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Indian Institute of Public Health Gandhinagar

(A University established under IIPHG Act, 2015 of Governmnt of Gujarat)

Recent Trends in Occupational Health Management

Dr Anish Sinha

Agenda

- **Occupational Health as Business Partner**
- Work Life Transformation
- Workplace Wellness
- New Age Workers, New Risks
- Workplace Health & Employee Engagement
- New Priorities, New Focus
- Case Studies
- Conclusion

Occupational Health Focus

- Protection of health at work,
- Promotion of health, wellbeing, work ability
- Prevention of occupational diseases and accidents
- Health education
- Health promotion – foundation for sound OH

Business Scenario & Perspectives

- Increased competition
- Globalisation
- Consumer groups and pressures
- Unforgiving & knowledgeable customers
- Human Resource as a major differentiator between “also ran” and “excellent” organisations

OH as a strategic business partner

- Assess effects of workplace on Health/Safety/Well-being of employees
- Identify risks and health hazards
- Advice and plan workplace and work practices
- Plan for mitigation of these risks and hazards
- Increase productivity, reduce cost

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OSH trends

- Massive Migration
- Economy – Agriculture to Manufacturing to Services
- Open market economy, MNC investments, less Govt. control
- Decline in public sector employment → decline in OSH
- Reducing statutory controls, increasing self regulation

OSH trends

- Jump from traditional to emerging OH problems
- Increasing female working population
- Traditional, New & Service sector related diseases
- Stress & Life style NCDs are major issues

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Workplace Wellness

- Wellness is a healthy balance of the mind, body and spirit that results in an overall feeling of well-being.
- It is also a condition of being in maximum physical and behavioural health.
- Workplace acts as a cohort providing the opportunity to inculcate long term healthy habits.
- Wellness at workplace is important to prevent increased lifestyle-related diseases among employees.

WHO Healthy Workplace Model

Progressive Industries

- Primary Prevention / Work Environment
- Occupational Health as Line Responsibility
- Wellness Promotion
- Targeted Interventions

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New Age Employee

- Younger, Educated
- Access to information
- Away from family influence (controls?)
- Behavioural safety
- Materialistic, focus on today
- In a hurry…….

The India Story – Younger & Stronger

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- World's largest and youngest population.
- Proportion of the working age population to rise from 58 % in 2001 to 64 % by 2021.
- Around 63.5 million new entrants to the working age group between 2011 and 2016.
- The bulk of this increase in the younger age group of 20-35.
- Multigenerational workforce comprising of a mix of Generation X and the Generation Y.

Source: CII-Deloitte Gen Next Workforce Study, 2013

Life Expectancy at Birth (2012)

From the top 100

Rank	Country	Year
1.	Monaco	89.52
2.	Japan	84.74
9.	Switzerland	82.50
18.	Canada	81.76
30.	Greece	80.30
33.	United Kingdom	80.54
39.	South Korea	80.04
43.	United States	79.68
63.	Dominican Rep.	77.97
84.	Sri Lanka	76.56
97.	China	75.41

From the bottom 100

Rank	Country	Year
140.	Indonesia	72.45
149.	Iran	71.15
151.	Bangladesh	70.94
153.	Russia	70.47
156.	North Korea	70.40
163.	India	68.13
167.	Pakistan	67.39
187.	Haiti	63.51
191.	South Africa	62.34
213.	Nigeria	53.02
222.	Afghanistan	50.87

CIA World Factbook Jan 2016

Disease Burden World Rank Order

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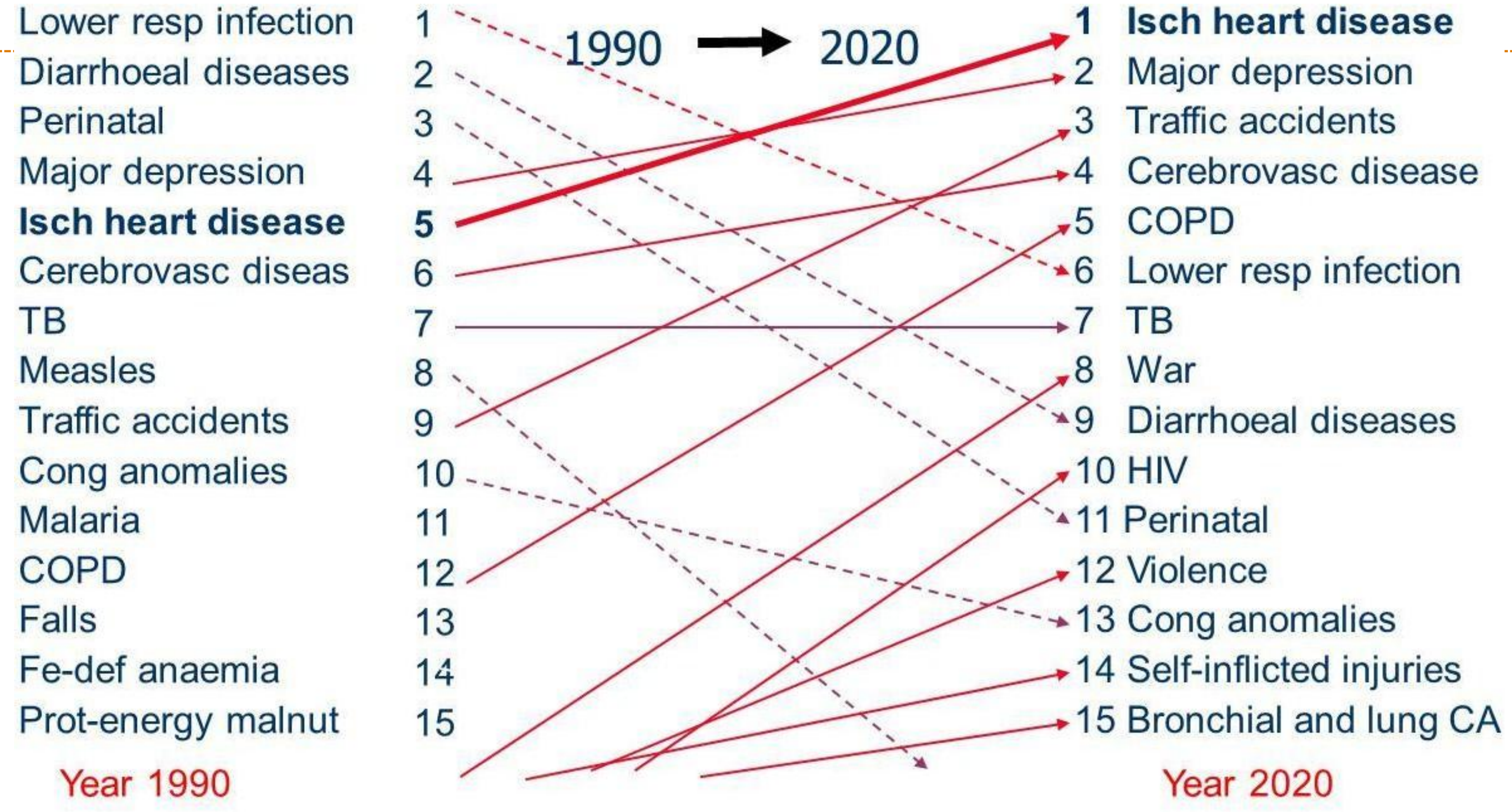
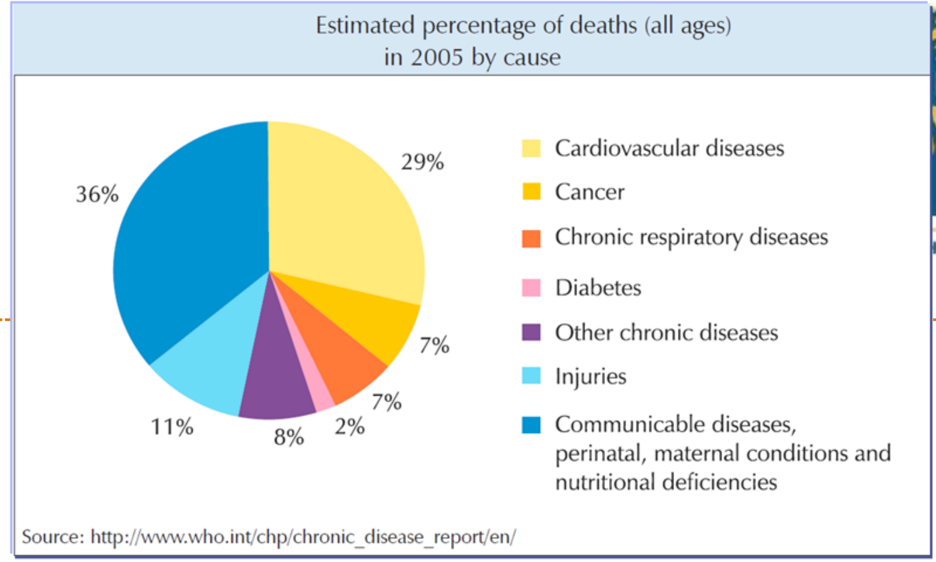


Source: WHO: The Global burden of disease, apps.who.int/iris/bitstream/10665/41864/1/0965546608_eng.pdf.

Patterns of Disease Change as Nations Develop

- Infectious diseases decline in frequency and severity
- Life expectancy increases
- Infant mortality declines
- Chronic diseases become increasingly prevalent

Health challenges



- Population growth
- Death rate has reduced but birth rates continue to be high
- Healthcare structure is over burdened by increasing population
- Twin epidemic of continued/emerging infectious diseases & chronic diseases
- High prevalence of infectious diseases: Malaria, Dengue, tuberculosis
- Growing threat of non-communicable diseases: Heart diseases, Diabetes, cancers, respiratory diseases
- Other significant risks: traffic accidents, self harm

NCDs at Catastrophic Levels

- Burden alarmingly high
- Death toll due to non-communicable diseases would mount to 52 million in 2030 from 38 million in 2012
- The leading causes of NCD-related mortality
  1. High blood pressure - 13% of deaths globally
  2. Tobacco-related deaths - 9%
  3. Increased blood glucose levels - 6%
  4. Physical inactivity - 6%
  5. Increased weight/obesity - 5%
- High rates of deaths and disease in low and middle income countries,
- Inadequate investment in cost-effective NCD interventions
- 60% deaths in India were from NCDs in 2014

Source: WHO reports

NCDs - high mortality in developing countries too ….!

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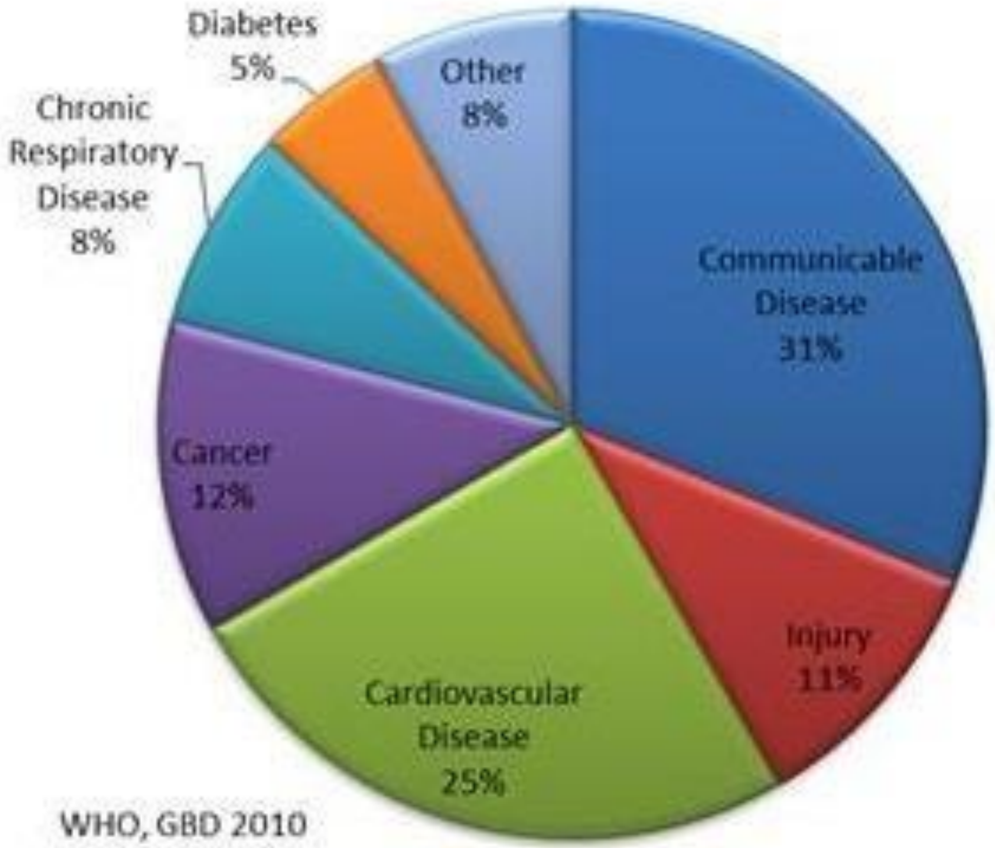
Causes of Deaths in Developing Countries



WHO, GBD 2010

http://www.cdc.gov/globalhealth/ncd/

Growing Mental Health Challenge

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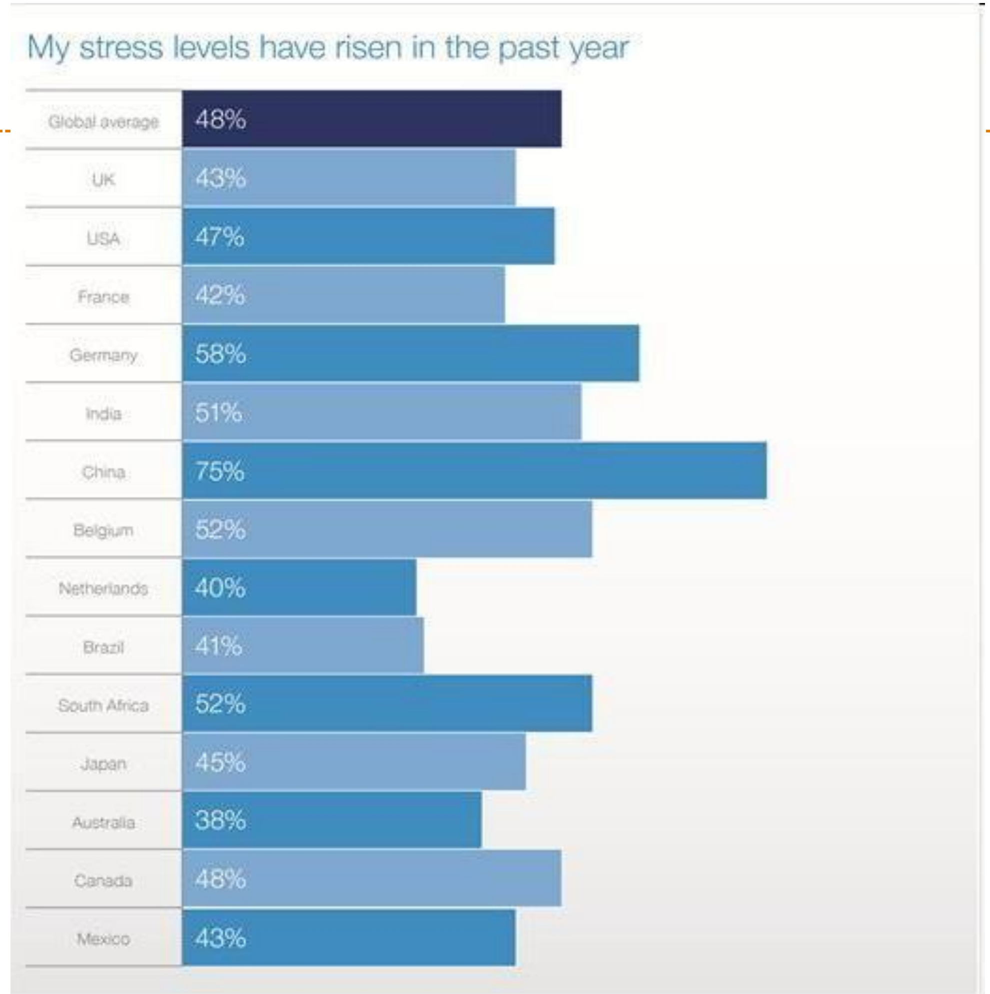

- Approximately half of all workers surveyed globally in 2012 by the Regus Group reported **higher stress** within the past year.[1]
- U.S. researchers found that stress related mental health issues may be a **factor in 60-80% of all visits to primary care physicians**.[2]
- The World Health Organization (WHO) estimates that mental disease will be a **leading cause of disability by 2020**.[3]
- The WHO identified work-related stress as an area of growing concern in **developing countries**.[3]
- Global **suicide rates** have increased 60% in the past 45 years, and attempts are 10-20 times more.[4]

Sources:
1. Regus Group (including graph) http://www.regus.presscentre.com/Resource-Library/GRAPH-Stress-level-rise-in-different-countries-acb1.aspx
2. JAMA Internal Medicine http://archinte.jamanetwork.com/article.aspx?articleid=1392494
3. World Health Organization http://www.who.int/occupational_health/topics/stressatwp/en/, http://www.who.int/occupational_health/publications/pwh6/en/index.html
4. Suicide.org http://www.suicide.org/international-suicide-statistics.html

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Basic components of Workplace Wellness

- Health Risk Assessment
- Physical Activity Promotion
- Stress Prevention / Mitigation - Employee Assistance Programs
- Healthy Nutrition
- Ergonomics

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Risk based Additions

- Health Education
- Women Well being Program
- Reproductive health (Healthy Pregnancy)
- Driving Safety
- Adult Vaccination
- Sleep / Rest Management

Development of HRA

1. Health Check a statutory requirement in hazardous exposure
2. Preventive physical health checks
3. Addition of emotional health / stress assessment
4. Personal habits
5. Complete health risk assessment

Physical Activity

- Community prevalence of Overweight / Obesity
- Increasing prevalence of NCDs
- Increasing mechanization and automation at traditional workplaces
- Advent of service sector, knowledge workers, IT / ITES sectors
- Healthy Employee Awards
- Fitness Champions

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EAP

- Increasing competition & high aspirations
- Globalisation
- Work life balance
- High levels of stress, depression and Self harm
- Addictions
- Mental Health stigma
- Developing Peers & Mentors
- Telephonic / web based solutions

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Employee Engagement

- Important factor to achieve business results, productivity
- To control absenteeism & presenteeism
- Employee morale
- To attract and retain employees
- Different approaches in different industries / sectors
- Workplace wellness is a great way to engage the employees in all enterprises

Employee Engagement

- New ways of employee engagement, talking their language to catch their attention.
- Innovative approaches
  - Incentives & recognition
  - Zumba and not exercises
  - Celebrity chef endorsement and not bland diet
- 'High Tech and High Touch' is the new approach for the Gen Y population.

Leadership Engagement - driving health as a value

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Leadership
- Prioritize health in the organization
- Create a health culture
- Define health related roles within organization

Managers
- Prioritize employee health
- Promote the health culture
- Health Mentors

Employees
- Prioritize own health
- Adopt and propagate the health culture
- Health Champions

Intense engagement / high risk cases

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Role of Occupational Physician

- Unique position in Industry,   Acceptability
- Major contribution to ‘Culture’
- Insight to real problems and health data
- Access to Top Management

Health & Productivity Linkage

Myth or Truth?

Why Invest in Healthy Workplaces?

- Healthy workplaces improve employee health and productivity, reduces health care costs and helps in employee retention

- Reports reveal that smokers miss more than 50 days per year costing employers billions of dollars and diabetes creates more than 15 million work days of absence

- Meta-analysis shows corporate wellness on average reduces sick leave absenteeism by 28%, healthcare costs by 26% and workers compensation claims by 30%

- It also shows that employees who participate in wellness programs are more likely to be loyal to their employer

Investment in Employee Health Produces ROI of 6:1

PREVENTION

By Katherine Baicker, David Cutler, and Zirui Song

Workplace Wellness Programs Can Generate Savings

ABSTRACT Amid soaring health spending, there is growing interest in workplace disease prevention and wellness programs to improve health and lower costs. In a critical meta-analysis of the literature on costs and savings associated with such programs, we found that medical costs fall by about $3.27 for every dollar spent on wellness programs and that absenteeism costs fall by about $2.73 for every dollar spent. Although further exploration of the mechanisms at work and broader applicability of the findings is needed, this return on investment suggests that the wider adoption of such programs could prove beneficial for budgets and productivity as well as health outcomes.

doi: 10.1377/hlthaff.2009.0626
HEALTH AFFAIRS 29,
NO. 2 (2010): -

Katherine Baicker (Kbaicker@hsph.harvard.edu) is a professor of health economics at the School of Public Health, Harvard University, in Boston, Massachusetts.

