Risk Analysis of Methanol Transfer Process by Hazard and Operability Study (HAZOP) Method in Biodiesel Plant

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Abstract

Accidents in the chemical process industry can not only result in loss of life (fatality) and property but can also cause irreparable damage (assets and the environment) to the external environment. For companies whose industrial activities are processing, storing, distributing, transporting and using hazardous chemicals to carry out a Risk Analysis of the potential hazards of chemicals, and the stages of Hazard Identification against Chemicals are steps to prevent industrial accidents and also as a form of prevention. Against work accidents and occupational diseases. The purpose of this study is to analyze the risk of chemical hazards in the Methanol transfer process in each operating process based on the P&ID Diagram document and to determine the potential hazards of chemicals in the process so that hazard control can be applied. This study focuses on the methanol transfer process in biodiesel companies using the Hazard and Operability Study (HAZOP) method. The results of the analysis after it was done that the value of before reduction after the application of safeguards on each item of the Methanol and Sodium Methylate Daily Tank process, the results of the after reduction risk assessment on the risk value changed from a Risk score of 20 to a Risk Score of 16. Based on the results of the Risk Analysis it can be seen that the risk analysis using the HAZOP method after safeguarding is obtained with an average risk level of moderate risk of 40%, low of 32% and high of 28%.

Keywords
OSH, Hazard Identification, Chemical Hazardous, HAZOP, Risk Analysis.

1. Introduction
Various chemical industries have grown and developed in Indonesia, including petrochemical, oleochemical, agrochemical, and so on. The chemical industry also produces various chemical products to meet the needs and improve the living standards of the Indonesian people. With a population of 250 million people and the support of natural resources as raw materials for the petrochemical industry, both non-renewable and renewable, Indonesia has an opportunity as a center for developing the petrochemical industry in the strategic environment of ASEAN and Asia. Industrial activities that process, store, distribute, transport and use hazardous chemicals will continue to increase due to the growing need for life (lifestyle) for human welfare and technological advances that are in line with the rapid development of development (Nedved, 1991). According to the Ministry of Manpower (1999), one of the potential hazards in the chemical industry is the occurrence of explosions and fires. With the increasing number of chemical industries in Indonesia, it will create the worst risks and even death due to these explosions and fires. The explosion can be defined as a phenomenon in which an explosive (pressure shock) wave is generated in the air with a rapid release of energy. This energy may have originally been stored in the system in various forms (e.g., nuclear, chemical, electrical, or pressure energy) (Nedved, 1991). To be considered explosive, the release of energy must be fast enough and concentrated enough to produce an audible pressure wave (Arendt & Lorenzo, 2000). According to the ILO (2018), there are three basic requirements for a fire to occur and get bigger: 1) the presence of fuel, 2) the presence of

a source of ignition/fire and 3) the presence of oxygen in the air to support combustion. According to the COMAH regulation (2015), that "major accident" means an event such as emission, fire, or a large explosion resulting from uncontrolled developments during operation. The consequences of accidents in the chemical process industry can not only result in loss of life (fatality) and property but can also cause irreparable damage (assets and the environment) to the outside environment (Mannan, 2014). The chemical industry accidents can be avoided if company management is committed to implementing control of hazardous chemicals in the workplace (Gharabagh et al., 2009). That there is a sizeable difference in the company's performance in terms of work safety. These differences can only be attributed to differences in management. The companies concerned attribute their full success to good management (Lees, 1996). The chemical industry accident data can be seen in Table 1.

