

Industrial Safety & Hazard Analysis

Industrial safety principles

Safety is no longer just the following of Occupational Safety & Hazard Analysis OSHA regulations. It is the coordination of all departments to produce the greatest profit for the company at the most minimal risk.

The importance of safety

Main reasons

- 1. Economic
- 2. Legal
- 3. Moral
- Economic
 - worker compensation
 - medical bills
 - abatement costs
 - equipment damage
 - OSHA fines
 - loss of productivity
- Legal

- OSHA regulations and fines
- Worker compensation laws
- Third party lawsuits

- Moral Issues
 - Safety is just the right thing to do for your employees

The best thing to do is to recognize and control hazards before they ever impact your business

Accidents

Industrial Accidents are caused by chemical, mechanical, civil, electrical, or other process failures, negligence or incompetence, in an industrial plant which may spill over to the areas outside the plant causing damage to life and property. These may originate in:

- Manufacturing and formulation installations including during commissioning and process operations; maintenance and disposal.
- Material handling and storage in manufacturing facilities, and isolated storages; warehouses and go-downs including tank farms in ports and docks and fuel depots.
- Transportation (road, rail, air, water, and pipelines).

PROBABLE CAUSES OF ACCIDENTS

- Process deviations i.e pressure, temperature & flow.
- Parameters with regard to the state of the substance i.e., solid, liquid or gas, proximity to other toxic substances.
- Runaway reaction.

- Hardware failure, resulting in large-scale spills of toxic substances.
- Boiling Liquid Expanding Vapour Explosion (BLEVE) on the chemicals during transportation.

Major Consequences

- Loss of life / injuries
- Impact on livestock
- Damage to Flora/fauna
- Environmental Impact (air, soil,water)
- Financial losses to industry.

Case studies

1. Bhopal Gas tragedy – December 2-3,1984 Union carbide India limited, Madhya Pradesh , india.
 - Worst industrial disaster in history
 - 2,000 people died on immediate aftermath (within three days)
 - Another 13,000 died in next fifteen years
 - 10-15 persons dying every month
 - 520,000 diagnosed chemicals in blood causing different health complications
 - 120,000 people still suffering from
 - Cancer
 - Tuberculosis
 - Partial or complete blindness,

- Post traumatic stress disorders,
- Menstrual irregularities
- Rise in spontaneous abortion and stillbirth

World accidents

FILXBOROUGH, 01.06.1974, UK

The **Flixborough disaster** was an explosion at a chemical close to the village of Flixborough, England on 1 June 1974. It killed 28 people and seriously injured 36 out of a total of only 72 people on site at the time; from the devastation on site it was clear that had the explosion happened in normal office hours the casualty figures could have been much higher. A contemporary campaigner on process safety wrote "the shock waves rattled the confidence of every chemical engineer in the country". The disaster involved (and may well have been caused by) a hasty modification. Mechanical engineering issues with the modification were overlooked by the managers (chemical engineers) who approved it, and the severity of the potential consequences of its failure was not appreciated. Flixborough led to a widespread public outcry over process plant safety. Together with the passage of the Health and Safety at Work Act in the same year it led to (and is often quoted in justification of) a more systematic approach to process safety in UK process industries, and – in conjunction with the Seveso disaster and the consequent EU 'Seveso directives' – to explicit UK government regulation of plant processing or storing large inventories of hazardous materials, currently (2014) by the Control of Major Accident Hazards Regulations.. Two months prior to the explosion, the number 5 reactor was discovered

to be leaking. When lagging was stripped from it, a crack extending about 6 feet (1.8 m) was visible in the mild steel shell of the reactor. It was decided to install a temporary pipe to bypass the leaking reactor to allow continued operation of the plant while repairs were made. In the absence of 28 inch nominal bore pipe (DN 700 mm), 20 inch nominal bore pipe (DN 500 mm) was used to fabricate the bypass pipe for linking reactor 4 outlet to reactor 6 inlet. The new configuration was tested for leak-tightness at working pressure by pressurization with nitrogen. For two months after fitting the bypass was operated continuously at temperature and pressure and gave no trouble. At the end of May (by which time the bypass had been lagged) the reactors had to be depressurized and allowed to cool in order to deal with leaks elsewhere. The leaks having been dealt with, early on 1 June attempts began to bring the plant back up to pressure and temperature.

MEXICO CITY, 19.11.1984

The **San Juanico disaster** was an industrial disaster caused by a massive series of explosions at a liquid petroleum gas (LPG) tank farm in San Juanico, Mexico on 19 November 1984. The explosions consumed 11,000 m³ of LPG, representing one third of Mexico City's entire liquid petroleum gas supply. The explosions destroyed the facility and devastated the local town of San Juan, with 500–600 people killed, and 5000–7000 others suffering severe burns. The San Juanico disaster was one of the deadliest industrial disasters in world history. The disaster was initiated by a gas leak on the site, likely caused by a pipe rupture during transfer operations, which caused a plume of LPG to concentrate at ground level for 10 minutes. The plume eventually grew large enough to drift on the wind towards the west end of the site, where the facility's waste-gas flare pit was located. At 5:40 a.m., the cloud reached the flare and ignited, resulting in a vapor cloud explosion that severely damaged the tank farm and resulted in a massive conflagration fed by the LPG leaking from newly damaged tanks. Just four minutes

later, at 5:44 a.m., the first tank underwent a BLEVE (Boiling Liquid/Expanding Vapor Explosion). Over the next hour, 12 separate BLEVE explosions were recorded. The fire and smaller explosions continued until 10 a.m. the next morning. It is believed that the escalation was caused by an ineffective gas detection system. The town of San Juan Ixhuatepec surrounded the facility and consisted of 40,000 residents, with an additional 61,000 more living in the hills. The explosions demolished houses and propelled twisted metal fragments (some measuring 30 tons) over distances ranging from a few meters to up to 1200 m. Much of the town was destroyed by the explosions and ensuing fire, with the current statistics indicating 500 to 600 deaths, and 5,000–7,000 severe injuries. Radiant heat generated by the inferno incinerated most corpses to ashes, with only 2% of the recovered remains left in recognizable condition.

Incident: An *unplanned, undesired* event that hinders completion of a task and may cause injury, illness, or property damage or some combination of all three in varying degrees from minor to catastrophic.

Accident: Definition is often similar to incident, but supports the mindset that it *could not have been prevented*. An accident is the opposite of the fundamental intentions of a safety program, which is to find hazards, fix hazard, and prevent incidents.