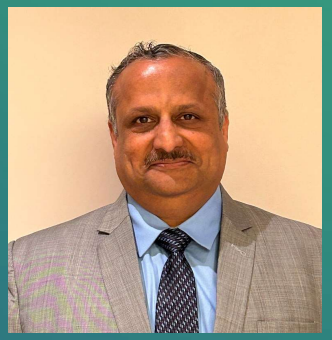
PNGRB Two-Day Mega Conference
Pioneering Technical Innovations for a Safe Tomorrow
16th & 17th December 2024

"Accident Prevention and Learnings from Major Incidents / Accidents in Petroleum Industry"



S N Soman
CGM- Operations, HPCL Mumbai Refinery

Agenda

Delivering Happiness

1. Industry Incident Data Overview
2. Common Root Causes of incidents
3. Major learning from Past incidents / accidents
4. HPCL Safety Initiatives
5. Way forward - Strengthening Safety

IOGP FAR

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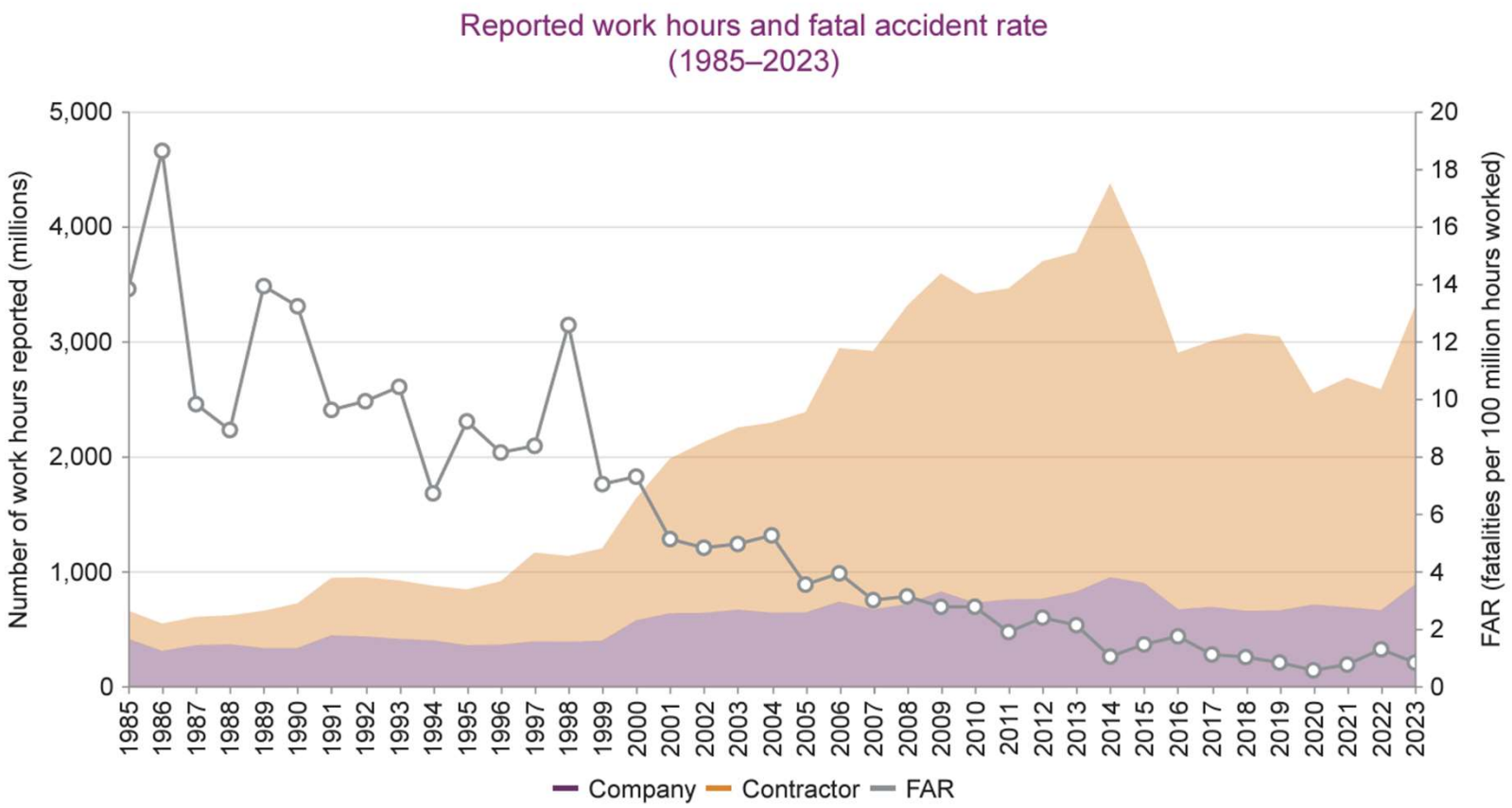
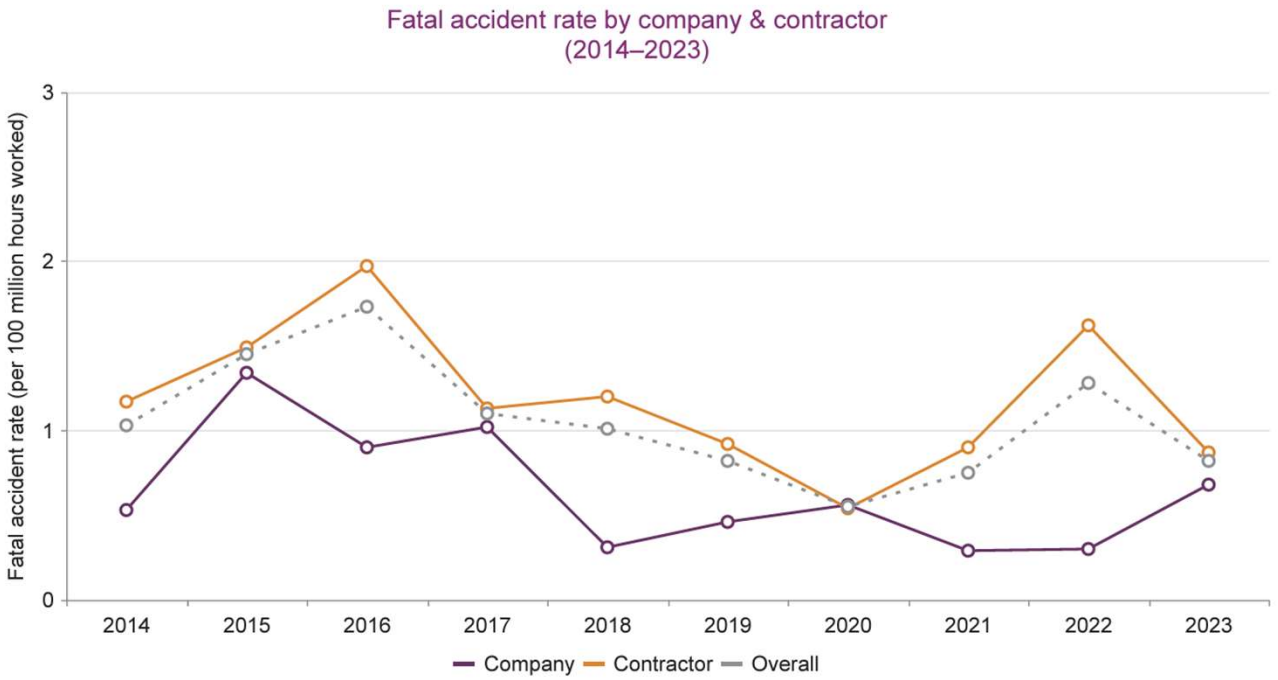
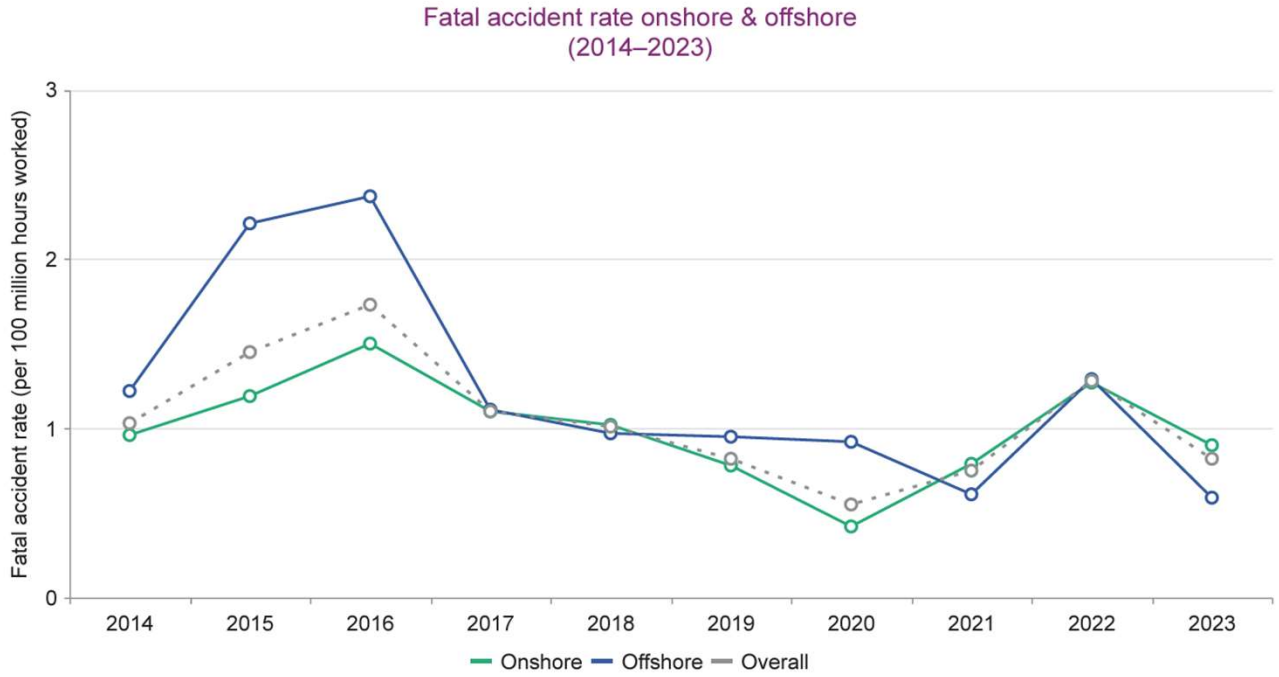