David Cutler is a professor of economics at Harvard University.

Zirui Song is a doctoral candidate at Harvard Medical School.

Conclusion - Healthy Workforce provides a competitive financial advantage

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Current health issues in the workplace

- Traditional OH issues
- Chronic Disease Management
- Lifestyle Issues
- MSDs
- Stress
- Safety & Security

Wellness for Gen Y

- Engagement
- Health is fun
- High tech
- Migrating employees – collaborative approach

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Case Study – Knowledge / Service Sector

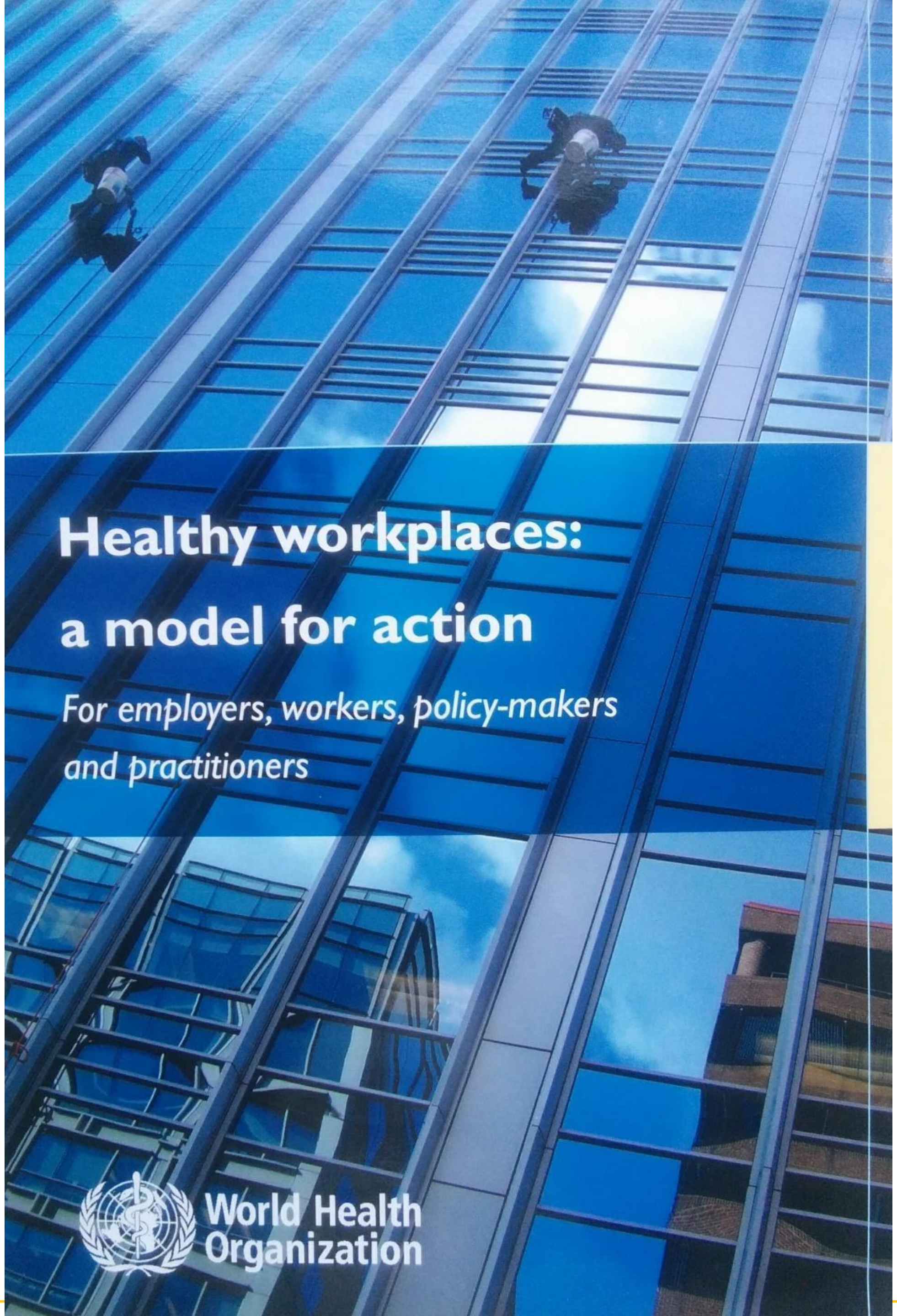
Participatory Approach to Life Style

Improvements – Fitness Champions

‘Healthy’ competition

Conclusion

- The key to success in attaining occupational health:
  - Enabling employees,
  - Buy-in and involvement of managers,
  - Connecting with the business need.
- Workplace wellness has ‘mass appeal’ which could be leveraged!
- Integrating occupational health with workplace wellness is the most efficient and effective way to achieve excellence in occupational health.


Healthy workplaces:
a model for action
For employers, workers, policy-makers
and practitioners
World Health
Organization

Labour codes….

	Pre Labour Reforms	Post Labour Reforms
Preventive Healthcare	No legal requirement for employers to provide free annual health check-ups to workers	Employers must provide all workers above the age of **40 years with a free annual health check-up**. Promote timely preventive healthcare culture
ESIC coverage	ESIC coverage was limited to notified areas and specific industries; establishments with fewer than 10 employees were generally excluded, and hazardous-process units did not have uniform mandatory ESIC coverage across India	**ESIC coverage and benefits are extended Pan-India** - voluntary for establishments with fewer than 10 employees, and mandatory for establishments with even one employee engaged in hazardous processes. Social protection coverage will be expanded to all workers.

Thank You

Latest Technologies and Real-World Challenges in Occupational Health

Dr Santhi Ganesan

Certifying Surgeon

Rajasthan Atomic Power Station

NPCIL

Today’s Checklist

- Part 1-How emerging technologies are changing occupational health practice
- Part 2-The real world challenge we face before ,during,and after accidents
- Part-3 How to bring all together with ethics integration and practical steps

Why This Topic Matters

- Chronic diseases and workplace hazards are making our workforce more vulnerable
- We need smarter ways to monitor, respond, and prevent — and we need to prove they work
- Technology helps, but only when it's backed by strong systems and real human insight

What's Changing in OH Tech

- Wearables & real-time monitoring
- AI & data analytics for early risk detection
- Robotics & exoskeletons to reduce physical strain
- Remote safety systems & telehealth
- Visual reality for immersive training and emergency simulations

Wearable & Sensor Technology

- Devices monitor health and environment: smart helmets, wristbands, vests.
- Used for fatigue detection, posture correction, hazard exposure.
- Benefits: Early intervention, personalization, continuous data.
- Challenges: Privacy, cost, worker acceptance, reliability.

Tracerco™ Personal Dose Monitors

- Lightweight wearable radiation monitors commonly issued in European and US nuclear plants for tracking accumulated dose and immediate alerting.

Garmin Smartwatches

- Garmin Smartwatches and Medical-Grade Wearables
  Used in nuclear industry studies for monitoring heart rate, movement, and fatigue—helpful for shiftwork, emergencies, and physical strain.
- Used during the Fukushima disaster cleanup, emergency workers used a combination of GPS-enabled and health-monitoring wearables to track location, movement, and vital signs, helping manage heat stress and ensure safe evacuation

Artificial Intelligence & Predictive Analytics

- Algorithms analyze health/safety data to predict risks, optimize schedules.
- Detect hidden hazards by combining incident/wearable/environmental data.
- Benefits: Targeted interventions, efficiency, resource use.
- Challenges: Data quality, transparency, bias, skill needs.

European Nuclear Research on Human Reliability

- Euratom projects integrate predictive analytics on workforce data—combining physiological, environmental, and task information—to predict operator performance dips.
- These predictions enable targeted interventions, such as task reassignment and personalized workload adjustments to maintain safety and efficiency

Advanced PPE, Robotics & Automation

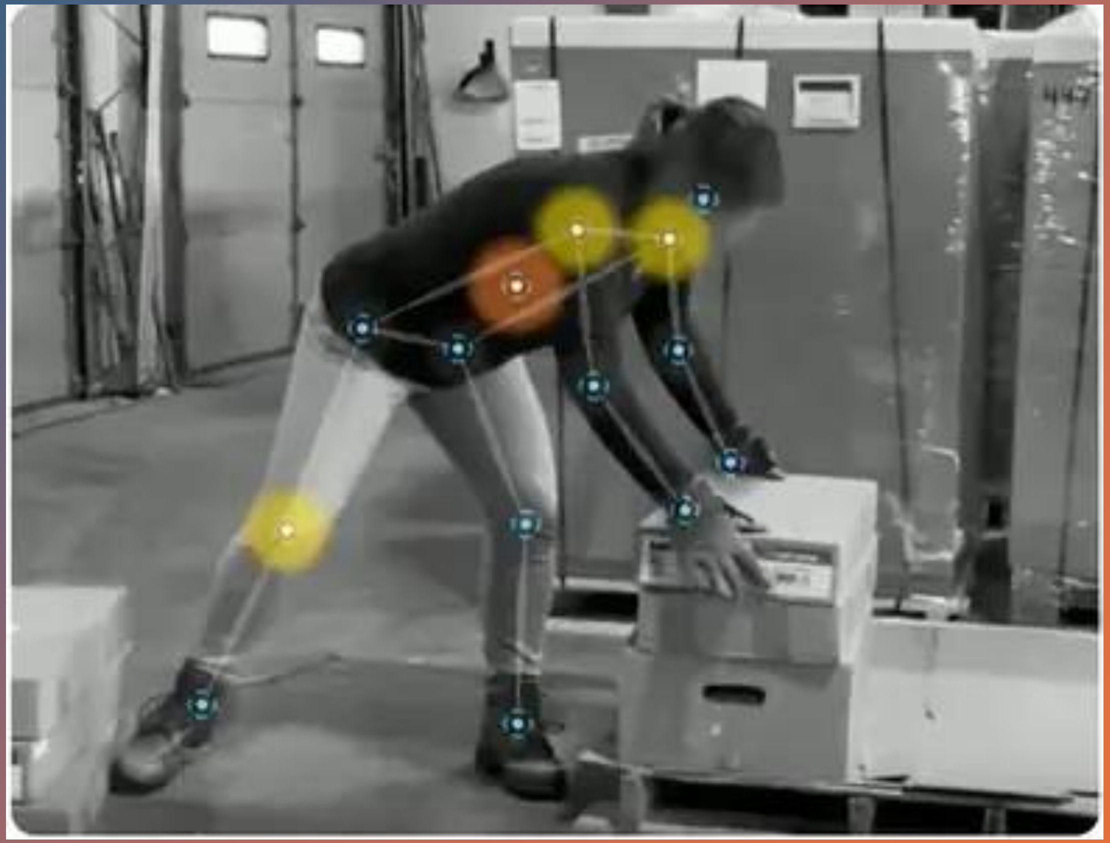
- Sensor-embedded PPE, exoskeletons, robots for hazardous tasks.
- Direct risk reduction and improved ergonomics.
- Benefits: Lower exposure, real-time detection, automation.
- Challenges: Cost/maintenance, adaptation, training needs.

Telehealth & Digital Platforms

- Remote health consultations, digital records, mobile health apps.
- Enables symptom reporting, wellness tracking, remote workforce care.
- Benefits: Accessibility, compliance, hybrid work support.
- Challenges: Digital divide, security, engagement.

VR, AR & Immersive Training

- Definition: Simulation tech for realistic, risk-free training and task guidance.
- Applications: Hazard scenario simulation, real-time AR task support.
- Benefits: Safer, more memorable training; rare/hazardous scenarios.
- Caveats: Hardware/software cost, scenario design, behavioral translation.



Ergonomics & Computer Vision Analytics

- **Definition: Vision/AI for posture, movement, ergonomics risk assessment.**
- **Applications: Office/industrial set ups, technique monitoring, corrective recommendations.**
- **Benefits: Early MSD risk alerts, personalized interventions.**
- **Caveats: Privacy (video use), accuracy issues, adjunct role.**

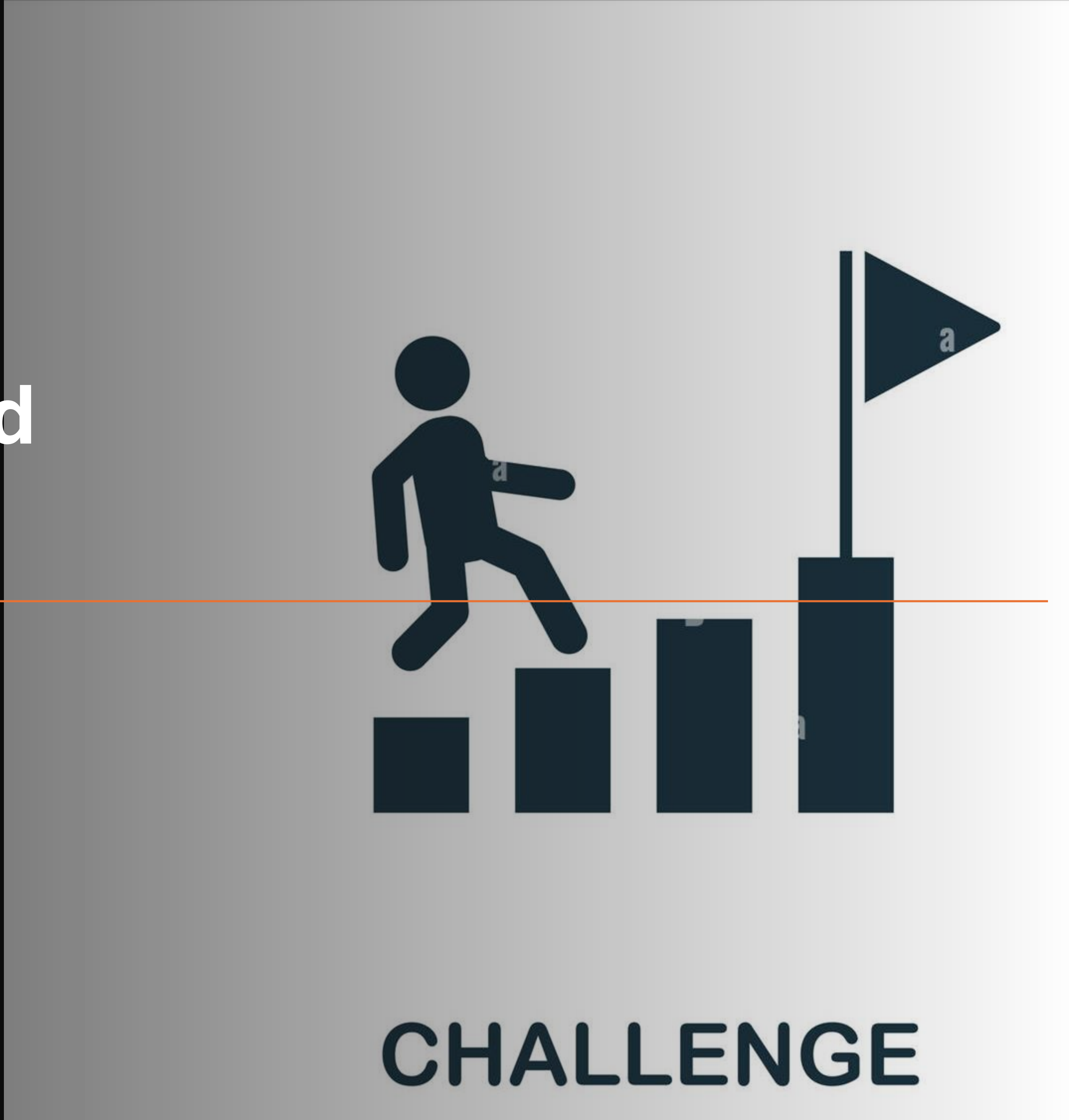
Data Management, Blockchain & Secure Health Records

- **Definition:** Blockchain/big-data platforms for secure health/exposure data.
- **Applications:** Longitudinal tracking, data governance, analytics.
- **Benefits:** Oversight, compliance, trusted data.
- **Caveats:** Complexity, cost, regulatory variation, consent.

Integration & Ethics

- Use platforms that talk to each other — avoid vendor lock-in
- Prioritize consent, anonymize data, and protect access
- Address cost, culture, and skills gaps with phased pilots and clear Key performance indicators

Pre-Incident Challenges I’ve Faced



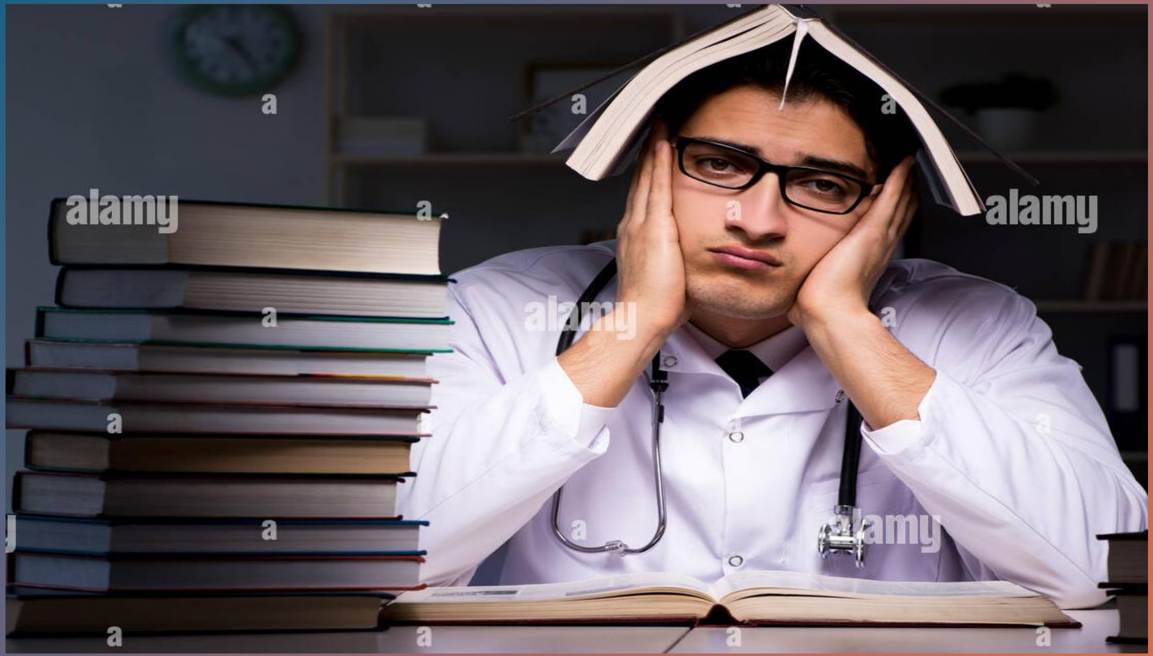
Chronic conditons – Diabetes &Hypertension often go undetected

- Non disclosure due to
  - Lack of awareness
  - Stigma
  - Fear of losing job
  - Privacy concern
  - Worsened outcomes

Prevention programs struggle with low participation

- Fear of disclosure
- Clarification of well being of employees
- By addressing privacy concern and following legal protocols- Confidentiality

During an Incident: What Matters Most



- **Keep exposure logs and medical cards handy**
- SOPs were made handy
- SOPs made easily accessible to everyone.

Patient Reference issues

- Problems while shifting the contract staff to higher centre for tertiary care.
- Need to get reference from ESIC facility while shifting to higher centre.

