Explosion Hazard And Their Control Using Accident Model in Oil And Gas Industry

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Abstract- *The safety of a system is about the features and a condition it is set of convictions or theories of the safety model. An accident model is a group of convictions on the way in which accidents and incidents occur in a system and the causal factors that make them possible. The mental models regarding safety are important because they influence system formation, operational decisions and behaviors. This paper gives an overview to the explosion hazard and their control using accident model in oil and gas industry. The Oil and Gas (O&G) industry is by its nature a chanceful industry and there is a hazard of major accidents such as fire, explosion and dispersion of toxic substances. The industries' products, hydrocarbons produced and transported, supply the world market with substantial amounts of fuel and crude item for a number of industrial exercises. Accident modeling is a technique utilized to relate the causes and impact of occasion that lead to accidents.*

Keywords- Accident causation model, oil and gas industry, accident analysis and prevention, Fire, Explosion

I. INTRODUCTION

The Oil and Gas (O&G) industry is by its nature a chanceful (high-risk) industry. The industries' products, hydrocarbons produced and transported, supply the world market with substantial amounts of fuel and crude items for a number of industrial exercises. The O&G industry handles expansive amounts of combustible and perilous substances in the high energy environment experienced subsurface, with high pressure and temperature scenarios. In few cases the chance circumstance is complicated by a profoundly harmful vaporous by item hydrogen sulphide (H2S).

In the petrochemical industry basis materials is known as hydrocarbon. They are utilized in liquefied forms, such as liquefied hydrogen, liquefied natural gas (LNG), and liquefied petroleum gas (LPG). These materials are frequently included in accident because of their combustibility.Tanks storing liquid and gas substances are an imperative component in industrial processes. These tanks are inclined to accident since of a few ominous characteristics, such as coverage of an extensive area, repeated transportation of fluids, and frequent equipment inspection and maintenance.

"An explosion is an exothermal chemical process that, when happening at steady volume, gives rise to a sudden and valuable pressure rise."

An explosion is a sudden discharge of vitality that creates heat, light, noise, and pressure which come about in a blast wave. A chemical explosion is caused by vitality discharge from chemical response. Explosion happens in a really brief length of time, ordinarily in thousandths of a moment. Portion of the vitality discharged is as thermal radiation and other portion is coupled into the air (air blast) and soil (ground shock). The chemical reaction may take put suddenly or can be started by start source such as fire or electrical charge. (flashes).The gases created by explosion extend rapidly in all direction from the point of explosion and the quickly growing gasses pushes the stationary gas before it cause a state of high pressure known as blast wave. These blasts grow outward at an awfully high speed greater than speed of sound. The blast waves lose its vitality as its remove expanding from the point of explosion. The contrast between encompassing air pressure and blast pressure is called the over pressure of the blast wave. As this blast wave grows outwards so quickly so behind the blast wave, could be a locale of low air pressure. This low air pressure locale sucks the air in conjunction with it and causing a wind that take after the blast wave making a suction impact.

An accident model is a group of convictions on the way in which accidents and incidents occur in a system and the causal factors that make them possible. The mental models regarding safety are important because they influence system formation, operational decisions and behaviors.

II. ACCIDENT CAUSATION MODELS

The different existing accident causation models appear a few principal differences. They can be recognized depending on the region of application, the reason and the focus. Critical differences can too be found in terms of their common structure, input information and results. Recognized three primary classes of accident causation models: (i) generic

accident process models (ii) human error and dangerous behavior models and (iii) human lesions mechanism models.

The generic accident process models can be assembled into four fundamental categories (i) sequential models (ii) epidemiological models (iii) energy transfer models and (iv) system models.

