Hazop Study and Fault Tree Analysis for Calculation Safety Integrity Level on Reactor-C.5-01, Oil Refinery Unit at Balikpapan-Indonesia

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ABSTRACT— *A plat former reactors are reactors that are in the plat forming unit is designed for developing your specific hydrocarbon molecules that are used in catalytic engine fuel in boiling point range naphtha and fuel mixture to produce components with a higher octane value. Plat former reactor system failure may disrupt operations in the oil processing refinery unit. These circumstances will cause the supply plaformat as products of the plat forming unit valued high octane which is the main raw material of gasoline blending system is reduced. Resulting in decreased production consequency large losses. The failure of the reactor system can also be harmful to the operator, the environment and there is a possibility of reactor unit may explode. To avoid these risks we conducted studies identify hazards that occur in the process rector Hazard and operability (HAZOP) analysis and calculate the value of safety integrity level (SIL). In this study reviewed three nodes Overview consisting of node stage 1, stage 2 and stage 3. Based on the results of identification are thirteen instruments on the third node, which includes equipment; PC-193, FI-005, PC-194 and FI-010. Standards-based Service Oriented systems have Unacceptable risk criteria and the criteria of likelihood 4 Consequences worth three. As for the evaluation of SIL is known that C-5-01 reactor system has two safety Integrity Function (SIS) located in the path of fuel gas and pilot gas lines of the reactor heater. Both SIS has a vote = 1oo3 architecture with similar characteristics, and a review of the SIS has a security level SIL = 2 with a value of PFD = 0.00103.*

Keywords— FTA, HAZOP, Reactor, SIL-SIS, Risk.

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1. INTRODUCTION

In this research has been conducted studies reference explore various sources, including journals, papers, books, and other supporting information. Studies may include studies on Plat forming process unit refinery house V Pertamina Balikpapan, especially plat former reactor[1-2]. The study also includes methods that implemented them on the Fault Three Analysis, HAZOP, and SIL SIS. The reactor is one of the vital elements in the refinery unit. The process is instrumental for separating hydrocarbon bonds heavy petroleum fractions into lighter fractions were carried out with the help of the catalyst granules are processed by heating finely so that it can flow like a liquid fluid. The capacity of the unit is processing 20,000 barrels per day and is able to produce 16.638 barrels platform at (C5 +) per day, with a minimum octane rating of 96.[3-4] Failure plat former reactor system will interrupt the operation of the oil processing refinery unit. This caused the supply of a product plat form plat forming unit that has a product with a high octane, the product is the main raw material will blended with gasoline will be reduced in number[5-6]

Impact Risk of failure should be minimized, the target company's production will decrease which will result in huge losses. The failure of the reactor system not only can harm humans, the environment and assets and will lead to a reduction in the company's reputation. See the function and role is very critical reactor, the necessary layer of protection analysis. All these layers of protection to be important no exception layers of safety integrity level on System Integrity System (SIS). [7-9]

Safety Integrity Level SIS dam should be guaranteed to guarantee that a plant can operate safely. An adequate value SIL is needed to guarantee the reactor system always operates in a sustainable manner. SIS can guarantee the existence of running processes, such as the reactor remains in a safe condition for the installed instrument not only to guarantee Basic Process Control Design, but the reliability of instrument systems also have to meet both in terms of redundancies and in terms of its quality. If a danger arises such as when there is excessive pressure or temperature excess in the reactor, then the system will guaranteed that the components of the instrument that is designed able to overcome the security level either when the system was designed and when operated, SIL according to the standards have been grouped into four levels Safety Integrity Level (SIL). It is expected that the SIL for the Pilot Gas and Gas Flow will be a valuable greater than or equal to two so that the reactor system-level security can be guaranteed[10-12].

2. MATERIAL AND METHOD

General overview of the process of mixing naphtha and recycle hydrogen gas at reactor consisting of a combined feed inputs, processes exchanger, output and feedback is shown in Figure 1.