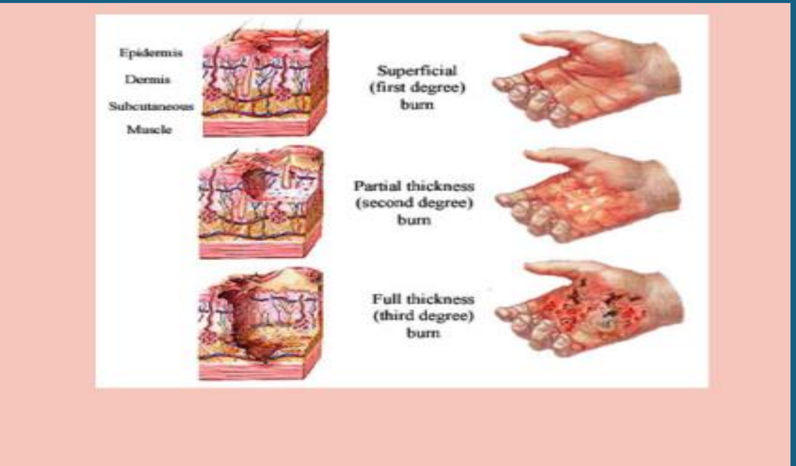
Uncoordinated Medical Consultations

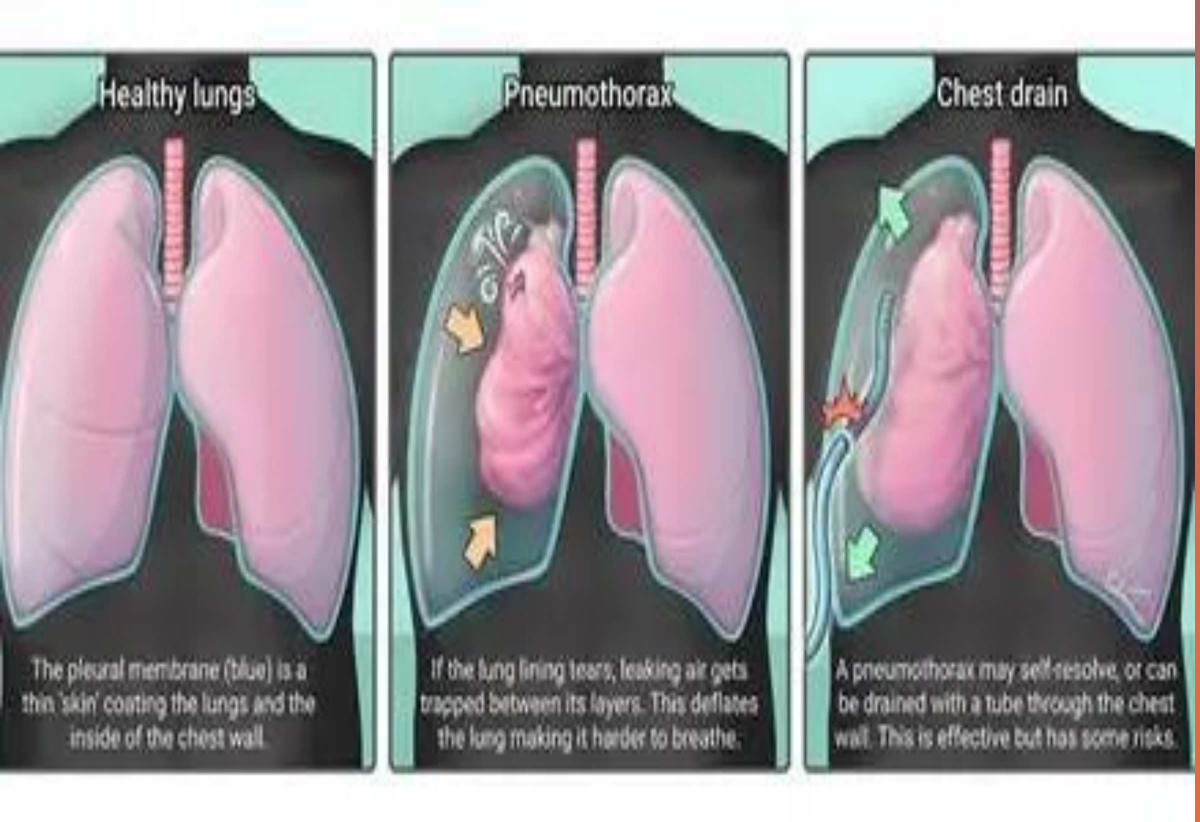
- Miscommunication between OH, safety, and operations
- Workers often approach hospital doctors without informing the safety department at the plant.

Post-Incident Challenges

Mental health issues and social stigma

- Electrical flash over and social stigma
- Visual disfigurement
- Family stress
- Awareness education
- Specialised rehabilitation services





Ignorance in safety rules

- With out having Height pass medial fitness employee climbed the shelf and had a fall and had had injury on chest
- Inadequate equipment –Ladder
- Hazard identification
- Inadequate training
- Lack of safe work procedure

What Changed the Game

- Use triage algorithms that prioritize workers with chronic conditions
- Offer psychological first aid early – it makes a big difference

Train on site-specific risks

Run realistic drills — not just tabletop exercises

Work pressure and stress management.

How to be a HERO in the workplace?

Hope
1. Set a SMART Goals
2. Stay motivated

Efficacy
1. Focus on past success.
2. Copy other people,
3. Create situations for success,
4. Reframe negative experience

Resilience
1. Face Reality
2. Search for Meaning
3. Improvise

Optimism
1. Accept the past
2. Appreciate the moment
3. View the future as opportunity

Lifestyle modification

Shift-friendly wellness programs

Continuing Medical Education Programme

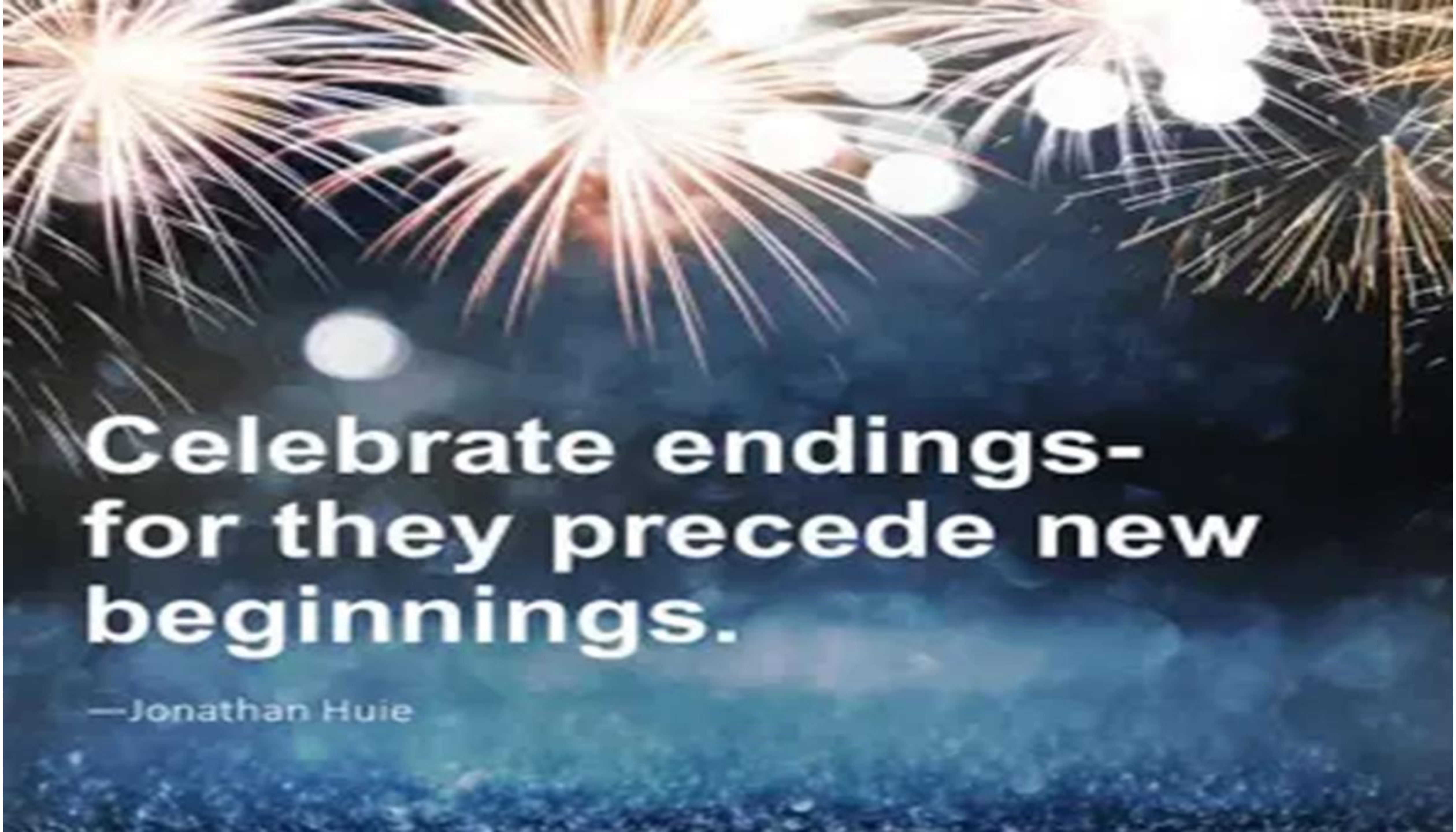
What Changed the Game

- Set clear health targets and track them
- Run drills that actually test systems and equipment
- Use one-page SOPs to simplify emergency roles
- Normalize mental health care and flexible return-to-work plans

Contract staff

Final Takeaways

- Tech is powerful – but only when paired with good systems and people
- Prevention and emergency readiness must go hand in hand
- Start small, measure what matters, and build trust along the way


Celebrate endings-
for they precede new
beginnings.
—Jonathan Huie


Thank You !

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Top Occupational Health Trends Shaping Workplace Wellness in 2025

Recent Trends in Medical Management of Occupational Musculoskeletal Disorders

Dr. M. A. Annal

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Senior Certifying Surgeon, NPCIL

Senior Consultant Specialist & Faculty

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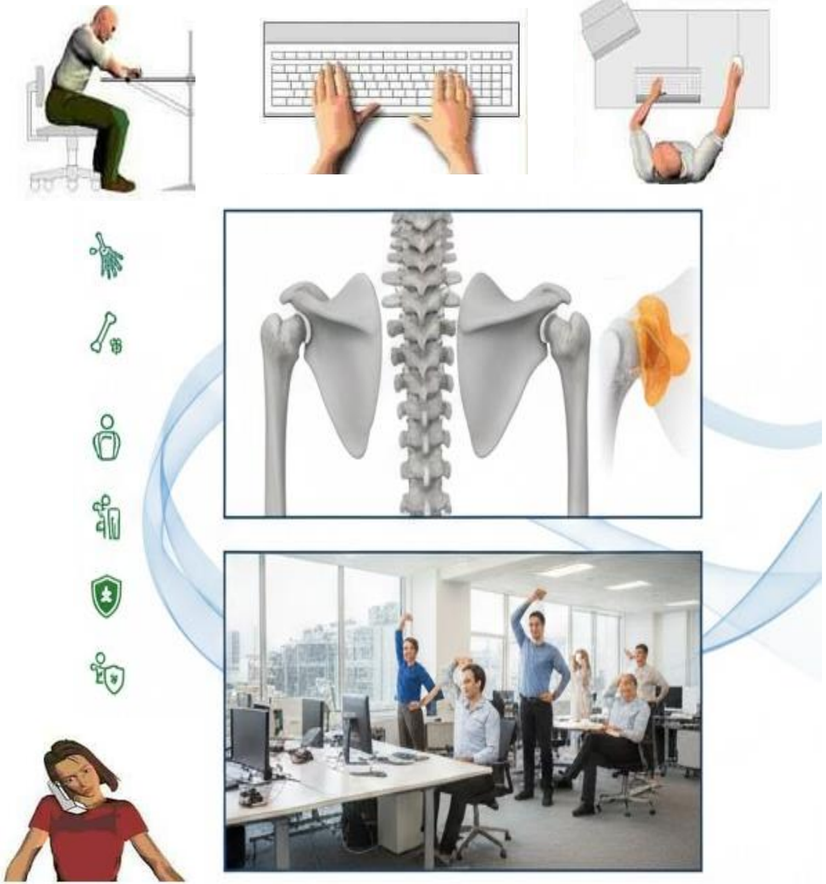
Contents / Agenda

- Anatomy Review
- Common Occupational Musculoskeletal Disorders
- Diagnostic Approaches
- Principles of Medical Management
- Recent Advances & Emerging Trends
- Case Examples
- Prevention & Workplace Integration
- Conclusion

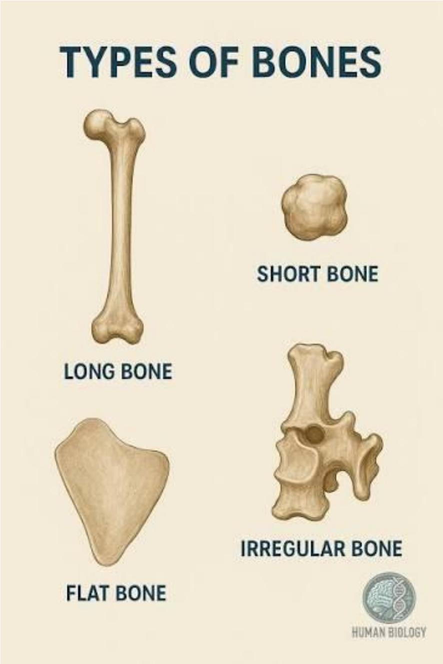


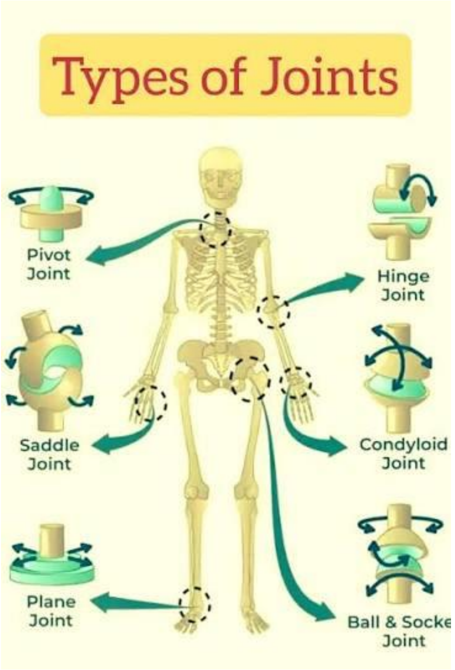
Overview of the Musculoskeletal System

- Components: bones, joints, muscles, tendons, ligaments, fascia, nerves
- Functions: structural support, mobility, load transfer
- Importance: central to occupational activity and risk exposure
- Occupational relevance: repetitive use → microtrauma; posture → static strain

Skeletal System: Bones & Joints

- Bone types: long, short, flat, irregular
- Joint types: synovial (most mobile), cartilaginous, fibrous
- Basic biomechanics: stability vs mobility balance
- Occupational stress points: spine, shoulder, wrist, knees





Muscles, Tendons & Soft Tissues

- Muscles: generate movement; prone to strain with overuse
- Tendons: transmit force; common site of tendinopathy
- Ligaments: joint stability; vulnerable to repetitive microstretch
- Fascia: tension modulation; key in myofascial pain
- Occupational link: repetitive tasks → chronic soft-tissue overload

Biomechanics & Load Transmission

- Spine: major load-bearing structure; influenced by posture
- Joints: distribute mechanical stress during tasks
- Soft tissues: adapt to load; may fail with overuse
- Occupational impact: lifting, pulling, vibration → cumulative strain
- Poor ergonomics → increased compressive + shear forces

Occupational Musculoskeletal Disorders: Definition & Scope

- Definition: Injuries/disorders affecting muscles, bones, tendons, nerves due to work exposure
- Burden: Leading cause of absenteeism & disability worldwide
- Economic impact: Reduced productivity, compensation claims
- Trend: Rise in sedentary + repetitive stress–related disorders

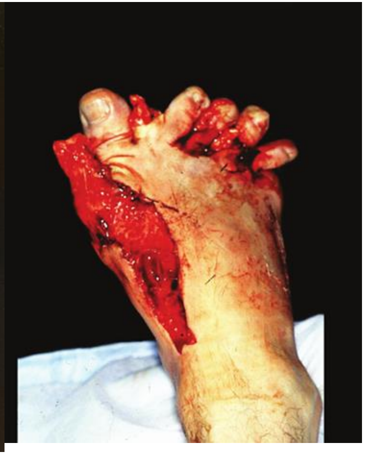
Acute Occupational Injuries – Overview

Key Points

- Sudden injuries caused by a specific workplace inciden
- Require immediate medical attention
- Common in high-risk work environments

Examples

- Fractures, cuts, burns
- Head injuries, chemical exposure



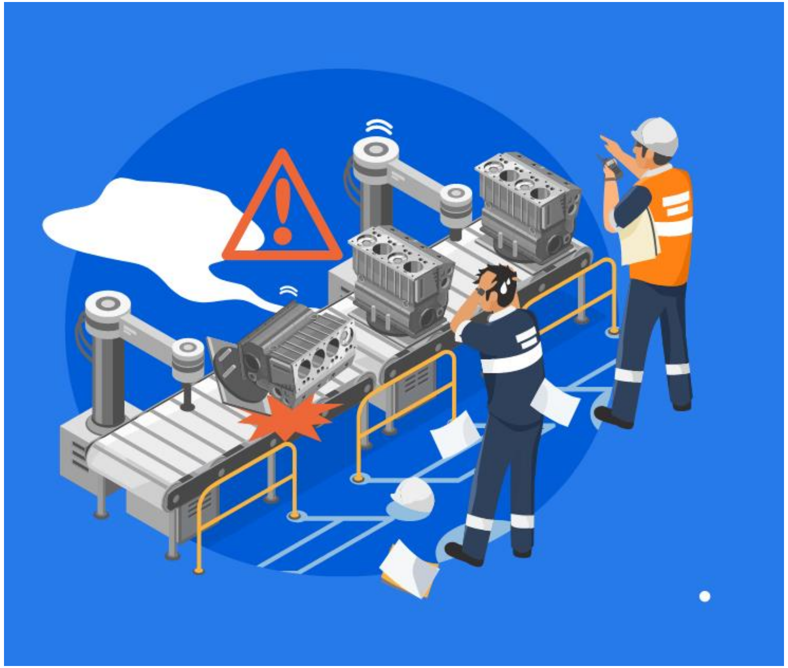
Causes & High-Risk Industries

Common Causes

- Falls from height
- Machinery and equipment accidents
- Slips, trips, and collisions
- Sudden chemical spills or explosions

High-Risk Industries

- Construction
- Manufacturing
- Mining
- Healthcare & Transportation



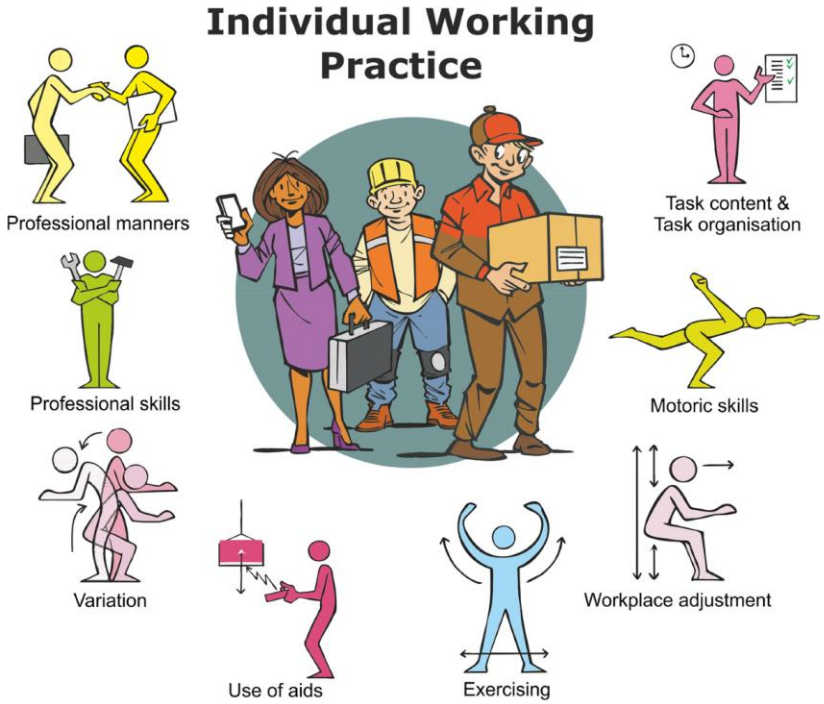
Prevention & Immediate Response

Prevention

- Safety training and procedures
- Use of PPE
- Machine guarding and inspections

Immediate Response

- First aid and emergency care
- Incident reporting
- Medical evaluation & safe return-to-work

