Safe distance analysis and modeling of Fire and Explosion of the LPG Storage Tanks at PT XYZ Gresik Regency East Java, Indonesia Using ALOHA (*Areal Locations of Hazardous Atmosphere*)

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Abstract

Oil and gas industries are categorized as high risk activities. Fire and explosion incident in LPG storage tanks illustrates the high safety risks of LPG storage tanks at oil and gas processing facilities. PT XYZ is an oil and gas company that has LPG storage tanks, which also has a potential of fire and explosion incident, therefore it is necessary to study the possible impact of fire and explosion incident. This research was conducted to analyze safe distance, and modeling the size of fire and explosion of LPG storage tanks at PT XYZ, and determine the appropriate control measure to reduce the impact of the incident, using ALOHA (Areal Location of Hazardous Atmospheres) Software simulation. The result of this study can also be an input for the Company to ensure the level of safety and reliability of their installation.

There were 3 (three) steps in this research, such as: identification of fire and explosion incident scenario in the LPG storage tanks, the range of fire and explosion modeling of the LPG storage tanks, and the safe distance analysis of LPG storage tanks to other facilities in the vicinity.

The results of the research showed that explosion and fire of the tank caused the spread of heat radiation to the farthest distance 188 meters from the location of the leak. The worst impact for residents of the settlement is the potential to cause second-degree burns with a thermal radiation level of> 5.0 kW / m2 within 60 seconds. The LPG tank explosion and fire distance models are: a distance of 0- 1.3 km high risk; 1.3-2.8 moderate risk; and> = 2.8 km low risk.

When the risks are properly identified and managed, LPG can be safely used as a fuel source for many applications. This information is aimed primarily at users of LPG to provide information and help to ensure it is used safely. Users may wish to consider recording information about their installation, such as the route of any pipework, risk assessments they may make and any maintenance undertaken. Initially the site will concentrate on people using small bulk LPG installations. Included in this is information on the bulk storage tank and service pipework.

A flammable chemical either in the form of gas or liquid if it gets ignited creates thermal radiation effects around the area of burning. A large fire may cause fatality or injuries of different degrees of burn. The severity of a burn injury depends on the time duration of such exposure.

The storage of chemicals are highly risky and hazardous in any industries which requires safety guidelines to be followed for its safer containment. Thus it is mandatory to know about the properties of any chemical that are stored in any premises. The safe and prevention methods must be practiced as the storage accidents cause fatalities in the surroundings. In this study results have been achieved by using FMEA approach and ALOHA software. A FMEA spread sheet was prepared by using the guidelines given in 'IS-11137.2012 Analysis Techniques for System Reliability-Procedure for Failure Mode and Effects Analysis (FMEA)' and'IS-15550:2005-Failure Mode Effects Analysis standards for its design and guidelines'. The causes and accident preventive methods are arrived from the fishbone diagram made for a typical study of storage tank accident. The major accident sources or inducers identified in the study such as operational errors, equipment or instrument failures, lightning, static electricity, maintenance error, tank crack or ruptures, piping rupture, operation, management etc., were used in the software as failure modes or causes for the dispersions to occur.

It was found that the BLEVE in tanker and bullet are highly hazardous. It takes about 10 seconds to generate a complete fireball of radius 117 m in tanker and 109 m in bullet. Jet fire effects are invariably confined to any industry premises. The jet fire after ignition takes 2-3 minutes for the complete completion of fuel burning. The jet flame length was estimated to be 40 m in length for both tanker and bullet. BLEVE and VCE can create offsite emergency situations. The second stage of serious effects for all the scenarios cross the factory boundary and could cause damage beyond the premises of factory. Vapour clouds and its explosion can occur in 3 minutes. It can cause 312 m of highly concentrated flammable threat zone for tanker and 311 m for bullet. The effect of toxic gases prevails for about 1 hour around its surroundings. It is therefore, imperative on the part of the storage area to be alert as for as the handling of LPG is concerned. Open land with plantation with a wide green belt must be planned around premises, in order to reduce the effects of any off-site risk. The Typical Plant/ industry needs to take extreme care as far as the safety of its surroundings and operations are concerned, which could be seen in the earlier sections. Based on the above results the safer distances between the LPG storages and the buildings, operational units, tanker/trucks can evolved and compared with Static Mobile &Pressure Vessel Rules framed under Indian Explosives act 1884.Also during siting and layout design of LPG storages safe distances can be predicated using the ALOHA dispersion model. In addition the industries should also strictly prepare the emergency plan and periodically conduct emergency drills as a precautionary measure.

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