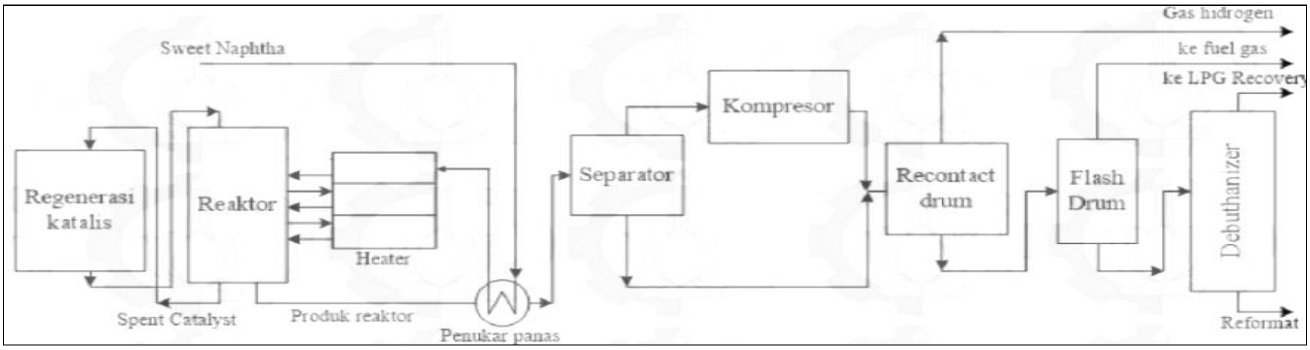

Figure 1: Flow Diagram Plat forming Unit

The data acquired in this study consisted of documents and images Plat forming process unit refinery. Data process in the reactor system C-5-01, A / B / C. Documents process flow diagram (PFD), P & ID and data maintenance equipment 2010-2015. Data maintenance of the system components of the reactor, the reactor process data for the full month date (1 -30) November 2014. The data sampling once every hour during the day. The data is processed and analyzed to assess the potential hazards, assessed SIL level of each component. Make safety recommendations plat former reactors as standard. The reactor system of Node 1 is shown in Figure 2. [13-15].

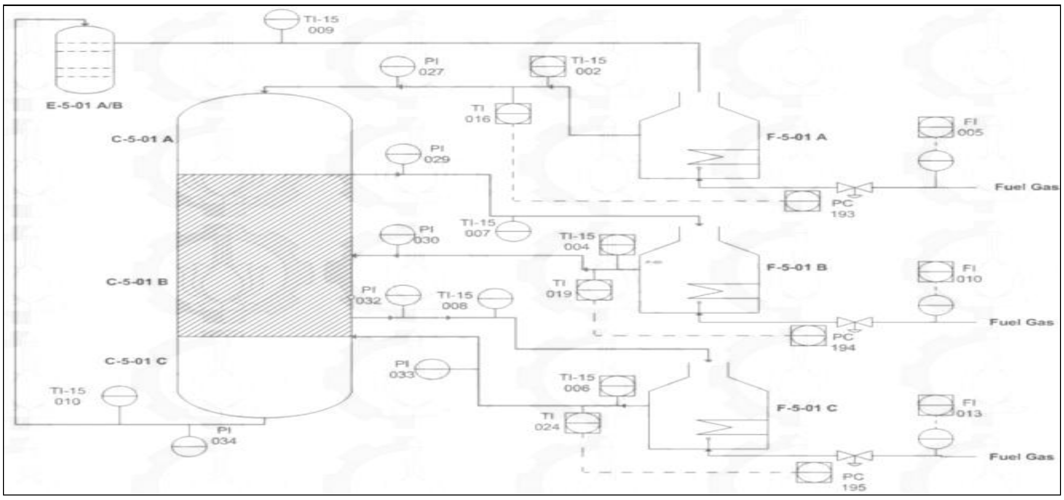

Figure 2: Reactor System as Node-1

Hazard identification starts with knowing the scope of study points (nodes) that are reviewed in the study. It is known that C-5-01 reactor has three stages tasks connected in series as a reactor heater F-5-01 A, F-5-01B and F-5-01C. The reaction process in the reactor has a relatively high temperature. So that the required heating repeated at every step of the working reactor. In the document flow sheet description that the control system can be described as follows; Variable operating process occurs in the reactor system and catalyst bed Temperatures chloride / water balance. Temperature is controlled via heaters Catalyst bed reactor, while the balance of water and chloride regulated through the water injection rate and propylene-dichloride. Heaters reactor F-5-01 A / B / C is a heating system that uses gas fuel, so that the continuity of gas supply be the deciding factor on plant fue [14-17].

In the gas heating system pilot lines, early propellant used in the form of natural gas. Referring to the HAZOP studies based on The Concept of Node, and then the flow of processes on the system studied in this research is the reactor C-5-01. The next stage of this part is divided into two nodes, namely: Node 1, Outlet Combined Feed Exchanger E-5-01A / B to Stage Reactor C-5-01A / B / C via Reactor Heaters F-5-01 A / B / C , and Node 2: Reactor Heaters F-5-01 A / B / C Firing System shown Figure 2. [15-19].