Table 1. Chemical industry accident data

Year	Location	Chemical	Type of Accident
2004	East Java	Phthalic anhydride dan maleic anhydride	Fire and explosion
2009	DKI Jakarta	Very flammable liquid	Fire
2010	Banten	Hydrochloric acid	Explosion
2011	Banten	Azodicarbonamide	Fire and explosion
2014	West Java	It is suspected that the explosion came from a burning chemical liquid	Fire and explosion
2015	West Java	LPG leaking from the flexible tube	Explosion
2016	Banten	Butyl acetate	Fire and explosion
2017	Banten	Magnesium, natrium, fransium, litium, boron, kalium, kalsium and various oxidizing agents.	Fire and explosion
2018	Banten	Tiner	Fire
2020	Banten	Solvent	Fire

According to the Ministry of Manpower (1999), the management of national vital objects that involve the livelihood of many people, the interests of the state and or sources of state income that are strategic require a controlled management system so that they are safe from disturbances/threats, one of which can take the form of events in the form of work accidents such as fires, explosions and detachments. Toxic gases and occupational diseases. Accidents in the chemical industry not only cause fatalities but can also damage property and cause enormous material losses (Shin, 2017). Therefore, it is necessary to take concrete steps to protect the workforce, the community and the environment by preventing and reducing the occurrence of work accidents to the maximum and minimizing the impact of accidents both inside and outside the workplace, especially those caused by hazardous chemicals (Haworth & Hughes, 2012). For this research, the author will focus more on the application of hazard and risk identification, a case study conducted in a biodiesel plant. Researchers will analyze the risk of explosion and fire in the transfer of methanol at the biodiesel plant with the HAZOP method and provide solutions and preventive and control measures in the chemical industry.

1.1 Objectives

This research is to get an overview of the identification technique used in chemical companies with the category of major hazard installation. By using data:

1. Conduct a comprehensive review of the literature on the specific hazard identification technique of the Hazop method
2. Reviewing the relative advantages and disadvantages of applying the operational hazard identification with the Hazop method.

2. Literature Review

Accident risk management is the basic process of the safety function of engineering and management systems (OHSAS, 2007). System Risk is a disciplined and control process that is applied from the initial system design concept, through detailed design and testing, to disposal of the system at the end of its useful life. (Sharma, 2013). The basic purpose of a Safety System is to identify, eliminate or control, and document system hazards (Ericson, 2005).

2.1 Hazard

According to the International Organization for Standardization (ISO) 45001 of 2018, a hazard is a source that has the potential to cause injury and health problems. A potential hazard is something that has the potential for an incident to occur that results in a loss (Haworth & Hughes, 2012). According to the Occupational Health and Safety Assessment Series (OHSAS) 18001, a hazard is defined as anything including a situation or action that has the potential to cause an accident or injury to humans, damage or other disturbance (OHSAS, 2007). A Hazard or Hazardous Event or Incident an inherent chemical or physical property that has the potential to cause damage to people, property or the environment (Hyatt, 2003). The main hazards facing the chemical industry concerned are fire, explosion and release of toxins (Mannan, 2014). Of these three, fire is the most common, but explosions being the most common are more significant in terms of their potential for damage, often causing death and property damage (Abbasi et al., 2018). To understand accident mechanisms and to develop accident prevention and control strategies it is important to know and learn from past accidents (Hyatt, 2003). However, the industry is generally reluctant to reveal what has happened and tends to belittle their mistakes (Chikhalikar & Jog, 2018). A hazard is an inherent physical or chemical characteristic that has the potential to cause harm to people, property or the environment. In chemical processes, 'It is a combination of a hazardous substance, an operation' environment, and certain unplanned events that can result in an accident" (Mcdonald, 2004).

The following are the steps for hazard analysis: 1) Preliminary Hazard Analysis (PHA) As the first step in analyzing the hazard, a PHA must be carried out. The implementation of the PHA must identify the type of failure or accident that is likely to occur in the installation, such as leakage of toxic chemicals, explosions, leaks of flammable chemicals and to check the work safety system 2) Hazard and Operability Study (HAZOP) study or other similar study should be carried out to determine deviations in the normal operation of the plant and errors in operation that can cause uncontrollable events to occur. HAZOP studies should be carried out on factories that are new in the design phase and on existing plants before major changes or for other operational or legal reasons. (Nedved, 1991).

