Risk Management Using HAZOP Study Method Base Fault Tree Analysis on Emergency Shutdown System-Vacuum Distillation Unit, PT.PQR, Dumai, Indonesia

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***Abstract*— Feed of reboiler heater system from PT. PQR is the object of study used to design risk management. The risk of failure on ESD components in reboiler Feed Heater is a plant shutdown. This study uses risk management to identify and calculate the risk of failure on plant reboiler feed heater, so that risks can be avoided resulting in increased losses of the company. Some of the causes and consequences of failure risk analyzed using HAZOP Study, while the development of the failure mechanism is analyzed using the FTA. Incorporate risk management to measure the likelihood and consequences of a risk score. Likelihood value is the frequency of failure each year in the form of MTTF values. Value of the consequences is the cost of failure in any component which is derived from multiplying the cost of repairs (CR) with a magnitude of Mean Time to Repair (MTTR), in addition to the value of the consequence is wasted time when there is a failure; it is derived from the MTTR. From the research that has been done can be seen that, the component with the highest risk score is FT1017C on Feed Pass # 2 flow. The consequent loss related to environment and personnel losses due to accident not been discussed in this study.**

Keywords: Risk Management, Likelihood, Consequences, HAZOP, Fault Tree Analysis

I. INTRODUCTION

Feed reboiler Heater is one of the most important components in the VDU unit at PT. PQR - Dumai. In the control system should have automatic shutdown systems so that emergencies can be anticipated in a proper way. The possibility of failure that occurs in the process in the VDU unit will cause a plant shutdown and be one cause of distracted or bogged VDU unit, such as decreased production process, the cost of repairs is likely to increase, safety is not guaranteed, and loss of production time lost. Moreover, the failure cannot be predicted when it will happen and how the losses caused by the failure. Improve the effectiveness of the management of potential opportunities and minimize risk. Managing risk is a systematic process that can be used to make decisions to improve the effectiveness and efficiency of the company's performance.

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Management is a structured process that aims to Managing risk is to identify an event that hurt the company in the future. This includes taking action to avoid or reduce the things that are not desirable company. This is what lies behind the need did a study to determine any potential hazards in the system and calculate the value of the risk in order to analyze and avoid risks that could hurt the company.

By knowing the risk, the relative size of the security system that is in progress can be known. Thus expected to provide recommendations appropriate maintenance so that the components in a system can function well with the design of ESD logic solver on the system in case of process safety hazards (hazard) causing plant shutdown. In the event of plant shutdown is expected to occur no harm risk. One method that can be used to manage the risk of harm (risk) is a method of Hazard and Operability (HAZOP) Study and Fault Tree Analysis (FTA).

To further how the actual process that occurs in the rebuilder Feed Unit Heater in the VDU works (Description process) and identifies the parameters of what is harmful to the process. How to analyze various parameters that exist by using Hazard Operability (HAZOP) Study and Fault Trees Analysis (FTA) for rekomemendation then generated from a variety of possibilities that will emerge. How ESD safety system on Unit VDU HAZOP study with regard to the outcome and FTA so as to create an optimal risk reduction.

II. MATERIALS AND METHODS

This study aims to identify the hazards that would arise from a design and operability, Analyze and evaluate the risks the design and operability of a process on the VDU unit. Designing risk management in the ESD system HAZOP method based Fault Tree Analysis (FTA) to improve the safety of Existing installation. Conduct a review of Feed System reboiler Heater System; VDU (Vacuum Distillation Unit) using Un Converted Oil (UCO) generated HCU as bait to produce distillation 100D and 150 D are then used as bait on Catalytic dew axing unit (CDW). HCU minimum feed: 130 m3/hr, maximum feed: 208.66 m3/hr (after revamping [1].