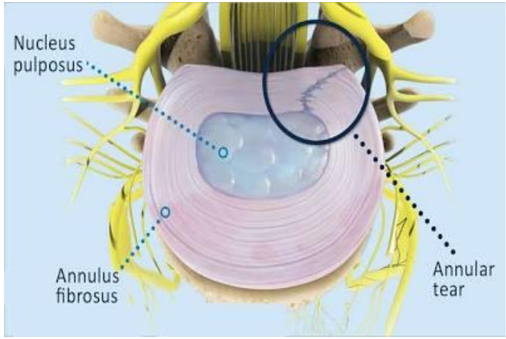


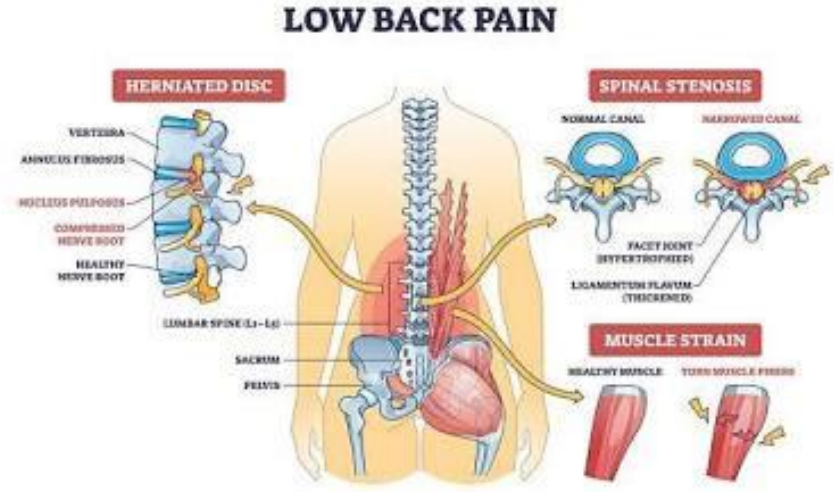
Low Back Pain (LBP): Introduction

- Most common occupational MSD
- Affects manual laborers & sedentary workers
- Spectrum: acute strain → chronic nonspecific LBP → radiculopathy
- Risk amplified by poor ergonomics, static sitting, lifting tasks

LBP: Pathophysiology & Risk Factors

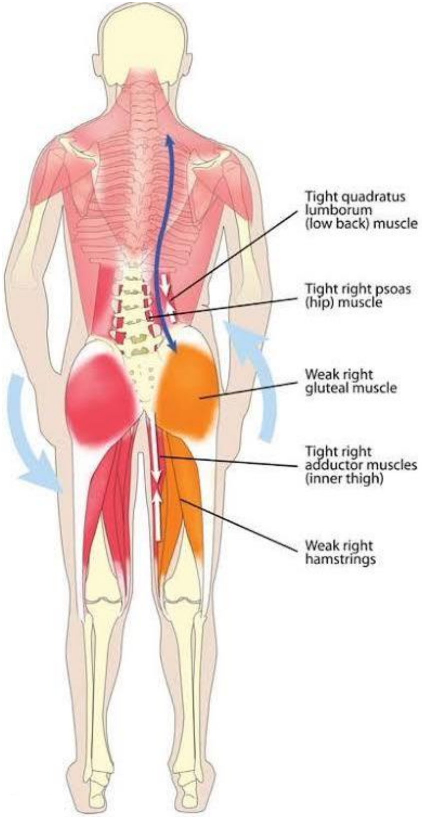
- Disc degeneration, annular tears, facet arthropathy
- Muscle imbalance, deconditioning
- Mechanical factors: flexion, twisting, vibratio
- Individual factors: age, obesity, smoking
- Occupational: repeated lifting, prolonged sitting, poor posture





LBP: Clinical Presentation

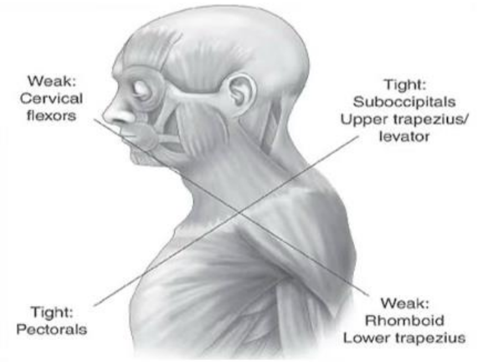
- Localized lumbar pain: mechanical pattern
- May radiate to thigh/leg (radiculopathy)
- Worse with bending, prolonged sitting/standing
- Red flags: weight loss, fever, trauma, bldder/bowel issues
- Functional limitations: reduced mobility, difficulty lifting



Neck Pain

- Common in computer- and desk-based occupations
- Caused by prolonged static neck posture
- Increasing prevalence with digital device use
- Often associated with trapezius & scapular muscle fatigue

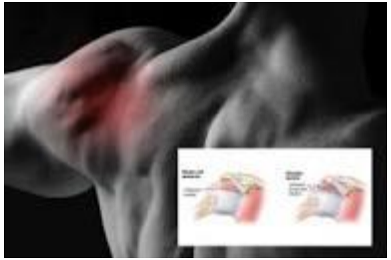
Neck Pain: Causes & Risk Factors

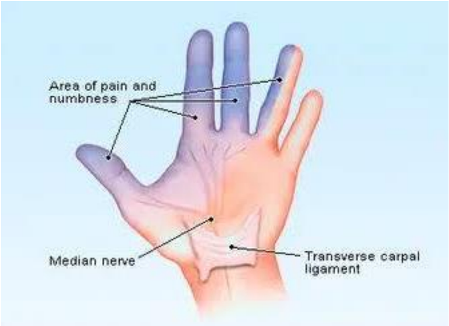


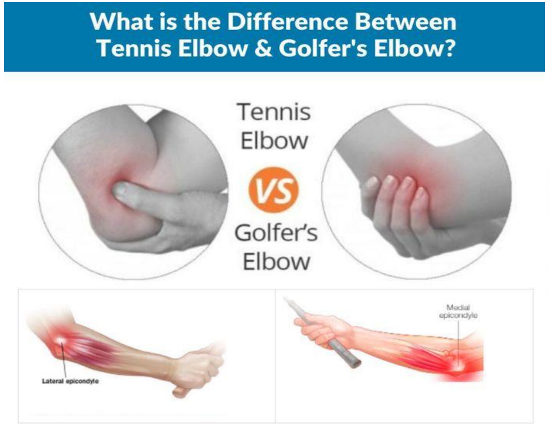
- Poor workstation ergonomics
- Forward-head posture
- Prolonged screen time
- Repetitive overhead tasks
- Increased muscle load on cervical extensors

Common Upper Limb Disorders

- Rotator cuff tendinopathy
- Lateral/medial epicondylitis
- Carpal tunnel syndrome (CTS)
- De Quervain’s tenosynovitis
- Forearm flexor/extensor overuse injuries

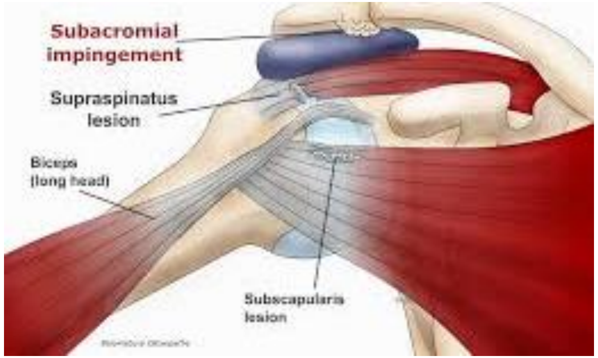


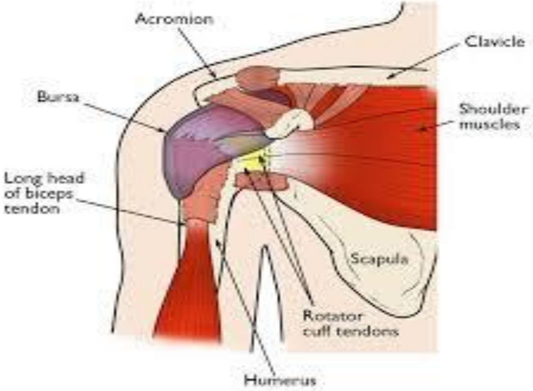




Rotator Cuff Disorders

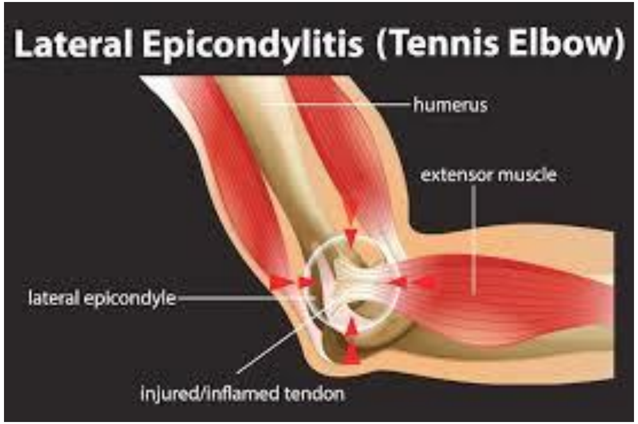
- Shoulder pain with overhead activity
- Tendon overload → Microtears
- Reduced ROM, especially abduction
- Positive impingement signs
- Occupations: painters, assembly-line workers, welders





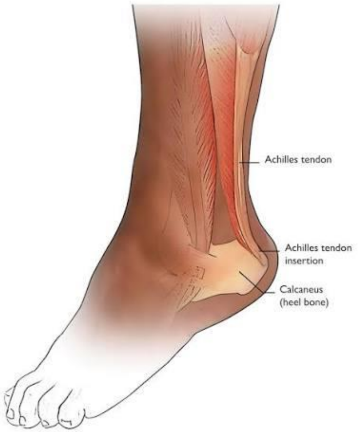
Elbow & Hand Disorders

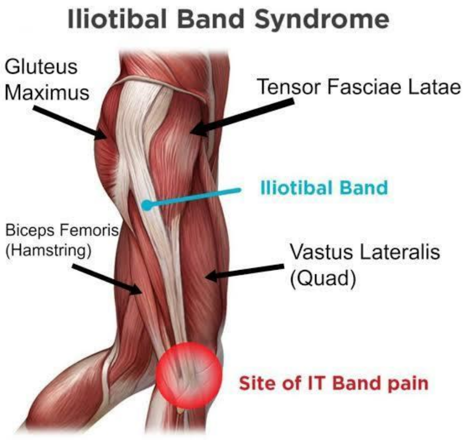
- Lateral Epicondylitis
- Repetitive gripping & wrist extension
- Common in factory work, typing, tool handli
- Carpal Tunnel Syndrome
- Median nerve compression
- Symptoms: numbness, tingling, nocturnal pa
- Risk: repetitive wrist flexion, prolonged typing



Lower Limb Disorders

- Common in standing/prolonged walking jobs
- Patellofemoral pain syndrome
- Plantar fasciitis
- Achilles tendinopathy
- Iliotibial band friction syndrome
- Seen in assembly-line workers, retail staff, warehouse workers





Risk Factors

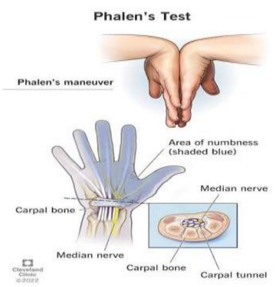
- Physical Factors
- Repetition
- Forceful exertion
- Awkward postures
- Vibration exposure
- Individual Factors
- Smoking
- Prior injuries
- Job strain
- Psychosocial Factors
- Low control, high demand
- Age, obesity, low fitness

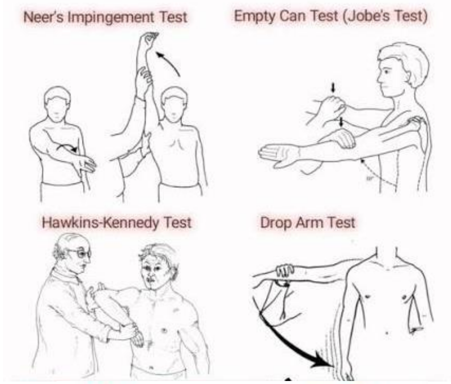
Clinical Evaluation: History

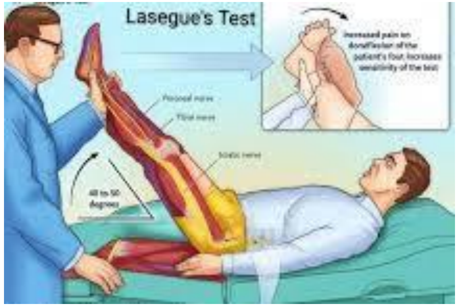
- Onset, duration, pattern of pain
- Job tasks associated with aggravation
- Prior injuries or treatment
- Red flags (trauma, fever, weight loss, severe weakness)
- Evaluate impact on work performance

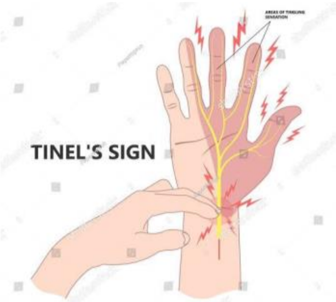
Clinical Evaluation: Physical Examination

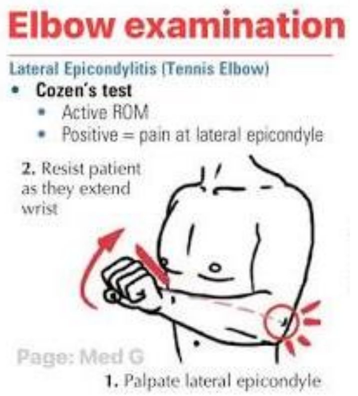
- Inspection: posture, deformity, asymmetry
- Palpation: tenderness, muscle spasm
- ROM assessment for spine/joints
- Neurological exam: reflexes, dermatomes, muscle strength
- Special tests:
- Straight-leg raise (SLR)
- Impingement tests
- Tinel/Phalen for CTS





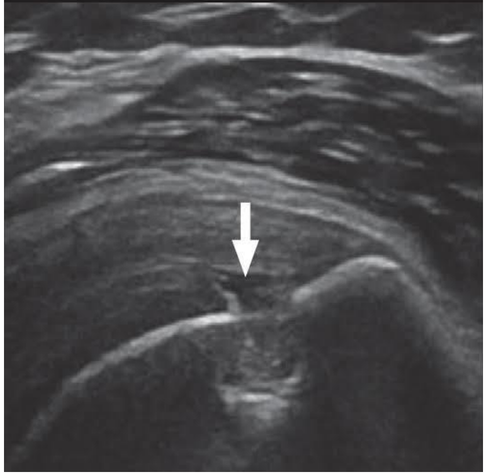






Diagnostic Imaging: X-ray and Ultrasound

- X-ray
- Useful for bone alignment, degenerative changes
- Excellent for tendons & soft-tissue structures
- Limited value for soft tissues
- Use only when indicated
- Ultrasound
- Dynamic assessment possible
- Cost-effective and widely available



Ultrasound scan of shoulder showing supraspinatus tear (arrow).

MRI & Advanced Imaging

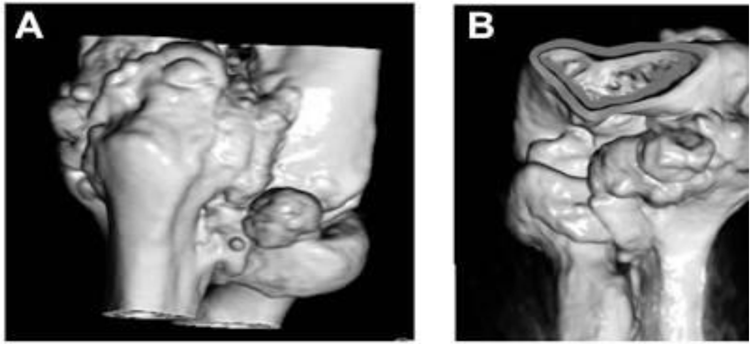
- MRI: gold standard for soft-tissue evaluation
- Useful for: disk herniation, nerve compression, tendon tears
- MRI STIR sequences detect early inflammation
- Avoid routine early MRI → prevents overdiagnosis
- Imaging must match clinical symptoms

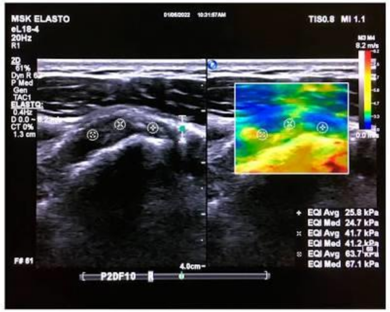
AI in Diagnostic Imaging

- AI algorithms detect early bone & soft-tissue pathology
- Improved accuracy in fracture detection
- Automated measurement of joint spaces & alignment
- Supports early prediction of MSD risk at workplace
- Enhances triage & reduces diagnostic delay

Emerging Imaging Technologies

- Photon-Counting CT
- Ultra-high resolution
- Better bone microarchitecture assessment
- 4D CT
- Shows real-time joint movement
- Useful for instability & kinematic studies
- Ultrasound Elastography
- Measures tendon stiffness
- Early detection of tendinopathy





Principles of Medical Management

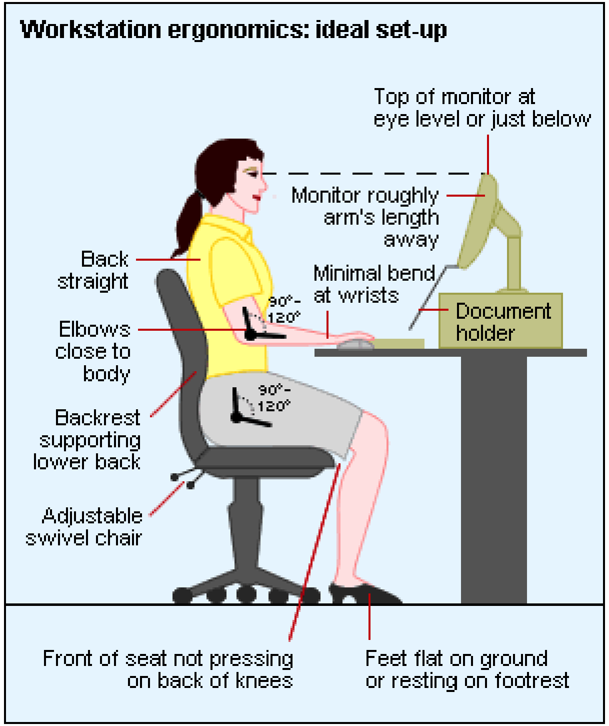
- Early evaluation and reassurance
- Maintain activity → avoid prolonged rest
- Individualized treatment plan
- Combine physical, pharmacologic & ergonomic strategies
- Focus on function over imaging findings

Education & Reassurance

- Explain condition in simple terms
- Address fear-avoidance beliefs
- Emphasize:
- “Movement is safe”
- “Pain ≠ Harm”
- Set realistic recovery timeline
- Encourage graded return to normal activity/work

Ergonomic & Activity Modification

- Correct workstation design
- Micro-breaks every 30–40 minutes
- Job rotation in repetitive tasks
- Mechanical lifting aids
- Adjust posture, chair height, monitor level
- Reduce exposure to vibration and cold



Physical Therapy & Exercise

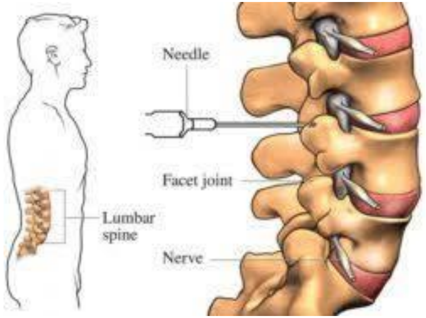
- First-line intervention for most OMSDs
- Strengthening + stretching + mobility work
- Focus on:
- Core stability (LBP)
- Scapular control (shoulder)
- Eccentric strengthening (tendinopathy)
- Graded exercise reduces recurrence and disability
- Supervised rehabilitation improves outcomes

Pharmacologic Management

- NSAIDs: short-term pain relief
- Paracetamol: mild-to-moderate pain
- Muscle relaxants: brief use for acute spasm
- Neuropathic agents: gabapentin, pregabalin, TCAs for radicular pain
- Topicals: NSAID gels, capsaicin
- Use lowest effective dose for shortest duration

Interventional Procedures

- Corticosteroid injections for selected tendinopathies
- Trigger-point injections for myofascial pain
- Nerve blocks for diagnostic clarification
- USG-guided tendon procedures (tenotomy, lavage)
- Spinal interventions:
- Epidural steroids
- Facet/medial branch blocks
- Indicated only when conservative care fails



When to Consider Surgery?