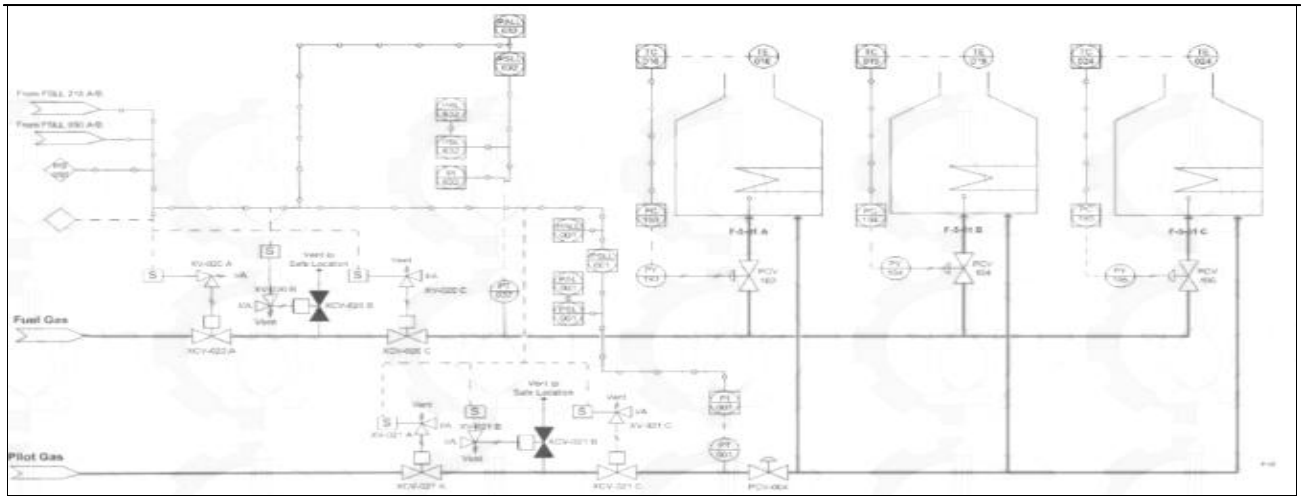

Figure 3: P & ID System Reactor Node 2

The next stage determines guideword using of process data. The data is processed so that it can be displayed in a chart that accompanied the upper control limit (UCL) and lower control limit (LCL). If the process normally, then the process aberrant activity would seem, especially when there is a process variable out of the upper limit or lower limit. The process will show a deviation that describes the potential dangers of the system. In other parts also reviewed supporting conditions existing security system to see the safeguards that exist on the P&ID shown in Figure 4. [20-22].

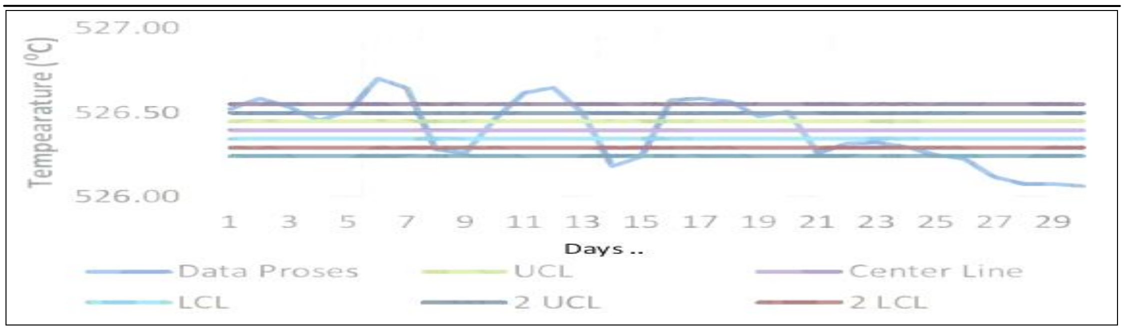

Figure 4: Control Chart for Temperature Process

Risk estimates consist of an analysis of the two reviews, the likelihood and consequences that refers to standard PT. Pertamina. Likelihood is the frequency of the possibility of a risk can occur to a component at a specific time period. In this study, the time period taken for five years (43 800 hours), so that the equations used; Likelihood = (43 800 / MTTF), the MTTF values, ◊ MTTF = {1 / failure rate (λ)}. Consequences qualitatively determined based on how big the losses incurred from the hazards that have been identified. Consequences can be viewed in terms of damage to the components cannot be resumed, in terms of its effect on humans, or in terms of the costs incurred due to the possible danger [23-25].

Risk analysis studied through hazard identification and risk estimation, in this research, risk analysis plat former reactor system using standardized risk matrix by combining the value of likelihood and consequences. SIL analysis through the FTA to use to calculate the value of SIL reactor system, Through modeling FTA, Looking SIS value at each node, and then do a quantitative analysis. The top event is used reactor failure [24-27].

3. ANALISYS AND DISCUSION

Overview reactor process can be explained that; process in the reactor consists of a naphtha feed to the specifications determined mixture, with the first conducted recycle hydrogen gas before entering the Combined Feed / Exchanger E-5-01A / B. This feed has a relatively low termepature and mixed with hydrogen, heated and vaporized before entering the charge heater F-5-01A. Description of the process can be seen in Figure 1. [14-18].

