan apa saja yang menyebabkan pulverizer mengalami kondisi berhenti beroperasi (down). Responden dapat memberikan jawaban (YA, untuk menjawab Bahwa jenis tersebut menyebabkan pulverizer berhenti beroperasi) dan (Tidak , untuk sebaliknya)

NO.	Description	Asset Description	Owner Group	Wo Priority	Work Type	YA	TIDAK
1	PEKERJAAN ELEKTRIK MILL PM 28D	MEDIUM SPEED MILL #1A	ELECU	NORMAL	PM		v
2	MILL PM 28D	MEDIUM SPEED MILL #1A	MECHU1	NORMAL	PM		v
3	KERUSAKAN POWER OUTLET SELENOID VALVE- PYRITE HOPPER	MEDIUM SPEED MILL #1B - PYRITE HOPPER - OUTLET SOLENOID VALVE	I&CU	NORMAL	CM	v	
4	PEMASANGAN FITTING PADA LINE DIFFERENTIAL PRESSURE BETWEEN MILL UNTUK AKSES PEMELIHARAAN	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL D TO CORNER NO.4 LAYER BURNER B SYSTEM		NORMAL	EJ		v
5	PEKERJAAN INSTRUMENT MILL PM 28D	MEDIUM SPEED MILL #1A	I&CU	NORMAL	PM		v
6	Pengencangan baut flange – INLET PYRITE GATE MILL	MEDIUM SPEED MILL #1D	MECHU1	NORMAL	CM		v
7	TEMPERATURE OUTLET MILL HUNTING	MEDIUM SPEED MILL #1D	I&CU	NORMAL	CM		v
8	PEKERJAAN MEKANIK MEDIUM SPEED MILL	MEDIUM SPEED MILL #1A	MECHU1	NORMAL	OH	v	
9	PENGGANTIAN BAUT TUAS CV HOT DAMPER MILL	MEDIUM SPEED MILL #1E - INLET HOT AIR MOTORIZED CONTROL VALVE	MECHU1	NORMAL	CM		v
10	OUTLET TEMPERATURE MILL TIDAK SESUAI	MEDIUM SPEED MILL #1A - OUTLET TEMPERATURE SENSING ELEMENT NO.3	I&CU	NORMAL	CM		v
11	PENGGANTIAN TUAS LIMIT SWITCH OUTLET PYRITE MILL	MEDIUM SPEED MILL #1E- PYRITE HOPPER - INLET SOLENOID VALVE	MECHU1	NORMAL	CM		v
12	INTERNAL CHECK MILL ROUTINE	MEDIUM SPEED MILL #1B	MECHU1	NORMAL	PAM	v	
13	PENGELASAN HOPPER PYRITE MILL	MEDIUM SPEED MILL #1D	MECHU1	NORMAL	CM	v	
14	KEBOCORAN UDARA DI SELENOID INNERTING MILL	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL E - SOLENOID VALVE	I&CU	NORMAL	CM	v	
15	KEBOCORAN PADA BODY SEPERATOR MILL	MEDIUM SPEED MILL #1C	MECHU1	NORMAL	CM	v	
16	TERLEPASNYA SELANG UDARA DARI NAPPLE PADA PANEL CO CONTENT MILL	MEDIUM SPEED MILL #1C	I&CU	NORMAL	CM		v
17	MCB PYRITE MILL TERINDIKASI SHORT	MEDIUM SPEED MILL #1B - PYRITE HOPPER - LOCAL CONTROL BOX		NORMAL	CM		v
18	PENGELASAN OUTLET MILL	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL E TO CORNER NO.1 LAYER BURNER A SYSTEM	MECHU1	NORMAL	CM	v	
19	INTERNAL CHECK MILL	MEDIUM SPEED MILL #1E	MECHU1	NORMAL	PAM	v	
20	PENGGANTIAN SWG - FLANGE INLET PURYTE MILL	MEDIUM SPEED MILL #1D SYSTEM	MECHU1	NORMAL	CM	v	
21	KEBOCORAN UDARA PADA PNNEUMATIC VALVE OUTLET PYRITE MILL	MEDIUM SPEED MILL #1D - PYRITE HOPPER - OUTLET VALVE	I&CU	NORMAL	CM		v
22	KEBOCORAN UDARA PADA PNEUMATIC VALVE INLET PYRITE MILL	MEDIUM SPEED MILL #1B - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM		v
23	JASA PENGGANTIAN INNERPART MILL 1B SAAT SI+ 2019	MEDIUM SPEED MILL #1B			PAM	v	
24	KEBOCORAN BATUBARA DI LINE OUTLET MILL	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL D TO CORNER NO.4 LAYER BURNER B PIPE	MECHU1	NORMAL	CM	v	
25	PENGGANTIAN TUAS CHANGE OVER FILTER LUBE OIL MILL	MEDIUM SPEED MILL #1A - LUBE OIL STATION PUMP	MECHU1	NORMAL	CM	v	
26	TERBUKANYA INNEERTING MILL	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL B - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM	v	
27	JASA ASSESMENT GEARBOX MILL UNIT 1	MEDIUM SPEED MILL #1E		OUTAGE	PAM	v	
28	PENGGANTIAN TUAS LIMIT SWITCH PYRITE MILL	MEDIUM SPEED MILL #1D SYSTEM	MECHU1	NORMAL	PM		v
29	TOP UP LUB OIL MILL	MEDIUM SPEED MILL #1C - LUBE OIL STATION PUMP	MECHU1	NORMAL	PAM		v
30	BUKAAN CV MIX AIR DAMPER MILL HUNTING (tuas dan connecting dilokal tidak ada)	MEDIUM SPEED MILL #1C - MIXED AIR MOTORIZED CONTROL VALVE	I&CU	NORMAL	CM	v	
31	PENGGANTIAN SLIDE GATE PYRITE OUTLET MILL	MEDIUM SPEED MILL #1E - PYRITE HOPPER - OUTLET VALVE	MECHU1	NORMAL	CM	v	
32	PENGGANTIAN VENT VALVE-FILTER LUBE OIL MILL	MEDIUM SPEED MILL #1A	MECHU1	NORMAL	CM		v
33	PENGGANTIAN VENTING VALVE NAPPLE VENTING FILTER LUBE OIL MILL	MEDIUM SPEED MILL #1B	MECHU1	NORMAL	CM		v
34	INLET SEALING MILL CLOSE FAULT	MILL AIR SYSTEM, CARRIER AIR SYSTEM - PAF #2A SYSTEM	I&CU	NORMAL	CM	v	
35	PENGELASAN DOUBLING PADA BOX PYRITE MILL	MEDIUM SPEED MILL #1D	MECHU1	NORMAL	CM		v
36	PERBEDAAN BUKAAN MOV HOT AIR MILL DENGAN DCS	MEDIUM SPEED MILL #1B - INLET HOT AIR MOTORIZED CONTROL VALVE	I&CU	NORMAL	CM	v	
37	KERUSAKAN PADA SELENOID OPEN OUTLET PYRITE MILL	MEDIUM SPEED MILL #1B - PYRITE HOPPER - OUTLET SOLENOID VALVE	I&CU	NORMAL	CM		v
38	MEDIUM SPEED MILL SIMPLE INSPECTION	MEDIUM SPEED MILL #1A		OUTAGE	OH	v	
39	CLEANING SEAT – OUTLET PYRITE MILL TIDAK BISA TERTUTUP RAPAT	MEDIUM SPEED MILL #1B - PYRITE HOPPER - OUTLET VALVE	MECHU1	NORMAL	CM		v
40	PAM - PENORMALAN TUAS PNEUMATIC INLET PYRITE MILL	MEDIUM SPEED MILL #1B - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	NORMAL	PAM		v
41	LINE INSTRUMEN PNEUMATIC VALVE INERTING MILL PUTUS	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL B - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM		v
42	PEMASANGAN HARD WIRE SHUT OFF OUTLET MILL DAN PNEUMATIC VALVE INERTING STEAM UNTUK FAIL SAFE BOILER	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL A TO CORNER NO.1 LAYER BURNER E - PNEUMATIC GATE VALVE		NORMAL	EJ	v	
43	PENGGANTIAN MEMBRAN EXPLOSION DOOR MILL 1B SISI BARAT+CLEANING BOWL MILL DAN SCRAPPER	MEDIUM SPEED MILL #1B	MECHU1	NORMAL	CM	v	
44	KEBOCORAN PADA REGULATOR UDARA INSTRUMERN INLET PYRITE MILL	MEDIUM SPEED MILL #1D - PYRITE HOPPER - INLET PNEUMATIC VALVE	I&CU	NORMAL	CM		v
45	KEBOCORAN/ LUBANG PADA BODY MILL	MEDIUM SPEED MILL #1E SYSTEM	MECHU1	NORMAL	CM	v	
46	PAM - PERBAIKAN SHUT OFF DAMPER MILL	MEDIUM SPEED MILL #1E	I&CU	NORMAL	PAM	v	
47	Pengencangan baut flange - KEBOCORAN BATUBARA DI OUTLET MILL SISI GATE FLANGES	SAC TO COAL SAMPLING MEDIUM SPEED MILL #1B - OUTLET VALVE NO.4	MECHU1	NORMAL	CM		v
48	ALLIGNMENT MOTOR LUBE OIL MILL 1A	MEDIUM SPEED MILL #1A - LUBE OIL STATION PUMP	MECHU1		PAM	v	
49	PENGUATAN PONDASI DAN SUPPORT MOV DAMPER MILL	MEDIUM SPEED MILL #1A SYSTEM	CIVILU	NORMAL	PAM		v

ATTACHMENT PULVERIZER A TTF & TTR CM DATA									
Description	Asset Description	Wo Priority	Work Type	Scheduled Start	Scheduled FInish	Actual Start	Actual Finish	TTF	TTR CM
boiler 1: indikasi drain innerting mill 1A buntu (manual valve sdh full open, tapi tdk ada aliran)	FIRE FIGHTING STEAM #1 - MEDIUM SPEED MILL A - INLET PNEUMATIC VALVE	NORMAL	CM	02-Dec-2013 09:19:57	30-Dec-2013 16:19:57	12/7/13 9:00 AM	12/24/13 3:31 PM	3981	415
unit 1 Mill 1A suara abnormal	MEDIUM SPEED MILL #1A SYSTEM	NORMAL	CM	20-Jan-2015 08:21:53	23-Jan-2015 15:21:53	1/21/15 4:49 PM	1/22/15 3:50 PM	9433	23
Boiler 1 – Material pyrite mill 1 A banyak, mohon internal chek	MEDIUM SPEED MILL #1A SYSTEM	NORMAL	CM	30-Mar-2015 07:43:47	31-Mar-2015 15:43:47	3/31/15 8:00 AM	3/31/15 3:00 PM	1624	7
Boiler unit 1 – vanewheel mill 1A patah	MEDIUM SPEED MILL #1A	URGENT	CM	10-Apr-2015 09:00:03	14-Apr-2015 16:00:03	4/11/15 8:00 AM	4/11/15 3:00 PM	257	7
Boiler unit 1 – indikasi suara kasar/ noise pada mill 1A	MEDIUM SPEED MILL #1A	NORMAL	CM	12-Feb-2016 15:52:15	27-May-2016 00:00:00	2/12/16 3:52 PM	5/27/16 12:00 AM	7369	2504
Mill 1A Noise (suara kasar di ruang scrapper)	MEDIUM SPEED MILL #1A SYSTEM	NORMAL	CM	07-Jun-2016 07:51:22	24-Jun-2016 07:51:26	6/7/16 7:51 AM	6/10/16 10:23 AM	272	75
Indikasi : Boiler Unit 1, Scraper mill 1A lepas dan masih berada dalam mill	MEDIUM SPEED MILL #1A	NORMAL	CM	08-Dec-2016 07:44:15	31-Dec-2016 07:44:19	12/13/16 7:45 AM	12/31/16 7:44 AM	4461	432
Boiler 1 – Inlet Pyrite Mill 1A tidak menyentuh Limit swich	MEDIUM SPEED MILL #1A - PYRITE HOPPER - INLET PNEUMATIC VALVE	NORMAL	CM	22-Dec-2017 09:00:40	05-Jan-2018 16:00:50	12/22/17 9:00 AM	12/22/17 11:00 AM	8545	2
Pengecekan mekanis valve - Manual valve sealing mill 1A tidak ada penguncinya	MEDIUM SPEED MILL #1A - INLET SEALING AIR SYSTEM	NORMAL	CM	02-Aug-2018 08:05:37	05-Aug-2018 08:05:45	8/2/18 8:00 AM	8/5/18 10:01 PM	5349	86
Boiler 1 – Permintaan pengecekan di orifice No. 2 mill 1A indikasi plugging Sehingga temperature men	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL A TO CORNER NO.2 LAYER BURNER E PIPE	NORMAL	CM	22-Aug-2018 08:00:00	31-Aug-2018 16:00:00	8/30/18 8:00 AM	8/30/18 4:00 PM	586	8
Internal check -1 Mill 1A Trip karena self combustion	MEDIUM SPEED MILL #1A - INLET DUCT	NORMAL	CM	05-Nov-2018 06:47:26	07-Nov-2018 06:47:31	11/5/18 6:47 AM	11/5/18 4:49 PM	1599	10

ATTACHMENT PULVERIZER B TTF & TTR CM DATA

Description	Asset Description	Wo Priority	Work Type	Scheduled Start	Scheduled FInish	Actual Start	Actual Finish	TTF	TTR CM
Boiler – unit 1 Mill B ampere tinggi	MEDIUM SPEED MILL #1B	NORMAL	CM			11/12/13 1:11 PM	11/13/13 4:00 PM	3385	27
: Boiler 1-Suara kasar pada mill 1B(noise)	MEDIUM SPEED MILL #1B	NORMAL	CM	30-Nov-2014 08:03:34	30-Dec-2014 08:03:34	12/1/14 8:03 AM	12/1/14 3:08 PM	9184	7
Boiler #1 – Mill 1B motor front bearing suara abnormal di lokal (SI#1)	MEDIUM SPEED MILL #1B	NORMAL	CM	01-Sep-2015 09:00:00	30-Oct-2015 15:00:00	10/1/15 10:00 AM	10/12/15 4:00 PM	7291	270
Boiler Unit 1, Adjusting ROD dan Deflector Mill 1B patah (Anjlok)	MEDIUM SPEED MILL #1B	NORMAL	CM	6/20/16 8:47 AM	30-Jun-2016 16:47:48	6/20/16 8:47 AM	6/21/16 2:52 PM	6041	30
Boiler Unit 1, Scraper mill 1B lepas dan keluar dari pyrite	MEDIUM SPEED MILL #1B	NORMAL	CM	07-Sep-2016 07:32:49	01-Oct-2016 07:32:55	9/7/16 7:32 AM	10/1/16 7:32 AM	1865	576
Boiler 1 – leakage pada line lube oil menuju gear box mill #1B	MEDIUM SPEED MILL #1B SYSTEM	NORMAL	CM	19-Dec-2016 07:59:41	23-Dec-2016 07:59:47	12/19/16 7:59 AM	12/24/16 5:42 PM	1896	130
Boiler#1 – Mill B suara abnormal diarea scraper	MEDIUM SPEED MILL #1B	NORMAL	CM	26-Dec-2016 08:07:55	31-Dec-2016 08:08:03	12/26/16 8:07 AM	12/31/16 8:00 AM	38	120
Boiler 1 – Material pyrite mill 1B banyak	MEDIUM SPEED MILL #1B	NORMAL	CM	23-Jan-2017 09:00:00	31-Jan-2017 16:00:00	1/23/17 9:00 AM	1/31/17 4:00 PM	711	199
SR Boiler 1 – level lube oil tank MSM 1B low 30% disebabkan kebocoran oli di inlet mill pada sisi fl	MEDIUM SPEED MILL #1B SYSTEM	NORMAL	CM	06-Feb-2017 07:41:59	12-Feb-2017 07:42:30	15-Feb-2017 20:19:56	25-Feb-2017 14:54:54	364	235
Pengelasan – Cover Spring grinding mill 1B bocor (sebelah barat)	MEDIUM SPEED MILL #1B	NORMAL	CM	16-Jul-2018 08:26:31	17-Jul-2018 08:26:31	16-Jul-2018 08:26:31	22-Jul-2018 15:06:41	12138	151
cleaning – Permintaan pengecekan di orifice No. 1 dan 3 mill 1B	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL B TO CORNER NO.1 LAYER BURNER D PIPE	NORMAL	CM	09-Aug-2018 20:02:32	09-Sep-2018 20:02:35	8/9/18 8:02 PM	9/9/18 8:02 PM	437	744
Boiler 1 – Suara Mill 1B Ubnormal dan ada Inner Part yang lepas	MEDIUM SPEED MILL #1B	URGENT	CM			10-Sep-2018 08:45:13	14-Nov-2018 11:32:00	13	1563
PENAMBAHAN TUAS – Tuas Change over filter lube oil Mill 1B	MEDIUM SPEED MILL #1B - LUBE OIL STATION PUMP	NORMAL	CM	01-Apr-2019 13:35:44	07-Apr-2019 13:35:53	01-Apr-2019 13:35:44	04-Apr-2019 16:30:42	3314	75
PENGGANTIAN MEMBRAN EXPLOSION DOOR MILL 1B SISI BARAT+CLEANING BOWL MILL DAN SCRAPPER	MEDIUM SPEED MILL #1B	NORMAL	CM	11-Apr-2019 19:36:10	20-Apr-2019 19:36:13	11-Apr-2019 19:36:10	23-Apr-2019 17:27:40	171	286