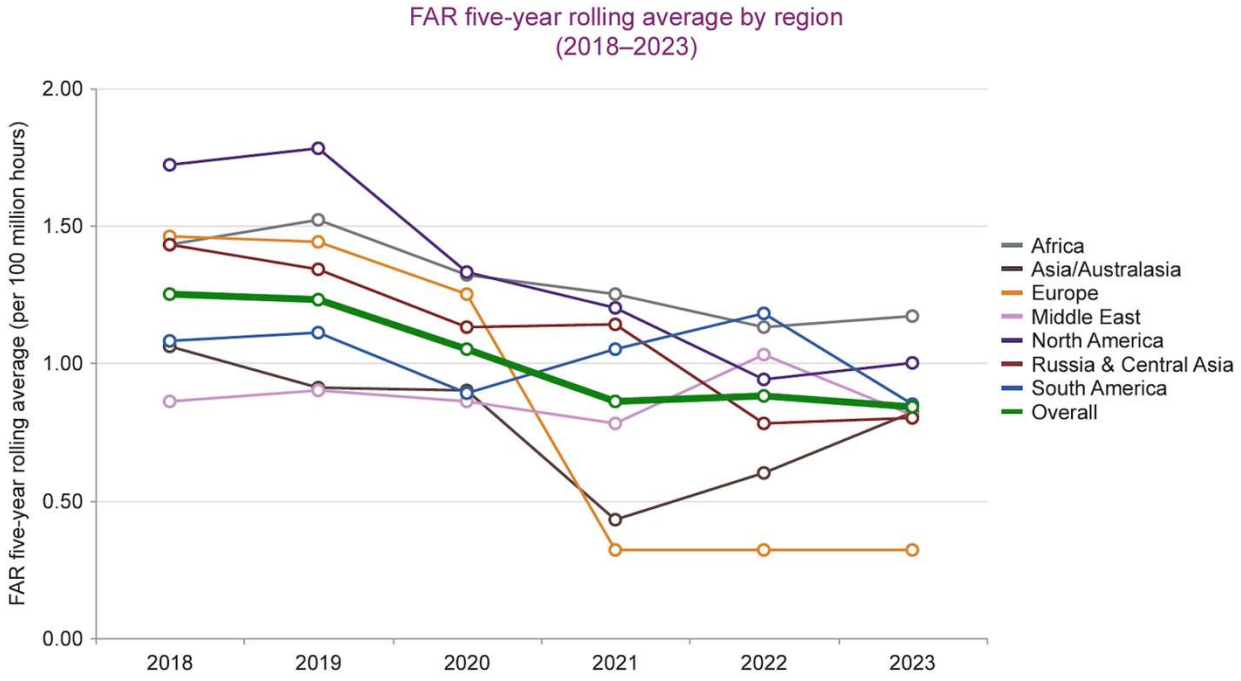
IOGP Fatal accident trend



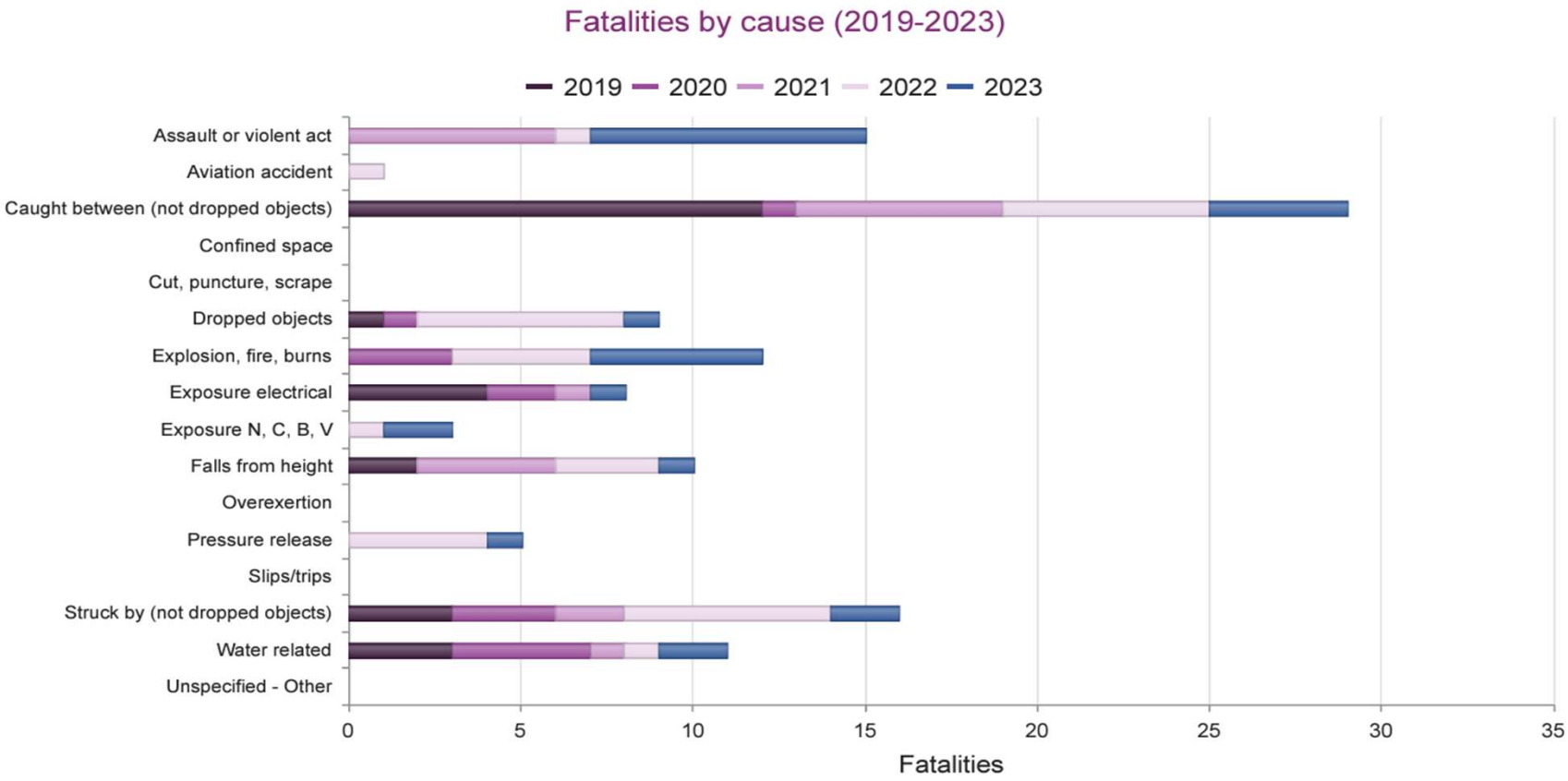
IOGP FAR onshore & Offshore



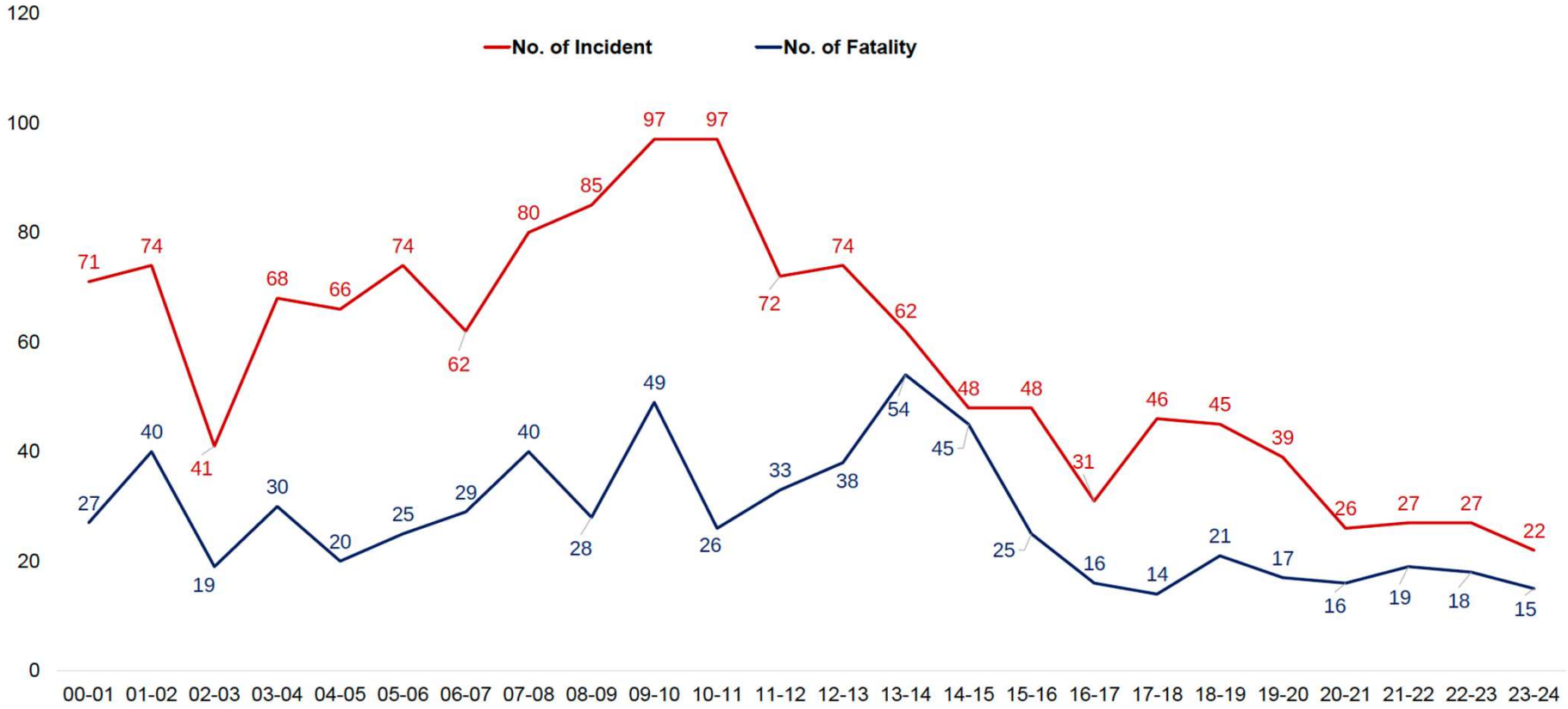
IOGP FA last 5 years



IOGP Fatality by Causes



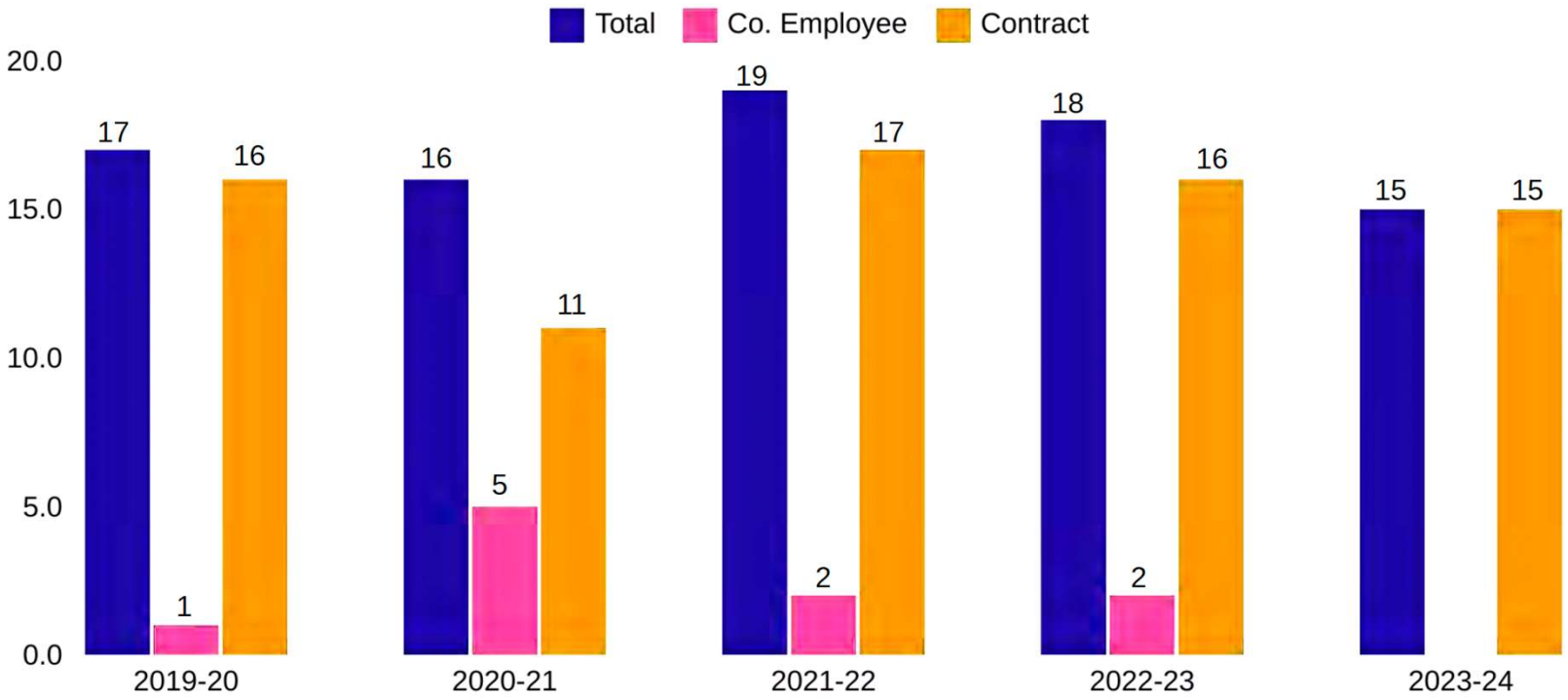
Major onsite incidents and fatalities-India



Does not include Retail Outlet, CGD, Offshore vessel, Helicopter, Road accident during transportation of petroleum products & Private marketing installations

Source: OISD SCM data

Fatality: Contract vs Company Employee-India



Source: OISD SCM data

Root Cause of major incidents worldwide

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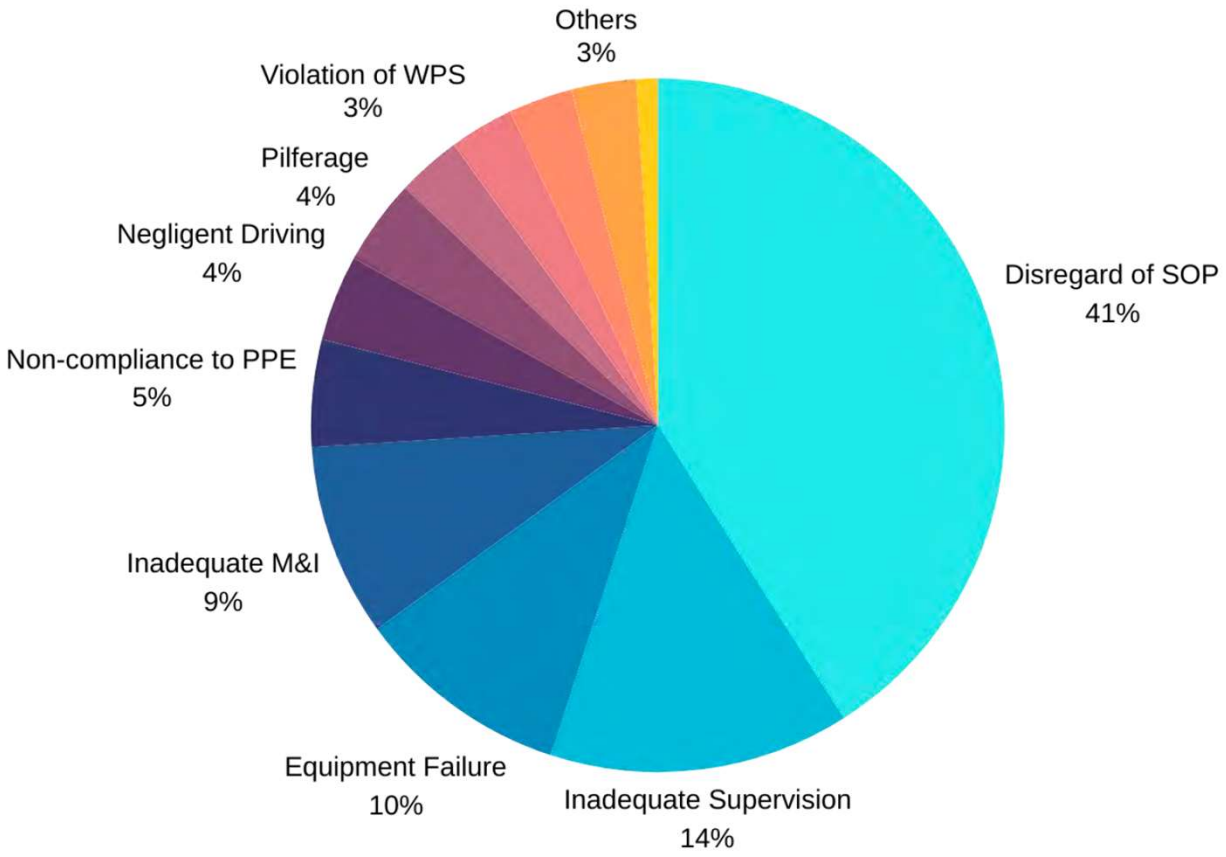
- **Worldwide, there have been @ 32 major incidents in O&G sector in last 20 years leading to 900 fatalities and 4908 injuries.**

- **Major causes have been under following categories:**

  - **Design Factors**
  - **Operational Factors**
  - **Maintenance Factors**
  - **Personal**
  - **Competency**
  - **Culture**
  - **Regulator**

Source: IChemE data

Root Cause of major incidents-India-Last 5 years



Source: OISD SCM data

Common Causes of Incidents

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Human Factors

1

- Inadequate training
- Complacency
- Fatigue and poor communication
- Normalization of Deviance
- Increase in errors

Behavioural and Cultural Issues

2

- Resistance to change
- High-risk tolerance
- Safety not a measurable matrix for business case

Common Causes of Incidents

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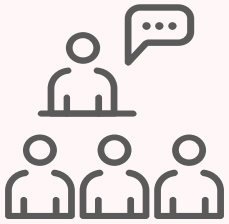
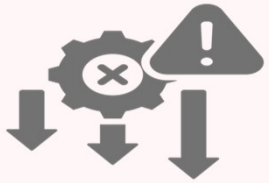


Organizational Factors 3

- Minimal Leadership focus on Safety Culture
- Inadequate supervision
- Insufficient Resources
- Outsourced Services
- Inconsistent Policy enforcement



Procedural Failures 4

- Lack of clear SOPs
- Too many SOPs
- Strict Adherence to Procedures
- Inadequate Risk Assessment
- Down time of Mitigation & Preventive barriers.

Common Causes of Incidents

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Environmental Conditions 5

- Increased Complexity
- Changing Operating conditions
- Poor hazard assessment
- Increased DCS
- Emergency preparedness

Incident Investigation Gaps 6

- Root Causes - Need to beyond Standard Reasons
- Systemic changes must
- Monitoring of implementation across the organization
