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M.Sc. Thesis in Chemical Engineering, Process Design

Title:

Hazard Evaluation of Unit 500(Slug Catcher and Gas Condensate Stabilization and Dehydration Unit) of Parsian Gas Refinery Using HAZOP Procedures

Supervisors:

Dr. Farhad Shahraki

Advisor:

Mr Mohammadreza sardashti birjandi

Research by:

Kaveh Rezaei

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In the Name of God

Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Chemical Engineering, Process Engineering, by Kaveh Rezaei.

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Full name **Signature** **Date**

Supervisor: Dr. Farhad Shahraki

Supervisor:

Advisor: Mr Mohammadreza sardashti birjandi

Examiner 1: Dr. Hosain Atashi

Examiner 2: Dr. Farshad Farshchi

Representative of the Graduate Office:

Dr.

University of Sistan and Baluchestan

Chabahar International Campus

Authenticity Commitment Letter

The undersigned, **Kaveh Rezaei**, a graduat student in Chemical Engineering – Process Design, student N. 8803624 guarantees that material written in this thesis are the result of my own original studies and work. Any reference from any other source have been properly cited and acknowledged.

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Student's Name and Surname: Kaveh Rezaei

Signature: Date:

Representative of the Graduate Office: Dr.

Signature: Date:

I do hereby present all the thing which I have achieved from the results of this research

To the affectionate looks of my mother And to the supporting hands of my father , The hands and the looks , surely being the bridge of success.

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But at the end of this long way with its ups and downs , I feel obliged to thank Almighty God and all dear ones who helped me without any expectations .

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Abstract

Safety is a matter of up-most importance in industrial and chemical facilities .Looking at statistics, it is realized that annual scale of human, environmental and economical damages & losses due to industrial accidents is very high. In addition, basically some of these impacts not are compensated. Therefore to prevent these damages, detect hazards leading to these damages and risk analysis of industrial units, specific measures should be taken and systematic approaches are required. In this study, hazard evaluation and risk analysis of Slug Catcher and Gas Condensate Stabilization and Dehydration unit in Parsiyan Gas Refinery (500) has been investigated. In order to identify hazards, Hazard and operability Analysis (HAZOP) technique has been adopted in which operability problems are also detected. Deviations have been considered by HAZOP team. This project terminates to recommendations from HAZOP study to reduce the risk and increase the safety coefficient in Slug Catcher and Gas Condensate Stabilization and Dehydration unit. Based on the expertise works, the efficiency of stabilization unit and absorption is strongly depended to the function of parts of kilns and towers because whatever we keep the kiln's temperature (Heat Medium) in the appropriate high degree, the reboiler of stabilizing tower helps with better separation of productions in the bottom and the above of tower and productions are generated with high quality and more separation. The most important suggestions provided in this study consist of installation and operation of ethane and butane extraction. In addition based on the findings of this study the guide lines of operation of the unit were modified.

Key Words: HAZOP, Safety, Hazard Identity, Slug Catcher Gas Condensate Stabilization and Dehydration Unit, Risk, Gas Refinery

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Preface:

Nowadays making a secure environment which all deleterious agents are identified, assessed, deleted or controlled to warrant health of people and facilities is of highest priorities of industrial managers. The science of safety same as traditional viewpoint of safety is based on reaction i.e. not before the accidents to be happened, managers would have not fallen into finding and solving problems. During recent decades conscience and ethics considerations of industry proprietors in addition to obligations made by law and insurance commitments, have placed safety science in a specific situation. In this regard effect of safety on profitability and competition with rivals should not be ignored. So a look at safety as a preventive viewpoint toward accidents especially in oil,gas and petrochemical which are prone to high potential human and environmental accidents are at the center of attention.

Gas industry in Iran as for huge reservoirs of gas is of great importance. Gas refineries are considered as one of the most important parts of this industry and improvement of the safety inthis section is one of the most important concerns of everybody, since any minor problem in this industry can lead to not only great enviornmental and human disasters but also irreparable economic effects on the country.

Various methods are being used to improve ongoing processes in gas industry that hazard and HAZOP study is one of the best methods of those. Using this method in industrial countries is obligatory. Performing this system in developing countries is strongly recommended and in many oil, gas and petrochemical industries is used. HAZOP implementation in Iran refineries has become one of the most important activities in these plants to improve safety of systems and have already been used in many industries related to oil,gas and petrochemical.

Among the activities which have done in this industry, HAZARD study and risk assessment can be mentioned which have been executed in Shiraz petrochemical Urea plant, sweetening units of Razi petrochemical complex, Ethylen oxide unit of Arak petrochemical complex, Fluor production unit of Esfahan UCF, Sodium Bicarbonat

unit of Shiraz petrochemical complex, LPG regeneration unit of Kangan refinery, Poly stiren production unit of Tabriz petrochemical complex, Dehloran and Danan upstream units, Sea water intake unit of Mobin petrochemical complex, and isomax unit of Bandar Abbas oil refinery company. However activities done in this area are various and are progressive and every day more unit of petrochemical plants are going under these studies.[1]

The reasons on urgency and justification of project performance in Parsian Gas Refinery:

1. It has been more than 7 years since this unit was assembled and operated while no research has been performed on identifying the risks through HAZOP studies except from initial HAZOP studies on this unit that its documents are not even existent and available.
2. Persian Gas Refinery is the biggest sweet gas refinery in the Middle East which supplies a large volume of national Pipeline, so its evaluation through performing this method seems to be necessary.
3. Governmental centers and individuals are always resistant against the changes. Presenting a scientific, modern and reasonable solution by a group of experts applying the experiences of the own staff of the company, would pave the way to improve the safety level operational systems at the earliest convenience.

