Emergency Response Program Designing Based On Case Study ERP Regulations In Ilam Gas Refinery

Mehdi Tahmasbi, Saeed Givehchi, Mahnaz Nasrabadi

Abstract: The study of Emergency response plan designing is one of the most important prevention approaches in crisis management. This study aims to design emergency response plan based on case study ERP regulations in Ilam gas refinery. On the basis of risk assessment and identification techniques such as HAZOP and FMEA in Ilam gas refinery, the risks have been prioritized and then according to this prioritization, the design of possible scenarios, which have the highest rate of occurrence and the highest level of damage, has been separated. Possible scenarios were simulated with PHAST software. Then, emergency response program has been designed for the special mode or similar cases. According to the internal emergency response plan for Ilam gas refinery and predictable conditions of the process, special instructions should be considered at the time of the incident to suffer the least damage on people and environment, in the shortest time possible.

Index Terms: Emergency Response Plan (ERP), hazard and operability study (HAZOP), failure mode and effects analysis (FMEA), hydrogen sulfide gas, Ilam gas refinery, Process Hazard Analysis Software tool (PHAST).

1 INTRODUCTION

I ran's special geopolitical position has always made this country subjected to the natural and industrial disasters, which some of them are due to the extent of the impact of the crisis. In spite of all efforts made in various industries in order to reduce accidents, every year lots of events threat industrial societies [1]. These events in the oil, gas and petrochemical industries are even more dangerous and cause major damages to the environment, equipment, organ failure, disability and death. In order to reduce the effects of such conditions which are known as emergency situations, anticipating probable events and planning for deal with them is vital. If emergency situations are not properly controlled, they may spread outside the industrial environment and influence the society. In this case, the emergency situation takes disaster or crisis mode and requires a more comprehensive planning[2]. Emergency response planning is a continuous process includes four main phases: prevention, preparedness, response, and recovery that means a return to the normal mode [3]. This study aims to design an emergency response plan based on the rules of the ERG in Ilam gas refinery that regarding to the high capacity of sour gas (containing hydrogen sulfide gas) in the refinery and significant volume of production of different essential fuel products, appears to be unbeatable. Among the reasons that could have caused the events, we can point to failure of process pipes, pipe corrosion and random events such as helicopters and missiles hit, shutting down or sudden over flow of flare and explosion or reversal of equipment, vessels and tanks due to the natural disasters such as flood or earthquake,…and consequently a large amount of gas leakage and accidents such as fire, explosions and toxic gas emissions will be predictable. process pipes, pipe corrosion and random events such as helicopters and missiles hit, shutting down or sudden over flow of flare and explosion or reversal of equipment, vessels and tanks due to the natural disasters such as flood or earthquake,…and consequently a large amount of gas leakage and accidents such as fire, explosions and toxic gas emissions will be predictable.

- *Mehdi Tahmasbi[1], Saeed Givehchi[2*] and Mahnaz Nasrabadi[3]*
- *[1]Department of Environment Management (HSE), Faculty of Engineering and Technology, Islamic Azad University, Zahedan Branch, Zahedan, Iran.*
- *[2*]Faculty of Environment, University of Tehran, Tehran, Iran. Givehchi@ut.ac.ir*
- *[3]Department of Environment Management (HSE), Faculty of Engineering and Technology, Islamic Azad University, Zahedan Branch, Zahedan, Iran.*

2 METHODOLOGY

In this study, based on previous studies, applicable materials such as hazard and operability study (HAZOP) and failure mode and effects analysis (FMEA) are used in Ilam gas refinery as the identification techniques and risk assessment tools. . According to the results, risks were identified and classified. Then, based on this assortment, designed probable scenarios which have the highest incidence rate and the highest level of damage were isolated. According to the obtained prioritize, possible scenarios simulation has been done with PHAST software in the condition of piping leak in the Amin process part and based on the ERG standards. Then, the emergency reaction plan was designed for the specific modes or similar modes.

2.1 Modeling the consequence

Predicting the effects and consequences of adverse events in a process unit by mathematical models**,** is called consequence modeling [4]. The results of consequence modeling along with the results of the quantitative evaluation of risks are applied in risk assessment of process units. Consequence modeling in a single process unit includes: 1. Scenario selecting, 2. Scenario characterization, 3. Consequence modeling of scenario 4.The analysis of the results. Modeling the consequences of probable events in a process unit, is one of the most important steps in emergency programs designing[5, 6]. This step involves modeling the release of substances in the environment followed by modeling the consequences of poisonousness, ignition or explosion of these substances.