- Periodic due-diligence
- Follow-up

Common Causes of Incidents

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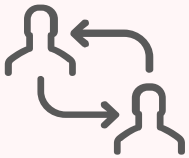
Asset Integrity 7

- Ageing
- Shifting of Maintenance Schedules
- Delayed Upgradation / modernization



Corporate Amnesia 8

- Individuals learn from mistakes throughout their lives
- Organization's frequently repeat the same mistakes
- Institutionalizing learnings is a challenge

Key Learnings from Major incidents worldwide

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❑ **As per Chat GPT, following are the Key Learnings from major incidents:**

1. Importance of Safety culture
2. Risk Assessment and Management
3. Need for robust Emergency Response Plans
4. Continuous monitoring and maintenance
5. Regulatory compliance and auditing
6. Human factors and decision making
7. Importance of Incident Investigation and Root Cause Analysis
8. Technological advancements for safety
9. Contractor Management
10. Environmental Responsibility and Response
11. Transparency and Accountability
12. Global Collaboration

Source: IChemE data

Key Learnings from Major incidents

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Human Factors

1

- Proper and time tested competency evaluation and trainings
- Job rotation to avoid complacency
- Impetus on effective (To Whom, When, What) communication
- Approval hierarchy for normalization of deviations
- Human factor Engineering
- Address cognitive biases

Behavioural and Cultural Issues

2

- Safety as Business case with POC
- Improve Safety Leadership
- Top driven but bottom implementation approach
- Create proactive safety culture
- Well defined Safety KPIs for each and every one
- Encourage open communication at all levels

Key Learnings from Major Incidents

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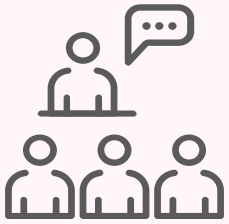
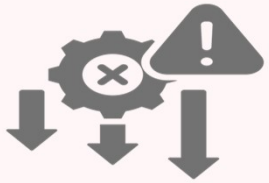


Organizational Factors 3

- Focussed Safety Leadership
- Provide adequate Supervision
- Provide adequate resources
- Outsourced manpower to be as employees for safety
- Policy enforcement to be consistent



Procedural Failures 4

- Well documented, owned and published SOPs
- Non routine Jobs monitoring
- Strict Adherence to Procedures
- Proactive Risk Assessment for new /add on assets
- Down time of Mitigation & Preventive barriers.