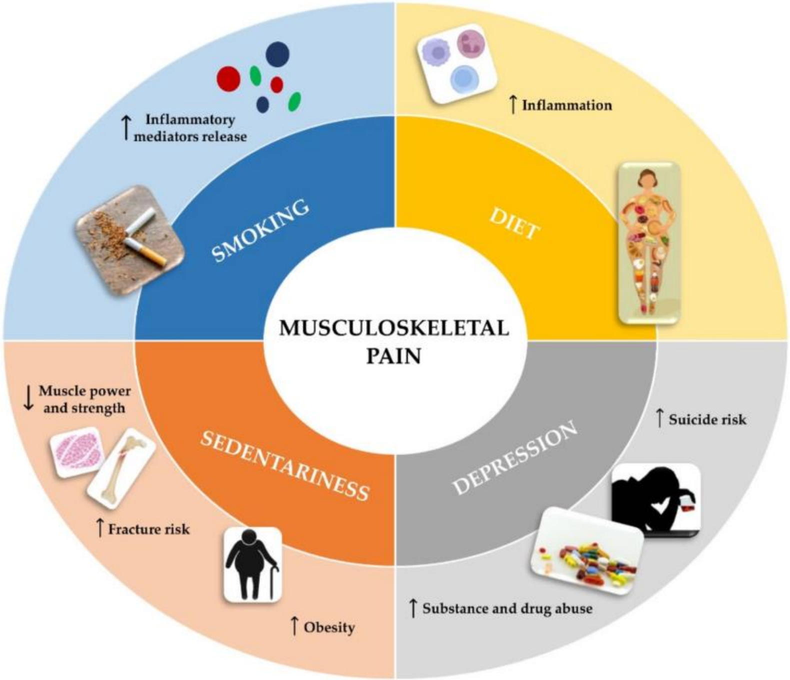
- Progressive neurologic deficit
- Structural lesions with clear correlation
- Failed conservative treatment (>12 weeks)
- Full-thickness rotator cuff tears with functional loss
- Carpal tunnel syndrome with severe nerve conduction delay
- Multidisciplinary decision + realistic RTW expectations

Multidisciplinary Care Approach

- Integrates expertise across specialties
- Orthopedics, physiotherapy, occupational therapy
- Ergonomists for workplace correction
- Psychologists for chronic pain coping
- Enhances recovery + reduces recurrence

Components of Multidisciplinary OMSD Management

- Comprehensive assessment
- Individualized treatment plan
- Combined physical + psychological rehab
- Biomechanical correction
- Regular review and progress tracking



Return-to-Work (RTW) Planning

- Gradual, structured return timeline
- Modified duties to prevent overload
- Clear communication with employer
- Functional ability assessment
- Supports safe reintegration into workforce

RTW Strategies

- Workstation modification
- Reduced hours or task rotation
- Monitoring early warning signs
- On-site physiotherapy sessions
- Continuous ergonomic feedback

Prevention Strategies

- Focus on eliminating workplace risk factors
- Strength & conditioning programs
- Posture training and task-specific education
- Regular breaks during repetitive tasks
- Use of supportive equipment

Workplace Ergonomics

- Proper desk & chair setup
- Adjustable height workstations
- Anti-fatigue flooring for standing tasks
- Safe lifting techniques
- Reduction of vibration exposure

Digital Ergonomics

- Managing screen time & device use
- Neck-neutral smartphone/tablet positioning
- Blue light precautions
- Healthy sitting–standing ratio
- Smart posture reminder device

Future Trends in OMSD Management

- AI-based risk prediction & early detection
- Regenerative medicine (stem cells / PRP evolution)
- Wearable sensor technology
- Robotics-assisted rehabilitation
- Virtual reality for posture training

Key Takeaways

- OMSDs are preventable with early intervention
- Multidisciplinary care improves outcomes
- Ergonomics + exercise = strongest protective factors
- Technology plays a growing role
- Focus on long-term wellness, not symptom control


thank you

ARCHITECTURAL DESIGN FOR OCCUPATIONAL HEALTH IN OPERATION THEATRES

A Tri-Integrated Framework for Safety, Ergonomics & Environmental Control

Presented by

Anusha Thati,

Architect, ASED, IGCAR

19th DEC 2025

Institute for Plasma Research
41st DAE Safety & Occupational Health Professional Meet (DAE SOHPM), 2025
Jointly Organized by Institute for Plasma Research and Atomic Energy Regulatory Board

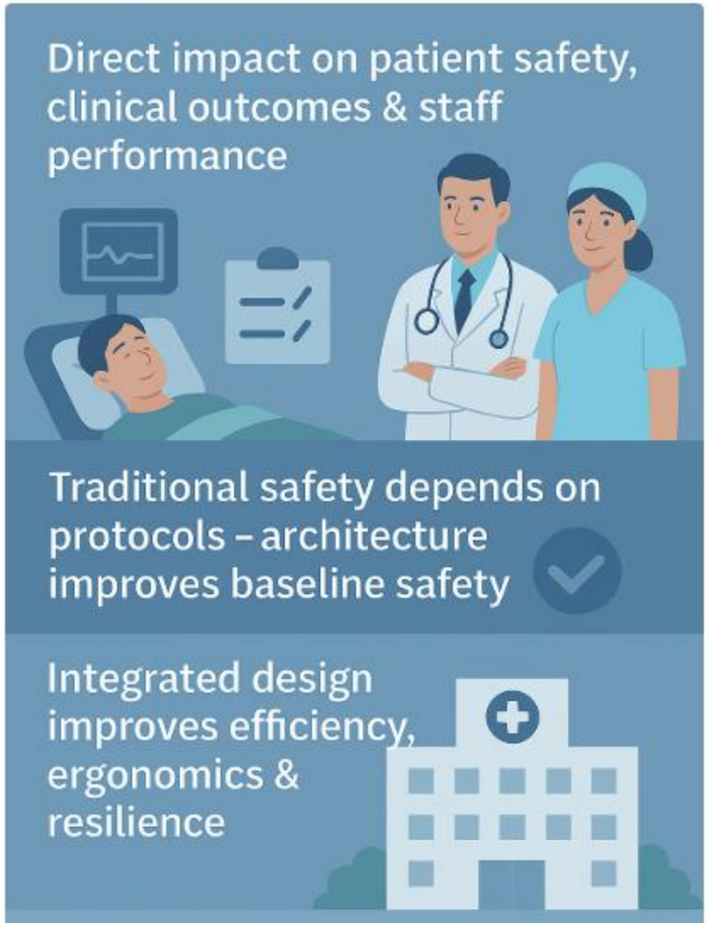
Why Architecture Matters?

Environment ↔ Health

- Built environment influences healing outcomes
- Poor design increases stress, errors, and energy load
- Nature-linked spaces improve recovery and productivity

Introduction

Why OT Design Matters ??



Key Architectural Goals

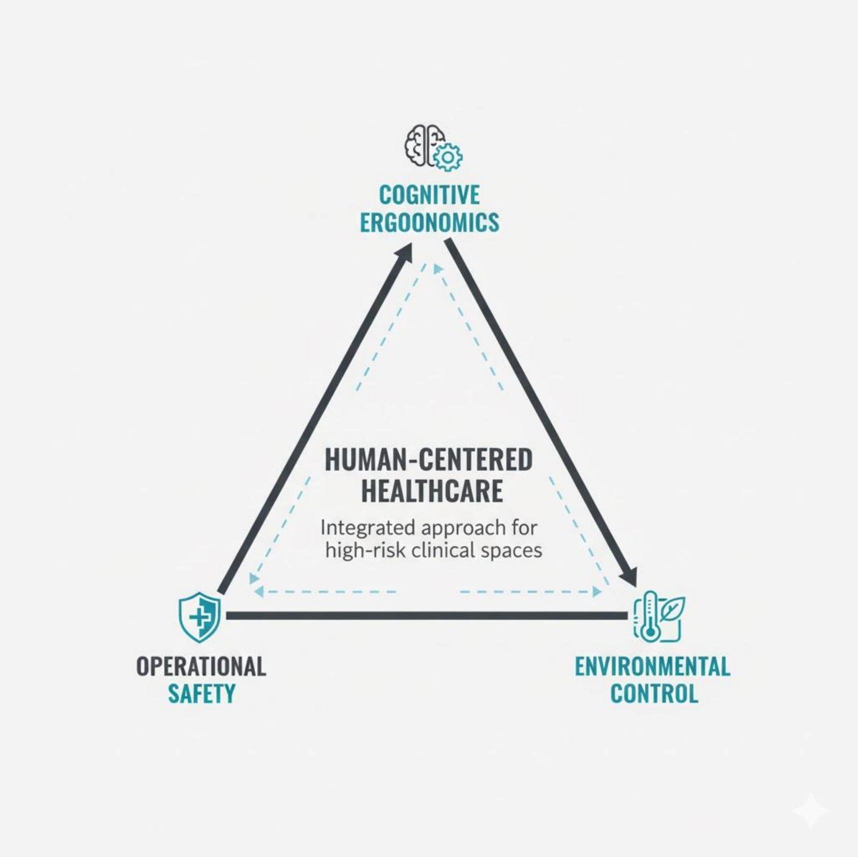
Problem Statement

•Existing designs use isolated solutions for ventilation, ergonomics, workflows.
•Lack of holistic architecture that integrates safety, ergonomics & environmental systems.
•Need for proactive, design-driven hazard mitigation.

Objective

To establish the **Tri-Integrated Architectural Framework** combining:

- Operational Safety
- Ergonomic Design
- Environmental Control



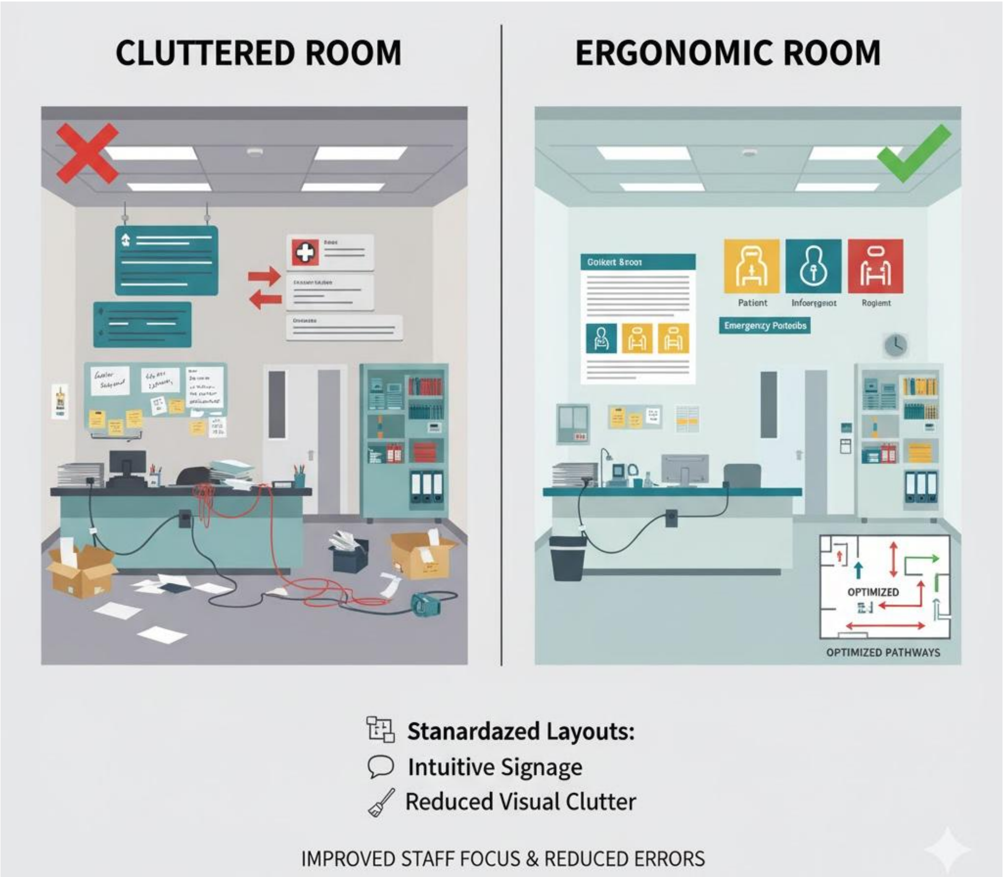
Component 1: Operational Safety

Label		Feature Description (Safety/Design Intent)
Safe & Clear Circulation	The wide, unobstructed corridor running down the center.	Safe Circulation: The ample width allows for two-way traffic, including beds and equipment, and prevents congestion. The clear sight lines aid in wayfinding and staff observation.
Slip-Resistant Material	The floor surface of the corridor and rooms.	Slip-Resistant Material: Modern hospital flooring is typically durable, non-porous, and certified slip-resistant to reduce the risk of patient and staff falls, especially in the event of spills.
Controlled Access	The wall-mounted panel beside the consultation room doors (left and right).	Controlled Access: These panels likely serve as ID badge readers or keypads for controlled access to sensitive areas (consultation rooms, patient records), enhancing security and patient privacy.
Fire Detection	The small, round devices recessed in the ceiling of the corridor.	Fire/Emergency Integration (Detection): These are smoke/heat detectors, which are a critical component of the fire and emergency response system.
Emergency Sprinkler	The small, round cover recessed in the ceiling, sometimes near the detectors.	Fire/Emergency Integration (Suppression): While less distinct, fire suppression systems (sprinklers) are integrated into the ceiling, activated by the detection system in an emergency.

Component 2: Cognitive Ergonomics and Reducing Physical Hazards

- Intuitive layouts reduce cognitive load
- Clear sightlines and visual cues
- Reduced decision fatigue for staff
- Logical placement of equipment

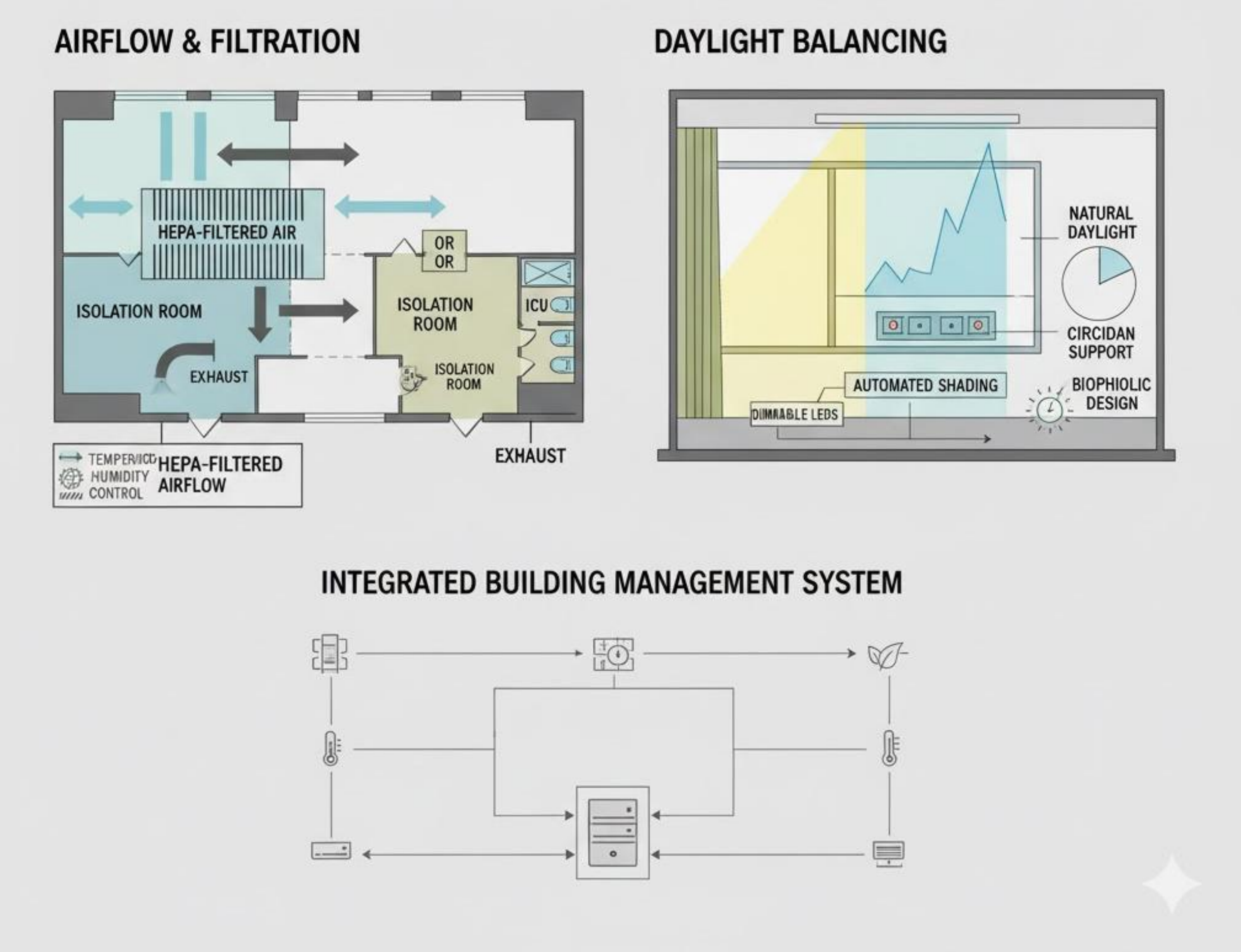
Figure 19. Floor plan showing courtyards



Component 3: Environmental Control

- Air quality, temperature, humidity regulation per room
- Lighting optimized for comfort and performance
- Noise control through acoustic materials
- HEPA filteration in high risk areas

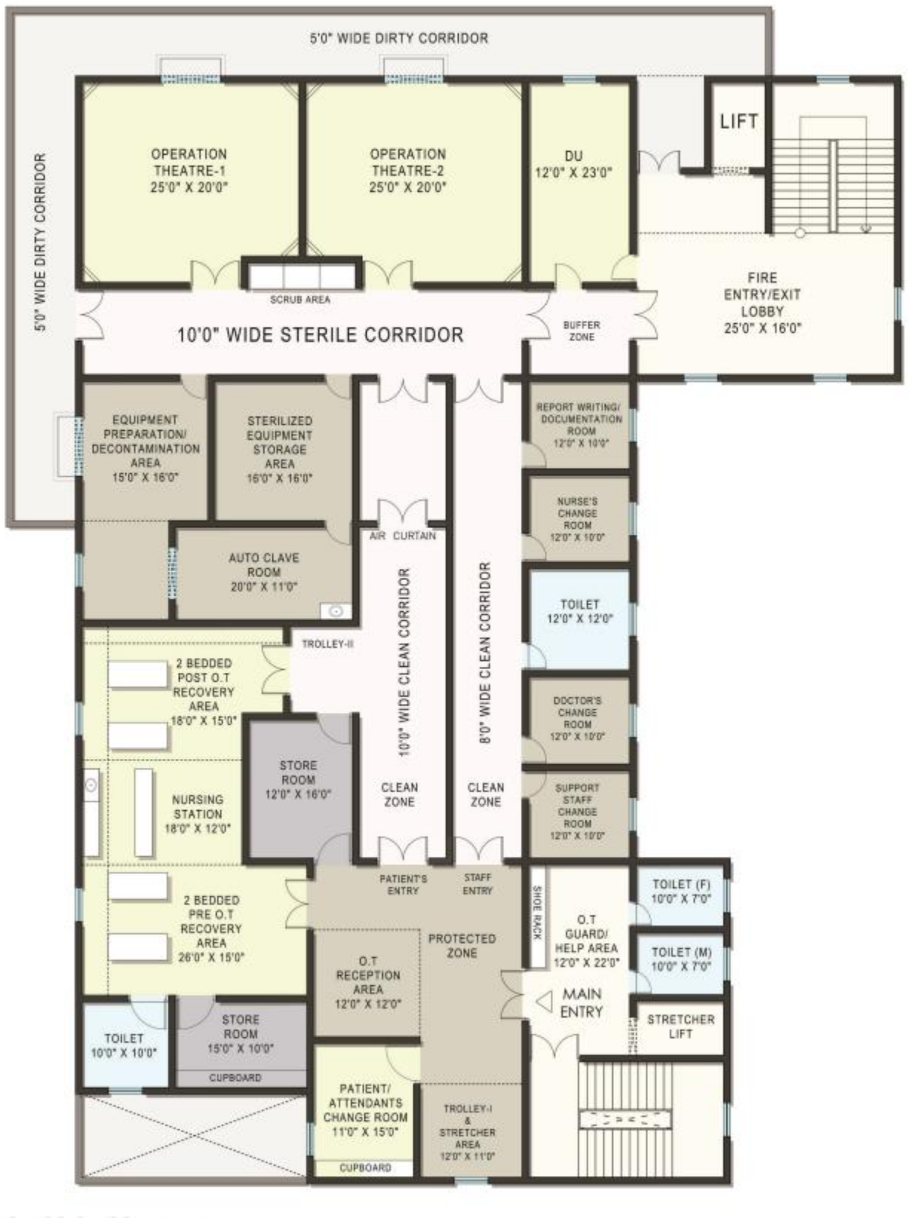
Parameter	Recommended Range	Purpose
Air Changes per Hour (ACH)	20–25 (general OT), 25–30 (orthopedic, transplant)	Ensures continuous dilution of contaminants
Temperature	20-24 ^{0}C	Higher for pediatric and orthopedic OTs if needed
Relative Humidity	45-60%	Prevents microbial growth and static charge
Filtration	HEPA (H13/H14)	Removes≥ 99.97% 0.3μ particles.
Pressure Differential	+10–15 Pa vs. adjacent zones	Ensures positive pressure barrier
Airflow Type	Unidirectional/laminar (for critical OTs), Turbulent (for general OTs)	Based on clinical need and local codes



