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Modeling the Consequences of Potential Accidents in One of the Gasoline Storage Tanks at Oil Storage of Yazd, in Terms of Explosion

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***Abstract* – Ever, there are potential hazards in chemical industries and facilities, can, cause, injuries, injuries and financial losses. Risk, is the expression of any factor that may have caused the injury or damage. Risk industries, including oil storage, mainly take the form of incident such as an explosion. These events can occur due to problems in process design, equipment malfunction or human error. To certify the figures, the damage from these events in the world are immense. For this reason, it should be considered, specific measures, and a concept called safety should be considered.**

In this paper, an overview of risk assessment - and how it is applied - which include risk identification process, a process of modeling the possible danger of the explosion is fully described and its implications for modeling, specifically, is done, the oil company's central warehouse in Yazd. Modeling is considered one of the most important steps in risk management. Today, this modeling is performed by powerful computer software, such as software ALOHA. Predict the effects and consequences of adverse events in a single process by a mathematical model, called the outcome of the analysis. Therefore, the risk of an oil depot, is not without consequence analysis. In this study, with the help of specialized software ALOHA, has been modeled, the consequences of possible accidents, one of the storage tanks of gasoline storage Yazd. Finally, the calculation of accident risk potential explosion in the warehouse, and comparison with authentic standards, appropriate recommendations are presented in order to reduce the risk of accidents.

***Keywords* – Consequence Assessment, Gasoline Storage Tank, Explosion, Risk, Aloha Software.**

I. Problem Statement

Our country on the path of industrialization, so far, has experienced significant industrial accidents. Even the best industrial units, designed to meet the latest findings and most experienced operating personnel also are not immune from accidents [1]. Storage tanks of petroleum products, is one of the important industrial facilities which are constantly exposed to the risk of toxic releases, fires and explosions, in the meantime, fire is the most popular, and explosive, the amount mortality that followed, the most important type of risk in the storage tanks of petroleum and petroleum products [2]. Worldwide, many studies have been carried out, the risk of warehouses and oil tanks. Of 242 incidents between 1960 to 2003, shows that 74% of accidents occurred in petrochemical refineries, terminals and oil tanks, and of those, 85% of these accidents are fires explosion, which is 33% of that caused by lightning, and 30% is derived from human errors, including operations, maintenance, and other causes including equipment failure, cracks and ruptures, leakage and rupture of the line, static electricity and open flame [3].

In existing industries around us, in everyday life, and even in the human body, the stakes are very high, are hidden. But some of them, if they emerge, have the ability to hurt others, would be likely to occur and influence. Hence, it is decent, so, using appropriate methods, to estimate the probability of the event [4]. Therefore, we can define a function called risk-related variables, severity, and likelihood that hazard identification is valid only with the risk function [5].

Of hazard identification and quantitative risk analysis, with parts removed, correcting, controlling and monitoring risk are the biggest, most important and most technical requirements of consulting engineers, safety engineers, and all process industries. After identifying the risks, and the quality of their risks, risks that have the quality of moderate and high risk, will research for quantitative assessment of risk. In general, all the above steps are known as Risk Assessment [6]. At the risk of detection, can be used many methods to uncover potential incidents. The best method for hazard identification in chemical processes is, Hazard & Operability [7]. Holism, systematic approach Hazop, all stakes, with different degrees of risk will be identified, but the remarkable thing in this project is that it only will be considered risks that are related to the release of hazardous materials, the devices, as their distribution, bring, risks such as fire, explosion or toxic effects. Next, the consequences of the release of substances into outer space and facilities will be measured, so that we can determine the severity or magnitude of future contingent events [8]. One solution, that is, how movement, physical and chemical changes of the discharge into the environment to place effectively be modeled, to be very precise. This process includes the steps of Discharge, Dispersion and effective. In this way, the determination of outcomes did quite a bit, so needs to be in possession of valid models and software, efficient, and fast [9].

Given this, it is important that, in general, is associated with the start of accidents in chemical processes, fluid leakage and emissions from process equipment, such as tanks, vessels and pipelines, which can occur, reasons different, such as corrosion, decreased endurance, and human error. In this study, using local data, and define the thermodynamic conditions, and climate research unit, to modeling, and analysis will, within the area affected in the blast.