Key Learnings from Major incidents

Delivering Happiness

Environmental Conditions 5

- Commitment to Net Zero
- Better spill response technologies
- Improve waste management practices
- Quick and effective Emergency Response
- Mock drills on various scenarios

Incident Investigation Gaps 6

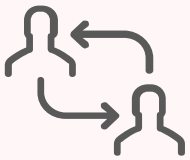
- Promote Open communication culture
- Systemic changes must
- Monitoring of implementation across the organization
- Periodic due-diligence
- Follow-up

Key Learnings from Major incidents

Delivering Happiness

Asset Integrity 7

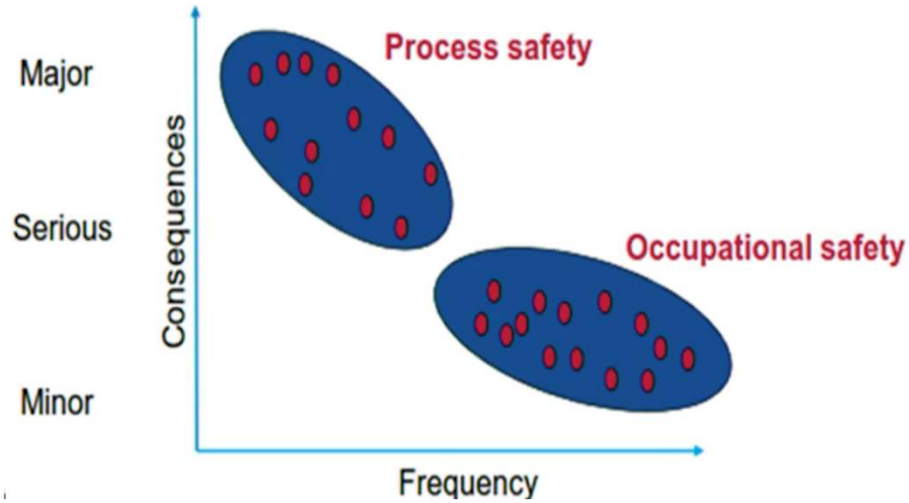
- Asset Integrity Management Program
- RLA schedule and Mitigations measures
- Obsolescence Management Program
- Usage of modern Technology for Predictive analysis
- Robust MOC process covering Asset integrity



Corporate Amnesia 8

- Common platform for sharing of learnings
- Horizonal compliance across organization
- One Organization-One Safety Culture
- Risk Identification /Assessment /Mitigation

Personal Safety & Process Safety



Personal Safety

- Focuses on protecting individuals from harm
- Skill based jobs
- Human Behavior
- Injury Prevention

Process Safety

- Risk Management
- System Integrity and Reliability
- Technology, Processes, and Equipment,
- Applied at the engineering and management level

Initiatives in HPCL for enhancing Safety

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How do we improve Safety Culture?? (What is Culture???)

1. Scheduled Safety tours by GMs and above
2. Do not walk past safety deviations initiative
3. Safety Volunteer program (50 volunteers)
4. EHS, RSC and PLSC meetings
5. Unit Area Team Concept for day to day working
6. Spot the Hazard initiative
7. Safety Pause concept implementation
8. Safety Challan concept by permit receivers themselves
9. “Error Café “concept implementation in Operations for critical jobs
10. Flare monitoring in mobile phone of Head Operations (Plant irregularity tracking off the shift)
11. Safe Operating Envelop Kiosk in offices of GMs and above
12. Safety Task Observations of operational activities by other UAT Section Heads
13. Innovation day (UAT) and innovation Council (Refinery) concept implementation

Initiatives in HPCL for enhancing Safety

Delivering Happiness

Other measures to improve Safety:

1. What Can Go Wrong (WCGW) analysis for each critical activity
2. Implementation of Job Vulnerability Index concept for all planned jobs (Plant, Process, People)
3. AI/ML based emergency handling scenario simulation training
4. Specific Process Safety Cardinal Rules for operations based on previous incidents
5. Driving Habit monitoring outside Refinery
6. Safe driving Dangler cards in all vehicles
7. First Air and CPR certification training to 100% employees of operations and F&S dept
8. Lone Worker protection thru Gas detector connected platform
9. Unit Trespassing monitoring thru digital tools
10. Positive Metal Identification for all the critical circuits in 3 stages
11. Process LOTO implementation and digitalization
12. Process Safety Leading indicators monitoring in EHS meeting
13. Visitor Pass Management system (Plant and non plant visitors and safety induction)
14. Life Saving rules experience center
15. STFO concept for all the tanks post T&I

Initiatives in HPCL for enhancing Safety

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Other measures to improve Safety:

1. PSM (total 19 elements) implementation
2. Animated incident display on all monitors including Canteen, Cafeteria
3. Metaverse training platform
4. Auto detection of PPE non compliance using CCTV camera monitoring system
5. Every meeting to start with Safety moment
6. Mega Insurance survey and action item implementation based on Global practices
7. Alarm Rationalization, Management and trip Management Authorization Digitalization

Way forward

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Leadership and Commitment

- Lead by example
- Encourage dialogue
- Fostering behavioural safety
- Bringing in Safety focus of Middle and Senior Management
- Promote open reviews
- Stop Work Authority – A Responsibility
- Celebration +ve safety outcomes
- Encourage innovation

Assurance

- Enhancing Safety Competency
- Dashboards – for KPI
- Monitor Operating excursions
- SOP monitoring through Video Analytics
- Mechanical integrity assurance
- Contractor rating system

Sense of Vulnerability

- Vulnerability Index to prioritize critical tasks
- What can go wrong sessions
- Safety Pause
- Knowledge of process safety events
- Near-misses
- Unsafe Conditions and Acts
- Critical review of Start-up jobs

Continuous Improvement

- Daily Safety Moment
- Institutionalizing Learnings from incidents
- Use Digital tools
- Remote Safety monitoring tools
- Advanced trainings
- Benchmarking Safety performance
- Networking and sharing

Thank You !!!

Personal Safety - Life saving rules

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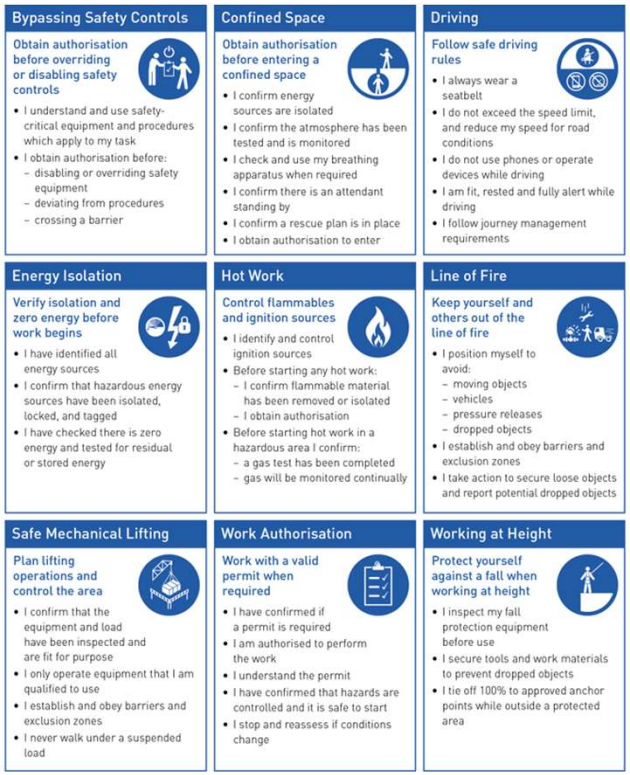
IOGP – Lifesaving Rules



HPCL – MR Lifesaving Rules

Process Safety Management

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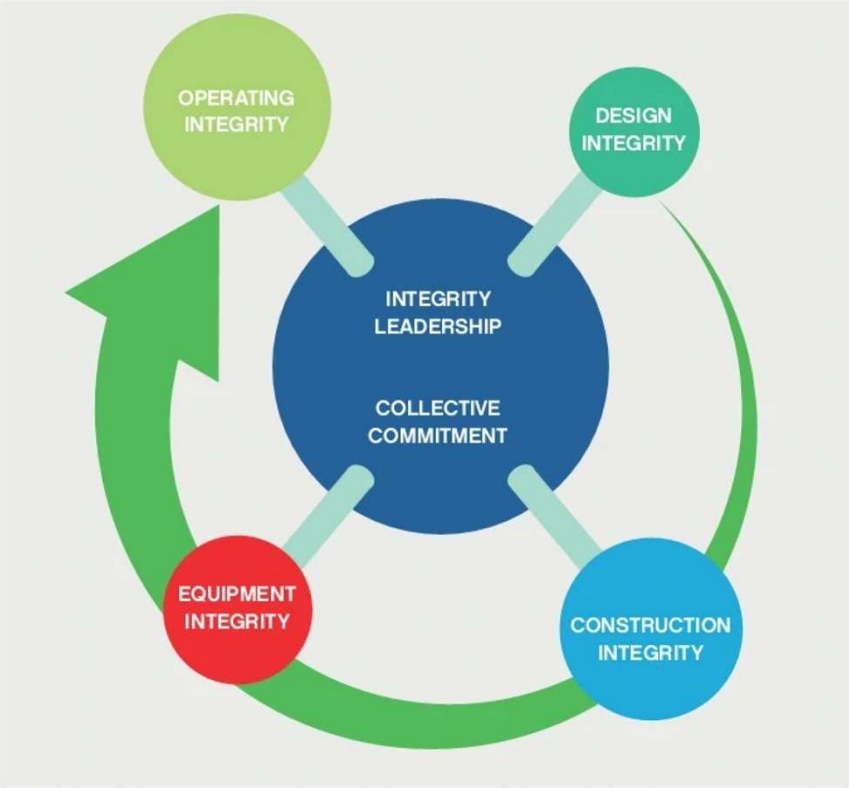