Case Study: Conceptual OT Design

- **For 100-bedded hospital at Anupuram**
- Designed per CPWD modular OT guidelines
- Circulation system
- Smart HVAC with laminar airflow & HEPA filtering
- Pendant systems for flexible ergonomics
- Durable & infection-resistant surface materials

2 Nos OT COMPLEX LAYOUT PLAN

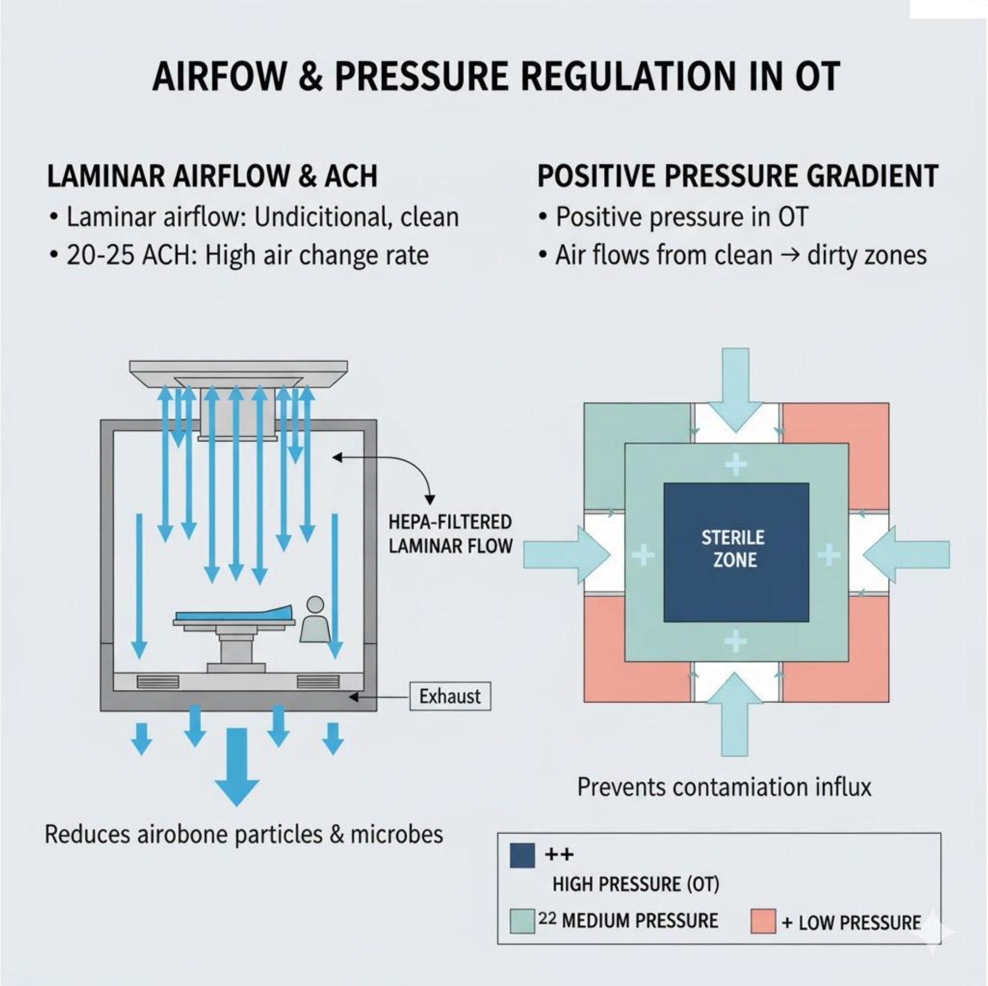


Zoning & Circulation

- **Sterile Zone**: OT rooms, scrub areas
- **Semi-Sterile Zone**: Preparation, recovery
- **Non-Sterile Zone**: Outer corridors, support rooms

Environmental Control (HVAC)

•Laminar airflow above sterile zone
•Floor-level exhaust for heavy particles & anesthetic gas removal
•Smart BMS for pressure, temperature & humidity control
•Positive pressure in OT; balanced pressure zoning



Ceiling-Mounted Equipment Booms – Functions- Clutter Reduction Through Suspended Systems

Feature	Ergonomic Benefit	Safety/ Environmental Benefit	
Clutter Elimination	Reduces cognitive load by clearing visual field, eliminating FDs.	Removes floor cables and hoses, eliminating trip hazards	. Prevent fatigue & improve workflow
Adjustable Monitor Arms	Optimizes visual line-of-sight and minimizes neck/eye strain for surgeons.	Allows precise positioning of monitors (data access) without compromising the sterile field.	Reduce neck/eye & musculoskeletal strain
Centralized Utilities	Provides required utilities (gas, data, power) at the point of need, minimizing user effort.	Keeps gas lines and power cables contained and organized, aiding infection control and cleaning.	Reduce trip hazards & improve infection control

Integration & Flexibility

- Modular ceiling service booms for utilities
- Reconfigurable installation points for future robotics & imaging
- Redundancy: UPS & emergency power
- Smart monitoring & digital control systems

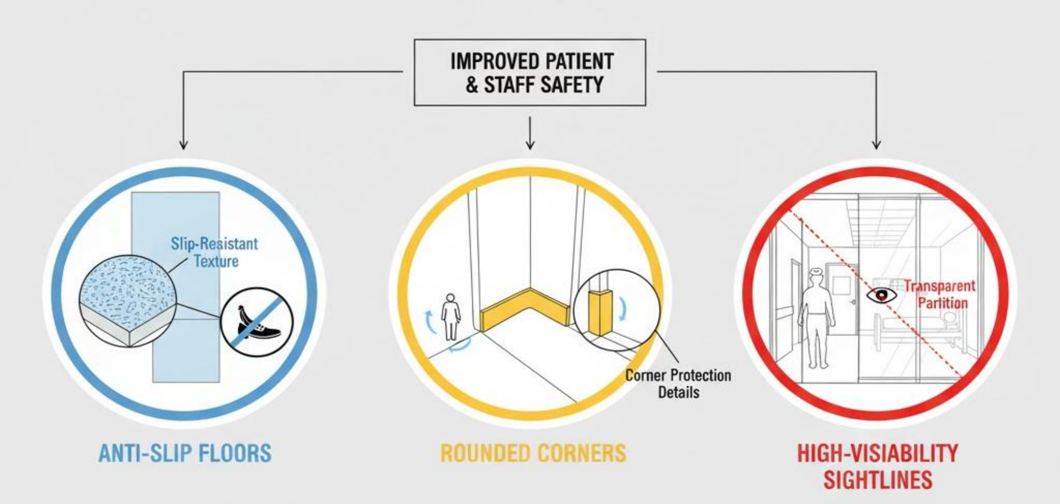
Application in Operation Theatres

OT as a High-Risk, High-Performance Environment

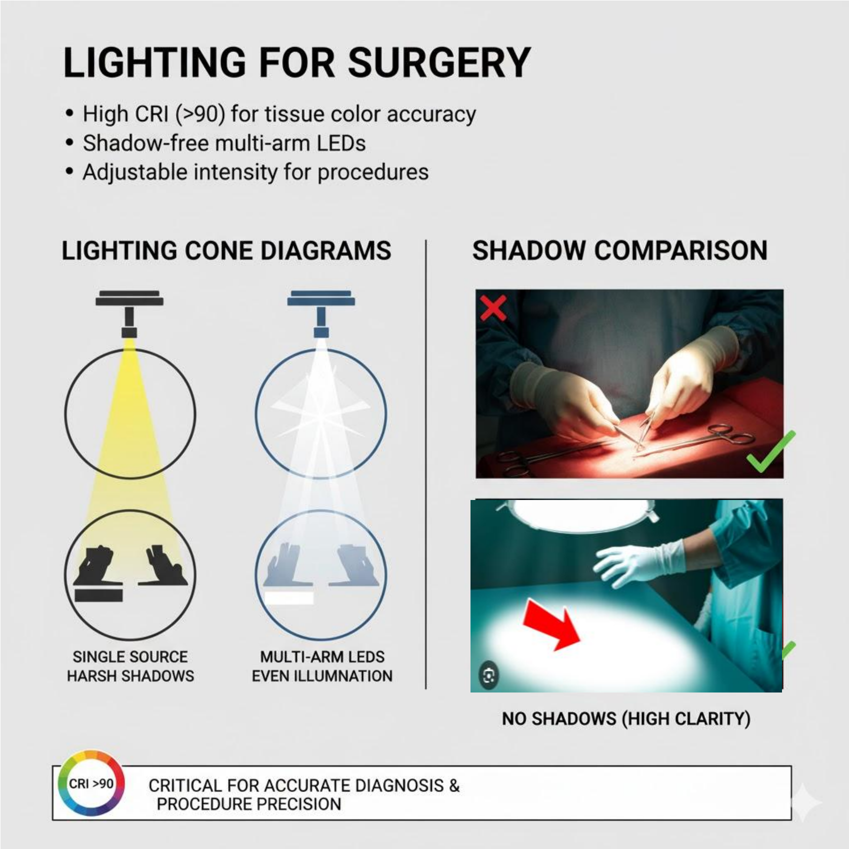
- Complex procedures
- Multidisciplinary teams
- Equipment-intensive space
- High infection control requirements

Material & Surface Design

- Seamless surfaces, Rounded corners
- Antimicrobial wall/door finishes
- Non-porous, antimicrobial, washable finishes
- Hermetically sealed sliding doors
- Flush lighting & integrated ceiling panels



Environmental Control – lighting, Air Changes & Pressure



- Good lighting is essential for visibility and surgical precision.
- OT lights should be shadow-free with adjustable intensity.
- The layout must support medical gas outlets, pendant-mounted equipment, emergency backup through UPS and generators, and secure cable management.
- Electrical safety standards including earthing, isolated power systems, and fire protection must be carefully implemented

Sustainability

Energy efficient HVAC with heat recovery

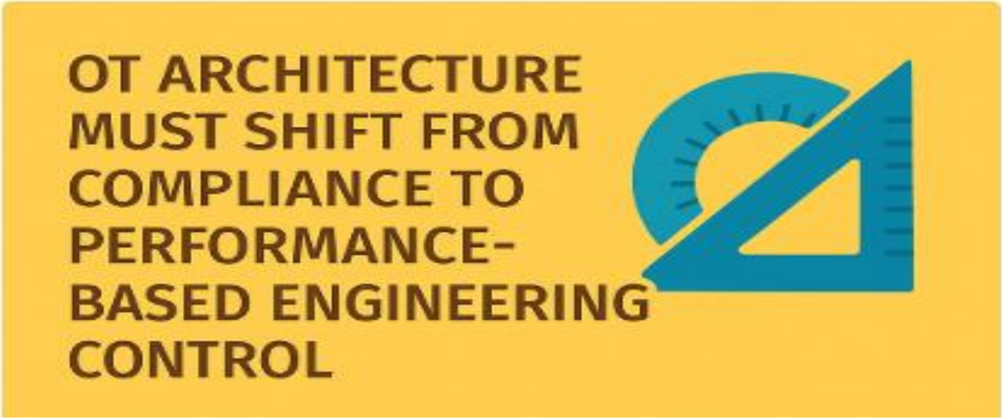
Water-efficient sterilization systems

Low-VOC and non-toxic materials

Supports certifications (LEED | GRIHA | Green Hospital)

Key Design Outcomes Expected

Conclusion


OT ARCHITECTURE
MUST SHIFT FROM
COMPLIANCE TO
PERFORMANCE-
BASED ENGINEERING
CONTROL


INTEGRATED DESIGN
IMPROVES SAFETY,
ERGONOMICS &
ENVIRONMENTAL
RESILIENCE


ARCHITECTS PLAY
A CRUCIAL ROLE
IN HEALTHCARE
SAFETY AND
SYSTEM EFFICIENCY

Thank You

Rear Elevation

Front Elevation

- WARM WISHES TO EVERYBODY

Digital Health, Telemedicine, and AI-IoT in Occupational Health

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Overview

- Rapid growth of digital health technologies in enhancing the quality, accuracy and accessibility of patient information
- Integration of AI, and IoT enables proactive intervention thereby improving short term safety and long-term health outcomes
- Focus on occupational health in high-risk industries

Introduction

- Digital transformation of healthcare systems – remote care to advanced AI integrated digital platforms
- COVID-19 accelerated telemedicine adoption
- Telemedicine usage surged 300% with more than 90 countries implementing it
- Shift from reactive to proactive occupational health
- National initiatives like ABDM in India ensure seamless delivery of healthcare across geographics

Digital Health Records

- Digitalization is “real-time collection, analysis and use of digital data for specific purpose”
- Foundation of modern healthcare systems and enable improved accuracy and accessibility of patient information
- Interoperability using HL7 FHIR, SNOMED CT
- HL 7 FHIR – (fast healthcare interoperability resources) – facilitate quick efficient and standardized exchange of electronic health information
- SNOMED CT (Standardized nomenclature of medicines-clinical terms) – provide standardized detailed and comprehensive vocabulary for all aspects of healthcare
- Supports long-term occupational exposure tracking

Electronic Medical Records

- EMR are digital versions of clinical services provided to patients by healthcare professionals
- EMR use AI and blockchain
- AI- use natural language processing for summarization and analytics
- Blockchain adds a layer of data security and traceability
- Supports regulatory compliance

Digital Health Ecosystem

Digital health leverages modern tools and platforms to improve healthcare outcomes. The various technologies and subfields use are

- Health IT and Informatics
- Wearables and biosensors
- Mobile health (mHealth)
- Telemedicine and SaMD (software as medical device)
- Personalized medicines

Telemedicine in Occupational Health

- Remote consultations and follow-ups
- Reduced travel and downtime
- Access to specialists in high-risk areas
- Improved continuity of care
- The average telehealth visit cost between USD 40-90 compared to USD 150-600 for in-office visits

Teleconsultation Guidelines & advantages

- Informed consent required
- Secure and real-time communication
- Confidentiality and documentation
- Emergency referral protocols

Advantages of digital health

- Significant improvement in patient care and diagnosis
- Clear and accurate documentation
- Lower healthcare costs by avoiding unnecessary visits and repeat investigations
- Reduced inconvenience for families and caregivers

Challenges in Atomic Energy Sector

- Ionizing radiation exposure
- Chemical and thermal hazards
- Mechanical and ergonomic risks
- Psychosocial stressors and shift work
- Operational constraints

Role of IoT in Occupational Health

- Smart radiation sensors and dosimeters
- Environmental monitoring sensors
- Wearables for vital signs, fall detection and fatigue
- Real-time alerts, location systems and dashboards
- Integrated alarms

Role of Artificial Intelligence

- Predictive exposure analytics – machine learning models forecast fatigue, exposure hot spots, equipment failures and risk trends
- Anomaly detection
- PPE compliance, unsafe behaviour detection via computer vision
- Decision support for OHS professionals
- Personalized risk profiling – combining historical data and real time metrics to tailor interventions
- Incident trend analysis

Integrated AI–IoT Framework

- Data layer – (sensors & wearables – IoT devices) capture physiological, environmental and operational data
- Edge & connectivity layer – secure transmission of data
- Cloud processing – data cleansing, aggregation and storage on secure platforms
- AI analytics – Predictive modules, computer vision, anomaly detectors and dashboards (common work platform)
- Response and feedback loop

Key Benefits

- Proactive safety management
- Continuous personalized monitoring
- Faster incident detection and response
- Improved compliance and reporting
- Operational efficiency
- Improved healthcare and productivity

Challenges and Mitigation

Technical and operational

- Cybersecurity – implement network segmentation, encryption and endpoint hardening
- Interoperability with legacy systems

Ethical and legal

- Data privacy – adopt data minimization, anonymization and clear consent policies
- Algorithmic transparency
- Governance and regulatory alignment

Organizational

- Cost and skill gaps
- Change management – involve workers and unions early to build trust

Conclusion and Recommendations

- Digital health enables safer workplaces, improve patient outcomes, ensure ethical and sustainable growth.
- AI – IoT systems to reduce exposures, prevent injuries and support regulatory compliance.
- AI triage bots and augmented reality for surgical assistance
- Predictive analysis will enable tailored healthcare delivery

Recommendations

- Start with small scale pilots, Adopt open standards, invest in cyber security, workforce training, establish evaluation metrics, engage regulators early

Future Directions

- Edge AI – means running AI in local devices (like phones, cameras & IoT sensors) and the benefits are local processing of data, low latency, improved privacy, offline capability
- Digital twins – is a dynamic virtual replica of a physical object. It is used in healthcare by creating human digital twins from health data for personalized medicines
- Federated AI is a decentralized ML method when a shared AI models is trained across many devices (like phones or hospitals) without moving raw data from its source, preserving privacy
- Regulation - aware AI


THANK YOU

Online Permit System:
A Digital Approach to Permit Management

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Computer Division

Authors:
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Safety Engineering Division

Introduction

Safety Work permit is a document that:

- ❖ Clearly defines the work to be done
- ❖ Identifies hazards and risks involved
- ❖ Specifies safety precautions and controls required
- ❖ Authorizes who can do the work, where, and for how long

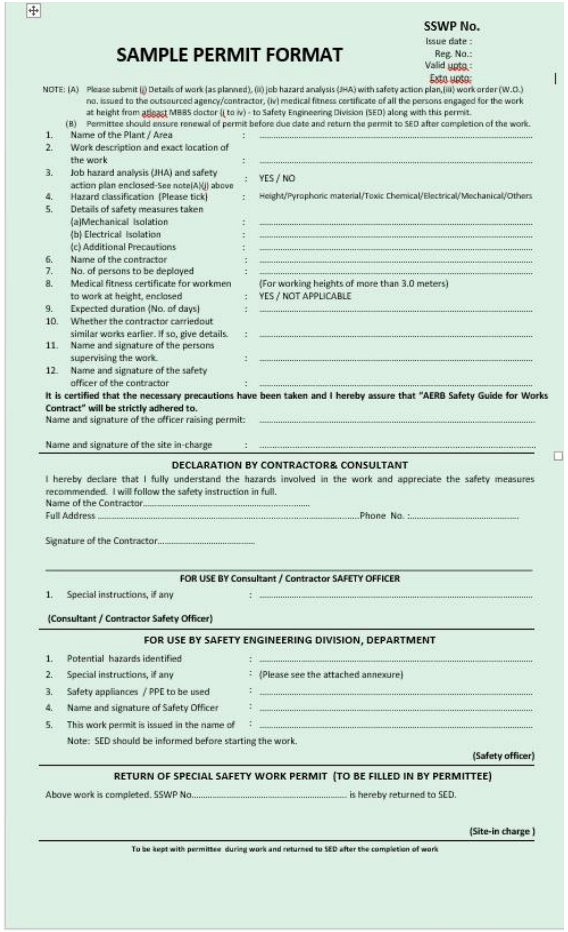
The work **cannot start** until the permit is approved and issued by an authorized person.

