Fire & Electrical Safety in Petroleum Oil Refinery

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CII- Kolkata
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TOPICS COVERED:

- Brief History of the Company
- Fire & Electrical Hazards in refineries
- Control measures
- Process safety measures
Digboi 0.65
Haldia 7.5
Koyali 13.7
Mathura 8.0
Panipat 15.0
Barauni 6.0
BRPL 2.35
Guwahati 1.0
Paradip 15.0
Digboi 0.65

GLOBAL RANKING

→ 161 in Global Fortune 500 List for year 2016
(1st and Topmost Indian company in Fortune 500 list)
Foundation Stone laid by Late Prof. Triguna Sen, Hon’ble Petroleum Minister on 6th Dec 1969.
Commissioned in January 1975.
One of the two refineries of IOCL producing Lube Oil Base Stocks (LOBS)
Refining capacity increased from 2.5 to 7.5 MMTPA in phases and last revamp done in Jan 2010.

Located at Haldia, Medinipur(E) District of West Bengal, 130 km from Kolkata.
Manpower: 1339 employees
2000 Contract workers.

Refinery
Port
Haldia Petrochemicals
PHBPL
Haldia Refinery – at the heart of Haldia Industrial Belt

2.5 2.75 3.6 4.6 6 7.5
MMTPA

3 times
Crude through Paradip - Haldia Pipeline

Crude from Haldia Port

Haldia Refinery

Crude to Barauni & Bongaigaon Refinery

- LPG
- Motor Spirit
- Naphtha
- Diesel
- ATF
- Kerosene
- LOBS
- Furnace Oil
- Wax
- Bitumen

34.5%
29.8%
16.5%
19.1%
Special Risks Associated with Petroleum industries

- Highly flammable material
- High Temperature/Pressure
- Modern Technologies use Hydrogen extensively
- Static Electricity
- Harmful Chemicals/Solvents/Catalysts used in the Process
- Pyrophoric Iron Fire
- Self Ignition of HC on Leakage from System
- Toxic gases/inert atmosphere
- Uncontrolled Process Reactions
- Loss of Containment/Accidental Releases
MAJOR POTENTIAL HAZARDS

- FIRE & EXPLOSION HAZARD
- STATIC ELECTRICITY
- ELECTRICAL HAZARD
- TOXIC GAS RELEASE HAZARD
- NITROGEN HAZARD
- HAZARDOUS CHEMICAL HAZARD
- OIL SPILLAGE
- RADIATION HAZARD
- WATER & STEAM HAZARD
- COMPRESSED AIR/LIQUID HAZARD
Boiling Liquid Expanding Vapour Explosion (BLEVE)
Boiling Liquid Expanding Vapour Explosion (BLEVE)

1. An adjacent fire heats the tank
2. Pressure increases by heat
3. The safety valve releases by the increasing pressure and the escaping gas ignites by the adjacent fire

A TANK OF LPG

Boiling Liquid Expanding Vapour Cloud Explosion
Boiling Liquid Expanding Vapour Explosion (BLEVE)

Water reduces heat input.

Insulation reduces heat input.

Where there is no liquid to absorb heat, the walls may overheat and burst at or below the set pressure of the relief valve—THE RELIEF VALVE WILL NOT PREVENT THE VESSEL FROM BURSTING.

Boiling liquid absorbs heat and prevents the walls from getting too hot.

Sloping the ground prevents liquid from accumulating under the vessel.

Remotely operated depressuring valve allows stress on the vessel to be reduced.
Unconfined Vapour Cloud Explosion
Unconfined Vapour Cloud Explosion

Explosion Refineria PEMEX Reynosa Sept 9, 2012 - YouTube [360p].mp4
Jet Fire

Gaseous Fire (Hydrogen / Lighter Hydrocarbon) in pressurized condition

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Hydrogen Fire Hazard

- Wide range of Explosive Limits (4.1% to 74.2%)
- Burning Hydrogen generates tremendous heat with flame speed of more than 3.3 m/s.
- Extremely lighter than air (rises immediately)
- Hydrogen flame is invisible, one may walk into the flame.
- It needs very low energy input to initiate fire.
Iron sulfide is one such pyrophoric material that oxidizes exothermically when exposed to air. It is frequently found in solid iron sulfide scales in refinery units.

