SPE 110521

Fire Protection In The Petroleum Industry

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This paper was prepared for presentation at the 2007 SPE Annual Technical Conference and Exhibition held in Anaheim, California, U.S.A., 11–14 November 2007.

Abstract

The risk of fire is present during all stages and operations of the petroleum industry, whether during exploration and production (E&P) both in onshore and offshore installations or during refining/processing or transportation, storage or during dispensing to the end user. All petroleum products from crude to final products produce vapor that is being mixed with air creating the potential for ignitable mixture. While petroleum products have different rates of releasing vapors to the environment, they all share the risk of starting a fire when an ignition source is introduced to the mixture. Fires involving hydrocarbons can take several shapes from pool fires to fire balls and jet fires. Due to the severity and Heat Release Rate (HRR) of Hydrocarbon fires (which may result in catastrophic consequences), fire prevention, protection and mitigation measures are considered to be of utmost importance/most advanced in relation to same measures in other industries.

FIRE PROTECTION IN THE PETROLEUM INDUSTRY:

Introduction: Hydrocarbons release vapor to the surrounding environment creating a mixture with air. This vapor/air mixture can take different concentrations depending on many factors. A fire can start if this mixture has concentration between two levels referred to as Lower Flammability limit (LFL) and Upper Flammability Limit (UFL). Any vapor/air concentration lass than LFL is considered too lean to burn and any concentration above UEL is too rich to burn. In the petroleum industry a facor of safety of 4 is normally used (that is several measures are in place to limit the vapor/air mixure concentration to 25 % of the Lower Flammability Limit (LFL) concentration).

What is fire:

Fire is a rapid chemical change that releases heat and light and is accompanied by flame, especially the exothermic oxidation of the flammable/combustible material.

Fire triangle:

For a fire to start, three elements must be present simultanuously:

1) Combustilble material (solid, liquid or gas).
2) Supply of air (oxygen) that is neccary for the combustion process.
3) Introduction of ignition source (flame, spark, static electricity, heat, …).

Fire extinguishing theory:

To extinguish fire, one or more of the three fire triangle elements will have to be eliminated.

Classes of fires and (fire extinguishing agents):

Class A fires: Involving ordinary combustibles (wood, clothing, papers,…) (extinguished by water, CO2, dry chemicals).

Class B fires: Involving hydrocarbons (both liquid and gas) and to be extinguished by (Foam,dry chemicals, Clean Agents (Halon replacements) and Fine Water Mist systems).

Class C fires: Involving electrical wiring and equipment. To be extinguished by CO2, dry chamicals and Clean Agents (Halon replacements).

Class D fires: involving metals. To be extinguished by special dry chemicals.

Fire hazards in onshore/offshore installations:

Fires in production facilities can be : Well blowout fires, flash fires, liquid pool fires, gas pool fires, jet fires, running liquid fires, confined and unconfined fires, etc.

Fire hazards during refining/processing:

Leakage in any piping system or equipment/vessels can result in jet fires, fire balls, liquid/gas pool fires, running liquid fires, etc.

Fire hazards during transportation: A leakage in any transportation mode (network of piping, rail cars, tankers may result in jet fires, running liquid fires, pool fires, etc.

Fire hazards during storage: A leakage in any storge tank can result in jet fires, pool fires, running liquid fires.

Conclusion:

The threat from fire is present at all times in the petroleum industry. To prevent fires from starting in the first place several measures have to be implemented including the proper design, proper construction matereials, proper processes and strict control of transient combustibles and ignition sources. Selecting the proper detection/suppression system provide assurance of controlling and extinguishing any potential fires as soon as they start developing. While having properly