Introduction

- Safety Work Permit System has been an integral part of Nuclear Fuel Complex (NFC)'s operations since its introduction in 1979.

- For many years, paper based permits were processed manually, which ensured compliance but also led to paper consumption, higher processing times, and increased personnel effort.

- Recognizing the need to reduce paper usage, improve response times, and enhance overall efficiency, NFC has developed an Online Permit System.



SSWP No.
Issue date :
Reg. No.:
Valid upto :
Extn upto:

SAMPLE PERMIT FORMAT

NOTE: (A) Please submit (i) Details of work (as planned), (ii) job hazard analysis (JHA) with safety action plan,(iii) work order (W.O.) no. issued to the outsourced agency/contractor, (iv) medical fitness certificate of all the persons engaged for the work at height from atleast MBBS doctor (i to iv) - to Safety Engineering Division (SED) along with this permit.
(B) Permittee should ensure renewal of permit before due date and return the permit to SED after completion of the work.

1. Name of the Plant / Area : ....
2. Work description and exact location of the work : ....
3. Job hazard analysis (JHA) and safety action plan enclosed-See note(A)(i) above : YES / NO
4. Hazard classification (Please tick) : Height/Pyrophoric material/Toxic Chemical/Electrical/Mechanical/Others
5. Details of safety measures taken
   (a)Mechanical Isolation : ....
   (b) Electrical Isolation : ....
   (c) Additional Precautions : ....
6. Name of the contractor : ....
7. No. of persons to be deployed : ....
8. Medical fitness certificate for workmen to work at height, enclosed : (For working heights of more than 3.0 meters) YES / NOT APPLICABLE
9. Expected duration (No. of days) : ....
10. Whether the contractor carriedout similar works earlier. If so, give details. : ....
11. Name and signature of the persons supervising the work. : ....
12. Name and signature of the safety officer of the contractor : ....

It is certified that the necessary precautions have been taken and I hereby assure that "AERB Safety Guide for Works Contract" will be strictly adhered to.

Name and signature of the officer raising permit: ....

Name and signature of the site in-charge : ....

DECLARATION BY CONTRACTOR& CONSULTANT

I hereby declare that I fully understand the hazards involved in the work and appreciate the safety measures recommended. I will follow the safety instruction in full.
Name of the Contractor..............
Full Address ....Phone No. :..............

Signature of the Contractor..............

FOR USE BY Consultant / Contractor SAFETY OFFICER

1. Special instructions, if any : ....

(Consultant / Contractor Safety Officer)

FOR USE BY SAFETY ENGINEERING DIVISION, DEPARTMENT

1. Potential hazards identified : ....
2. Special instructions, if any : (Please see the attached annexure)
3. Safety appliances / PPE to be used : ....
4. Name and signature of Safety Officer : ....
5. This work permit is issued in the name of : ....

Note: SED should be informed before starting the work.

(Safety officer)

RETURN OF SPECIAL SAFETY WORK PERMIT (TO BE FILLED IN BY PERMITTEE)

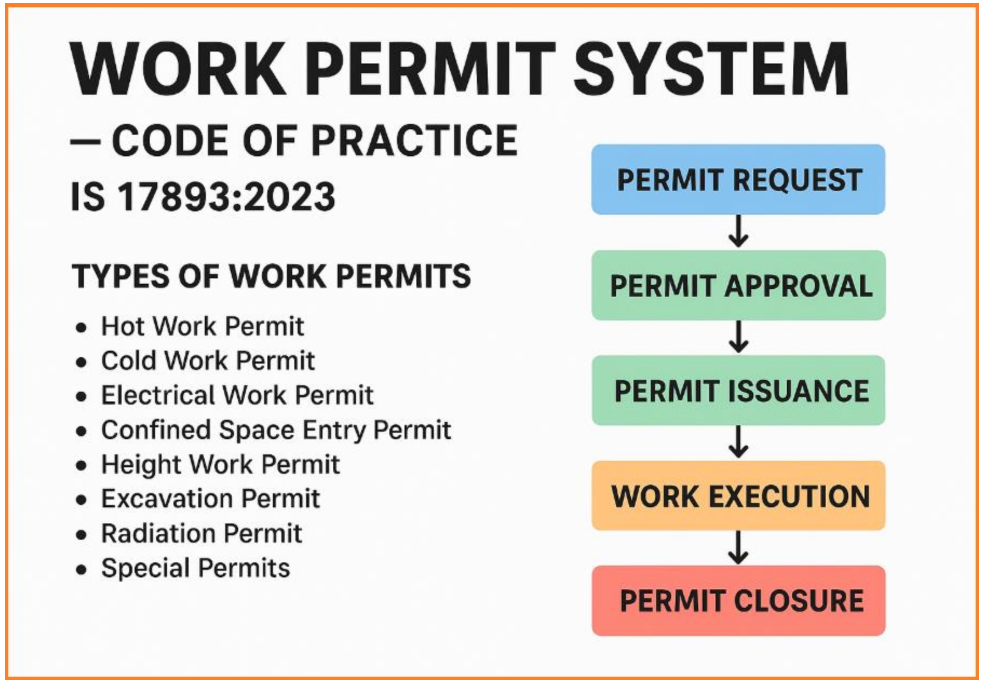
Above work is completed. SSWP No.............. is hereby returned to SED.

(Site-in charge)

To be kept with permittee during work and returned to SED after the completion of work

Types of permits

- Safety permits are classified as Safety Work Permits (SWP) and Special Safety Work Permits (SSWP).
- SWP in the prescribed format is to be obtained for executing work by Employees.
- SSWPs in the prescribed format are to be obtained whenever the work is carried out by an outside agency within the plant or its premises.



Process of paper based permit system

The old permit system involved a fully manual process with multiple steps and physical document handling. The workflow can be summarized as follows:

Collection of Forms:

➢Plant personnel visit the Safety Division to collect empty permit forms.

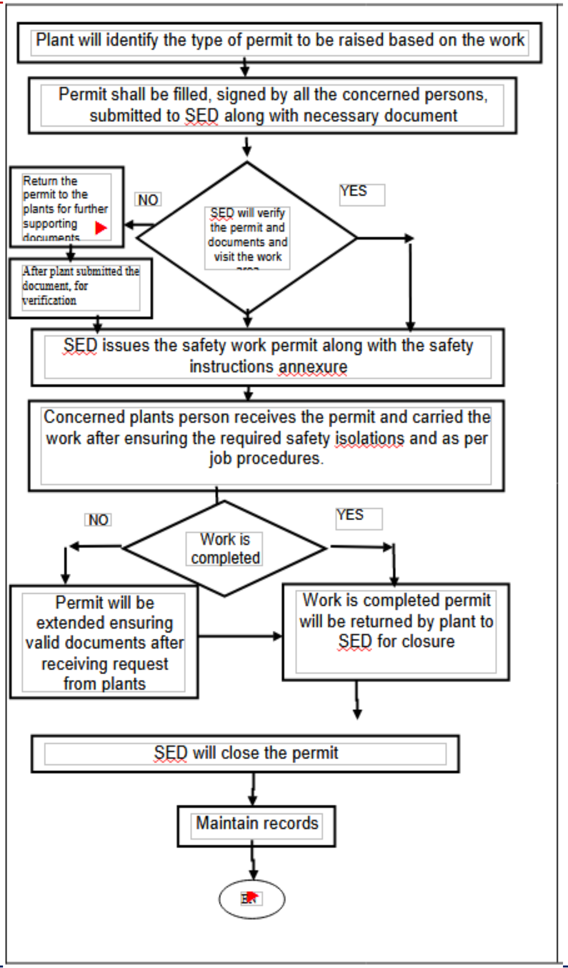
Form Filling and Submission:

➢The concerned officer fills out the forms and attaches all required supporting documents.

➢The completed forms and documents are manually sent to higher authorities for approval.

Approval Process:

➢Once the permit is approved by the higher authorities, a copy of the permit is submitted in person to the Safety Office.



Process of paper based permit system

Safety Verification:

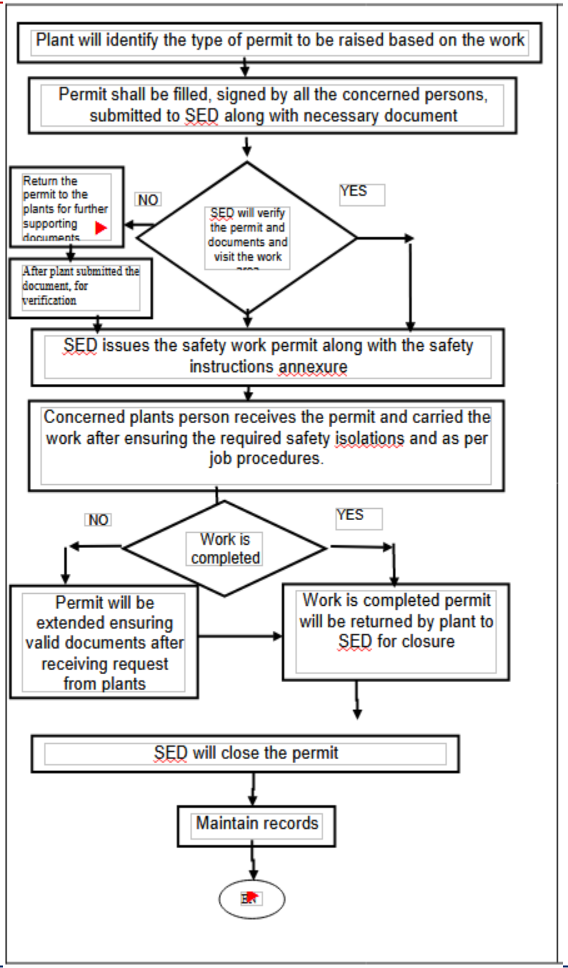
- Safety officials verify all submitted documents.
- If all documents are in order, a safety annexure is prepared and enclosed with the permit.
- The permit is then submitted to the approving authority for final approval.

Handling Corrections:

- If any documents are missing or corrections are required, the permit is returned to the user manually for rectification.

Final Approval and Collection:

- The approving authority verifies the documents and issues the permit.
- The user collects the permit in person from the Safety Office.



WHY ONLINE PERMIT SYSTEM?

Issues in Manual System

- Manual form collection and physical approvals
- Possibility of misplaced forms
- No real-time status tracking
- Long processing time
- High paper consumption due to multiple copies and manual document handling
- Challenging long-term record maintenance

- To overcome these issues, there was a clear need for a faster, more reliable, and environmentally friendly system.

ONLINE PERMIT SYSTEM AT NFC

❖ Computer division, NFC has developed a web based online permit system to streamline the permit process by digitizing workflows and reducing manual intervention in line with the requirements of the safety engineering division. The same was implemented from November' 2020 which replaced the paper based permit system.

Technologies Used (Version 1):

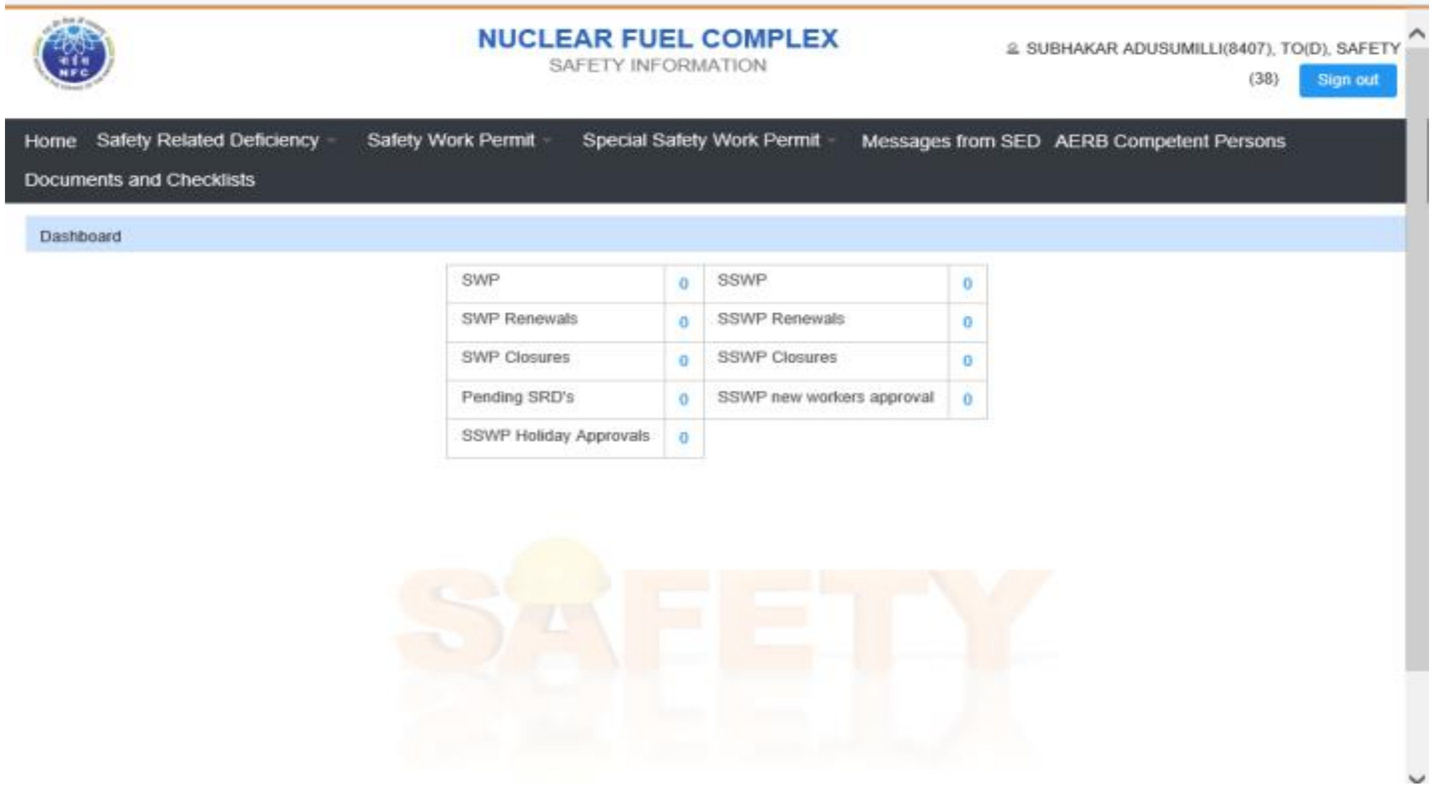
- JSF (Prime Faces)
- PostgreSQL (version 13.4)
- Jboss 7.2(cluster)

Technologies Used (Version 2):

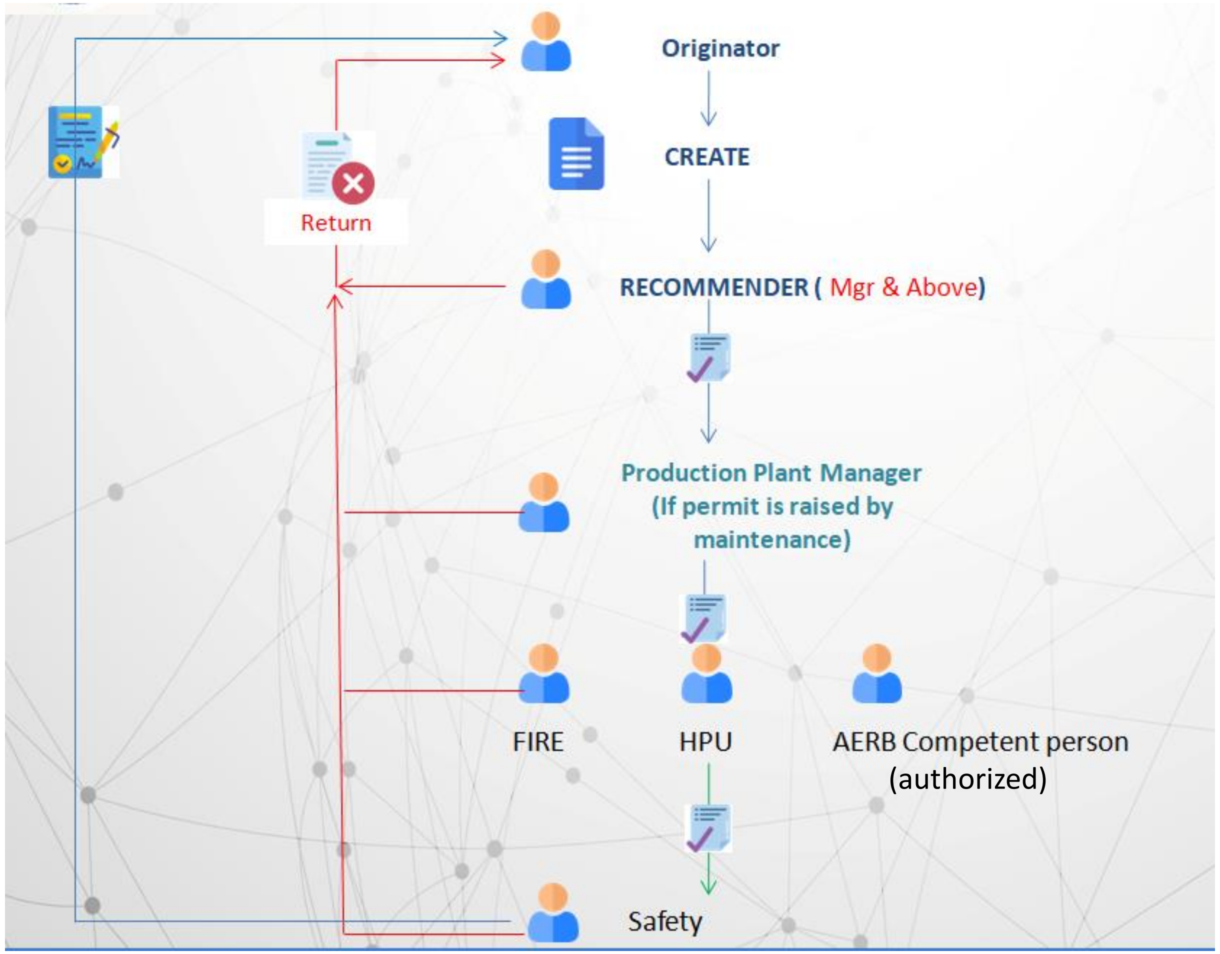
- React 18.3 (Prime React)
- Java 8 (Spring boot framework)
- PostgreSQL (version 16.6)
- Jboss 7.2(cluster)

ONLINE PERMIT SYSTEM AT NFC

The system features a Dashboard that provides users with comprehensive safety-related information and permits management.