ATTACHMENT PULVERIZER C TTF & TTR CM DATA

Description	Asset Description	Wo Priority	Work Type	Scheduled Start	Scheduled FInish	Actual Start	Actual Finish	TTF	TTR CM
Inlet pyrite hopper mill 1C buntu terganjal plat	MEDIUM SPEED MILL #1C - PYRITE HOPPER - INLET PNEUMATIC VALVE	URGENT	CM	30-Sep-2014 14:00:39	07-Oct-2014 14:00:44	10/1/14 8:15 AM	10/7/14 2:00 PM	11132	150
Boiler 1 - material pyrite mill 1C keluar bunga api dan tidak habis	MEDIUM SPEED MILL #1C SYSTEM	NORMAL	CM	01-Aug-2016 09:47:46	06-Aug-2016 09:47:52	8/1/16 9:47 AM	8/6/16 9:47 AM	15932	120
SR Boiler 1 - Regulator pneumatic inlet hooper pyrite mill 1C bocor	MEDIUM SPEED MILL #1C - PYRITE HOPPER - INLET SOLENOID VALVE	NORMAL	CM	11-Nov-2016 08:00:05	16-Nov-2016 10:09:09	11/12/16 9:00 AM	11/12/16 1:00 PM	2351	4
Boiler Unit 1, Tedapat percikan api pada flanges mill 1C	MEDIUM SPEED MILL #1C	NORMAL	CM	08-Dec-2016 07:54:31	31-Dec-2016 07:54:39	12/8/16 7:54 AM	12/31/16 7:54 AM	619	552
SR Boiler 1– explosive door mill 1C jebol sisi timur	MEDIUM SPEED MILL #1C SYSTEM	NORMAL	CM	25-Jan-2017 14:09:37	10-Feb-2017 14:09:40	1/25/17 2:09 PM	2/10/17 4:29 PM	606	386
SR Boiler 1 – matrial MILL 1E protol ditemukan saat pyrite mill	MEDIUM SPEED MILL #1E	NORMAL	CM	13-Feb-2017 08:43:31	26-Feb-2017 08:43:39	2/15/17 8:19 PM	2/25/17 3:39 PM	124	235
Boiler 1 – Coal flow di corner 3 mill C tidak bisa maksimal	MEDIUM SPEED MILL #1C - PYRITE HOPPER - LEVEL SWITCH (HIGH AND NORMAL)	NORMAL	CM	28-Feb-2017 08:00:21	10-Mar-2017 11:00:26	3/8/17 8:00 AM	3/8/17 12:00 PM	256	4
Boiler Unit 1- Hasil pyrite mill 1C banyak material batubara halus	MEDIUM SPEED MILL #1C SYSTEM	OUTAGE	CM	08-Jul-2017 08:00:00	27-Jul-2017 16:00:54	7/8/17 8:00 AM	7/27/17 4:00 PM	2924	464
Perbaikan kebocoran udara di flange inlet line pyrite mill 1C	MEDIUM SPEED MILL #1C	NORMAL	CM	02-Jan-2018 08:09:28	13-Jan-2018 08:09:32	1/2/18 8:09 AM	1/17/18 9:21 PM	3808	373
Boiler 1– outlet pyrite mill 1C tidak rapat	MEDIUM SPEED MILL #1C	NORMAL	CM	28-Jun-2018 09:00:51	29-Jun-2018 16:00:59	6/28/18 9:00 AM	29-Jun-2018 16:00:59	3876	31

ATTACHMENT PULVERIZER D TTF & TTR CM DATA									
Description	**Asset Description**	**Wo Priority**	**Work Type**	**Scheduled Start**	**Scheduled FInish**	**Actual Start**	**Actual Finish**	**TTF**	**TTR CM**
Repair dan Inspeksi Mill 1D	MEDIUM SPEED MILL #1D		CM	04-Nov-2013 10:25:02	30-Nov-2013 10:25:13	11/5/13 8:48 AM	11/5/13 3:54 PM	3213	7
boiler unit 1 – leakage pada manhole mill 1 D	MEDIUM SPEED MILL #1D	NORMAL	CM	08-Sep-2014 11:01:25	08-Oct-2014 11:01:29	9/9/14 8:38 AM	9/9/14 3:42 PM	7385	7
boiler unit 1 – suara noise pada mill 1D (indikasi scapper lepas)	MEDIUM SPEED MILL #1D	NORMAL	CM	11-Sep-2014 07:50:24	11-Oct-2014 07:50:40	9/12/14 8:37 AM	9/12/14 3:43 PM	65	7
mill d unit 1	MEDIUM SPEED MILL #1D	NORMAL	CM	10-Aug-2015 20:45:07	12-Aug-2015 15:45:15	8/10/15 7:42 AM	8/12/15 3:45 PM	7960	56
Noise pada mill 1D	MEDIUM SPEED MILL #1D	URGENT	CM	17-Aug-2015 08:09:50	25-Sep-2015 16:10:20	8/17/15 8:09 AM	8/26/15 11:21 AM	112	219
Boiler 1- noise pada mill 1D dan ditemukan patahan komponen mill & baut saat pyrite	MEDIUM SPEED MILL #1D	NORMAL	CM	05-Nov-2015 07:30:16	12-Nov-2015 16:30:21	11/5/15 7:30 AM	11/16/15 4:20 PM	1700	273
line inlet pyrite Mill 1D penyok	MEDIUM SPEED MILL #1D - PYRITE HOPPER - INLET PNEUMATIC VALVE	NORMAL	CM	13-Jun-2016 08:38:22	17-Jun-2016 16:38:35	6/13/16 8:38 AM	6/14/16 12:26 PM	5032	28
Boiler unit#1 Main hole Mill 1D kurang rapat	MEDIUM SPEED MILL #1D SYSTEM	NORMAL	CM	28-Sep-2016 08:23:23	30-Sep-2016 15:23:33	9/28/16 8:23 AM	9/30/16 3:23 PM	2540	55
Boiler unit 1- inlet pyrite mill 1D bocor	MEDIUM SPEED MILL #1D	NORMAL	CM	18-Oct-2016 12:29:31	24-Dec-2016 12:29:36	10/18/16 12:29 PM	10/26/16 5:26 PM	429	197
Boiler 1 – suara mill 1D kasar di sisi grinder (permohonan internal check)	MEDIUM SPEED MILL #1D	NORMAL	CM	08-Nov-2016 07:49:40	26-Nov-2016 07:49:50	11/8/16 7:49 AM	11/26/16 7:49 AM	302	432
Boiler 1 – Ring gasket flange pyrite mill 1D sobek	MEDIUM SPEED MILL #1D	NORMAL	CM	08-Nov-2017 18:39:36	29-Nov-2017 18:39:43	11/8/17 6:39 PM	11/29/17 3:03 PM	8339	500
Pyrite Mill #1D Plugging	MEDIUM SPEED MILL #1D - INLET SEALING AIR MOTORIZED DAMPER	EMERGENCY	EM			12/9/17 10:15 AM	12/28/17 7:55 AM	235	454
Pengecekan tuas manual valve - Manual valve sealing mill 1D tidak ada penguncinya	MEDIUM SPEED MILL #1D - INLET SEALING AIR SYSTEM	NORMAL	CM	02-Aug-2018 08:13:16	05-Aug-2018 08:13:24	8/2/18 8:13 AM	8/5/18 8:13 AM	5208	72
Indikasi : Boiler 1 – Mill 1D ampere hunting perbandingan coal flow dan ampere tidak seimbang	MEDIUM SPEED MILL #1D	NORMAL	CM	14-Sep-2018 09:00:13	20-Sep-2018 16:00:24	9/14/18 9:00 AM	9/28/18 2:40 PM	961	342
pemasangan liner dan vanewheel – Mill 1D suara lokal noise	MEDIUM SPEED MILL #1D	NORMAL	CM	29-Jun-2019 13:56:59	08-Aug-2019 13:57:03	1/1/19 2:05 PM	2/1/19 2:05 PM	2279	744
Pengelasan hopper pyrite mill 1D berlubang	MEDIUM SPEED MILL #1D	NORMAL	CM	05-Feb-2019 08:28:27	10-Feb-2019 20:28:38	2/5/19 8:28 AM	2/11/19 8:06 PM	90	156
Penggantian SWG- Flange Inlet Puryte Mill 1D Bocor	MEDIUM SPEED MILL #1D SYSTEM	NORMAL	CM	05-Mar-2019 14:46:37	10-Mar-2019 14:46:45	3/5/19 2:46 PM	3/18/19 6:22 PM	523	316
PENAMBAHAN TUAS – Tuas Change over filter lube oil Mill 1D	MEDIUM SPEED MILL #1D - LUBE OIL STATION PUMP	NORMAL	CM	01-Apr-2019 13:33:49	06-Apr-2019 13:33:57	4/1/19 1:33 PM	4/4/19 4:36 PM	331	75

ATTACHMENT PULVERIZER E TTF & TTR CM DATA

Description	Asset Description	Wo Priority	Work Type	Scheduled Start	Scheduled FInish	Actual Start	Actual Finish	TTF	TTR CM
Perbaikan dan Repair Mill 1E	MEDIUM SPEED MILL #1E		CM	01-Nov-2013 15:13:17	30-Nov-2013 15:52:03	11/5/13 8:34 AM	11/5/13 3:41 PM	3213	7
BOILER 1: indikasi trafo pyrite mill 1E terbakar	MEDIUM SPEED MILL #1E - PYRITE HOPPER - OUTLET VALVE	NORMAL	CM	02-Dec-2013 09:00:31	30-Dec-2013 09:00:31	12/2/13 11:08 AM	12/10/13 3:33 PM	643	196
Boiler #1, Orifice gate valve outlet mill 1E no.1 leakage.	MEDIUM SPEED MILL #1E	URGENT	CM	20-Mar-2015 09:00:28	27-Mar-2015 16:00:10	3/20/15 9:30 AM	3/20/15 3:00 PM	11154	5
MILL 1E AMPERE LEBIH TINGGI DIBANDING MILL YG LAIN HARAP DILAKUKAN INTERNAL CHECK	MEDIUM SPEED MILL #1E - MOTOR STATOR COIL V - TEMPERATURE SENSING ELEMENT NO.1	NORMAL	CM	23-Jul-2015 08:00:00	29-Sep-2015 16:28:52	7/23/15 9:00 AM	7/23/15 3:00 PM	2994	6
Kabel selenoid outlet pyrite mill 1E lepas	MEDIUM SPEED MILL #1E - PYRITE HOPPER - OUTLET SOLENOID VALVE	NORMAL	CM	27-Aug-2015 09:00:21	18-Sep-2015 14:48:34	9/3/15 9:00 AM	9/3/15 1:00 PM	1002	4
Kebocoran udara pada pistone pneumatic slight gate outlet pyrite mill 1E	MEDIUM SPEED MILL #1E - PYRITE HOPPER - OUTLET VALVE	NORMAL	CM	22-Sep-2016 08:00:17	06-Nov-2016 16:00:21	11/5/16 9:00 AM	11/5/16 1:00 PM	10292	4
Boiler Unit 1-Slide gate outlet pyrite mill 1E hanya open setengah	MEDIUM SPEED MILL #1E - PYRITE HOPPER - OUTLET VALVE	NORMAL	CM	27-Dec-2016 08:00:06	06-Jan-2017 11:00:10	12/28/16 8:00 AM	12/28/16 12:00 PM	1267	4
Perbaikan Mill 1E area scrapper	MEDIUM SPEED MILL #1E - INLET SEALING AIR MOTORIZED DAMPER	NORMAL	CM	13-Nov-2017 10:07:41	19-Nov-2017 10:08:32	11/13/17 10:07 AM	11/22/17 3:27 PM	7678	221
Pengelasan body mill 1E	MEDIUM SPEED MILL #1E - INLET SEALING AIR SYSTEM	NORMAL	CM	27-Nov-2017 10:27:03	03-Dec-2017 10:27:08	11/27/17 10:27 AM	11/27/17 5:08 PM	115	7
Penggantian SWG - SWG flanges inlet pyrite mill 1E bocor	MEDIUM SPEED MILL #1E	NORMAL	CM	03-Nov-2018 21:31:28	21-Nov-2018 21:31:44	11/3/18 9:31 PM	11/19/18 7:52 AM	8188	370
Pengelasan Outlet Mill 1E (elbow sisi depan feeder) + pengecekan area scrapper mill 1E	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL E TO CORNER NO.1 LAYER BURNER A SYSTEM	NORMAL	CM	11-Feb-2019 20:12:57	17-Feb-2019 20:13:00	2/11/19 8:12 PM	2/14/19 1:49 PM	2028	66
Pengelasan body mill 1E – Terdapat lubang pada body mill 1E sisi barat	MEDIUM SPEED MILL #1E SYSTEM	NORMAL	CM	15-Apr-2019 11:04:23	18-Apr-2019 11:04:26	4/15/19 11:04 AM	4/23/19 5:31 PM	1437	198

ATTACMENT PULVERIZER A PREVENTIVE MAINTANANCE DATA

Description	Asset Description	Wo Priority	Work Type	Scheduled Start	Scheduled FInish	Actual Start	Actual Finish	TTR PM
PM PEKERJAAN MEKANIK MILL - 28D	MEDIUM SPEED MILL #1A		PM	07-Feb-2014 10:24:46	14-Feb-2014 15:00:00	07-Feb-2014 10:24:46	10-Feb-2014 11:00:00	73
MEDIUM SPEED MILL MECHANIC INSPECTION	MEDIUM SPEED MILL #1A		PM	07-Mar-2014 15:41:14	14-Mar-2014 15:00:00	07-Mar-2014 15:41:14	10-Mar-2014 10:00:00	66
MEDIUM SPEED MILL MECHANIC INSPECTION	MEDIUM SPEED MILL #1A		PM	30-Mar-2014 08:00:06	07-Apr-2014 15:00:00	30-Mar-2014 08:00:06	02-Apr-2014 15:00:00	79
MEDIUM SPEED MILL MECHANIC INSPECTION	MEDIUM SPEED MILL #1A		PM	02-May-2014 09:00:00	09-May-2014 15:00:00	5/3/14 9:31 AM	5/6/14 12:00 PM	74
Boiler 1- Penggantian rubber coupling dan reallignment Lube oil Pump Mill 1A	MEDIUM SPEED MILL #1A - LUBE OIL STATION PUMP	URGENT	PDM	16-Mar-2015 14:00:02	17-Mar-2015 16:00:10	16-Mar-2015 12:20:49	17-Mar-2015 15:52:34	28
BOILER #1 - PENGGANTIAN BEARING MOTOR MILL 1A	MEDIUM SPEED MILL #1A	OUTAGE	PDM	27-Aug-2015 08:00:00	23-Sep-2015 16:00:00	07-Sep-2015 08:00:00	08-Sep-2015 16:00:00	32
PAM " Flushing lube oil mill 1A"	MEDIUM SPEED MILL #1A - LUBE OIL STATION PUMP	NORMAL	PAM	10/23/15 8:56 AM	27-Oct-2015 16:55:29	10/23/15 8:56 AM	10/23/15 11:17 AM	2
PAM "Internal Check Mill 1A"	MEDIUM SPEED MILL #1A	NORMAL	PAM	12/23/15 8:12 AM	29-Dec-2015 08:13:15	12/23/15 8:12 AM	12/29/15 8:13 AM	144
PEKERJAAN ELEKTRIK MILL #1A - PM 28D	MEDIUM SPEED MILL #1A	NORMAL	PM	21-Sep-2016 10:00:00	21-Sep-2016 15:00:00	21-Sep-2016 10:00:00	21-Sep-2016 11:00:00	1
PAM "INTERNAL CHECK MILL 1A-PERIODE OKTOBER"	MEDIUM SPEED MILL #1A	NORMAL	PAM	03-Oct-2016 08:04:27	15-Oct-2016 08:04:33	10/3/16 8:04 AM	10/15/16 8:04 AM	288
RESETING SISTEM PROTEKSI MILL 1 A	MEDIUM SPEED MILL #1A SYSTEM	NORMAL	PAM	13-Apr-2017 08:22:50	21-Apr-2017 08:22:53	4/13/17 9:00 AM	4/13/17 10:00 AM	1
INTERNAL CHECK MILL 1A	MEDIUM SPEED MILL #1A	NORMAL	PAM	17-Apr-2018 18:54:42	29-Apr-2018 18:54:46	4/19/18 8:02 AM	4/19/18 4:02 PM	8
Replace outlet pyrite mill 1A dan clean out feeder 1A	MEDIUM SPEED MILL #1A - PYRITE HOPPER - OUTLET VALVE	NORMAL	PAM	25-Jun-2018 10:09:20	01-Jul-2018 10:09:25	6/25/18 10:09 AM	7/1/18 10:09 AM	144
PM INTERNAL CHECK MILL 1A	MEDIUM SPEED MILL #1A	NORMAL	PM	13-Feb-2014 08:49:37	19-Feb-2014 14:49:53	2/13/14 7:21 AM	2/24/14 7:58 AM	265
PENGGANTIAN SWG INLET PYRITE MILL 1A	MEDIUM SPEED MILL #1A - PYRITE HOPPER - INLET PNEUMATIC VALVE	NORMAL	PAM	03-Dec-2018 17:49:31	09-Dec-2018 17:49:34	12/3/18 5:49 PM	12/9/18 5:49 PM	144

