

Improving Equipment Performance by Overall Equipment Effectiveness (OEE) Method on Sewage Treatment Plant (STP) Equipment Soekarno Hatta Airport

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Abstract:- Sewage Treatment Plant (STP) Soekarno – Hatta Airport is equipment processing waste liquid at Soekarno – Hatta Airport. In the processing process waste the there is a decomposition process use aeration equipment and stabilization equipment. The impact of Covid-19 at Soekarno – Hatta Airport is experiencing decline passengers, based on BPS data in 2018 number passenger Soekarno – Hatta Airport departures reached 30,402,108 while in 2021 the number passenger only 8,557,607, this causes exists policy company that is exists efficiency budget at all line business company including existence efficiency budget maintenance equipment. From the data obtained happen decline The average performance value of STP equipment in 2020 was 96% down to 88.31% in 2022. For this reason, this research aims to find out Overall Equipment Effectiveness (OEE) value with count mark availability rate, performance rate, and quality rate of STP equipment, to find out the cause decreasing equipment performance value with know root problem the with using Fish Bone Diagram, 5 Whys Analysis, and 5W+1H to get reference in recommendation repair system maintenance on STP equipment. Recommendation repair the estimated capable increase the OEE value of STP equipment from the previous one in 2022 was 68 % to 79% in 2023.

Keywords:- OEE, 5 Whys Analysis, STP.

I. INTRODUCTION

Indonesia is an archipelagic country that has an area of 1.9 million kilometers, this condition makes need will transportation air is really needed. In transportation air one element important things needed is the airport or normal called Airport. According to Regulation Director General Air Transportation Number: SKEP/124/VI/2009, Airport is areas on land and/ or waters with certain limits used as place aircraft air landing and taking off take off, up and down passengers, unload load things and places intra and inter transfer mode transport, which is equipped with facility safety and security flight as well as facility principal and facilities support other. In Indonesia itself there is several management operators the airport is one of them is PT. Angkasa Pura II (Persero).

PT. Angkasa Pura II (Persero) is one of the active State-Owned Enterprises in field business service service airports and services service related to existing airports since August 13 1984. Establishment of PT. Angkasa Pura II (Persero) aims to carry out management and business in field service airports and services related to airports with optimizing empowerment potency source owned power and application governance practices good company.

Indonesia is an archipelagic country that has an area of 1.9 million kilometers, this condition makes need will transportation air is really needed . In transportation air one _ element important things needed is the airport or normal called Airport. According to Regulation Director General Air Transportation Number : SKEP/124/VI/2009, Airport is areas on land and/ or waters with certain limits used _ as place aircraft air landing and taking off take off , up and down passengers , unload load things and places intra and inter transfer mode transport , which is equipped with facility safety and security flight as well as facility principal and facilities support other . In Indonesia itself there is several management operators the airport is one of them is PT. Angkasa Pura II (Persero).

In management currently PT. Angkasa Pura II (Persero) always endeavor reduce every impact emerging environment _ consequence activity Company operations . Impact environment created by activities _ Company operations , efforts are made to suppress as low as perhaps for sustainability environment can awake . company arrange and determine stated policies _ in Company Regulation No. 38 Regarding the PT Angkasa Pura II Eco-Airport Master Plan that has been determined in the Directors' Decision Number : KEP.02.04/10/2012. The purpose of This rule is to protect environment from impact operation and development of airports , the regulation of which based on the framework management airport environment and surrounding areas .

One of airport managed by PT. Angkasa Pura II (Persero) is Soekarno – Hatta International Airport or often called by society general Cengkareng Airport Because the location close to the Cengkareng area of West Jakarta though in a way geographical is in Benda sub-district , Tangerang City. Soekarno – Hatta Airport itself has 3 passenger terminals namely Terminal 1, Terminal 2 and Terminal 3.

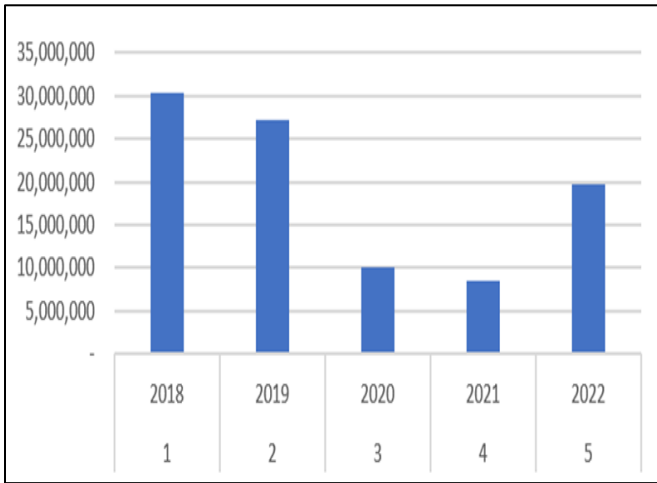


Fig 1 Number of Departing Passengers

Based on the data quoted from the Central Statistics Agency (BPS) occurred decline amount passenger departure at Soekarno – Hatta Airport from Originally in 2018 it had a total of 30,402,108 passengers and this dropped very significantly in 2021, namely a total of 8,557,607 passengers. Condition the naturally We know with one the cause that is covid-19 pandemic with rule Enforcement Restrictions Activity Masyarakat (PPKM) so public recommended to stay at home so you can reduce number covid-19 transmission, however amount passenger will gradually recover in 2022, namely a total of 19,817,893 passengers. As is decline amount passenger naturally the company also implements adjustment pattern Terminal operations at Soekarno – Hatta Airport, among others namely cost efficiency strategies and minimum operation patterns.