Table 1. Risk Matrix PERTAMINA Standard

Risk Ranking	*Category*	*Description*
1-4	A	Acceptable –No risk control measures are needed
5-7	C	Acceptable With control –Risk control measures are in place
8-9	N	Not Desirable- Risk control measured to introduced within a specified time period
16-20	U	Unacceptable

Table 2: Safety Integrity Level for SIF

SIL categories	*PFD SIF*	*RRF= (1/PFD)*
SIL categories	**PFD SIF**	**RRF= (1/PFD)**
NR- not requirement	$1 \leq PFD$	RRF≤1
SIL 0	$10^{-1} \leq PFD < 1$	$1 < RRF \leq 10^{1}$
SIL 1	$10^{-2} \leq PFD < 10^{-1}$	$10^{1} < RRF \leq 10^{2}$
SIL 2	$10^{-3} \leq PFD < 10^{-2}$	$10^{2} < RRF \leq 10^{3}$
SIL 3	$10^{-4} \leq PFD < 10^{-3}$	$10^{3} < RRF \leq 10^{4}$
SIL 4	$10^{-5} \leq PFD < 10^{-4}$	$10^{4} < RRF \leq 10^{5}$

Source: ISA TR 84.00.02-2002

Risk analysis on node-1 occurs when the heating process naphtha wherein the reaction temperature inside the reactor, can be achieved, so that the temperature is a variable that must be considered intersting prose. In node-1 also contained process variable, but the variable is not significant. From Figure 2 can be observed that there are seven temperature instruments; IT-15002, TI-15007, TI-15009, TI-15004, TI-15008, IT-15006 and IT-15010.

Table 3. : Guide Word and Deviation Component Node 2

N0.	*Component*	*Guideword*	*Deviation*
1.	Temperature Indicator (TI-15002)	More	High Temperature
		Less	Low Temperature
2.	Temperature Indicator (TI-15007)	More	High Temperature
		Less	Low Temperature
3.	Temperature Indicator (TI-15009)	More	High Temperature
		Less	Low Temperature
4.	Temperature Indicator (TI-15004)	More	High Temperature
		Less	Low Temperature
5.	Temperature Indicator (TI-15008)	More	High Temperature
		Less	Low Temperature
6.	Temperature Indicator (TI-15006)	More	High Temperature
		Less	Low Temperature
7.	Temperature Indicator (TI-15010)	More	High Temperature
		Less	Low Temperature

Risk analysis at node 1, is the result of multiplying likelihood by reference to the risk matrix consequences. Risk analysis node component unit 1 is shown in Table 4. It is known that most of the components on node 1, classified Acceptable risk, there is only one component of which is classified as "Acceptable with Control". Risk Analysis Node-2 is based on a standard risk matrix Pertamina shown by Table -5. It is known there are four components that have the potential Unacceptable Risk namely; PC-193, FI-005, PC-194 and FI-010. Meanwhile, four other components have the potential Not Desirable Risk namely; PC-195, FI-013, PI-632 and PI-001. Evaluation of SIL with the Fault Tree Analysis (FTA) of P & ID, that on heating the reactor has two SIS, each contained in fuel gas lines and gas pilot lines. After calculating the PFD, in both systems, then the value of SIL can be determined based on the trend graph process data on the components node2, created a table guide word, calculated deviation of each component as shown in Table 5.[17].

Table 4: Risk Matrix Component in Node 1

No.	Deviation	Risk Score		
		Likelihood	Consequent	Risk Ranking
1.	High Temperature Low Temperature	2 2	2 2	4 4
2.	High Temperature Low Temperature	2 2	2 2	4 4
3.	High Temperature Low Temperature	2 2	2 2	4 4
4.	High Temperature Low Temperature	2 2	2 2	4 4
5.	High Temperature Low Temperature	2 2	2 2	4 4
6.	High Temperature Low Temperature	2 2	2 2	4 4
7.	High Temperature Low Temperature	2 2	2 3	4 6

Table 5: Guide Word and Deviation Component in Node 2

No.	Component	Guideword	Deviation
1.	Pressure Control (PC-193)	More	High Pressure
		Less	Low Pressure
2.	Flow Indicator (FI-005)	More	More Flow
		Less	Less Flow
3.	Pressure Control (PC-194)	More	High Pressure
		Less	Low Pressure
4.	Flow Indicator (FI-010)	More	More Flow
		Less	Less Flow
5.	Pressure Control (PC-195)	More	High Pressure
		Less	Low Pressure
6.	Flow Indicator (FI-013)	More	More Flow
		Less	Less Flow
7.	Pressure Indicator (PI-632)	More	High Pressure
		Less	Low Pressure
8.	Pressure Indicator (PI-001)	More	High Pressure
		Less	Low Pressure

Table 6: Risk Matrix of Component node 2

No.	Deviation	Risk Score		
		Likelihood	Consequent	Risk Ranking
	High Pressure Low Pressure	4 3	3 3	12 9
1.	More Flow Less Flow	4 3	3 3	12 9
2.	High Pressure Low Pressure	4 3	3 3	12 9
3.	More Flow Less Flow	4 3	3 3	12 9
4.	High Pressure Low Pressure	4 3	2 2	8 6
5.	More Flow Less Flow	4 3	2 2	8 6
6.	High Pressure Low Pressure	4 3	2 2	8 6
7.	High Pressure Low Pressure	4 3	2 2	8 6

In the fuel gas lines are SIS as a protection system for the fuel system. Fuel system implemented on the heating system has been running the pressure flowing into the heater should be kept to maintain the operating temperature. In the document flow sheet described that the fuel gas is supplied to the heating lines of 5.3 Kg / cm2g and controlled, the pressure was lowered to 2 Kg / cm2g pa. Heating path on each F-5-01 A, B & C by each control valve. SIS on gas fuel lines can be explained by Figure 4. Figure 5 SIF Based on the SIS on line gas fuel consisting of a pressure transmitter (PT-632) as an element of the sensor, logic solver, DCS, and three valve (XCV-020 A, B & C as well as solenoid valve (XV-020 A, B & C) in a single line as the final element. [18-19].