Defines the reasoning of sequential models through the domino theory, in which an accident is the culmination of a series of events and circumstances. The greatest commitment of this hypothesis is to recognize that an accident can be maintained a strategic distance from by evacuating any figure within the arrangement leading to it. Afterward models in this category were created considering accident as result from the meeting of numerous arrangements of events. The epidemiological models direct the examination of accidents by giving a structure to organize the different variables impacting their event. These variables can be isolated depending in the event that they concern the bearer, the agent or the environment. By permitting posting techniques to avoid harms, in specific, avoiding the aggregation of energy, decreasing the energy potential, anticipating the discharge of energy, decreasing the rate of energy discharge, isolating or putting an obstruction between the source of energy and the receptor, retaining energy, fortifying the receptor or recognizing and reacting to the discharge of energy. Energy transfer models are especially valuable for distinguishing risk and characterizing measures in safety and health administration. System models consider man-machine systems behavior to be comparable to open or closed systems, setting up a similarity with electrical control systems. Accidents are considered unsettling influences within the system, making a difference to get it how the system that utilize data from past accidents to arrange reactions to future unsettling influences are more productive.

Human errors and intentional dangerous practices are regularly referenced as transcendent sources of accidents. The accident causation models centered on human errors and dangerous behavior can be organized into four fundamental categories: (i) behavioral models; (ii) human decision process models; (iii) human information processing models(iv) error taxonomy models.

Behavioral models center on characteristic and situational angles of human conduct which will be within the beginning of accidents. The human decision process models emphasize that the particular objective and targets in a given circumstance are significant to clarify unsafe behaviors. Human information processing models can be seen as variations of the system models centering within the data flux through the people whereas performing a task. The fundamental idea is that the data streams through a few stages, counting sensation, recognition, memory, decision taking and reaction and errors are a result from irritations in any of them. These models permit the assessment of viewpoints such as the involvement or the assets in accident prevention. Human errors can be tended to from a few viewpoints. From a systems perspective, errors are deviations in execution, which may result from unsettling influence within the system where the work is being carried out. The error taxonomy models are valuable for relating diverse components that clarify human error. The errors related with deadly accidents in disappointment to precept recognize or react to warnings. The taxonomy models are valuable for relating different components that clarify human mistake.

Accidents resulting in injuries or fatalities of laborers whereas shaping their errands are best dissected utilizing models of human lesions mechanism. These models are basically based on ergonomic standards and can be gathered into two fundamental categories (i) cumulative stress models and (ii) immediate lesions modes models.

The cumulative stretch models are the premise of a few measures that setup introduction limits for different forceful specialists. They are closely related to issues of ergonomic working environments and tools. A wide extend of approaches pointed at modeling accidents with the purposeful of distinguishing modes of prompt harm, particularly those planned to dissect the threat in taking care of hazardous materials. The Descriptive model of work conduct may be classified as a different sort of accident causation models that endeavor to get it accident without reference to standardizing concepts of error or infringement. The model accept that labors work inside a work system formed by goals and imperatives (e.g. financial, utilitarian, security related) and direct their behavior based on criteria such as workload, cost effectiveness, hazard of failure or bliss of investigation, among others.

The different categories of the models surveyed are not commonly exclusive. The different models have been created which include components relating to the different categories. Within the field of word related security and wellbeing, highlights the taking after: (i) the two factors model and (ii) the trajectory model. The two factors model that occurrences result from the combination of uncontrolled exposures to risks with performing assignments in hazardous conditions. In spite of the fact that the relative significance of each calculate may shift in each case both are continuously show. The trajectory or “Swiss chess” model accept that accident take put when a disappointment happens at same time

in all lines of defence within the direction of the accident. The defence lines are made up of specialized, organizational, person and social perspectives, in expansion to the existing securities.

III. HAZARDOUS AREA CLASSIFICATION

An area will be deemed to be hazardous where

- Petroleum having flash point below 65 deg.C or any flammable gas or vapour in a concentration capable of ignition is likely to be present.
- Petroleum or any flammable liquid having flash point above 65 deg.C is likely to be refined, blended, handled or stored at or above its flash point.