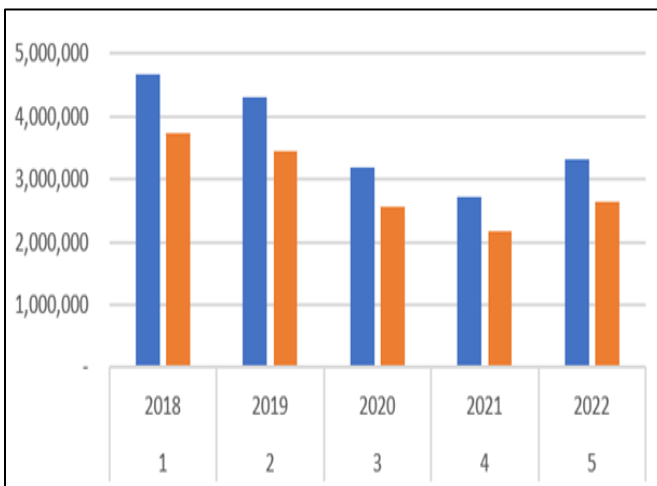


Fig 2. Data on Total Clean Water Use & CGK Waste Water Management

In connection with the adjustment pattern operation so It also has an impact on clean water consumption at Soekarno - Hatta Airport, namely in 2018 which reached 4,667,044 m3 / year experience a very significant decrease in 2021, namely 2,714,059 m3 / year. This is also in line with the decline wastewater processing which was originally in 2018 amounted to 3,733,635 m3 / year experience decrease in 2021 to 2,171,247 m3 / year. Which is in accordance with waste water generation calculated by assuming that 80% of clean

water needs will become waste water. This is in accordance with the standards set by the Directorate General Cipta Karya, so waste water calculations obtained than 80% of clean water needs (First, 2018) However of course it is adjustment pattern operations, and the existence of an efficiency strategy cost must still notice One of the mandatory things is that is must still guard sustainability environment according to inside Company Regulation No.38 Concerning PT Angkasa Pura II's Eco-Airport Master Plan as stipulated in the Directors' Decision Number: KEP.02.04/10/2012.

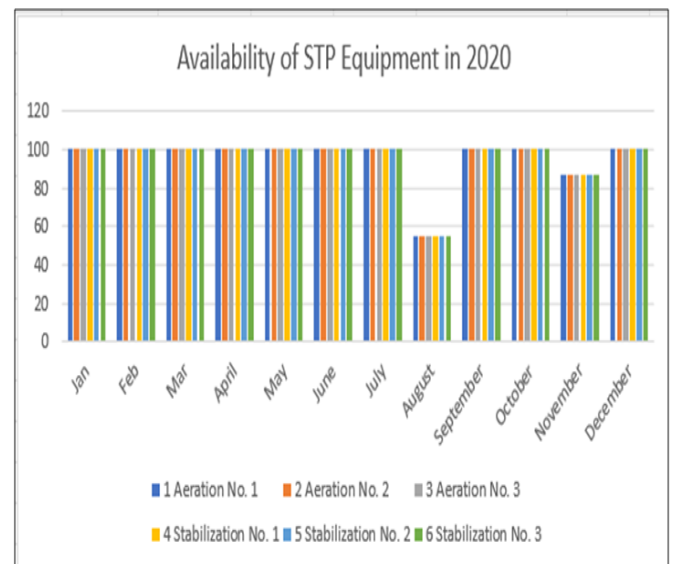


Fig 3 Availability of STP Equipment 2020

In accordance with the data above that as it is implementation of cost efficient strategies and adjustments pattern operation there is decline average value of equipment performance from 2020 that is of 96%, in 2021 it is 98%, and in 2022 it is 88.31%, so can seen exists decline average value of equipment performance for each the year. Even for results standard quality Still meet the standards in accordance with the RKL – RPL report every semester from 2020 to 2022 but activity maintenance and repair equipment is very dependent on cost maintenance provided by the company. And based on the Director's Decision General Civil Aviation number: SKEP/157/IX/03 concerning Guidelines Maintenance and Reporting Equipment Facility Aviation Electronics and Electricity in article 17 paragraph 1 Evaluation maintenance as referred to in article 8 letter c, carried out every 1 year for determination planning repair, provision ethnic group spare and replacement equipment. Paragraph 2 Evaluation results equipment facility electronics and electricity flight as referred to in paragraph (1) is divided in 3 groups namely: group very frequent equipment experience interference / damage with value availability < 70 %, group frequent equipment experience interference / damage with value availability 70%<A<95%, Rare equipment group experience interference / damage with value availability ≥ 95 %. average value of equipment performance in 2022 is 88.31% so including to category group frequent equipment experience disruption / damage so that required something possible methods _ increase mark availability equipment with one the method namely by counting Overall Equipment Effectiveness (OEE) value of STP equipment at Soekarno – Hatta Airport.