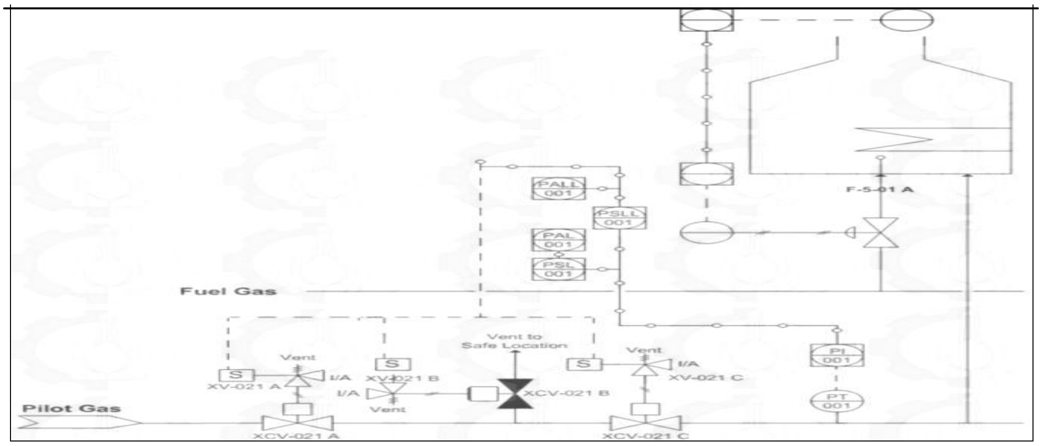

Figure 5: SIS in Fuel Gas

On the track there is a gas pilot SIS as the protection system in the initial combustion heating system heater. Pilot gas supply in the form of natural gas that is given at the start of the heating process with the supply of 3.5 Kg / cm2g, the pressure should be lowered because of the design pressure of the burners of 0.35 Kg / cm2g. SIS on track for pilot gas can be seen in Figure 6. Based on the SIF Image of SIS on line gas pilot consists of a pressure transmitter (PT-001) as an element of the sensor, logic solver (DCS), and three valve (XCV 021 A, B & C) and solenoid valve (XV-020 A, B & C) are in one line as the final element. The value of any component failure rate can be searched generic data reliability, while the value of the test interval (Ti) adjusted with the turnaround time of plant, approximately an average of one year.

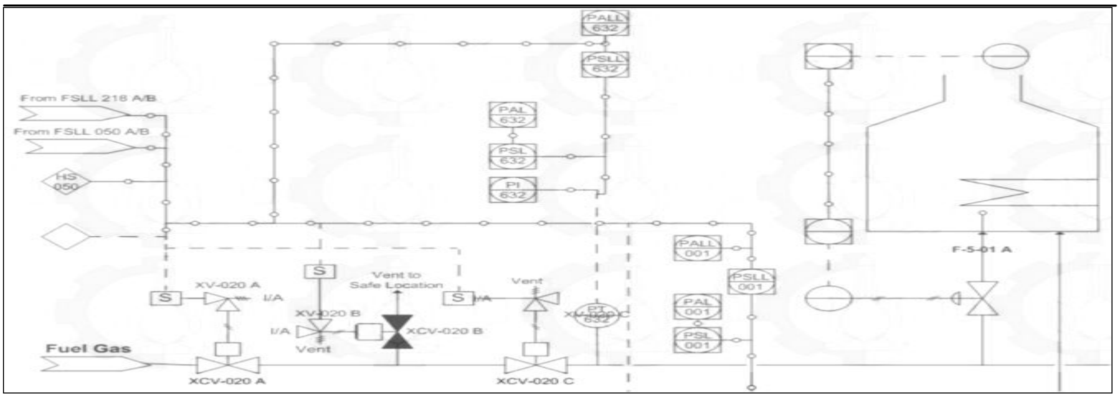

Figure 6: SIS in Pilot Gas

Table 7: Calculation PFD in Fuel Gas System

Component	***Failure rate (λ_{DU})***	***Test Interval (Ti)***	***PFD_{avg}***
Sensor (PT-632)	0.01	1 year	0.000004
Logic Solver (DCS)	-	-	0.000057
Shutdown Valve	0.020	1 year	0.000032
Solenoid	0.042	1 year	0.000289

