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Gas Sweetening Units Risk Assessment Using HAZOP Procedure

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Abstract. HAZOP Study (Hazard and operability study) is a well known Hazard analysis tool used for process safety management and HSE risk assessment of plans and facilities. The Hazard and Operability (HAZOP) study is a widely used formal technique for examining potential safety and operational problems associated with a system. In this work, hazards of Gas Sweetening Units were assessed by using HAZOP procedure. All of the deviations were considered by HAZOP team and the recommendations were suggested to reduce the likelihood of consequences that mostly were related to the environmental risk.

Keywords: Safety; Hazard Identification; Hazard and Operability Study; Gas Sweetening Unit, Risk

1. Introduction

HAZOP is the method recommended for identifying hazards and problems which prevent efficient operation of a processing plant. The HAZOP team focuses on specific portions of the process called "nodes". Generally these are identified from the P&ID of the process before the study begins. A process parameter is identified and an intention is created the node under consideration. Then a series of Guidewords is combined with the parameter to create a deviation. The team considerer about causes of deviation beginning with the consequences, safeguard and recommendation. The result of HAZOP depend more upon the experience and attitudes of the participants and on the leadership style adopted, than on the procedures themselves [4-6].

2. Hazard Identification

The Hazard identification process should consider all operating modes of the facilities and all activities that are expected to occur. It should also consider human and system issues as well as engineering issues. The hazard identification process should be ongoing and dynamic. It should not just be carried out during development of the safety case but also in a range of defined.. There are the number of hazard identification and hazard analysis method available, which can either be qualitative or quantitative in nature. Qualitative method including Checklist, What-If Review, Hazard an Operability Review (HAZOP), Preliminary Hazard Analysis, and Failure Mode Analysis (FMA). Quantitative method includes Event Trees, Failure and Effects Analysis (FMEA) [3]. HAZOP analyses and FMEA involve many people and tend to be more expensive but, you can have greater confidence in the exhaustiveness of HAZOP and FMEA techniques their rigorous approach helps ensure completeness [1, 8].

3. Hazard Evaluation of Gas Sweetening Units

Natural Gas is supplied to this plant. The CO_2 is removed from the process gas stream in two-stage CO_2 Absorber. The absorber overhead gas enters KO drum, where any entrained solution is separated out. Semi-lean solution enters the top of the bulk section of the bulk of the CO_2 removal takes place. Lean solution

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enters the top of the lean section of the absorber where the final CO_2 removal takes place. The rich solution from the absorber bottom passes through the Hydraulic Turbine for power recovery. The desorbed gases leave via the vapour outlet and passes into the fuel gas system. The solution enters the CO_2 Stripper. The rich solution from the HP Flash Vessel enters the LP flash section, which uses a mixture of steam and stripping gas generated in the stripping section below to remove the chemically bonded CO_2. The rest of the carbon dioxide is released to the atmosphere on pressure control. The lean solution is cooled before being sent to the top section of the absorber by the Lean Solution Pumps.

4. Results and Discussion

Entrance streams to Absorber tower are NG and MDA. CO_2 exit from overhead stream and rich solution exit from bottom stream. The most important deviations discussed in this part. If entrance gas to this absorber is cut, solvent will leave this tower without doing absorption. If No Flow is occurred in MDA stream by any reason, Natural Gas will enter to this line and NG enters to environment. H_2 is existed in NG and explosion may be occurred. Inlet NG stream should be cut rapidly when MDA stream doesn't have any flow rate. To considerer a XV or shut off valve in this line for preventing to enter gas to this line. This shut of valve should be act automatically or manually. The position of this valve is important. Operator should be had able close it rapidly. This shut of valve had been shut down plant by sending a signal.