II. Background

- Jafari & Roazi Tabari (2010) [10], in a study titled "A Case Study, risk assessment, by William Fine, Abadan Oil Refining Company's power plants", of William Fine, that is, the use of structured techniques and systematic risk assessment, identifying potential risks, and estimate the level of risk in order to manage risk, and reduce it to an acceptable level. To this end, the identification of activities and business processes, risks and potential damage were identified, and then, depending on the severity of the impact, probability of occurrence, and the likely consequences of that exposure, with humans, environment, equipment, work assessment and risk stratification was done. Level of risk, start-up activities, and service to the generator (electric shock), with a score of 300, Rogue boilers, (Azjht noise) with a score of 300, grinding on boiler tubes, with a score of 240 and inspection, control and monitoring of the compressor (explosion), with a score of 200, had the highest level of risk (emergency), and activities such as gun control and care homes) body contact with the hot fluid), with a score of 192, refuel Cases (risk of falls, the waste water ponds) with a score of 180, the welding process, with a score of 160, chemical injection, with a score of 120, had a risk of moderate (abnormal), and activities such as the production and distribution of air (inhalation of oil vapor in the atmosphere) with a score of 16, received the injection of steam (waste heat) with a score of 9 and tear paths, water and puncture tubes boilers, and water retention in place, with a score of 5, shall have The least amount of risk (normal). Occupational accidents during the execution of this research has been a relative decline, and the units in the year under study (study period), compared to the previous year, accidents intensity factor, the average has been declining, and was at par with about 33 percent, and the number of working days lost by about 49 percent.
- Samavati jame and colleagues (2010)[11] , in this study, entitled "Outcome Assessment process events, the martyr Tondgooyan petrochemical company using the software PHAST", expressing the modeling of possible events that a process exists it is possible to happen to them, it turns out to assess the consequences of accidents, they may be, can be divided into three categories consequences of toxic substances released in the environment, and the consequences of abandoned explosive environment. One of the necessary information on the outcome of the evaluation process the events, is the vulnerability criteria, using the following scenario modeling stage, to determine the extent of possible damage should be compared to each of these outcomes, the standards that are indicates the amount of damage. In this scheme, using the software PHAST, is assessed, the outcome of events in a process, the scenarios chosen (20 scenarios), a petrochemical company, Shahid Tondgoyan two selected conditions of atmospheric usual, the diagrams obtained from the software implementation, the one scenario (the raw Trftalyk acid unit CTA), in particular atmospheric conditions, has been plotted in the end.
- Golbabai and colleagues (2012)[12], conducted a research titled "Modeling propagation propane leak in an industry." In this study were considered an industry in East Tehran. Input software PHAST, ex, given the climatic conditions of the region, and determined that, at a distance of one kilometer, propane, has density equal to 17 times the TLV, and the other, the distance is the beneficial effects of the explosion, which is the loss of around 916 personnel and 130 vehicles passengers, as well as financial loss, at least approximately, 401 million dollars. Therefore, recommendations were presented, including the construction and equipping stations crisis management and rescue center, installing dikes, fencing, traffic control, exation equipment near the tank to prevent and control the spread of risks.
- Rigas (2002)[13], conducted a project risk assessment and analysis of the consequences of dangerous chemicals in separate premises and goods depots Port Aikonyo Greece. In this study, the risks associated with handling toxic chemicals and flammable, a large port which, in its vicinity, there are different homes, schools, and are constantly exposed to the threat of chemical hazards, Risk was evaluated under four scenarios that were identified, a toxic gas leak from the tank, causing mortality in a huge range of facilities, ports, and a fire ball, with a high dose of radiation, heat, up to 132 meters away cause severe burns, and in the event of an explosion, cloud of steam, causing damage to homes, about a kilometer and a public release of the caches, has a high risk, due to their small distance, with the school.
- Rumchev and colleagues (2011)[14], in his article, emphasizing that the most important part of the process of risk assessment is to identify hazards, points out, to assess the impact of rules, and training programs on risk health.
- In a paper Zhou, introduced in (2011)[15], pointed out, the use of Monte Carlo simulation models in health risk assessment of air pollutants and their effects, in closed environments. The simulation parameters such as the amount of contact, activities and indoor conditions, enters the simulation model as a variable.

III. Research Purposes

- Review the accident scenario creation - leaking gasoline storage tank manhole, and gasoline vapor cloud explosion
- and determine the severity and scope of its work.
- Set the privacy risk, and the radius covered by risk level.