2.2 Risk

Risk is something we can roughly measure by making a scale based on the product of frequency and consequence (Abbasi et al., 2018). For example, we can measure consequences in terms of injury to people. Risk is usually defined as a combination of the severity and probability of an event (Meel et al., 2007). In other words, how often can it happen and how bad is it when it does happen? Risk can be evaluated qualitatively or quantitatively (McDonald, 2004). Risk = Frequency × Consequence of hazard The calculated overall risk should be compared with the accepted Risk Criteria. Depending on the acceptable level of risk, the decision to take the risk or take corrective action is made (ISO, 2018). If the level of risk is within an acceptable margin, then no further action will be required. If the level of risk is higher than expected, then the action requires recovery and costs of factory renovation, changes to procedures, possible emergency response planning is required (Abbasi et al., 2018).

2.3 Risk Analysis

Frequency is evaluated in several ways. Frequency can be evaluated from the history of similar facilities or modeling errors or incidents using system component failure data rates. Since Risk is a product of Consequences and Frequency, knowing the probability of death as a result and knowing the probability of occurrence of Frequency, Risk can be determined. As Risk is additive, all potential scenarios must be assessed and Risk calculated, to calculate Overall Risk (ISO, 2018). Risk Reduction Measures (also known as Risk Control) may need to be evaluated from an economic/design/procedural point of view. To analyze the risk assessment, a Risk Matrix and Risk Level are needed which are used in determining the Risk Score, which can be illustrated in Table 2 and Table 3.

Table 2. Risk matrix

Very High (5)	5	10	15	20	25
High (4)	4	8	12	16	20
Medium (3)	3	6	9	12	15
Low (2)	2	4	6	8	10
Very Low (1)	1	2	3	4	5
Remark	Very Low (1)	Low (2)	Medium (3)	High (4)	Very High (5)

Table 3. Risk level

Risk Level	Risk Acceptability	Recommended Actions
Low Risk	Acceptable	- No Additional risk control measure may be needed - Frequent review and monitoring of hazards are required to ensure that the risk level assigned is accurate and does not increase over time
Medium Risk	Tolerable	- Interim risk control measures such as administrative controls or PPE may be implemented while longer term measures are being established - Management attention required
High Risk	Not Acceptable	- High risk level must be reduced to at least medium risk before work commences - There should not be any interim risk control measure. Risk control measures should not be overly dependent on PPE or appliances - If practicable, the hazard should be eliminated before work commences - Management review is required before work commences

3. Methods

This type of research is a type of research that uses descriptive research. The study describes several data which are then analyzed and compared based on events in the ongoing field. Next, try to provide solutions to existing problems. This study focuses on the methanol transfer process in biodiesel companies using the Hazard and Operability Study (HAZOP) method. The method that will be used in this research is the HAZOP method. The Hazop process is part of the Process Hazard Analysis (PHA) stage (Abbasi et al., 2018) which is a method of analyzing and identifying the hazards contained in industrial processes that use hazardous chemicals (Sharma, 2013). Where in its implementation, the level of Risk Analysis is to examine the hazards and operating problems that arise due to deviations from either design or due to the operating system (Ora, 2015). Data processing and analysis techniques were carried out based on secondary data from the results of data collection in the company. A case study was conducted on a biodiesel company, one of the chemicals used was Methanol by analyzing the operating process that occurred in the Methanol and Sodium Methylate Daily Tank section, which was only in the Node 3 section. Node is a part that is used as an identification reference. Stages in identifying operational hazards in an installation based on the P&ID Diagram document (Mcdonald, 2004) that has been determined by the Hazop Team and Company Management. are as follows :

1) Parameter and Guide Word
2) Cause
3) Safeguard
4) Risk Score
5) Highest Risk Analysis

4. Results and Discussion

The results of the Risk Analysis in the methanol transfer process are fire and explosion hazards. This risk can cause death and damage to property and the surrounding environment. The results of this discussion focus on the process at Node 3. Node 3 is a plant inlet that has an emergency shutdown system. The following are the results of the risk identification carried out at node 3. The P&ID diagram can be seen in Figure 1.

4.1 Parameter and Guide Word

To get a guide word can be done by looking at the existing historical data can be seen in Table 4.