ATTACMENT PULVERIZER B PREVENTIVE MAINTANANCE DATA

Description	Asset Description	Wo Priority	Work Type	Scheduled Start	Scheduled FInish	Actual Start	Actual Finish	TTR PM
PM PEKERJAAN MEKANIK MILL - 28D	MEDIUM SPEED MILL #1B		PM	07-Feb-2014 10:24:46	14-Feb-2014 15:00:00	07-Feb-2014 10:24:46	10-Feb-2014 11:00:00	73
MEDIUM SPEED MILL MECHANIC INSPECTION	MEDIUM SPEED MILL #1B		PM	07-Mar-2014 15:41:14	14-Mar-2014 16:00:00	07-Mar-2014 15:41:14	10-Mar-2014 11:00:00	67
MEDIUM SPEED MILL MECHANIC INSPECTION	MEDIUM SPEED MILL #1B		PM	30-Mar-2014 08:00:06	07-Apr-2014 15:00:00	30-Mar-2014 08:00:06	02-Apr-2014 12:00:00	76
MEDIUM SPEED MILL MECHANIC INSPECTION	MEDIUM SPEED MILL #1B		PM	02-May-2014 09:00:00	09-May-2014 15:00:00	5/3/14 9:31 AM	5/6/14 11:00 AM	73
PERBAIKAN SOLENOID INLET VALVE PYRITE MILL 1B	MEDIUM SPEED MILL #1B - PYRITE HOPPER - INLET PNEUMATIC VALVE	NORMAL	PAM	23-Mar-2016 08:00:58	24-Mar-2016 16:00:58	24-Mar-2016 08:00:41	24-Mar-2016 11:00:41	3
Boiler #1- Jasa repair hard facing grinding rool mill unit 1	MEDIUM SPEED MILL #1B SYSTEM		PAM	21-Aug-2015 14:26:17	16-Sep-2015 14:26:40	8/21/15 2:26 PM	21-Sep-2015 16:00:00	746
PAM " Flushing lube oil mill 1B"	MEDIUM SPEED MILL #1B - LUBE OIL STATION PUMP	NORMAL	PAM	23-Oct-2015 08:04:38	27-Oct-2015 16:05:16	10/23/15 8:04 AM	10/27/15 4:05 PM	104
PAM "Internal Check Mill 1B"	MEDIUM SPEED MILL #1B SYSTEM	NORMAL	PAM	02-Dec-2015 08:10:45	03-Dec-2015 16:11:00	12/2/15 8:10 AM	12/3/15 4:05 PM	32
PAM "Penggantian expantion joint all mill"	MEDIUM SPEED MILL #1B - INLET HOT AIR DUCT	NORMAL	PAM	21-Jan-2016 13:33:58	29-Jan-2016 13:34:03	21-Jan-2016 13:33:58	29-Jan-2016 13:34:03	192
INTERNAL CHECK MILL 1B	MEDIUM SPEED MILL #1B	NORMAL	PAM	15-Jul-2016 09:44:25	22-Jul-2016 09:44:28	15-Jul-2016 09:44:25	22-Jul-2016 09:44:28	168
PAM "BOILER 1-INTERNAL CHECK MILL 1B PERIODE OKTOBER 2016"	MEDIUM SPEED MILL #1B SYSTEM	NORMAL	PAM	13-Oct-2016 08:09:05	22-Oct-2016 08:09:10	10/13/16 8:09 AM	10/22/16 8:09 AM	216
RESETING SISTEM PROTEKSI MILL 1 B	MEDIUM SPEED MILL #1B SYSTEM	NORMAL	PAM	13-Apr-2017 08:27:36	21-Apr-2017 08:27:40	13-Apr-2017 10:00:00	13-Apr-2017 11:00:00	1
PAM-INTERNAL CHECK MILL 1B (DEFLECTOR LINER MILL TERLEPAS)	MEDIUM SPEED MILL #1B SYSTEM	NORMAL	PAM	05-Jun-2017 07:30:34	17-Jun-2017 07:30:39	05-Jun-2017 07:30:34	17-Jun-2017 07:30:39	288
INTERNAL CHECK MILL 1B-ROUTINE	MEDIUM SPEED MILL #1B	NORMAL	PAM	23-Jan-2019 07:41:21	31-Jan-2019 07:41:23	28-Jan-2019 18:47:00	06-Feb-2019 08:18:49	206

ATTACMENT PULVERIZER C PREVENTIVE MAINTANANCE DATA								
Description	**Asset Description**	**Wo Priority**	**Work Type**	**Scheduled Start**	**Scheduled FInish**	**Actual Start**	**Actual Finish**	**TTR PM**
PM PEKERJAAN MEKANIK MILL - 28D	MEDIUM SPEED MILL #1C		PM	07-Feb-2014 10:24:46	14-Feb-2014 15:00:00	07-Feb-2014 10:24:46	10-Feb-2014 12:00:00	74
MEDIUM SPEED MILL MECHANIC INSPECTION	MEDIUM SPEED MILL #1C		PM	07-Mar-2014 15:41:14	14-Mar-2014 15:00:00	07-Mar-2014 15:41:14	10-Mar-2014 12:00:00	68
MEDIUM SPEED MILL MECHANIC INSPECTION	MEDIUM SPEED MILL #1C		PM	30-Mar-2014 08:00:06	07-Apr-2014 15:00:00	30-Mar-2014 08:00:06	02-Apr-2014 11:00:00	75
MEDIUM SPEED MILL MECHANIC INSPECTION	MEDIUM SPEED MILL #1C		PM	02-May-2014 09:00:00	09-May-2014 15:00:00	5/3/14 9:31 AM	5/6/14 10:00 AM	72
JASA PENGGANTIAN TABLE MILL UNIT 1C	MEDIUM SPEED MILL #1C SYSTEM	OUTAGE	PAM	27-Aug-2015 08:00:00	23-Sep-2015 16:00:00	8/27/15 8:00 AM	9/4/15 12:00 AM	184
PAM " Flushing lube oil mill 1C"	MEDIUM SPEED MILL #1C - LUBE OIL STATION PUMP	NORMAL	PAM	23-Oct-2015 08:07:54	27-Oct-2015 15:08:19	10/23/15 8:07 AM	10/25/15 2:52 PM	55
Boiler 1 - Penggantian regulator pneumatic pyrite mill 1C	MEDIUM SPEED MILL #1C - PYRITE HOPPER - INLET PNEUMATIC VALVE	NORMAL	PAM	04-Jan-2017 09:00:48	12-Jan-2017 16:00:48	05-Jan-2017 09:00:51	05-Jan-2017 13:00:51	4
Boiler 1 - penggantian solenoid outlet mill no.2 mill 1C	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL C TO CORNER NO.3 LAYER BURNER C PIPE	NORMAL	PAM	11-Apr-2017 09:00:42	19-Apr-2017 16:00:52	12-Apr-2017 08:00:25	12-Apr-2017 11:00:25	3
RESETING SISTEM PROTEKSI MILL 1 C	MEDIUM SPEED MILL #1C SYSTEM	NORMAL	PAM	13-Apr-2017 08:32:12	21-Apr-2017 08:32:15	13-Apr-2017 11:00:00	13-Apr-2017 12:00:00	1
PENGECEKAN RUBBER COUPLING DAN PENGGANTIAN - LUBE OIL PUMP MILL 1C INDIKASI MISALIGNMENT	MEDIUM SPEED MILL #1C - LUBE OIL STATION PUMP	NORMAL	PDM	20-Sep-2017 10:55:49	23-Sep-2017 10:56:00	9/25/17 9:40 AM	10/9/17 8:43 AM	335
PENGGANTIAN RUBBER COUPLING LUBE OIL MILL 1C (CEK ALIGNMENT)	MEDIUM SPEED MILL #1C - LUBE OIL STATION PUMP	NORMAL	PDM	26-Oct-2017 13:02:16	29-Oct-2017 13:02:19	10/26/17 1:02 PM	10/29/17 1:02 PM	72
PAM-PENGECEKAN NOISE DI MILL 1C	MEDIUM SPEED MILL #1C	NORMAL	PAM	05-Dec-2017 16:18:28	27-Jan-2018 16:18:35	12/5/17 4:18 PM	12/6/17 4:18 PM	24
INTERNAL CHECK MILL 1C	MEDIUM SPEED MILL #1C	URGENT	PAM	17-Apr-2018 19:06:12	29-Apr-2018 19:06:16	17-Apr-2018 19:06:12	29-Apr-2018 19:06:16	288
Rekomendasi LOP Mill 1C Indikasi kerusakan Bearing pada pompa dan Misalignment	MEDIUM SPEED MILL #1C - LUBE OIL STATION PUMP	NORMAL	PDM	23-Aug-2018 08:00:00	30-Aug-2018 16:00:00	8/26/18 8:02 AM	8/26/18 2:02 PM	6
PAM - Pengecekan orifice mill 1C (Cleaning)	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL C TO CORNER NO.1 LAYER BURNER C SYSTEM	NORMAL	PAM	22-Aug-2018 08:00:00	31-Aug-2018 16:00:00	8/28/18 9:52 AM	8/30/18 4:02 PM	54
PM INTERNAL CHECK MILL 1C	MEDIUM SPEED MILL #1C	NORMAL	PM	13-Feb-2014 08:49:37	19-Feb-2014 14:49:53	13-Feb-2014 07:27:25	13-Feb-2014 15:49:12	8
PENGELASAN ELBOW OUTLET MILL 1C DAN PENGECEKAN BEARING POMPA LUBE OIL MILL 1C	MEDIUM SPEED MILL #1C	NORMAL	PAM	13-Nov-2018 08:13:47	18-Nov-2018 08:13:50	11/13/18 8:13 AM	11/14/18 7:49 PM	36

ATTACMENT PULVERIZER D PREVENTIVE MAINTANANCE DATA

Description	Asset Description	Wo Priority	Work Type	Scheduled Start	Scheduled FInish	Actual Start	Actual Finish	TTR PM
PM PEKERJAAN MEKANIK MILL - 28D	MEDIUM SPEED MILL #1D		PM	07-Feb-2014 10:24:46	14-Feb-2014 16:00:00	07-Feb-2014 10:24:46	10-Feb-2014 12:00:00	74
MEDIUM SPEED MILL MECHANIC INSPECTION	MEDIUM SPEED MILL #1D		PM	07-Mar-2014 15:41:14	14-Mar-2014 16:00:00	07-Mar-2014 15:41:14	10-Mar-2014 12:00:00	68
MEDIUM SPEED MILL MECHANIC INSPECTION	MEDIUM SPEED MILL #1D		PM	30-Mar-2014 08:00:06	07-Apr-2014 06:00:00	30-Mar-2014 08:00:06	03-Apr-2014 13:00:00	101
MEDIUM SPEED MILL MECHANIC INSPECTION	MEDIUM SPEED MILL #1D		PM	02-May-2014 00:00:00	09-May-2014 06:00:00	5/3/14 9:31 AM	5/5/14 10:00 AM	48
internal check mill 1D	MEDIUM SPEED MILL #1D	NORMAL	PAM	14-Oct-2014 17:10:19	14-Nov-2014 17:10:22	10/15/14 8:38 AM	10/15/14 3:43 PM	7
Perbaikan vanwheel mill 1D	MEDIUM SPEED MILL #1D	URGENT	PAM	25-Dec-2014 17:30:38	25-Jan-2015 17:30:38	12/25/14 5:30 PM	12/26/14 8:03 AM	15
INTERNAL CHECK MILL 1D	MEDIUM SPEED MILL #1D	NORMAL	PAM	02-Mar-2015 07:46:01	02-Mar-2015 15:46:01	27-Feb-2015 08:14:19	27-Feb-2015 16:00:00	8
Boiler #1 - Penggantian Inner Part Mill 1D	MEDIUM SPEED MILL #1D	OUTAGE	PAM	27-Aug-2015 08:00:00	23-Sep-2015 16:00:00	8/27/15 3:09 PM	16-Sep-2015 15:09:20	480
Boiler unit 1 – Permintaan internal check pada mill 1D	MEDIUM SPEED MILL #1D	URGENT	PM	24-Nov-2015 08:00:11	24-Nov-2015 15:00:11	11/24/15 8:00 AM	11/26/15 10:23 AM	50
"PAM" PENGGANTIAN BEARING POMPA LUBE OIL MILL #1 (ME)	MEDIUM SPEED MILL #1D - LUBE OIL STATION PUMP	OUTAGE	PAM	01-Mar-2017 08:00:00	30-May-2017 16:00:00	6/15/16 8:30 AM	20-Jun-2016 14:39:05	126
PERBAIKAN MOTOR MILL 1D	MEDIUM SPEED MILL #1D SYSTEM	URGENT	PAM	12-Apr-2017 07:57:56	21-Apr-2017 07:58:00	6/9/17 12:00 AM	20-Jun-2017 00:00:00	264
RESETING PROTEKSI MILL 1 D	MEDIUM SPEED MILL #1D SYSTEM	NORMAL	PAM	13-Apr-2017 08:11:11	21-Apr-2017 08:11:15	13-Apr-2017 13:00:00	13-Apr-2017 14:00:00	1
PERBAIKAN PROTEKSI MOTOR MILL 1D	MEDIUM SPEED MILL #1D SYSTEM	URGENT	PAM	04-Jul-2017 00:00:00	12-Jul-2017 00:00:00	04-Jul-2017 10:00:00	04-Jul-2017 14:00:00	4
JOINT INSPECTION-PENGECEKAN MILL 1D	MEDIUM SPEED MILL #1D SYSTEM	NORMAL	PAM	18-Sep-2017 08:36:52	23-Sep-2017 08:36:56	22-Sep-2017 09:35:51	26-Sep-2017 17:20:35	104
Pyrite Mill #1D Plugging	MEDIUM SPEED MILL #1D - INLET SEALING AIR MOTORIZED DAMPER	EMERGENCY	EM			12/9/17 10:15 AM	12/28/17 7:55 AM	454
PAM - Penggantian Solenoid outlet mill 1D no.1	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL D TO CORNER NO.1 LAYER BURNER B PNEUMATIC VALVE - SOLENOID VALVE	NORMAL	PAM	16-Jan-2018 14:00:53	24-Jan-2018 16:00:04	16-Jan-2018 09:00:00	16-Jan-2018 11:00:00	2
INTERNAL CHECK MILL 1D	MEDIUM SPEED MILL #1D	NORMAL	PAM	17-Apr-2018 19:14:36	29-Apr-2018 19:14:39	4/17/18 7:14 PM	4/29/18 7:14 PM	288
PAM - Penggantian Deflector Liner dan Air Throtling Ring Mill 1D	MEDIUM SPEED MILL #1D	URGENT	PAM	11-Jun-2018 08:00:00	18-Jun-2018 16:00:00	12-Jun-2018 11:00:00	15-Jun-2018 16:00:00	77
PAM - Pengecekan orifice Mill 1D (Cleaning)	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL D TO CORNER NO.1 LAYER BURNER B SYSTEM	NORMAL	PAM	22-Aug-2018 08:00:00	31-Aug-2018 16:00:00	8/28/18 9:00 AM	8/30/18 4:00 PM	55
PAM-INTERNAL CHECK MILL 1D (PENGECEKAN AREA BOWL MILL, COAL FEEDER DAN CLEANING ORIFICE)	MEDIUM SPEED MILL #1D	NORMAL	PAM	24-Sep-2018 08:06:26	26-Sep-2018 18:06:35	9/24/18 8:06 AM	26-Sep-2018 18:06:35	58

