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Health and Safety Hazards Management in Oil and Gas Industry

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Abstract **- This paper deals with the hazards and safety issues and its management practices in Oil and gas industry. In Oil and gas industry, during the well drilling and other service activities involve the use and production of potential hazards. Oil and gas wells can release hydrogen sulfide and expose workers to hydrogen-sulfide gas. The three best practices to help prevent injury and death are: active monitoring for hydrogen-sulfide gas; good planning; and training programs for workers. Oil and gas workers exposed to chemicals produced and used in oil and gas industry may suffer occupational diseases of lungs, skin and other organs at levels relying on the amount and length of exposure time. Those exposed to hazardous noise levels may suffer noise-induced hearing loss (NIHL). Other hazards include confined spaces that may injury or threaten life of untrained workers. The aim of occupational safety and health risk management is to identify and assess safety and health hazards existing at the workplace and to define appropriate control and retrieval steps.**

Keywords: Drilling, occupational safety, hazard, chemicals, workplace

INTRODUCTION

Air is a mixture of gases, but because its composition is reasonably constant it is usually considered as a single gas, which simplifies the measurement of toxic and flammable gases for safety and health applications. Flammable and toxic gas hazards are generally well understood by operators, technicians and safety personnel in the oil, gas and petrochemical industries, continuous training and refreshment of knowledge is essential to avoid potential incidents caused by complacency. New personnel are often assigned work activities in potentially hazardous areas with only very limited training about gas hazards and the use of gas detection equipment. Most organic compounds will burn. Burning is a simple chemical reaction in which oxygen from the atmosphere reacts rapidly with a substance, producing heat. The simplest organic compounds are hydrocarbons, which are the main constituents of crude oil and gas. Hydrocarbons are composed of carbon and hydrogen, the simplest hydrocarbon being methane, each molecule of which consists of one carbon atom and four hydrogen atoms. It is the first compound in the family known as alkanes. The physical properties of alkanes change with increasing numbers of carbon atoms in the molecule: those with one to four being gases, those with five to ten being volatile liquids, those with 11 to 18 being heavier fuel oils and those with 19 to 40 being lubricating oils. Longer carbon chain hydrocarbons are tars and waxes.

When hydrocarbons burn they react with oxygen from the atmosphere to produce carbon dioxide and water (although if the combustion is incomplete because of insufficient oxygen, carbon monoxide will result as well).More complex organic compounds contain elements such as oxygen, nitrogen, sulphur, chlorine, bromine or fluorine and if these burn, the products of combustion will include other compounds as well. For example, substances containing sulphur such as oil or coal will result in sulphur dioxide whilst those containing chlorine such as methyl chloride or polyvinyl chloride (PVC) will result in hydrogen chloride.
In most industrial environments where there is the risk of explosion or fire because of the presence of flammable gases or vapors, a mixture of compounds is likely to be encountered. In the oil, gas and petrochemical industries the raw materials are a mixture of hydrocarbons and chemicals, some of which may be being altered by a process. For example crude oil is separated into many materials using processes referred to as fractionation (or fractional distillation), fractions are further converted using processes such as ‘cracking’ or ‘catalytic reforming’. Flammable hazards are therefore likely to be represented by many substances on a typical petrochemical refining plant.

Techniques involved in Identifying Hazard

1. Hazard and Operability study (HAZOP)
2. Failure Mode and Effective Analysis (FMEA)
3. Quantitative Risk Assessment (QRA)
4. Event Tree Analysis (ETA)
5. Fault Tree Analysis (FTA)

HOZOP AND ITS IMPACTS

Hazard and Operability (HAZOP) Study is a structured and systematic evaluation of a planned and/or existing operation to identify and evaluate potential hazards in design and operation. This study is carried out by a team of engineers from different disciplines. The team looks at each section of a plant or system or operation (node), considers potential deviations from intended operation and analyses their consequences against any existing safeguards. Impact of identified hazards on safety, asset and environment are assessed.HAZOP is a guideword driven brainstorming technique. Team members contribute based on their collective experience and lessons learnt from past projects. HAZOP study records the identified hazards without proposing any solution, unless a solution is obvious. Proposed solutions may include additional safeguards or operational procedures as necessary. The study record serves as a guide to determine the Health, Safety and Environment (HSE) issues to be resolved during the project.