Table **4.** Parameter and guide word node 3

Parameter	**Guide Word**	**Scenario**
Flow	No Flow	No More of Flow
	Less Flow	Less of Flow
	More Flow	More of Flow
	Reserve Flow	Reserve of Flow

	Misdirected Flow	Misdirected of flow
	Less Level	Less Level Of Flow
	More Level	More level of Flow
Pressure	Less Pressure	Less Of Pressure
	More Pressure	More Of Pressure
Temperature	Less Temperatur	Less Of Temperatur
	More Temperatur	More Of Temperatur

4.2 Cause and Consequences

After the hazard scenario is known, the next step is to identify the cause of the hazard. The following are the results of the identification that has been carried out. After knowing the cause of the hazard, the next step is to carry out a Consequence Analysis based on the existing causes. The result can be seen in Table 5.

Table 5. Cause and consequences node 3

Item	Cause	Consequences
N3.1.1.1	Each manual valve on the line (intake & discharge) of the methanol/catalyst discharge pump is accidentally closed	Potential damage to PU-MET/CAT-30-001 due to cavitation/overheating. Damage to the seal may result in the release of methanol/methylate which creates a fire/explosion hazard
N3.1.3.1	The Y filter on the suction line of the truck unloading pump is clogged	Potential damage to PU-MET/CAT-30-001 due to cavitation/overheating. Damage to the seal may result in the release of methanol/methylate which creates a fire/explosion hazard
N3.1.4.1 N3.1.4.2	Methanol/catalyst truck demolition pump	No methanol/catalyst is transferred to the daily tank. In case of minimum stock of methanol/catalyst in a daily tank, it will lead to less production or plant shutdown
N3.1.5.1	Each manual valve on the line (intake & discharge) of the methanol/catalyst pump is accidentally closed	Potential damage to PU-MET-10-001/2 & PU-CAT-5-001/2 due to cavitation (dry running)/overheating. Damage to the seal may result in the release of methanol/methylate which creates a fire/explosion hazard
N3.1.8.1	The on/off valve on the suction line of the methanol transfer pump and catalyst dosing pump failed (failed to open)	No methanol/catalyst is transferred to 160V2 and fed into the reactor causing plant shutdown
N3.1.9.1 N3.1.9.2	The Y filter on the suction line of the methanol transfer pump is clogged	No methanol/catalyst is transferred to 160V2 and fed into the reactor causing plant shutdown
N3.1.10.1	The methanol and catalyst on/off valves to the reactor fail to open	Potential damage to PU-MET-10-001/2 & PU-CAT-5-001/2 due to cavitation (dry running)/overheating. Damage to the seal may result in the release of methanol/methylate which creates a fire/explosion hazard
N3.1.11.1	The Y filter on the suction line of the truck unloading pump is clogged	No methanol is transferred to the tank daily. In the case of a daily minimum stock of methanol/catalyst in the tank, it will lead to less production or plant shutdown
N3.1.13.1	Each manual valve on the line (intake & discharge) of the methanol barge unloading pump is accidentally closed	Potential damage to the methanol barge unloading pump due to overheating. Damage to seals may result in release of methanol causing a fire/explosion hazard
N3.2.1.1	Methylate/methanol unloading hose leaks at the truck unloading station	The release of sodium methylate/methanol at the truck unloading station will be accommodated in a special drain hole. Potential fire hazard:
N3.5.1.1	Vacuum condition in catalyst ISO tank	Potential damage to PU-MET-10-001/002 and PU-CAT-5-001/002 due to cavitation. Damage to the seal

		may result in the release of catalyst causing a fire/explosion hazard
N3.5.1.2	Nitrogen compressor trip	There is no nitrogen supply for the blanketing system in the tank. The tank has the potential to be vacuumed causing collapse and failure. This will cause the release of methanol/catalyst in the bund wall
N3.9.1.1	PCV nitrogen blanket system stuck close	There is no nitrogen supply for the blanketing system in the tank. The tank has the potential to be vacuumed causing collapse and failure. This will cause the release of methanol/catalyst in the bund wall
N3.9.2.1	The Y-filter on the suction line of the methanol transfer pump is partially blocked	Less methanol/catalyst transferred to 160V2 and fed into the reactor leading to less production and plant shutdowns
N3.11.1.1	The Y-filter on the suction line of the truck unloading pump is partially blocked	No methanol/catalyst is transferred to 160V2 and fed into the reactor causing plant shutdown
N3.12.1.1.		Potential increase in pressure leading to tank failure leading to escalation of fire incidents

4.3 Safeguard and Risk Score

For each consequence, there is a safeguard system to reduce the impact of the risks that occur. The following Safeguards and Risk Score are on Node 3 can be seen in Table 6.

