



IndianOil

PNGRB Knowledge Sharing Workshop

Safety during Shutdown & Startup

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Paradip Refinery - The Energy Gateway to Eastern India

Our Commitment
Zero Tolerance to
Unsafe Conditions,
Unsafe Practices &
Unsafe Behaviors :
“We believe this
will Lead to Zero
Accident”



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- ❖ Indian Oil has a systematic approach to turnaround management (TAM) system and has developed excellent expertise in execution of shutdowns. Based on Indian Oil's experience of successfully carrying out TAMs of over 200 process units in its different refineries for over five decades, Indian Oil is equipped to provide world-class technical support for management of TAM. As part of its services to clients, Indian Oil also provides its services for Refinery Turnaround Maintenance Management.
- ❖ With an extensive experience of performing the TAM of the entire refinery at one go that includes all the Process Units, Utilities & Offsite Facilities simultaneously, Indian Oil is having the expertise to manage shutdowns in a safe, structured & time bound manner.
- ❖ Such a concept requires enormous resources in terms of manpower, material & equipment, along with a scientific way of executing TAM, utilizing advanced tools and tackles, user friendly software packages in multi-user environment, effective communication facilities amongst the coordinators, stringent safety standards, etc.

❖ A meticulous plan, integrating all aspects of jobs, is drawn and is monitored on day-to-day basis with an hourly schedule. Monitoring software like MS Project, Primavera for planning, scheduling, monitoring & control are used extensively. These software are used for generating daily status and exception reports on a number of criteria such as activities due for start but not started, activities due for finish but not finished, effect of delay in completion of critical and non-critical activities on shutdown completion schedule. In the event of delay/unanticipated work, catch-up plans are made to meet the overall schedule.

❖ Definition:

In Petroleum Refining, Turnaround means a scheduled large-scale maintenance activity wherein an entire process unit or the Refinery is taken off stream for an extended period for comprehensive revamp and renewal. This operation involves a lot of preparations and requires many precautions, especially during startup.

❖ Criteria for Turnaround Objectives:

- ❑ Aligned with business goals
- ❑ Clear & unambiguous and prioritized
- ❑ Measurable, objective and monitored
- ❑ Based on experience, scope, knowledge and data
- ❑ Aggressive but achievable
- ❑ Deliberated and agreed to key stakeholders

❖ Turnaround Process / Procedure:

- ❑ Make plant safe to operate till next outage.
- ❑ Improve efficiency & throughput of plant by suitable modification.
- ❑ Reduce routine maintenance costs
- ❑ Perform Regulatory Inspection
- ❑ Increase reliability / availability of equipment during operation
- ❑ Re-establish Plant Capacity.
- ❑ Upgrade technology by introducing modern equipment & Technology
- ❑ Complete corrective /preventive maintenance & project work



❖ Turnaround Process / Procedure:

- ❑ Collection of all inputs such as previous reports, procurement lead times, job lists, own and contractor resources availability etc.
- ❑ Gathering information from the previous turnaround by way of group discussions, reviewing previous plans and turnaround reports
- ❑ Finalization of job list and freeze after challenging by experience multi-disciplinary Challenging Team
- ❑ Setting of turnaround run lengths and approximate turnaround duration
- ❑ Preparation of work scope for next turnaround
- ❑ Critical review of work scope
- ❑ Breakdown jobs into specific activities
- ❑ Review implementation option and resource requirement
- ❑ Prepare an achievable plan and well integrated level I, II, III schedule
- ❑ Procurement of material
- ❑ Split between the jobs to be carried out by Company personnel and contractor

❖ Turnaround Process / Procedure:

- ❑ Contract Planning, Agency Line-up
- ❑ Resources for running units
- ❑ Check the jobs for pre-requisites such as scaffolding, insulation removal, blinds, etc.
- ❑ Pre-shutdown fabrication
- ❑ Progressive hand over of the execution portion to the field coordinators, planners, field engineers, contractor supervisors
- ❑ Ensure availability of tools and construction equipment
- ❑ Ensure adequate infrastructure facilities like, labor colony, canteen / space for eating for workman, medical facilities, transportation, drinking water, toilet facility, etc.
- ❑ Administrative & Security arrangements
- ❑ Implementation Plans
- ❑ Monitoring of jobs during execution
- ❑ Contingency plan for additional resources required during turnaround
- ❑ Turnaround Close-out

❖ Pre Shutdown Preparation:

- ✓ Keep end blinds /spectacles near line flanges as per positive isolation plans indicating required date for readiness on tags.
- ✓ Keep adequate numbers of Testing Spools, temporary Connections for connecting pressure gauges & drains/vents for testing of Heat Exchangers (Both Shell & Tube side)
- ✓ Fabrication of Spool Pieces for Heater Pigging Jobs.
- ✓ Erection of scaffolding wherever possible e.g. For Heat Exchanger, inaccessible Blind locations, control Valve s, safety valves, etc.
- ✓ Lifting and shifting arrangement for control valves, Safety Valves, etc.
- ✓ Provision of Power supply points at planned locations e.g. laying of additional cable if any for welding, Hydro jetting and Hydro testing M/C.
- ✓ Arrangement of temporary lift and Dehumidification at defined locations.

Preparation for Safe & Effective Execution:

- ✓ Detailing of Scope of work for all S/D Jobs
- ✓ Preparation of Maintenance Execution Procedure & Work Pack for all S/D Jobs
- ✓ Preparation for all Critical S/D activities e.g. hot jobs, Modification job, work at height, confined space jobs
- ✓ Assignment of specific job responsibilities to a group of cross functional team e.g. team involving Maintenance, Operation, Process, Safety and Inspection
- ✓ Engaging Quality & experienced contractors having good track record of executing S/D Jobs in other Refineries to the maximum extent.
- ✓ Arrangement for Pre S/D Training to Contract Manpower
- ✓ Use of only Certified Tools & Tackles
- ✓ Use of Flame Arrestor for all Vehicles, Trailers, Crane
- ✓ Tool Box Talk by Engineer to Contract Manpower
- ✓ Strict Compliance of Safety Work Permit System
- ✓ Use of General & Specific PPE's e.g. Life line belt, Fall Arrestor
- ✓ Certified Lifting plan for heavy lift
- ✓ Certification of Scaffolds & use of "Safe to use" Tag

❖ Facilities and Services Required for Shutdown :

- ❑ Contractor office space / working area
- ❑ Canteen facilities for contractor
- ❑ Canteen facilities for officers
- ❑ Drinking Water Facilities
- ❑ Shutdown office
- ❑ Urinals & Toilets
- ❑ Resting Place
- ❑ First Aid Centre
- ❑ Accommodation for Labor / Transport
- ❑ Office space for foreign expatriates

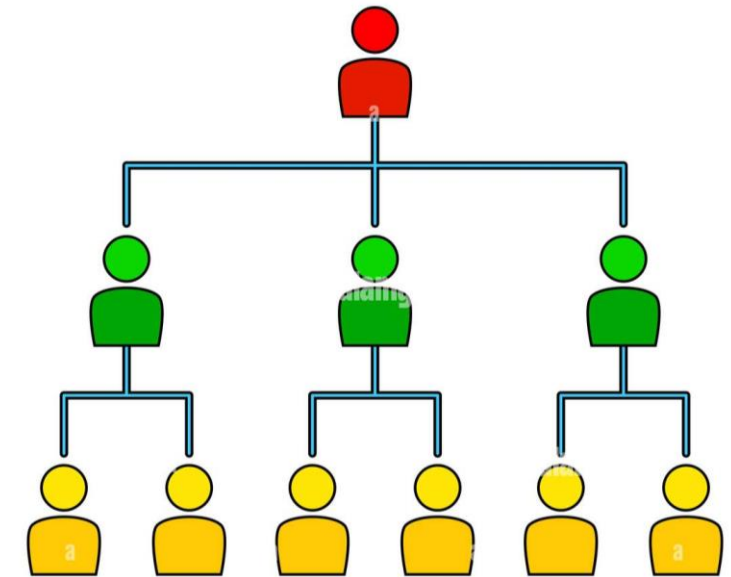
❖ Detailed Shutdown Planning :

- ❑ Planning started with setting of Milestones for Planning activities
- ❑ Compilation, discussion and finalization of Job list
- ❑ Cost Estimation of S/D Jobs, Detail technical study and BOM preparation for S/D activities, material procurement action
- ❑ Preparation of detail scope for awarding the contract
- ❑ Preparation of Work packs by operations and standard maintenance procedures by maintenance
- ❑ Finalization of resources, Heavy Equipment, Inspection Plans, identifying service requirements of technical specialist & expatriate +Organization of S/D meetings for review, micro detailing and finalization of overall S/D schedule



❖ Turnaround typical organization :

- ❑ Head-Refinery
- ❑ Chief Turnaround Manager
- ❑ Overall Operation Coordinator
- ❑ Technical Services Coordinator
- ❑ Construction Coordinator
- ❑ F&S / HSE Coordinator
- ❑ Turnaround manager
- ❑ Turnaround planning Coordinator
- ❑ Turnaround Coordinator
- ❑ Operation Coordinator
- ❑ Engineering & Inspection
- ❑ Revamp/Expansion Project Manager
- ❑ Revamp/Expansion Execution Manager
- ❑ Project Coordinator / Overall Tie-ins Coordinator
- ❑ Instrumentation support team leader
- ❑ Electrical support team leader
- ❑ Civil support team leader
- ❑ Security
- ❑ Admin
- ❑ Commercial



Zero Tolerance Criteria

- Work with valid work permit required for the job.
- Valid energy isolation before commencement of work.
- Obtain authorization before overriding or disabling safety critical equipment.
- Obtain authorization before entering a confined space.
- Protect against fall when working at height.
- Use the correct Personnel Protective Equip.(PPE) when handling hazardous chemicals.
- Job Safety Analysis for all critical jobs.
- Do not position yourself under a suspended load.
- Smoking is not allowed inside refinery.
- Do not bring potential ignition source into the process areas without authorization/permit.
- Do not drive vehicle beyond specified speed limit on roads.



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Additional Hazards in Shutdown

- Involvement of mixed laborers (Skilled, Semi-skilled, unskilled)
- More No. of people working in limited area.
- Activities at multi layer position.
- Presence of HC & toxic gases due to draining.
- Scattered hot jobs.
- Scattered electrical cables, machineries, scrap.
- More activities in confined spaces. Work in Inert atmosphere
- Work at heights, improper scaffolding.
- Inadequate supervision.
- Prolonged working hours by same group.
- Pyrophoric iron fire.
- Stress due to tight shutdown schedule.



Implementation of Multi-modal Safety Surveillance system

Entire Refinery divided into Seven Zones. Round the clock safety surveillance shall be ensured in each zones by following 5-tier Safety Surveillance Teams : –

Tier 1 - Process Safety Assurance Team : A Team of Officers drawn from TS, HSE, Production & QC Laboratory

Tier 2 – Core Safety Surveillance Team : F&S Officers, hired Safety Professionals, Project Safety Personnel & CISF(Fire Wing)

Tier 3 – Electrical Safety Surveillance Team: Electrical Engineers & Technicians from Engineering Services & Maint Departments

Tier 4 - Emergency Handling Team : Establishment of Temporary Fire & Safety Posts at Two strategic locations for quick response during any emergency & monitor safety compliance with on the spot correction at site.

Tier 5 – Surveillance by Drone and Artificial Intelligence (AI) Enabled Cameras (both fixed and movable) through expert agency



TIER-I
Process Safety Assurance



TIER-II
F&S Officers, hired Safety Professionals & CISF(Fire Wing)



TIER-III
Electrical Safety Surveillance Team



TIER-IV
Temporary F&S Posts at 2 locations

Tier 1 - Process Safety Assurance Team (Officers drawn from TS, HSE, Production & QC Laboratory)

1. Check for following process safety conditions -

- Safe hand over of equipment (Gas free & Hydrocarbon free)- Draining/ De pressurization, Decontamination etc.
- Safe Isolation and flushing including checking . review of Flushing Schemes.
- Ensure blinding / de blinding as per standard blinding list.
- Ensure sealing of OWS manholes & Vent stacks.
- Emptying of CBD & OWS system HC free.
- Check for Isolation at Unit Battery limits.
- Safe handling of Nitrogen & other utilities.
- Ensure compliance to work permit conditions like periodic gas testing, disposal of pyrophoric scales etc.
- Ensure safety during pre-commissioning & Compliance to PCSA/ PSSR.

2. Ensure proper utility connections to confined spaces (Nitrogen utility points shall be of different coupling)

3. Availability of proper MOC for any process modification done.

4. Ensure safety for all temporary arrangements made for transfer, de-choking, draining etc. for hydrocarbon.

5. Ensure compliance to pre start up procedures.

6. Daily observations report to be shared to Fire & Safety nodal officer for discussion in Daily Shutdown Meeting.

Tier 2 - F&S Officers Team, Hired Safety Professionals, Safety Professionals from various Project Sites

1. Check for SMS (Sanitization, Masking & Social Distancing) for COVID-19
2. First Time man entry check by F&S along with operations and maintenance personnel.
3. Safety Signage/ Poster Display in 8 nos. Satellite booth being erected for the shutdown.
4. Special drives during lunch hours to ensure workers take rest at the designated locations
5. Provide standby duty during vapour line, flare line blinding/de blinding job, critical confined space jobs.
6. On the spot training on Fire prevention and protection.
7. Issue F&S material on loan
8. Emergency handling and rescue.
9. The multi disciplinary team will be given a checklist, which needs to be filled and submitted to DGM(F&S) for sharing the observations in the Shutdown review meeting.
10. Observations, unsafe conditions/practices and Safety Violations will be shared on daily basis at Shutdown Review Meeting.
11. Colour code for work permits(Yellow- Cold, Red- Hot & Green- Confined space). Ensure timely release of work permits.
12. On spot demonstrations and trainings during shut down period.
13. Ensure compliance to start up Clearance.
14. "COMMISSIONING CREW" stickers on helmets of personnel engaged during start up activities
15. 30 Nos. of stand alone gas detectors shall be installed at strategic location to checks for presence of any toxic/HC vapours beyond permissible limits.



Microsoft Excel
97-2003 Worksheet

Tier 3 - Electrical Safety Surveillance Team

1. Check for SMS (Sanitization, Masking & Social Distancing) for COVID-
2. Electrical equipment checking at site and sticker affixing
3. Check power connection from Electrical Substation to end use
4. Check for RCCB installation, Earthing/Bonding etc.
5. Random testing of RCCB/ELCB.
6. Overall Electrical Safety Compliance
7. Check for LOTO Compliance



Tier 4 – Surveillance by CISF (Fire Wing Personnel)

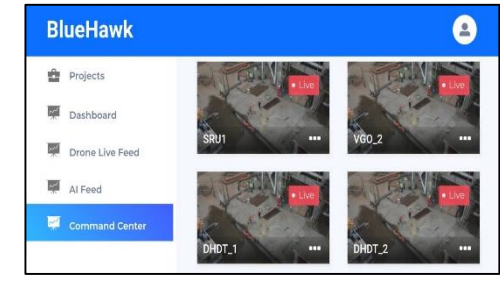
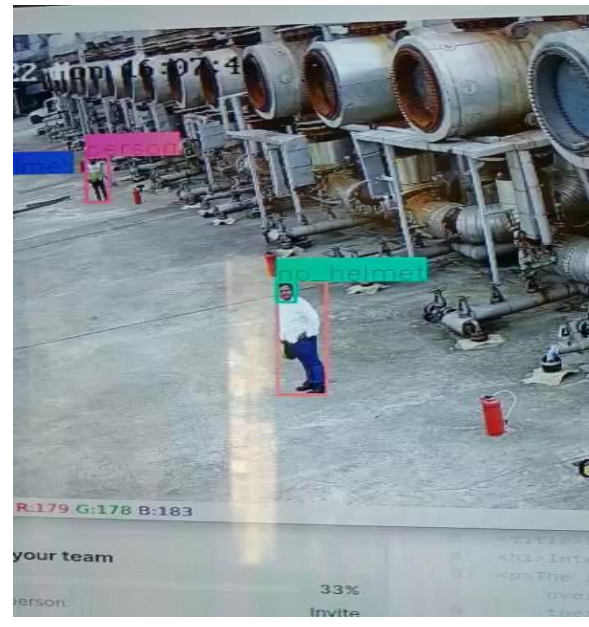
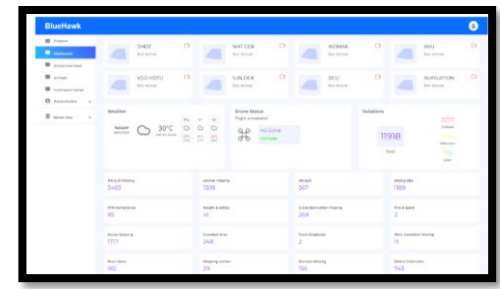
(Establishment of Temporary F&S Posts at Two Strategic Locations for quick response during any emergency and checking Fire Prevention Measures on Round-the-clock basis)

1. Check for SMS(Sanitization, Masking & Social Distancing) for COVID-19
2. Check for availability of work permit at site.
3. Safety surveillance by Quick response vehicle. Safety announcements from the QRV.
4. Special drives during lunch hours to ensure workers take rest at the designated locations
5. Provide standby duty during vapour line, flare line blinding/de blinding job, critical confined space jobs.
6. Ensure availability of fire tender along with crew for quick handling of any emergency.
7. Continuous support with BA set trolley for inert gas entry jobs.
8. On the spot training on Fire prevention and protection.
9. Issue F&S material on loan
10. Emergency handling and rescue.

Role & Responsibilities of Tier-5:Surveillance by Drone & AI Cameras

Tier 5 -Surveillance by Drone and Artificial Intelligence (AI) Enabled Cameras (Both fixed and movable) : (Through an expert agency exclusively lined up for Shutdown)

- 1. Installation of fixed camera at strategic location for continuous monitoring of unsafe act and conditions at critical jobs like working in Confined Spaces, difficult positions and at high elevations.
- 2. Generation of daily report based on AI based software/dashboard.
- 3. Surveillance through drone based camera for critical jobs at height and generation of report.
- 4. Compilation of compliance report and daily monitoring of compliance at site.



Special Initiatives Taken for Incident Free Shutdown

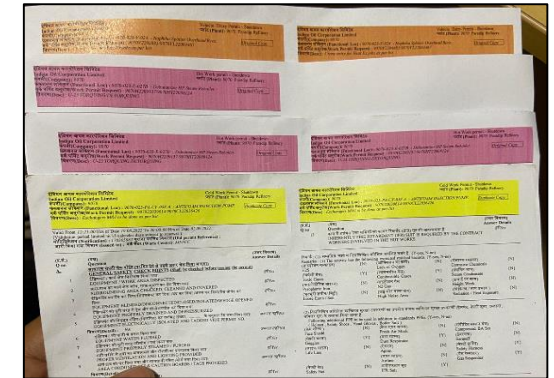
1. Special Shutdown Safety Sensitization Programme for Employees from all Departments organised from 19.07.2022 to 23.07.2022 with Faculty Assistance from Ex CGM(HSE)-Haldia Refinery.
2. Safety Theme for month of Aug-2022 taken as “Safety During Shutdown” and for September “Safety during Start-up”
3. Sharing of Incidents & Lessons Learn from PRPC, BGR, BR, HR & JR during last 5 years.
4. Wide scale publication of “15 Life Saving Safety Rules” which are non-negotiable and zero tolerance was practiced - communicated to all concerned in Hindi, English & Odia through Posters, Banners, Leaflets & Local Announcement.
5. Compliance to mandatory Covid Protocols at the time of entry inside the refinery premises.
6. Mandatory Inspection & Stickers on all Electrical & Mechanical Equipment, Heavy Vehicles Tools & Tackles brought by contractors for shutdown jobs. Material Gate Passes issued only after verification and stamping.
7. Mandatory compliance to IFR Coverall and Safety Shoes for all Employees and Contract Workers ensured.
8. Training to Contractor Supervisors of executing agencies on Critical Safety Points whose compliance is required at sites .
9. Implementation of RHQ Shutdown checklist in letter & spirit.
10. Implementation of RHQ SOP on Flange opening and flushing scheme.



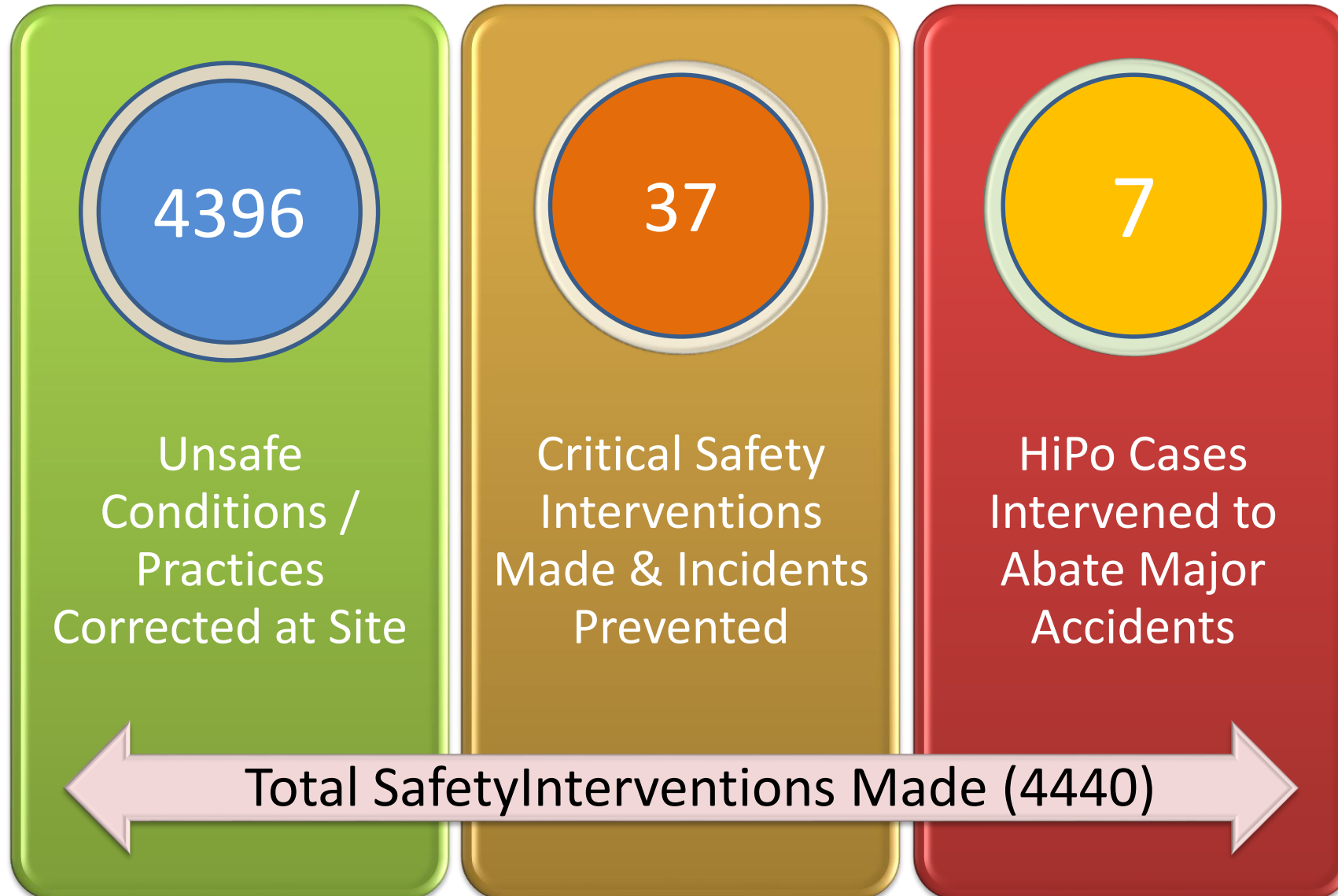
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Special Initiatives taken for Incident Free Shutdown

- ❖ Safety Induction for more than 13,000 workers
- ❖ Five-Tier Safety Surveillance system
- ❖ Job Safety Analysis of 104 critical jobs.
- ❖ AI based Drone mounted and fixed cameras for monitoring of safety violations.
- ❖ Sharing of daily Safety observation for immediate compliance
- ❖ Traffic Control at Gate no.-02 by deployment of safety supervisors along with CISF & HR Security.
- ❖ 24 X 7 manned Shutdown safety control room set up at 1st floor of South Fire Station
- ❖ Safety Meeting with Process licensors for enforcing safety in line with licensor requirements.
- ❖ Shutdown Training to 608 employees
- ❖ Joint gas test and blind checking for 291 nos. vessels/column prior to confined space entry.
- ❖ IFR suits for contract workers & other PPEs on round the clock basis.
- ❖ Availability of heat protective suits, chemical handling suits, Fire Proximity suits, Fall protection equipment, Safety Torches, Head Lamp, Gas Detectors, Area monitors etc. to attend critical jobs.
- ❖ Random inspection & Checking of lifting tools and tackles.
- ❖ Strict compliance of start-up clearance procedure before safe start up of units.