Petroleum Product classification

Petroleum means any fluid hydrocarbon on mixture of hydrocarbons and any inflammable mixture (fluid, gooey or strong) containing any fluid hydrocarbon, counting rough oil and condensed petroleum gas, and the expression petroleum product might cruel any item fabricated form petroleum and petroleum items are classified concurring to their closed glass streak focuses as given underneath to be specific:

(i) Class-A Petroleum: Liquids which have flash point below 23 °C;
(ii) Class-B Petroleum: Liquids which have flash point of 23 °C above but below 65 °C;
(iii) Class-C Petroleum: Liquids which have flash point of 65 °C and above but below 93 °C;
(iv) Excluded Petroleum: Liquids which have flash point of 93 °C and above;
(v) Liquefied gases including Liquefied Petroleum Gas (LPG) do not fall under this classification but form separate category;

Heat release rate

Heat release rate is the function of viscosity, density, calorific value, latent heat of fuels and burning velocity of fuels, and combustion temperature. The heat release rate consists of premixed combustion, controlled combustion, and late combustion. The heat release rate is derived from the first law of thermodynamics assuming it to be an open system.

dQc = du + w + dQh
dQc - heat release due to combustion of hydrocarbon fuel
dQh - heat transfer from combustion chamber to wall
du - internal energy
w - work output

- Heat release rate (HRR) is the rate of heat generation by fire. It is typically measured in Joules per second or Watts, since the output of a fire can generate more than a watt. For easier quantification, megawatts or kilowatts are used.

$q_{Hc} = \Delta H_c \times m_{fuel}$

where:
q_{Hc} = the heat release rate (kJ/s)
ΔH_c = the heat of combustion ($MJ.kg^{-1}$)
m_{fuel} = the mass flow rate of the fuel (g/s)

Analysis and methodology

The simple sequential accident linear models accepts that accidents are the perfection of a arrangement of events or circumstance which associated sequentially with each other in a direction fashion and hence accident are preventable by eliminating one of the causes within the linear sequence.
The commonest and the most punctual modal of accident investigate that describing a temporal sequence where the accident is overall depiction of an arrangement of occasion's decisions and circumstance coming full circle in injury or damage is a chain of different events.

Accident happened due to more than one factor in sequence. The group of unwanted sequences of events makes a dangerous accident.

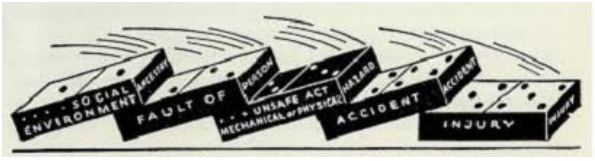

Fig.1:- Accident causation model

Prevention of accident by using simple sequential modeling in which accident can be avoided by removing any factor in the sequence leading to it. By removing such factors or replacing with some other which will make to stop major accidents.

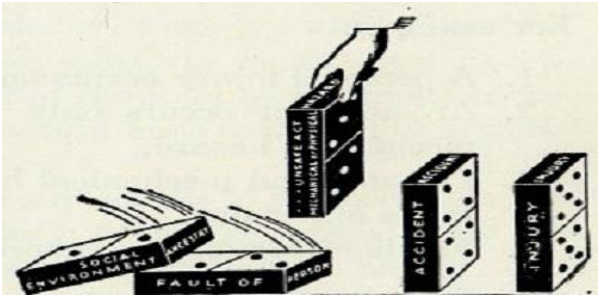

Fig.2:- Accident causation model

IV. CONCLUSIONS

A review of existing accident modeling approaches provides insight into limitations in the modeling and analysis of accidents in modern complex process systems. Accident causation approaches have been crucial to developing a holistic understanding of accidents and improving system performance over decades, they have also been in the prevention of accident.Oil and gas industry are workplaces that enclose a diversity of hazards to the safety and health of workers and many of the activities developed are potentially dangerous. The accident modeling approaches provides insight into limitations in the modeling and analysis of accidents in modern complex process systems. This paper provides descriptions and analyses of of Generic Accident Process Models accident models.

By Sequential model method prevention of explosion hazard in Oil and Gas industry by avoided by removing any factor in the sequence leading to it.

Some factors are:

I. Separation distance between storage tanks
II. By using Dyke wall surrounding the storage tanks
III. By using internal fire wall
IV. According to class of petroleum product tank will be provided water sprinkler system

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