II. LITERATURE REVIEW

➤ *Definition of Airport*

Indonesia is an archipelagic country _ largest in the world so An easy transportation system is needed for the public to access throughout the region, one mode the transportation that is transportation air where is one its components is the airport. An airport is part from one service system transportation air Good national nor international, which is one of them is network transportation namely airports, navigation _ aviation, and networking service. (DR Hadi Suharno, 2009). Refer from understanding the so the role of airports is very important in mode transportation air. Whereas definition of airport is an airfield used for landing and takeoff take off aircraft air, up and down passengers, and/ or demolish load cargo and/ or post, as well be equipped with facility safety aviationand as place displacement intermodal transportation. Airport functions among them that is give facility for the airplane landed and stayed takeoff, place transfer mode transportation from land to air, as center activity regional and central economy. (DR Hadi Suharno, 2009).

➤ *Wastewater Treatment*

According to regulation government Republic of Indonesia Number 82 of 2001, waste water is remainder from something business and or tangible activities _ liquid , waste water can originate from House household (domestic) and industry. Every activity production in an industry always produces waste water , therefore it is necessary further treatment _ in a way right so that it doesn't pollute environment (Asmadi & Suharno , 2012). As well as case activity service airport naturally give rise to impact to the environment is one of them that is waste liquid from passengers / users airport services. This is of course required equipment that can process waste liquid intended to be able to processed in accordance with applicable rules. In its category waste generated by services airport is waste liquid domestic. Waste domestic liquid is results waste daru housing, buildings, commerce, offices and facilities the like. Domestic waste is complex solution consists from water (usually above 99%) and substances organic as well as inorganic, fine form solids dissolved or those that settle. Wastewater characteristics are divided into three major parts, namely physical, chemical and biological characteristics.

➤ *Equipment Maintenance*

Activity maintenance is one of very important activity carried out in activities airport operations, especially on equipment that is directly connected with activity flight Good to passenger or with activity flight. According to Mobley (2011), maintenance is important function in a production unit or factory. With exists activity good maintenance so will created condition equipment that can operate with good too. Classification maintenance according to Kiameh (2011) divided to in 2 categories, namely planned maintenance (maintenance planned) and unplanned maintenance (maintenance No planned). Unplanned maintenance carried out by the corrective maintenance team through breakdown maintenance. Meanwhile, planned maintenance is divided into 2 parts, namely preventive and corrective maintenance.

➤ *Overall Equipment Effectiveness*

Overall Equipment Effectiveness (OEE) is effectiveness equipment in a way overall to evaluate how much big mark performance and reliability something machine (Felecia & Limantoro, 2013).

➤ *Root Cause Analysis*

According to Okes (2019), Root Cause Analysis (RCA) is approach structured to identify factors effect on one or more past events in order to get it used to improve performance. Whereas according to Latino et al. (2019), RCA is a popular tool used by the running company Lean Six Sigma concept. RCA is one the tools used in problem solving initiatives to help team find root the cause (root cause) of current problem currently faced (KC Latino et al., 2020). Another opinion according to Fantin (2014), Root cause(s) is part from a number of factors (events, conditions, factors organizational) that provides contribution, or give rise to cause and followed by an undesirable effect expected. Whereas according to Barsalou (2014), RCA is an adequate Lean tool easy used to help team find root problem 33 or answer from A moderate problem faced. According to Fantin (2014).