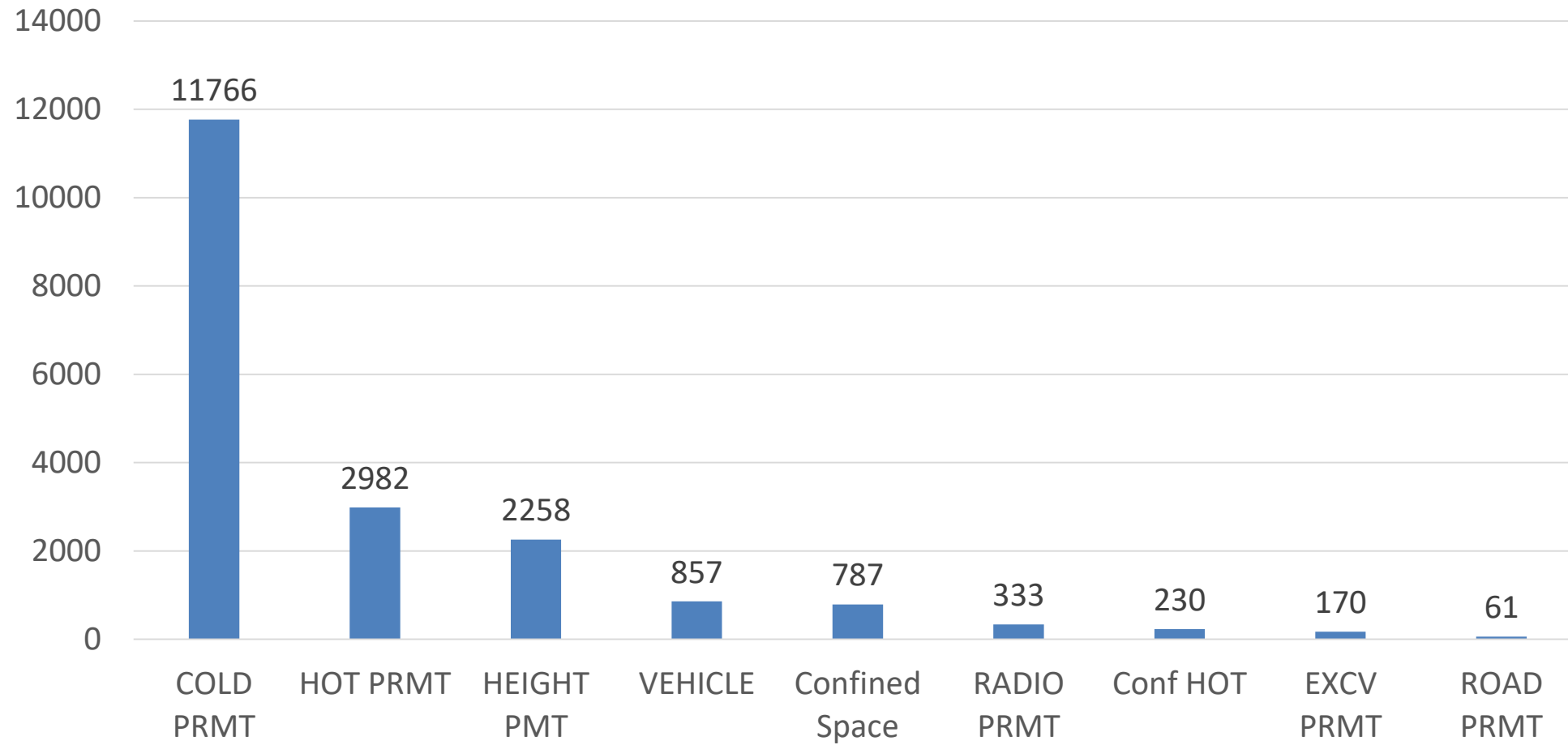
Safety Interventions Made during Shutdown



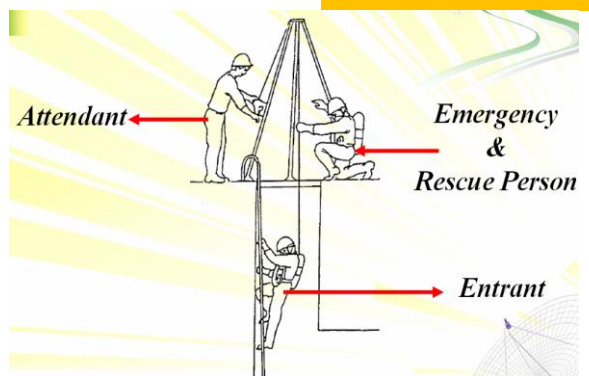
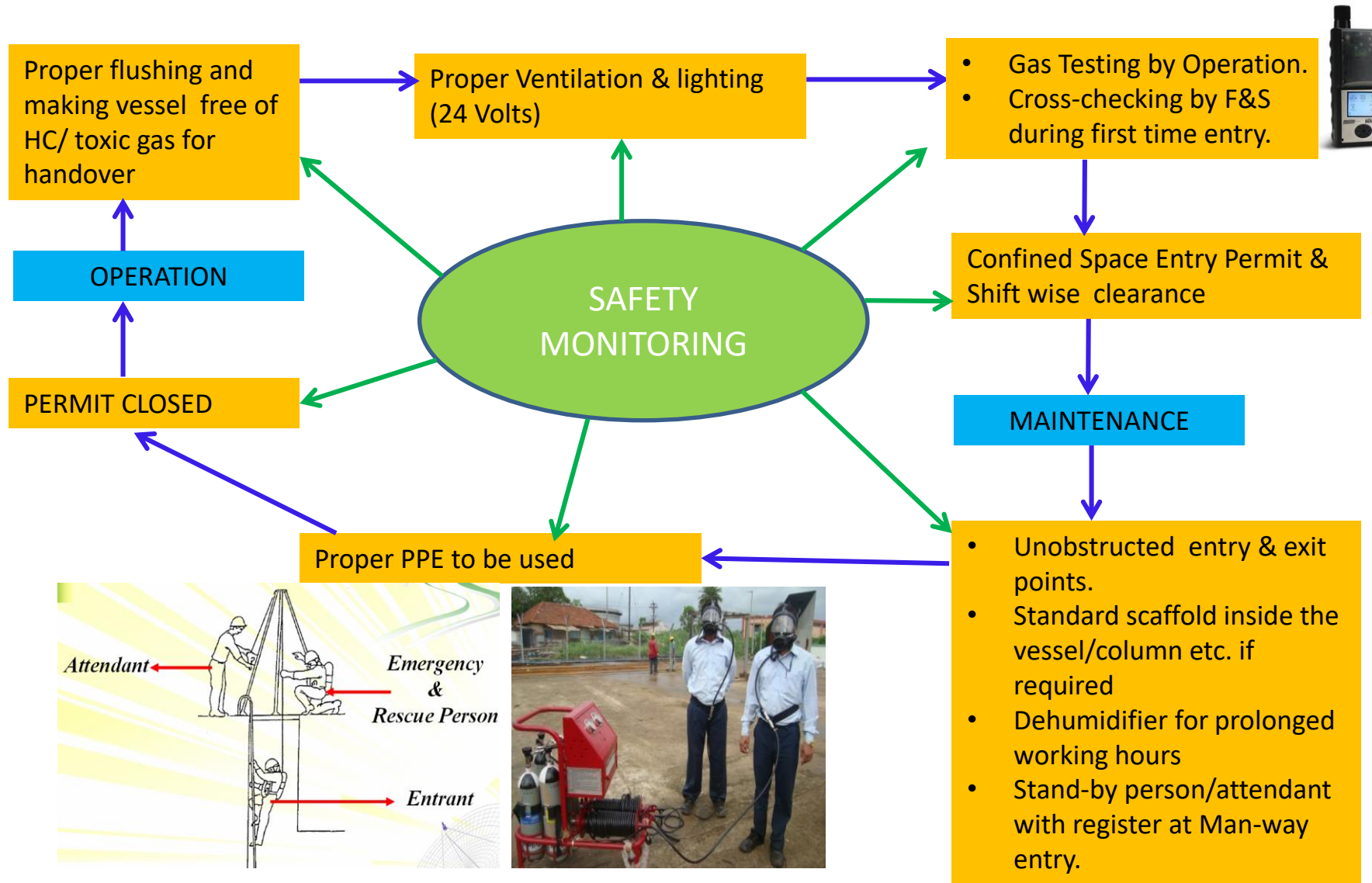
Microsoft Excel
Worksheet

Shutdown Permit Details

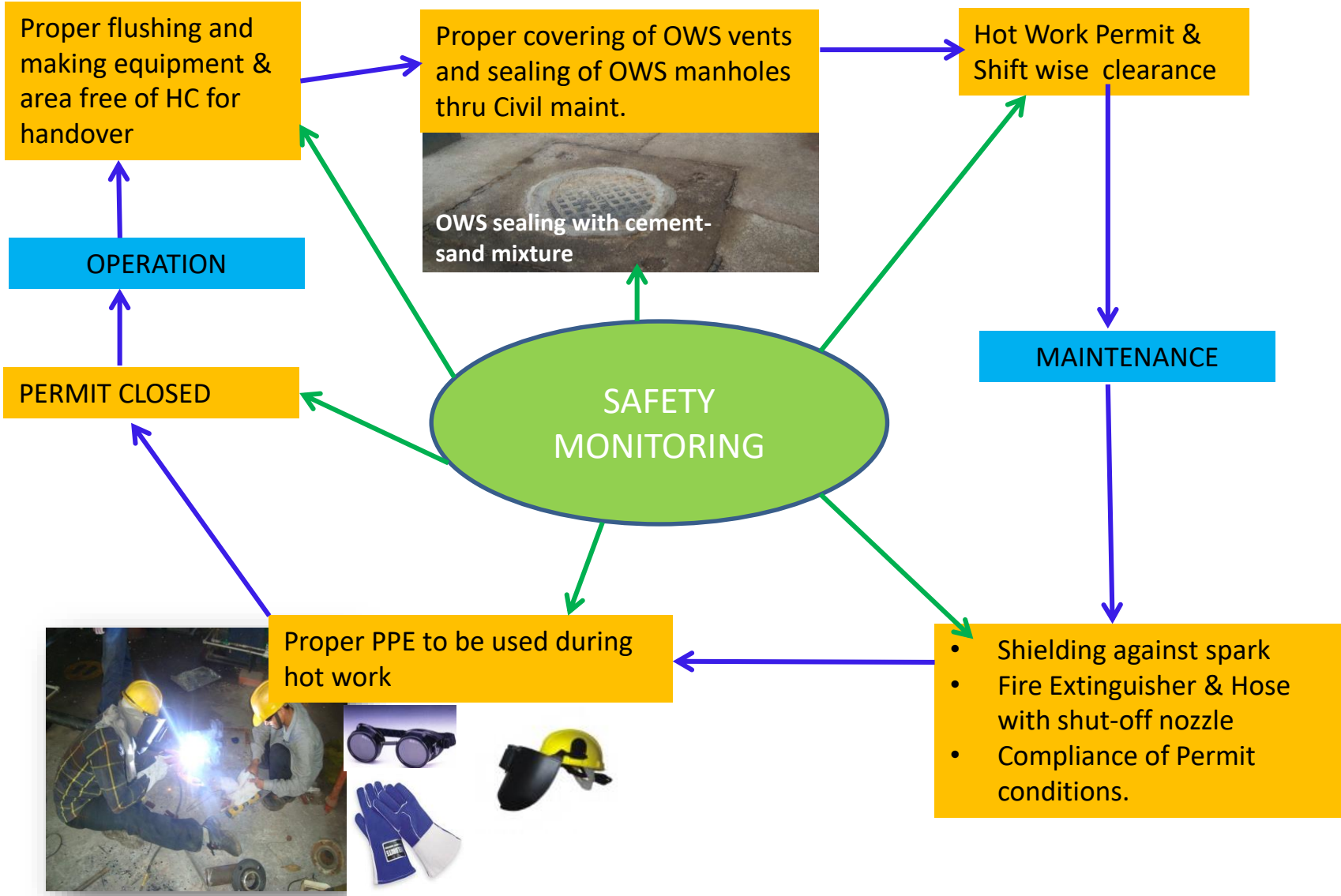
Total Permits	Clearances	Clr/Permit ratio%	Due for Closure	% Closure
19506	98408	504.5	8753	55.13



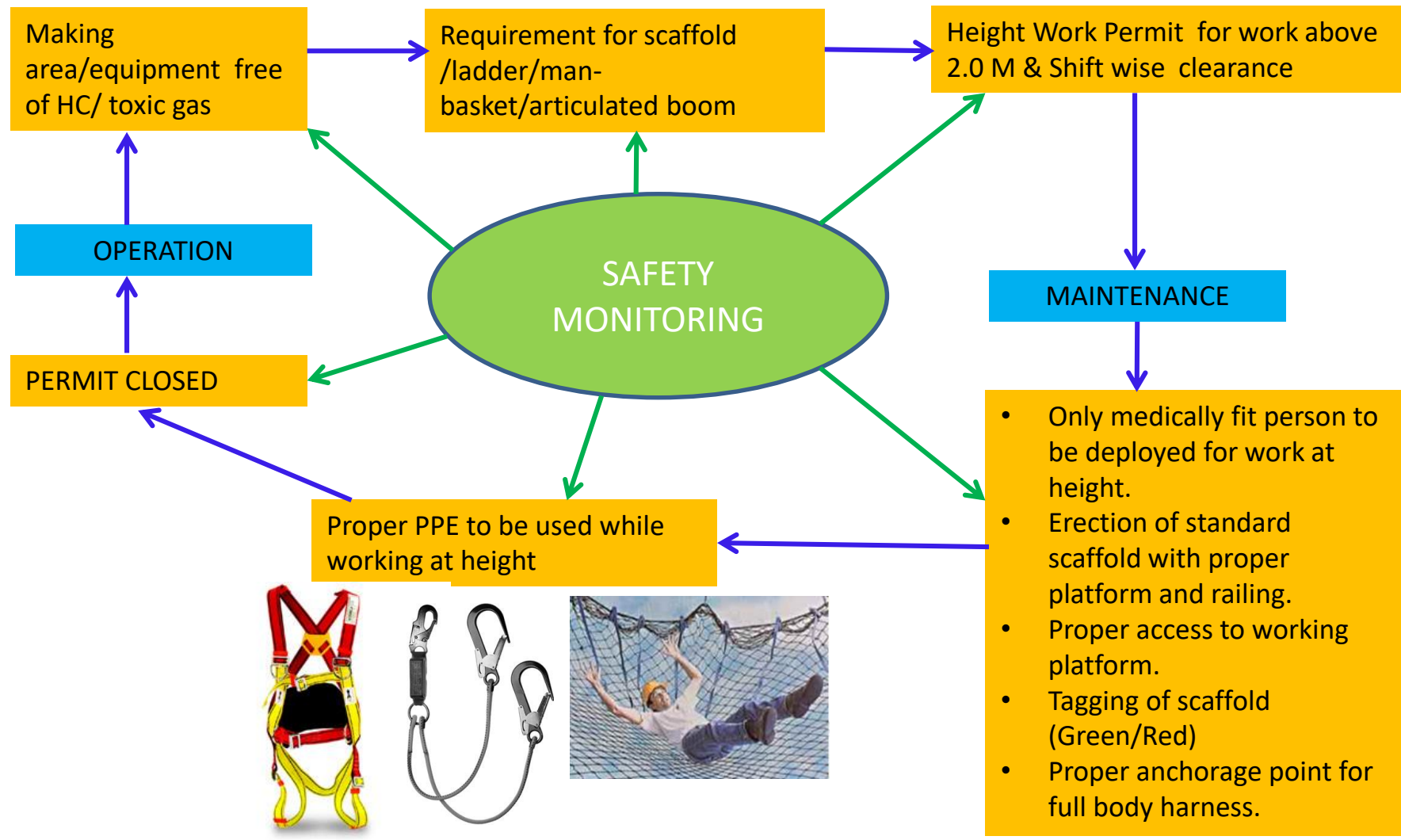
CONFINED SPACE SAFETY



HOT WORK SAFETY

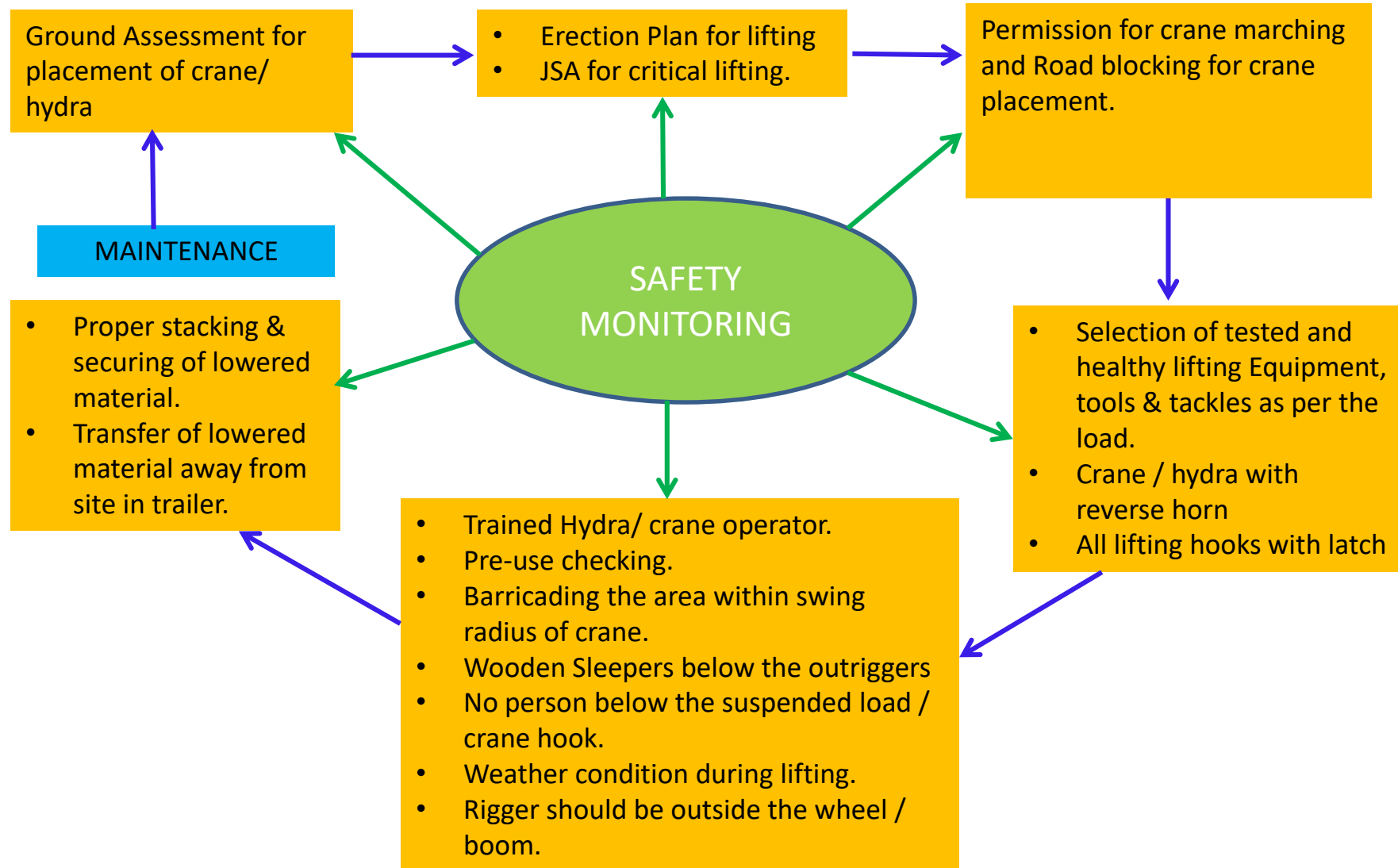


WORK AT HEIGHT SAFETY

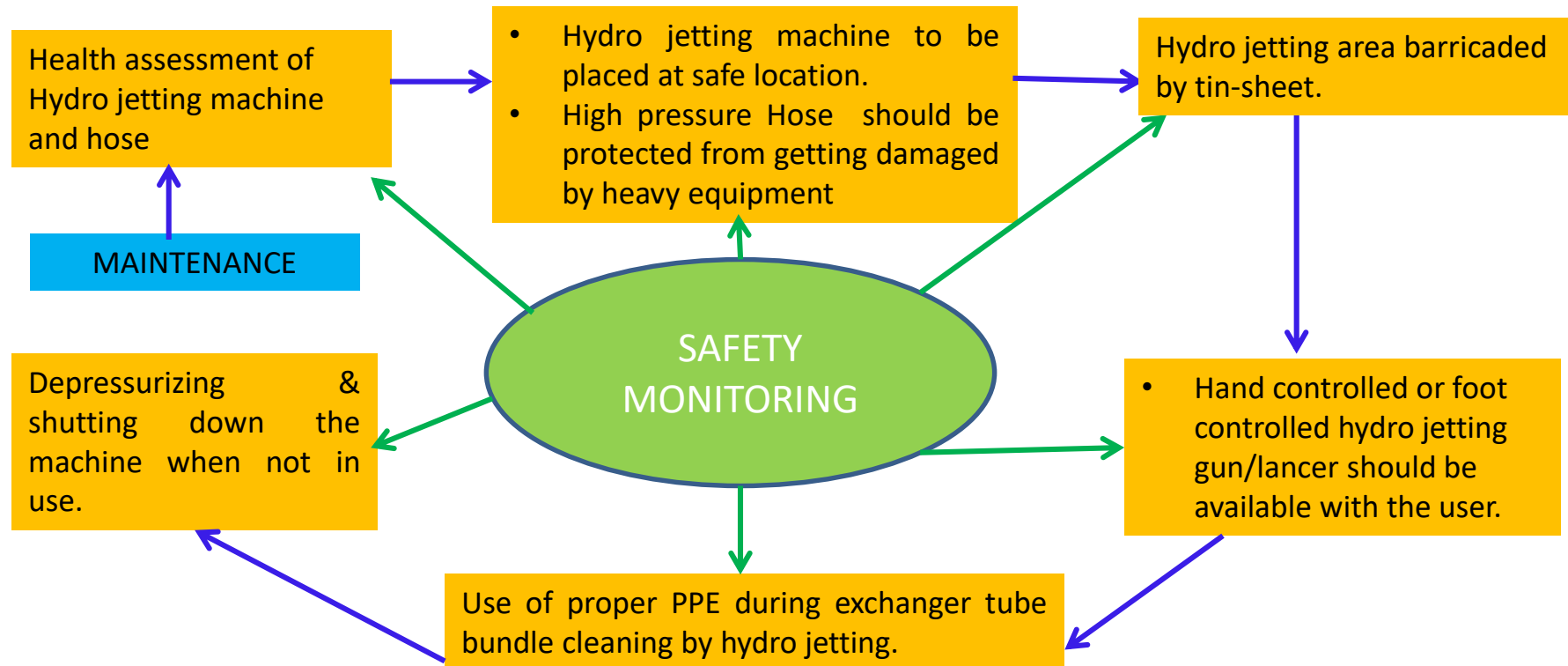


- Only medically fit person to be deployed for work at height.
- Erection of standard scaffold with proper platform and railing.
- Proper access to working platform.
- Tagging of scaffold (Green/Red)
- Proper anchorage point for full body harness.