Process Safety Rules

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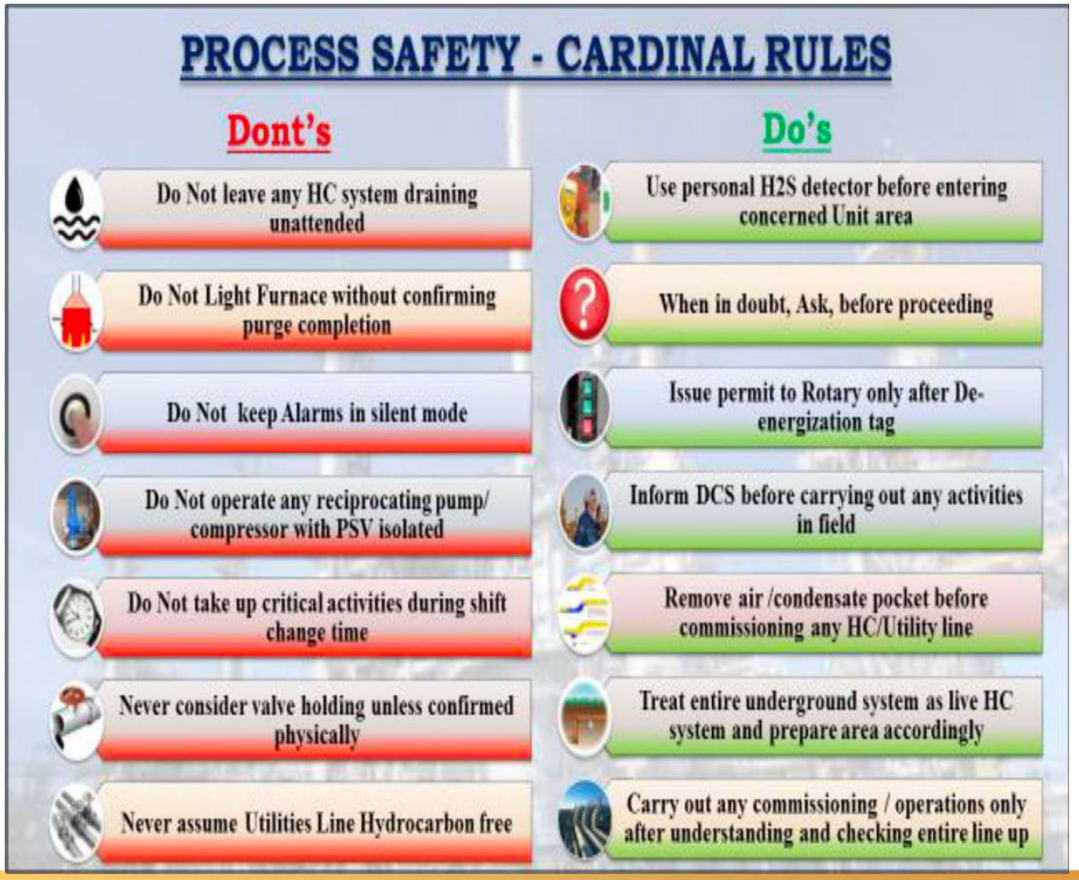
HPCL – MR Process safety Cardinal Rules



Process Safety Fundamental

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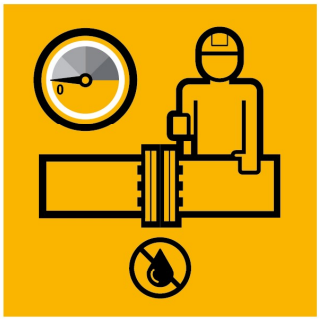
IOGP – PSF



Maintain safe isolation

Walk the line

Apply procedures

Sustain barriers

Control ignition sources

Recognize change

Respect hazards

Stay within operating limits

Stop if the unexpected occurs

Watch for weak signals

EPSC Process Safety Fundamentals

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Focus on Human barriers

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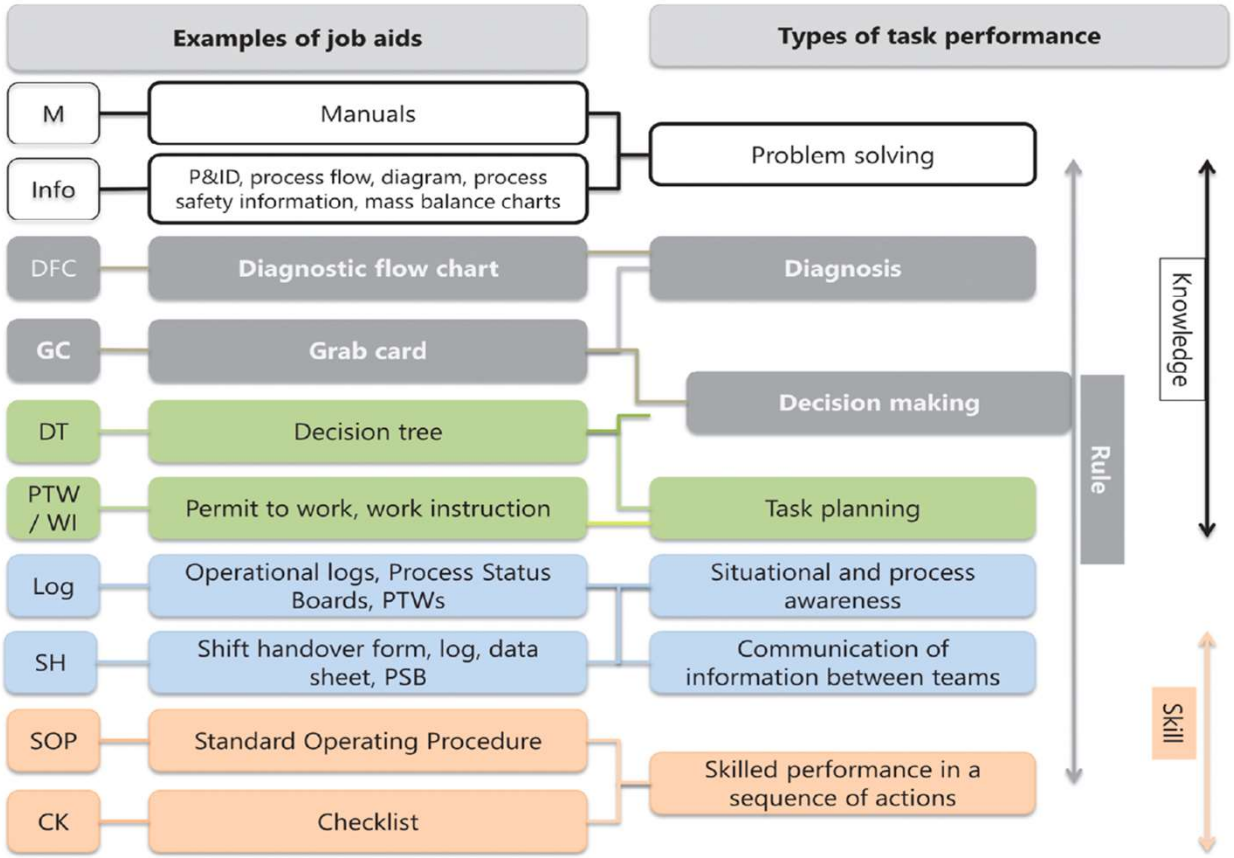
Tools for safety



Key:

CK = Checklist.
GC= Grab card.
DFC = Diagnostic flow chart
DT = Diagnostic tree
Info = Process safety information
Log = Log books etc.
M = Manual
PSB = Process Status Board
PTW = Permit to work
SH = Shift Handover
SOP = Standard Operating Procedure
WI = Work Instruction

Safety Awareness Communication

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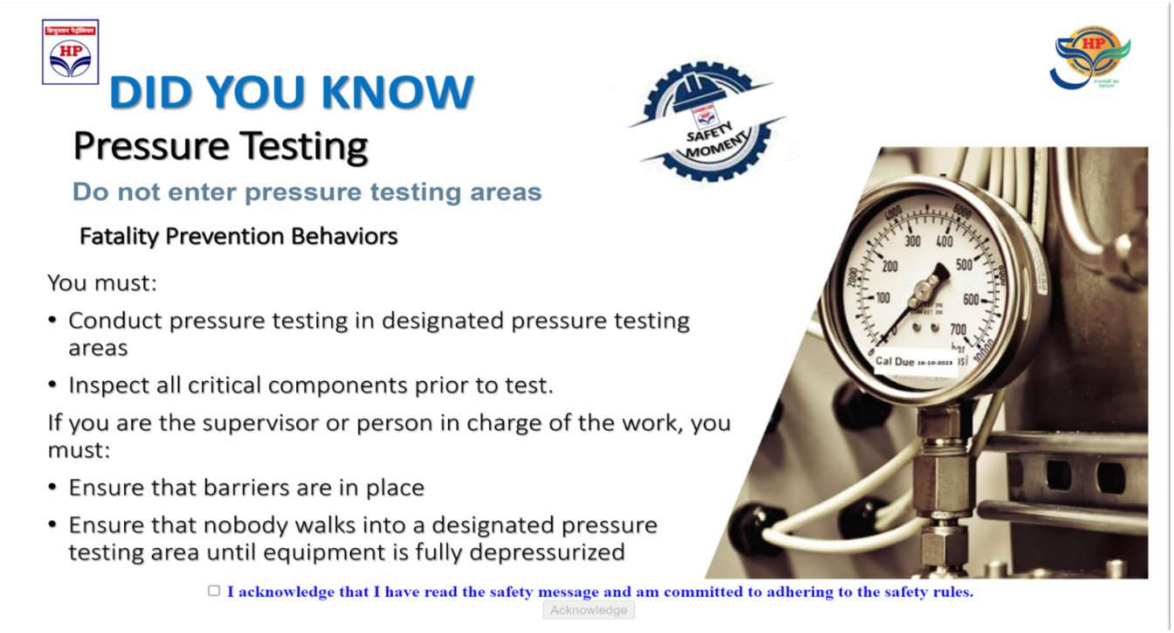
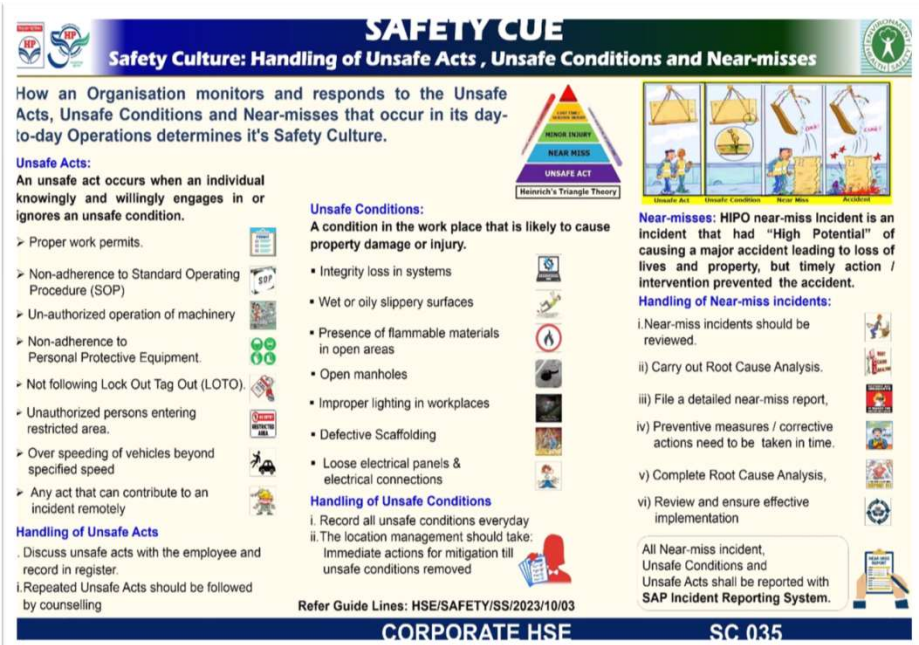
1. HPCL introduced **"Safety Cues**" as a communication tool. Visual reminders of fey safety practices.
2. Safety Cues are one-page documents with safety messages and images.
3. HPCL also shares weekly **safety videos**. Engaging multimedia safety content
4. **Safety moment:** A safety message popup appears on the screen, and the PC cannot be accessed until it is read and acknowledged.