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IV. Method

Gasoline storage tanks, oil storage, Yazd is included, 3 tank, that at the beginning of the study, data were collected, the reservoirs studied, such as size, material, thickness, etc., as studies in library and Internet searches, and then visited and field observations, referring to the engineering department, and operation of reservoirs. Climate data, were obtained using the reference site weather, and was used, taking the average of the amount of humidity, temperature and wind speed during the first six months of the year, then the contents of the reservoir under study, the Landscape and explosion hazards associated, under the scenario "spill gasoline, the manhole tank maintenance, and explosive steam cloud of gas" in the warm and cold seasons, reviewed and analyzed, considering all the factors mentioned by the software ALOHA, the results the output of the software is available, and written in two curves. Finally, by comparing the results obtained from the application of guidelines and standards, regarding the effects of the blast wave, rather than analyzing the results, it was proposed action in relation to the safe zone around the study area. Then, the consequence of the steps offered.

1 - Scenario study

In this study, the gas stored in the reservoir under study, from the perspective of the explosion and its associated risks, by a scenario that had the highest probability of occurrence, were studied and modeled, in cold and warm seasons, that is, as follows:

- Leaking gasoline from the storage tank manhole, and gasoline vapor cloud explosion

2 - Data entry software for modeling:

2-1 - atmospheric data

Given that, stable climate is affecting the amount and distribution of gas and liquid at ambient atmospheric parameters, which for this study have been used in the modeling software, provided is shown in Table 1.

Table 1: Details of atmospheric

Description	Unit	Amount	Parameter	
Average wind speed in warm seasons	Meters per second	15	Wind speed	
Average wind speed in winter	Meters per second	10		
Prevailing wind direction in summer, Northwest	Degree	320	Wind	
Direction of the prevailing wind, cold, Southeast	Degree	120		
C: for the weather warm seasons (almost unstable with lots of sunshine)	----	C	Sustainability and climate conditions	
D: For cold weather conditions (low sun, windy nights)	----	D		
Average temperature in warm seasons	°C	38	H.S[1]	Ambient temperature
The average temperature in the cold season	°C	7	C.S[2]	
Moisture out warm seasons	Percent	22	H.S	The moisture content
Moisture out of the cold seasons	Percent	42	C.S	

* Any of the above parameters, has been prepared based on information received, the reference sites in the weather.

2-2 - Local Information

Local data, which have been used for this study, the model is presented in Table 2.

Table 2: Local Information

Altitude	Latitude	Longitude	Location
m 1230	31 degrees 55 minutes north	54 degrees 22 minutes east	Iran – Yazd

2-3 - Chemical data

Petrol chemical information, as the case study presented in this study (Table 3):

Table 3: Chemical data

Freezing point	Spot welding	UEL	LEL	IDLH	EPRG-1	ERPG-2	ERPG-3	Molecular weight	The chemical name
-40 °C	126.7 °C	74000 ppm	14000 ppm	5 $\frac{mg}{m^3}$	200 ppm	1000 ppm	4000 ppm	72 $\frac{g}{mol}$	gasoline

2-4 – Data of storage tank

Information gasoline storage tank studied in this research, which has been used for modeling are presented in Table 4.

[1]Hot Seasons
[2]Cold Seasons

Table 4: Data storage tank

Leaking from the bottom of the tank height	Qatar leakage is considered	The liquid level in the tank	Storage tank capacity	Status of gasoline saved	Stored gas temp-erature	Diameter tank	Tank height	Model a storage tank	Seasons
30 cm	70 cm	67%	Lit 20000000	Liquid	20℃	41.8 m	14.6 m	Cylinder	Warm
30 cm	70 cm	29%	Lit 20000000	Liquid	10℃	41.8 m	14.6 m	Cylinder	Cold

3 - Results of the scenario

Scenario: spill gasoline, gasoline vapor cloud explosion

In this scenario, taking into account the storage tank manhole, diameter 70 cm, as the source of the leak, and atmospheric storage tanks, we have modeled the outcome of leaking gasoline, gasoline vapor cloud explosion, which the results, presented in the summer and cold in table 5.