PHAST software is used in order to modeling incidents such as fires and explosions of tanks and pipes and the results are applied in emergency response planning and risk limits of complexes. This model covers a wide range of pure materials that are lighter or heavier than the air and also has the ability to model a mixture of materials and includes sudden release, permanent release and evaporation from the surface of the ponds.

3 CASE STUDY: ILAM REFINERY

Ilam gas refinery is established in order to supply consumption gas of Ilam and Western provinces and also to provide petrochemical feedstock of Ilam and to reinforce the gas pressure and to gas sweetening of Gas field of Tange bijar (Figure 1).

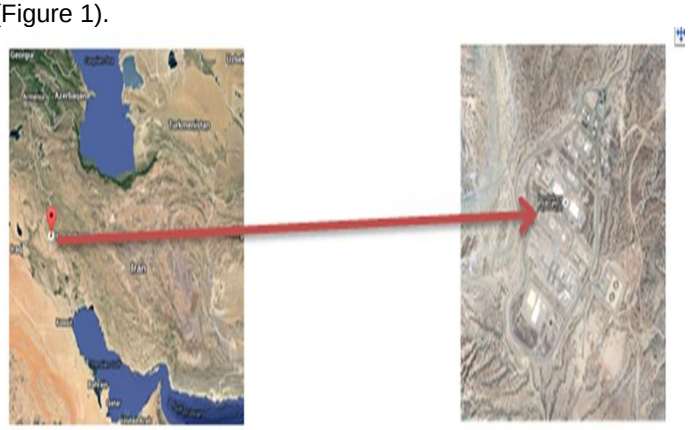

Figure 1. *Ilam gas refinery geographical position*

According to the meteorological information obtained about the region, the majority of annual rain in Ilam station is in cold months (November, December, January, February and March). According to meteorological data The mean temperature of 25 ° C is considered. The prevailing direction and speed of the wind is one of the most important parameters which influence weather conditions. After applying Linear averaging method, speeds of 1.5 m/s and 5 m/s were selected as medium speeds. West and South West are the dominant directions of the wind during the year. Climate stability is the disturbance rate of atmospheric layers that is considered as a criterion for commixture of distributed substances in the environment In the direction perpendicular to the surface and also for distribution and expansion of materials on the ground in different directions.

4 RESULTS AND DISCUSSION

With regard to the risk assessment and identification techniques such as HAZOP and FMEA which are applied in the refinery and the obtained results, the risks have been identified and classified, and then the design of probable scenarios, which have the highest rate of occurrence and the highest level of damage in Ilam gas refinery has been separated, and then according to this prioritization, simulation of probable scenarios was conducted by the means of PHAST software and a response model is provided to control the processes before the occurrence of the incident till the final control step and accordingly modeling the release of substances in the environment followed by modeling the consequences of poisonousness, ignition or explosion of these substances in the process unit were conducted. The results are applied in emergency response planning and risk limits of complexes. According to the internal emergency response plan for Ilam gas refinery and predictable conditions of the process, special instructions should be considered at the time of the incident to suffer the least damage on humans and environment, in the shortest time possible.

4.1 INTERPRETATION OF THE RESULTS ON THE BASIS OF ASSUMPTIONS OF PHAST SOFTWARE

Climate conditions:
a) Temperature: 25 •C
b) Wind speed: 1.5 m/s and 5 m/s

Modes	Explosion radius	Wind speed	Density
1	16	1.5	21500 ppm
2	12	1.5	43000 ppm
3	24	5	21500 ppm
4	15	5	43000 ppm

Based on the table above, it is clear that within 10 minutes or 600 seconds since the start of the event (H2S gas leakage), circumstances of the surrounding environment is as follow:

1. If the wind speed is 1.5 m / s then, the concentration of H2S gas within a radius of 12 meters from the zero point (scene) is equal to 43000 ppm and Within a radius of 16 meters from zero point is equal to 21500 ppm.
2. If the wind speed is 5 m / s then, the concentration of H2S gas within a radius of 15 meters from the zero point (scene) is equal to 43000 ppm and within a radius of 24 meters from zero point is equal to 21500 ppm.

According to the above mentioned standard (ERG), concentrations more than 500 ppm, cause headache, dizziness, unconsciousness, nausea and within 5 minutes to 1 hour respiratory problems appear and between 30 and 60 minutes is fatal. In cases where death is not the end, it may result in Alzheimer, Paralysis of facial muscles and nervous tissues damages. In concentrations higher than 800 ppm, it may result in sudden death. Due to the concentration of hydrogen sulfide gas in the environment and within 10 minutes (standard time to cut off the input gas, manually or automatically from the control room), and also the prevailing wind direction that is usually from the West and Southwest, because of the Outdoor Surroundings, the farther we get from the accident site, the concentration is lower. So, at the time of the event, no fire, explosion or poisonousness threats the surrounding environment. However, since the dominant wind direction is from the West and Southwest, H2S gas released to the outside of the refinery, will be extended to a distance of 465 meters (based on phast software output) and then the rate of concentration will be less than 0.05 ppm, that is actually negligible. Anyway, given that the risk site is in the refinery and close to the location and seating of staff, a series of preparations and considerations should be investigated.