DO NOT WALK PAST SAFETY DEVIATION

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What is a Safety Deviation?

- ✓ ***Unsafe Practices**: Improper use of tools or equipment, bypassing safety guards, or neglecting personal protective equipment (PPE).*
- ✓ ***Hazardous Conditions**: Spills, leaks, damaged equipment, or obstructed pathways.*
- ✓ ***Incomplete Safety Protocols**: Missing signage, unmarked hazards, or incomplete documentation.*

Why It Matters:

- ✓ *Prevent Accidents*
- ✓ *Promote a Safety Culture*
- ✓ *Ensure Compliance*

"Spot Safety Deviations, Shape a Safer Workplace!".

LIFE-SAVING RULES

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- ✓ **Set clear expectations** for responsibilities.
- ✓ **Lead by example**, modeling appropriate behavior and timely intervention.
- ✓ Introduce **Life-Saving Rules** during new joiner inductions.
- ✓ Facilitate **discussions on the rules** in toolbox talks and safety meetings.
- ✓ **Emphasize the Life-Saving Rules**' purpose of saving lives.
- ✓ Encourage **peer-to-peer intervention** and reporting without fear.
- ✓ Approach **Life-Saving Rules observations** with a learning mindset.
- ✓ Implement Fair Event Handling and a systems approach to **promote reporting** and self-reporting.
- ✓ **Investigate high-risk or learning opportunities**, focusing on improvements and compliance. Analyze trends to enhance controls.

Volunteer Safety - Contractor Safety Connect

Personalized Engagement: taking the time to learn about their family background, life experiences, and the challenges he have faced.

- ✓ *Building Trust Through Connection*
- ✓ *Family-Inclusive Safety Culture*
- ✓ *Future-Oriented Growth*
- ✓ *Continuous Support and Development*

"Building Trust, Connecting Lives: A Family-Inclusive Safety Culture for a Stronger, Safer Future"

SAFETY PAUSE

Observing a brief 5-minute safety pause upon arrival at the worksite is a critical practice to ensure the safety and well-being of all workers. Here's a brief overview in 6 Easy Steps

- ✓ *Safety Compliances*
- ✓ *Unsafe Conditions*
- ✓ *Equipment Inspection*
- ✓ *Establish a Communication*
- ✓ *Documentation*
- ✓ *Worker Connect*

"Pause. Inspect. Connect. Ensure Safety "

Safety Awareness Trainings

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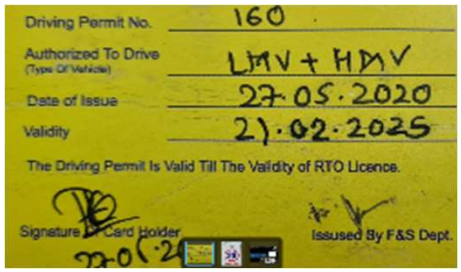
- Induction Trainings
  - 5 Days F&S Induction for Employees
  - Safety Induction for workmen (Gate pass interlock with safety training)
  - F&S Induction for Transferred employees
- Refresher Trainings
  - Fire Fighting Refresher for Employees
- Work Permit Training
- Traffic Safety Training (RDP)
- Contractor Supervisor Safety Training and competency certification with yearly validation
- Fire Training to CISF Employees
- Training to Apprentice and Summer Trainees



Safety Awareness Trainings

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SN	ACTIVITY	DAYS
1	General Department Overview	1 Day
2.	Individual Unit Assignment and Overview	1 Day
3.	Training on Process Flow Diagram	2 Days
4.	Line Tracing of Individual Unit Assigned	7 Days
5.	Process Equipment Start Up, Shutdown, Emergency Handling	7 Days
6.	Written test and personal interview with Section Head	1 Day
7.	Standby Charge in Day Shift	7 Days
8.	Standby Charge in Evening Shift	7 Days
9.	Residual Training Requirement Basis Assessment	7 days
10	Routine Independent Charge in Shifts	7 days

Contractor safety

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- Safety Induction Training
- Scaffolding Certification by Competent Person
- Certification & Tagging of Equipment
- Tool Box Talks
- Site Safety Briefings
- Training/Certification for Contractor Supervisors
- Pre-shutdown Meeting for major works
- HSE Requirement In Tenders

Employee Engagement

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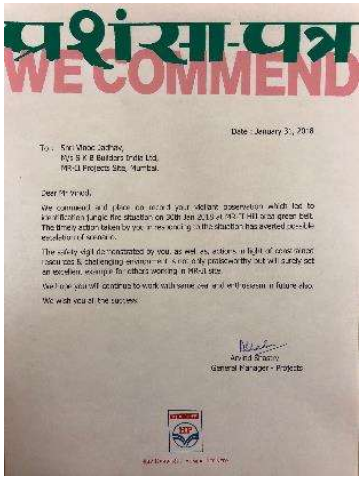
- Safety Register System
- Participation in ISA,JSA, RSC and PLSC.
- Loss Control Meetings/ Safety Talks
- On the Job Trainings
- Monthly Incident sharing
- Appreciation/Commendation



PROCESS SAFETY - INCIDENT TRIANGLE

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- Knowledge
- Communication
- Experience
- Training

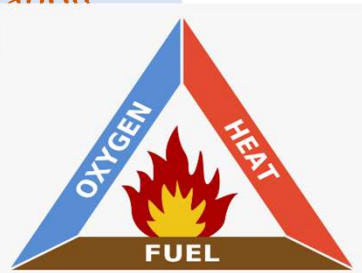
Lack of understanding Wrong Safety focus