Feed reboiler heater Heater is the source for the separation of UCO feed on vacuum tower with 8 pass. FC1014 to FC1028 when the maximum set of feeds: 62 kl / hr, when a

train 56 kl / hr. Flow P0108 vacuum bottom (reboiler circulation pump) and mixed with feed UCO then inserted into the feed reboiler heater (H0101). Flow control (FT1015A/B/C up with FT1029 A / B / C) mounted on each pass and the flow is controlled by the tube skin temperature of each pass (Max tube skin temperature: 400 ^{0}C). If the stream below the set point defined as plugging or other reasons then logic will be activated automatically and H0101 will be shutdown. The following are the main parts of the feed reboiler heater shown in Figure 1.

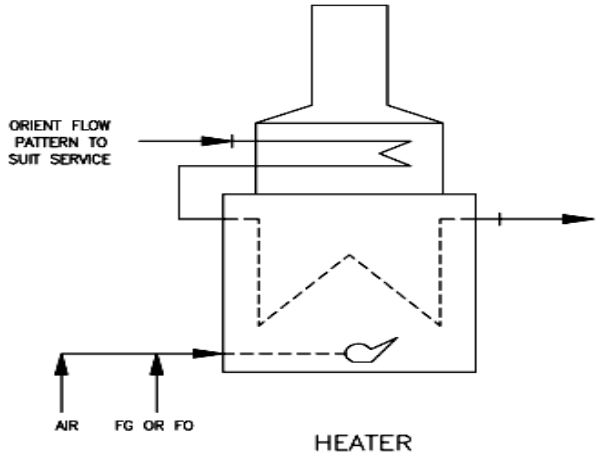

Fig. 1. Feed Reboiler Heater [2]

Risk is a combination of Likelihood and Consequence. Likelihood is possible within a time period of a risk they will appear. Historical data is used to determine and estimate the probability. Probability calculation is commonly used frequency. Consequence is a result of an event that is usually expressed as a loss of an event or a risk. Risk calculation is done by multiplying the value of the Likelihood Consequence, where examples of the consequences for a risk. (Losses $) and Likelihood = frequency of failure for a given risk, examples per year.

Initiating the Risk Management Process contains steps that may be in the planning process consisting of risk management; Identify problems and or questions about the risks that may arise. Arrange (for) background information or data that may be potentially harmful (destructive or inhibiting), identify the resources required and determine timeliness in decision-making.

Risk Assessment is the process of identifying the value of damage (severity), analysis and evaluation of risk include: Risk identification is the use of data or information system to recognize (identify) the danger that led to the description of the problem that has been created, Risk analysis (risk analysis) is an estimate of the combined risk and hazard identification and risk Evaluation. At the evaluation stage can be compared between the identification and analysis of risks that will get the results as a material consideration to address the issues or resolve risks.

In the process of risk management can be used to facilitate a variety of analysis tools to analyze the situation at hand. Some tools that can be used include: Basic risk management facilitation methods (flowcharts, check sheets, etc...), Fault Tree Analysis (FTA), Hazard Operability Analysis (HAZOP), Preliminary Hazard Analysis (PHA), and Risk ranking and filtering

The methodology used in the design of risk management is the HAZOP study and FTA (Fault Tree Analysis). Some preliminary information is needed before making a HAZOP Study, among others ; Preliminary include Process Flow Sheet HAZOP / Process Flow Diagram (PFD or PFS) and Description of the process, as for HAZOP Details include: Piping and Instrumentation Diagram (P & ID), Process Data Sheets (Heat and Material Balance), Instrument Data Sheets, Interlock Schedules Schedule of alarm and trip settings, cause and effect chart.

Having fulfilled all the required information, it can be done HAZOP Procedure, as for the following stages ; division of the system into several parts based on the components of the most important processes, stages Election study (such as line, vessel, pump, and operating instruction), describe the purpose of the design (design Intent), Process parameters Selecting, Implementing Guide- Words, Identifying the causes that exist, Evaluating emerging issues and define the possibilities of potential hazards and provide a good recommendation action safety system action or recommendation.