The objectives of the HAZOP study are:

- Identify and evaluate potential hazards and risks associated with process facilities
- Identify operability and maintenance issues
- Understand these hazards / issues and determine their potential consequences
- Determine (design and procedural) safeguards or risk reduction measures incorporated in the design and evaluate their adequacy and
- Recommend additional safeguards or operational procedures as necessary

MAINTENANCE HAZARDS AND PRECAUTIONS

Tank Cleaning

Hydrogen sulphide is a potential problem in the transport and storage of crude oil. The cleaning of storage tanks presents a high hazard potential. Many of the other classic confined-space entry problems can occur here, including oxygen deficiency resulting from previous inerting procedures, rusting, and oxidation of organic coatings. Carbon monoxide can be present in the inerting gas. In addition to H2S, depending on the characteristics of the product previously stored in the tanks, other chemicals that may be encountered include metal carbonyls, arsenic, and tetraethyl lead.

"Alky" (Alkylation) Unit

The lightest fraction from the crude unit is first processed in the gas plant. Some of the liquid hydrocarbons from the wet gas are run straight to the gasoline blending plant, but others go through the alkylation process. These light parts are put together using hydrofluoric acid or sulphuric acid as catalysts. The main hazards in this process come from possible exposure to the catalysts, hydrofluoric acid or sulphuric acid, and their dusts, byproducts, and residues as well as hydrogen sulphide, carbon monoxide, heat, and noise.

HAZOP METHODOLOGY

The HAZOP study progresses through the plant node by node. The selection of the node sizes and the route through the plant is made before the study by the facilitator. The node should be described in terms of:

- Brief description of the node
- Typical operating and design conditions

SAFE WORK PRACTICES AND PROCEDURES

Personnel

- ✓ Hearing protection and safety glasses must be worn in all operating areas or as posted.
- ✓ Respiratory protection or equipment must be fittested. Facial hair is unacceptable where the mask must make an airtight seal against the face.
- ✓ Shirts must be long-sleeved and worn with full-length pants or coveralls.
- ✓ Clothing must not be of a flammable type such as nylon, Dacron, acrylic, or blends. Fire-resistant types include cotton, Nomex, and Proban.
- ✓ Other PPE required may include acid hood, impervious outerwear, rubber boots, face shields, rubber gloves, disposable coveralls, monogoggles, and fall-arrest equipment.
- ✓ Smoking is allowed only in designated areas.
- ✓ Vehicle entry is by permit only and keys are to be left in parked vehicles.
- ✓ Vehicles must be shut down at the sound of any emergency alarm. • Vehicles must be equipped with ground straps.

TYPICAL PARAMETERS/ELEMENTS

1. Flow, Pressure, Temperature, Level
2. Composition, Concentration, Sediments
3. Fouling, Air or Moisture Ingress
4. Separation
5. Measure, Control, Sequence in batch operations

STEP BY STEP APPROACH

Hazop study is conducted in a systematic way with following step by step approach.

- ✓ Select a system. Explain its general intent in terms of design and operation
- ✓ Select a node (small area of focus) in the selected system. Usually a vessel and its piping or a pump and its piping. Explain its general intent in terms of design and operation
- ✓ Apply the first operating parameter, such a Flow or Pressure. Apply to the parameter a guide word or possible deviation, such as No to develop a deviation e.g. No Flow
- ✓ For the deviation look at possible causes and consequences; their hazards, existing safeguards. Recommend additional protection as necessary.
- ✓ Repeat for all guide words applicable for the selected parameter
- ✓ Repeat for all parameters.
- ✓ Node complete. Repeat for all nodes in the system
- ✓ System complete. Repeat for all systems in the plant

HAZOP APPROACH

The HAZOP study usually is started with an overview of process facilities and plant layout. This helps the team members to become familiar with the facility. A brief introduction will be given on systems with high pressure, high temperature, low temperature and hazardous chemicals.