There is a greater likelihood of this reaction occurring when the process involves a feedstock with high sulfur content.
Slop over: A slopover results when a water stream is applied to the hot surface of burning oil, causing the burning oil to slop over the tank sides.

Froth over: A frothover is the overflowing of a container not on fire when water boils under the surface of viscous hot oil. An example is hot asphalt loaded into a tank containing some water. The water may become heated and start to boil, causing the asphalt to overflow the tank.
Boil over: Boil over is a sudden and violent ejection of crude oil (or other liquids) from the tank resulting from a reaction of the hot layer and the accumulation of water at the bottom of the tank.
Slop over/ Boil over/ Froth Over

kitchen_fire.wmv
Electrical Hazards
Electrical Hazards

- Inadequate wiring
- Exposed electrical parts
- Overhead power lines
- Defective insulation
- Improper grounding
- Improper electrical equipment
- Overloaded circuits
- Wet conditions
- Damaged tools and equipment
- Improper PPE
Effect of exposure to electric current

- Shock.
- Burns.
- Arcing.
- Fire and explosion.

*Remember – B SAFE*
Burns

Direct:
• Caused by the current flowing through the body.
• Skin and internal.

Indirect:
• Caused by arcing, fire or explosion of other equipment during electrical accidents.
The danger from electrical shock depends on the amount of the shocking current through the body, the duration of the shocking current through the body, and the path of the shocking current through the body.

Physiological effect of current

<table>
<thead>
<tr>
<th>Milliamps</th>
<th>Perceptible Current</th>
<th>Involuntary Reflexes</th>
<th>Cramps</th>
<th>Muscular Paralysis</th>
<th>Breathing Problems</th>
<th>Ventricular Fibrillation</th>
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</table>
A safe work environment is created by controlling contact with electrical voltages and the currents they can cause damage.

Electrical currents need to be controlled so they do not pass through the body.

In addition to preventing shocks, a safe work environment reduces the chance of fires, burns, and falls.

Make your environment safer by doing the following:
- Treat all conductors—even “de-energized” ones—as if they are energized until they are locked out and tagged.
- Verify circuits are de-energized before starting work.
- Lock out and tag out circuits and machines.
- Prevent overloaded wiring by using the right size and type of wire.
- Prevent exposure to live electrical parts by isolating them.
- Prevent exposure to live wires and parts by using insulation.
- Prevent shocking currents from electrical systems and tools by grounding them.
- Prevent shocking currents by using GFCIs (ELCBs)
- Prevent too much current in circuits by using overcurrent protection devices.
Controlling Hazards: LOTO

Lock-out/tag-out is an essential safety procedure that protects workers from injury while working on or near electrical circuits and equipment.

Lock-out involves applying a physical lock to the power source(s) of circuits and equipment after they have been shut off and de-energized.

The source is then tagged out with an easy-to-read tag that alerts other workers in the area that a lock has been applied.

![Image of lock-out/tag-out procedure]

Movie-3  -LOTO_Safety_Video_Animation.mp4
Control – Use ELCB (Earth Leakage Circuit Breaker)

- Protects you from shock
- Detects difference in current between the black and white wires
- If ground fault detected, ELCB shuts off electricity in 1/40th of a second
- Regular checking of ELCB to be ensured.
Controlling Hazards: OISD Norms
(Standards/ Guidelines/Recommended Practices)

- OISD-STD-105 Work Permit System
- OISD-RP-110 Recommended Practices on Static Electricity
- OISD-STD-113 Classification of Area for electrical installations at Hydrocarbon processing and handling facilities
- OISD-STD-118 Layouts for Oil and Gas Installations
- OISD-STD-137 Inspection of electrical equipment
- OISD-RP-146 Preservation of idle electrical equipment
- OISD-RP-147 Inspection & safe practices during electrical installations
- OISD-RP-148 Inspection & safe practices during overhauling electrical equipment
- OISD-RP-149 Design aspects for safety in electrical systems
- OISD-STD-173 Fire Protection System for Electrical Installations
- OISD-GDN-180 Lightning Protection
Preventive measures for Electrical hazards

- Safety during design
- Operational Control
- Equipment selection (Flame-proof/intrinsically safe) as per Area classification in line with OISD standards
- Preventive maintenance of electrical equipment
Hazardous areas are classified into zones based on an assessment of the frequency of occurrence and duration of an explosive gas atmosphere.

