Quest Masterclass

Risk Analysis & Reduction Methods in Process Safety Management Programme

How to Implement Process Safety Management Systems?

Oil and gas companies handle chemicals and processes across all industries. The products of failure to manage process safety are catastrophic incidents and casualties. It is essential to always improve in handling risk and hazard as the danger present in everyday operations is evolving. There is a constant need to continuously improve implementation and existing methodologies in order to gain better efficiency and attain optimal operations in a safe work environment. It's important for companies to not only learn the methodologies and techniques in reducing risks and hazards. But also integrate the concept of business continuity improvement to address how to further develop existing methodologies that companies have. Also the procedures in risk and hazard reduction, and their application in having an inherently safer system design is another important thing that companies need to learn. This eBook will throw light on how to improve productivity and profitability through continuous improvement in safety management.

2 Key Pain Points of Process Safety Management

An efficient Process Safety Management programme includes techniques to tackle the Technical elements on risk & hazard identification and perform hazard analysis. HSM managers should always check that the safety standards are met and there is no danger to the lives of employees working in such challenging situations. PSM engineers and managers should take care that process designs are designed efficiently and designated places such as fire zoning are built appropriately. Also, maintenance engineers and managers should built efficient and speedy processes that can effectively deal with incidences of fatalities of workmen, in case such thing happens.