Fault Tree Analysis (FTA), there are three step the FTA analysis, which includes; identification system to be analyzed, the top event is the focus of this analysis. What is the condition when the system starts up, or whether his failure level later he was safe when operated; for achieving top event, the identification of the relationship of each component in the system whether it will act as the primary event and intermediate events. This relationship is used in the form of a fault tree moving parts / components of the system to the smallest of the top event (system as a whole). In the manufacture of the fault tree are some of the symbols used and qualitative evaluation of fault tree, Boolean algebra is used to calculate numerically the probability of system failure. With corellation logic gates and mathematical rules for corellation there are tables of logic gates into a mathematical model. Failure distribution in this research, statistical distributions used were normal and weibull distribution. There is a term in the Weibull distribution function solid chance (probability density function) are weibull distribution:

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

where:
η = scale parameter, $\eta>0$
β = shape parameter, $\beta>0$
γ = locations parameter

$$MTTF = \beta\Gamma\left(1+\frac{1}{\alpha}\right)$$

(2.32)

Where. : $\Gamma(n) = \int_0^{\infty} x^{n-1}e^{-x}dx$ (2)

For systems with lognormal distribution, If the random variable T (time of failure) has a lognormal distribution,

logarithmic T has a normal distribution. Density functions for the lognormal distribution opportunities are:

$$f(t) = \frac{1}{\sigma t\sqrt{2\pi}} \exp\left[-\frac{1}{2}\left(\frac{\ln t - \mu}{\sigma}\right)^2\right] \quad (3)$$

$$\text{MMTF} = \mu \quad (4)$$

III. METHODS

In this study work necessary steps which include; Distribution System Node Being Study. This is the initial stage of the identification process. Study node is split based on the sequence of production processes and parameters that can lead to plant reboiler Feed Heater (H0101) shutdown. For Multiple Node Data Collection and Data Verification, in this stage is collecting data of each sensor measurement which can result in plant shutdown Heater reboiler feed that includes variable Pressure and Flow. In the data collection, there are thirteen (13) points taken with the iteration time, data collection was done during the 8 days after the incident H0101 shutdown (March 1, 2009 01:00:00 until March 8, 2009 00:00:00) with duration every 1 minute. Due Identification, Causes, and if there is a hazard Preliminary Recommendations then identified what are the causes, effects, and recommendations. Then the identification is done on other nodes. If the node is no hazard, so the observations were made at the next node. If all nodes have been identified, then the HAZOP method is complete.

Describe Intention Design & Operating Conditions, the data obtained from measurements at 13 spots available, at this stage, the analysis of each point by a comparison of the data obtained to the data average calculations to determine the extent of the deviation occurs. The comparison of these two types of data using MINITAB 14 program package, and can be seen results calculation statistics such as mean, standard deviation, Upper Control Limit (UCL) and Lower Control Limit (LCL). The following example shows the calculation results in Figure 2.

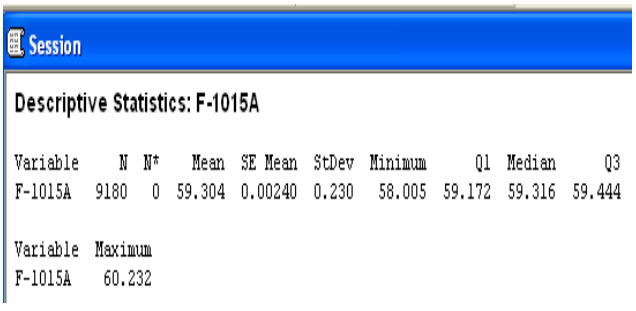

Fig. 2. Results of Statistical Calculation

The next stage is the processing of the data by comparing the measured data with the design data, this comparison method Xbar Chart.