- Work load
- Stress
- Age factor

Comfort & Convenience Saving Time / Short cuts

- Behavioral

Complacency Achievement Orientation

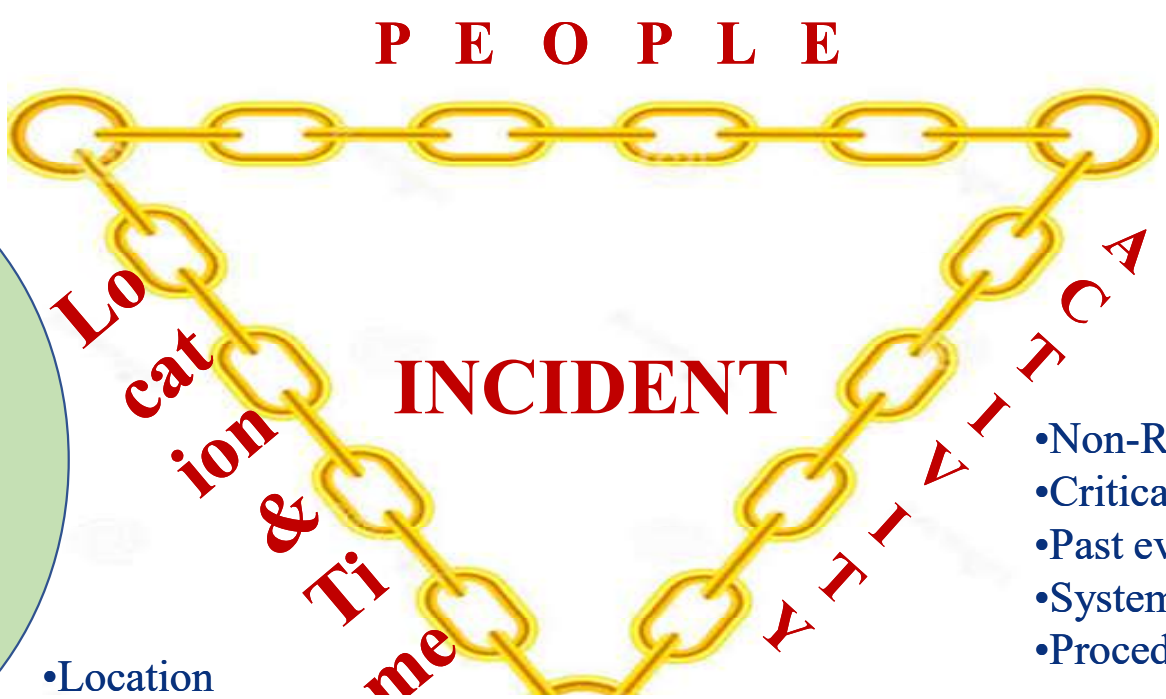


THE 3 A'S OF SAFETY

AWARENESS

ANTICIPATION

ACTION



- Location

- Non-Routine
- Critical Routine
- Past events
- Systems
- Procedures

Vulnerability Index

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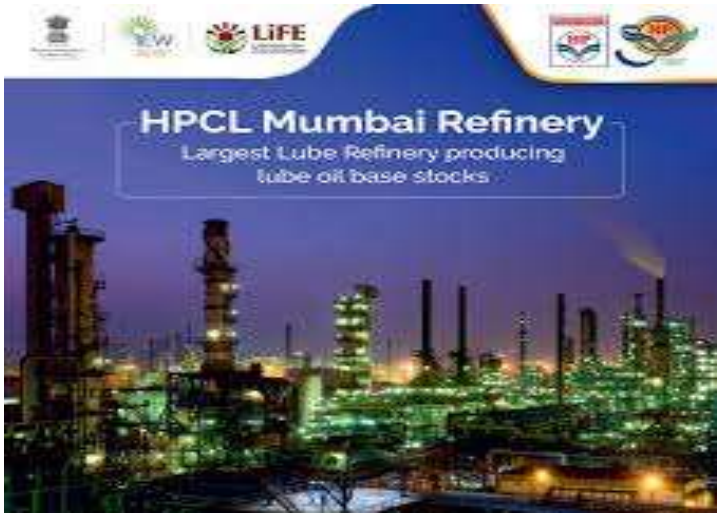
1. Vulnerability Index (VI) is a tool to understand and predict complexity of High hazard activities
2. **VI Score Assignment -** Risk level assessment for each work area
3. **Targeted Monitoring -**Focused oversight based on VI severity
4. **Continuous Improvement -**Ongoing efforts to reduce risks and enhance safety

VI is based on three factors for identification of Hazards:

1. Location of the job (based on Assets, lines, instruments etc.
2. Nature of job (Type of permit)
3. Human factor (Experience of supervisor, Maintenance, and Contractors etc.)



- High-risk areas are given prioritized attention to reduce incidents and improve workplace safety.
- A proactive approach helps allocate resources effectively.
- Potential safety concerns are addressed before they escalate, ensuring continuous safety improvement.

Vulnerability Index

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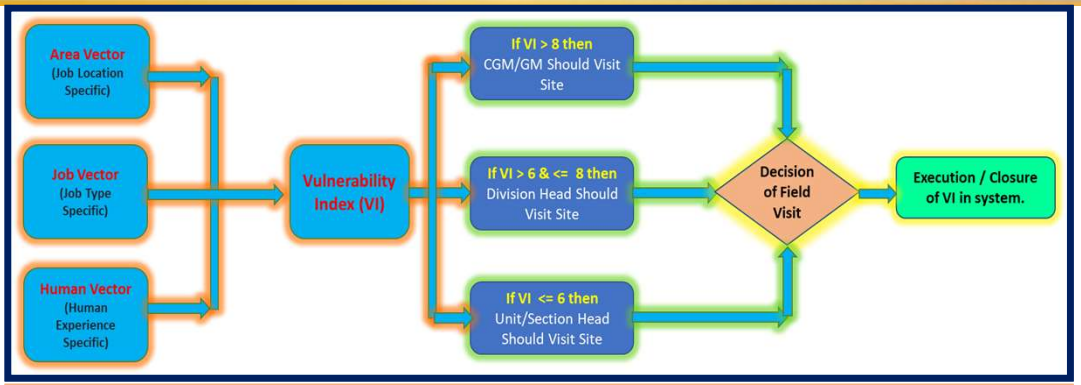

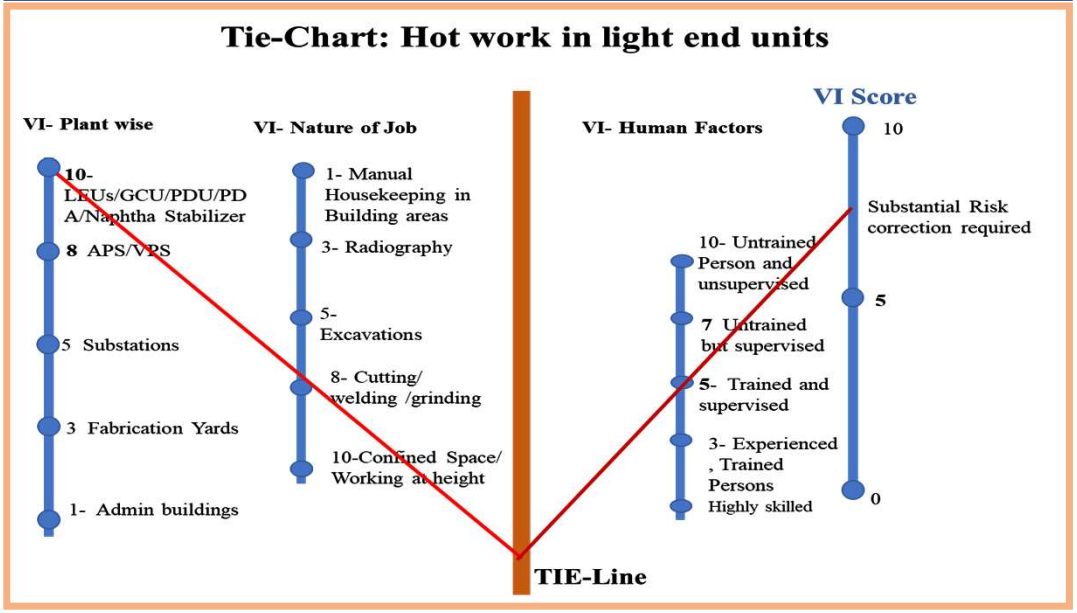

Permit No. 100000303040

Hindustan Petroleum Corporation Limited 6000 - Mumbai Refinery Hot Work Permit	Work Order	130000264726
	Start Date	23:10:2024 15:50:07
	End Date	29:10:2024 23:59:59

Description of work	To do vehicle entry at LPG unit for scaf 23.10.2024 15:49:44 INDIA (31999520) To do vehicle entry at LPG unit area for scaffolding material shifting.				
Functional Location	LPG STORAGE AREA OMCC FR	Work Center	STATIC		
Equipment					
Exact Location of work	LPG UNIT ISBL			Vulnerabilty Index	06
Issued to Contractor	MAGS ANTI CORROSIVE COATINGS PVT. L			No. of Workmen	0010
Issued on	24.10.2024 - 10:42:13	Shift	08:00-16:00	Start Time	10:42:13
JSA Ref No.		Electrical Isolation No.		Mechanical Isolation No.	
Permit Sub Type	Crane / Forklift / Vehicle Entry				

VI Score	Risk Level	Action
Low	Min	Regular monitoring
Medium	Moderate	Enhanced supervision
High	Significant	Prioritised mitigation

Job Vulnerability Index

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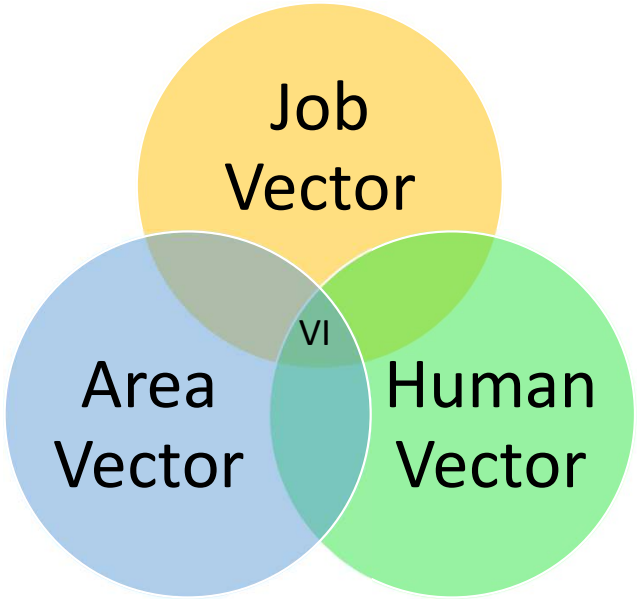
Final Job Vulnerability Index is average of Job VI, Area VI and Human VI

$$\frac{\text{Area VI + Job VI + Human VI}}{3}$$



Safety Chalan System

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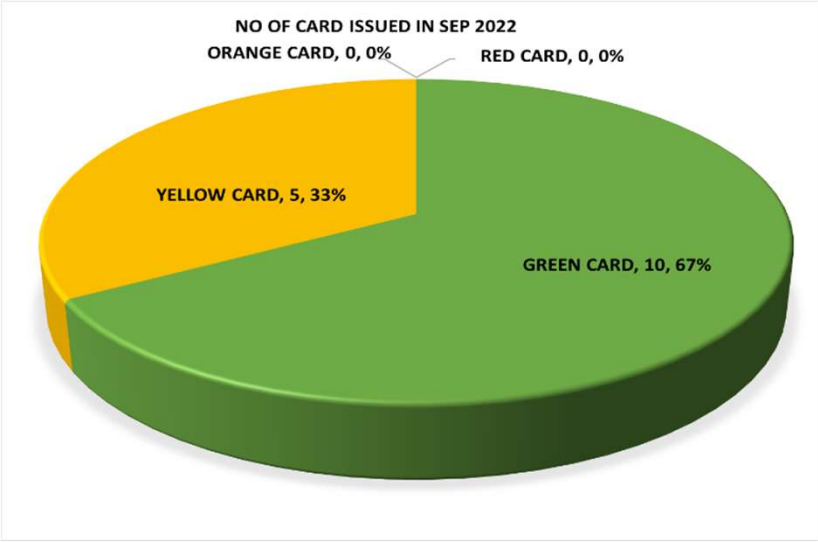
Sr No	Green Card	Yellow Card	Orange Card	Red Card
No of Cards Issued	10	05	00	02



Card Type	Green Card			Yellow Card			Orange Card			Red Card		
Period	Till Aug 22	During Sep 22	Total	Till Aug 22	During Sep 22	Total	Till Aug 22	During Sep 22	Total	Till Aug 22	During Sep 22	Total
No of Cards	183	10	193	150	05	155	10	00	10	03	02	05

SAFE OPERATING ENVELOPES(SOEs)

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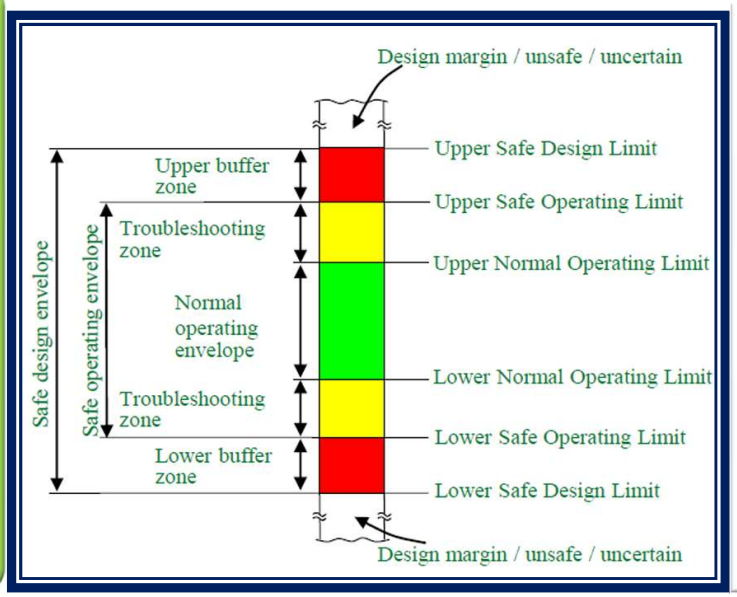
At HPCL, Mumbai Refinery have made SOEs Dashboard showing real-time values and range of critical process parameters.