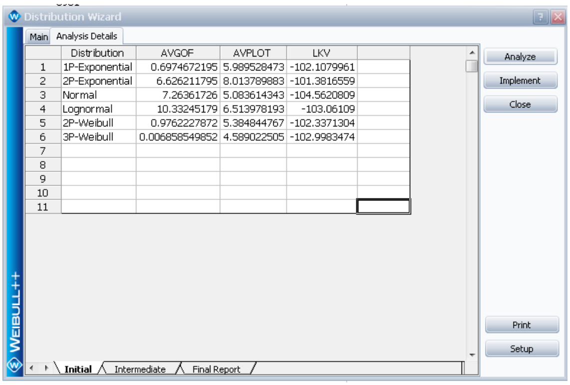
ATTACMENT PULVERIZER E PREVENTIVE MAINTANANCE DATA

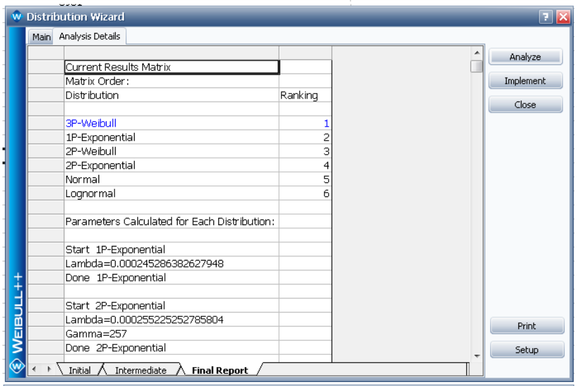
Description	Asset Description	Wo Priority	Work Type	Scheduled Start	Scheduled FInish	Actual Start	Actual Finish	TTR PM
PM PEKERJAAN MEKANIK MILL - 28D	MEDIUM SPEED MILL #1E		PM	07-Feb-2014 10:24:46	14-Feb-2014 15:00:00	2/7/14 10:24 AM	2/10/14 1:00 PM	75
MEDIUM SPEED MILL MECHANIC INSPECTION	MEDIUM SPEED MILL #1E		PM	07-Mar-2014 15:41:14	14-Mar-2014 15:00:00	3/7/14 3:41 PM	3/11/14 10:00 AM	90
MEDIUM SPEED MILL MECHANIC INSPECTION	MEDIUM SPEED MILL #1E		PM	30-Mar-2014 08:00:06	07-Apr-2014 15:00:00	3/30/14 8:00 AM	4/3/14 11:00 AM	99
MEDIUM SPEED MILL MECHANIC INSPECTION	MEDIUM SPEED MILL #1E		PM	02-May-2014 09:00:00	09-May-2014 15:00:00	5/3/14 9:31 AM	5/5/14 11:00 AM	49
Boiler #1 - Jasa Pembongkaran dan Perbaikan Grinding Roll Mill 1E	MEDIUM SPEED MILL #1E	NORMAL	PAM	08-Jul-2014 08:45:46	05-Aug-2014 15:46:10	7/8/14 8:45 AM	8/5/14 3:46 PM	679
PAM " Flushing lube oil mill 1E"	MEDIUM SPEED MILL #1E - LUBE OIL STATION PUMP	NORMAL	PAM	23-Oct-2015 08:11:55	29-Oct-2015 15:12:43	10/23/15 8:11 AM	10/25/15 2:58 PM	55
Jasa cleaning Mill dan Condensor #1	BUNKER, FEEDER AND PULVERIZING SYSTEM #1	OUTAGE	PAM	20-Jun-2016 08:00:00	06-Jul-2016 16:00:00	6/20/16 8:00 AM	7/6/16 4:00 PM	392
RESETING PROTEKSI MILL 1 E	MEDIUM SPEED MILL SYSTEM #1	NORMAL	PAM	13-Apr-2017 08:16:12	21-Apr-2017 08:16:16	4/13/17 2:00 PM	4/13/17 3:00 PM	1
Perbaikan outlet pneumatic mill 1E no.4	MEDIUM SPEED MILL #1E	NORMAL	PAM	19-Jun-2017 09:00:11	20-Jun-2017 16:00:22	6/19/17 10:00 AM	6/19/17 12:00 PM	2
Boiler 1 - Penggantian Adjusting Shroud & Ring Vane Wheel Mill #1E	MEDIUM SPEED MILL #1E	URGENT	PAM	29-Jun-2017 08:00:00	30-Jun-2017 16:00:00	6/29/17 8:00 AM	6/30/17 4:00 PM	32
Mean Inspection penggantian actuator pneumatic pyrite mill #1	MEDIUM SPEED MILL #1E - PYRITE HOPPER - INLET PNEUMATIC VALVE	OUTAGE	PAM	08-Jul-2017 09:00:00	22-Aug-2017 16:00:00	7/10/17 9:00 AM	7/10/17 1:00 PM	4
PAM-INTERNAL CHECK MILL 1E	MEDIUM SPEED MILL #1E	NORMAL	PAM	04-Dec-2017 10:17:00	16-Dec-2017 10:17:08	12/4/17 10:17 AM	12/12/17 5:18 PM	199
PAM-INTERNAL CHECK MILL 1E	MEDIUM SPEED MILL #1E	NORMAL	PAM	23-Aug-2018 13:50:54	31-Aug-2018 13:50:59	8/23/18 8:00 AM	8/31/18 1:50 PM	198
PM INTERNAL CHECK MILL 1E	MEDIUM SPEED MILL #1E	NORMAL	PM	13-Feb-2014 08:49:37	19-Feb-2014 14:49:53	2/13/14 7:29 AM	2/14/14 3:44 PM	32
PAM-Pengecekan Orifice Mill 1E no 4	VAPOR / EXHAUST GAS #1 - OUTLET MEDIUM SPEED MILL E TO CORNER NO.4 LAYER BURNER A SYSTEM	NORMAL	PAM	17-Sep-2018 13:14:26	22-Sep-2018 13:14:26	9/17/18 1:14 PM	9/18/18 7:25 PM	30
INTERNAL CHECK MILL 1E	MEDIUM SPEED MILL #1E	NORMAL	PAM	13-Feb-2019 08:19:10	17-Feb-2019 08:19:13	2/13/19 8:19 AM	2/14/19 2:05 PM	30
Pengelasan body mill 1E – Terdapat lubang pada body mill 1E sisi barat	MEDIUM SPEED MILL #1E SYSTEM	NORMAL	CM	15-Apr-2019 11:04:23	18-Apr-2019 11:04:26	4/15/19 11:04 AM	4/18/19 11:04 AM	72

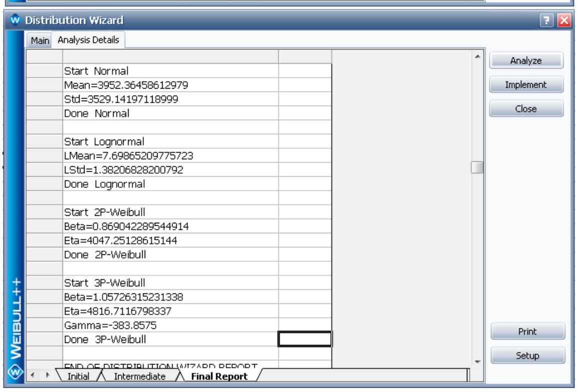
1. *Pulverizer A*

1.1. *TTF MILL A*

	Time Failed (Hr)	Subset ID 1
1	3981	MILL A
2	9433	MILL A
3	1624	MILL A
4	257	MILL A
5	7369	MILL A
6	272	MILL A
7	4461	MILL A
8	8545	MILL A
9	5349	MILL A
10	586	MILL A
11	1599	MILL A

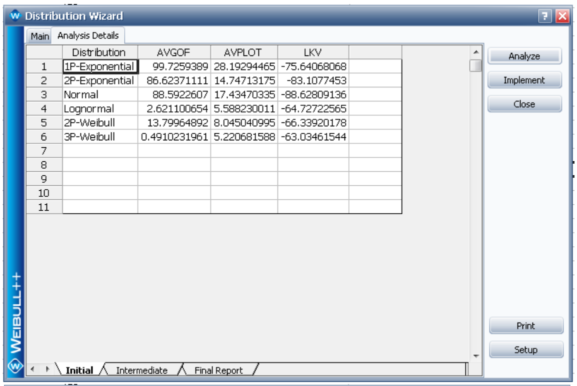




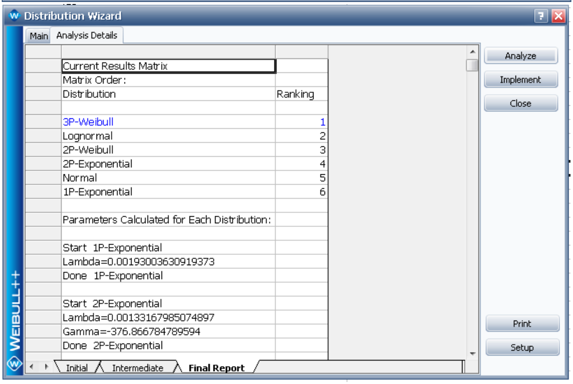


1.2. TTR CM MILL A

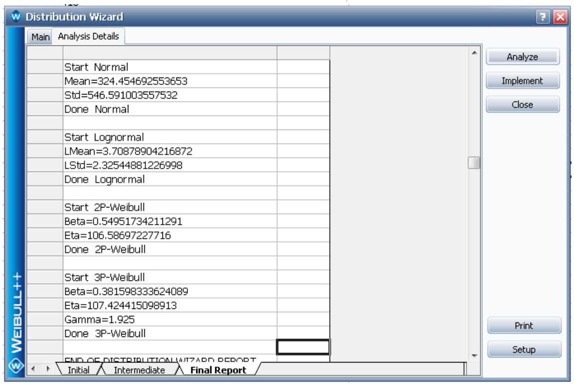
	Time Failed (Hr)	Subset ID 1
1	415	MILL A
2	23	MILL A
3	7	MILL A
4	7	MILL A
5	2504	MILL A
6	75	MILL A
7	432	MILL A
8	2	MILL A
9	86	MILL A
10	8	MILL A
11	10	MILL A



	Distribution	AVGOF	AVPLOT	LKV
1	1P-Exponential	99.7259389	28.19294465	-75.64068068
2	2P-Exponential	86.62371111	14.74713175	-83.1077453
3	Normal	88.5922607	17.43470335	-88.62809136
4	Lognormal	2.621100654	5.588230011	-64.72722565
5	2P-Weibull	13.79964892	8.045040995	-66.33920178
6	3P-Weibull	0.4910231961	5.220681588	-63.03461544
7				
8				
9				
10				
11				



Current Results Matrix	
Matrix Order:	
Distribution	Ranking
3P-Weibull	1
Lognormal	2
2P-Weibull	3
2P-Exponential	4
Normal	5
1P-Exponential	6
Parameters Calculated for Each Distribution:	
Start 1P-Exponential	
Lambda=0.00193003630919373	
Done 1P-Exponential	
Start 2P-Exponential	
Lambda=0.00133167985074897	
Gamma=-376.866784789594	
Done 2P-Exponential	



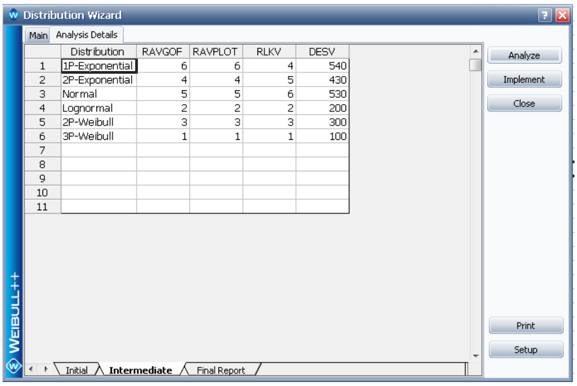
Start Normal
Mean=324.454692553653
Std=546.591003557532
Done Normal

Start Lognormal
LMean=3.70878904216872
LStd=2.32544881226998
Done Lognormal

Start 2P-Weibull
Beta=0.54951734211291
Eta=106.58697227716
Done 2P-Weibull

Start 3P-Weibull
Beta=0.381598333624089
Eta=107.424415098913
Gamma=1.925
Done 3P-Weibull

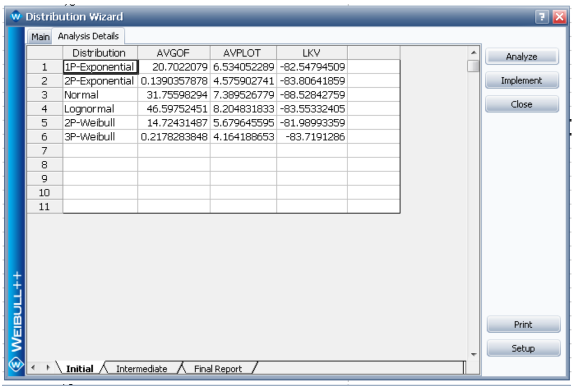
END OF DISTRIBUTION WIZARD REPORT



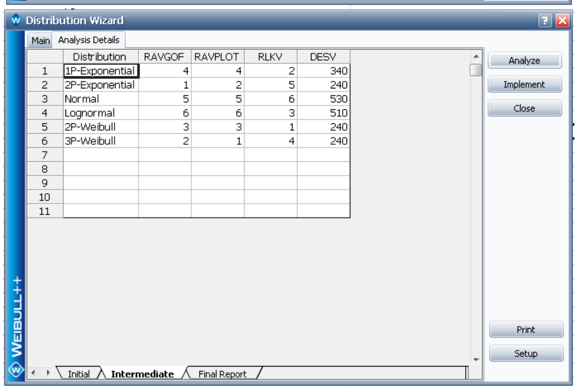
	Distribution	RAVGOF	RAVPLOT	RLKV	DESV
1	1P-Exponential	6	6	4	540
2	2P-Exponential	4	4	5	430
3	Normal	5	5	6	530
4	Lognormal	2	2	2	200
5	2P-Weibull	3	3	3	300
6	3P-Weibull	1	1	1	100
7					
8					
9					
10					
11					

1.3. TTR PM MILL A

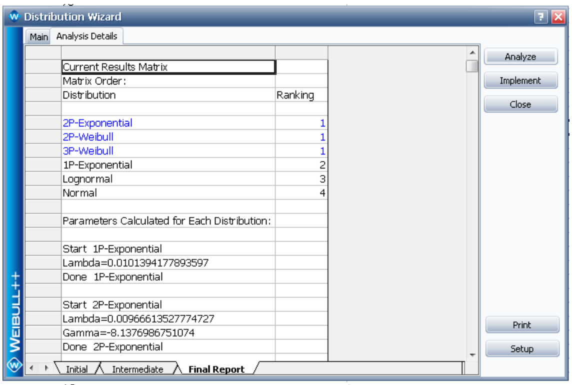
	Time Failed (Hr)	Subset ID 1
1	73	PM A
2	66	PM A
3	79	PM A
4	74	PM A
5	28	PM A
6	32	PM A
7	2	PM A
8	144	PM A
9	1	PM A
10	288	PM A
11	1	PM A
12	8	PM A
13	144	PM A
14	265	PM A
15	144	PM A

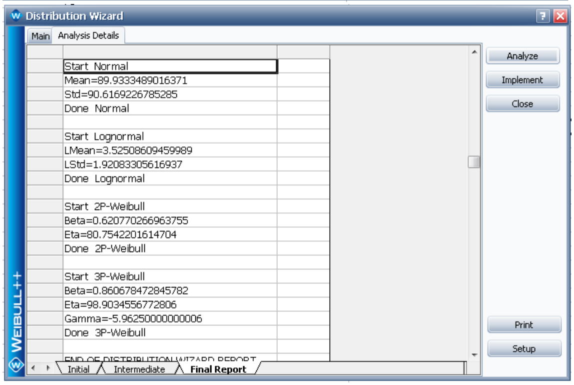


	Distribution	AVGOF	AVPLOT	LKV
1	1P-Exponential	20.7022079	6.534052289	-82.54794509
2	2P-Exponential	0.1390357878	4.575902741	-83.80641859
3	Normal	31.75598294	7.389526779	-88.52842759
4	Lognormal	46.59752451	8.204831833	-83.55332405
5	2P-Weibull	14.72431487	5.679645595	-81.98993359
6	3P-Weibull	0.2178283848	4.164188653	-83.7191286
7				
8				
9				
10				
11				



	Distribution	RAVGOF	RAVPLOT	RLKV	DESV
1	1P-Exponential	4	4	2	340
2	2P-Exponential	1	2	5	240
3	Normal	5	5	6	530
4	Lognormal	6	6	3	510
5	2P-Weibull	3	3	1	240
6	3P-Weibull	2	1	4	240
7					
8					
9					
10					
11					