Safety During Heavy Equipment Operation



Safety During High Pressure Hydro Jetting



Timely Support with F&S Equipment On-the Job

Equipment	Quantity
Ear Plug	945
Green tag	550
Red Tag	550
Dust Mask	277
Leather Gloves	150
Chemical Goggles	149
Delivery Fire Hose	130
Male Coupling	59
Barricading Tape	40
Safety Helmet	39
Safety goggles	35
PVC Gloves	34
Cotton Gloves	33
Safety Harness	29
Fire Blanket	28
Zone 0 torch	25

Equipment	Quantity
Nitrile Gloves	22
Ear Muff	20
Suction pipe	14
Canister mask	8
Chemical Suit	6
Female coupling	6
Noise Meter	6
Welding face sheild	5
Nozzle	5
Rope Ladder	4
Fire fighting suit	4
Head lamp	4
Teal Suit	4
Dewatering pump	3
Pelicon Tournch	3
Gum boot	3
Fall arrestor	2
Fire extinguisher	2
Safety net	2
Steam Suit	2
Heat resistance gloves	2

Gas Detector	Quantity
H2S Gas Detector	11
Multi Gas Detector	8
CO Gas Detector	2
Area monitor	2
Oxygen Gas Detector	1

Glimpses for Shutdown Activities

- Total 119 Job safety analysis performed for the shutdown activities and job completed safely.
- Safety Meeting with Process licensor for safe execution of the job and enforcing safety precaution in line with licensor requirement additional to existing safety rules.
- Daily interaction with safety supervisors, Agencies Head and closed monitoring of critical jobs.
- On the spot safety briefing by DGM (F&S) and other fire and safety personnel.
- Ensured compliance of IFR for all hot job activities.
- 24 X 7 manned Shutdown safety control room set up at 1st floor of South Fire Station for registering permit, issuing PPEs, providing assistance with safety gadgets and issuing of gas detectors round the clock

Steps to Ensure Incident Free Shutdown

Actions by Operating Personnel (A/B/C-Line managers)

1. Ensure positive isolation of equipment/circuit as per the blind list.
2. Ensure the equipment/ circuit is gas free.
3. Ensure sealing of all OWS funnels/pits & drains
4. Issue of hot work/Confined space permit after cross checking of H-C for each job.
5. Ensure availability of Gas detectors in working condition.
6. Explain the potential hazards to the executing department & Specify the requirement of appropriate PPE.
7. Ensure periodic gas test of confined space & record.
8. Ensure all precautions are taken for handling pyrophoric iron.
9. Take all precautions while working in inert atmosphere.
10. Ensure display of de-energization tags at individual motors & at Sub-stations.
11. Ensure that Radiography permit is issued during lean period & announcement is made.
12. Ensure availability of emergency lights.

Steps to Ensure Incident Free Shutdown

Action by Operating Personnel (Sectional Head / Middle Management)

1. Ensure availability of equipment/circuit wise blind/de-blind list.
2. Ensure blinding of flare lines at the unit battery area.
3. Random checking of positive isolation & gas freeness of critical equipment/circuit.
4. Carryout random checking of critical hot jobs, jobs at height & in confined space.
5. Preparation of pre start up checklist.

Action by Execution Department :

- ❖ Ensure availability of valid work permit & clearance before start of work.
- ❖ Ensure installation of ELCB on electrical distribution board.
- ❖ Ensure that the lifting machine, tools & tackles are properly tested & date of testing is displayed on the equipment.

EIC to keep a copy of test certificate of tools & tackles. F&S will conduct random checking at site.

- ❖ Ensure that skilled workers are employed for critical jobs.
- ❖ Ensure that medical fitness of workers engaged for working at height is available.
- ❖ Impart toll box talk prior to start of the job.
- ❖ Ensure presence of standby person with life line at man way in case of confined space entry.
- ❖ Prior identification of locations for working at height. A list to be displayed at the shutdown office.
- ❖ Ensure availability of required Fall protection devices
- ❖ Safe disposal of pyrophoric iron /scales.
- ❖ Maintain good housekeeping & area cleaning

Action by Execution Department :

- ❖ Ensure erection of proper scaffolding & “FIT FOR USE” tag is displayed.
- ❖ Model Scaffolding is to be erected at different units.
- ❖ EIC to issue “FIT FOR USE” tags. F&S will carry out random checking of the erected scaffolding.
- ❖ Prepare erection, dismantling & safety plan for work at high altitudes
- ❖ Ensure 100% compliance of PPE & IFR clothing
- ❖ Maintain good housekeeping & area cleaning

The shutdown procedure should generally include the following sequences:

- Cooling and depressurizing the system.
- Pumping out the system.
- Removal of corrosive or poisonous material.
- Removal of water
- Blinding and opening.
- Decontamination, Removal of Pyrophoric iron sulphide.
- Inspection for entering.

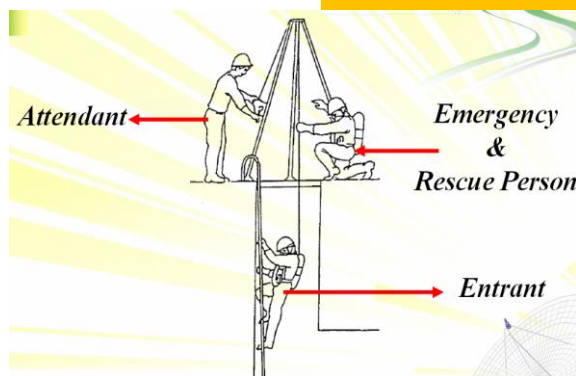
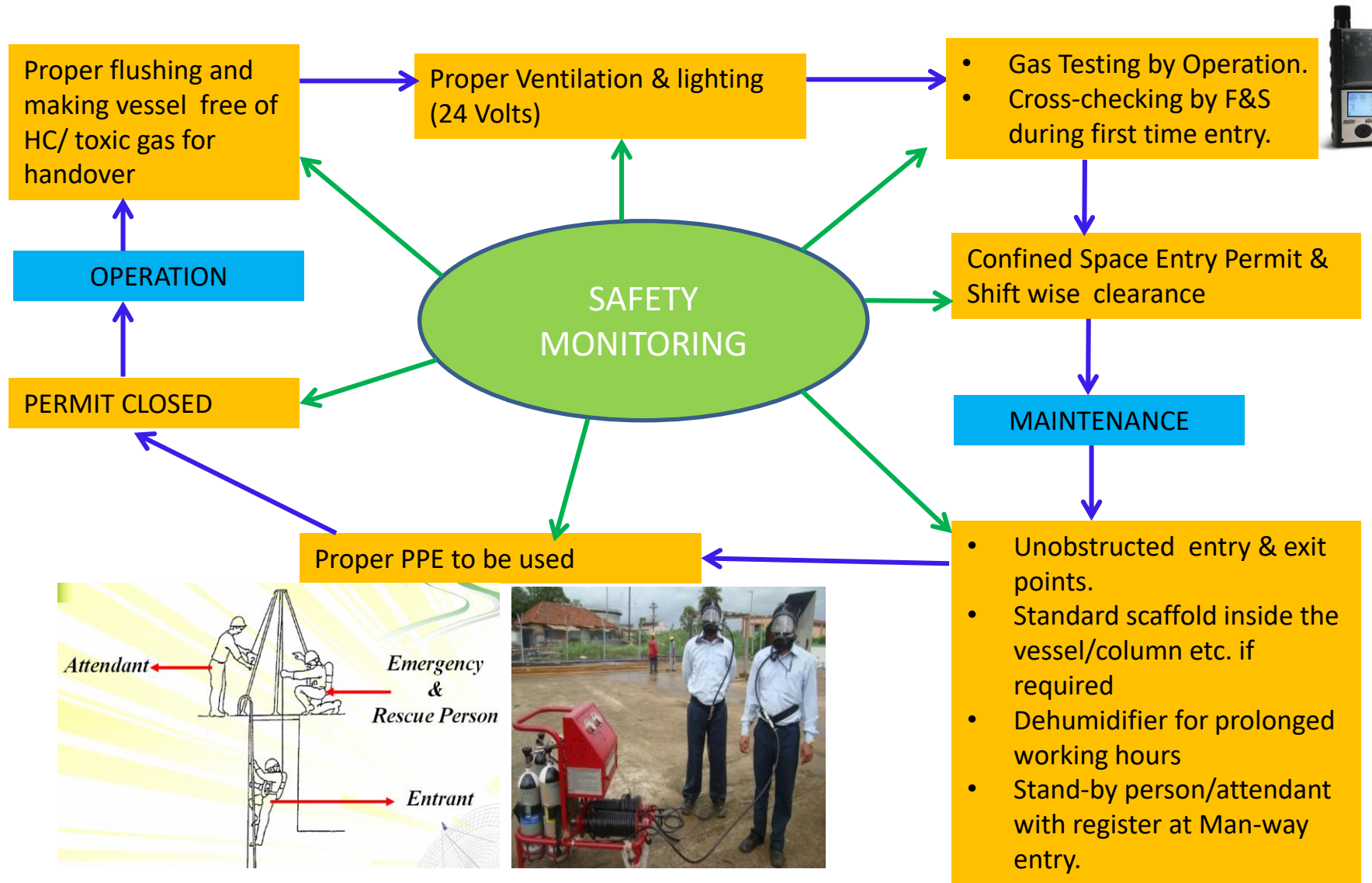


Sources of Accidents & Fire During Shutdown

- Improper Blinding Of Hydrocarbon Lines.
- Improper Sealing Of OWS.
- Improper Barricading Of Hot Job Area.
- Improper Scaffolding.
- Improper Work At Height Activities.
- Improper Erection.
- Improper Tools And Tackles.
- Misuse Of Utility Lines.
- Use Of Defective Electrical Equipment.
- Improper Gas Cutting Set.
- Improper Material Handling.
- Non Compliance Of Work Permit System



CONFINED SPACE SAFETY



Near Miss Incident in Confined Space

Incident: While working inside the VDU-II main column, one worker suddenly became unconscious.

Root Cause:

- Fatigue due to continuous working inside confined space.
- Improper air circulation.

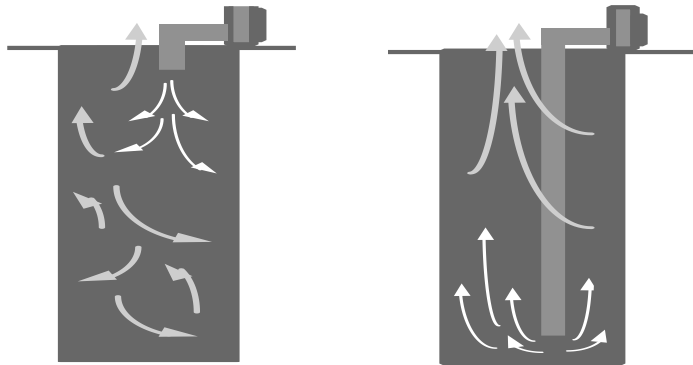
Lessons Learnt:

Ventilation / air circulation to be maintained during confined space entry.



Ventilation inside Confined Spaces

- Blowers & fans provide mechanical dilution ventilation.
- Be sure the blower is appropriately sized, explosion-proof, and its intake is placed far enough away from any source of contamination - like an exhaust pipe on a vehicle!
- A space under positive pressure will eventually expel the contaminant through an opening but the time it takes is the real question.
- Localized exhaust ventilation is better suited to capture fumes (welding), dust and chemical contaminants.



Remember, purging a space with an inert gas expels a flammable but leaves no oxygen.



Ventilation must be continuous when there is an existing or potential atmospheric hazard.

Fatal Accidents In Confined Space

Date & Time	Incident	Root Cause	Lessons Learnt
16.10.2013 15:20 hrs.	Fatal accident of two contract workers at MR due to Nitrogen Asphyxiation while cleaning of Reflux vessel Propane Recovery Unit.	Nitrogen hose placed inside the vessel in place of air hose	<ul style="list-style-type: none"> ➤ Proper tagging/ stenciling / colour coding of N2 utility point. ➤ Different type of fitting for N2 utility point to eliminate chance of error. ➤ Hose connection should be done in presence of operation.
	Fatal accident due to exposure to H2S at MR while cleaning acid gas knock out vessel with hydro jetting to dechoke bottom drain.	<ul style="list-style-type: none"> ➤ Inadequate Awareness and deficient assessment of situation. ➤ Inadequate Job Procedure. ➤ Improper Blinding. ➤ Inadequate training for contractor workmen. 	<ul style="list-style-type: none"> ➤ Ensure Positive isolation of the equipment prior to opening the vessel. ➤ Carry out job safety analysis for all critical jobs prior to issue of the permit. ➤ Awareness to be increased regarding confined space hazard. Even inserting head inside the confined space is considered as Confined Space Entry. ➤ Blind register to be maintained properly.



Person might have carried out the hydro jetting operation in the posture as depicted above.
(Photograph taken only for reconstructing the event)



(PSV discharge line of the vessel to Flare)
Bypass valve not blinded prior to opening the vessel

Fall From height in A confined Space

The Incident

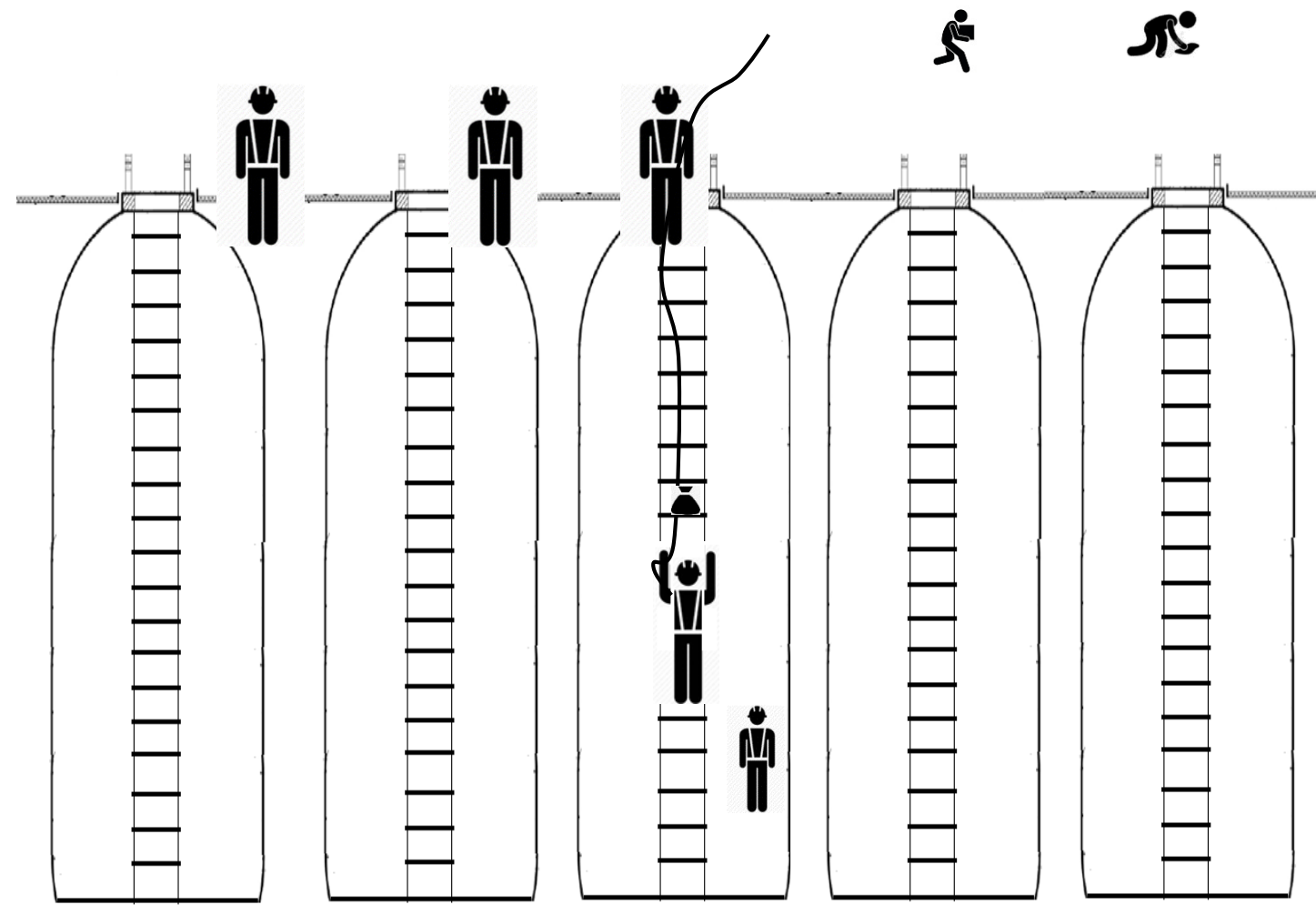
- Scaffolding erection around PSA vessels were carried for unloading/ loading job.
- All PSA vessels catalyst unloading and cleaning job started on 18.02.2019 and got completed on 24.02.2019. These jobs were executed by M/s Kliff.
- On 25.02.2019 at 15.45 Hrs, M/s UOP (Licensor) representative went inside the vessel V-326 through rope ladder, inspected vessel, came out at 15.55 Hrs and asked for further cleaning of vessel.
- On 25.02.2019 at 16.15 Hrs, Inspection engineer entered inside the vessel through same rope ladder for inspection & NDT (DP Test) wearing safety harness along with life line.
- One additional inspection engineer was outside the vessel V-326 along with Sh. Shyam of M/s Kliff.
- Immediately after landing of IPE, Late Sh. Vipul Shukla of M/s Radiant went inside the vessel through same rope ladder wearing safety harness along with life line.