- *Based on Theories the so Framework Thinking in this Research as Follows:*

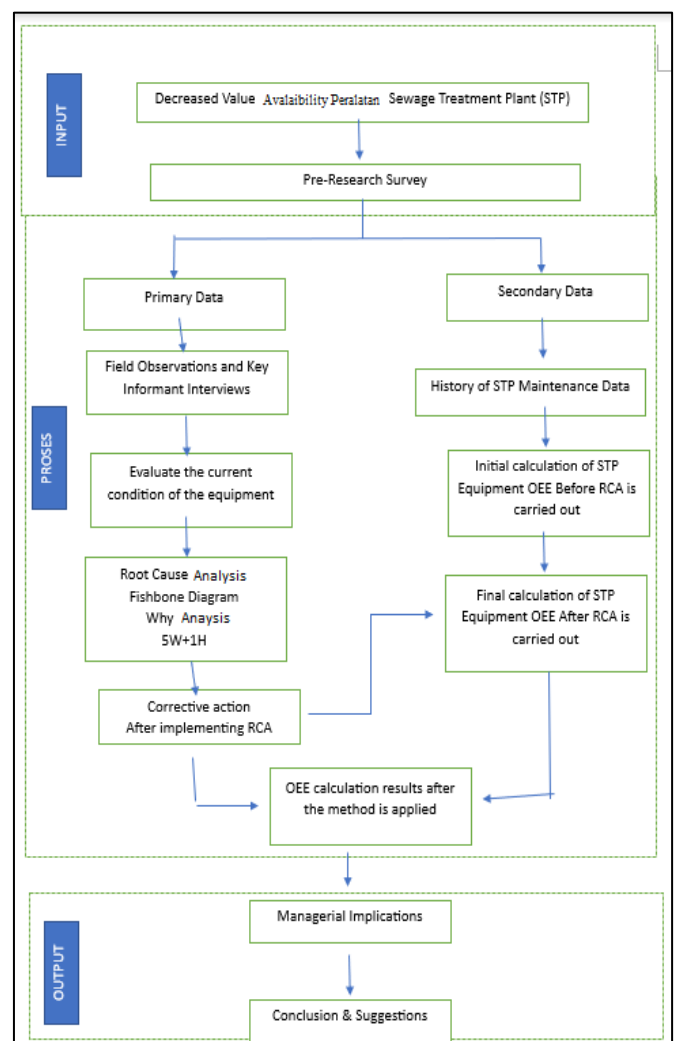


Fig 4 Framework Thinking

III. RESEARCH METHODOLOGY

The method used in this research is the Quantitative Descriptive method. Analysis method descriptive in This research is used to find out overall equipment effectiveness (OEE) value in application implementation of Total Productive Maintenance (TPM) on Soekarno – Hatta Airport Sewage Treatment Plant (STP) equipment. Apart from that method quantitative used to measure STP equipment performance, downtime of STP equipment using OEE method. Descriptive Quantitative expected capable provide output results research that can used as implications managerial for management company PT. Angkasa Pura II.

This research begins from low mark availability Sewage Treatment Plant (STP) equipment at Soekarno – Hatta Airport. Based on observation author supported by activity data company, high equipment downtime so that the STP equipment system is off operation. Therefore, this research was conducted to analyze factors the resulting cause low mark availability on STP equipment.

Taking sample used in This research is non-probability with purposive sampling technique. Purposive sampling technique is technique determination sample study with consideration certain. Determination sample in this research was carried out with method determine the target of element most appropriate population for use as informant key is the implementation level until with supervisor with total of 5 people.

Data analysis method used in this research is as 1. Stages identification level of performance, availability and quality of Sewage Treatment Plant equipment during three year Lastly, 2. Carry out Root Cause Analysis with use the Fishbone Diagram and Why Analysis to find out factors What that's the only thing that causes it OEE value of Sewage Treatment Plant (STP) equipment at Soekarno - Hatta Airport is low, 3. Then next with analysis use 5W+1H method to get action Corrective is a must done to improve OEE value of Sewage Treatment Plant (STP) equipment at Soekarno-Hatta Airport, 4. Evaluation All data is collected to determine improvement ideas to address low OEE value of Sewage Treatment Plant (STP) equipment at Soekarno – Hatta Airport, 5. Calculating return OEE value of Sewage Treatment Plant (STP) equipment at Soekarno – Hatta Airport after done actions repair.

IV. RESULTS

A. Data Analysis

➤ *Calculation of Overall Effectiveness Equipment (OEE)*

• *Calculation of Availability Values Equipment*

Availability value equipment can calculated with formula 2.2. from chapter 2, where The loading time value is the total number of operating hours each month, meanwhile The operation time value is number of operating hours equipment in each the month. Based on secondary data equipment namely report data daily and monthly reports on

aeration and stabilization equipment for the sewage treatment plant (STP) at Soekarno – Hatta Airport calculated as follows:

- ✓ *Availability of Aeration Equipment Number 1 in February 2022:*

$$\frac{672 \text{ Jam} - 240 \text{ Jam}}{672 \text{ Jam}} \times 100 \% = 64,28\%$$

- ✓ *Availability of Stabilization Equipment Number 2 in March 2022:*

$$\frac{744 \text{ Jam} - 168 \text{ Jam}}{744 \text{ Jam}} \times 100 \% = 77,41\%$$

The results of calculating the availability of aeration and stabilization equipment using the same calculation method from 2020 to 2022 can be seen from the following table image:

Table 1 Availability of STP Equipment in 2020

Availability of STP Equipment in 2020														
No	Equipment Name	Jan	Feb	March	April	May	June	July	Augst	Sept	Oct	Nov	Dec	Avg
1	Aeration No. 1	100	100	100	100	100	100	100	55	100	100	87	100	95
2	Aeration No. 2	100	100	100	100	100	100	100	55	100	100	87	100	95
3	Aeration No. 3	100	100	100	100	100	100	100	55	100	100	87	100	95
4	Stabilization No. 1	100	100	100	100	100	100	100	55	100	100	87	100	95
5	Stabilization No. 2	100	100	100	100	100	100	100	55	100	100	87	100	95
6	Stabilization No. 3	100	100	100	100	100	100	100	55	100	100	87	100	95
Average Value of STP Equipment Availability in 2020														95

Table 2 Availability of STP Equipment in 2021

Availability of STP Equipment in 2021														
No	Equipment Name	Jan	Feb	March	April	May	June	July	Augst	Sept	Oct	Nov	Dec	Avg
1	Aeration No. 1	100	96	100	97	74	100	100	100	93	100	70	94	94
2	Aeration No. 2	100	96	100	97	74	100	100	100	93	100	70	94	94
3	Aeration No. 3	100	96	100	97	74	100	100	100	93	100	70	94	94
4	Stabilization No. 1	100	96	100	97	74	100	100	100	93	100	93	94	96
5	Stabilization No. 2	100	96	100	97	74	100	100	100	93	100	93	94	96
6	Stabilization No. 3	100	96	100	97	74	100	100	100	93	100	93	94	96
Average Value of STP Equipment Availability in 2021														95

Table 3 Availability of STP Equipment in 2022

Availability of STP Equipment in 2022														
No	Equipment Name	Jan	Feb	March	April	May	June	July	Augst	Sept	Oct	Nov	Dec	Avg
1	Aeration No. 1	100	64	71	100	100	100	100	100	87	32	100	100	88
2	Aeration No. 2	100	100	61	93	100	100	100	100	87	32	100	100	89
3	Aeration No. 3	100	100	61	93	100	100	100	100	100	100	100	100	96
4	Stabilization No. 1	100	100	100	100	100	100	100	100	100	100	100	100	100
5	Stabilization No. 2	100	100	77	0	0	100	100	100	100	100	100	100	81
6	Stabilization No. 3	100	100	35	0	0	100	100	100	100	100	100	100	78
Average Value of STP Equipment Availability in 2022														89

From calculation data on found average value of availability Sewage Treatment Plant (STP) equipment from 2020 until in 2022 experience decline that is from 95 to 89.