Table 6. Result of risk score node 3

Item	Before Risk Reduction			Safeguards	After Risk Reduction		
	S	L	RR		S	L	RR
N3.1.1.1	5	4	20	Pump with double mechanical seal	4	4	16
				Methanol gas detector in pump house (MCFA)	3	4	12
				Pump's seal pot cooling system	2	4	8
				The level transmitter at methanol and catalyst daily tank LIT002001/002002/002003/002004			
				Manual level indicator (pendulum) at methanol and catalyst daily tanks			
				PM & PdM by the maintenance team	1	4	4
				Pressure gauge at discharge line of the truck unloading pump PU-MET/CAT-30-001 (PI 002008)			
				Monitoring logsheet (tank farm field data sheet FBD006)			
				SOP & WI (WBD025 &WBD027) for catalyst and methanol truck unloading procedures			
N3.1.3.1	5	4	20	The level transmitter at methanol and catalyst daily tank LIT002001/002002/002003/002004	4	4	16
				Pump's running status on PLC	3	4	12
				Manual level indicator (pendulum) at methanol and catalyst daily tanks	2	4	8
				Monitoring logsheet (tank farm field data sheet FBD006)	1	4	4
				Chemicals stock inventory control			
				PM & PdM by yhe maintenance team			
				Pressure gauge at discharge line of the truck the unloading pump PU-MET/CAT-30-001 (PI 002008)			
				SOP & WI (WBD025 &WBD027) for catalyst and methanol truck unloading procedures			
N3.1.4.2	5	4	20	Pump with double mechanical seal	4	4	16
				The level switch LALL16013 at dried methanol tank 160V2	3	4	12
				The level transmitter at methanol and catalyst daily tank LIT002001/002002/002003/002004			

				Pump's seal pot cooling system	2	4	8
				Stand-by methanol/catalyst transfer pump			
				The level transmitter LT16002 (dried methanol tank) in plant			
				Flowmeter of catalyst dosing to reactor (FT16304, FT16305, FT16306 & FT16314)			
				Methanol gas detector in pump house (MCFA)			
				PM & PdM by the maintenance team	1	4	4
				Monitoring logsheet (DCS and field data sheet section 160 & 163 FBD001 & FBD002)			
				Monitoring logsheet (tank farm field data sheet FBD006)			
				Pressure gauge at discharge line of methanol transfer pump and catalyst dosing pump (PI 002004/002005/002006/002007)			
				WBD007 (normal operation of biodiesel plant) & WBD017 (start-up biodiesel plant)			
N3.1.5.1	5	4	20	Pump with double mechanical seal	4	4	16
				The level switch LALL16013 at dried methanol tank 160V2	3	4	12
				The level transmitter at methanol and catalyst daily tank LIT002001/002002/002003/002004			
				Pump's seal pot cooling system	2	4	8
				Stand-by methanol/catalyst transfer pump			
				The level transmitter LT16002 (dried methanol tank) in plant			
				Flowmeter of catalyst dosing to reactor (FT16304, FT16305, FT16306 & FT16314)			
				Methanol gas detector in pump house (MCFA)			
				PM & PdM by the maintenance team	1	4	4
				Monitoring logsheet (DCS and field data sheet section 160 & 163 FBD001 & FBD002)			
				Monitoring logsheet (tank farm field data sheet FBD006)			
				Pressure gauge at discharge line of methanol transfer pump and catalyst dosing pump (PI 002004/002005/002006/002007)			
				WBD007 (normal operation) and WBD017 (start-up biodiesel plant)			
N3.1.8.1	5	4	20	The level transmitter at methanol daily tank LIT002001/002002	4	4	16
				Manual level indicator (pendulum) at methanol daily tanks	3	4	12
				Monitoring logsheet (tank farm field data sheet FBD006)	2	4	8
				Chemicals stock inventory control			
				WBD028 for methanol barge unloading procedure			
N3.1.9.2	5	4	20	The level transmitter at methanol daily tank LIT002001/002002	4	4	16
				Manual level indicator (pendulum) at methanol daily tanks	3	4	12
				Monitoring logsheet (tank farm field data sheet FBD006)	2	4	8
				Chemicals stock inventory control			
				WBD028 for methanol barge unloading procedure			
N3.1.10.1	5	4	20	The level transmitter at catalyst daily tank LIT002003/002004	4	4	16
				Manual level indicator (pendulum) at catalyst daily tanks	3	4	12
				Quick connect dry break coupling and braided stainless steel hose	2	4	8
				WBD025 for catalyst truck (ISO tank) unloading procedures	1	4	4
				Pressure gauge at discharge line of the truck unloading pump PU-MET/CAT-30-001 (PI 002008)			
				Fire Extinguisher at unloading station			
N3.1.11.1	5	4	20	Level transmitter at catalyst daily tank LIT002003/002004	4	4	16
				Manual level indicator (pendulum) at catalyst daily tanks	3	4	12
				ISO tank is equipped with venting line to break the vacuum	2	4	8
				Pressure gauge at discharge line of truck unloading pump PU-MET/CAT-30-001 (PI 002008)	1	4	4