Table 5: Results of scenario spill gasoline, gasoline vapor cloud explosion, the warm and cold seasons

Risk of explosion wave			Data release			Seasons
Yellow	Orange	Red	Bump diameter	Speed of delivery (kg/min)	Hole diameter	
psi 1	psi 2.5	psi 5				
-	-	-	m 98	18500	Cm70	Warm
m 630	m 346	m 255	M123	18700	Cm70	Cold

In this scenario, given that, in summer, any part of the fuel vapor cloud mass, at any time, would not be above the LEL, and includes, without exploding, so the fuel vapor cloud explosion modeling outcomes in warm seasons, is not possible. In the cold season, there are chances of gasoline vapor cloud explosion, and the danger zone, depending on the severity of the wave from the explosion, at various levels, is divided into three regions, as shown in figure (1). The severity of the wave from the explosion of gasoline vapor cloud in the red zone, which has been extended to a radius of 255 meters in the direction of the wind, and the oil depot northwest of Yazd, is more than five psi. In an area that is marked with an orange color, the intensity of the blast wave from a vapor cloud of gasoline is more than 2.5 psi, and overshadowed, to a radius of 346 meters in the direction of the wind, and the northwest oil Depot of Yazd, and the yellow area, too, is influenced by the intensity of the wave, more than one psi, with a radius of 630 meters downwind of the oil depot northwest of Yazd.

- In this scenario, we have modeled the outcome of leaking gasoline, gasoline vapor cloud explosion, which given that, in summer, in part, gasoline vapor cloud mass, at any time, is not higher, of the LEL, and no explosive fuel vapor cloud explosion consequence modeling Thus, in warm seasons, is not possible. In the cold season, there are chances of gasoline vapor cloud explosion, and the danger zone, depending on the severity of the blast wave, at various levels, is divided into three regions. In each area, according to the intensity of the blast wave, and contact with it can establish, with different consequences.

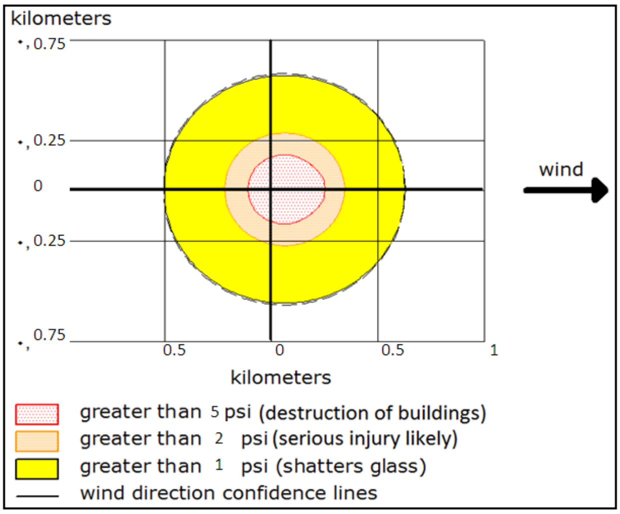

Fig.1. different levels of intensity of the blast wave, the cold season

- In this scenario, given that, in summer, any part of the fuel vapor cloud mass, at any time, would not be above the LEL, and non-explosive, therefore, gasoline vapor cloud explosion consequence modeling, in summer, it is not possible, but cold, danger zone, depending on the severity of the blast wave, at various levels, is divided into three

V. DISCUSSION

In this study, the gas stored in the reservoir under study, from the point of explosion, and its associated risks, were studied and modeled by a scenario in warm and cold seasons. In this study, taking, storage tank manhole, diameter 70 cm, as the source of the leak, which can occur due to corrosion of the tank manhole flange bolts, the pressure in the reservoir, which is due to a defect technical, or terrorist attacks, and sabotage, as well as giving information on petrol chemicals, gasoline storage tank cases, local information, and the atmosphere - due to changes in parameters affect the heating and cooling seasons - the soft software ALOHA, the consequences of the scenario, modeling was studied and the oil storage Yazd.