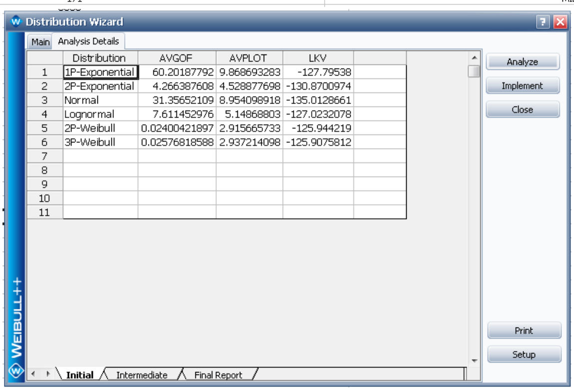


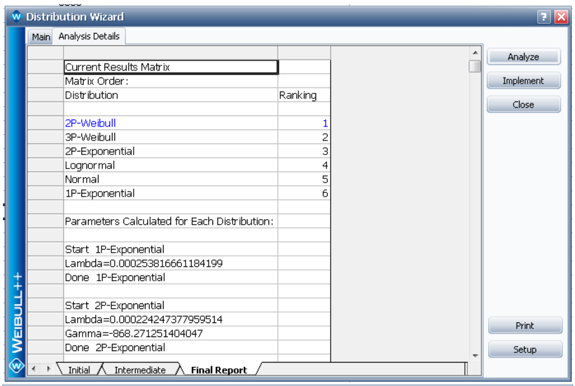


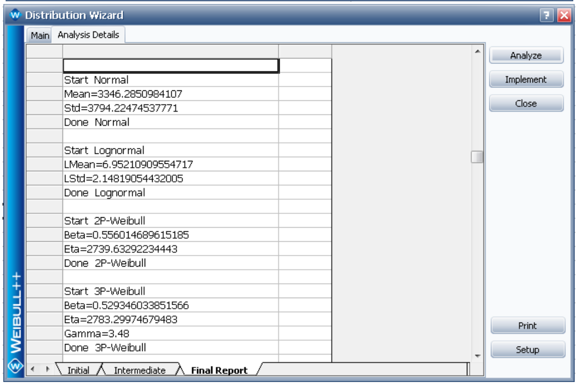
2. *Pulverizer B*

2.1. TTF MILL A

	Time Failed (Hr)	Subset ID 1
1	3385	MILL B
2	9184	MILL B
3	7291	MILL B
4	6041	MILL B
5	1865	MILL B
6	1896	MILL B
7	38	MILL B
8	711	MILL B
9	364	MILL B
10	12138	MILL B
11	437	MILL B
12	13	MILL B
13	3314	MILL B
14	171	MILL B

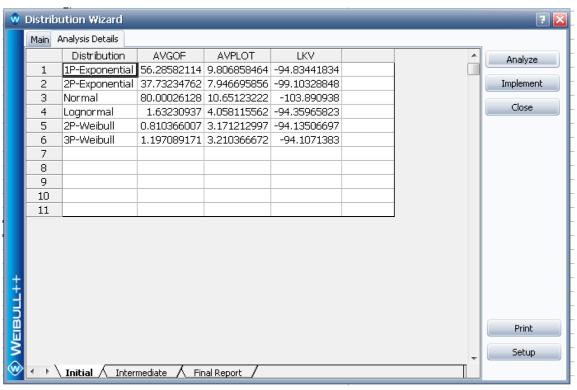




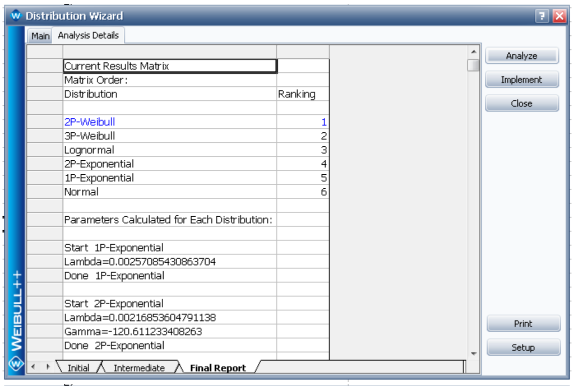


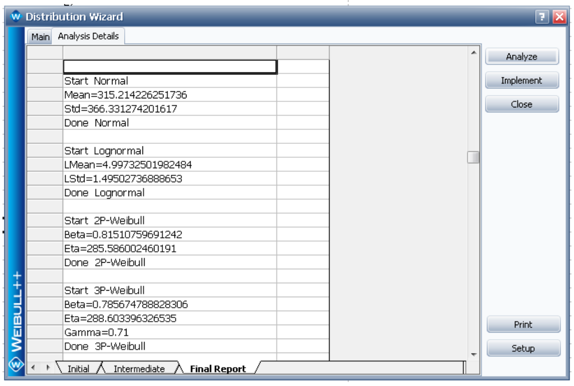
2.2. TTR CM MILL B

	Time Failed (Hr)	Subset ID 1
1	27	MILL B
2	7	MILL B
3	270	MILL B
4	30	MILL B
5	576	MILL B
6	130	MILL B
7	120	MILL B
8	199	MILL B
9	235	MILL B
10	151	MILL B
11	744	MILL B
12	1563	MILL B
13	75	MILL B
14	286	MILL B



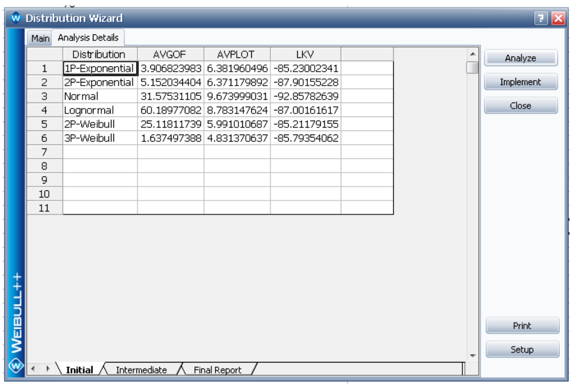
	Distribution	AVGOF	AVPLOT	LKV
1	1P-Exponential	56.28582114	9.806858464	-94.83441834
2	2P-Exponential	37.73234762	7.946695856	-99.10328848
3	Normal	80.00026128	10.65123222	-103.890938
4	Lognormal	1.63230937	4.058115562	-94.35965823
5	2P-Weibull	0.810366007	3.171212997	-94.13506697
6	3P-Weibull	1.197089171	3.210366672	-94.1071383
7				
8				
9				
10				
11				

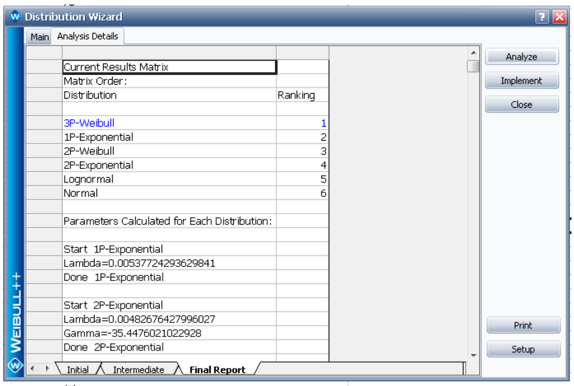


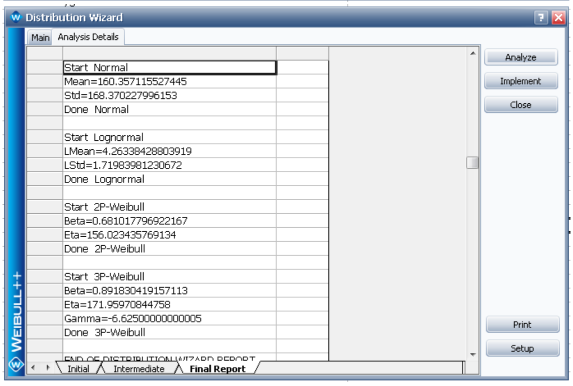


2.3. TTR PM MILL B

	Time Failed (Hr)	Subset ID 1
1	73	PM B
2	67	PM B
3	76	PM B
4	73	PM B
5	3	PM B
6	746	PM B
7	104	PM B
8	32	PM B
9	192	PM B
10	168	PM B
11	216	PM B
12	1	PM B
13	288	PM B
14	206	PM B



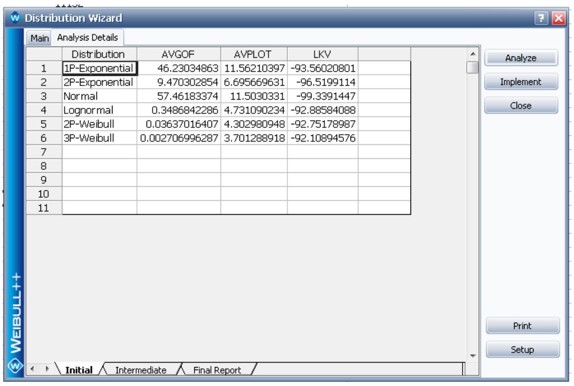




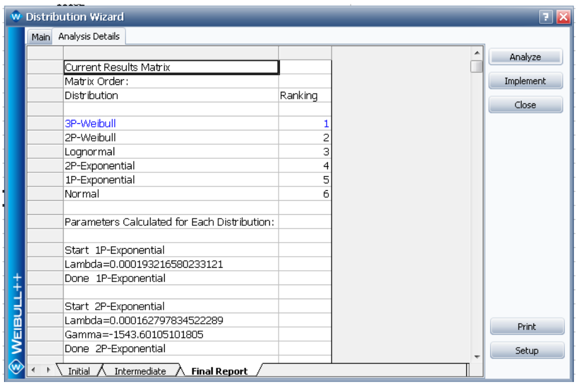
3. *Pulverizer C*

3.1. TTF Mill C

	Time Failed (Hr)	Subset ID 1
1	11132	MILL C
2	15932	MILL C
3	2351	MILL C
4	619	MILL C
5	606	MILL C
6	124	MILL C
7	256	MILL C
8	2924	MILL C
9	3808	MILL C
10	3876	MILL C

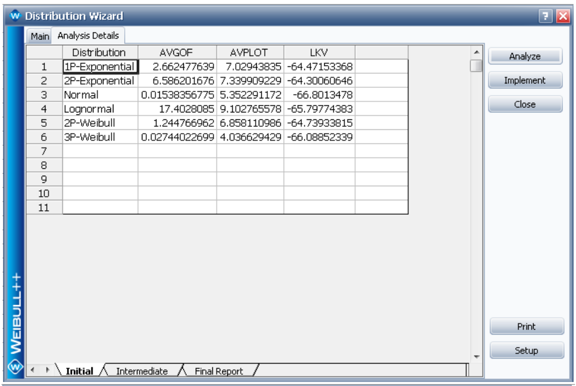


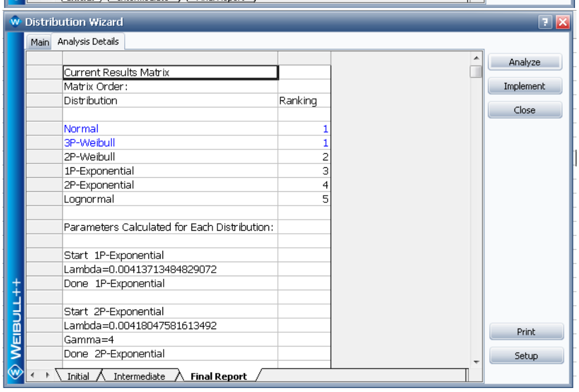
	Distribution	AVGOF	AVPLOT	LKV
1	1P-Exponential	46.23034863	11.56210397	-93.56020801
2	2P-Exponential	9.470302854	6.695669631	-96.5199114
3	Normal	57.46183374	11.5030331	-99.3391447
4	Lognormal	0.3486842286	4.731090234	-92.88584088
5	2P-Weibull	0.03637016407	4.302980948	-92.75178987
6	3P-Weibull	0.002706996287	3.701288918	-92.10894576
7				
8				
9				
10				
11				

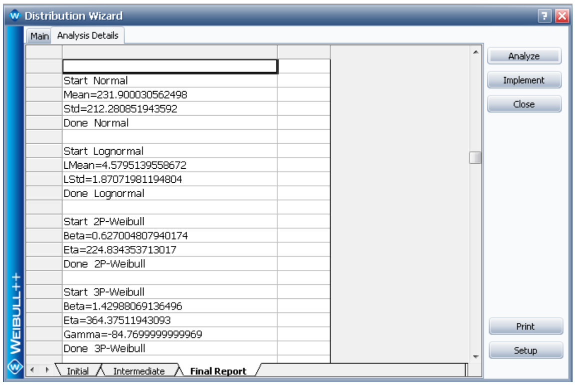


3.2. TTR CM MILL C

	Time Failed (Hr)	Subset ID 1
1	150	MILL C
2	120	MILL C
3	4	MILL C
4	552	MILL C
5	386	MILL C
6	235	MILL C
7	4	MILL C
8	464	MILL C
9	373	MILL C
10	31	MILL C

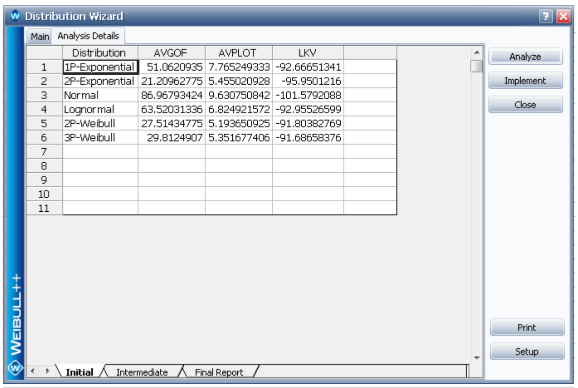


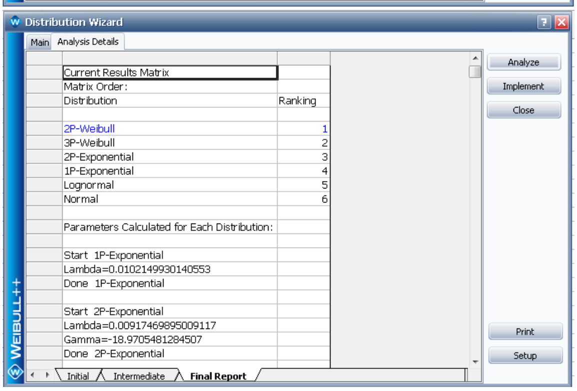


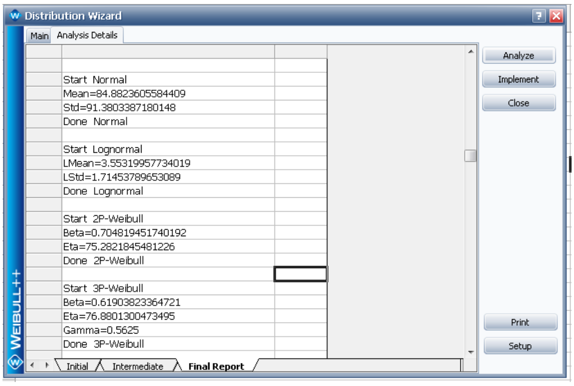


3.3. TTR PM MILL C

	Time Failed (Hr)	Subset ID 1
1	74	PM C
2	68	PM C
3	75	PM C
4	72	PM C
5	184	PM C
6	55	PM C
7	4	PM C
8	3	PM C
9	1	PM C
10	335	PM C
11	72	PM C
12	24	PM C
13	288	PM C
14	6	PM C
15	54	PM C
16	8	PM C
17	120	PM C



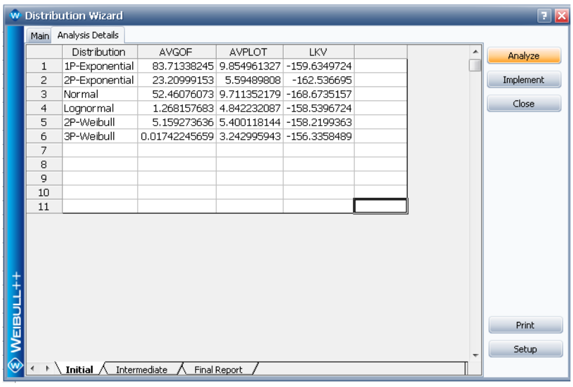




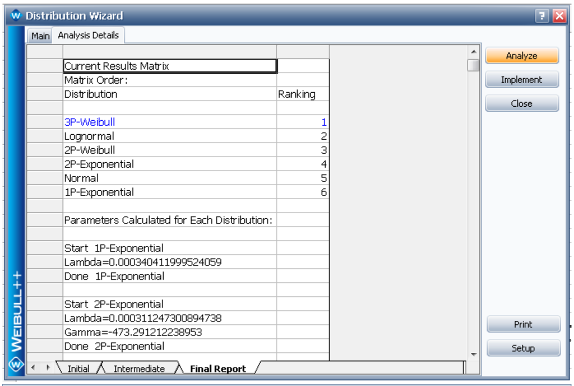
4. Pulverizer D

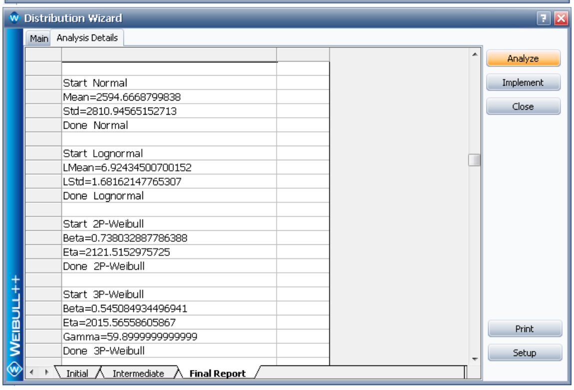
4.1. TTF MILL D

	Time Failed (Hr)	Subset ID 1
1	3213	MILL D
2	7385	MILL D
3	65	MILL D
4	7960	MILL D
5	112	MILL D
6	1700	MILL D
7	5032	MILL D
8	2540	MILL D
9	429	MILL D
10	302	MILL D
11	8339	MILL D
12	235	MILL D
13	5208	MILL D
14	961	MILL D
15	2279	MILL D
16	90	MILL D
17	523	MILL D
18	331	MILL D