The direct and indirect expenses derived by the accidents, divert considerable financial and corporal harms to industries of the country and gas refining in particular due to its risky nature, thus, to prevent such accidents, applying a systematic method to identify the hidden risks in industrial unites and their continuous revision seem to be necessary.

Many managers and experts consider the attention to safety matters as a providence of time and capital. Performance of security programs in industrial units, identification of potential risks and providing performable solutions to prevent and reduce the harms caused by such accidents, can be followed by a lot of economical

advantages and time optimization. The following items can be mentioned as some of these advantages:

- Reducing the expenses related to:
  - Equipment destruction
  - Work suspension
  - Reoperation and coming to an steady status in incessant processes
  - Transmission and treatment of injured employees
  - Training new personnel
- Increasing the output of resources and economical profitability of the company as a result
- Improving the organizational prestige due to observing safety principles and work sanitation

This thesis includes 5 chapters, in the first chapter contains some definitions related to safety and a concise explanation of different common methods to identify the risks. Then, in the second chapter, the HAZOP method has been represented entirely and based on present standards in order to accustom the honorable readers and coworkers of the project. The Condensate Stabilization unit and drying process along with some explanations on flood embanking entrance section of the unit and the controlling issues are widely described in third chapter. In the fourth chapter, the performance of HAZOP studies in Slug Catcher and Condensate Stabilization and Drying units are indicated along with its hypothesis and considerations; and in the fifth chapter, a general conclusion and some suggestions are discussed in details.

Chapter 1

An introduction to safety and Hazard Identification methods

1-1-The history of the safety in the industry [1 &2]

1-1-2 - Health and safety movement from past to present

From a long time ago, the necessity of promoting safety was usually noticed when lack of it resulted in conditions with social or economical adverse consequences. The incidents in industrial facilities and technologic systems illustrates the necessity of continuous evolution in safety researches in the fields of safety standards, event and incident rooting, improving the methods of safety assessment and hazard identification and the role of effective elements on safety. Usually following the shock of an incident, the industrial facility and technological systems' management, decide to ponder the roots of the causing factors of the adverse condition. If these evaluations are not done properly the active causative roots of the incidents remain in the system intact and in other opportunities, combining with certain operating conditions, hardware failure, human errors and organizational deficiencies brings out another incident.

The national safety association has grown comprehensively since the modest activities in a small Chicago office in 1913, expanding through thousands of members in business, industry, agriculture, education, labor and government parties. The safety movement's progress in America was parallel and simultaneous to National Safety Society (NSC). In early 1900, the industrial incidents in this country were considered commonplace; for instance, in 1907, more than 3200 people were killed in mining accidents. At the same time, law, history and public opinion were all concentrated on management. There was little support for the safety of workers. Nowadays, industrial workers are in much better condition than their counterparts in the past. Industrial fatal accidents are less than half of their predecessors in the last 60 years. According to NSC, the common death rate from work-related injuries is approximately 4 out of every 100,000 people or less than one third of it 50 years ago. The safety improvement from before is the result of putting pressure on the law for promoting health and safety. The growing costs have always been related to incidents, injuries and professionalizing safety as a job. The future improvements

would probably be like a great outcome of awareness about the effects of cost and a competitive advantage of a healthy and safe plant.

A first aid box or supplies shall be available and the health and safety director should consult a physician about selecting the material. Unfortunately, medical specialists are reluctant for such consults maybe that is because they abhor the future involvement in courts about the incidents related to lack of sufficient effective material.

1-1-3- The primary improvements in safety

It is essential for industrial health and safety apprentices to start their studies in retrospect. Understanding the past can help test the health and safety in past and future professionally. The new improvements in health and safety are contiguous to the past and they are not discrete and independent, they are relatively the long section of continuous progress in health and safety movement.

This has been going on narrowly from the ancient Egypt that we can observe how industrious Egyptians were, judging from the permanent pyramids and temples. Many workers were slaves and there are ample evidences that they did not have proper condition. They needed better terms and proper treatment from strict masters.

One of these cases took place in the reign of Ramses II who was to build a great edifice. To provide proper protection of the workers who built that great temple in his name, he constructed an industrial medical service to take care of the workers. They needed daily bath in the Nile and regular medical examinations. The sick workers were quarantined.

1-1-4- Incidents and their effects on the industry

A long history of debate in America is related to the effects of accidents on the industry (workers and companies) and the prevention costs. The historical predominant view was that the prevention programs were costly as well. Most modern theories argue that while the incidents are costly, preventing them is