4.2 PREPARATION FOR EMERGENCY RESPONSE

In reality there are always the risks of events which can take the organizations into crisis. On the other hand, some of these events, such as earthquakes, floods, wars and hurricanes are

unpredictable. Therefore, the identification of these probabilities (Items that can lead to a crisis) as well as creating and maintaining readiness and preparation to respond in these situations can minimize the damage caused by such events. The steps of the implementation of an emergency response plan from the beginning to the end are as follows:

Phase1. Emergency response

Step1- The initial contact based on the occurrence of the incident

Step2- Inform the commander of the operation and the preparation of the Operations Command Center

Step3- Assessment of the teams deal with emergency response and consideration of the situation they are faced to

Step4- Determining the commander of the operation seated in site

Step5- Set the danger zone

Step6- Contact with internal and external rescue teams if needed.

Step7- Contacting officials, and managers which must be aware of the event.

Step8- Contact with legal authorities if needed.

Step9- Informing the staff, the people at the site and the media.

Phase2. Recovery and deterrent reactions

Step10- Contact with the personnel family (spouse, parent, child).

Step11- Assessing damages and losses to the unit.

Step12- Expressing evaluation report to senior management.

Step13- Contact with legal persons related to the organization (such as insurance companies, etc).

Decision making by senior management about cutting the unit out of the service or continuing unit operations, emergency evacuation of personnel is done in the first phase, and obviously after the start of operations based on the orders of the commanders of the operation, emergency evacuation plan will be implemented. Cleaning the site after the event and preparing analytical reports will be considered and is known as supplementary actions. Then, an operational reaction will be carried out which is called "after reaction" and is conducted in order to complete the emergency response plan in the form of complementary actions. At the end, with regard to the terrible consequences of the events (natural, industrial, etc.) having a plan to address and control the consequences of these events will support organization durability. Accordingly, identification of critical points of the organization, natural disasters which exist in organization geographic location and potential crisis is vital and creating emergency response plan is necessary. Trainings and related documentation is very useful to reinforce the plan. Maneuvers and exercises of emergency response are also of requirements. It should be noticed that, these exercises must not be confused with fire exercises and the importance of emergency response exercises must be maintained. Finally, organizing a crisis committee and an appropriate model for emergency response plan along with periodic and permanent exercises can reduce the consequences of these crises to a considerable extent.

5 Conclusion

The study of emergency response plan is one of the most important preventive approaches in crisis management. The aim of this study is to design an emergency response plan based on the rules of the ERG in Ilam gas refinery. Based on the identification techniques and risk assessment tools such as HAZOP and FMEA in Ilam gas refinery risks were prioritized and classified. Then, according to this assortment, designed probable scenarios which have the highest incidence rate and the highest level of damage were isolated. The simulation of possible scenarios has been done with PHAST software. Then, the emergency response plan was designed for the specific modes or similar modes. Finally, organizing a crisis committee and an appropriate model for emergency response plan along with periodic and permanent exercises can reduce the consequences of these crises to a considerable extent.

References

[1] M. Nikbakht, A. Sayyah, and N. Zulkifli, "Hazard identification and accident analysis on city gate station in natural gas industry," in 2010 International Conference on Environmental Engineering and Applications (ICEEA), 2010, pp. 13-17.

[2] Federal Emergency Management Agency (FEMA), Guide for All-Hazard Emergency Operations Planning, 1996, [Online : www.fema.gov/pdf/plan/slg101.pdf].

[3] Joint Commission on Accreditation of Healthcare Organizations, "Standing together: An emergency planning guide for America's communities," Retrieved online, vol. 12, p. 07, 2005.

[4] M. A. Taghehbaf, S. Givehchi, M. Ardestani, and A. Baghvand, "Modeling the Consequences of Potential Accidents in One of the Gasoline Storage Tanks at Oil Storage of Yazd, in Terms of Explosion," IJEIR, vol. 5, pp. 55-560, 2014.

[5] V. A. Banuls, M. Turoff, and S. R. Hiltz, "Collaborative scenario modeling in emergency management through cross-impact," Technological Forecasting and Social Change, vol. 80, pp. 1756-1774, 2013.

[6] Emergency Management Planning, Public Safety Canada, "All Hazards Risk Assessment Methodology Guidelines," 2012.