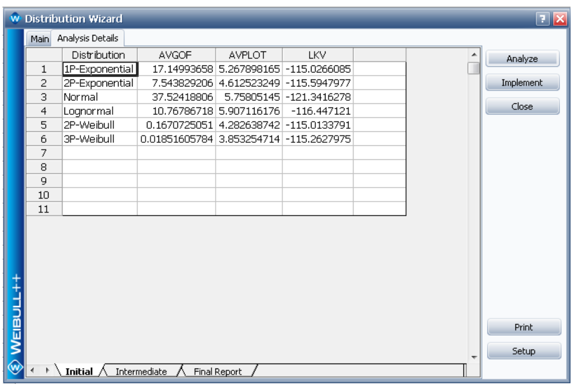
	Distribution	AVGOF	AVPLOT	LKV
1	1P-Exponential	83.71338245	9.854961327	-159.6349724
2	2P-Exponential	23.20999153	5.59489808	-162.536695
3	Normal	52.46076073	9.711352179	-168.6735157
4	Lognormal	1.268157683	4.842232087	-158.5396724
5	2P-Weibull	5.159273636	5.400118144	-158.2199363
6	3P-Weibull	0.01742245659	3.242995943	-156.3358489
7				
8				
9				
10				
11				

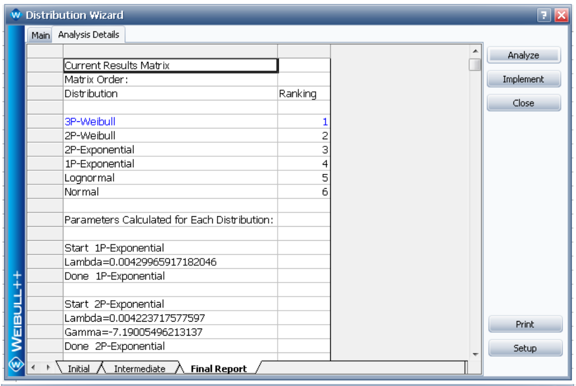


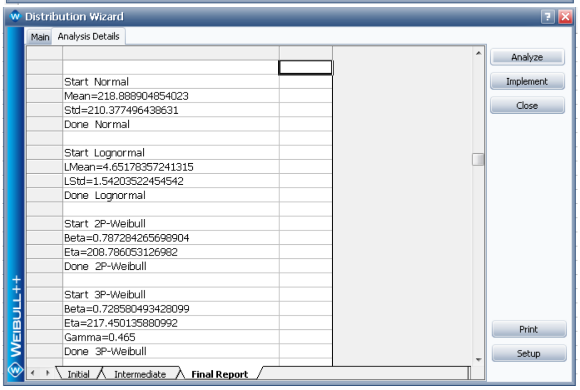


4.2. TTR CM MILL D

	Time Failed (Hr)	Subset ID 1
1	7	MILL D
2	7	MILL D
3	7	MILL D
4	56	MILL D
5	219	MILL D
6	273	MILL D
7	28	MILL D
8	55	MILL D
9	197	MILL D
10	432	MILL D
11	500	MILL D
12	454	MILL D
13	72	MILL D
14	342	MILL D
15	744	MILL D
16	156	MILL D
17	316	MILL D
18	75	MILL D

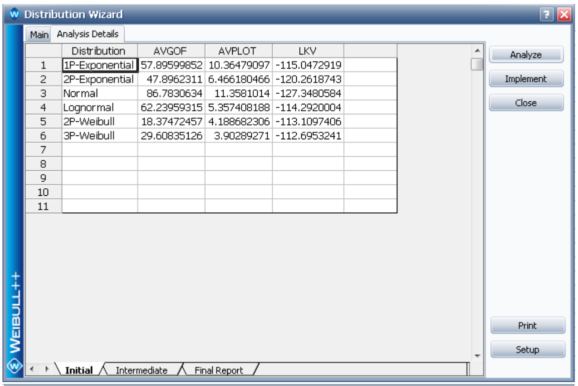


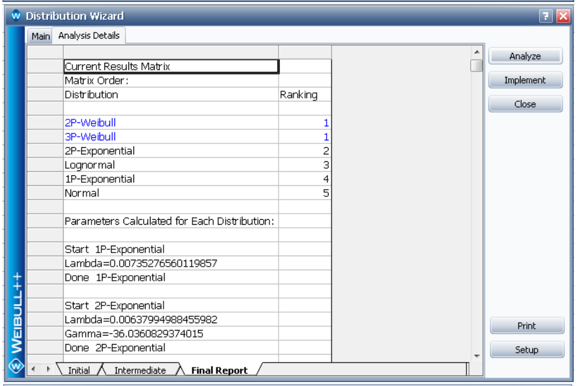


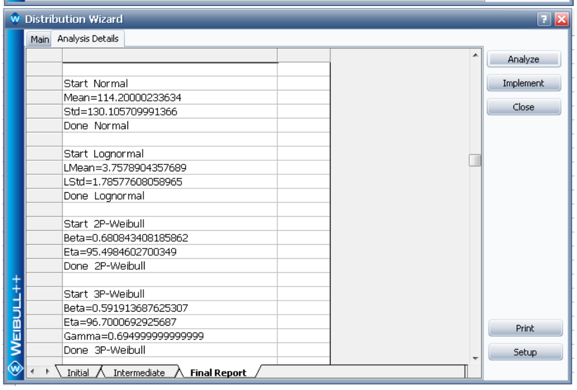


4.3. TTR PM MILL D

	Time Failed (Hr)	Subset ID 1
1	74	PM D
2	68	PM D
3	101	PM D
4	48	PM D
5	7	PM D
6	15	PM D
7	8	PM D
8	480	PM D
9	50	PM D
10	126	PM D
11	264	PM D
12	1	PM D
13	4	PM D
14	104	PM D
15	454	PM D
16	2	PM D
17	288	PM D
18	77	PM D
19	55	PM D
20	58	PM D



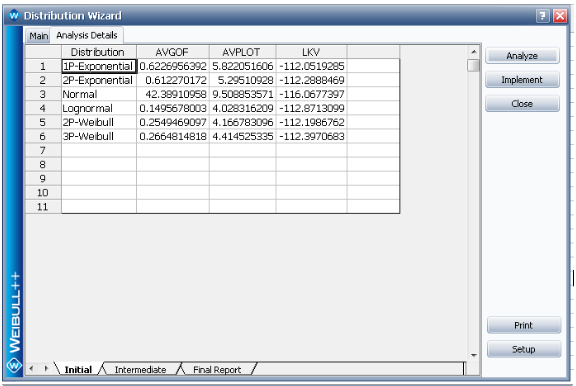


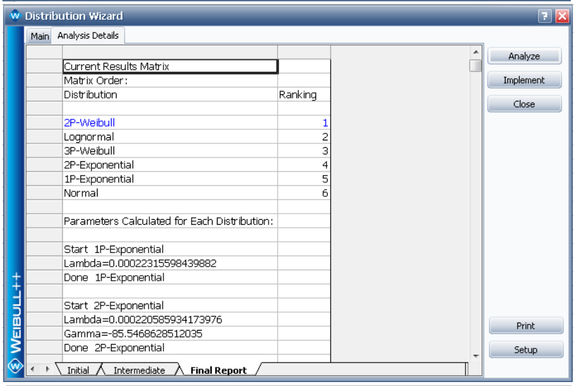


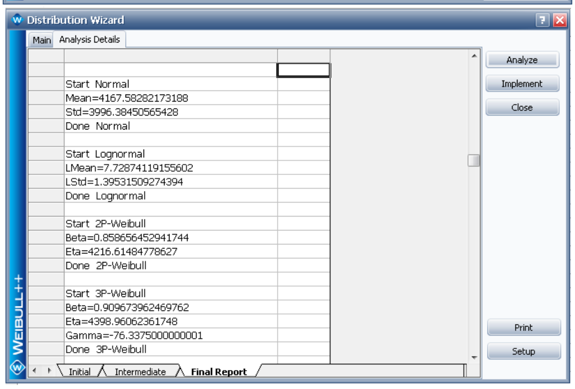
5. Pulverizer E

5.1. TTF CM MILL E

	Time Failed (Hr)	Subset ID 1
1	3213	MILL E
2	643	MILL E
3	11154	MILL E
4	2994	MILL E
5	1002	MILL E
6	10292	MILL E
7	1267	MILL E
8	7678	MILL E
9	115	MILL E
10	8188	MILL E
11	2028	MILL E
12	1437	MILL E

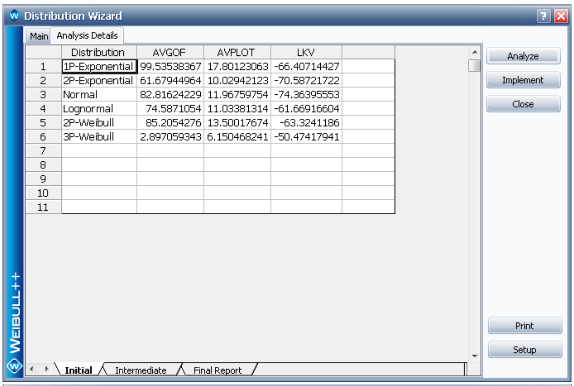




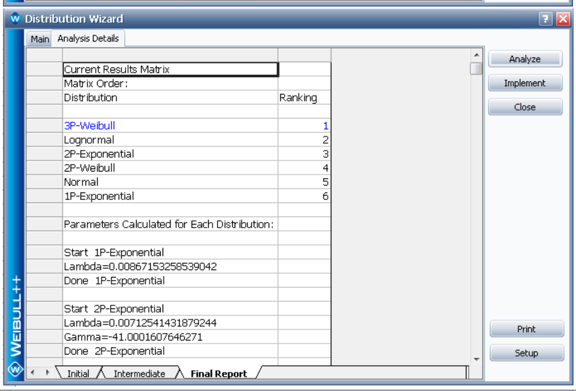


5.2. TTR CM MILL E

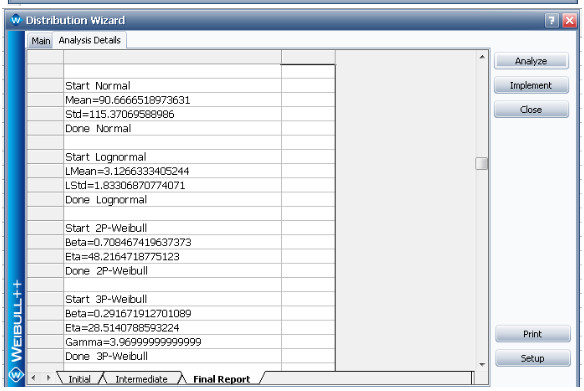
	Time Failed (Hr)	Subset ID 1
1	7	MILL E
2	196	MILL E
3	5	MILL E
4	6	MILL E
5	4	MILL E
6	4	MILL E
7	4	MILL E
8	221	MILL E
9	7	MILL E
10	370	MILL E
11	66	MILL E
12	198	MILL E



	Distribution	AVGOF	AVPLOT	LKV
1	1P-Exponential	99.53538367	17.80123063	-66.40714427
2	2P-Exponential	61.67944964	10.02942123	-70.58721722
3	Normal	82.81624229	11.96759754	-74.36395553
4	Lognormal	74.5871054	11.03381314	-61.66916604
5	2P-Weibull	85.2054276	13.50017674	-63.3241186
6	3P-Weibull	2.897059343	6.150468241	-50.47417941
7				
8				
9				
10				
11				



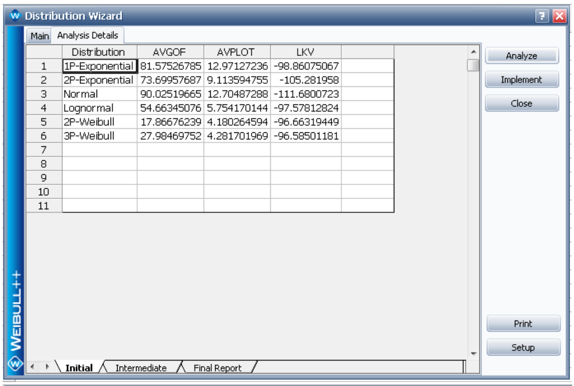
Current Results Matrix	
Matrix Order:	
Distribution	Ranking
3P-Weibull	1
Lognormal	2
2P-Exponential	3
2P-Weibull	4
Normal	5
1P-Exponential	6
Parameters Calculated for Each Distribution:	
Start 1P-Exponential	
Lambda=0.00867153258539042	
Done 1P-Exponential	
Start 2P-Exponential	
Lambda=0.00712541431879244	
Gamma=-41.0001607646271	
Done 2P-Exponential	

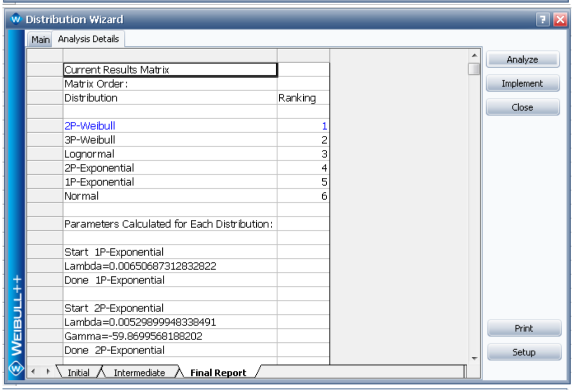


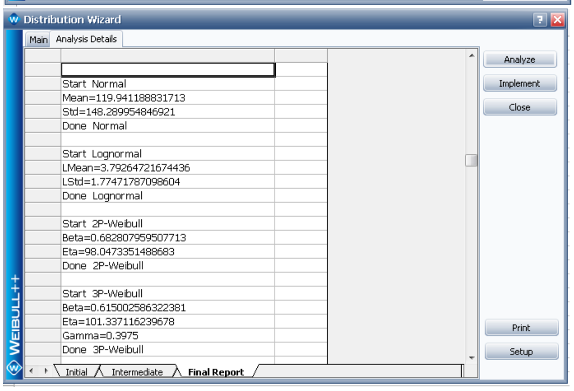
Start Normal	
Mean=90.6666518973631	
Std=115.37069588986	
Done Normal	
Start Lognormal	
LMean=3.1266333405244	
LStd=1.83306870774071	
Done Lognormal	
Start 2P-Weibull	
Beta=0.708467419637373	
Eta=48.2164718775123	
Done 2P-Weibull	
Start 3P-Weibull	
Beta=0.291671912701089	
Eta=28.5140788593224	
Gamma=3.96999999999999	
Done 3P-Weibull	

5.3.TTR PM MILL E

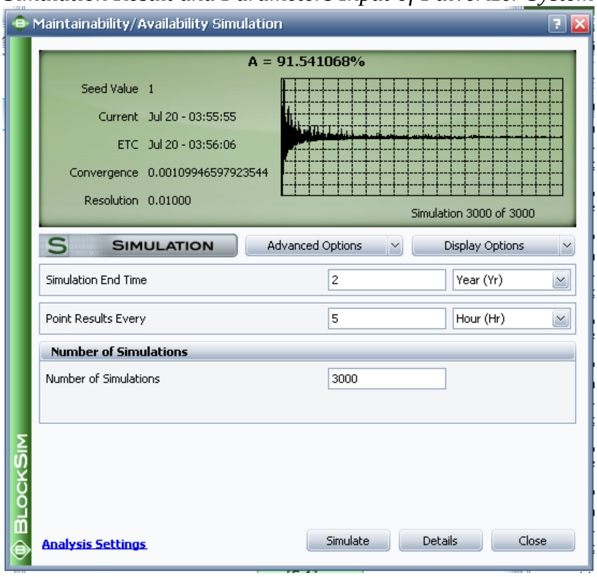
	Time Failed (Hr)	Subset ID 1
1	75	PM E
2	90	PM E
3	99	PM E
4	49	PM E
5	679	PM E
6	55	PM E
7	392	PM E
8	1	PM E
9	2	PM E
10	32	PM E
11	4	PM E
12	199	PM E
13	198	PM E
14	32	PM E
15	30	PM E
16	30	PM E
17	72	PM E