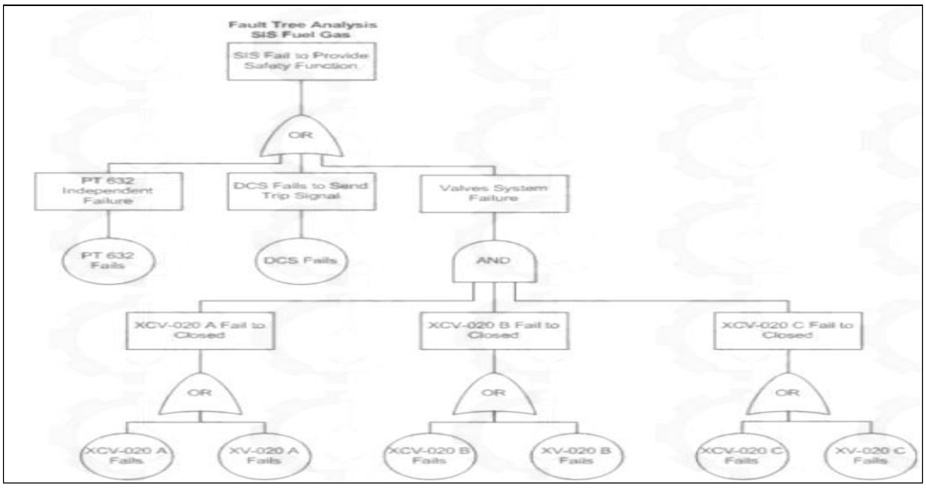

Figure 7: Fault Tree Analysis SIS in System ***Fuel Gas***

- PFD Total = [PFD(XCV 020 A) U PFD (XV 020 A)] ∩[PFD(XCV 020 B) U PFD (XV 020 B)] ∩ [PFD (XCV 020 C) U PFD (XV 020 C)] U [PFD (PT 632) U PFD (DCS)]
- PFD Total = {[PFD(XCV 020 A) + PFD (XV 020 A)] x[PFD(XCV 020 B) + PFD (XV 020 B)] x [PFD (XCV 020 C) + PFD (XV 020 C)] x [PFD (PT 632) + PFD (DCS)]
- PFD Total = {[0.000032+ 0.000289421] x[0.000032 + 0.0002894] x[0.000032 + 0.0002894] x [0.000004 + 0.000057}

PFD◊ Total = 0.001025, PFD Obtained total of node 1 = 0.001025 with the same characteristics and the design of the node 2 has a value of PFD and SIL same. So based on Table Standard SIL known that SIS in the path of fuel gas and pilot gas has SIL 2 criteria.

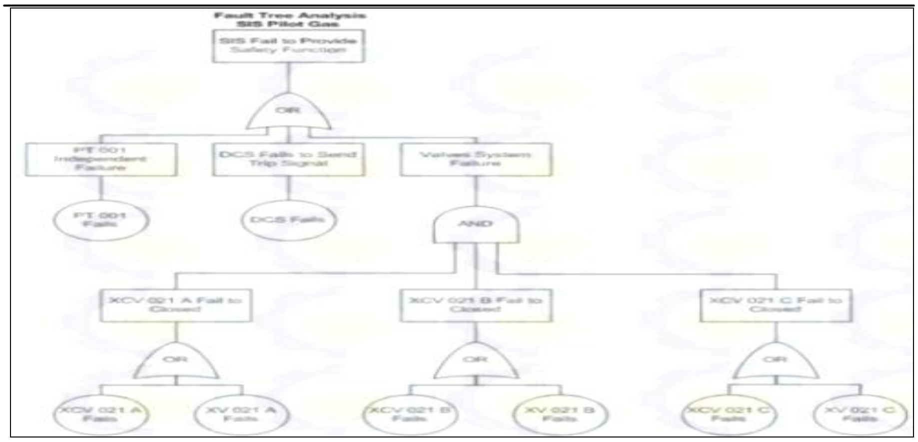

Figure 8: Fault Tree Analysis SIS in Pilot Gas System

Table 8: Calculation of PFD in ***Pilot Gas System***

Component	***Failure rate (λ_{DU})***	***Test Interval (Ti)***	***PFD$_{avg}$***
Sensor (PT-001)	0.010	1 year	0.000004
Logic Solver (DCS)	-	-	0.000050
Shutdown Valve	0.020	1 year	0.000032
Solenoid	0.042	1 year	0.000289

- PFD Total = [PFD(XCV 021 A) U PFD (XV 021 A)] ∩[PFD(XCV 021 B) U PFD (XV 021 B)] ∩[PFD(XCV 021 C) U PFD (XV 021 C)] U [PFD(PT 001) U PFD (DCS)]
- PFD Total = {[PFD(XCV 021 A) + PFD (XV 021 A)] x[PFD(XCV 021 B) + PFD (XV 021 B)] x[PFD(XCV 021 C) + PFD (XV 021 C)] x [PFD(PT 001) + PFD (DCS)]
- PFD Total = {[0.000032+ 0.0002894] x[0.000032 + 0.0002894] x[0.000032 + 0.0002894] x [0.000004 + 0.000057}, PFD Total = 0.001025,

PFD total of node 1 = 0.001025 with the same characteristics and the design of the node 2 has a value of PFD and SIL same. Based on Table Standard SIL known that SIS in the path of fuel gas and pilot gas has SIL 2 criteria.