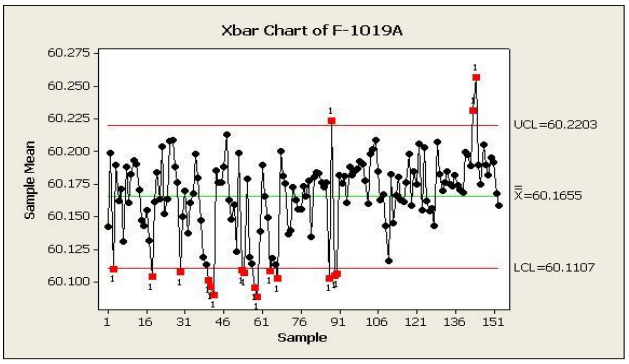

Fig. 3. Display of Grafik Xbar

Of the bar graph display X type of deviation can be analyzed. As in the picture above, look at the number of data that are above Control Upper Limit (UCL) and also the frequency of the data with a high value on the possible deviation of the histogram that appears is Less Flow. So forth analyzed one by one for each point on the existing 13 point and subsequently sought the causes and consequences of these deviations with reference to the Interlock schedule. Consider the following stage is the First and Next Guide Word. At this stage the local word used is determined based on the results of previous calculations. Here's your kind word shown are used by type of deviations, Table 1.

Table 1. Corelation of guide word and parametre [3]

Guide word No	Parameter					
	Flow	Pressure	Level	Temperature	Viscocity	Contaminant
Loss	*					
More	*	*	*	*	*	
Part of	*	*	*	*	*	
As well as						*
Reverse	*					*
Other than						*

*) From table 1. Parameters used are the Flow and Pressure

Identify All Cause, Consequences and Record

After determining the type of deviation at this stage analyzed the causes and consequence arising from such deviations. Risk Assessment is the next stage; this stage aims to get the leveling of the hazard that has been identified using HAZOP taking into account the probability and severity using the Risk Matrix. The risk is the main criteria in risk assessment and attributes that specify large or small of a risk.

To determine the risk criteria used in this study, historical data necessary maintenance process which has been carried out mainly on plant reboiler feed heater. These criteria are included Likelihood criteria associated with damage frequency component which is the value that indicates how often a failure occurs in a component of the equipment in the system over a period of time. Which in this study is the number of times the component is defective in each year? Researchers used data collected Time to Failure to have intervals for 9 months i.e. between the months of July 2008 to March 2009.

The data collected from the Work Order on the Performance and Maintenance Control, Operation and Maintenance PT.PQR Dumai. The data is processed to find the appropriate distribution for each component reboiler Feed System Heater. Determination of the distribution is a decisive stage distribution trends with the function of the system time changes. Criteria used by researchers is the likelihood that damage frequency component at a given time period. Likelihood values obtained from the ratio between the numbers of operating days per year to the value of MTTF.

Consequence criteria related to the loss by the Health and Safety Personnel is a consequence of the failures that occur in each component of the safety (Health and Safety) personnel who were around the plant area, the consequences can be death, disability, minor injuries that do not to cause defects, injuries requiring only first aid. Losses based on repair costs, is the cost to the company due to repairs to the damage that occurs in each equipment, in this case includes the cost of replacing spare parts, labor costs and consequences of the company's operations. And losses based on time (Discontinuity days), is time wasted when the equipment is lost or damaged. Distribution Model determination using the program package Reliability Weibull + +6, this software is used to test the data time between failures and repair cost data [4-5].

IV. Results

Analysis and Interpretation, at this stage of the analysis and interpretation of the results of the retrieval and processing of data and the results of the risk evaluation. Determination of the risk level using the risk matrix. At the risk matrix of criteria for each class in the likelihood and consequences of a discussion with the company. The next stage is the Phase Simulation Logic Solver in ESD System. After going through the next stage of the risk evaluation is simulating it in the form of risk management simulation on Emergency Shutdown systems using software Prosafe-RS and CENTUM CS3000, which is shown by Fig.4-5 as follows.