The facility is segregated into nodes, as detailed in HAZOP worksheets. Nodes are the sections in the plant enabling the team to stay focused.For each node – potential hazards were identified in a systematic way, using a Guideword and Parameter. Each hazard and possible causes or initiating events were discussed and recorded in the

HAZOP worksheet. Then the team discusses potential impact for each cause or event and reviewed available safeguards – as a result of standard design practices or company requirements. Where it is deemed necessary, the team suggests additional protection or changes to philosophy or calls for additional studies to be performed. All these points are captured in the HAZOP worksheet and projected on an overhead screen for all participants to review and concur before closing out the session.

RISK MANAGEMENT PRACTICES

Risk Management is crucial for preventing work related injury and illness. It includes:

• Identifying the risks
• Evaluating and prioritizing the risks
• Implementing preventive/protective measures to control the risk.

There are a number of circumstances in the Oil and Gas industry where a proper risk management process is essential.

1. Job safety analysis:

It is a process of systematically evaluating certainjobs, tasks, processes or procedures and eliminating or reducing the risks or hazards to as Low as Reasonably Practical (ALARP) in orderto protect workers from injury or illness

2. Government Limitations

Regulations on where, when and how extractions can be done is very different based on location and laws. This risk usually emerges abroad due to a shift in political aspects. Some times the government changes its arrangement – possibly taking advantage of its authority to gain a higher percentage of profits. Most companies tend to lean towards countries that are secure and who usually offers long-term leases with no deviating; so a surprise limitation on reserves after the financial commitment has been made will be less likely to occur among additional taxes and exporting issues.

3. Environmental Constraints

Some locations are environmentally depleted and the last resort is to move to unconventional and unfamiliar areas where hard drilling is required and extraction of resources is known to be difficult – like drilling platforms in the middle of the ocean. This puts more pressure and challenges on companies due to the harm it can cause on the environment and public health and safety. The oil spill in the Gulf of Mexico raised concerns about deep-water offshore drilling due to health and safety concerns for workers, environment and wildlife. On-shore impacts include tailing ponds that are used to contain waste water

4. Supply and Demand

It requires a large financial investment to start an extraction in any location in the world and because reserves can be limited or excess this creates an unstable production which affects the pricing of oil and gas. Macro-economic factors can influence the industries prosperity like being dependent on a single market to buy from or sell to.

5. Cost

Cost focuses on operational factors and an extraction project can commonly exceed capital invested based on regulations, global production and drilling in unfamiliar areas. A major risk is not being able to find qualified workers due to many who are retiring which also add to the increasing operational cost. A risk for companies is also dealing with stakeholders who feel like they can cut cost and still have healthy growth while incurring more costs through spending on new technology for a more efficient extraction.

CONCLUSION

Hydrocarbon releases are often the precursor to major incidents and in 2015/16, hydrocarbons accounted for 40% of all dangerous occurrences that were reported. In liquid form, hydrocarbons can create slippery and dangerous surfaces and in gas form they are equally hazardous, with the main danger being accidental ignition that results in an explosion.Common workplace hazards include exposure to heat and flame, contact with harmful substances and dealing with hydrocarbon releases. Often, workers must also work in difficult conditions such as confined spaces and contaminated environments – both of which could prove life threatening if proper training and equipment is not provided.The hazards of the petrochemical industry are closely related to those of oil refining, particularly in the raw material stages. Atmospheric contamination hazards in the petrochemical industry can be complex, particularly when substances or processes combine. These combined effects are often much more toxic and dangerous than individual effects.

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