

SAFE PROCESSES, EQUIPMENT & SYSTEMS IN PETROLEUM INDUSTRY

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Safety in Petroleum Industry ...

- Refineries and Petrochemical plants are highly energy-intensive
- Handle highly inflammable and toxic liquids and gases. Sheer volume of fluids handled is huge
- Hence, most hazardous and prone to accidents
- Emergencies range from simple on-site to major off-site cases, resulting in injuries, loss of human lives and property

How are these risks managed?

- Design stage - Proper selection of processes, Incorporating safety features in design of equipment and systems, Spelling out safe operating & maintenance procedures
- Fabrication stage – Proper quality control procedures during fabrication, Inspection
- Operation stage – Regular inspection of safety systems, no violation of safety procedures, strict implementation of work permit rules, looking for tell-tale signs to prevent accidents

How are these risks managed ...

- Processes – Though the reaction conditions can be hazardous, safeguards are built-in, to prevent run-away conditions, toxic gas releases in to atmosphere
- Equipment – Type of equipment to contain the hazard, corrosion allowance, safe material of construction (including cladding, lining), Fixing minimum distances, Relief systems like safety valves, Rupture discs

How are these risks managed ...

- Systems – consisting of piping, instruments, electrical components

All safety interlocks are provided to ensure safe running of the unit and safe shut-down. The most common of these are – cutting off the heat source (heater fuel, steam) under abnormal conditions, cutting off supply of a reactant like Hydrogen, air / Oxygen, depressuring the system to Flare

Accident statistics ...

- Despite such meticulous efforts, accidents in petroleum industry continue to occur with alarming regularity
- Oil Industry Safety Directorate (OISD) has compiled and analysed all accidents that occurred in 2004-2009 in Indian E & P companies and refineries.
- As per their report,
 - 60% are caused by Human failure
 - 18% by Equipment failure
 - 6% by Electrical-related incidents
- In 2011-12 also, more than 60% caused by human failure

Accident causes ...

- Under Human Failure,
 - 61% caused by non-compliance to laid- down safety procedures
 - 14% due to fall / slippages
 - 6% due to lack of supervision
 - 6% due to improper inspection
 - 6% due to lack of training

SOME CASE STUDIES

Fire at POL Depot, Jaipur, 29th Oct 2009

- Motor Spirit (Petrol) got overfilled in a tank, gushed out, got ignited
- Product leaked for 75 minutes- 1000 tons of MS
- Fire spread to 9 of the 11 tanks and it continued till the fuel contents were totally burnt out
- 60000KL product burned out in 11 days
- 11 fatalities, many injured and Rs 280 cr loss

Causes ...

- Tank level indication was not functioning correctly
- Warning alarms were ignored
- No provision to shut off supply automatically
- No remote operation of inlet valve
- Lack of adequate supervision

MB Lal Committee passed strictures against unsafe provisions & procedures. Its recommendations are now being implemented at huge costs. Such unsafe situations still exist in some refineries

HPCL-Vizag refinery Explosion

14th September 1997

- Fire broke out at 6:15 am, following a suspected leak in the LPG pipeline from the Vizag port to the storage farm.
- It caused a BLEVE and a series of explosions, and soon spread to at least six other naphtha and petrol tanks.



Damages ...

- Affected the entire product terminal area, including 11 storage tanks containing naphtha, petrol, diesel, kerosene and furnace oil, besides the six Horton spheres containing LPG.
- The refinery's administrative building, its canteen and some other buildings came crashing down .
- Fatality crossed 80
- Caused a high-level Offsite Emergency
- Even an earthquake measuring eight on the Richter scale might not have caused so much damage.

Causes ...

- Minor LPG leakage on the pipe line from Port to refinery was reported to be continuing from previous day
- Leaking pool and vapour cloud of LPG found an ignition source in the neighbouring canteen, causing a huge ball of fire that spread to LPG spheres, initiating BLEVE and explosions.
- Being a very old refinery, safe distances were not maintained between spheres and buildings
- Inadequate attention to the already existing leakage, improper maintenance

Change in Design

- This fatal explosion triggered a review of the sphere design by Chief Controller of Explosives (CCE).
- All new storages for LPG / Propane were mandated to be of 'Mounded' construction.
- The sand mound protects LPG from external leakages and fire

BP Texas Refinery Fire

March 2005

- In Isomerization unit, liquid naphtha overflowed and spewed from vent stack, when a Column was being filled during start-up, caused a huge fire killing 15 contract men
- Level indication and High level Alarms did not function
- Causes :
 - Poor maintenance of instruments
 - Negligence of operating staff, violation of SOPs, Poor supervision
 - Poor Management Attitude
 - Old refinery belonging to Amoco

BP Texas Refinery Fire ...

- Wrong to install an open stack for hydrocarbon releases
- Should always be a completely closed system, connected to a Flare, to allow combustion of releases emissions
- ***MANY OF THE RECOMMENDATIONS OF US CHEMICAL SAFETY BOARD STILL UNDER IMPLEMENTATION, AFTER 8 YEARS***

Other improved safety design features – Learnings from accidents

- Automatic Rim Seal fire quenching in Floating roof tanks, by installing Foam Pourers
- Automatic shut-off of inlet valve to tanks, to prevent overfilling, multiple levels of alarms
- Remote-operated MOVs to isolate tanks, to shut loading / unloading, during emergencies
- Automatic de-coupling of Loading arms, when ship sways
- Vapour recovery system for tanker / wagon loading
- Emergency Power for critical equipment, to prevent pressure rise

Improved design features ...

- More accurate and reliable instruments help in early detection of faults and better process control , multiple redundancies
- Improved fire fighting equipment like long-range monitors
- Lightning arresters to prevent ignition of fugitive emissions, during lightning
- CCTV in critical units
- Increased awareness of PHA, Hazop

Need of the Hour ...

- Strict compliance to safe procedures
- No deviation in Management of Change procedures
- Priority for safety over production
- Planned inspection schedule of equipment
- Follow inspection recommendations
- Conduct regular Process Hazard Analysis
- Pro-active and predictive maintenance
- Adequate Refresher Training to avoid complacency

Need of the Hour ...

- Top Management 's responsibility
 - must give top priority to safety related items
 - must respect safety recommendations and deadlines
 - must provide adequate funds for safety-related items
 - must review safety compliances regularly and remove bottlenecks
 - must cultivate and sustain good safety culture

**IT SHOULD BE A 'TOP DOWN' APPROACH
ON SAFETY**



***Thank you
for your attention !!***