Distribution Wizard
Main
Analysis Details
Distribution AVGOF AVPLOT LKV
1 1P-Exponential 81.57526785 12.97127236 -98.86075067
2 2P-Exponential 73.69957687 9.113594755 -105.281958
3 Normal 90.02519665 12.70487288 -111.6800723
4 Lognormal 54.66345076 5.754170144 -97.57812824
5 2P-Weibull 17.86676239 4.180264594 -96.66319449
6 3P-Weibull 27.98469752 4.281701969 -96.58501181
7
8
9
10
11
Analyze
Implement
Close
Print
Setup
WEIBULL++
Initial
Intermediate
Final Report


Distribution Wizard
Main
Analysis Details
Current Results Matrix
Matrix Order:
Distribution Ranking
2P-Weibull 1
3P-Weibull 2
Lognormal 3
2P-Exponential 4
1P-Exponential 5
Normal 6
Parameters Calculated for Each Distribution:
Start 1P-Exponential
Lambda=0.00650687312832822
Done 1P-Exponential
Start 2P-Exponential
Lambda=0.00529899948338491
Gamma=-59.8699568188202
Done 2P-Exponential
Analyze
Implement
Close
Print
Setup
WEIBULL++
Initial
Intermediate
Final Report


Distribution Wizard
Main
Analysis Details
Start Normal
Mean=119.941188831713
Std=148.289954846921
Done Normal
Start Lognormal
LMean=3.79264721674436
LStd=1.77471787098604
Done Lognormal
Start 2P-Weibull
Beta=0.682807959507713
Eta=98.0473351488683
Done 2P-Weibull
Start 3P-Weibull
Beta=0.615002586322381
Eta=101.337116239678
Gamma=0.3975
Done 3P-Weibull
Analyze
Implement
Close
Print
Setup
WEIBULL++
Initial
Intermediate
Final Report

Simulation Result and Parameters Input of Pulverizer System



Simulation Summary of Pulverizer System

System Overview	
General	
Mean Availability (All Events):	0.915411
Std Deviation (Mean Availability):	0.070235
Mean Availability (w/o PM, OC & Inspection):	0.949987
Point Availability (All Events) at 17520:	0.922667
Reliability(17520):	0.062
Expected Number of Failures:	5.997
Std Deviation (Number of Failures):	4.089976
MTTFF (Hr):	4729.033071
MTBF (Total Time) (Hr):	2921.46073
MTBF (Uptime) (Hr):	2674.336362
MTBE (Total Time) (Hr):	1777.837911
MTBE (Uptime) (Hr):	1627.451816
System Uptime/Downtime	
Uptime (Hr):	16037.99517
CM Downtime (Hr):	876.219359
Inspection Downtime (Hr):	0
PM Downtime (Hr):	605.785476
OC Downtime (Hr):	0
Waiting Downtime (Hr):	0
Total Downtime (Hr):	1482.004835
System Downing Events	
Number of Failures:	5.997
Number of CMs:	5.997
Number of Inspections:	0
Number of PMs:	3.857667
Number of OCs:	0
Number of OFF Events by Trigger:	0
Total Events:	9.854667
Costs	
Total Costs:	$0.00
Opportunity Costs (CM):	$0.00
Opportunity Costs (Total):	$0.00
Throughput	
Total Throughput:	N/A
Max. Capacity:	N/A
Actual Utilization:	N/A
Revenue	
Total Revenue:	$0.00

Individual Block Summary of Pulverizer System Simulation Summary of Pulverizer System

Individual Block Summary																					
Block Name	RS FCI	RS DECI	RS DTCI	Mean Av. (All Events)	Mean Av. (w/o PM, OC & Insp.)	Expected # of Failures	Expected # of OFF Events by Trigger	System Downing Events	Block Downtime (Hr)	Block Uptime (Hr)	Number of CMs	CM Downtime (Hr)	Number of Inspections	Inspection Downtime (Hr)	Number of PMs	PM Downtime (Hr)	Number of OCs	OC Downtime (Hr)	Throughput	Total Cost
1 SB 4 ACT	100.00%	100.00%	100.00%	0.915411	0.949987	6.385333	0	9.854667	1482.004835	16037.99517	0	0	0	0	5.990667	605.785476	0	0	N/A	$0.00
START	0.00%	0.00%	0.00%	1	1	0	0	0	0	17520	0	0	0	0	0	0	0	0	N/A	$0.00
FINISH	0.00%	0.00%	0.00%	1	1	0	0	0	0	17520	0	0	0	0	0	0	0	0	N/A	$0.00
MILL A	0.00%	0.00%	0.00%	0.902855	0.924287	3.717667	0	0	1701.984569	15818.01543	3.717667	1326.487464	0	0	3.725333	375.497105	0	0	N/A	$0.00
MILL B	0.00%	0.00%	0.00%	0.876135	0.903407	5.364333	0	0	2170.116395	15349.88361	5.364333	1692.309932	0	0	2.771	477.806463	0	0	N/A	$0.00
MILL C	0.00%	0.00%	0.00%	0.918367	0.938392	4.444667	0	0	1430.207142	16089.79286	4.444667	1079.367874	0	0	3.755333	350.839268	0	0	N/A	$0.00
MILL D	0.00%	0.00%	0.00%	0.884723	0.904451	6.352333	0	0	2019.654073	15500.34593	6.352333	1674.023031	0	0	2.838	345.631042	0	0	N/A	$0.00
MILL E	0.00%	0.00%	0.00%	0.953867	0.983969	1.128	0	0	808.242625	16711.75738	1.128	280.860314	0	0	4.280333	527.382311	0	0	N/A	$0.00
1 SB 4 ACT_Switch	0.00%	0.00%	0.00%	1	1	0	0	0	0	17520	0	0	0	0	0	0	0	0	N/A	$0.00

Detailed Block Summary of Pulverizer System

Detailed Block Information Block Name: 1 SB 4 ACT	
General Information	
General Information	
Number of Block Downing Events:	12.376
Number of System Downing Events:	9.854667
Number of Failures:	6.385333
Number of System Downing Failures:	5.997
Number of OFF Events by Trigger:	0
Mean Availability (All Events):	0.915411
Mean Availability (w/o PM, OC & Inspection):	0.949987
Block Uptime (Hr):	16037.99517
Block Downtime (Hr):	1482.004835
Metrics	
RS Criticality Indices	
RS DECI:	100.00%
Mean Time Between Downing Events (Hr):	1295.894891
RS FCI:	100.00%
MTBF (Hr):	2606.564101
Mean Downtime per Event (Hr):	119.74829
RS DTCI:	100.00%
RS BCCI:	-
Block Downtime Contribution Index	
Non-Waiting Time CI:	100.00%
Total Waiting Time CI:	0.00%
Waiting for Opportunity/Maximum Wait Time Ratio:	-
Crew/Part Wait Ratio:	0
Part/Crew Wait Ratio:	0
Downtime Summary	
Downtimes	
Non-Waiting Time (Hr):	1482.004835
Waiting for Opportunity (Hr):	0
Waiting for Crew (Hr):	0
Waiting for Parts (Hr):	0

Detailed Block Summary of Pulverizer A

Detailed Block Information Block Name: MILL A	
General Information	
General Information	
Number of Block Downing Events:	7.103333
Number of System Downing Events:	0
Number of Failures:	3.717667
Number of System Downing Failures:	0
Number of OFF Events by Trigger:	0
Mean Availability (All Events):	0.902855
Mean Availability (w/o PM, OC & Inspection):	0.924287
Block Uptime (Hr):	15818.01543
Block Downtime (Hr):	1701.984569
Standby Information	
Block Uptime (Active) (Hr):	15988.14269
Block Downtime (Active) (Hr):	360.580131
Block Uptime (Quiescent) (Hr):	0
Block Downtime (Quiescent) (Hr):	1341.404439
Metrics	
RS Criticality Indices	
RS DECI:	0.00%
Mean Time Between Downing Events (Hr):	2226.844031
RS FCI:	0.00%
MTBF (Hr):	4355.826917
Mean Downtime per Event (Hr):	239.603647
RS DTCI:	0.00%
RS BCCI:	-
Block Downtime Contribution Index	
Non-Waiting Time CI:	100.00%
Total Waiting Time CI:	0.00%
Waiting for Opportunity/Maximum Wait Time Ratio:	-
Crew/Part Wait Ratio:	0
Part/Crew Wait Ratio:	0
Downtime Summary	
Downtimes	
Non-Waiting Time (Hr):	1701.984569
Waiting for Opportunity (Hr):	0
Waiting for Crew (Hr):	0
Waiting for Parts (Hr):	0
Event Count Summary	
CM Actions	
Number of CMs:	3.717667
CM Downtime (Hr):	1326.487464
Inspections	
Number of Inspections:	0
Inspection Downtime (Hr):	0
PM Actions	
Number of PMs:	3.725333
PM Downtime (Hr):	375.497105
OC Actions	
Number of OCs:	0
OC Downtime (Hr):	0

Detailed Block Summary of Pulverizer B

Detailed Block Information Block Name: MILL B	
General Information	
General Information	
Number of Block Downing Events:	7.985667
Number of System Downing Events:	0
Number of Failures:	5.364333
Number of System Downing Failures:	0
Number of OFF Events by Trigger:	0
Mean Availability (All Events):	0.876135
Mean Availability (w/o PM, OC & Inspection):	0.903407
Block Uptime (Hr):	15349.88361
Block Downtime (Hr):	2170.116395
Standby Information	
Block Uptime (Active) (Hr):	15490.68917
Block Downtime (Active) (Hr):	556.18611
Block Uptime (Quiescent) (Hr):	0
Block Downtime (Quiescent) (Hr):	1613.930286
Metrics	
RS Criticality Indices	
RS DECI:	0.00%
Mean Time Between Downing Events (Hr):	1922.179355
RS FCI:	0.00%
MTBF (Hr):	2950.541863
Mean Downtime per Event (Hr):	271.751437
RS DTCI:	0.00%
RS BCCI:	-
Block Downtime Contribution Index	
Non-Waiting Time CI:	100.00%
Total Waiting Time CI:	0.00%
Waiting for Opportunity/Maximum Wait Time Ratio:	-
Crew/Part Wait Ratio:	0
Part/Crew Wait Ratio:	0
Downtime Summary	
Downtimes	
Non-Waiting Time (Hr):	2170.116395
Waiting for Opportunity (Hr):	0
Waiting for Crew (Hr):	0
Waiting for Parts (Hr):	0
Event Count Summary	
CM Actions	
Number of CMs:	5.364333
CM Downtime (Hr):	1692.309932
Inspections	
Number of Inspections:	0
Inspection Downtime (Hr):	0
PM Actions	
Number of PMs:	2.771
PM Downtime (Hr):	477.806463
OC Actions	
Number of OCs:	0
OC Downtime (Hr):	0

Detailed Block Summary of Pulverizer C

Detailed Block Information Block Name: MILL C	
General Information	
General Information	
Number of Block Downing Events:	7.588
Number of System Downing Events:	0
Number of Failures:	4.444667
Number of System Downing Failures:	0
Number of OFF Events by Trigger:	0
Mean Availability (All Events):	0.918367
Mean Availability (w/o PM, OC & Inspection):	0.938392
Block Uptime (Hr):	16089.79286
Block Downtime (Hr):	1430.207142
Standby Information	
Block Uptime (Active) (Hr):	16039.20232
Block Downtime (Active) (Hr):	460.970422
Block Uptime (Quiescent) (Hr):	188.513206
Block Downtime (Quiescent) (Hr):	969.23672
Metrics	
RS Criticality Indices	
RS DECI:	0.00%
Mean Time Between Downing Events (Hr):	2120.426049
RS FCI:	0.00%
MTBF (Hr):	3698.95728
Mean Downtime per Event (Hr):	188.482755
RS DTCI:	0.00%
RS BCCI:	-
Block Downtime Contribution Index	
Non-Waiting Time CI:	100.00%
Total Waiting Time CI:	0.00%
Waiting for Opportunity/Maximum Wait Time Ratio:	-
Crew/Part Wait Ratio:	0
Part/Crew Wait Ratio:	0
Downtime Summary	
Downtimes	
Non-Waiting Time (Hr):	1430.207142
Waiting for Opportunity (Hr):	0
Waiting for Crew (Hr):	0
Waiting for Parts (Hr):	0
Event Count Summary	
CM Actions	
Number of CMs:	4.444667
CM Downtime (Hr):	1079.367874
Inspections	
Number of Inspections:	0
Inspection Downtime (Hr):	0
PM Actions	
Number of PMs:	3.755333
PM Downtime (Hr):	350.839268
OC Actions	
Number of OCs:	0
OC Downtime (Hr):	0

Detailed Block Summary of Pulverizer D

Detailed Block Information Block Name: MILL D	
General Information	
General Information	
Number of Block Downing Events:	9.190333
Number of System Downing Events:	0
Number of Failures:	6.352333
Number of System Downing Failures:	0
Number of OFF Events by Trigger:	0
Mean Availability (All Events):	0.884723
Mean Availability (w/o PM, OC & Inspection):	0.904451
Block Uptime (Hr):	15500.34593
Block Downtime (Hr):	2019.654073
Standby Information	
Block Uptime (Active) (Hr):	15614.39494
Block Downtime (Active) (Hr):	468.563006
Block Uptime (Quiescent) (Hr):	0
Block Downtime (Quiescent) (Hr):	1551.091066
Metrics	
RS Criticality Indices	
RS DECI:	0.00%
Mean Time Between Downing Events (Hr):	1686.592354
RS FCI:	0.00%
MTBF (Hr):	2494.512825
Mean Downtime per Event (Hr):	219.758522
RS DTCI:	0.00%
RS BCCI:	-
Block Downtime Contribution Index	
Non-Waiting Time CI:	100.00%
Total Waiting Time CI:	0.00%
Waiting for Opportunity/Maximum Wait Time Ratio:	-
Crew/Part Wait Ratio:	0
Part/Crew Wait Ratio:	0
Downtime Summary	
Downtimes	
Non-Waiting Time (Hr):	2019.654073
Waiting for Opportunity (Hr):	0
Waiting for Crew (Hr):	0
Waiting for Parts (Hr):	0
Event Count Summary	
CM Actions	
Number of CMs:	6.352333
CM Downtime (Hr):	1674.023031
Inspections	
Number of Inspections:	0
Inspection Downtime (Hr):	0
PM Actions	
Number of PMs:	2.838
PM Downtime (Hr):	345.631042
OC Actions	
Number of OCs:	0
OC Downtime (Hr):	0

Detailed Block Summary of Pulverizer E

Detailed Block Information Block Name: MILL E	
General Information	
General Information	
Number of Block Downing Events:	5.408333
Number of System Downing Events:	0
Number of Failures:	1.128
Number of System Downing Failures:	0
Number of OFF Events by Trigger:	0
Mean Availability (All Events):	0.953867
Mean Availability (w/o PM, OC & Inspection):	0.983969
Block Uptime (Hr):	16711.75738
Block Downtime (Hr):	808.242625
Standby Information	
Block Uptime (Active) (Hr):	4944.906693
Block Downtime (Active) (Hr):	435.038972
Block Uptime (Quiescent) (Hr):	11961.97277
Block Downtime (Quiescent) (Hr):	373.203653
Metrics	
RS Criticality Indices	
RS DECI:	0.00%
Mean Time Between Downing Events (Hr):	3090.001364
RS FCI:	0.00%
MTBF (Hr):	15282.92525
Mean Downtime per Event (Hr):	149.443937
RS DTCI:	0.00%
RS BCCI:	-
Block Downtime Contribution Index	
Non-Waiting Time CI:	100.00%
Total Waiting Time CI:	0.00%
Waiting for Opportunity/Maximum Wait Time Ratio:	-
Crew/Part Wait Ratio:	0
Part/Crew Wait Ratio:	0
Downtime Summary	
Downtimes	
Non-Waiting Time (Hr):	808.242625
Waiting for Opportunity (Hr):	0
Waiting for Crew (Hr):	0
Waiting for Parts (Hr):	0
Event Count Summary	
CM Actions	
Number of CMs:	1.128
CM Downtime (Hr):	280.860314
Inspections	
Number of Inspections:	0
Inspection Downtime (Hr):	0
PM Actions	
Number of PMs:	4.280333
PM Downtime (Hr):	527.382311
OC Actions	
Number of OCs:	0
OC Downtime (Hr):	0

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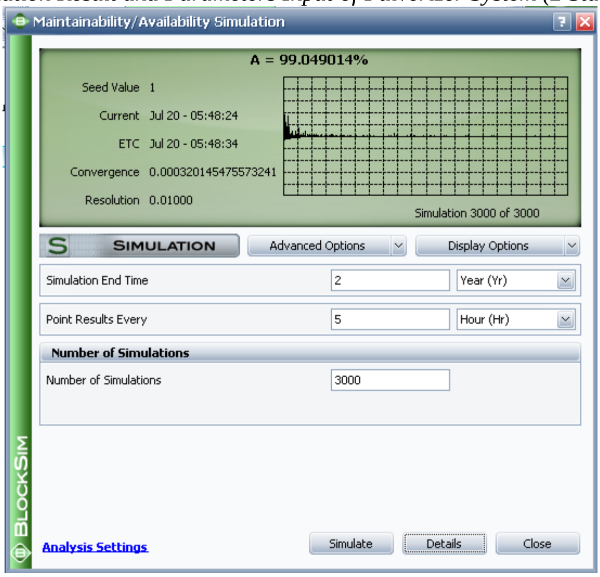
Simulation Result and Parameters Input of Pulverizer System (2 Standby)