4. CONCLUSION

Based on the study can be conclusion that: From a review third set point, there are four components that have risks and potential dangers of the relatively high; PC-193, PC-194, FI-005 and FI-010. The components are included in the criteria of likelihood = 4, indicating a failure will occur 3-5 times within a period of five years. Criteria with the consequences = 3, indicating Injury / Health Impact Moderate.The risk level of risk matrix, it is known that the risk posed of the four components, which are included in the category Unacceptable. And there are four components belonging to the Risk Not Desirable, Acceptable risks with Control total = 1 fruit and risks classified as Acceptable Risk = 6 components. To keep the potential hazard does not happen; there should be a recommendation on each rank the risk. Evaluation SIL conducted by the method of FTA, suggesting that the reactor system plat former has a = 2 pieces SIS which serves as a protection system operational reactor, SIS is first found in the path of fuel gas and SIS both are on track pilot gas to the value PFD nearly equal = 0.001018, so SIS has a SIL-value = 2.

5. ACKNOWLEDGEMENT

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ANNEX-1; Worksheet HAZOP Node – 1

Node 1. Outlet Combined Feed Exanger E-501 A/B to Stage Reactor C-5-01 F-5-01 A/B/C A/B/C via Reactor						**Drawing : 2**
1.1 High Temperature						
Cause	Consequences	Safeguard	*Risk Score*			Recommendation
			L	C	RR	
1. The task overload on reactor heater F-5-01 A / B / C	1. Cracks excess reacator wall heater F-5-01 A / B / C causes the reaction to be incorrect	1.TI-016/019 /024 2.TI-1502/ 15004/ 15006	2	2	4	1. Safeguards are sufficient
	2. Excessive heat causes damage to the reactor material heaters F-5-01 A / B / C	1. TI 15001/15003/ 15003	3	2	6	1. Safeguards are sufficient
	3.Run away to the reactor heater F-5-01 A / B / C	1.TI016/019/ 024 2. TI-1502/ 15004/ 15006	2	2	4	1. Safeguards are sufficient
1.2. Low Temperature						
Low Temperature						
1. The low input temperature	1. Duties and reactor material consumption heater F-5-01 A / B / C increased and led to a reduction and termination of proceedings	1.TI-15007/ 15008/ 15009	2	2	4	1. Safeguards are sufficient
1. Reactor heater F-5-01- A/B/C trip.	1. Operating conditions is not reached that cause the reaction process does not run correctly	1. TI-016/019/ 024 2. PCV-193/194/ 195	2	2	4	1. Safeguards are sufficient 2. Carry out routine maintenance PCV193 SOP / 194/195
3. Reactor Work heaters F-5-01 A / B / C is too low	1. Operating conditions is not reached that cause the reaction process does not run correctly	1.TI-016/019/024 2. TI-15002/15004/ 15006 3. PCV-193/194/195	2	2	4	1. Safeguards are sufficient 2. Carry out routine maintenance PCV193 SOP / 194/195