• *Equipment Performance Calculations*

Equipment performance value can calculated in accordance with formula 2.3, then based on report data daily and reports monthly average amount of waste water production daily in February 2022 that is amounting to 7,300 m3/ day. Meanwhile, the % of working hours for aeration number 1 in February 2022 is calculated as follows:

$$\% \text{ jam kerja} = 1 - \frac{240 \text{ Jam}}{432 \text{ Jam}} \times 100 \% = 44,44 \%$$

$$\text{Cycle Time} = \frac{672 \text{ Jam}}{144.000 \text{ m}^3 / \text{month}} \times 100 \% = 0,00467\%$$

$$\text{Performance Ratio} = \frac{144.000 \text{ m}^3 / \text{month} \times 0,20741}{432 \text{ jam}} \times 100 \% = 69,13 \%$$

✓ *The Performance Calculation for Stabilization Equipment Number 2 for March 2022 is as Follows:*

$$\% \text{ jam kerja} = 1 - (168 \text{ Jam}) / (576 \text{ Jam}) \times 100 \% = 70,83 \%$$

$$\text{Cycle Time} = (744 \text{ Jam}) / (175.200 \text{ m}^3 / \text{month}) \times 100 \% = 0,00425\%$$

$$\text{Performance Ratio} = (175.200 \text{ m}^3 / \text{month} \times 0,30080) / (576 \text{ jam}) \times 100 \% = 91,49 \%$$

The results of calculating the performance of aeration & stabilization equipment using the same calculation method from 2020 to 2022 can be seen from the following table image:

Table 4 STP Equipment Performance in 2020

STP Equipment Performance in 2020														
No	Equipment Name	Jan	Feb	March	April	May	June	July	Augst	Sept	Oct	Nov	Dec	Avg
1	Aeration No. 1	100	96	100	97	100	100	100	100	93	100	70	94	96
2	Aeration No. 2	100	96	100	97	100	100	100	100	93	100	70	94	96
3	Aeration No. 3	100	96	100	97	100	100	100	100	93	100	70	94	96
4	Stabilization No. 1	100	96	100	97	100	100	100	100	93	100	93	94	98
5	Stabilization No. 2	100	96	100	97	100	100	100	100	93	100	93	94	98
6	Stabilization No. 3	100	96	100	97	100	100	100	100	93	100	93	94	98
Average Value of STP Equipment Performance 2020														97

Table 5 STP Equipment Performance in 2021

STP Equipment Performance in 2021														
No	Equipment Name	Jan	Feb	March	April	May	June	July	Augst	Sept	Oct	Nov	Dec	Avg
1	Aeration No. 1	100	100	100	100	88	100	100	100	99	100	82	100	97
2	Aeration No. 2	100	100	100	100	88	100	100	100	99	100	82	100	97
3	Aeration No. 3	100	100	100	100	88	100	100	100	99	100	82	100	97
4	Stabilization No. 1	100	100	100	100	88	100	100	100	99	100	99	100	99
5	Stabilization No. 2	100	100	100	100	88	100	100	100	99	100	99	100	99
6	Stabilization No. 3	100	100	100	100	88	100	100	100	99	100	99	100	99
Average Value of STP Equipment Performance 2021														98

Table 6 STP Equipment Performance in 2022

STP Equipment Performance in 2022														
No	Equipment Name	Jan	Feb	March	April	May	June	July	Augst	Sept	Oct	Nov	Dec	Avg
1	Aeration No. 1	100	69	83	100	100	100	100	100	98	0	100	100	87.5
2	Aeration No. 2	100	100	60	99	100	100	100	100	98	0	100	100	88.1
3	Aeration No. 3	100	100	60	99	100	100	100	100	100	100	100	100	96.6
4	Stabilization No. 1	100	100	100	100	100	100	100	100	100	100	100	100	100
5	Stabilization No. 2	100	100	91	0	0	100	100	100	100	100	100	100	82.6
6	Stabilization No. 3	100	100	0	0	0	100	100	100	100	100	100	100	75
Average Value of STP Equipment Performance 2022														88.3

From the data in the calculation tables above, it is found that the average performance value of Sewage Treatment Plant (STP) equipment from 2020 to 2022 has decreased, namely from 97 to 88.

• *Equipment Quality Calculations*

Equipment Quality Value can be calculated in accordance with formula 2.4, then based on report data daily and reports monthly average amount of waste water production daily in February 2022 that is amounting to 7,300 m³/ day.