Topics to be Coverd

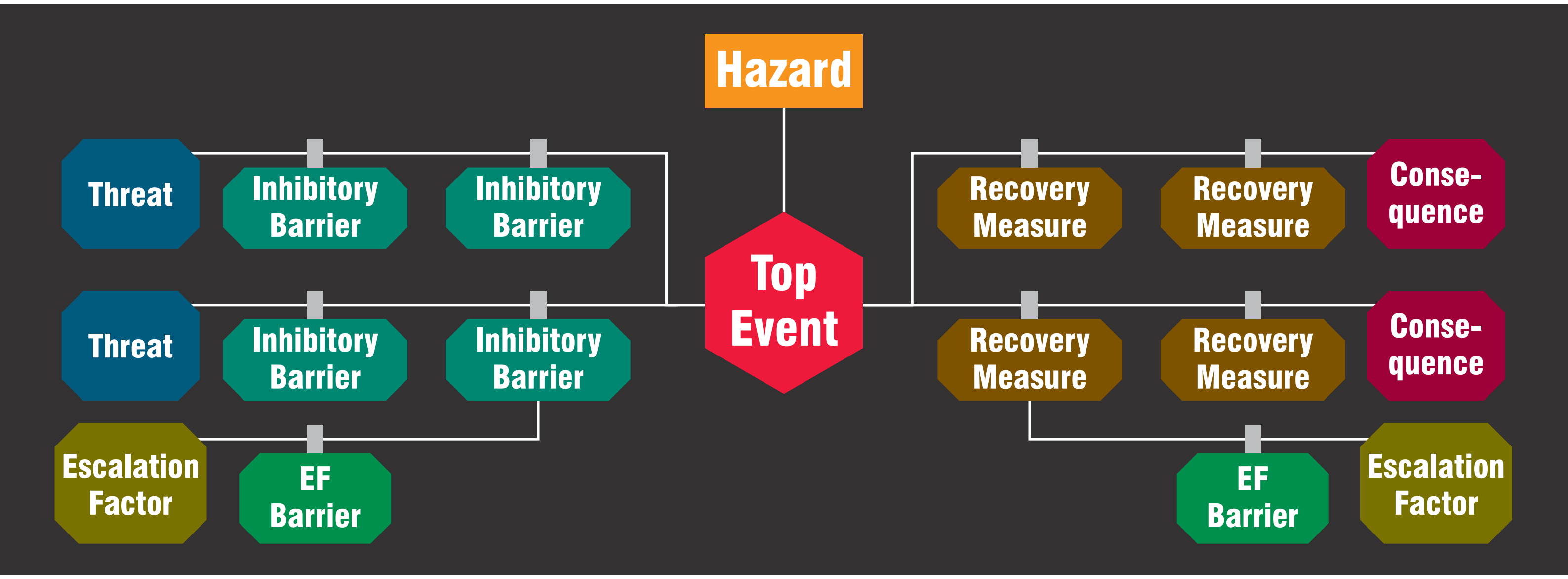
1. Risk & Hazard Analysis

2. Risk Reduction Methods

1. Risk & Hazard Analysis

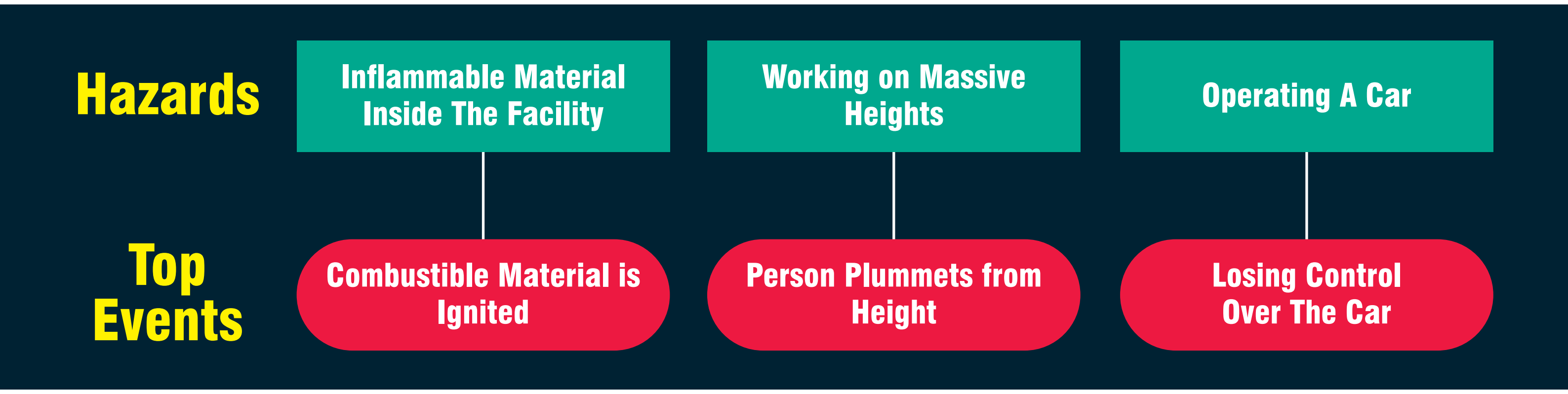
To understand the definition of risk and hazard and their implications is quite important. Hazard identification, risk assessment, and risk control procedures are three major things that can help prevent accidents. Companies need to not only develop efficient HSE procedures and process safety systems but also design effective parallel systems to keep uncalled disasters in check. But this is not sufficient. There are human errors, miscalculations, and unseen mistakes that can become big over time. These disasters need to be analysed critically so that they do not repeat in the future. Hence various analysis methods such as Bow-Tie event principle, Fault tree analysis, HAZID, HAZOP etc. need to be implemented. Let's check the Bow-Tie event principle in detail.

A. Bow-Tie Event Principle



Hazard is the beginning of any bowtie. Instances such as driving a car or dealing with hazardous substances are potential cases which can cause damage. The first step is to determine all the hazards that can take place. This is done by hazard determining processes such as HAZID. The Bow-Tie event principle is applied only for those hazards that have the maximum probability of causing extensive damage.

a. Top Event:



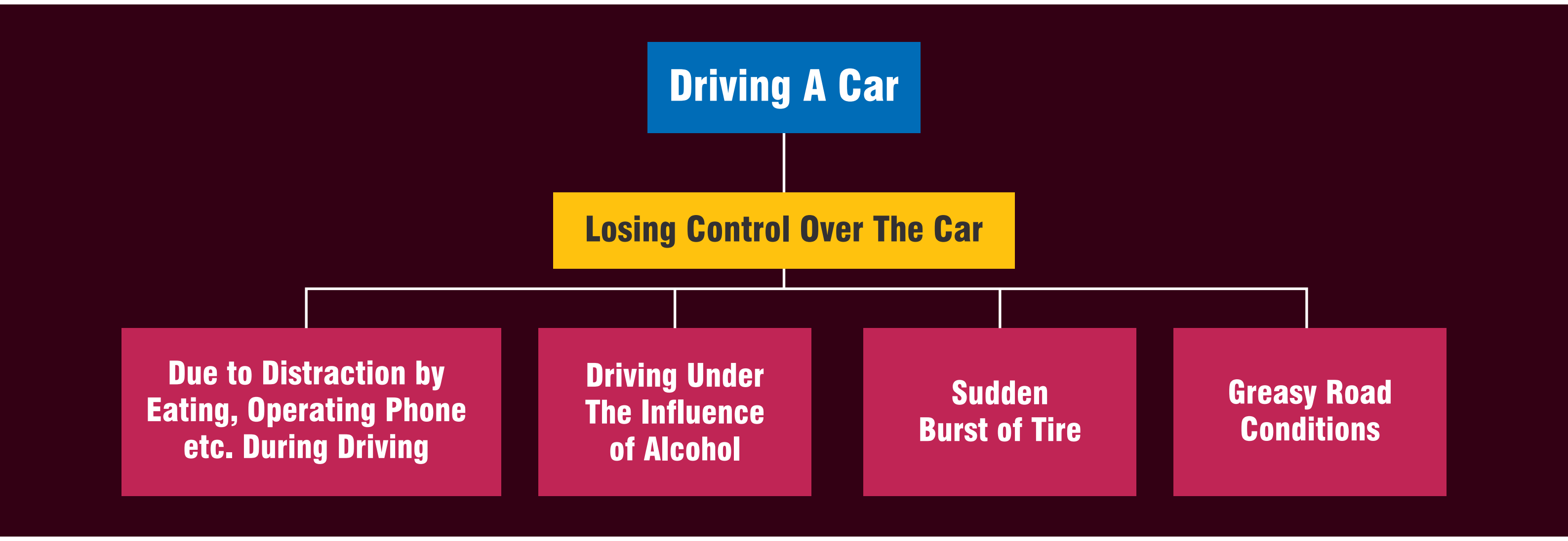
1. After choosing all hazards, the next step is to describe the "Top Event". At this moment, there is no damage, but it is imminent.