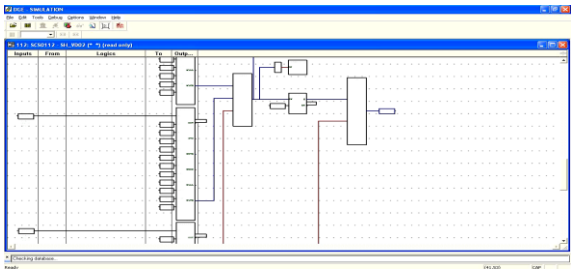

Fig. 4. Example Program with Prosafe-RS

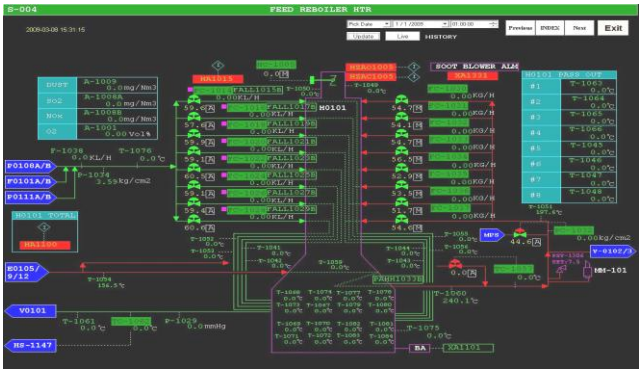

Fig.5. Simulation with Centum CS-3000

Each Node Analysis and Determination of the deviation, as already described in the previous section that there are 13 points that affect the ESD system of the entire feed reboiler heater system to be analyzed, with the only parameter being measured pressure and flow. The following is an analysis of one of these points. The next node is Node1.Feed Pass # 1 Flow (FT-1015A/B/C), this section is the initial part of the input into the reboiler feed heater system. At this point in measuring the amount of flow at the beginning of the input (feed Pass # 1), namely UCO Feed which is the output of the Vacuum Tower reboiler Feed (P01008A / B) and UCO Feed (F0101A / B). Description of the sensor is shown in Figure 6. [6-7].

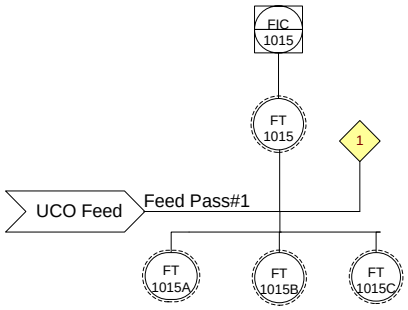

Fig.6. FT1015A/B/C

Of the data obtained later analyzed and searched the value of the UCL, LCL, standard deviation, and the mean is shown by Fig. 7. In the same way also count for the performance of the transmitter; FT1015B and FT1015C. Subsequently analyzed in the model Xbar-R to find out irregularities that occurred in devise transmitter.

Session

Descriptive Statistics: F-1015A

Variable	N	N*	Mean	SE Mean	StDev	Minimum	Q1	Median	Q3
F-1015A	9180	0	59.304	0.00240	0.230	58.005	59.172	59.316	59.444

Variable	Maximum
F-1015A	60.232

Fig. 7. Calculation results of FT1015A

Figure 8. Plot is a graph of values FT1015A with UCL values: 59.3822 kl / h, Center line: 59.3035 kl / h and LCL: 59.2249 kl / h, can be seen the tendency of data is below the

LCL. Thus the deviation of ESD components FT1015A is Less Flow. Processes that occur in Feed Pass # 1 Flow included in the normal operation of the process because it is still included in the limits tolerated by the plant H0101. In the same way for the other transmitter made; Xbar-R Chart of FT1015B and Xbar-R Chart of FT1015C. Results of measurements on Feed Flow Pass # 1 is still in the design process within normal limits. Because it does not exceed the high setting, high high, low and low low. Setting low: 55.00 kl / h, low low: 15:00 kl / h, high: 67.0 kl / h, high high: 80.00 kl / h. The following is a summary of the analysis of the deviation of each component of ESD. [8].