✓ *The Calculation of Quality Aeration Value Number 1 for February 2022 is Calculated as Follows:*

$$\frac{131.400-73.000}{131.400} \times 100 \% = 44 \%$$

✓ *The Calculation of Quality Stabilization Value Number 2 for March 2022 is Calculated as Follows:*

$$\frac{175.200-51.100}{175.200} \times 100 \% = 71 \%$$

Table 7 STP Equipment Performance in 2020

Quality of STP Equipment in 2020														
No	Equipment Name	Jan	Feb	March	April	May	June	July	Augst	Sept	Oct	Nov	Dec	Avg
1	Aeration No. 1	100	96	100	97	100	100	100	100	93	100	70	94	96
2	Aeration No. 2	100	96	100	97	100	100	100	100	93	100	70	94	96
3	Aeration No. 3	100	96	100	97	100	100	100	100	93	100	70	94	96
4	Stabilization No. 1	100	96	100	97	100	100	100	100	93	100	93	94	98
5	Stabilization No. 2	100	96	100	97	100	100	100	100	93	100	93	94	98
6	Stabilization No. 3	100	96	100	97	100	100	100	100	93	100	93	94	98
Average Value of STP Equipment Quality in 2020														97

Table 8 STP Equipment Performance in 2021

Quality of STP Equipment in 2021														
No	Equipment Name	Jan	Feb	March	April	May	June	July	Augst	Sept	Oct	Nov	Dec	Avg
1	Aeration No. 1	100	96	100	97	65	100	100	100	93	100	57	93	92
2	Aeration No. 2	100	96	100	97	65	100	100	100	93	100	57	93	92
3	Aeration No. 3	100	96	100	97	65	100	100	100	93	100	57	93	92
4	Stabilization No. 1	100	96	100	97	65	100	100	100	93	100	93	93	95
5	Stabilization No. 2	100	96	100	97	65	100	100	100	93	100	93	93	95
6	Stabilization No. 3	100	96	100	97	65	100	100	100	93	100	93	93	95
Average Value of STP Equipment Quality in 2021														93

Table 9 STP Equipment Performance in 2022

Quality of STP Equipment in 2022														
No	Equipment Name	Jan	Feb	March	April	May	June	July	Augst	Sept	Oct	Nov	Dec	Avg
1	Aeration No. 1	100	44	59	100	100	100	100	100	85	0	100	100	82.3
2	Aeration No. 2	100	100	37	93	100	100	100	100	85	0	100	100	84.5
3	Aeration No. 3	100	100	37	93	100	100	100	100	100	100	100	100	94.1
4	Stabilization No. 1	100	100	100	100	100	100	100	100	100	100	100	100	100
5	Stabilization No. 2	100	100	71	0	0	100	100	100	100	100	100	100	80.9
6	Stabilization No. 3	100	100	0	0	0	100	100	100	100	100	100	100	75
Average Value of STP Equipment Quality in 2022														86.2

From table data calculation on found average value of Sewage Treatment Plant (STP) equipment quality from 2020 until in 2022 experience decline that is from 97 to 86.

• *Calculation Overall Equipment Effectiveness (OEE) value*

After getting the results of calculating the OEE factors, the OEE value can be calculated using formula 2.1 as follows:

$$2020 \text{ OEE Value} = 0.95 \times 0.96 \times 0.95 = 87$$

$$\text{OEE Value for 2021} = 0.94 \times 0.98 \times 0.93 = 87$$

$$\text{OEE Value for 2022} = 0.88 \times 0.88 \times 0.86 = 68$$

With the calculation results, the OEE value of STP equipment obtained experienced a significant decline, where according to the Japan Institute of Plant Maintenance (JIPM), the OEE value = 85% of production is considered world class, OEE = 60% of production is considered reasonable, but shows that there is large room for improvement (Siahaan & Arvianto, nd).

Therefore, further analysis is needed to find out what factors influence the decline in the OEE value of Soekarno - Hatta Airport STP equipment and what corrective actions must be implemented so that the OEE value of STP equipment can increase again.

➤ *Root Cause Analysis*

Stages The next step in this research is stages analysis reason exists decline Overall Equipment Effectiveness (OEE) value for Sewage Treatment Plant (STP) equipment at Soekarno – Hatta Airport, namely with method carry out Focus Group Discussions (FGD) / interviews with experts and found results as follows:

• *Fishbone Diagrams*

Data analysis using Fishbone diagrams aims to find all possible cause happen through an interview process with experts. Problem general start grouped and focused in more detail and depth to explore root reason from problem. In a two- way discussion between writer with experts, writers on duty utilise the experience of experts to find root problems and searches step improvements that must be made taken. Interview with experts carried out to search possibility factors reason problem (cause).

Interview result with experts found a number of reason main with write all sub chapters possible cause happen into 5 factors reason main namely: 1) Man; 2) Machines; 3) Method; 4) Materials; 5)Money.