2. "Top Event" is a choice. It depends upon the one documenting and analysing the hazard.

3. The exact moment when the control is lost is subjective. But it is often reformulated after the rest of the bowtie has terminated.

4. As we can see in diagram 1, which consists of a sequence of hazards followed by their subsequent "Top Events". For example, working at height is a hazard and its following Top Event is that a person falls from height.

b. Threats:



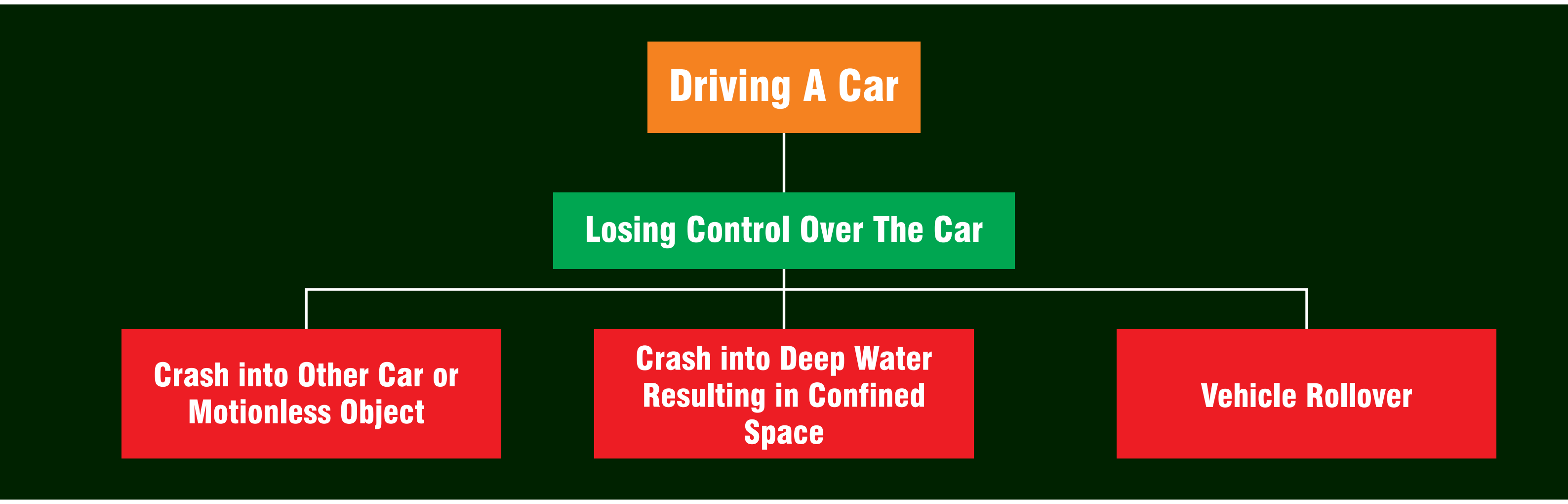
1. Threats are instances that are the reason behind "Top Event".

2. There can either be a single threat or many of them.

3. Threats can include human error, weather conditions, equipment failure etc. but it's a good practice to be too specific while describing the threat.

4. For example in the above diagram we can see the threats that can lead to losing control over the car. Distraction due to eating, driving under the influence of alcohol, sudden burst of tire, greasy road of conditions etc.

c. Consequences:



1. 'Top Events' leads to consequences.