				WBD025 for catalyst truck (ISO tank) unloading procedures			
				Fire Extinguisher at unloading station			
N3.1.13.1	5	4	20	Stand-by nitrogen compressor (back-up)	4	4	16
				Breather valve	3	4	12
				Stand-by nitrogen in the receiver tank	2	4	8
				Emergency vent			
				Monitoring logsheet (tank farm field data sheet FBD006)	1	4	4
				Monitoring logsheet (DCS and field data sheet section 160 & 180 FBD001)			
				PM and PdM by the maintenance team			
N3.2.1.1	5	4	20	Flowmeter of catalyst dosing to reactor (FT16304, FT16305, FT16306 & FT16314)	4	4	16
				The level transmitter LT16002 (dried methanol tank) in plant	3	4	12
				Stand-by clean strainer and transfer/dosing pump	2	4	8
				Monitoring logsheet (tank farm field data sheet FBD006)	1	4	4
				Monitoring logsheet (DCS and field data sheet section 160 & 163 FBD001 & FBD002)			
				Pressure gauge at discharge line of methanol transfer pump and catalyst dosing pump (PI 002004/002005/002006/002007)			
N3.5.1.1	4	4	16	Monitoring logsheet (tank farm field data sheet FBD006)	3	4	12
				SOP & WI (WBD025, WBD027 & WBD028) for catalyst/methanol truck and barge unloading procedures			
				WBD007 (normal operation) and WBD017 (start-up biodiesel plant)			
N3.5.1.2	5	4	20	Tank High Level Alarm (LSH002001/002002/002003/002004)	4	4	16
				Tank High High Level Alarm (LSHH002001/002002/002003/002004)	3	4	12
				Pressure transmitter PIT002001/002002/002003/002004	2	4	8
				Breather valve and emergency vent			
				WBD007 (normal operation of biodiesel plant) & WBD017 (start-up biodiesel plant)	1	4	4
				Manual level indicator (pendulum) at methanol and catalyst daily tanks			
				Monitoring logsheet (tank farm field data sheet FBD006)			
				SOP & WI (WBD025, WBD027 & WBD028) for catalyst/methanol truck and barge unloading procedures			
				Fire Extinguisher in bund wall			
N3.9.1.1	5	4	20	Breather valve	4	4	16
				Pressure transmitter PIT002001/002002/002003/002004	3	4	12
				Emergency vent	2	4	8
				Fire extinguisher in bund wall	1	4	4
				Pressure gauge on each tank			
				PM and PdM by maintenance team			
N3.9.2.1	4	3	12	Spray water (sprinklers) on the roof of tank	2	3	6
				Methanol gas detector (Crowcon)			
				Nitrogen blanketing system for each of daily tank			
				Temperature transmitter TIT002001/002002/002003/002004			
				Emergency vent			
				Pressure transmitter PIT002001/002002/002003/002004			
N3.11.1.1	4	3	12	Temperature transmitter TIT002001/002002/002003/002004	2	3	6
				Foam chamber			
				Emergency vent and breather valve			
				Spray water (sprinklers) on the roof of tank			
				Pressure transmitter PIT002001/002002/002003/002004			
				Nitrogen blanketing system for each of daily tank			
				Scully grounding			
				Fire extinguishers in unloading station	2	3	6