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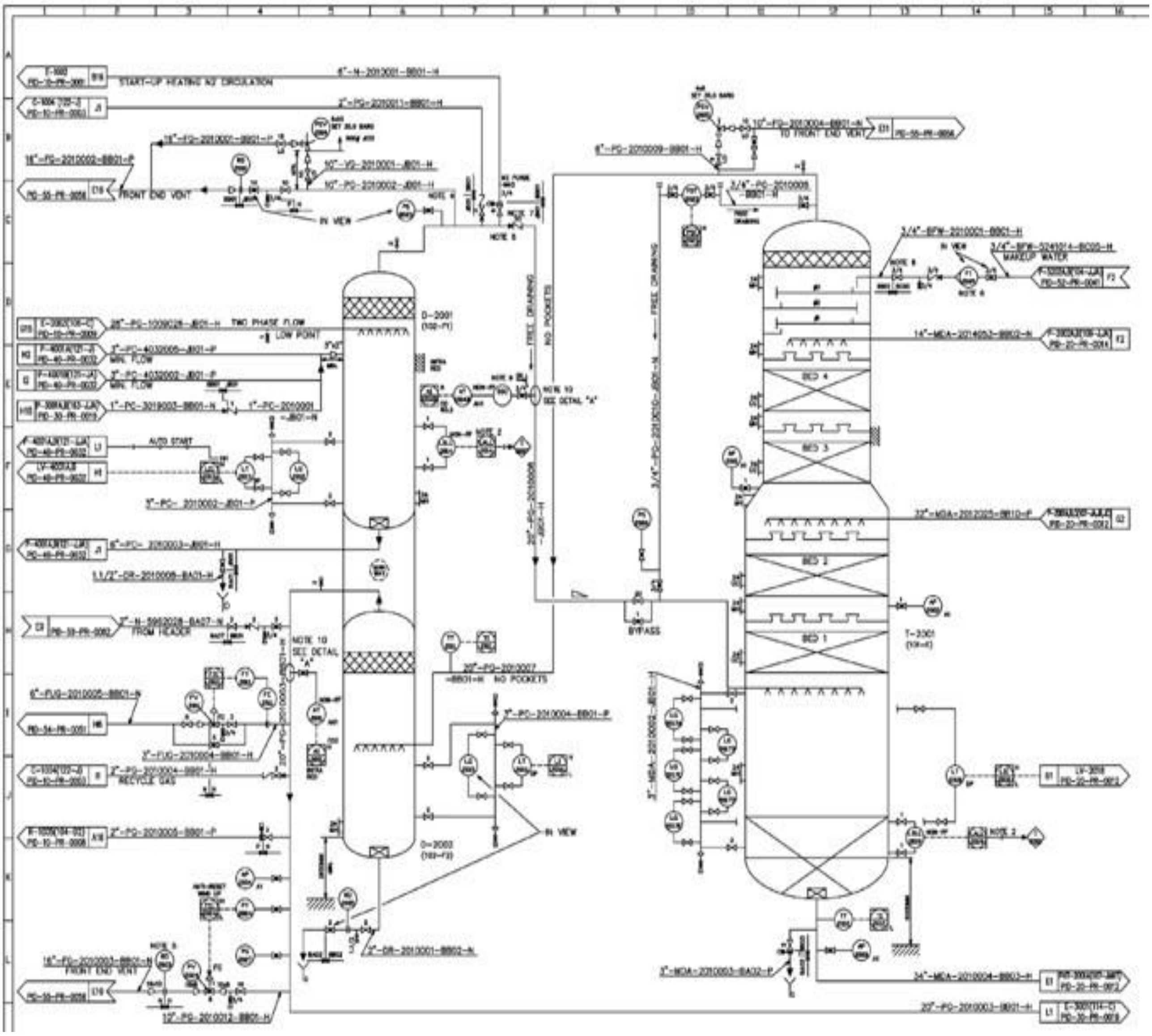

Figure 1: P&ID of Gas Sweetening section

Node:. CO2 Absorber System

Drawings:

Type:

Equipment ID:

Design Conditions/Parameters:

Deviation: 1. No Flow

Causes	Consequences	Risk Matrix			Safeguards	Recommendations	Responsibility	Status
		S	L	RR				
1. No gas feed to T-2001	1. Lower pressure in T-2001	1	4	4				
2. Blocked outlet (MOV-3001 or XV-3001 by any reason fully closed)	1. Pressure increase in T-2001 and upstream equipment	2	4	8	1. PIC-2024 , PSV-2005, PSVs and PICs for upstream equipment	1. RBI and FFS study should be done		
3. FV-2004A fails closed or low set point due to human error.	1. Loss of absorbent for T-2001 results in CO2	2	3	6	1. FALL-2004B closes MOV-3001 and XV-3001			
	2. level decrease in T-2001 and level increase in T-2002				2. AIAH-2001			
					3. FV-2004 bypass line			
4. No lean solution to T-2001 (P-2002A trip FV-2005 fails locked)	1. CO2 slip from T-2001	2	3	6	1. FALL-2005B closes MOV-3001 and XV-3001			
	2. Level decrease in T-2001 and increase in T-2002				2. AIAH-2001			
5. LIC-2018 malfunction or high set point	1. Level increase in T-2001 and level decrease in T-2002, 2003	1	2	2	1. PDI-2025			
	2. Pressure increase in T-2001 and the flooding and foaming may be occurred.	1	2	2	2. PSV-2005			
	3. loss of absorbent in T-2001 so co2 concentration in overhead stream increah	1	2	2	3. LIC-2018			
					4. AIAH-2001			
6. LV-2008 fail to close	1. Level increase in T-2003 and level decrease in T-2002.	1	2	2				
	2. pressure increase in T-2003 and pressure decrease in T-2002	1	2	2				

Node: CO2 Absorber System

Drawings:

Type:

Equipment ID:

Design Conditions/Parameters:

Deviation: 2. More Flow

Causes	Consequences	Risk Matrix			Safeguards	Recommendations	Responsibility	Status
		S	L	RR				
1. More gas feed to T-2001 due to more flow in pervious node	1. Higher pressure in T-2001, D-2002, E-3001, 3002 shell side,	1	2	2	1. PIC-2024 will control system pressure			
					2. PSV-2004			
2. PV-2024 wide open due to PIC-2024 malfunction or low set point	1. pressure decrease in T-2001, D-2002, E-3001, 3002 shell side	1	2	2				
3. Over speed of PHT-2001A due to pressure balance change between T-2001 and T-2003	1. Potential damage to PHT-2001A	1	2	2	1. Speed alarm high for PHT-2001A closes LV-2018C			
	2. Level decrease in T-2001 and level increase in T-2003	1	2	2	2. LIC-2008, %OP FV-2004A will decrease to control of flow rate			
	3. Semi lean flow rate increase so absorption performance and temperature increase.	1	2	2				
	4. Flooding and foaming may be occurred.	1	2	2				
4. FV-2004 A wide open	1. Higher level in T-2001	1	2	2	1. LAH-2018			
	2. Lower level in T-2002 may cause cavitations of P-2001 ABC	1	2	2	2. LAL-2002 (on T-2002 middle)			
	3. Possible flooding in T-2001	1	2	2	3. FALL-2004B stops P-2001ABC			
					4. PDAH-2025			
5. More lean solution to T-2001 (FV-2005 wide open)	1. Higher level in T-2001	1	2	2	1. LAH-2018			
	2. Lower level in T-2002 may cause cavitations of P-2002 AB	1	2	2	2. LAH-2018 LAL-2006 (on T-2002 bottom)			
	3. Possible flooding in T-2001	1	2	2	3. FALL-2005B stops P-2002AB			
					4. PDAH-2025			
6. LV-2008 wide open	1. Level and pressure decrease in T-2003 and up stream equipment	1	2	2	1. LSLL-2022, LIC-2008, PIC-2010 will decrease % OP. PV-2010, LIC -2018 will decrease % OP PV-2018			