ANNEX-2; Worksheet HAZOP Node – 2

Node 2 Reactor Heaters F-5-01 Firing System						Drawing : 3
1.1. More Flow Fuel Gas						
Cause	***Consequences***	***Safeguard***	Risk Score L	C	RR	***Recommendation***
1. The PCV-193/194/195, cannot close (Stuck opened)	1. F-5-01 temperature increases considerably and lead to decreased catalyst lifetime and quality, and potentially damage the reactor tube	1. TI-016/019/024 2. TI-1502/15004/15006 3. PCV-193/194/195	3	3	9	1. Safeguard Replace gate valve after PCV. 2. Carry out re-calibration and routine maintenance SOP PCV 193/194/195
	2. Overheating of the heating tube causes the hot spots or material explosion on the tube.	1.FI-005/010/013 2.TI-5001/15003/15005 3.PCV-193/194/195	4	3	12	1. Safeguard Replace gate vale after PCV-193/194/195
2. . By Pass PCV-193/194/195 Open / passing	1. F-5-01 Temperature increases cause decreased catalyst lifetime and quality, process quality decreases, potentially damaging the reactor tube heaters.	1.FI-005/010/013 2.CV-193/194/195	3	3	9	1. Safeguards are sufficient 2. Carry out routine maintenance on the SOP PCV 193/194/195
	2. Overheating of the heating tube hot spots or even cause explosions on the tube.	1.TI-016/019/024 2.TI-15001/15003/ 15005 3.PCV-193/194/195	4	3	12	1. Safeguards are sufficient 2.Carry out routine maintenance on the SOP PCV 193/194/195
3. PCV-193/194/195 open due to weak output signal	1. F-5-01 temperature increases considerably and lead to decreased catalyst lifetime and quality. Decrise process, potentially damaging the reactor tube heaters.	1.FI-005/010/013 2.Ti-016/019/024	3	3	9	1 Safeguar install the gate, value after PCV-193/194/15 2. SOP performs routine maintenance and checks on the control loop.
	2. Overheating of the heating tube causes the hot spots or even blowup on the tube	1.FI-005/010/013	4	3	12	1 Safeguard install the gate, value after PCV-193/194/15 2. SOP performs routine maintenance checks on a control loop.
1.2. More Flow Pilot Gas						
1 PCV -004.. Mech. failure	1.Not Significant	-	-	-	-	-
1.3. Less/No Flow Fuel Gas						
1. Strainer clogged on the flow of fuel gas	1. F-5-01 temperature decreases and causes the operating conditions are not right and the quality of the process of decline	4.FI-005/010/013 5.TI-016/019/024	3	2	6	1. To check the condition of the strainer regularly.
2. The flow of weak upstream,	1. F-5-01 temperature decreases and causes the operating conditions are not right and the quality of the process of decline	1.FI-005/010/013 2.TI-016/019/024	3	3	9	1. Safeguards are sufficient
3. PCV-193/194/195 fails to open	1. F-5-01 temperature decreases and causes the operating conditions not right& process of decline.	1.FI-005/010/013 2.Ti-016/019/024	3	3	9	1. PCV recalibration 193/194/195

1.4 Less/No Flow Pilot Gas							
1. There is no input stream	1. F-5-01 trip due to low pressure gas supply to the gas pilot	1.PAL-001, PALL-001 2.XCV-021/A/B	1	1	1	1. Safeguards are sufficient
2.PCV-004 Clogged / deadlocked	1. The flow of gas pilot missing	1.PI-001	1	1	1	-
1.5 High Pressure Fuel Gas							
1. High upstream pressure	1.Not Significant	-	-	-	-	-
2. PCV-193/194/195 cannot close (stuck opened)	1. F-5-01 temperature increases considerably and leads to decreased catalyst lifetime and quality, process quality decreases, and potentially damage the reactor tube heaters.	1.TI-016/019/024 2.PCV-193/194/ 195	3	3	9	1 Safeguard tide gate, value after PCV-193/194/15 2. Perform routine maintenance on the SOP PCV 193/194/15
	2. Overheating of the heating tube causes the hot spots or even an explosion on the tube	1.TI-016/019/024 2.TI- 5001/15003/ 15005 3. PCV-193/194/ 195	4	3	12	1 Safeguard tide gate, value after PCV-193/194/15 2. Perform routine maintenance on the SOP PCV 193/194/15
3. By Pass PCV 193/194/195 open / passing	1. F-5-01 temperature becomes much and cause catalyst lifetime and quality, process decline and potentially damage the reactor tube heaters.	1.TI-016/019/024 3.PCV-193/194/ 195	3	3	9	1. Safeguards are sufficient 2. Perform routine maintenance on the SOP PCV 193/194/15
	2. overheating of the heating tube causes the hot spots explosion on the tube	1.TI-016/019/024 2.TI-5001/15003/ 15005 3.PCV-193/194 /195	4	3	12	1.Safeguards are sufficient 2. Perform routine maintenance on the SOP PCV 193/194/15
1.6. High Pressure Pilot Gas							
1. Mechanical failure on the PCV-004	1.Not Significant	-	-	-	-	-
1.7. Low Pressure Fuel Gas							
1. Low pressure upstream	1. F-5-01 temperature decreases and causes the operating conditions are not right.	1.TI-016/019/ 024 2.PI-632 (local) 3.PAL-632,PALL-632 4.XCV020,/A/B/C	3	3	9	1. Safeguards are sufficient
2. 93/194/195 PCV- not fail to close	1. F-5-01 temperature decreases and causes the operating conditions are not right and the quality of the process of decline	1.TI-016/019/024 2.PI-632 (local)	3	3	9	2. Carry out routine maintenance on the SOP PCV 193/194/15
3. Steiner fuel gas stream clogged	1. F-5-01 temperature decreases and causes the operating are not correct and quality process decries.	1.TI-016/019/024 2.PI-632(Local)	3	2	6	1. Checking the condition of the strainer regularly
1.8. Low Pressure Pilot Gas							
1. Low pressure upstream	1. Not the flame to the combustion reactor heaters F-5-01	1.PI-001 2.PI-002 (local) 3.PAL-001,PALL-001	4	2	8	1. Safeguards are sufficient
2. Steiner the pilot gas flow is clogged	1. Not the flame to the combustion reactor heaters F-5-01	1.PI-001 2.PI-002 (local) 3.PAL-001,PALL-001	4	2	8	2. Carry out checking and cleaning strainer before start up