				WBD027 for methanol truck unloading procedures			
				Basic PPE			
N3.12.1.1	5	5	25	Methanol gas detector in methanol tank farm of biodiesel plant (1 on bund wall and 1 on pump house)	4	5	20
				Closed bund wall	3	5	15
				Foam chamber	2	5	10
				Tank's inspection log sheet	1	5	5
				Restricted area			
				Fire fighting system			
				Water sprinklers, activated by heat detection			

After reduction results that are still in the High Risk position will be displayed in the Table 7.

Table 7. Risk score with high result (node 3)

Item	Before Risk Reduction			Safeguards	After Risk Reduction		
	S	L	RR		S	L	RR
N3.1.1.1	5	4	20	Pump with double mechanical seal	4	4	16
N3.1.3.1	5	4	20	Level transmitter on daily tank of methanol and catalyst	4	4	16
N3.1.4.2	5	4	20	Pump with double mechanical seal	4	4	16
N3.1.5.1	5	4	20	Pump with double mechanical seal	4	4	16
N3.1.8.1	5	4	20	Level transmitter on daily tank of methanol	4	4	16
N3.1.9.2	5	4	20	Level transmitter on daily tank of methanol	4	4	16
N3.1.10.1	5	4	20	Level transmitter in catalyst daily tank	4	4	16
N3.1.11.1	5	4	20	Level transmitter in catalyst daily tank	4	4	16
N3.1.13.1	5	4	20	Compressor nitrogen standby (backup)	4	4	16
N3.2.1.1	5	4	20	Catalyst does flowmeter to the reactor	4	4	16
N3.5.1.2	5	4	20	Tank High Level Alarm	4	4	16
N3.9.1.1	5	4	20	Breathing valve	4	4	16
N3.12.1.1	5	5	25	Methanol gas detector in the methanol tank farm of the biodiesel plant (1 in the bund wall and 1 in the pump house)	4	5	20

The results of the analysis after it is done that the value of before reduction after the application of safeguards is carried out on each item of the Methanol and Sodium Methylate Daily Tank process, the results of the after reduction risk assessment on the risk value have changed from a Risk score of 20 to a Risk Score of 16. Based on the results of the Risk Analysis, it can be seen that the risk analysis using the hazop method after safeguarding is obtained with an average risk level of 40%, moderate risk, 32% low and 28% high.

5. Conclusion

That the results of the risk analysis using hazop can be seen using several very detailed hazard analysis methods because all installations from input, process and output are part of the hazard identification process. One of the most structured and detailed methods used is the HAZOP (Hazard and Operability Analysis) method, where each operation process is based on the P&ID Diagram document. From the application of Hazard Identification, the result is that the Risk Score Before Reduction value is still on average 20 and after the application of safeguards is then scored, the result is that the Risk Score after Reduction is 16 and this requires special attention in the Node 3 section of the Methanol and Sodium Methylate Daily Tank plant operation process. It is necessary to take steps to improve the results that are still at high risk, namely to carry out a Mitigation Step plan in the form of a Hazop Recommendation. Hazop Recommendation is a form of strategy implementation for the implementation of hazardous chemical control and OSH as the end result of efforts to improve and reduce Risk in the Methanol and Sodium Methylate Daily Tank process. That hazard identification and risk assessment must be carried out in every operating process in the chemical industry to determine and be able to estimate the potential hazards and risks faced. And risk control must be implemented to prevent major accidents in the chemical industry and reduce the risk of disasters in the chemical industry.