Simulation Summary of Pulverizer System

System Overview	
General	
Mean Availability (All Events):	0.99049
Std Deviation (Mean Availability):	0.01882
Mean Availability (w/o PM, OC & Inspection):	0.99455
Point Availability (All Events) at 17520:	0.991
Reliability(17520):	0.583667
Expected Number of Failures:	0.948333
Std Deviation (Number of Failures):	1.580452
MTTFF (Hr):	30505.78238
MTBF (Total Time) (Hr):	18474.5167
MTBF (Uptime) (Hr):	18298.82668
MTBE (Total Time) (Hr):	11107.35418
MTBE (Uptime) (Hr):	11001.72483
System Uptime/Downtime	
Uptime (Hr):	17353.3873
CM Downtime (Hr):	95.4862
Inspection Downtime (Hr):	0
PM Downtime (Hr):	71.126497
OC Downtime (Hr):	0
Waiting Downtime (Hr):	0
Total Downtime (Hr):	166.612697
System Downing Events	
Number of Failures:	0.948333
Number of CMs:	0.948333
Number of Inspections:	0
Number of PMs:	0.629
Number of OCs:	0
Number of OFF Events by Trigger:	0
Total Events:	1.577333
Costs	
Total Costs:	$0.00
Opportunity Costs (CM):	$0.00
Opportunity Costs (Total):	$0.00
Throughput	
Total Throughput:	N/A
Max. Capacity:	N/A
Actual Utilization:	N/A
Revenue	
Total Revenue:	$0.00

Individual Block Summary of Pulverizer System

Individual Block Summary

	A	B	C	D	E	F	G	H	I	J
2	Block Name	RS FCI	RS DECI	RS DTCI	Mean Av. (All Events)	Mean Av. (w/o PM, OC & Insp.)	Expected # of Failures	Expected # of OFF Events by Trigger	System Downing Events	Block Downtime (Hr)
3	1 SB 4 ACT	100.00%	100.00%	100.00%	0.99049	0.99455	1.066	0	1.577333	166.612697
4	START	0.00%	0.00%	0.00%	1	1	0	0	0	0
5	FINISH	0.00%	0.00%	0.00%	1	1	0	0	0	0
6	MILL A	0.00%	0.00%	0.00%	0.921089	0.923493	3.780333	0	0	1382.522988
7	MILL B	0.00%	0.00%	0.00%	0.912952	0.916382	4.752333	0	0	1525.082517
8	MILL C	0.00%	0.00%	0.00%	0.941518	0.94421	4.001	0	0	1024.611961
9	MILL D	0.00%	0.00%	0.00%	0.910274	0.912838	5.873333	0	0	1572.00814
10	MILL E	0.00%	0.00%	0.00%	0.988686	0.99305	0.484	0	0	198.21669
11	MILL F	0.00%	0.00%	0.00%	0.980245	0.983181	1.215667	0	0	346.110072
12	1 SB 4 ACT_Switch	0.00%	0.00%	0.00%	1	1	0	0	0	0

	A	K	L	M	N	O	P	Q	R	S	T	U
2	Block Name	Block Uptime (Hr)	Number of CMs	CM Downtime (Hr)	Number of Inspections	Inspection Downtime (Hr)	Number of PMs	PM Downtime (Hr)	Number of OCs	OC Downtime (Hr)	Throughput	Total Cost
3	1 SB 4 ACT	17353.3873	0	0	0	0	1.014333	71.126497	0	0	N/A	$0.00
4	START	17520	0	0	0	0	0	0	0	0	N/A	$0.00
5	FINISH	17520	0	0	0	0	0	0	0	0	N/A	$0.00
6	MILL A	16137.47701	3.780333	1340.397453	0	0	0.423	42.125535	0	0	N/A	$0.00
7	MILL B	15994.91748	4.752333	1464.99097	0	0	0.331333	60.091547	0	0	N/A	$0.00
8	MILL C	16495.38804	4.001	977.444739	0	0	0.494	47.167223	0	0	N/A	$0.00
9	MILL D	15947.99186	5.873333	1527.081517	0	0	0.344667	44.926623	0	0	N/A	$0.00
10	MILL E	17321.78331	0.484	121.770172	0	0	0.608333	76.446518	0	0	N/A	$0.00
11	MILL F	17173.88993	1.215667	294.666134	0	0	0.516667	51.443937	0	0	N/A	$0.00
12	1 SB 4 ACT_Switch	17520	0	0	0	0	0	0	0	0	N/A	$0.00

Detailed Block Summary of Pulverizer System

	A	B
1	**Detailed Block Information**	
2	**Block Name: 1 SB 4 ACT**	
3		
4	**General Information**	
5	General Information	
6	Number of Block Downing Events:	2.080333
7	Number of System Downing Events:	1.577333
8	Number of Failures:	1.066
9	Number of System Downing Failures:	0.948333
10	Number of OFF Events by Trigger:	0
11	Mean Availability (All Events):	0.99049
12	Mean Availability (w/o PM, OC & Inspection):	0.99455
13	Block Uptime (Hr):	17353.3873
14	Block Downtime (Hr):	166.612697
15	**Metrics**	
16	RS Criticality Indices	
17	RS DECI:	100.00%
18	Mean Time Between Downing Events (Hr):	8341.637864
19	RS FCI:	100.00%
20	MTBF (Hr):	16345.69775
21	Mean Downtime per Event (Hr):	80.089423
22	RS DTCI:	100.00%
23	RS BCCI:	-
24	Block Downtime Contribution Index	
25	Non-Waiting Time CI:	100.00%
26	Total Waiting Time CI:	0.00%
27	Waiting for Opportunity/Maximum Wait Time Ratio:	-
28	Crew/Part Wait Ratio:	0
29	Part/Crew Wait Ratio:	0
30	**Downtime Summary**	
31	Downtimes	
32	Non-Waiting Time (Hr):	166.612697
33	Waiting for Opportunity (Hr):	0
34	Waiting for Crew (Hr):	0
35	Waiting for Parts (Hr):	0

Detailed Block Summary of Pulverizer A

Detailed Block Information Block Name: MILL A	
General Information	
General Information	
Number of Block Downing Events:	4.167333
Number of System Downing Events:	0
Number of Failures:	3.780333
Number of System Downing Failures:	0
Number of OFF Events by Trigger:	0
Mean Availability (All Events):	0.921089
Mean Availability (w/o PM, OC & Inspection):	0.923493
Block Uptime (Hr):	16137.47701
Block Downtime (Hr):	1382.522988
Standby Information	
Block Uptime (Active) (Hr):	16153.92013
Block Downtime (Active) (Hr):	753.479693
Block Uptime (Quiescent) (Hr):	0
Block Downtime (Quiescent) (Hr):	629.043295
Metrics	
RS Criticality Indices	
RS DECI:	0.00%
Mean Time Between Downing Events (Hr):	3872.374903
RS FCI:	0.00%
MTBF (Hr):	4279.940714
Mean Downtime per Event (Hr):	331.752437
RS DTCI:	0.00%
RS BCCI:	-
Block Downtime Contribution Index	
Non-Waiting Time CI:	100.00%
Total Waiting Time CI:	0.00%
Waiting for Opportunity/Maximum Wait Time Ratio:	-
Crew/Part Wait Ratio:	0
Part/Crew Wait Ratio:	0
Downtime Summary	
Downtimes	
Non-Waiting Time (Hr):	1382.522988
Waiting for Opportunity (Hr):	0
Waiting for Crew (Hr):	0
Waiting for Parts (Hr):	0

Detailed Block Summary of Pulverizer B

Detailed Block Information Block Name: MILL B	
General Information	
General Information	
Number of Block Downing Events:	5.069
Number of System Downing Events:	0
Number of Failures:	4.752333
Number of System Downing Failures:	0
Number of OFF Events by Trigger:	0
Mean Availability (All Events):	0.912952
Mean Availability (w/o PM, OC & Inspection):	0.916382
Block Uptime (Hr):	15994.91748
Block Downtime (Hr):	1525.082517
Standby Information	
Block Uptime (Active) (Hr):	16011.85097
Block Downtime (Active) (Hr):	519.020745
Block Uptime (Quiescent) (Hr):	0
Block Downtime (Quiescent) (Hr):	1006.061772
Metrics	
RS Criticality Indices	
RS DECI:	0.00%
Mean Time Between Downing Events (Hr):	3155.438446
RS FCI:	0.00%
MTBF (Hr):	3378.342364
Mean Downtime per Event (Hr):	300.864572
RS DTCI:	0.00%
RS BCCI:	-
Block Downtime Contribution Index	
Non-Waiting Time CI:	100.00%
Total Waiting Time CI:	0.00%
Waiting for Opportunity/Maximum Wait Time Ratio:	-
Crew/Part Wait Ratio:	0
Part/Crew Wait Ratio:	0
Downtime Summary	
Downtimes	
Non-Waiting Time (Hr):	1525.082517
Waiting for Opportunity (Hr):	0
Waiting for Crew (Hr):	0
Waiting for Parts (Hr):	0

Detailed Block Summary of Pulverizer C

Detailed Block Information Block Name: MILL C	
General Information	
General Information	
Number of Block Downing Events:	3.952
Number of System Downing Events:	0
Number of Failures:	4.001
Number of System Downing Failures:	0
Number of OFF Events by Trigger:	0
Mean Availability (All Events):	0.941518
Mean Availability (w/o PM, OC & Inspection):	0.94421
Block Uptime (Hr):	16495.38804
Block Downtime (Hr):	1024.611961
Standby Information	
Block Uptime (Active) (Hr):	16475.82922
Block Downtime (Active) (Hr):	253.661775
Block Uptime (Quiescent) (Hr):	36.997663
Block Downtime (Quiescent) (Hr):	770.950186
Metrics	
RS Criticality Indices	
RS DECI:	0.00%
Mean Time Between Downing Events (Hr):	4173.93422
RS FCI:	0.00%
MTBF (Hr):	4134.605164
Mean Downtime per Event (Hr):	259.26416
RS DTCI:	0.00%
RS BCCI:	-
Block Downtime Contribution Index	
Non-Waiting Time CI:	100.00%
Total Waiting Time CI:	0.00%
Waiting for Opportunity/Maximum Wait Time Ratio:	-
Crew/Part Wait Ratio:	0
Part/Crew Wait Ratio:	0
Downtime Summary	
Downtimes	
Non-Waiting Time (Hr):	1024.611961
Waiting for Opportunity (Hr):	0
Waiting for Crew (Hr):	0
Waiting for Parts (Hr):	0

Detailed Block Summary of Pulverizer D

Detailed Block Information Block Name: MILL D	
General Information	
General Information	
Number of Block Downing Events:	6.218
Number of System Downing Events:	0
Number of Failures:	5.873333
Number of System Downing Failures:	0
Number of OFF Events by Trigger:	0
Mean Availability (All Events):	0.910274
Mean Availability (w/o PM, OC & Inspection):	0.912838
Block Uptime (Hr):	15947.99186
Block Downtime (Hr):	1572.00814
Standby Information	
Block Uptime (Active) (Hr):	15960.81204
Block Downtime (Active) (Hr):	473.147387
Block Uptime (Quiescent) (Hr):	0
Block Downtime (Quiescent) (Hr):	1098.860753
Metrics	
RS Criticality Indices	
RS DECI:	0.00%
Mean Time Between Downing Events (Hr):	2564.810527
RS FCI:	0.00%
MTBF (Hr):	2722.971365
Mean Downtime per Event (Hr):	252.815719
RS DTCI:	0.00%
RS BCCI:	-
Block Downtime Contribution Index	
Non-Waiting Time CI:	100.00%
Total Waiting Time CI:	0.00%
Waiting for Opportunity/Maximum Wait Time Ratio:	-
Crew/Part Wait Ratio:	0
Part/Crew Wait Ratio:	0
Downtime Summary	
Downtimes	
Non-Waiting Time (Hr):	1572.00814
Waiting for Opportunity (Hr):	0
Waiting for Crew (Hr):	0
Waiting for Parts (Hr):	0

Detailed Block Summary of Pulverizer E

Detailed Block Information Block Name: MILL E	
General Information	
General Information	
Number of Block Downing Events:	1.092333
Number of System Downing Events:	0
Number of Failures:	0.484
Number of System Downing Failures:	0
Number of OFF Events by Trigger:	0
Mean Availability (All Events):	0.988686
Mean Availability (w/o PM, OC & Inspection):	0.99305
Block Uptime (Hr):	17321.78331
Block Downtime (Hr):	198.21669
Standby Information	
Block Uptime (Active) (Hr):	1783.066875
Block Downtime (Active) (Hr):	80.494267
Block Uptime (Quiescent) (Hr):	15564.40136
Block Downtime (Quiescent) (Hr):	117.722423
Metrics	
RS Criticality Indices	
RS DECI:	0.00%
Mean Time Between Downing Events (Hr):	15857.59839
RS FCI:	0.00%
MTBF (Hr):	35946.75584
Mean Downtime per Event (Hr):	181.461724
RS DTCI:	0.00%
RS BCCI:	-
Block Downtime Contribution Index	
Non-Waiting Time CI:	100.00%
Total Waiting Time CI:	0.00%
Waiting for Opportunity/Maximum Wait Time Ratio:	-
Crew/Part Wait Ratio:	0
Part/Crew Wait Ratio:	0
Downtime Summary	
Downtimes	
Non-Waiting Time (Hr):	198.21669
Waiting for Opportunity (Hr):	0
Waiting for Crew (Hr):	0
Waiting for Parts (Hr):	0

Detailed Block Summary of Pulverizer F

Detailed Block Information Block Name: MILL F	
General Information	
General Information	
Number of Block Downing Events:	1.564667
Number of System Downing Events:	0
Number of Failures:	1.215667
Number of System Downing Failures:	0
Number of OFF Events by Trigger:	0
Mean Availability (All Events):	0.980245
Mean Availability (w/o PM, OC & Inspection):	0.983181
Block Uptime (Hr):	17173.88993
Block Downtime (Hr):	346.110072
Standby Information	
Block Uptime (Active) (Hr):	3444.836308
Block Downtime (Active) (Hr):	151.324558
Block Uptime (Quiescent) (Hr):	13746.64508
Block Downtime (Quiescent) (Hr):	194.785514
Metrics	
RS Criticality Indices	
RS DECI:	0.00%
Mean Time Between Downing Events (Hr):	10976.0694
RS FCI:	0.00%
MTBF (Hr):	14169.45478
Mean Downtime per Event (Hr):	221.20371
RS DTCI:	0.00%
RS BCCI:	-
Block Downtime Contribution Index	
Non-Waiting Time CI:	100.00%
Total Waiting Time CI:	0.00%
Waiting for Opportunity/Maximum Wait Time Ratio:	-
Crew/Part Wait Ratio:	0
Part/Crew Wait Ratio:	0
Downtime Summary	
Downtimes	
Non-Waiting Time (Hr):	346.110072
Waiting for Opportunity (Hr):	0
Waiting for Crew (Hr):	0
Waiting for Parts (Hr):	0

BIOGRAPHY

The author's name is Fadhillah Muttaqien and was born on November 14th, 1997 in Jakarta, Indonesia. Born to be the son derived from a couple with father named Helmi Maemozax and mother named Gita Mediana. The author had completed the formal studies at SDIT AL-Mubarak Jakarta (2006-2009) for elementary school, SMPIT Nurul Hikmah Jakarta (2009-2012) for Junior high school, and SMAN 45 Jakarta Utara for senior high school (2012-2015). After graduated from senior high school the author continue the study in Marine Engineering Departement of Institut Teknologi Sepuluh Nopember (Double Degree Program with Hochschule Wismar) and specialized in Marine Operation and Maintanance. During the college study, the author had involved as member in student organization, Department of Marine Engineering (HIMASISKAL FTK-ITS) as a staff of external affairs in the 2016/2018 period. Then as a head of external affairs in the 2018/2019 period. Then the author involves as a "Pemandu" LKMM Pra-TD and LKMM TD in the 2016/2018 period. On the second year of collage, the author participated in On the Job Training Program of PT. Daya Radar Utama Jakarta. On the third year of collage, the author participated in On Job Training Program of PT. Krakatau Bandar Samudera. In the final year, the author focused as the member of Marine Opertaion and Maintanance Laboratory. For Further discussion and suggestion regarding to this research, the author can be reached through email : fadhillah.muttaqin@gmail.com