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regions, which is consistent with the guidelines provided by CCPS, for quantitative assessment of risk of detonation waves more than 5 psi, main structures, heavy, heavy losses are incurred, the results obtained indicate that, depending on the weather location to within 255 meters of reservoirs studied are strongly affected by the explosion. Also, to within 346 meters of the reservoir, the intensity of the blast wave, is more than 2.5 psi, which causes rupture of the eardrum, and damage to light structures, and to within 630 meters of the reservoir study, is influenced by the intensity of the blast wave more than 1 psi, which leads to the breaking of glass and windows, and damage of projectile impact, is likely. Affected areas, the intensity of the blast wave, the cold season, as shown in Figure (2)

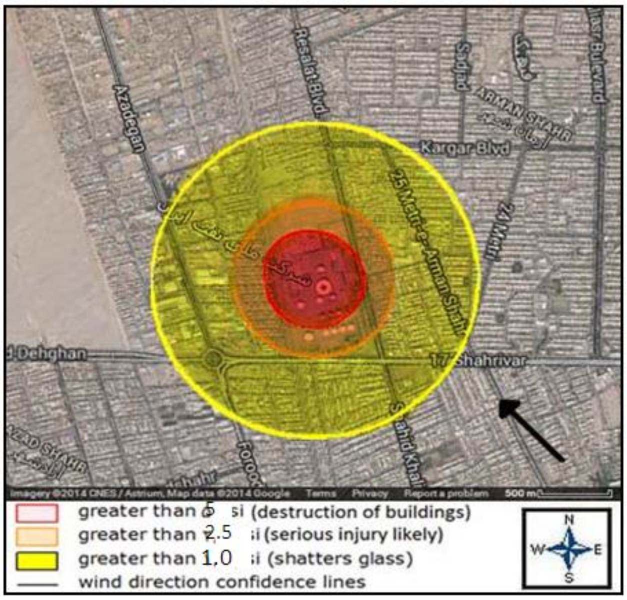

Fig.2. Affected areas, the intensity of the blast wave, the cold season

- Heat from the fire, and the fuel vapor cloud explosion wave, which overshadowed the whole of Yazd oil depot and residential area adjacent to it. Considering the range of thermal radiation due to pool fire, the dimensions of space is less than the coverage radius of the blast wave, a psi, which will affect up to 630-meter radius, and with respect to the scope, safety Privacy oil storage as Yazd, safety radius, sudden fire, will comply.
- According to the results, spill gasoline, oil companies of Yazd in central warehouse needs to be projected response in emergency situations. Also, due to heat, fire and blast wave tank of gasoline, oil company stock Yazd eclipse that, nearby residential area.

VI. Provide Suggestions and Guidelines

Given that, oil storage, Yazd is located within the city limits, and the proximity to residential areas, so the risk of toxicity, fire and explosion hazard due to the severity of the leaves, is doubled. Therefore, the following recommendations are offered in order to reduce the damaging effects, prevention and risk control toxic, fire and explosion:

- Voltage control engineering, and securing means, such as using equipment FSD
- Risk Information Exchange program (Hazcom)
- Use, safety signs, the locations of high risk
- Use of CCTV cameras, especially when working with high-risk
- Handling and use amplified alarm, and fire
- using heat sensors, smoke and fire at the tanks and loading bay canopy
- applying passive defense measures to counter deliberate act of terrorism, based on the principles of camouflage, concealment, cover, deception, division and fragmentation, retrofit and announced.
- applying the principles of passive defense is a strategy for risk reduction against various risks, and increase efficiency, the occurrence of risk that must be considered at different levels of regional planning, urban design and architecture. Passive defense measures, in architecture and urban planning can be useful, in addition to man-made threats to damage reduction, to reduce risk, against a variety of natural hazards.
- Possible in all development projects and future design, to avoid the exposure of buildings and sensitive equipment in areas listed.
- In development projects, and any civil action, be considered as a safe reservoir radius, depending on the plan.
- Increased vane, and deployment of information systems in emergencies, to evacuate staff, use of certain routes, according to the wind direction means of low-cost, but highly effective in reducing fatalities.
- Regarding the role of training and staff awareness of the consequences of reducing the severity of accidents, with courses and practical exercises to ensure the readiness of personnel in emergency situations.
- Using the results of this study can be attempted, the completed risk management rings, which are the basic needs of high-risk industries.
- Use of insurance coverage could reduce economic losses to some extent.
- When necessary, the personnel, the use of respiratory protective equipment properly, and their familiarity with the accumulation and discharge locations.
- Comprehensive database of managers, and key personnel of each company with fixed and variable telephone numbers, places of residence, and immediate access to them, be prepared for an emergency.
- Inspections and regular inspections of said systems, alarm systems, water spray, to fuel dilution, and personal protective equipment.
- Be predicted, emergency telephone lines, communications equipment, for greater co-ordination with the industry and the nearby relief centers.

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