Fall From height in A confined Space

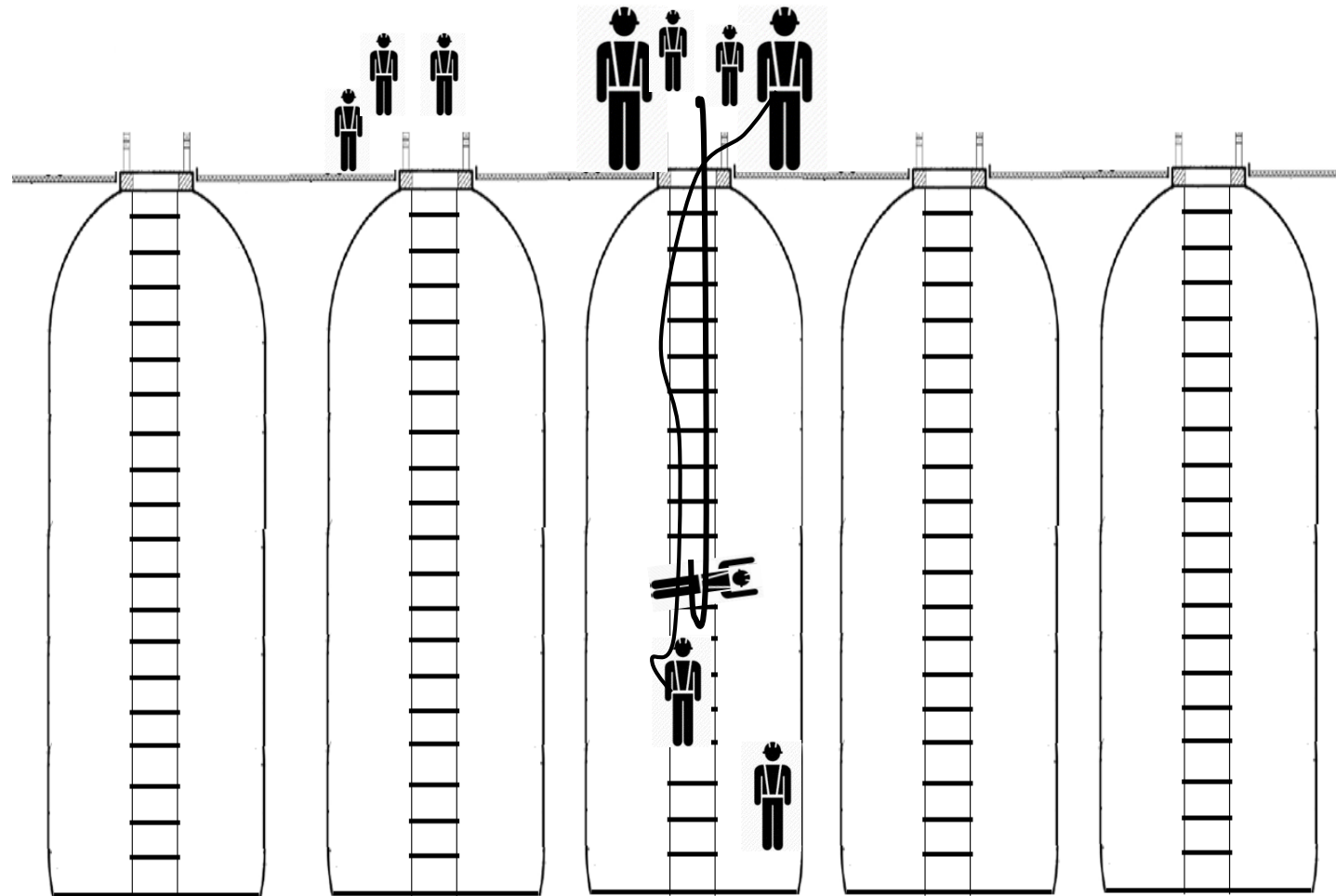
- One additional worker of M/s Radiant was outside the vessel as stand by person.
- At around 16.35 Hrs, IPE came out of the vessel using same life line along with safety harness.
- As soon as IPE came out of the vessel, Worker of M/s Kliff working as stand by saw that Late Shri Vipul Shukla has already climbed up to middle of the vessel without using life line.
- At the same moment, Late Shri Vipul Shukla got slipped and fell down inside the vessel at around 16.41 Hrs.



After performing DP test, Inspection engineer started climbing up using safety harness with life line. Material was tied with his life line



The person was taken out by securing life line to his safety harness.



The immediate cause of death of the deceased Shri Shukla was the head injury caused by fall from height and detachment of the helmet from his head.

The simultaneous use of the rope ladder while climbing up might have led to abnormal swings of the rope ladder and resultant imbalance and loss of grip on the ladder by the deceased causing his fall.

The fall from the rope ladder from height of about 5-6 meter to the bottom of vessel was due to the fact that the deceased apparently removed his tagline from the safety harness.

Recommendations

- **Work Permit Issuer & Receiver must ensure to depute two stand by person outside confined space entry point and shall explain safety conditions to enter inside confined space & associated hazards to the stand by persons, special hazards for entry/ exit.**
- **Proper location and job specific JSA should be carried out for all the confined space entry jobs by multidisciplinary team.**
- **To avoid intra/inter departmental communication gap, Job specific permits should be taken for all the individual jobs carried out inside confined space.**
- **Job safety analysis (JSA) submitted by any contractor or agency shall be used as reference only. JSA for any critical activity to be done by IOCL multidisciplinary group.**
- **Minimum test parameters shall be freezed for medical examination to work inside confined space and to work at height.**

Recommendations

- The person to enter confined space shall read these conditions and shall clearly write “I have read and understood the safety conditions & associated hazards to work inside confined space and agree to abide”. This statement shall be written in a register kept with standby person. Record of entry/ exit of every entrant to be maintained in the same register. Format for maintaining record in register is proposed as:

SN	Permit No.	Name of entrant	Agency Name	Medically Fit Yes/ No	Declaration statement as stated above	Entry time	Sign	Exit time	Sign	Sign of Standby person

Near Miss Incident in Confined Space jobs

Incident : Connection of nitrogen hose instead of air hose for ventilation purpose. It was discovered on time, accident avoided

LESSONS LEARNT :

- Proper color coding and tagging (Nitrogen Line : Silver white & Air Line : Green)
- Warning signs on nitrogen utility point.
- Nitrogen line to be blinded with flange type fittings.
- Nitrogen points to be kept out of reach.



Near Miss Incident in Confined Space jobs

Incident: Confined space entry job was observed carried out in one vessel. All workers involved in men entry job didn't have specialized confined space entry training card. No fall protection safety arrangements provided at site like full body harness, fall arrester & life line. Column tray removed and kept at platform, which is obstructing free movement at platform No separate register/booklet maintained for In/Out entry record. Approved JSA copy not found with permit.



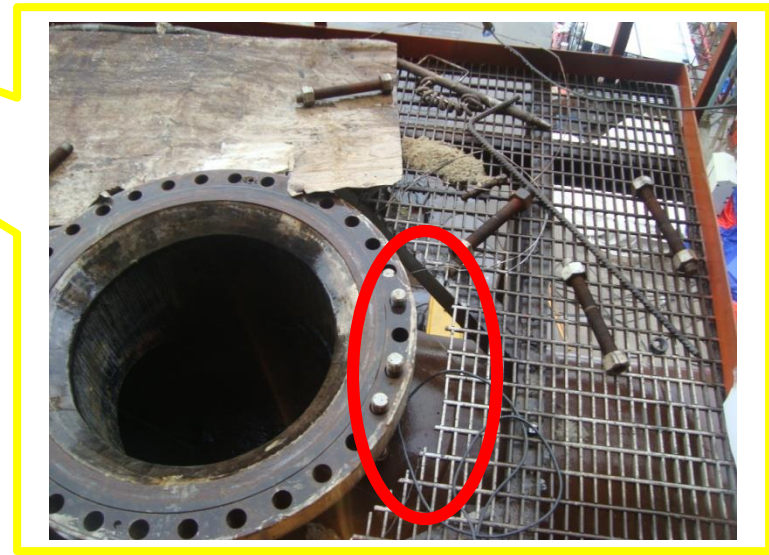
Root Cause:-

1. Lack of supervision by agency supervisor.
2. Non compliance of confined space entry permit.
3. Non use of fall protection devices.

Lesson Learnt

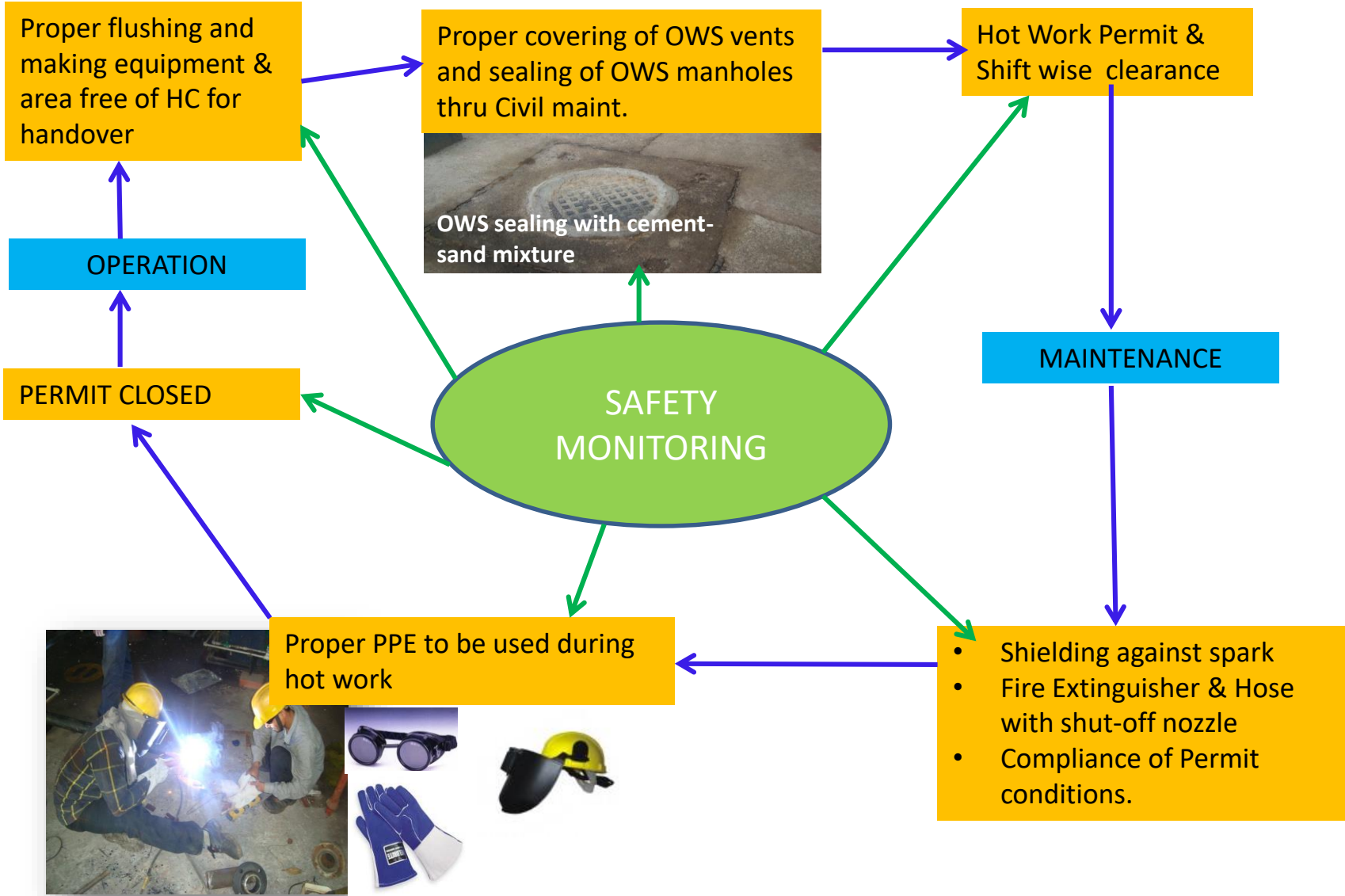
1. The job shall all be carried out using the fall protection devices to prevent from free fall and injuries.
2. Workers shall undergo special training and get them validated for working in confined space.
3. Entry/exit manhole of the confined space shall be kept free from any obstruction for easy movement as well as any rescue activity if required.
4. Each entry and exit time shall be recorded in confined space entry register.

INCIDENT OF FALL OF OBJECTS FROM UPPER PLATFORM DURING S/D



Narrow escape due to fall of nut bolts from height

HOT WORK SAFETY



Fire Incident at ETP area

Date & Time of Incident : 07.01.2020 @ 11:47 Hrs.

Location : Mathura Refinery – ETP

- fit up job between pre-fabricated spool (8") of about 3 meter length and existing spent caustic line was in progress.

Chronology of events leading to the Incident

- VOC system was installed on Industrial Sewer (IS) sump about 2 months back. During erection of VOC system, a beam was installed at wall of the sump which was fouling with the existing spent caustic line, was removed by cold cutting to install the beam on the sump wall.
- For erection of pre-fabricated spool piece, the left over elbow of old Spent caustic header was removed by gas cutting at around 11:00 Hrs. on 07.01.2020.
- The side cover of VOC system over IS sump was removed for placing of the pre-fabricated spool.
- The fit up job between pre-fabricated spool (8") of about 3 meter length and existing spent caustic line was in progress.
- For alignment of the spool, cleat tack welding was initiated, the spark generated and resulted into fire at 11:47 hrs.



**Another fire incident was reported at around 16:43 Hrs at the same location which fire fighting team extinguished instantly. The reason of second fire incident was suspected to be spark generation in burnt cables of IS Oil Skimming pump, which was operated in the meantime*

Fire Incident at ETP area

Basic Cause :

- HC Vapour from IS Sump and generation of spark either by tack welding or by striking of welding holder with metal during alignment of spent caustic line resulting in fire.

Contributory Causes :

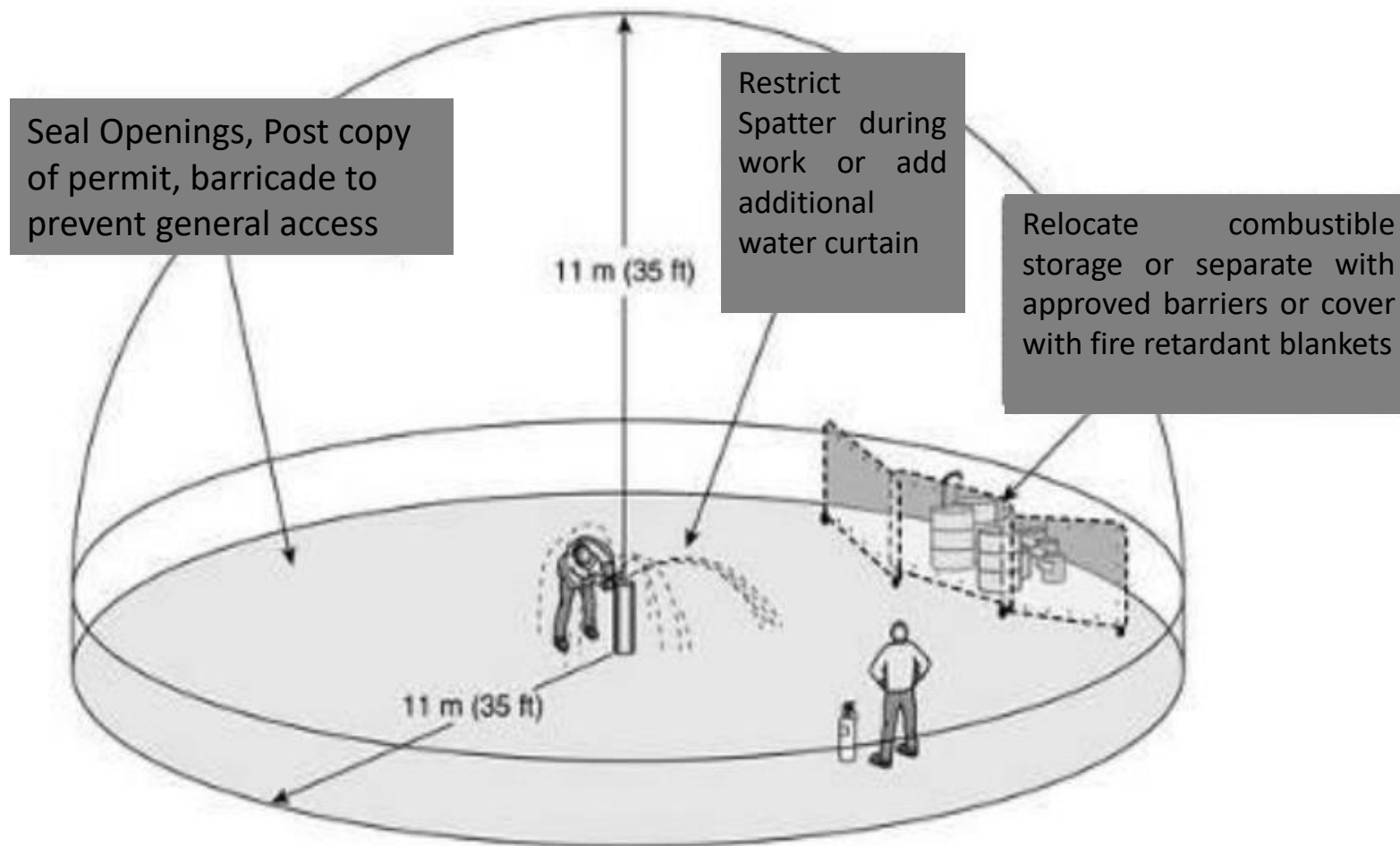
- Common Work permit was issued for ETP Modernization work for piping erection in ETP plant area. However, no specific hot work permit was issued for replacement of Spent Caustic line to IS Sump.
- Gas Testing before start of hot work was not evidenced.
- Job Safety Analysis (JSA) was not conducted before the execution of the job.
- Tool Box talk for this specific job was not conducted.

Fire Incident at ETP area

Lessons Learned

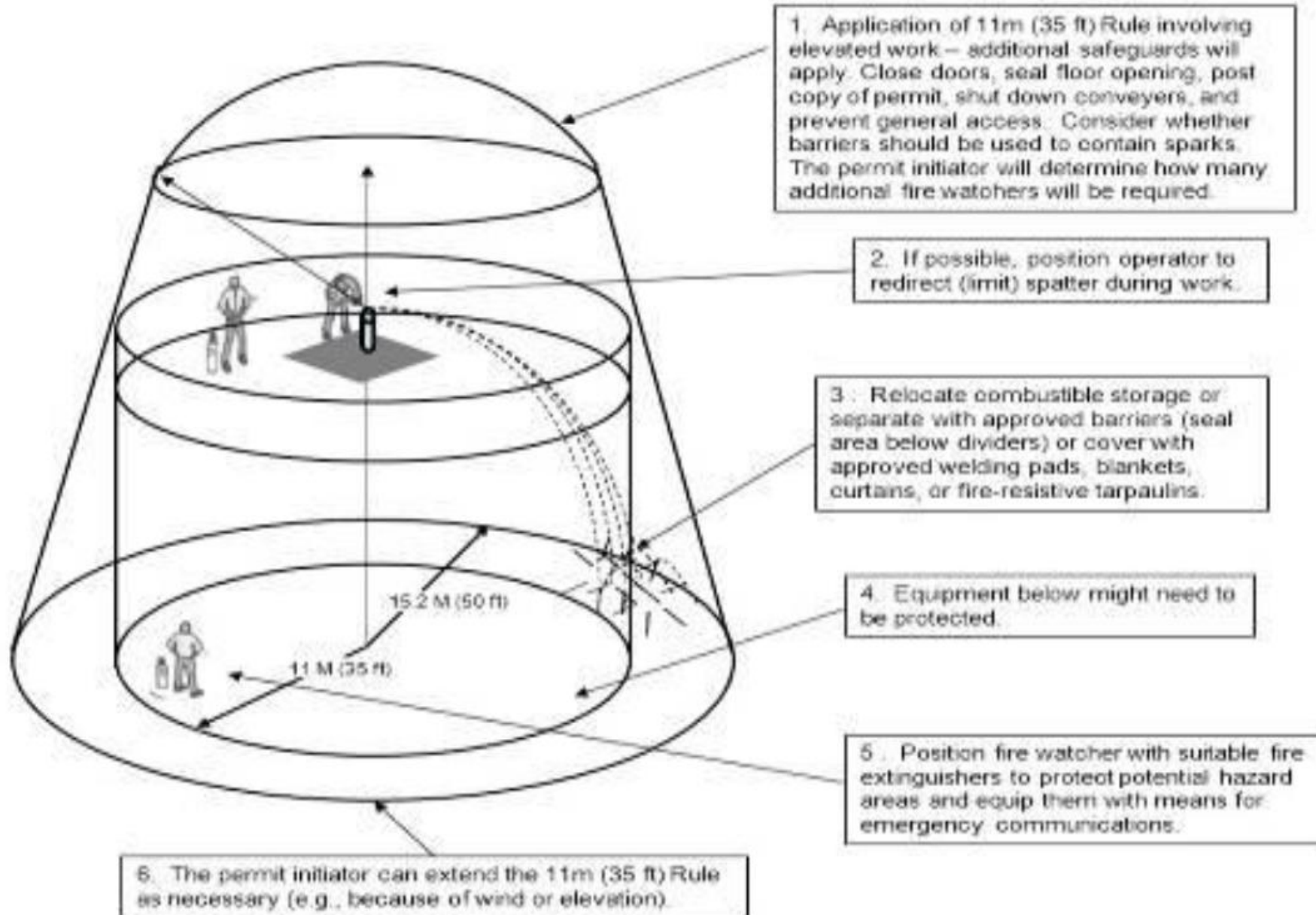
- Work permit should be taken for specific jobs and it must have clear and complete description of the work.
- Job safety Analysis shall be necessarily conducted for all critical hot jobs.
- Tool Box talk shall be given for the specific job.
- Mandatory Gas Testing before hot job to be done.
- Continuous monitoring of HC Vapors / toxic gases shall be ensured while carrying out hot jobs in plants under operation.

General Rules for Hot Work



Ensure availability of Fire Extinguisher, Fire water and if needed position fire watch to protect from potential hazard

General Rules for Hot Work



FLASHBACK IN THE GAS CUTTING TORCH

INCIDENT:

Flashback causing rupturing of mixture chamber. Had flashback arrestor not been used, it would have led to explosion in cylinder.



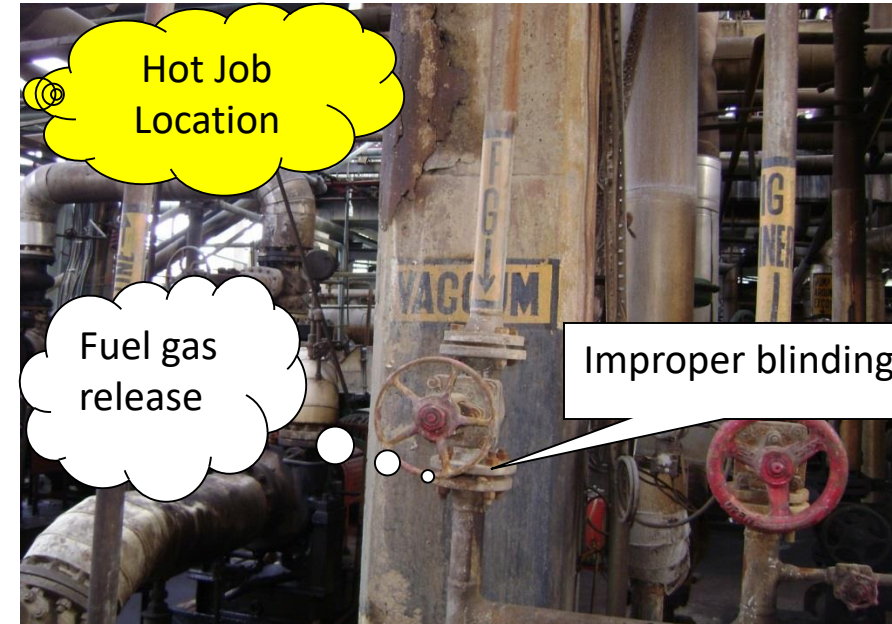
LESSON LEARNT:

Never light your torch with a mixture of fuel and oxygen. After purging the lines, light the torch with only the fuel gas valve open. Always ensure use of Flash Back Arrestor at Torch end & cylinder end.