2. Every 'Top Event' can have more than one consequence.

3. While describing events, it's better to focus on specific categories (car crash, formation of toxic clouds etc.) rather than generic categories (asset or financial damage etc.)

4. In the above flowchart we can see the consequences of a car crash. The car can crash into another object, drown in a confined space or the car can roll over and cause fatal injuries.

Now let's discuss the benefits of the above state method.

Benefits of Bow Tie Analysis:

- 1. Is greatly efficient for initial analysis of Process Hazard.
- 2. Guarantees identification of high probability and high consequence events.
- 3. Is a collective implementation of high-level event trees.
- 4. Correctly represents the cause of a hazardous scenario event, possible outcomes, and the steps that can be taken to prevent such mishaps in the future.
- 5. On the pre-event side (left side), the identified scenarios are depicted which makes it easy to read and comprehend the threats, so that they can be mitigated even before they arise.
- 6. On the post-event side (right side), the probable outcomes are depicted which lets one to study the specific possible outcomes and plan for them in advance.

2. Risk Reduction Methods

Risk Reduction Methods play a pivotal role in Process Safety Management. But for implementing the right safety methods, along with complete knowledge of general safety systems, role of audit and assessment need to be understood well. Also, Training and Development (T&D) including Emergency Shutdown Systems (ESD), Fire and Gas Systems (F&G), Safety Instrumented Systems (SIS), Safety Instrumented Functions (SIF), incident investigation and reporting in different forms in the workplace is what is needed.

Let's study Safety Instrumented Systems (SIS) in detail.

1. It comprises of an engineered set of software and hardware controls which are applied on critical process systems.

2. SIS is often used to provide protection in the following three cases:

i. When the main fuel gas valve closes due to high fuel gas pressure.

ii. When the cooling media valve is opened due to high reactor temperature.

iii. When a pressure vent valve is opened because of high distillation column pressure.

3. The functional requirements and the safety integrity requirements of SIS can be determined from HAZOP, LOPA etc.

4. The functional requirements are verified through failure modes, effects, criticality analysis, site acceptance testing etc.

5. The safety integrity requirements are verified through reliability analysis. But since this method does not address all factors, it is wise to have procedures and competence to circumvent, disclose, and correct SIS related failures.

Hazard Identification Process:

1. Once the engineering design phase of each section of the process has been completed, a team of project engineers begin with the formal process of hazard identification.

2. The team performs a procedural review of each area of probable hazard. Such a detailed study is known as HAZOP study.

3. This study contains details regarding the hazardous scenarios that need risk alleviating techniques, which can be achieved through Safety Instrumented Functions (SIF).

4. Integrity Levels (IL) are defined for the SIFs in their respective scenarios through approved methods such as Layer of Protection Analysis (LOPA).

5. There are two classifications of Integrity Levels (IL):

i. Safety Integrity Level (SIL)

ii. Environmental Integrity Level (EIL)

6. Once the IL rating of the SIFs and the HAZOP study recommendations are out, the engineering design for each unit operation is completed.

System Design:

1. When a dangerous condition occurs, a SIS is engineered to perform “specific control functions” to carry out specific functions of a process.

2. To ensure that SIS functionality isn’t compromised, the SIS system should not be dependent on any other control systems that exercise authority over the same equipment.

3. SIS comprises of logic solvers, actuators, and sensors etc. as Basic Process Control System (BPCS)

4. Safety Instrumented Functions (SIF) are specific control functions that are performed by SIS. They are a part of the overall risk reduction strategy which eliminates risks ranging from small equipment damage to catastrophic accidents.

Equipment:

1. An SIS contains efficient sensors that have the ability to detect abnormal operating conditions such as incorrect valve positioning, high flow or level.

2. To acquire the correct sensor input signal and generate probable decisions on the basis of nature of signals, a logic solver is required.

3. The logic solver uses electronic equipment such as relays, programmable controllers, amplifiers etc.

4. Various extra support systems such as power supply and communication equipment are also needed.

Today, there are myriad programmes on Process Safety Management, but unfortunately, most of them are devoid of tools that can train PSM managers and engineers on how to improve safety skills, integrate risk and hazard reduction methods. This advanced workshop will help you apply techniques in process safety management and overcome the limitations and blocks to achieve optimal safety. In our 4 day masterclass, Deborah Grubbe will teach you how to sail your way through the nitty-gritties of Process Safety Management, through real life case studies, presentations, exercises, and group discussions, to make you achieve PSM sustainability and assurance by identifying the gaps and addressing safety, operability, and reliability that are targeted to assure containment of hazardous materials and control of risks from high energy and other mechanical equipment.

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