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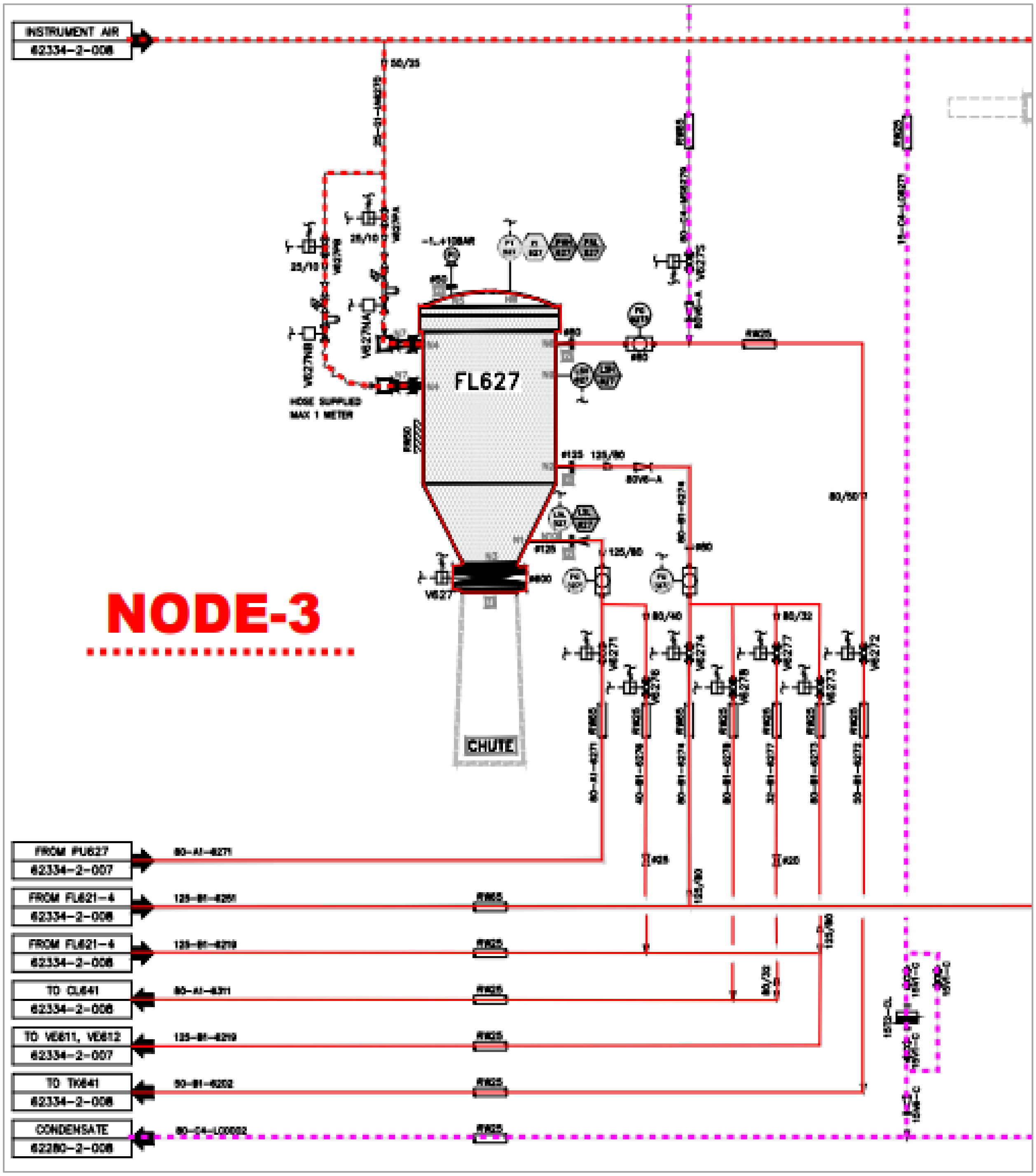

Figure 1. P&ID diagram