IMPROPER BLINDING

Incident: Improper blinding led to fire from hot job nearby. Three cases of similar nature took place.

Root Cause : Fuel gas line was isolated by block valve and blinded by a tail blind still fuel gas was slightly passing.



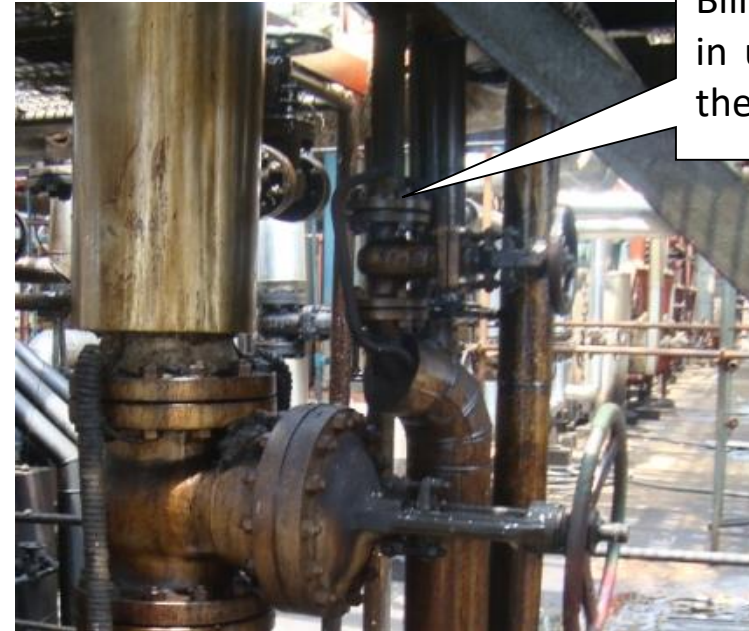
LESSON LEARNT: Proper blinding with proper gasket. Do not rely entirely on block valves, also ensure for positive isolation by blinds.

IMPROPER BLINDING

Incident : Fuel Gas leak from flange while deblinding during the startup of on of the unit.

Root Cause:

Blinding done in the upstream of valve.



Blinding done in upstream of the valve.

Lesson Learnt: Blinding to be done in the downstream of valve under proper supervision of Production/Mech Maint.

IMPROPER BLINDING

Incident:

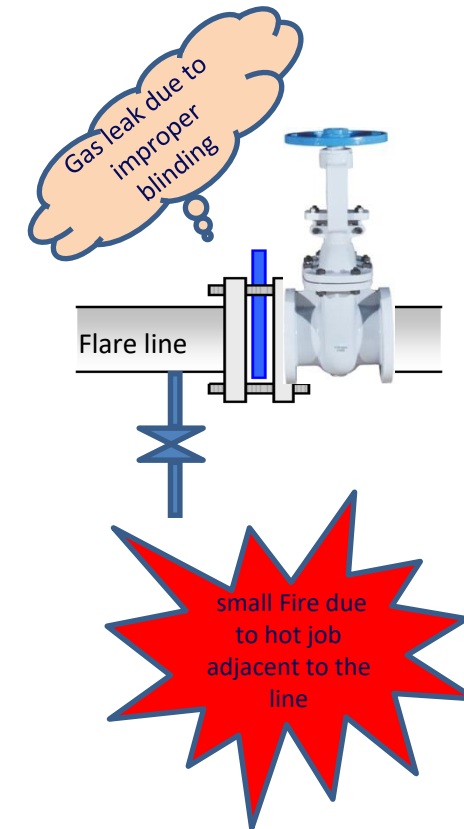
While doing grinding job at newly welded drain line on new portion of Flare line in CDU-II, there was fire at the adjacent blinded flange.

Root Cause:

Blind was not properly tightened causing some gas from flare line to be released which ignited from the sparks from grinding job.

Lessons Learnt:

Blinds to be properly tightened and gas test done before allowing hot work in the vicinity.



IMPROPER BLINDING

Incident: Fire at blinded flange in off-gas line connected to a process column at an height of approx 15 m near PSV technical structure.

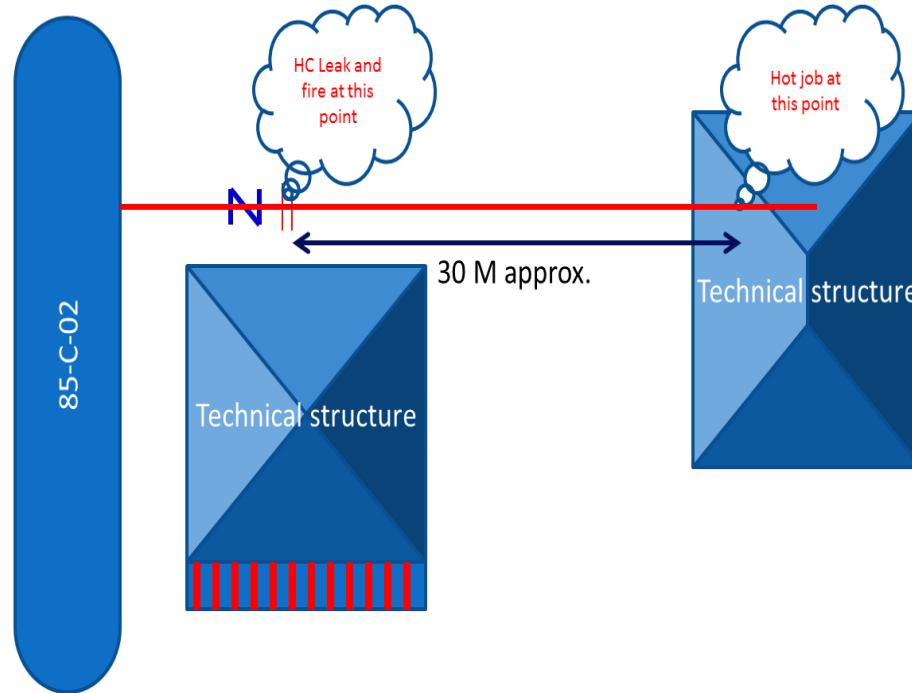
Root Cause:

Carryover of hydrocarbon from C-02 side to hot job point due to:

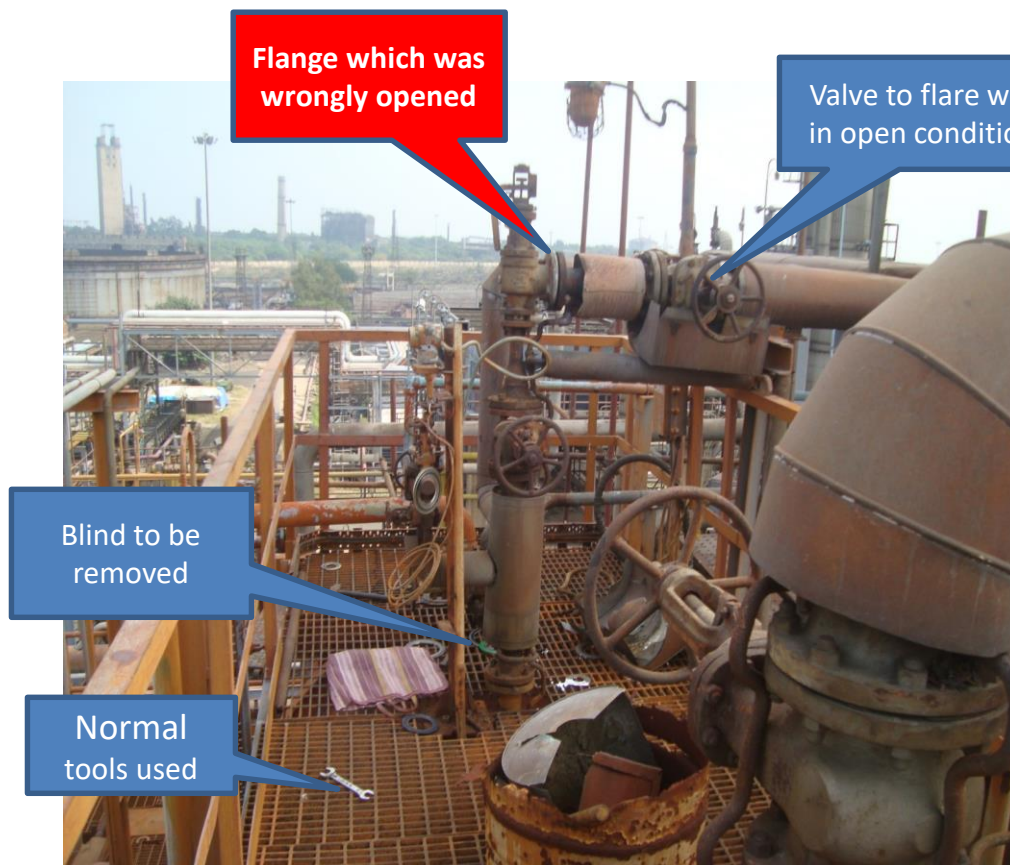
- Improper blinding
- stoppage of steaming

Lessons Learnt:

Proper blinding to be ensured before hot job.



IMPROPER DE-BLINDING



Incident: Wrong opening of PSV flange with flare valve in open condition resulting in flash fire.

Root Cause:

- De blinding job was issued in the permit but actual job location was not shown as the same contract workmen did the blinding job.
- Same contractor with different workmen could not assess the blinding positions.
- Due to use of normal tool, spark led to flash fire.

LESSONS LEARNT

- Always ensure such critical job to be done in supervision of production & Maint.
- Ensure use of non sparking tools.

Insecure Scaffolding Work Platform

Date : 19.03.2018
Time : 16:00 hrs.
Location : FCCU, 23-AC-15 Platform

During shutdown activities, one of the technicians of M/s CORROSONIC was preparing for thickness survey of the inlet line of 23-AC-15. While climbing on to the scaffold platform at the elevated location about 37 mtr. at 23-AC-15, suddenly the technician got imbalanced as he placed his leg on one side of the scaffolding platform (Jaali) & the Jalli got lifted & tilted to one side as it was not fixed properly.

The platform (Jaali) was tied with the pipe in one side only and the other side was not tied with the scaffolding pipes. However, a green tag was found fixed on the scaffold pipe.

Fortunately, the technician was saved from a imminent fall accident.

Root cause of the incident:

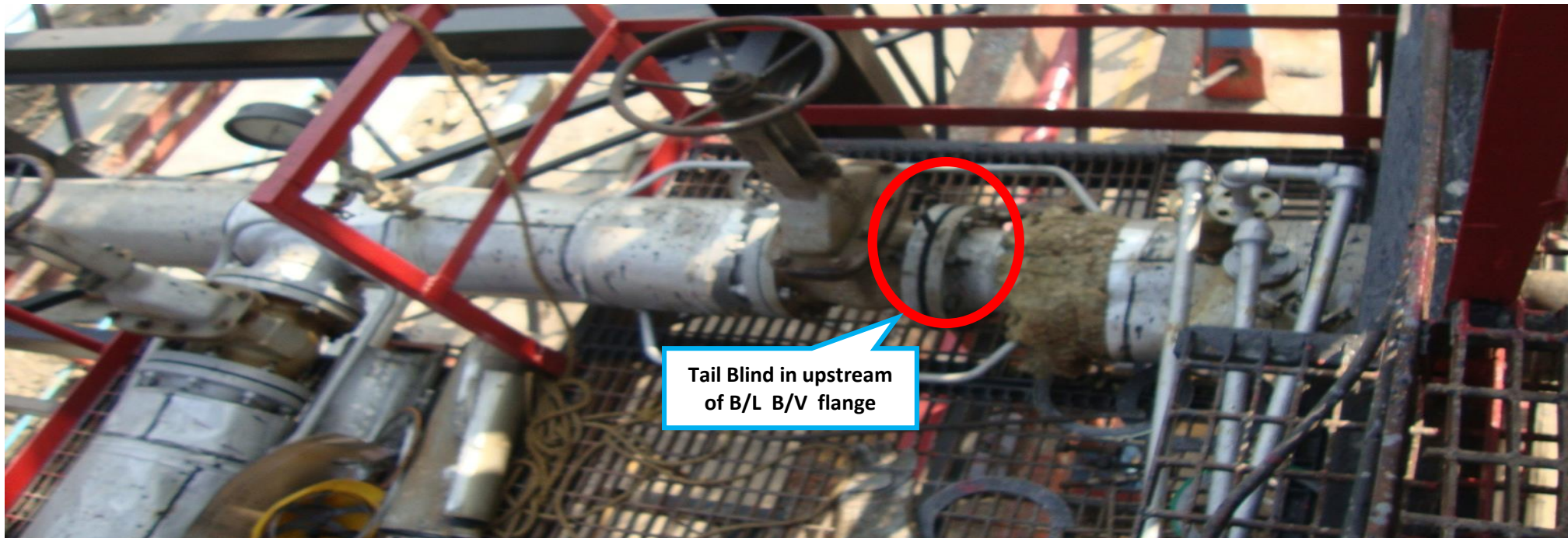
Improper inspection / checking & tagging of the scaffolding.
Non compliance of the scaffold safety procedure.



Exposure to Toxic Gases

❖ Brief of the Incident:

- One casual worker got exposed to acid gas while performing blinding of acid gas line in SRU-3 at around 17:30 Hrs on 07.02.2020 and fainted on working platform.
- He was immediately rescued by F&S personnel and taken to Refinery First Aid centre and then to HR township hospital. He was subsequently shifted to Fortis, Kolkata for further treatment.
- The affected casual worker was released from Hospital at 16:45 Hrs on 09.02.2020 (Sunday) and joined duty on 10.02.2020.



Exposure to Toxic Gases

❖ Root Cause:

Unsafe Act : Improper Hazard Assessment; Sudden removal of face mask of BA set before completion of job and exposure to acid gas.

Unsafe Condition : Suspected passing of battery limit isolation valve; Non-availability of specific SOP, JSA not conducted, Issue of work permit without ensuring depressurization of the system.

❖ Gaps and Lapses:

1. List of SOPs available for the unit does not contain the particular SOP for blinding / deblinding of acid gas line in SRU-3. However, SOPs for blinding & de-blinding activity of process lines in general are available with mechanical maintenance.
2. JSA was not done before the execution of the job of blinding in acid gas line.
3. Work permit was not filled properly before the start of the job :
 - (i) It was marked "Not Applicable" under safety check point – Equipment blinded/disconnected, Equipment properly drained and de-pressurized, Equipment properly steamed / purged.
 - (ii) Under additional PPE requirement, it was mentioned "No" against Compressed BA set.

❖ Gaps and Lapses:

4. Tool box talk before start of the job was given as verbal instructions by the supervisor. However, record of the same was not available.
5. Blinding/De-blinding register was not properly maintained. However, instruction for blinding job was given by PNM through e-mail dtd 04.02.2020.
6. Zonal Meeting is being conducted with a gap of 2-3 days because of ongoing M&I shutdown of SRU-IV & SRU-II. Frequency of the same needs to be improved.
7. The gas test reading was mentioned on 4th, 5th & 7th Feb'20 morning shift as NIL. This was taken without drain and depressurization of acid gas line with isolation valve of drain lines in closed condition. The purging activity of the line started at 11:00 Hrs on 07.02.2020.
8. Based on facts collected, it seems that complete depressurization of acid gas line was not achieved, although the line was purged with N₂, drained and depressurized.
9. Based on interactions with production, it is observed that there was lack of proper planning for the blinding job.

Exposure to Toxic Gases

Indian Oil Corporation Limited
इंडियन आयल कॉर्पोरेशन लिमिटेड
 Company (कंपनी): 9040
 Functional Loc (फंक्शनल लोकेशन): 9040-083-PIPING - PIPING SRU-III.
 Work Permit Request (वर्क पर्मिट अनुरोध): 904020007254/9040CL20006714
 Desc (विवरण): U-83 AAG line Blinding to be done.

Cold Work Permit - Shutdown
 Plant (प्लांट): 9040 Haldia Refinery
Original Copy

Valid From 08:47:37 Hrs of Date 04.02.2020 To 17:00:00 Hrs of Date 18.02.2020.
 (Validation period limited to 15 calendar days subject to renewal)
 Notification (नोटिफिकेशन): 161007554 Old permit Reference (पुराना परमिट विवरण):
 Issued to (जारी किया गया विभाग): Vendor 10108405, AB ENTERPRISE Work Centre (वर्क सेंटर): MEDHDS

Q no (प्र.सं.)	Question (प्रश्न)	Answer Details (उत्तर विवरण)
A.	GENERAL SAFETY CHECK POINTS (Shall be checked before issuing the permit) सामान्य सैफ्टी चेक पॉइंट (परमिट देने से पहले जरूर चेक किया जाएगा)	
1	EQUIPMENT / WORK AREA INSPECTED ईक्विपमेंट / कार्य क्षेत्र निरीक्षण किया गया	Yes/हाँ
2	SURROUNDING AREA CHECKED, CLEANED AND COVERED आस-पास का कार्य क्षेत्र जाँच, साफ़-सफ़ाई कर डेक किया गया	Yes/हाँ
3	EQUIPMENT BLINDED/DISCONNECTED/CLOSED/ISOLATED/WEDGE OPENED ईक्विपमेंट ब्लाइंड कर दिया/डिसकनेक्ट कर दिया /बंद कर दिया /अलग कर दिया/विज ओपेन कर दिया	NA/ जरूरत नहीं
4	EQUIPMENT PROPERLY DRAINED AND DEPRESSURIZED ईक्विपमेंट को पूरी तरह से ड्रेन और डी-प्रेसराइज कर दिया गया	NA/ जरूरत नहीं
5	EQUIPMENT ELECTRICALLY ISOLATED AND TAGGED VIDE PERMIT NO. ईक्विपमेंट को विद्युत रहित (बिजगित) कर परमिट संख्या.....के अनुसार टैग लगा दिया गया	NA/ जरूरत नहीं
	Detail (विवरण): NA	
6	EQUIPMENT WATER FLUSHED ईक्विपमेंट को पानी से फ्लश किया गया	NA/ जरूरत नहीं
7	EQUIPMENT PROPERLY STEAMED / PURGED ईक्विपमेंट को पूरी तरह स्टीमींग / पर्ज किया गया	NA/ जरूरत नहीं
8	PROPER VENTILATION AND LIGHTING PROVIDED सही तरीके से हवा का आवागमन और रोशनी का इंतजाम किया गया	NA/ जरूरत नहीं
9	AREA CORDONED OFF & CAUTION BOARDS / TAGS PROVIDED. कार्य क्षेत्र को घेर दिया गया और सावधानी संकेत /बोर्ड लगा दिया गया।	NA/ जरूरत नहीं
	Detail (विवरण): NA	
10	GAS TEST: HCS (% LEL) गैस टेस्ट : हाइड्रोजन कार्बन (% एल ई एल)	Yes/हाँ
	Detail (विवरण): 0	
1	GAS TEST: TOXIC GAS (PPM) गैस टेस्ट : विषैली गैस (पीपीएम)	Yes/हाँ
	Detail (विवरण): 0	
11	TAG WITH DE-ENERGISATION PERMIT NO. & LOTO PERFORMED / DISPLAYED ON SUBSTATION/	NA/ जरूरत नहीं
1	LOCAL SWITCH AND VERIFIED BY EAS OF OPERATION / EXECUTOR (NAME & SIGNATURE) लोकल स्विच द्वारा किए गए डी-एनर्जाइज्ड परमिट संख्या के साथ सबस्टेशन / लोकल स्विच में टैग लगाया गया / ई.ए.एस ऑपरेशन / एक्जिक्यूटर (नाम और हस्ताक्षर) के द्वारा जाँच कर सुनिश्चित किया गया।	NA/ जरूरत नहीं
12	RELEVANT OPERATIONAL HAZARDS AND THEIR PRECAUTIONS COMMUNICATED TO CONCERNED PERSONNEL	Yes/हाँ
1	THRU "TOOLBOX TALKS" GIVEN BY SITE ENGINEER / SHIFT-IN-CHARGE कार्य शुरू करने से पहले "टूल बॉक्स टॉक" के माध्यम से कार्य से सम्बंधित खतरे और उनसे बचाव, कार्य सम्बंधित व्यक्ति को साइट इंजीनियर और शिफ्ट ईंचार्ज के द्वारा बताया गया।	Yes/हाँ

Remarks : (1) The activity has the following expected residual hazards. (Y=yes, N=no)
 टिप्पणी: (1) सम्बंधित कार्य में निम्नलिखित अपेक्षित अवशिष्ट खतरे हैं . (Y=yes, N=no)

Indian Oil Corporation Limited
इंडियन आयल कॉर्पोरेशन लिमिटेड
 Company (कंपनी): 9040
 Functional Loc (फंक्शनल लोकेशन): 9040-083-PIPING - PIPING SRU-III.
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 Desc (विवरण): U-83 AAG line Blinding to be done.

Cold Work Permit - Shutdown
 Plant (प्लांट): 9040 Haldia Refinery
Original Copy

Released By	User-ID	Name	Desg.	Date	Time	Sign
	136855	Saumen Sutradhar	SPNE	04.02.2020	08:48:19	
FFS/GSI/Issuer (Site visited & conditions explained) साइट की जाँच की गयी और कार्य शर्तों को समझाया	136855	Saumen Sutradhar	SPNE	04.02.2020	08:48:25	
CISF/DSO/Safety सी.आई.एस.एफ./ डी.एस.ओ./ सेफ्टी						

Please see GENERAL INSTRUCTIONS on next page ...
 कृपया वागले पेज पर सामान्य निर्देश को देखें

Exposure to Toxic Gases

Indian Oil Corporation Limited

इंडियन आयल कार्पोरेशन लिमिटेड

Company (कंपनी): 9040

Functional Loc (फंक्शनल लोकेशन): 9040-083-PIPING - PIPING SRU-III

Work Permit Request (वर्क पर्मिट अनुरोध): 904020007254/9040CL20006714

Desc (विवरण): U-83 AAG line Blinding to be done.