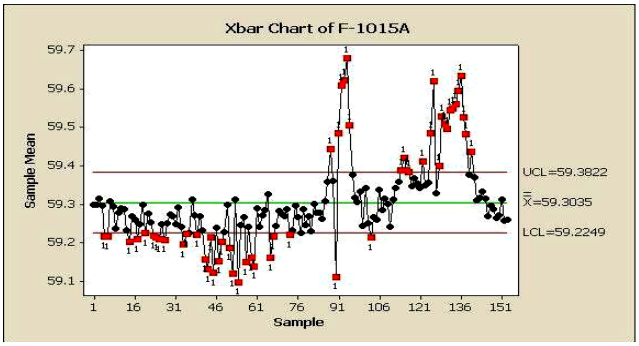

Fig. 8. Xbar-R *Chart* of FT1015A

Identify Cause Identifying the cause of the deviation is based on the study of P & 1D, Interlock Schedule, and also manual book of reboiler Feed Heater. Identify and Consequence for HAZOP Study using FTA, reboiler Feed Heater H0101 will trip or die if one of the few events occurred, i.e. Feed # 1 Flow low low Pass, Pass # 2Flow Feed low low, etc.. Failure that occurs in some of the event can be caused by the detection of two of the three transmitters (2oo3 system) which is attached showing the value of the input and output low low transmitter module on safety control station in case of error. With the possibility of system failure can 2oo3 breakdown be some event that is for example in the Feed Flow Pass # 1, A & B FT1015, FT1015A&C, B&C, FT1015, FT1015A&B&C.

Failure to know the Probability Density (PDF) on the Top Event is H0101 shutdown, then the first calculation PDF on every basic event. Evaluation Function Solid Opportunity (pdf) FT1015 A & B LLLn done by performing quantitative analysis on the data history events LLLn, then the results of the test data distribution time between failures of FT1015 A & B LLLn most suitable is the Weibull distribution 3 (rank 3), with parameters : β = = 0.1565.γ0.4870 ; η = 158.7999, and By equation (1) with the parameters that have been obtained, it can be determined the function of solid opportunities (puff) for FT1015 LLLn A & B are as follows [4-5].

$$f(t)=\frac{0.4870}{158.799}\left[\frac{t-(0.1565)}{158,7999}\right]^{0.4870-1}\exp\left[-\left(\frac{t-(0.1565)}{158,7999}\right)^{0.4870}\right]$$

Of computation nodes A and B FT1015 LLLn failure probability values obtained for 0.9137 with T = 1000 days approach, in the sense that at the time of 1000 days (from March 2009) FT1015 conditions LLLn A & B has a value of probability of failure of 0.9137. Evaluation Function Solid Opportunity (pdf) IOM FT1015 A & B Channel Error, done by performing quantitative analysis on the data history events IOM channel error, then the results of the test data distribution time between failures of IOM FT1015 A & B Channel Error is the most appropriate is the Weibull distribution 3 (rank 3), with parameters: β = 0.4813; η = 124.3249; γ = 0.0390. By equation 1 with the parameters that have been obtained, it can be determined the function of solid opportunities (pdf) to the IOM FT1015 Error Channel A & B are as follows:

$$f(t)=\frac{0.4813}{124,3249}\left[\frac{t-(0.039)}{124,3249}\right]^{0.4813-1}\exp\left[-\left(\frac{t-(0.039)}{124,3249}\right)^{0.4813}\right]$$

Of computation nodes IOM FT1015 Error Channel A & B failure probability values obtained for 0.9346 with T = 1000 days approach, in the sense that at the time of 1000 days (from March 2009) IOM condition FT1015 Error Channel A & B has a value of probability of failure of 0.9346. Evaluation Function Solid Opportunity (pdf) FT1015 A & B LTPn done by looking for opportunities failures FT LTPn 1015 A & B is the event where FT1015A & B produce a trip signal to H0101. PDF calculations of A & B LLLn FT1015 and FT1015 IOM Error Channel A & B can be calculated for pdf FT1015 A & B LTPn using the operation shown in Table 2. Following.