• *Why Analysis*

Based on The results of the 5 Why analysis above were found results root reason happen problem down performance value of STP equipment at Soekarno – Hatta Airport which is divided into 5 factors main namely man, machine, method, material, money. As for explanation about root reason problem the is as follows:

Man Factor (Person), factor the first to be expected become reason down the performance value of STP equipment is the first human factor that is lack of supervision, lack of supervision in this thing ie No fulfillment formation power technician organic in accordance with Regulation Directors of PT. Angkasa Pura II number : PD.01.01/03/2019/0011 concerning Name of Position, Class Position, Formation and Requirements in the Main Branch Office Work Unit of PT. Angkasa Pura II (Persero) Soekarno – Hatta International Airport actually amount formation of a Sanitation Facility Unit with 17 personnel while in 2020 and 2021 the formations are filled is 12 personnel, and in 2022 the formation will be filled is 9 personnel, this is of course influential to supervision activity maintenance STP equipment due to personnel technician on duty No only do supervision to STP equipment only but also do supervision his other job in accordance with the job profile of the Sanitation Facility unit. Then factor second is less power executor maintenance equipment, this is caused exists efficiency budget from PT. Angkasa Pura II so exists adjustment power implemented by partners Work in accordance with given budget, in 2020 efficiency budget reaching 80% means realization budget only 20% so amount Initially there were 8 workers streamlined into 2 personnel, this continues until with in 2022. Third factor is PT technician. Angkasa Pura II only have 1 certificate mandatory skills owned that is license from Airport Directorate with field Teknik Airport Mechanical with Water Pumping System (WPS) expert rating. And factors final that is power executor maintenance not enough certified because who has Certificate Skill only experts for implementation maintenance Not yet own certificate skill.

Machine Factor (machine), factor both suspects become reason down The performance value of STP equipment at Soekarno – Hatta Airport is factor from one of the machines that is factor age equipment installed where in this research there are 3 aeration motors and 3 stabilization motors based on the electric motor equipment manual book along with a gearbox with type QVPC3-VDN-28 where equipment it is already installed from 1984. Meanwhile age economical equipment processing waste in accordance with Regulation Directors of PT. Angkasa Pura II (Persero) number: PD.05.03/08/2019/0084 concerning Determining the Capitalism Value of Fixed Assets, Age Economical for calculations Depreciation of Fixed Assets, Amount of Asset Expenses charged, and Overlay Costs borne and Amortization at PT. Angkasa Pura II (Persero) is 20 years, meanwhile conditions in the field equipment It has been installed for more than 20 years. Furthermore that is Corrective maintenance activities also contribute mark down performance STP equipment at Soekarno – Hatta Airport because based on data obtained in the field for the most frequent corrective maintenance work held namely rewinding / rolling reset the motorbike, where? work the use partner Work with a long time reaches 30 – 45 days. And the third factor is capacity STP processing at Soekarno – Hatta Airport according to the actual STP construction data sheet capacity his that is amounting to 4,200 m³/ day as for conditions currently if referring to research previously waste water generation calculated with assume that 80% of clean water

needs will into wastewater (Wardhani et al., 2023), with actual data Clean water use in 2023 will reach 12,000 m³ / day then waste water arises _ namely 9,600 m³/ day, this is of course will effect on performance equipment in a way whole .

Method factor, this factor is suspected become reason decreased performance, namely No implementation of maintenance Standard Operational Procedures (SOP). Sewage Treatment Plant (STP) equipment number: 14.08.27/00/04/2018. That is at the point of daily routine maintenance exists checking equipment motor current However implementation in the field Not yet held optimally during the period 2020 until with in 2022 due to exists limitations personnel maintenance during the Covid 19 pandemic.

Material Factors, factors next that is, what is suspected donate decreasing STP performance value at Soekarno – Hatta Airport because exists limited stock of spare parts. This happened Because No exists related monitoring system availability of spare parts stock so that when the stock has passed the lower limit No There is reminder to come soon can held return.

Money Factor (finance), the last factor is factor finance, with the Covid 19 pandemic caused exists efficiency maintenance budget, namely realization absorption budget in 2020 in the Q2 period was 20%, Q3 was 46 % , and in Q4 was 56%, while in 2021 efficiency budget by 56%, and in Q1 up to with Q3 2022 efficiency budget of 20%, in Q4 2022 the budget can be realized by 100%.

Based on results 5W+1H analysis above action suggestions are generated corrective / improvement for the company in implementation activity maintenance equipment over the years next. Cooperation and commitment from all parties involved, OK internal company parties nor party external companies involved in activity maintenance Soekarno – Hatta Airport STP equipment with hope equipment performance level in accordance with rules that have been set. This was conveyed at the time regular evaluation meetings work maintenance Soekarno – Hatta Airport STP equipment implemented daily, monthly and yearly with goals for each party committed to achieving the targets that have been set determined by the company.

V. DISCUSSION

➤ *Result of Calculation Analysis of Overall Equipment Effectiveness (OEE) Value*

After calculating the Overall Equipment Effectiveness (OEE) value of Soekarno – Hatta Airport STP Equipment, the following results were found, the OEE value in 2020 was 87, the OEE value in 2021 was 87, and the OEE value in 2022 was 68. From the OEE value it was found a downward trend from 2020 to 2022. Based on monthly report data, it was found that the decrease in OEE values was due to low equipment availability, performance and quality values, especially in 2022, namely Stabilization equipment number 2 and number 3 which were off operation in the months of

April and May due to corrective maintenance work rewinding the induction motor of the equipment in question. The length of rewinding work itself from the administration process to completion of the work can reach 30 days because the rewinding process is carried out by partners/vendors.