Cold Work Permit - Shutdown

Plant (प्लांट): 9040 Haldia Refinery

Original Copy

H2S (हाइड्रोजन सल्फाइड)	(Y)	Lack of Oxygen (ऑक्सिजन का कमी)	(N)	Corrosive Chemicals (संभारक रसायन)	(N)
Toxic Gases (विषैली गैस)	(N)	Combustible Gases (ज्वलनशील गैस)	(N)	Steam Condensate (संघनित भाप)	(N)
Pyrophoric Iron (पाइरोफोरिक आइरन)	(N)	N2 Gas (नाइट्रोजन गैस)	(N)	Height Work (ऊंचाई पर काम)	(Y)
Loose Earth / Soil (भुरसुरी ज़मीन/ मिट्टी)	(N)	High Noise Area (उच्च शोर वाला क्षेत्र)	(N)	Radiation / Heat Exposure (विकिरण / ताप प्रभाव)	(N)

(2) Following additional PPE to be used in addition to standards PPEs. (Y=yes, N=no)

(Helmet, Safety Shoes, Hand Gloves, Boiler Suit)

निम्नलिखित अतिरिक्त व्यक्तिगत सुरक्षा उपकरणों का उपयोग मानक व्यक्तिगत सुरक्षा उपकरणों (हेलमेट, सेफ्टी जूता, दस्ताना, बॉयलर सूट) के अलावा किया जाना है

Face Shield (फेस शील्ड)	(N)	Fresh Air Mask (फ्रेश एयर मास्क)	(N)	Compressed BA Set (संपीड़ित स्वशन यंत्र)	(N)
Goggles (सेफ्टी चश्मा)	(N)	Dust Respirator (डस्ट मास्क)	(N)	Earmuff (ईयरमफ़)	(N)
Life Line (लाइफ लाइन)	(N)	Apron (ऐपरन)	(N)	Safety Harness (सेफ्टी हार्नेस)	(N)
Safety Net (सेफ्टी नेट)	(N)	Airline (एयर लाइन)	(N)	Gas Responder (गैस रेस्पोंडर)	(Y)

(3) Additional Precaution (if any):
अतिरिक्त सावधानी (अगर कोई हो)

CLEARANCE DETAILS क्लियरेंस विवरण

CLR No (क्लियरेंस)	Validity date (वैधता दिनांक)	Time from समय (कबसे)	Time To समय (कब तक)	Gas Test (गैस टेस्ट)	Requested By (अर्धी)	Issued By (आरीकता)
1	04/02/20	9.00	14.00	NIL	N. D. Samal	
2	05/02/20	9.00	14.00	NIL	N. D. Samal	
3	05/02/20	9.00	14.00	NIL	N. D. Samal	
	07/02/20	14.00	17.00	NIL	N. D. Samal	
	07/02/20	18.00	19.00	NIL	N. D. Samal	
4	05/2/20	9.00	17.00	H2S-17.11/17	N. D. Samal	

EMERGENCY PHONE NOS.

FIRE : 00, 101, 110 FIRST AID : 102, 3301, 5466 AMBULANCE : 102 CONTROL ROOM : 3710, 5710

Exposure to Toxic Gases

❖ Recommendations:

Immediate:

1. SOP should be developed for blinding & de-blinding activities in acid & sour gas line of SRUs.
2. Job Safety Analysis (JSA) should be necessarily carried out for all critical jobs for which SOPs are not available.
3. Work permit conditions should be filled correctly after assessing the site conditions and requirement.
4. For critical activities, where BA set is used, the stand by rescue personnel should be ready with well equipped self-contained BA set .

Specific:

1. Record of tool box talk should be maintained in the unit and also to be mentioned in the work permit.
2. Instructions should be conveyed to the workers during tool box talk on how to communicate in case of problematic situations during activities.
3. Blind / De-blind register should be maintained properly.
4. To improve behavioral aspects of workers, frequent risk takers to be identified and counseled by concerned department on regular basis.

Exposure to Toxic Gases

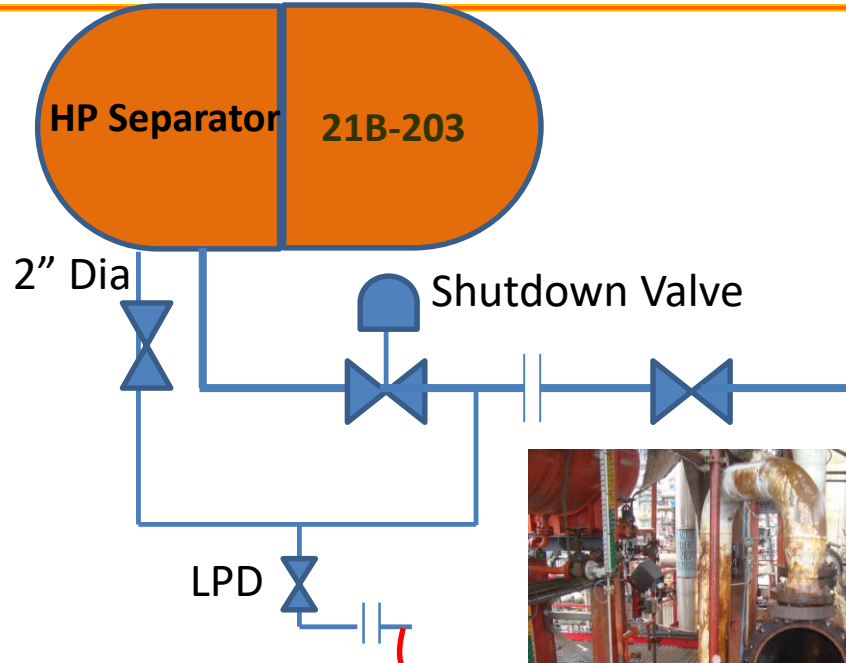
❖ Recommendations:

Additional Recommendations upon review of incident at RHQ

1. Provision of air hoses to be kept for such jobs where the possibility of exposure to toxic gases are more.
2. Ensure the complete depressurization of the line/section before handing over for maintenance jobs.
3. Instruction book should be separate from log book and have complete details of critical jobs planned in the unit.
4. Toxic gas neutralizer should be used while carrying out such activities inside the unit.
5. Before commencing such jobs, reassessment of change in conditions needs to necessarily done as in this case passing of the isolation valve might have developed the presence of H₂S.
6. Depressurization needs to be routed through flare line so as to avoid its concentration at ground level.
7. CCTV camera installed in the unit need to upgraded with provision of recording facility. Monitoring of critical jobs should also be done through it.

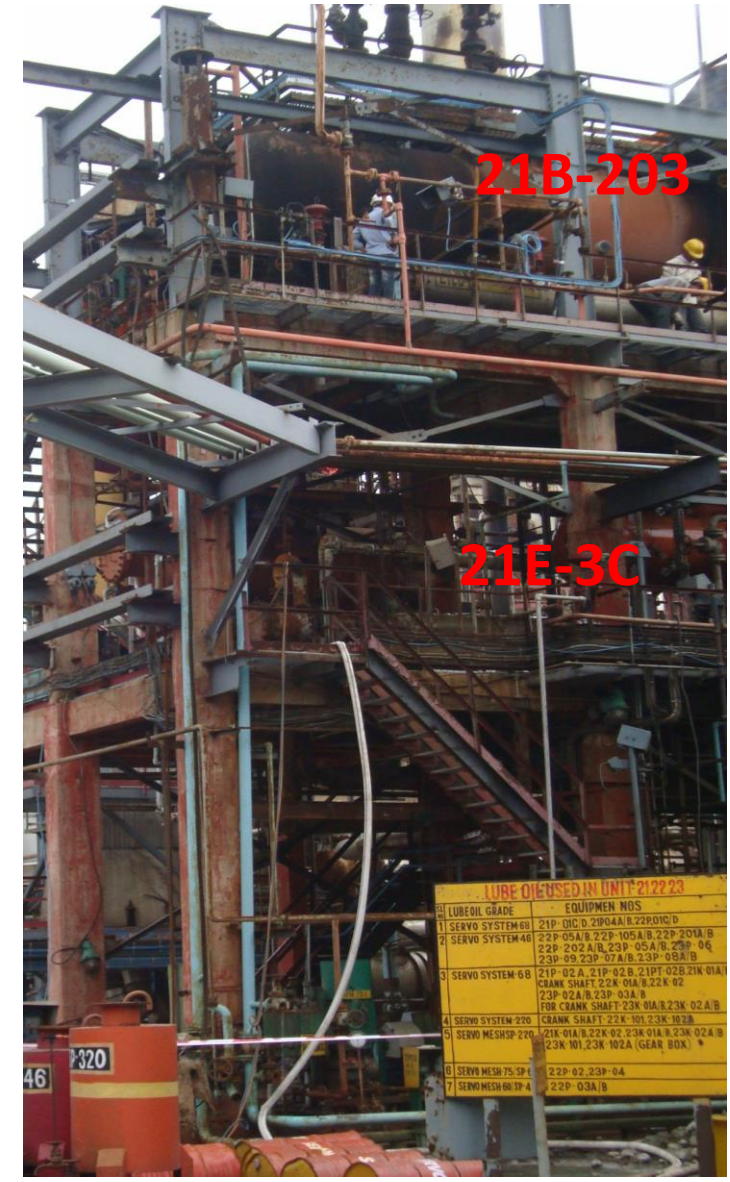
Fire Due To Hose Connected to Naphtha Vessel near Hot Work

Incident: Contract worker connected hose with LPD of vessel considering vessel having water. Naphtha from vessel spread in the area and caught fire due to hot job for grating.



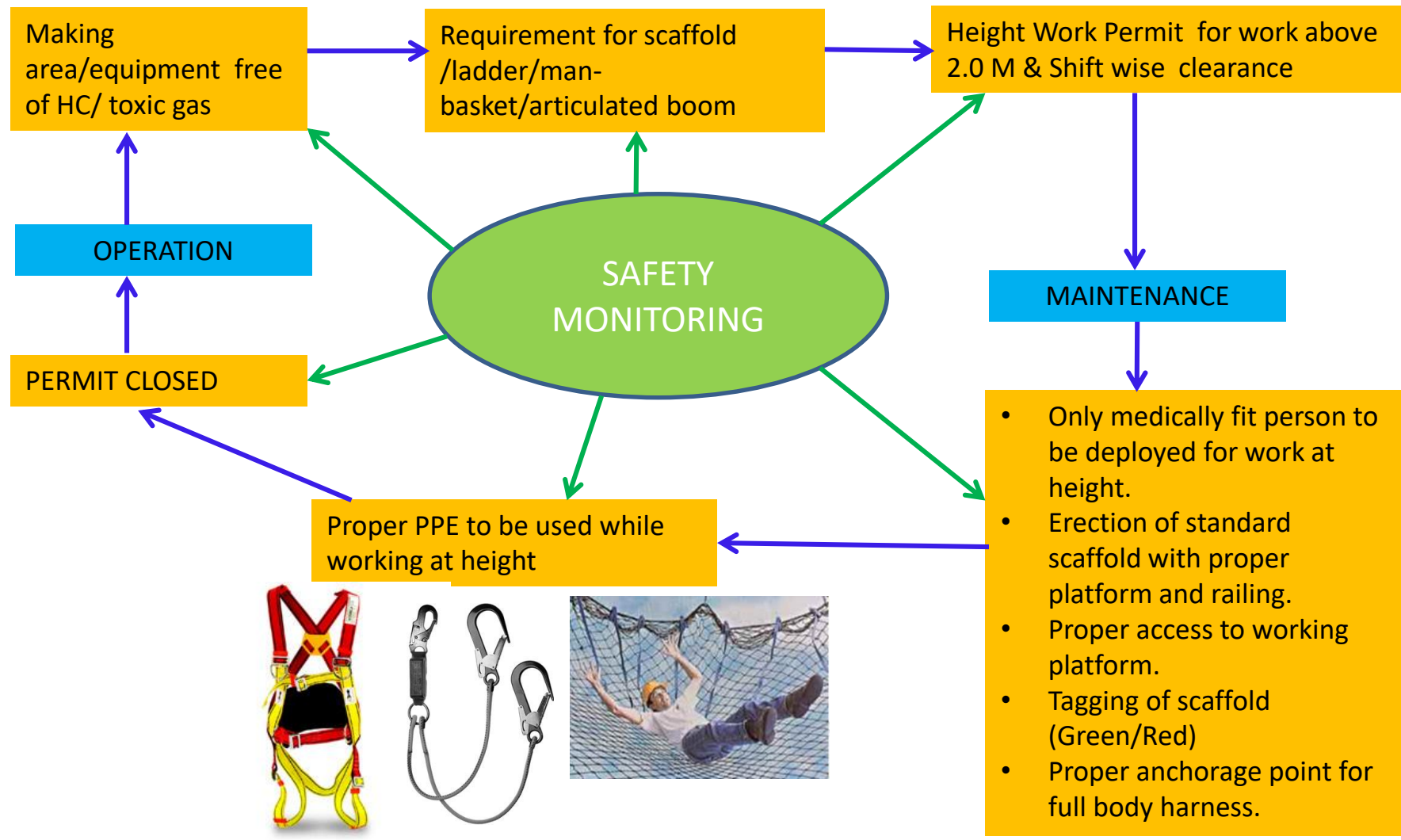
LESSONS LEARNT:

Always keep LPD and HPD capped to avoid such connection. Instruct the agency to connect any utility point in presence of production only



LUBE OILED IN UNIT 212223	
LUBRICATION	EQUIPMENTS NOS
1. LUBRICATION	21P-01C, 21P04A/B, 22P01C/D
2. SERVO SYSTEM 6B	22P-05A/B, 22P-105A/B, 22P-201A/B
3. SERVO SYSTEM 4B	22P-02A/B, 23P-05A/B, 23P-06, 23P-09, 23P-07A/B, 23P-08A/B
4. SERVO SYSTEM 6B	21P-02A, 21P-02B, 21PT-02B, 21K-01A, CRANK SHAFT, 22K-01A, 22K-02, 22P-02A/B, 23P-03A/B FOR CRANK SHAFT, 23K-01A/B, 23K-02A/B
5. SERVO SYSTEM 210	CRANK SHAFT, 22K-101, 23K-102A
6. SERVO MESH SP 220	21K-01A/B, 22K-02, 23K-01A/B, 23K-02A/B, 23K-101, 23K-102A (GEAR BOX)
7. SERVO MESH 75-5P-1	22P-02, 23P-04
8. SERVO MESH 60-1P-4	22P-03A/B

WORK AT HEIGHT SAFETY



Fall From height from a caged Ladder

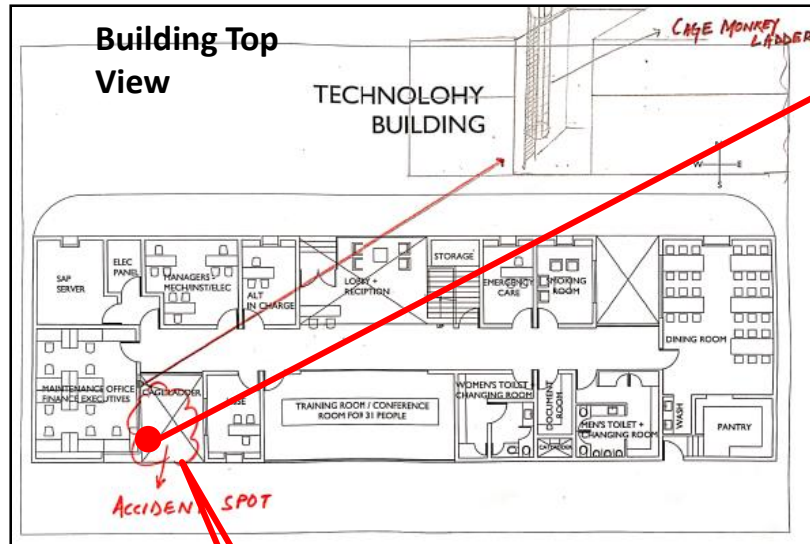
- Date: 11.06.2020
- Time : 10:25 Hrs.
- Location:- Technology Building IOTUES BOOT-03
- Details of Incident:

Shri Tushar Kanta Das, aged about 35 years, an Electrician working with M/s Unique Power Generation Pvt. Ltd., a contractor of M/s IOTUES fell down from the caged monkey ladder of the Technology Building of IOTUES in BOOT 3 area at around 10:25 hrs. on 11.06.2020.

While descending, his leg could have got entangled between the parapet wall and the top rung. The hand rail was placed on the side while ascending but not in the side of the descending. Therefore, while descending, there is the possibility that instead of three point contact, due to design deficiency of the ladder, two point contact might have occurred leading to slip an fall of Mr. Tushar.



Fall From height from a caged Ladder



Cage Ladder Location at the Back side of the Technology building



Fall From height from a caged Ladder

Analysis of the Accident:-

- Additionally, wet condition due to rains could have made the rung slippery.
- Mr. Tushar was wearing helmet. However, its chain strap was turned towards back of the helmet (chin strap not used). Hence, the helmet might have got detached from his head before he hit the ground.

Cause of the Accident :

- Fouling of the two top rungs of caged monkey ladder with the parapet wall
- Non-adherence of safety practises by the IP– Fall Protection device not used -Double hooked full body safety harness
- Improper use of PPE- Safety Helmet used however its Chin Strap was not tied)

Improperly Secured Monkey Ladder

Date : 27.03.2018
Time : 01:00 hrs.
Location : DCU

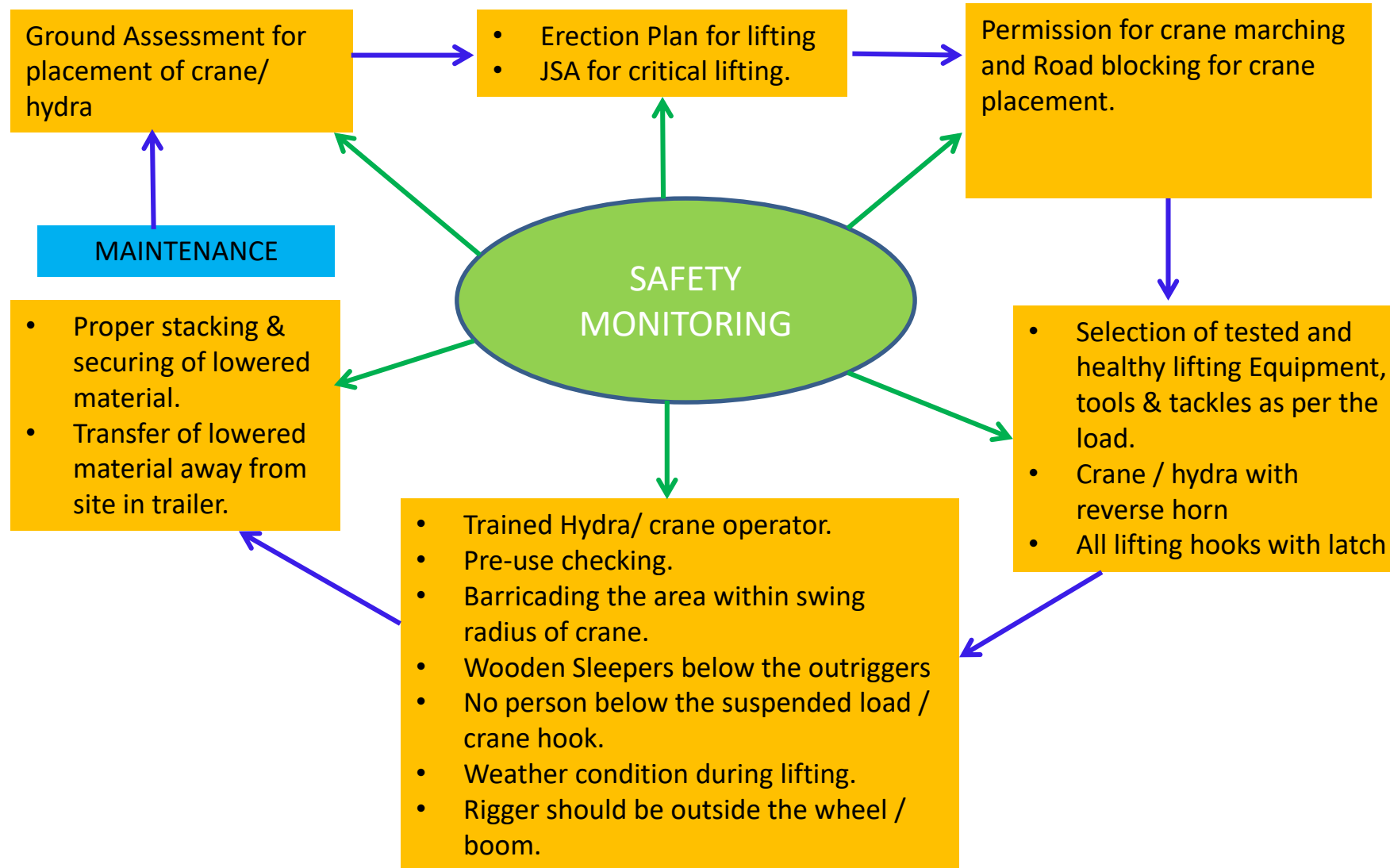
In DCU, while going to box up the man way no.1 and 2 (going from C-001 PSV area to C-001 man way area) using the monkey ladder of C-001, one rigger of M/s Radiant engineering, got imbalanced while descending. The worker saved himself by holding the ladder rung/nearby railing and slowly came down and landed on the structural platform.

It was observed that the monkey ladder was found fixed with structure by tying with thin metallic wire and the wire snapped while the worker was descending.

Root cause of the incident: Equipment failure.



Safety During Heavy Equipment Operation



Fatal Accidents by Lifting Equipment

Date & Time	Incident	Root Cause	Lessons Learnt
02.11.2013 09.15 hrs.	Fatal accident of Chief Production Manager at MR when he was run-over by a Hydra while walking near the stores.	In old hydras front left view is completely hindered due to the boom. Hydra was having starting problem. Tractor was used for push start.	<ul style="list-style-type: none">➤ Pre-use check of hydra/cranes.➤ Provision of helper in old generation hydras.➤ Deployment of new generation hydras (like K-10/F-15) models of Escorts etc.) for better vision.

Incidents During Lifting Operation

Date & Time : 13.06.2012 at 1100 Hrs
Location : MSQ (Shutdown)

Incident:
During Shutdown while pulling out exchanger bundle of 86E21 using chain pulley block of the monorail trolley as shown, trolley along with chain pulley block came out of the monorail & fell on the platform. The person underneath had narrow escape.