The critical Operating parameters limits are called “Safe Operating Limits (SOLs) ” or “Safe Operating Envelope (SOEs)” Technical Department reviews SOEs parameters on daily basis and provide guidelines to operation as and when required.

As per API RP 754 Process Safety Performance Indicators for the Refining and Petrochemical Industries one of the Tier 3 Process Safety Events (PSE) of Plant critical operating parameters should have Safe Operating Limit / Envelop (SOL/SOE) and its excursions are need to be monitored in a specified time period.



DIU SOEs Report

		SOE Limit		Actual		Remarks	Action to be taken
escription	Tag No	Low	High	Low	High		
ass flow to Tr-1.	71FC9001.PV	1535	4000	2233.7	2555.0	OK	
ube oil pressure fro 71-C-02-B, kg/cm2g.	71PI9709B.PV	2.2	5	2.4	2.8	OK	
tripper level, %	71LC9901.PV	20	90	63.9	66.2	OK	
tripper O/H pressure, kg/cm2g	71PC0001.PV	4	10	5.9	5.9	OK	
evel in 71-D-01 %.	71LC8401.PV	70	90	79.7	96.0	Exceed High Limit	
Vash water flow, MT/Day	71FC0603.PV	85	250	251.4	257.6	Exceed High Limit	
nlet temperature of R-01, deg. C.	71TC8702.PV	250	380	364.8	374.4	OK	
ressure drop in 71-R-01, kg/cm2	71PDI8704.PV	0	6.5	3.0	3.5	OK	
ressure drop in 71-R-02, kg/cm2	71PDY1407.PV	0	8	4.8	5.1	OK	
tripper (T-02) Inlet Temperature, deg. C.	71TI9901.PV	210	240	223.0	228.5	OK	
urrent for 71-P-20, Amps	71IT1601.PV	0	670	369.9	420.3	OK	
eed rate, MT/Day	71FI8301.PV	2000	7500	4743.7	5413.8	OK	
re-filter pressure drop, kg/cm2g	71PDI8301.PV	0	1	0.4	0.8	OK	
emperature at 71-P-01-A/B/C S/C	71TC8402.PV	30	120	103.6	104.3	OK	
ressure of 71-D-01, kg/cm2g	71PC8401.PV	2	4.5	1.9	2.4	Exceed Low Limit	
ass flow to Tr-2	71FC9002.PV	1535	4000	2249.6	2557.0	OK	
os pressure in 71-F-01, MMWC	71PI1120.PV	-20	10	-14.2	-4.6	OK	
lush diesel flow to 71-P-20 m3/hr.	71FT1611.PV	0.2	1	0.4	0.4	OK	
Vinding temperature of 71-P-20, deg. C.	71TI1601.PV	40	90	47.8	51.2	OK	
op bed level in 71-R-01, %	71LT8731.PV	20	85	62.3	77.1	OK	
ottom bed level in 71-R-01. %	71LT8732.PV	20	85	39.1	98.2	Exceed High Limit	

Artificial Intelligence-Visual Aanalytics

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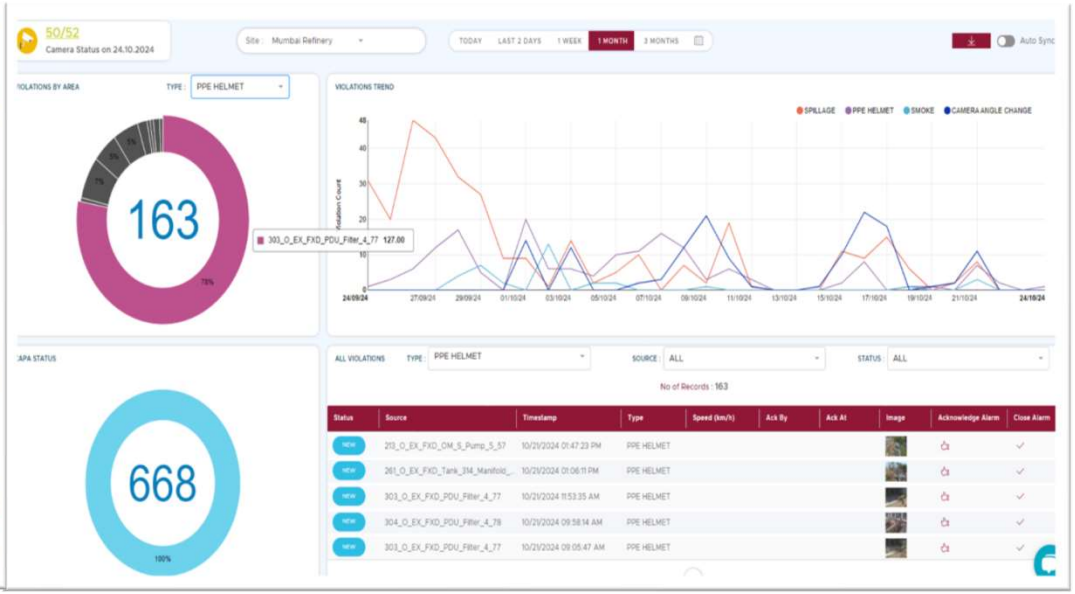
Artificial Intelligence – Visual Analytics (AI-VA) of PPE violation implemented HPCL Mumbai Refinery as part of Digitalisation, has collaborated with HPCL marketing team and implemented

This system make use of existing CCTV and using AI, helps in identifying safety violations.

Current model includes PPEs violation, trespassing, smoke detection, spillage etc.



Why all behave differently?

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Bhagavad Gita: Chapter 18, Verse 14

अधिष्ठानं तथा कर्ता करणं च पृथग्विधम् |
विविधाश्च पृथक्चेष्टा दैवं चैवात्र पञ्चमम् || 14||

adhiṣhṭhānaṁ tathā kartā karaṇaṁ cha pṛithag-vidham
vividhāśh cha pṛithak cheṣhṭā daivaṁ chaivātra pañchamam

The body, the doer (soul), the various senses, the many kinds of efforts, and Divine Providence,
these are the five factors of action.

Five Factors of Action

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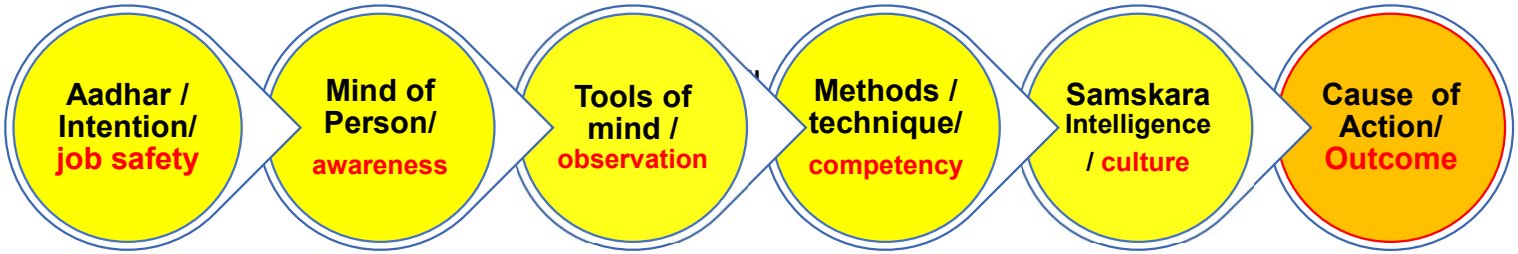
The body, the doer (soul), the various senses, the many kinds of efforts, and Divine Providence— these are the five factors of action.



Feature of Human Mind

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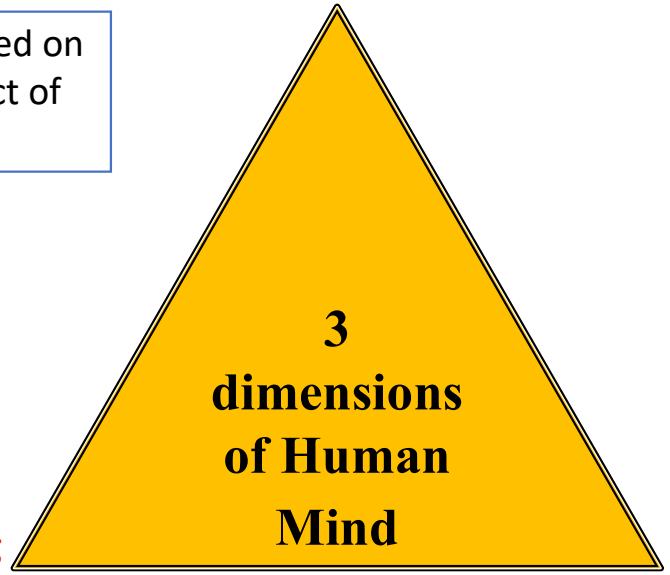
3 feature of action based on their interest in subject of Action



Think and Act

Action

सत्त्व

Act without thinking

Reaction

रजोगुण

Thinking not Acting

तमस

Results of Action in number of combinations

= (5 Number of factors of our job) ^ (3 type people act)

Number of combinations = 5^3 = 5 * 5 * 5 = 125

So, there are 125 different combinations of Quality Results can happen.

There may be many Near misses,

but incidents are few

Spot the Hazards and Take Corrective Action

Learn from each Near miss