After analyzing the causes of the decline in the performance value of Soekarno - Hatta Airport STP equipment and carrying out corrective actions that have been implemented, the following calculation of the OEE value of Soekarno - Hatta Airport STP Equipment in the period January 2023 to October 2023 is as follows: $0.91 \times 0.96 \times 0.89 = 79$. The OEE value of Sewage Treatment Plant (STP) equipment at Soekarno - Hatta Airport has increased from the previous year (2022).

➤ *Results of Analysis of Factors Causing Decreased Performance Values of STP Equipment*

The factors that are thought to have caused the decline in the performance value of Soekarno - Hatta Airport STP equipment were analyzed for the most influential factors including man, machine, method, material, money. Based on the results of the FGD and brainstorming together with research sources which were then processed using 5 why analysis.

➤ *Results of Analysis of Corrective Actions / Improvements*

After carrying out an analysis using the 5 why analysis method, the root of the problem was found in the five factors which were thought to be the cause of the decline in the performance value of Soekarno - Hatta Airport STP equipment. The root of the problem must be addressed immediately to avoid problems occurring in the following years. The root causes of the five factors suspected to be the cause of the decline in the performance value of Soekarno - Hatta Airport STP equipment include:

- Human factor: lack of human resources to implement equipment maintenance and also the number of human resources to supervise equipment maintenance.
- Machine factor: the age of the equipment is more than the economic age of the equipment
- Method factor: failure to implement equipment maintenance SOPs properly
- Material factors: materials/equipment spare parts that are not available when needed
- Money/financial factor: there is efficiency in maintenance costs that occurred during the 3 years 2020 to 2022

After finding the root of the problem of the five factors which are thought to be the cause of the decline in the performance value of Soekarno - Hatta Airport STP equipment, the steps that can be taken are to overcome these problems as corrective/improvement action for this year and the coming year.

➤ *Managerial Implications*

The application of equipment performance calculations using the Overall Equipment Effectiveness (OEE) method, and cause analysis along with corrective action plans using fishbone diagrams, the 5 why analysis method, and the

5W+1H method to be carried out by management is expected to have a positive impact on the company in the future. The application of the OEE method can help to determine the performance value of Soekarno - Hatta Airport STP equipment so that the equipment performance value can be included in the category of equipment groups that rarely experience interference/damage with an availability value of $\geq 95\%$ in accordance with the Decree of the Director General of Civil Aviation number: SKEP/157 /IX/03 concerning Guidelines for Maintenance and Reporting of Aviation Electronic and Electrical Facility Equipment in article 17 paragraph 1. Meanwhile, the 5 why analysis method is able to find the root of the problem in the problem of decreasing performance value of Soekarno - Hatta Airport STP equipment which is followed by the 5W+1H Analysis method so that the company is able to formulate possible corrective actions to be taken based on the results of the analysis that has been carried out.

By applying the results of the analysis that has been carried out, it was found that there was an increase in the OEE value of Soekarno - Hatta Airport STP equipment from 2022 with the original value of 68% increasing in 2023 by 79%. Where according to the Japan Institute of Plant Maintenance (JIPM) the value of OEE = 85% of production is considered world class, OEE = 60% of production is considered reasonable, with the OEE value of STP equipment at Soekarno - Hatta Airport achieved still at 79% of course there must be hard work and a joint commitment to be able to pursue STP equipment OEE values that can reach 85% to obtain world-class OEE values.

With the implementation of proposed corrective actions so that the implementation of preventive maintenance can run well, in 2023 it is proposed that routine maintenance costs will not be budget efficient so that preventive maintenance budget absorption is 100%, with the implementation of this, it is found that there will be cost efficiency in corrective maintenance activities up to the period Q3 2023 compared to 2022 for Soekarno - Hatta Airport STP equipment, which was IDR. 307,253,750,000. Where the total maintenance costs for STP equipment in 2022 will be IDR. 1,410,185,000 while the total maintenance costs for STP equipment in 2023 will be IDR. 1,369,133,750.

VI. CONCLUSION

➤ *Conclusion*

- Found calculation Overall Equipment Effectiveness (OEE) value of Sewage Treatment Plant (STP) equipment in the range time 2020 that is by 87%, in 2021 by 87%, and in 2022 by 68%, while in 2023 it is by 79%.
- Based on results analysis that has been carried out with use fishbone diagram method , 5 Why Analysis found a number of factor mutual causes related namely: the man (human) factor due to exists adjustment executor maintenance on range April 2020 until with September 2022 so method implementation carried out non- optimal, method maintenance becomes very important because equipment maintained own age use equipment that is

more than 20 years old, this is impact exists efficiency budget to activity maintenance equipment,

- After know factors reason decreasing Overall Effectiveness Equipment (OEE) value of Sewage Treatment Plant (STP) equipment continues analysis with 5W+1H method to get proposal activities repair so found Overall Equipment Effectiveness (OEE) value experienced increase in 2023 with OEE value was 79% where in year previously in 2022 the OEE value of STP equipment was 68 %.

SUGGESTION

- Study furthermore expected can carry out research on ranges longer time to get Overall Equipment Effectiveness (OEE) value of Sewage Treatment Plant (STP) equipment.
- Study furthermore expected can carry out study with all Sewage Treatment Plant (STP) equipment is good from pre-treatment, treatment, post-treatment equipment.
- Can be implemented study similar in different places and with characteristics similar waste so that can implemented at the Sewage Treatment Plant (STP) in another location with characteristics similar waste.

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