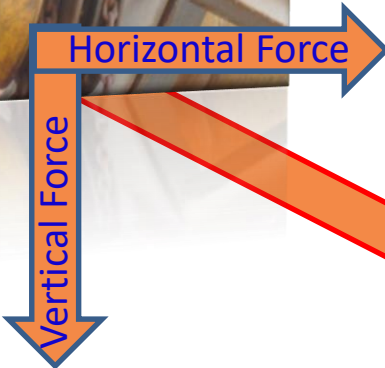
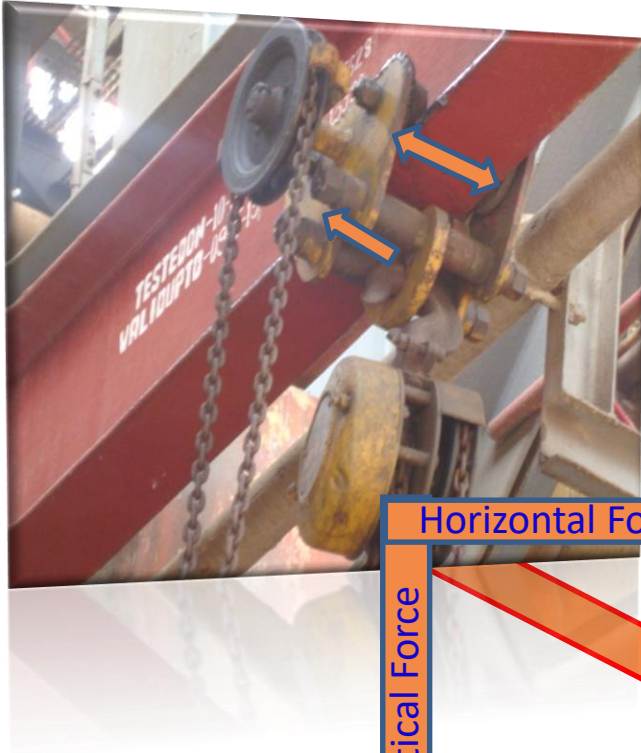
MONORAIL
L 1
SWL : 5T
Testing
Date :
10.05.2012

MONORAIL 2
SWL : 3 T
Testing Date :
10.05.2012

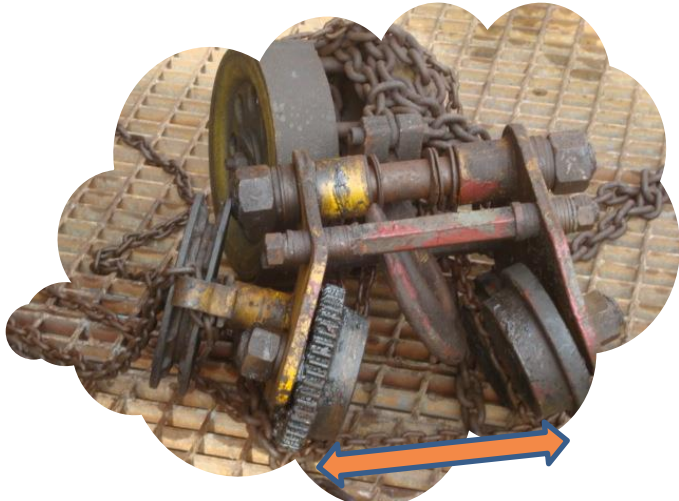


Failure Analysis

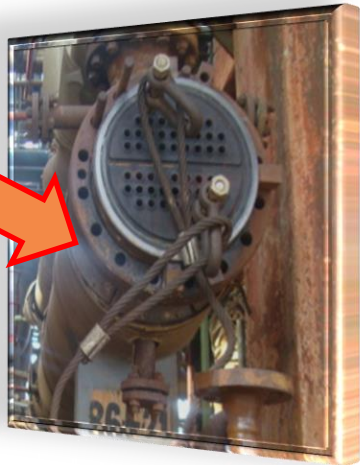
Monorail Trolley 1 was used for pulling out adjacent exchanger bundle (86 E21) at an angle to vertical direction



Pulling of bundle at an angle to vertical position



Due to lateral force gear wheel plate got buckled and assembly came out.



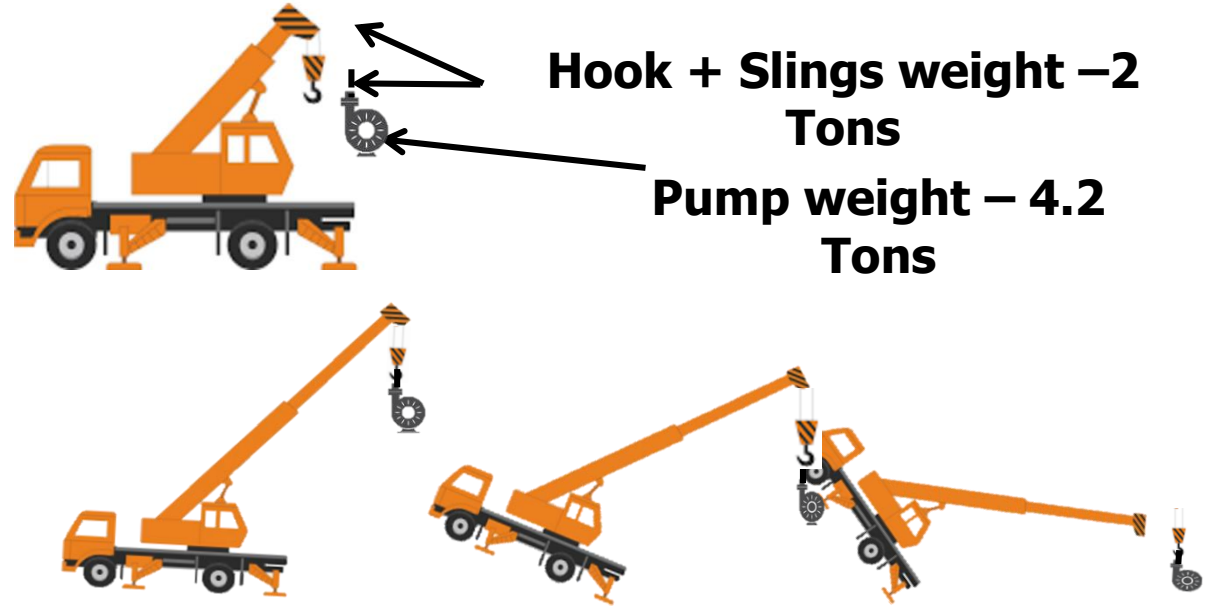
Incident of Crane Toppling

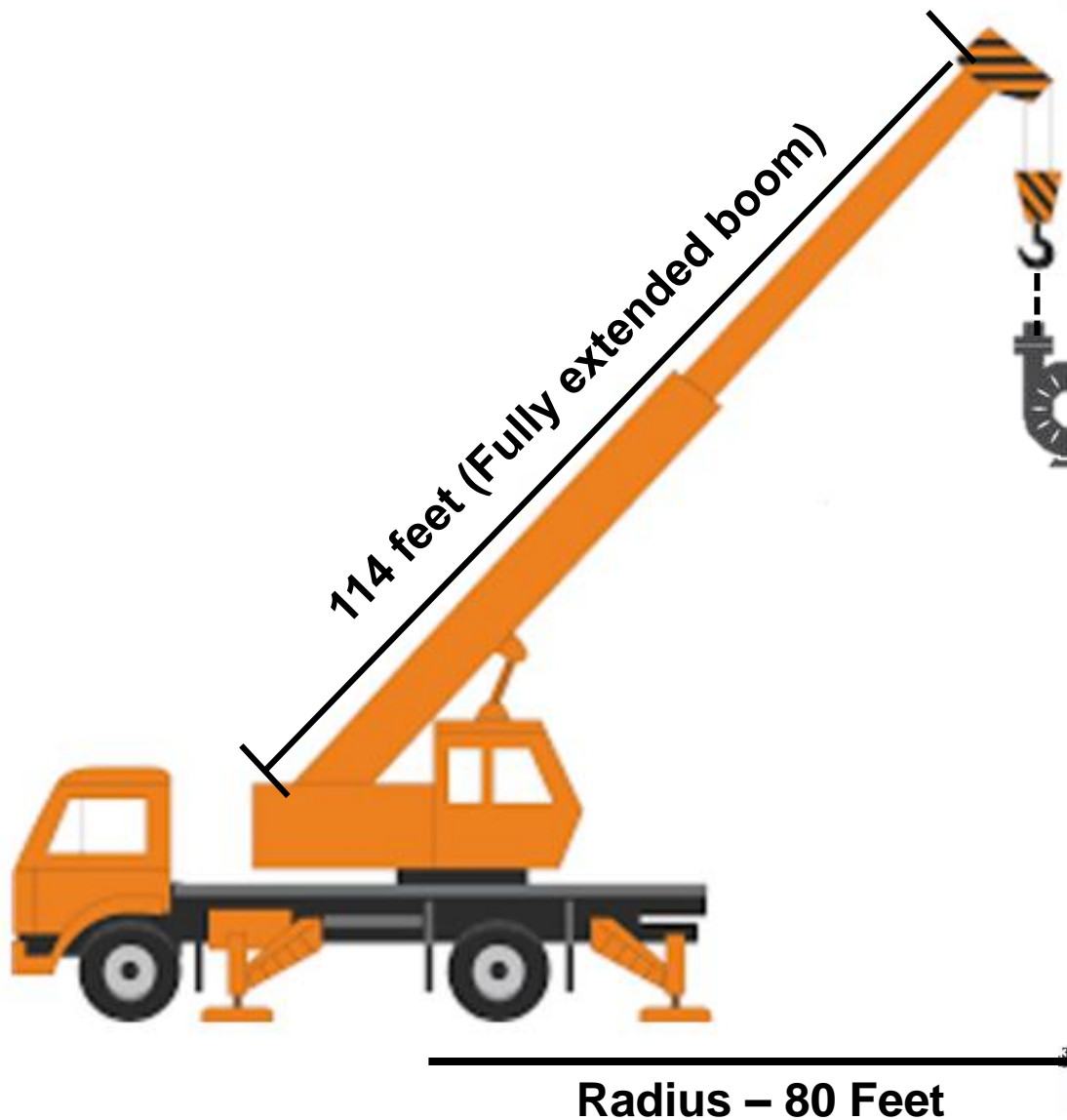
Incident:

Crane toppled while lowering of one cooling tower pump near Cooling tower at PR. There was no injury.

Root Cause:

No erection plan and no JSA.





ON OUTRIGGERS FULLY EXTENDED - 360°

Radius In Feet	Main Boom Length in Feet									
	36	42	51	60	69	78	87	96	105	114
10	160,000 (67)	106,700 (70.5)	101,600 (74)	100,000 (77)	96,700 (79)					
12	123,500 (63)	105,700 (67.5)	101,600 (71.5)	96,500 (75)	87,850 (77)	84,700 (79)				
16	105,000 (62.5)	105,000 (63)	95,300 (66)	84,900 (72)	79,200 (74.6)	77,550 (77)	64,500 (79)			
20	78,850 (47)	78,850 (54.5)	78,850 (61.5)	70,550 (66.5)	64,350 (70)	63,800 (73)	55,000 (75.5)	51,900 (77)	46,450 (78.5)	38,750 (80)
25	60,000 (34)	60,000 (45.5)	60,000 (55)	60,000 (64)	54,000 (65.5)	49,700 (69)	45,600 (72)	43,600 (74)	41,300 (76)	34,000 (77)
30		48,050 (34)	48,050 (47.5)	46,050 (55.5)	46,650 (61)	42,750 (65)	39,150 (68.5)	38,400 (71)	35,350 (73)	30,300 (74.5)
35		38,850 (16.5)	38,850 (39)	38,850 (49.5)	38,850 (56)	37,300 (61)	34,050 (64.5)	32,700 (67.5)	30,700 (70)	27,250 (72)
40	See Warning		31,650 (28.5)	31,650 (42.5)	31,650 (50.5)	31,650 (56.5)	29,950 (61)	28,850 (64.5)	27,000 (67)	24,750 (69)
45	Note 16			25,450 (34.5)	25,450 (45)	25,450 (51.5)	25,450 (57)	25,450 (61)	23,900 (64)	22,650 (66.5)
50				20,800 (24)	20,800 (38.5)	20,800 (46.5)	20,800 (52.5)	20,800 (57.5)	20,800 (61)	20,800 (63.5)
60					14,400 (20)	14,400 (35)	14,400 (43.5)	14,400 (49.5)	14,400 (54)	14,400 (57.5)
70							10,150 (32)	10,150 (40.5)	10,150 (46.5)	10,150 (54)
80								7,150 (12.5)	7,150 (29.5)	7,150 (38)
90									4,900 (7)	4,900 (37)
100										3,080 (24.5)
Minimum boom angle (deg.) for indicated length (no load)										0
Maximum boom length (ft.) at 0 deg. boom angle (no load)										114

**Load Capacity = 7150 Pounds
= 3.575 Tons**

Load of about 6 Tons was being lifted

Lessons Learnt:

JSA to be carried out along with erection plan for such kind of critical jobs.

Outrigger of Crane got Depressed into the Ground



Incident : while one crane was lifting bundle puller carrying exchanger tube bundle, suddenly its rear right side outrigger, which was resting near the other exchanger , got depressed into the ground causing the crane to tilt ; luckily the crane did not overturn.

Lessons Learnt: As a practice metal base plates are to be placed below the outriggers for proper load distribution

- ***Incident detail :***

On Wednesday 15th July 2013 about 03:45 Hrs in Feed Preparation Plant-2 (GHC) Exchanger (03-EE-103D) tube bundle removal job was going on with the help of 2 hydras.



While removing tube bundle, it was supported by two hydras at each end of bundle. One of the hydra was pulling the bundle with little bit more speed than other hydra (GJ-6 AP 9357). Due to heavy unbalanced load, the exchanger bundle and hydra (GJ-6 AP 9357) was tilted.

Fatal Accident Due to Failure of Slings During Erection

Incident:

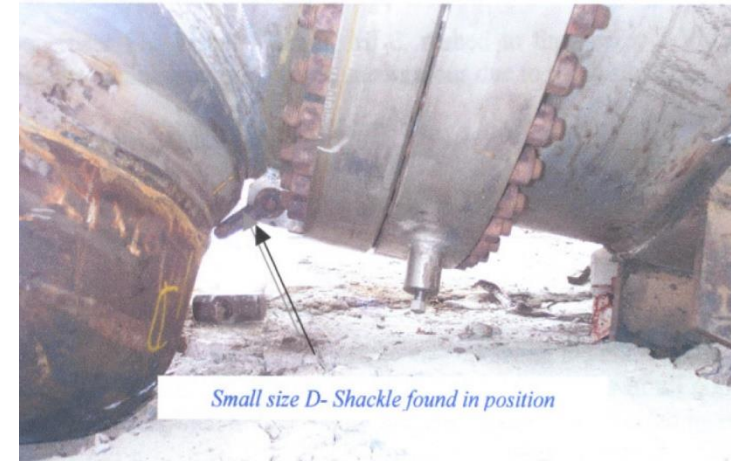
An accident took place at about 4.00 PM on 29th July, 2007 in the FCC Unit while Debutanizer pre heat exchanger erection was in progress, involving the proprietor, who got trapped under the exchanger and succumbed to the injuries.

Root Cause:

Use of under capacity wire rope slings, which has resulted in snapping and falling of the exchanger over the proprietor of the firm engaged for the work.

Recommendations:

- EIC to ensure availability and use of certified lifting tools & tackles before execution of the work. A copy of the certificate may be retained with EIC.
- Erection plan for critical jobs may be made more comprehensive considering feasibility w.r.t. site condition & equipment involved.



Small size D- Shackle found in position

One D- Shackle of about 2 tones capacity found in position

Crane Incident

Crane Incident

These pictures are of a crane incident that occurred in the Netherlands at Shell's Antwerp Refinery.

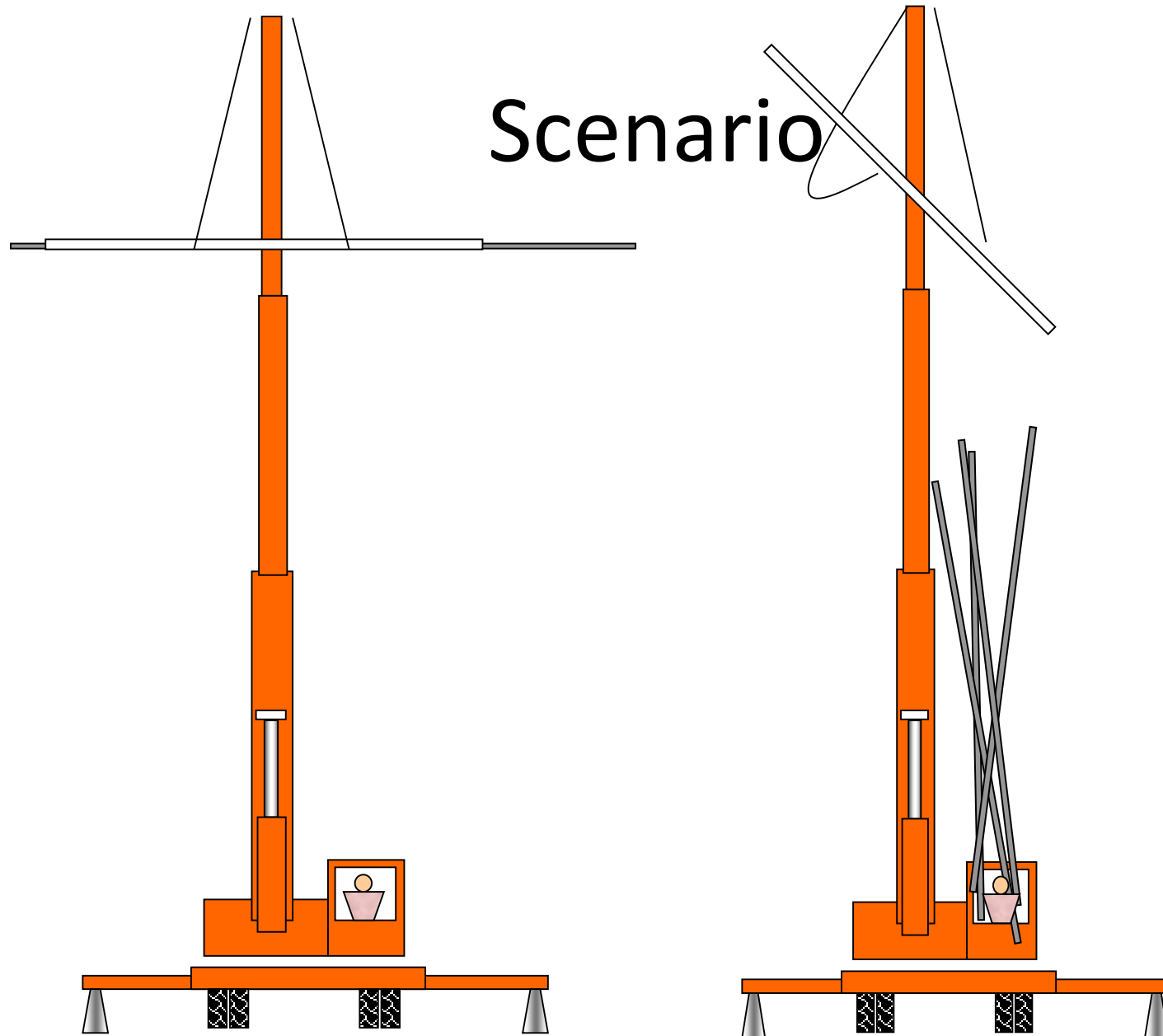
During a major turnaround, fan tubes were being lifted using a tube tray.

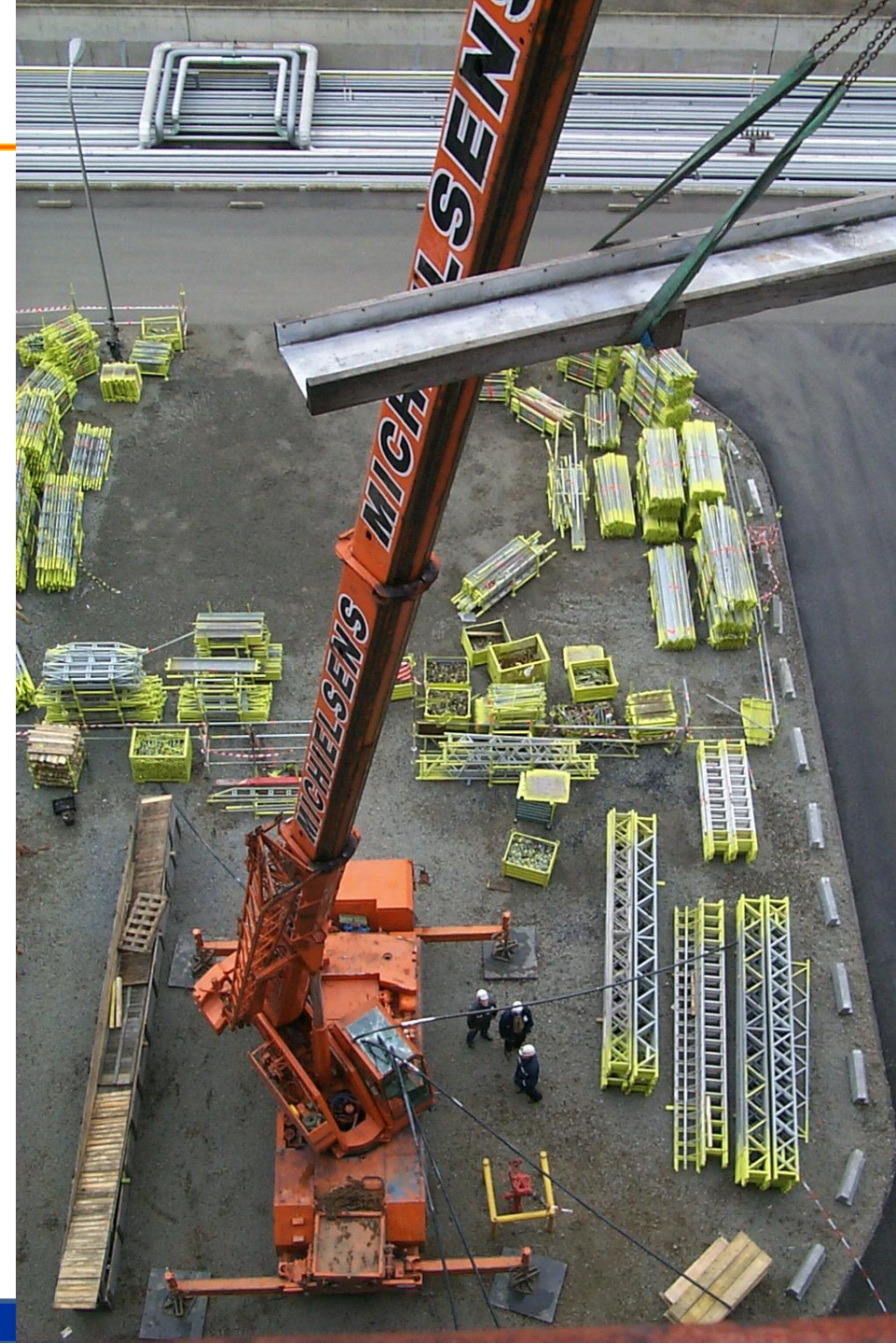
During the lift and while the tube tray was directly over the crane operator's cab, the tube tray deviated from horizontal and the fan tubes slid off and plunged like arrows into the operator's cab.