- **Zone 0**
  an area in which an explosive gas atmosphere is continuously present, for long periods or frequently;

- **Zone 1**
  an area in which an explosive gas atmosphere is likely to occur in normal operation occasionally;

- **Zone 2**
  area in which an explosive gas atmosphere is not likely to occur in normal operation but, if it does occur, will persist for a short period only.
Zone 0

Zone 1

Zone 2

Flammable liquid

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Safety during design

- Intrinsically safe / flame proof equipment designed as per standards and approved by national/international certifying agencies like CIMFR/PESO/ATEX/BASEEFA
- Earthing of storage tanks/ vessels/ pumps handling hydrocarbons.
- Bonding and grounding of flanges on pipes carrying LPG and light hydrocarbons.
- Control of flow rate within safe velocity.
What is static electricity?

It is created when two objects or materials that have been in contact with each other are separated.

If these charges don't have a path to the ground, they are unable to move and become "static".
Static electricity is commonly produced when:
liquid flows though a pipe or hose, or though

- an opening in a pipe or hose
- spraying or coating
- blending or mixing
- filling tanks, drums, cans or pails
- dry powdered material passes through chutes or pneumatic conveyors
- non-conductive conveyor belts or drive belts are moving appliances are plugged into
- electrical outlets
Static Electricity

06StaticSparks_pdl.wmv
Most static electricity control measures provide ways for the static charges to dissipate harmlessly before sparks occur.

Some ways to prevent static charges from accumulating on materials are:

- bonding and grounding
- humidification
- static collectors
- additives
Safety during Operation

- Following of SOPs during loading
- Earthing of tankers and TWL with interlocks.
- Filling only with Mass flow meter to fill at controlled rate and prevent static charge generation and also avoid overfilling.

Confirmation System For Tanker Truck Loading – Typical Assembly

Provides connection to “high-integrity” ground point. Offers visual confirmation of proper ground contact and through “interlocks”, can control pumps, valves, motors or interface with PLC or DCS controls. Can also initiate a sound alarm if needed. For road tankers, an optional system is available offering “tanker recognition” in addition to the above mentioned functions.
Safety during Operation

Typical Pipe Grounding Jumper at Swivel Connections

Large Typical Grounding Clamp

"Retract-a-Cable" Typical Grounding Clamp with Reel or Recoiling Cable

Typical Grounding Clamp

Grounding "Bus" (Typical)

Ground Rod for Grounding Loading Rack/Platform

Level Measuring Device or Pipe Shall Be Grounded Before Inserting into Any Car or Truck

NOTE:
Ground Conductivity of all piping, equipment, devices, cables and connections must be checked for electrical continuity at the time of installation and periodically thereafter.

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SAFEGUARDS IN REFINERIES

- Community Emergency Response
- Plant Emergency Response
- Dykes, ROVs, fire protection system
- Relief Devices, flare system, Blowdown systems
- (SIS) Safety Instrumented System
- Critical Alarms, Operator Intervention
- (BPCS) Basic Process control system

Correct Priority of Safeguards
- Avoid
- Prevent
- Control
- Mitigate

Some safeguards prevent LOC
Some safeguards control / mitigate LOC
Some safeguards avoid LOC
Some safeguards mitigate the consequences
Process Safeguards in Refineries

- Fixed Gas Detection
- Critical levels Alarms at Panels
- Safety Relief Devices
- Dual Mechanical Seals
- Emergency Trips
- Blow down
- Flaring System
- Process Interlocks
Safe System to Work

- Work Permit System
- Need based Training
- Safety Inspection/Loss Control Tours
- Safety Awareness Programme
- Safety Audits
- Safety Meetings
- Management of Change
- Near Miss/Incident Investigation

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Thank You