Table 2. Operation Gate OR dan AND

Gate	Input	Outpur
OR	P+P	P
	F+F	F
	F=P	Not OK
AND	PxP	P
	FxF	Not OK
	FxP	F

Logical relationships are shown in the following equation 5-6

AND GATE: P(A.B) = P(A) x P(B) (5)

OR GATE: P (A+B) = P(A) + P(B) - P(A) x P(B) (6)

On modeling FTA for FT1015 A & B LTPn form OR GATE, then the PDF for FT1015 A & B LTPn are as follows: P (FT1015 A & B LLLn + IOM FT1015A & B Channel Error) = P (FT1015 A & B LLLn) + P (IOM FT1015A & B Channel Error) - P (FT1015 LLLn A & B) x P (IOM FT1015A & B Channel Error)

P (A & B LTPn FT1015) = 0.9137 + 0.9346 - 0.9137 x 0.9346 thus, P (A & B LTPn FT1015) = 0.99436.

V. Discussion

From calculations on FT1015 A & B LTPn failure probability value obtained by 0.99436. That means the chances of a trip H0101 flow due to the detection of very low signal from transmitter FT1015 A & B of 0.99436. The Opportunity Compact Function Evaluation (pdf) FT1015 A &B LTPn.

After doing the calculations pdf for each basic event contained in the FTA, we can see the magnitude of Failure Probability Density shutdown on reboiler Feed Heater H0101. PDF H0101 shutdown is equal to 0.9846, it means the

opportunity H0101 trip or death caused by a high enough one of the basic event. Recommendations made by the researchers in order to trip in the event H0101 over safety conditions can be seen in HAZOP Worksheet.

Determination of the Damage Distribution Between Time Reliability program package Weibull + + 6 is used to test the data time between failures, long time data improvement and repair cost data. The test results will be obtained in the form of a representative distribution model for these data. Example: P1146A (Pressure Transmitter for Atomizing Steam), Time between damage (days) is 0.024027778; 0.050798611; 7.8015625; 1.80505787; 0.593217593; 11.84166667; 1.084953704; 16.40569444. Having tested turns 3 Weibull distribution with the following parameters: Beta (β) = 0.3662; Eta (η) = 3.3676; Gamma (γ) = 0.0198; Γ (n) = 4.32367757; MTTF=14, 56042 days; Likelihood = 25.06796 / year For PT1146A ESD components, has Weibull distribution with parameters 3 Beta (β) = 0.3662; Eta (η) = 3.3676; Gamma (γ) = 0.0198 so MTTF for Weibull distribution following results [9-10].

$$MTTF = 3{,}3676\Gamma(1+\frac{1}{0{,}3662}) = 14{,}56042 hari$$

So that the MTTF values indicate that the predictable component of ESD damage in an average time of every 14.56042 days. Likelihood value was sought after by dividing the number of days the unit VDU run prodeksi a year with the value of the MTTF. Because a VDU unit never stops running distillate production 100D and 150D (B / D, the company assumed production run for 365 days. Then the calculation is as follows:

$$Likelihood\ value = \frac{365}{14{,}56042} = 25,\ 06796$$

So Likelihood value for P1146A is 25.06796 per year or in other words that the frequency of occurrence of damage is 25.06796 times per year. In that is table that contains values for each component Likelihood ESD. Any deviation from the values obtained ESD components, that component has the highest damage ESD PT1146C at 154.039596 times per year. The determination of the consequences of this risk is divided into two criteria, namely the loss based on the time and losses based on repair costs. And the calculation of damages based on time, any damage that occurs can lead to losses in terms of time, where time is wasted when a risk of damage to occur can be searched using the MTTR calculation. MTTR is the average interval of time is wasted to make improvements for the damage. For PT1146A ESD components, which have a Waybill distribution with parameters 3 Beta (β) = 2.9987; η = 4.5023; γ = 2.0363 so the MTTR for the Waybill distribution is obtained as follows:

$$MTTR = 4{,}5023\Gamma(1+\frac{1}{2{,}9987}) = 4,\ 020385 \text{ hour},$$

So the loss of time is wasted if the transmitter component of ESD damage, the average is equal to 4.020385 hours. MTTF value and likelihood of each component indicated that ESD ESD components which have the highest damage time are FT1017C Flow Transmitter (Feed Pass # 2Flow) with decay time of 50.876476 per hour once the damage. Losses are calculated based on the cost of repairs loss calculation can be obtained from the sum of the cost of replacing the ESD component multiplication MTTR values and CV values. CV value is itself a labor cost of repairs to the equation as follows; CR = Cf + (CV x MTTR)

ESD component replacement costs are costs incurred for procurement of components ESD until ready for use. The price of each component is installed and ESD related events reboiler Feed Heater (H0101) shutdown is as follows:

a. Pressure Transmitter (PT1033 A / B / C, PT1036 A / B / C, PT1142 A / B / C, PT1146 A / B / C, PT1149 A / B / C) = U.S. $ 1, 500 = CHF 1.773 million
b. Flow Transmitter (FT1015 A / B / C s / d FT1029 A / B / C) = U.S. $ 1, 500 = CHF 1.773 million
c. Input-Output Module Prosafe Rs = U.S. $ 1, 500 = CHF 1.773 million

In the MTTF value and Likelihood Each Component ESD explained that, the level of likelihood and consequence of each component in the ESD reboiler Feed Heater (H0101). Knowing the risk level of each component of ESD, the management and maintenance will be able to more easily take the maintenance policy priorities. Based on the results of the calculation of the level of risk in each ESD components can be analyzed that one of the ESD components identified as having the 2nd level of risk is PT1146C (Atomizing Pressure Transmitter on the line). ESD component is identified with less pressure deviation, probability of failure (likelihood) likely, and the level is Low and negligible consequences, which lead to system cannot operate. Failure data on ESD components 3 PT1146C show weibull distribution with parameter β = 0497, η = 1174, and γ = 0:03. Recommendations for level - 2 is a risk to take measurements for a reduction in the value of risk mitigation by risk level to 3rd.

The following recommendations are given for each level of risk based risk which Matrix has been approved by the company.

Table 3. Recommendation for each risk level

Risk Ranking	Basis of Recommendations
1	Intolerable (Mitigate into Risk Ranking below "3" and additional risk reduction measures required)
2	Incorporate Risk Reduction Measures (Mitigate into Risk Ranking below "3") and managing risk ALARP (As Low As Reasonably Practical)
3	Manage for Continuous Improvement (Recommendations can be proposed in terms of operability)
4	Manage for Continuous Improvement (Recommendations can be proposed in terms of hazard)

VI. Conclusion

HAZOP Heater reboiler feed system data shows that the highest risk level of one in the components of ESD Flow Transmitter (FT1017C) Feed Flow Pass # 2, with 2nd level of risk. From the calculated value of the frequency of component failure, it is found that the ESD component on the H0101 which has the highest frequency of 154.039596 times per year

i.e. PT1146C. From the calculation of damages based on time, showing that the ESD components which have the highest damage time is FT1017C. Time for damage once the damage 50.876476 hours each. From the calculation of damages based on the cost of repairs has shown that the highest damage repair costs are PT1146C (Atomizing Steam Pressure Transmitter for Line) at a cost of KWR 287, 446, 615.46. Through HAZOP Study can provide recommendations for improvement and work instructions, and can identify the cause of Hazard as a study, and the calculation for each basic event contained the results of FTA modeling, we can see the magnitude of Failure Probability Density shutdown on reboiler Feed Heater H0101 is equal to 0.9846.

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