Note that the tubes were not properly secured to the tray during the lift operation.

The pictures show the condition of the operator's seat just after the accident. The pictures tell the tale.

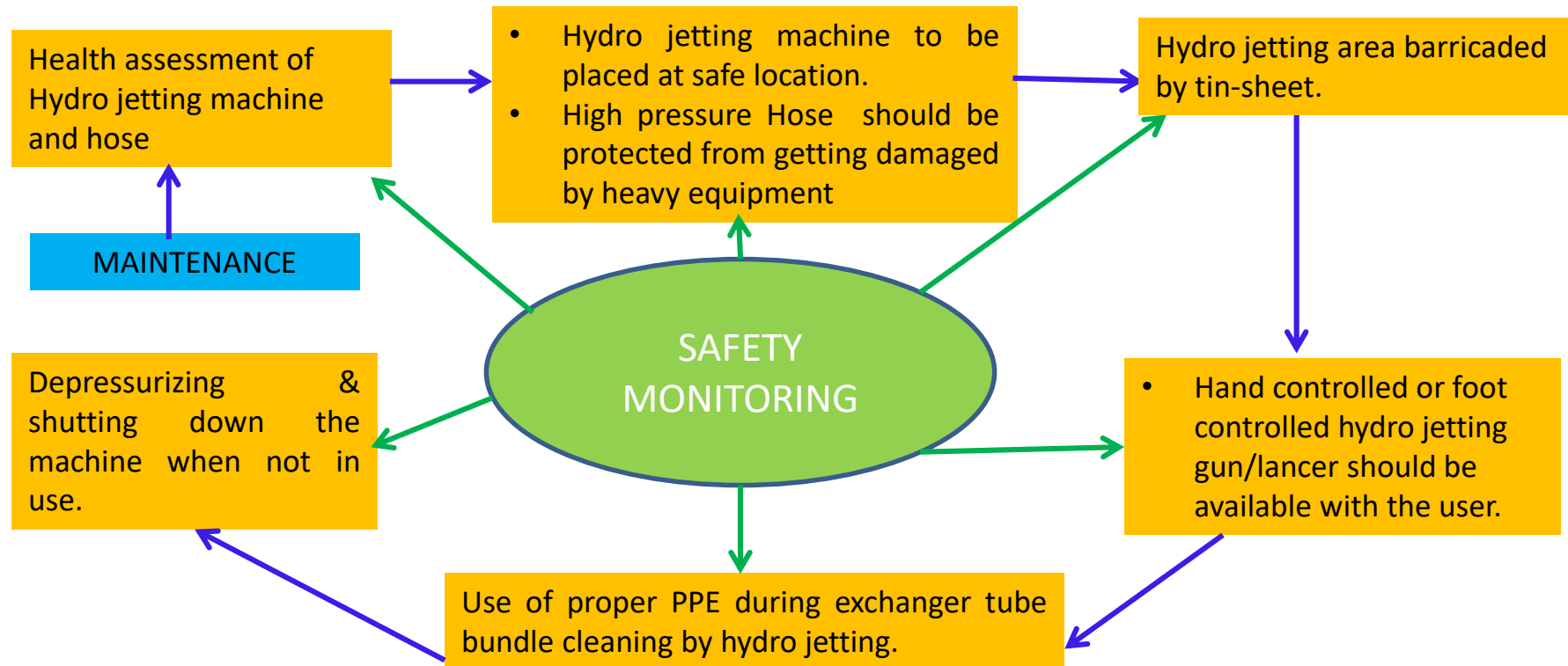
Scenario







Safety During High Pressure Hydro Jetting



SAFETY DURING HIGH PRESSURE HYDROJETTING



Amrit Mahotsav IndianOil



Shotgun with single dump valve



Typical foot-operated valve

Diffused water must be discharged away from personnel



Typical anti-withdrawal device for stiff lancing

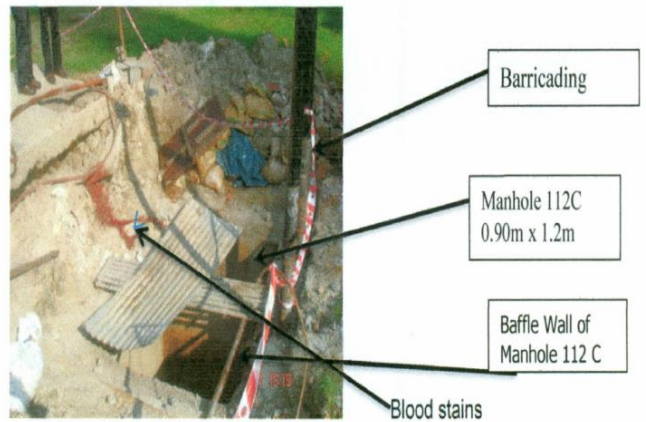
Deflector sized to permit free sliding fit for the pipe, but small enough to prevent the nozzle from passing the end in stiff lancing operation



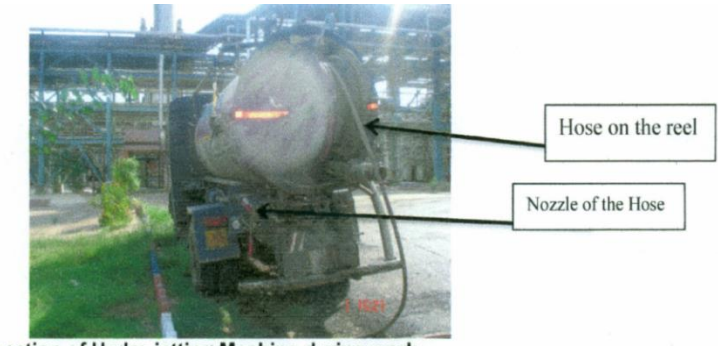
Typical anti-withdrawal device for flex lancing



Date & Time	Incident	Root Cause	Lessons Learnt
01.10.2015 15:20 hrs.	Fatal accident of one contractor worker at PR while dechoking OWS by hydro-jetting machine.	Lack of coordination between Hydro-jetting machine operator and person (victim) holding the hose.	<ul style="list-style-type: none"> ➤ Pressure control of hydro jetting should be with the person holding the hose. ➤ Before awarding specialized outsourced jobs the Work Order should seek SOP and safety related process for undertaking the work. ➤ Comprehensive Job Safety Analysis shall be done for all outsourced and specialized jobs.



Photograph of Accident site



Location of Hydro jetting Machine during work

Date & Time	Incident	Root Cause	Lessons Learnt
13.08.2008 16:00 hrs.	Fatal accident on one contract worker in MSQ Unit at JR while dechoking drain line of boot of one naphtha vessel.	Sudden release of Naphtha @ 5 kg/cm ² after blockage was suddenly cleared. Victim swallowed Naphtha and died after two days.	<ul style="list-style-type: none"> ➤ Such risky jobs should be avoided in running unit. ➤ If at all, any risky job is to be taken up, it should be thoroughly analyzed and detailed procedure should be prepared.
23.08.2015 00.03 hrs.	Major Fire in AU-II at JR causing fatality of one fire fighter and burn injuries to other 3 employees due to naphtha leak while transferring naphtha from Naphtha Stabilizer column in AU-II S/D.	<ul style="list-style-type: none"> ➤ Rupture of flexible SS hose due to hammering caused by vapour locking and sudden pressure surge. ➤ Spark generation due to friction of metallic hose with structure. 	<ul style="list-style-type: none"> ➤ All vessels and pump drain to be connected to CBD. ➤ Proper MOC should be followed even for temporary connection as in this case. ➤ Tested hose should be used.

The Incident :

While the PM Job on Air fin cooler fan in ISOM unit of JR was still in progress, Electrical Operation energized the Fan from S/S on the request of Elect. Maint. without involving Production Dept.

Starting of fan caused fatal injury to one contractor worker who was carrying out PM jobs on the same fan.

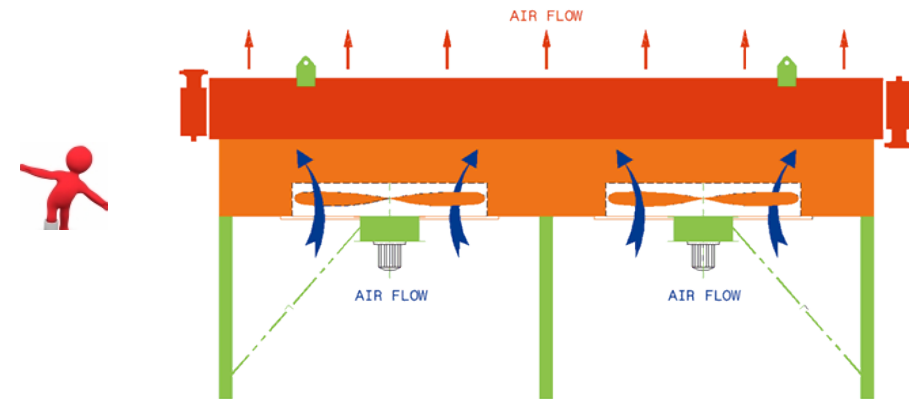
Root Cause

- Non compliance of LOTO system.
- Lack of coordination between two agencies.

Lessons Learnt

Electrical de-energization / energization should always be done through the custodian of the equipment/Area.

Fool Proof LOTO (Lock Out Tag Out) System to be followed for Electrical de-energization/energization.



Fatal Accident at Bongaigaon Refinery

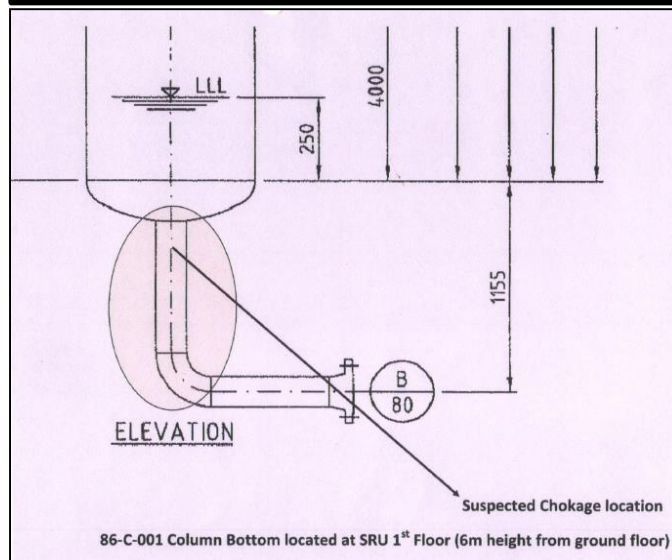


Anniversary Mahotsav IndianOil



Refinery	Date	Time	Location	Incident Category
Bongaigaon Refinery	21.08.2018	2030 Hrs	TGTU section of SRU	Fatal

❑ **Brief of the Incident :** While dechoking 3" bottom outlet nozzle of wash water quench column (86-C-001) at TGTU by poking with a metal rod, hot water gushed out from the nozzle and spilled resulting in burn injury to two contract workers engaged in dechoking job. One of the workers (Mr. Baijnath Prasad of M/s P.K.M. Erectors) succumbed to burn injury on 30.08.2018.



97

❑ Cause :

- **Basic Cause** - Sudden gushing out of hot water during dechoking operations of the bottom line of Quench Column (86-C-001)
- **Root Cause** - Inadequate precautions in carrying out the dechoking job

❑ Consequence :

- **Fatality** – 1 no. [Mr. Baijnath Prasad of M/s P.K.M. Erectors, 45 years, Experience – 17 years]



This portion was checked physically and found clear. To ensure thoroughness at elbow also, planned to put an L-shaped rod through the nozzle.

The Incident :

On 23-08-2013 there was a major fire at Visage Refinery of HPCL at Vishakhapatnam. The fire was in the newly constructed cooling tower.

The OISD investigation committee had noted a number of lapses which lead to the accident and had given some recommendations.



(Fire Incident at AVU-1 of Panipat Refinery)



Date & Time of Incident : 16.03.2019 at about 18:30 hrs

Location of Incident : 1st floor of Technical Structure-2 (TS-2) of AVU-1

Nature of Incident : Explosion followed by Fire

Death : Two 2 contract Workers aged 22 & 24 years

Injury : A EA of F&S Dept.

Sequence of Events

SI No	Event
1	Unit was under planned shutdown since 14 th February-2019
2	CDU feed cut-in was done on 16 th March 2019 at 03:15 hrs. & VDU fed cut done at 11:40 hrs. on 16 th March 2019
3	Naphtha was taken in stabilizer column at 14:30 hrs. on 16.03.2019
4	Stabilized Naphtha was routed to Naphtha splitter at 17:30 hrs. on 16.03.2019
5	Naphtha Splitter bottom was routed to run down via trim Cooler by starting pump at about 18:05 hrs.
6	Fire was observed near trim cooler bottom at 18:30 hrs. Pump was stopped at 18:35 hrs.
7	An explosion followed by a major fire broke out. Fire fighting operations were started and fire was extinguished at about 20:20 hrs. Unit emergency shutdown was actuated from DCS panel

Paradip Refinery

(Fire Incident at AVU-1 of Panipat Refinery)



Observations by OISD Team during investigation from 17.03.2019 to 19.03.2019

Sl No	Observation
1	There were many temporary non FLP lighting fixtures installed on ground and 1 st floor of TS-2. Power Cables from power distribution panels to different points of usage were found lying on floor
2	Even though the LPD on the trim cooler inlet line was installed, it could be inferred by the team during the course of investigation that the end blind was not there on the LPD at the time of leakage.
3	Normal torches were being used by Inspection Maintenance personnel in the unit
4	Fastners were missing in two covers of electrical Junction Boxes near the trim cooler
5	Oil soaked insulation, other combustibles like plastic hoses, wooden planks were lying inside plant
6	Extensive scaffolding at various locations were observed in the plant
7	During Turn Around, Filed operators were not writing log book. The log book for DCS officer & shift-in-charge was common. No separate log book was maintained
8	During shutdown, DCS was migrated from M/s ABB to M/s Honeywell. Many process parameters/tag values/history trends were yet to be configured
9	There was no Hardwired alarm or audio visual annunciator in DCS for Hydrocarbon Detector Alarm
10	A gas detector near the incident site was showing 'NaN' value since 15.03.2019 in spite of it being calibrated on 13.03.2019 and reported to be ok by an external agency.

Paradip Refinery

The Energy Gateway to Eastern India ...

(Fire Incident at AVU-1 of Panipat Refinery)



Observations by OISD Team during investigation from 17.03.2019 to 19.03.2019

Sl No	Observation
11	Two more fires were reported on 16 th March 2019 during start up on the Vacuum Colum overhead line flange. Same was not recorded in the operation log book of plant
12	As per fire call report 15,300 Litres of Foam Concentrate & 2,240 Kg of DCP was consumed to extinguish the fire
13	The leak test of the unit was carried out at 1.2 Kg/cm ² g of steam pressure against 4.0 Kg/cm ² g steam pressure as mentioned in the Operating Manual.
14	As per Electrical supervisor of the agency, the electrical technicians who lost their lives were not assigned any job near the incident site. Reasons for their presence at TS-2 was not known
15	Unit Start up clearance was issued with out close out of all actionable points.

Root Cause Analysis

SI No	Probable cause
1	The immediate cause of Fire/Explosion was due to leakage/spillage of Naphtha from Low Point Drain provided at the inlet line of trim cooler.
2	The valve was improperly tightened/closed during its last operation. LPD might have been kept de blinded for draining/checking of condensate and remained inadvertently open after the last activity of steam condensate draining
3	Another possibility was LPD might have had scales deposition inside and the drain valve did not get fully closed due to choking. Subsequently when the upstream pump was started, it got unplugged and Naphtha came out from the LPD.
4	The leaked out Naphtha vapour formed a combustible mixture with air and blew the trim cooler floor.
5	Since no hot work was being performed near the site and CDU & VDU furnaces are about 60-70 m away from Naphtha trim cooler, generation of electrical spark (from either non FLP electrical wiring/connections or from the electrical junction boxes in which fasters were missing) is considered most likely source of ignition resulting in explosion/fire.

Action that could have Prevented the Incident

SI No	Actions
1	Box-up of the trim cooler LPD with blind flange after condensate draining and prior to putting the trim cooler into hydrocarbon service
2	Compliance to observations made in the unit start up checklist namely, removal of temporary electrical connections & non FLP fixtures, readiness of DCS system, removal of extensive scaffolding etc.
3	Testing & ensuring operability of Gas Detectors prior to Hydrocarbon feed in
4	Proper checking/monitoring of the circuits after same is put in line so as to identify any abnormality/leakage etc.

Recommendations:

Sl No	Actions
1	Temporary electrical connections and non flame proof lightings to be removed from plant before taking hydrocarbon inside the unit.
2	Availability and working of all Hydrocarbon Detectors to be ensured before unit start up
3	Additional portable HC detectors with Audio-Visual signal to be deployed during unit commissioning
4	Integrity of Explosion Proof enclosures to be ensured.
5	No job to be permitted inside unit after start up clearance is issued. Entry of unauthorized persons inside the unit during start up should not be allowed. Practice of having Safety helmets embossed with 'Commissioning Crew" can be adopted to ensure entry of only authorized persons.
6	Pressure test of the unit should be carried out as per approved SOP.
7	Before & after line up of any circuit or equipment for commissioning, thorough physical checking of the same is to be ensured for detection of any abnormality (e.g. loose joint, leak, vibration etc.)
8	Availability of CCTV camera at strategic location in the unit to be reviewed and provided for better coverage and monitoring.
9	Fire retardant suit/apron should be used by all the personnel engaged for working inside the plant

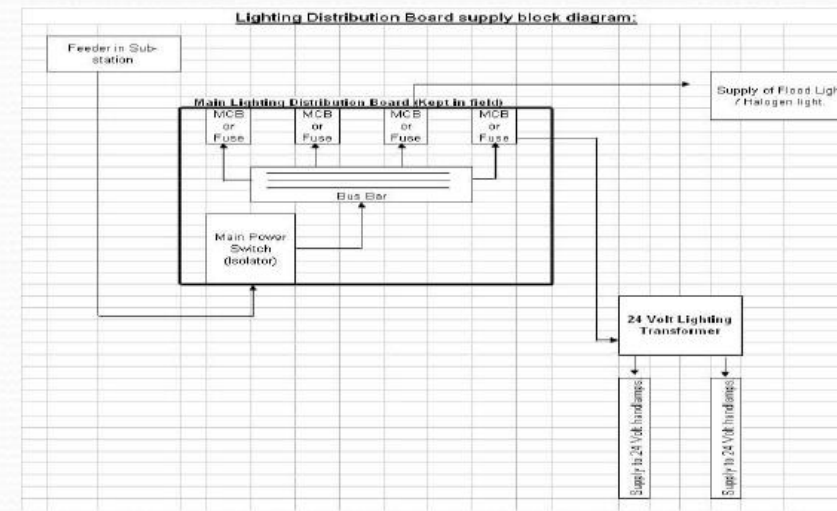
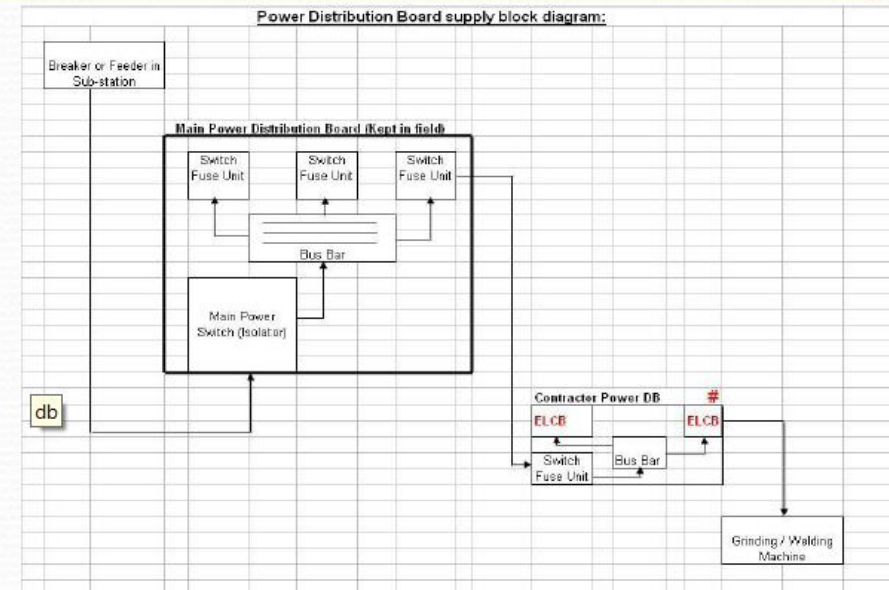
Recommendations:

SI No	Actions
10	All the operation & maintenance related activities are to be noted in adequate detail in the shift log book for record and benefit of subsequent shift –in-charges as well as others.
11	Start up clearance report to be prepared with utmost care after careful assessment / focus on: (i) All the actionable points under the exception list, Operational readiness review report and the F&S checklist (ii) Major operational changes undertaken in the unit(DCS system in this case)
12	Comprehensive health assessment of fire affected area to be carried out for assessing the integrity of equipment , piping, electrical cables etc. and necessary M&I to be completed before re- start up of the unit
13	For enhancement of Plant Safety, following actions suggested by OISD investigating team: (i) Specific assignment of roles/responsibilities to be defined amongst the shift officers & operating staff deployed particularly during the plant stat up phase. (ii) Based on past experience, critical fire prone areas due to line leaks, gland leaks, valve passing etc. to be identified and specific SOPs to be developed, displayed and discussed amongst the crew before the start of any critical activity. (iii) Along with start-up checklist, SOP on “what Can Go Wrong” analysis to be prepared along with mitigation measures in place.

Paradip Refinery

Temporary Electrical Connections

1. Ensure only licensed electricians are permitted for electrical works.
2. Ensure use of 3-pin plug & sockets.
3. Ensure proper earthing.
4. Do not use loose, damaged naked cables.
5. Ensure use of ELCB of proper rating for all temporary electrical connections.
6. Ensure cables are laid above ground & are prevented from any mechanical damages.
7. Do not apply water on live electrical equipment.
8. Do not overload electrical circuit.
9. Keep the mains off after completion of job
10. Ensure periodic checking of ELCB



1. Proper Supervision during execution of job
2. Following of SOPs
3. Explaining the potential hazards to the executing depts.
4. Avoiding shortcuts
5. Use of proper equipment
6. Increased level of awareness

Operations, Maintenance & F&S : All Departments to remain extra vigil during the shut down period. Any shortcomings to be addressed promptly.