WORKFLOW IN E-APPLICATION



ONLINE PERMIT SYSTEM AT NFC

SSWP - FOR ALL WORKS TO BE EXECUTED BY OUTSOURCED AGENCIES, WITHIN NFC

Plant* CD-45

Work Carried Out By*
Maintenance

Production Plant*
Select plant

Work Carried out in *
Select work carried out in

Work and contractor details

Work Description and Exact location of the work*
Enter Work Description and Exact location of the work

Hazard Classification *
Select hazards

Details of safety measures taken (a)Mechanical Isolation*
Enter Mechanical Isolation

(b)Electrical Isolation*
Enter Electrical Isolation

(c)Additional Precautions*
Enter Additional Precautions

Name of the Contractor*
Enter name of the contractor

No. of persons to be deployed*
Enter No. of persons to be deployed

Expected duration (No. of Days)*
Enter Expected duration (No. of Days)

Whether the Contractor carried out similar works earlier. if so, give details*
Enter Whether the Contractor carried out similar works earlier. if so, give details

Name of the persons supervising the work(maximum 4 persons)*
Select Name of the persons supervising the work

Work order/Purchase order valid till*
select W.O/P.O valid upto date

DECLARATION BY CONTRACTOR

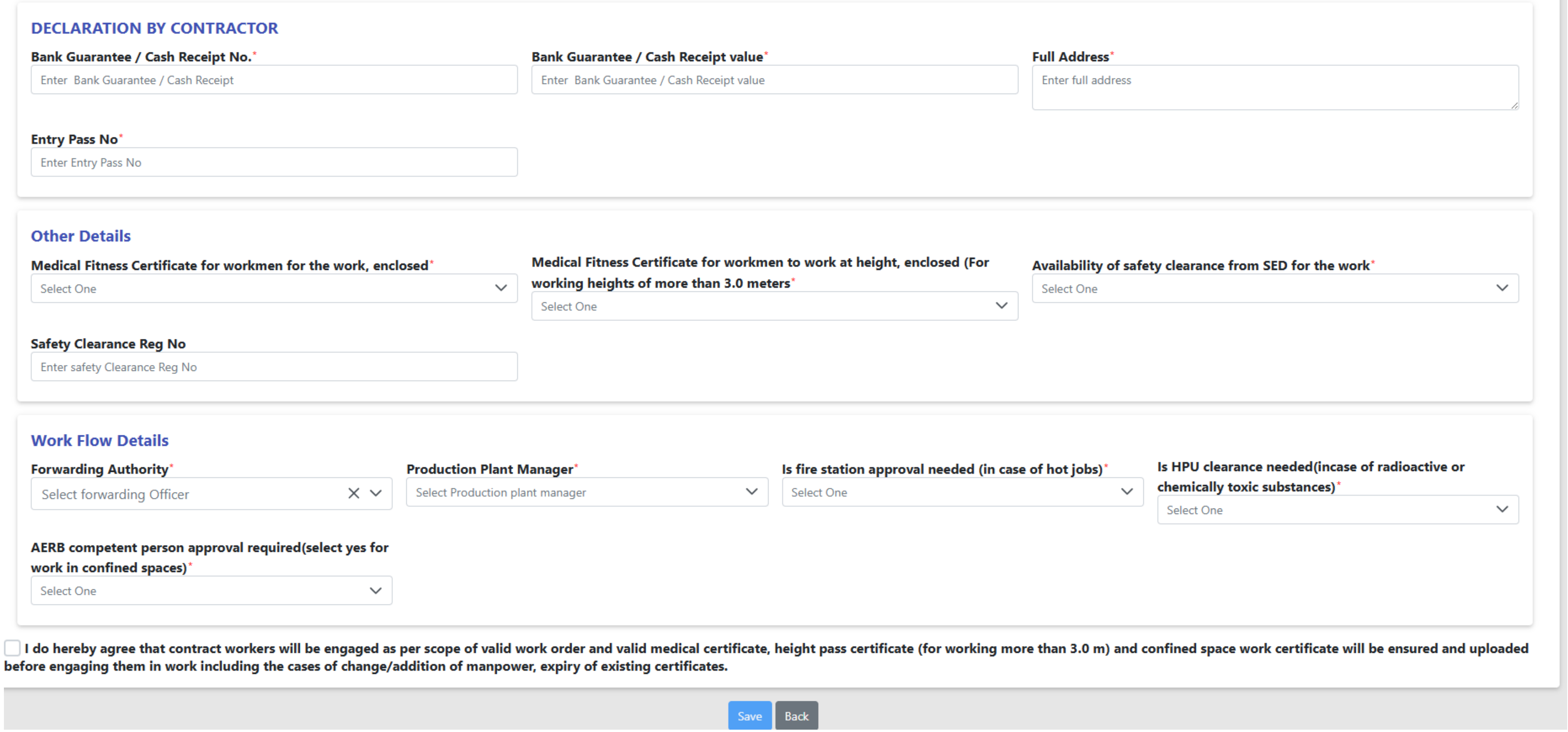
Bank Guarantee / Cash Receipt No.*
Enter Bank Guarantee / Cash Receipt

Bank Guarantee / Cash Receipt value*
Enter Bank Guarantee / Cash Receipt value

Full Address*
Enter full address

Entry Pass No*
Enter Entry Pass No

ONLINE PERMIT SYSTEM AT NFC



ONLINE PERMIT SYSTEM AT NFC

Documents

Sl.No	Document Type	Document Description	File Name	Uploaded Date	Uploaded By
	Search	Search	Search	Search	Search
1	Job Hazard Analysis	JHA	JHA-6.rar	19/11/2025, 15:18:26	ANIL KARUNAKAR AMBATI-7621
2	Declaration By Contractor	Declaration	SAFETY DECLARATION-116.pdf	19/11/2025, 15:18:43	ANIL KARUNAKAR AMBATI-7621
3	Work Order	WO	Workorder_Contractorcopy-7.pdf	19/11/2025, 15:19:12	ANIL KARUNAKAR AMBATI-7621
4	SUPPORTING_DOC	EOT	SRI PERLA EOT till 14.02.26.pdf	19/11/2025, 15:19:35	ANIL KARUNAKAR AMBATI-7621
5	Medical fitness certificates of workers	Fitness certificates	medical certificates 31.10.25-1.rar	19/11/2025, 15:20:08	ANIL KARUNAKAR AMBATI-7621
6	Minutes of meeting with safety officer	MOM	MOM-813.pdf	19/11/2025, 15:20:25	ANIL KARUNAKAR AMBATI-7621
7	Details of work	List -1	List dt. 20.5.25-1.pdf	19/11/2025, 15:20:57	ANIL KARUNAKAR AMBATI-7621
8	Details of work	List 2	LIST OF WORKS - Defined scope-1.docx	19/11/2025, 15:21:12	ANIL KARUNAKAR AMBATI-7621
9	Details of work	list 3	List-1.docx	19/11/2025, 15:21:25	ANIL KARUNAKAR AMBATI-7621
10	Details of work	list 4	MR Status as on 16.11.24-1.docx	19/11/2025, 15:21:38	ANIL KARUNAKAR AMBATI-7621

« ‹ 1 2 › » 10

Workflow Name	Workflow
SSWP	ANIL KARUNAKAR AMBATI SUBMITTED 10/12/2025 13:10 PM; ARULSAMY S FORWARDED 10/12/2025 14:13 PM; MAHIMABRATA MISRA FORWARDED 12/12/2025 10:18 AM; HPU-pay category-1 RECOMMENDED 15/12/2025 16:37 PM; FS-pay category-1 RECOMMENDED 13/12/2025 10:12 AM; SAFETY-pay category-1 Pending; SAFETY-pay category-2 Pending; SAFETY-DEPUTY MANAGER-pay category-1 Pending

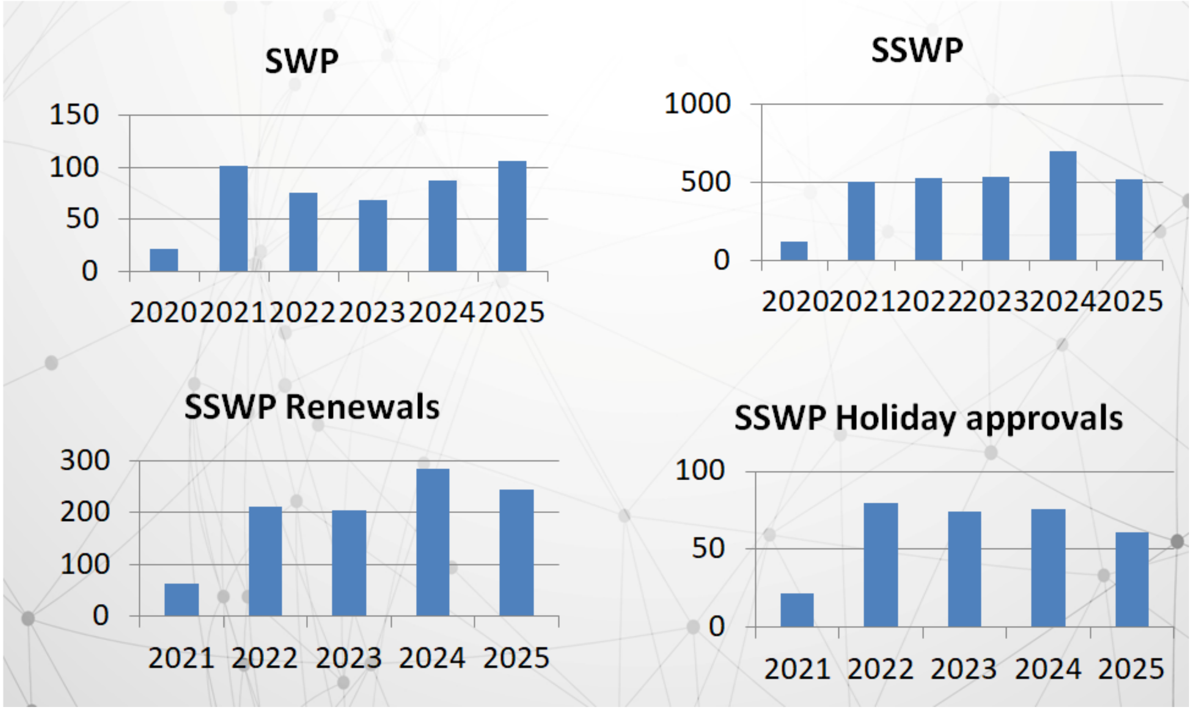
ONLINE PERMIT SYSTEM AT NFC

Advantages:

- Centralized Access and Information Management
- Online status monitoring
- Time Efficiency and Faster Processing
- Enhanced Transparency and Tracking
- Error Reduction and Accuracy
- Improved Safety Compliance
- Auditability and Record Keeping
- Convenience and User-Friendly Interface
- Environmentally Friendly

Other Features:

1) Renewal
2) Holiday Approval
3) New Documents
4) Closure
5) Intimate Violations
6) Suspend Permit and Revoke Suspension
7) Safety Messages / Circulars



Summary

- The shift from the earlier manual permit system to the Online Permit System has greatly improved efficiency, transparency, accountability and safety management at all stages in the plant.
- The manual process involved multiple in-person visits, physical paperwork, and long approval times, which often caused delays and errors.
- The online system, with its central dashboard and digital workflow, makes the permit process faster, more accurate, and easier to track. It saves time, reduces mistakes, ensures compliance with safety rules, and keeps a clear record of all activities.
- **Overall, the Online Permit System shows how using technology can simplify traditional processes, improve efficiency, and promote a safer, more organized workplace.**

THANK YOU

DeepCXR : Augmenting AI for Automated Health Screening in India

AI & Digital Twin Division,
Institute For Plasma Research, Gandhinagar-Gujarat

Mrs. Manika Sharma

Division members : *Mr. Agraj Abhishek, Abhishek Sharma , Satish Patel , Bhanu D Parashar , Gaurav Garg, Aman Pandey, Tony Sandeep , Sunil Bassi*

Content

DeepCXR : Artificial Intelligence (AI) for Automatic Screening/detection of Pulmonary TB and other lung diseases using Chest X-rays

- Data Collection & Development
- Validation & approval
- Deployment for Pan India under national program

Leveraging AI in occupational healthcare

AI and Machine learning being used since decades. With on going digitization & technology like GPU servers , AI is transforming occupational safety in India by enhancing workplace safety, employee well-being, and productivity through risk assessment, disease prevention, mental health support, and streamlined administration.

AI for Workplace Risk Detection & Monitoring

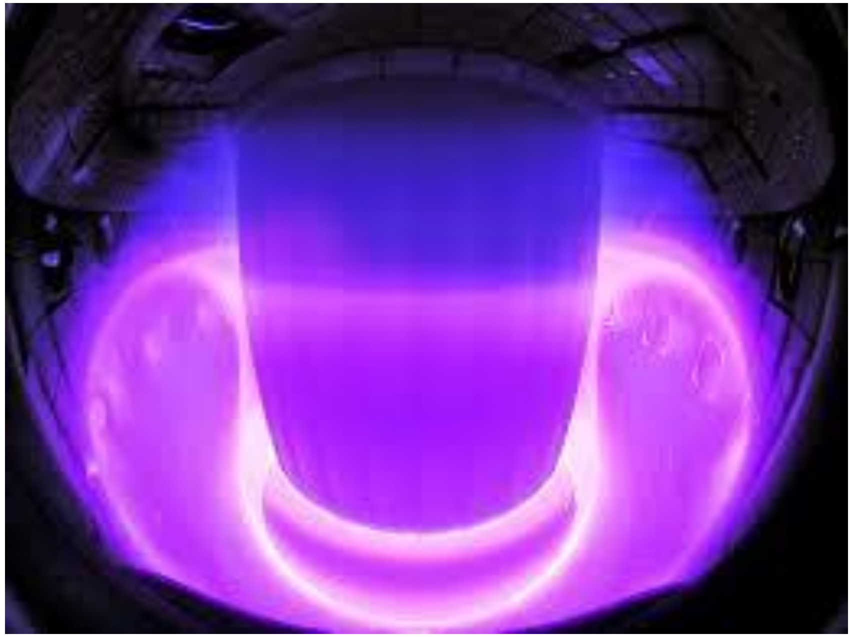
Industries such as **Steel, C**onstruction e.g AI-powered CCTV analytics. **24×7 automated monitoring** of large industrial sites where human supervision is limited.

AI-Enabled Health Screening for Industrial & mines Workers

AI is augmenting the health services to reach the most needy in remote India , speed up and help reduce the load in urban and semi urban areas PHC & hospitals , in a vast country like India.

Deep Learning is Data *hungry !!*

IPR has been utilizing Deep Learning and AI for its fusion research activities.



TCV tokamak based at Switzerland's EPFL research facility

2 system operating operating in India providing ~2000 seconds of data per year
https://www.wired.com/story/deepmind-ai-nuclear-fusion/

Over 70,000 sytems operating in India 24x7, > 2 Cr CXR data /year

The AI does not differentiate between a tokamak and a human lung image

IPR Gandhinagar:
Computational Capability

IPR with its long-standing focus on high performance computing facilities, 1 Petaflop HPC facility

- ANTYA has 261 Nodes, with a total of 10,520 cores and 46 GPU Cards.

- Newly built Container data centre

DeepCXR : Artificial Intelligence (AI) for Automatic Screening/detection of Pulmonary TB and other lung diseases using Chest X-rays

IPR expertise in AI has been leveraged to support India’s TB Eradication Programme launched by the Hon’ble Prime Minister.

Tuberculosis (TB) remains one of the leading causes of death globally. CXR images interpretation by radiologists is time-intensive, susceptible to intra and inter-observer variability of the order of 20-30%, and often laborious , when done under high volume public health programs.

AI-driven detection can support the elimination of TB, especially in countries like India with unbalanced healthcare resources. Low-cost AI-based radiographic screening improves access to early diagnosis and thus helps save lives.

Team members : Mr. Agraj Abhishek, Abhishek Sharma , Satish Patel , Manika Sharma

DeepCXR : *Introduction*

- IPR initiated the study with CXR Data from Civil hospital Ahmedabad —> Initial model .

- IPR —> MoU with ICMR Delhi Hq. Qtr & NIRT Chennai (for Data) .

Institute for Plasma Research, Gandhinagar started developing an Artificial intelligence (AI) software in collaboration with ICMR, Delhi for automated detection of footprints of pulmonary tuberculosis/other chest ailments in Chest X-Ray Images.

- IPR with ICMR Delhi presented status of DeepCXR in WHO ITU.
- DeepCXR initiated for pan India - AI Tool aligned with the requirement of health screening programs in India - National Program - NTEP —a scalable , reliable & cost effective AI for National Programme .

DeepCXR : Artificial Intelligence (AI) for Automatic Screening/detection of Pulmonary TB and other lung diseases using Chest X-rays

Institute for Plasma Research

IPR Gandhinagar: AI software development & optimisation

ICMR Headquarters, New Delhi: **Central Co-ordinating Institute** ,website AI4TB & data management for uploaded images.

Participating Institutes: NIIH Mumbai, KEM Hospital Mumbai, BJ Wadia Hospital for Children Mumbai, NITRD Delhi, RBIPMT Delhi, UCMS Delhi, NIOH Ahmedabad, RMRC Bhubaneshwar, SCB Medical College & Hospital Cuttack, St. John Medical College Bengaluru, BMMRC Hyderabad, NIRT Chennai, AIIMS Delhi, KGMU Lucknow, AIIMS Bhopal, Government Medical College Ratlam, NIIRNCD Jodhpur ~ 20 institutes from all over India: **Provide Chest X-Ray Image Data Collection as per gold standards (based on Lab tests)**

AIIMS & NITRD Delhi: Central Annotation Team: Validation of Xray + Annotation from 20 Labs.

A project plan with time line (Phase 1 , Screening Tool) (Phase 2 , Diagnostic Tool) □ ICMR, MoHFW monitoring committee .

IPR (Software Development) + ICMR (Central Coordinating Agency) + Data : 20 Participating Hospitals/Institutions /Medical Hospitals → **DeepCXR** : AI for screening and diagnostics of chest Abnormality in CXR images

DeepCXR: Development : Training on Indian Data Set

Institute for Plasma Research

DeepCXR : Data collection

Motivation:

DeepCXR performs better on Indian CXR Data with Specificity/Sensitivity >90 % .This is better than AI from other BRICS (SA) which gave low accuracy on Indian data set (~30 % as reported by ICMR)

- Chest X–Ray images are annotated with marked lesions for training AI .
- Till date > 1 Lakh Chest X-Rays images have been uploaded for > 50 classes.

Dashboard	Adult						Pediatric						
Site Name	TB Case	Non TB Case	Normal Case	Suspected Case	Special Case (TB/Non-TB/Normal)	Total	TB Case	Non TB Case	Normal Case	Suspected Case	Special Case (TB/Non-TB/Normal)	Total	
ICMR Headquarters, New Delhi	8	4	11	1	2	26	1	1	0	0	2	4	More details
NIIH, Mumbai	1	0	0	0	0	1						0	More details
KEM Hospital , Mumbai	461	332	1823	57	17	2690	13	3	103	1	1	121	More details
BJ Wadia Hospital for Children, Mumbai	119	5	55	0	2	181	438	384	1615	0	15	2452	More details
NITRD, Delhi	937	376	392	0	1	1706	40	0	120	0	0	160	More details
UCMS, New Delhi	282	123	798	39	7	1249	40	154	171	26	3	394	More details
NIOH, Ahmadabad	60	82	0	0	0	142						0	More details
RMRC, Bhubaneshwar	315	1160	2302	10	32	3819	8	102	568	0	3	681	More details
St John Medical College, Bengaluru	1592	394	3009	23	150	5168	337	75	408	0	116	936	More details
BMMRC, Hyderabad	61	74	544	29	12	720	1	1	236	0	0	238	More details
NIRT, Chennai	4496	0	837	0	0	5333	754	0	0	0	0	754	More details
KGMU, Lucknow	988	918	555	6	15	2482	69	245	116	2	31	463	More details
AIIMS, Bhopal	172	573	751	49	3	1548	25	149	212	3	1	390	More details
Government Medical College, Ratlam	269	2106	492	0	33	2900	11	14	83	0	1	109	More details
NIRRNCD, Jodpur	1017	117	1034	0	22	2190	15	37	147	0	0	199	More details
Sir J J Group of Hospitals, Mumbai	22	0	0	0	0	22	667	558	24	4	0	1253	More details
MGIMS, Wardha	1157	1037	686	0	6	2886	0	1	0	0	0	1	More details
Vallabhbhai Patel Chest Institute (VPCI), Delhi, Delhi	1072	1527	186	69	1164	4018	13	32	15	5	79	144	More details
AGMC, Agartala, West Tripura	140	351	516	47	132	1186	2	61	510	3	13	589	More details
Total	13169	9179	13991	330	1598	38267	2434	1817	4328	44	265	8888	

Low Cost Digitizer for AI4TB program by IPR

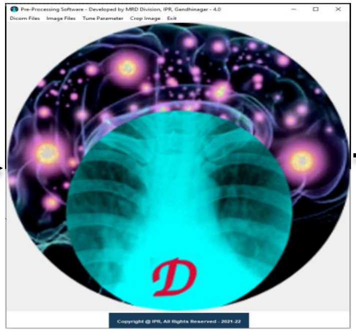
Pls. visit IPR exhibit stall .

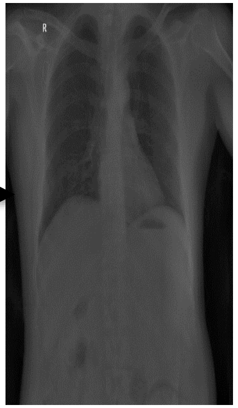
- Takes radiographic films to produce the digital output .
- Teleconsultation
- X-ray digitization and data storage.

DeepCXR : Software Development

Pre-processing software is developed by IPR & training given to all participant institutes, to improve image quality & annotations.

- Enhance image quality.
- Convert different image formats to PNG. Anonymize DICOM files.
- Compatible with Ubuntu & Windows.

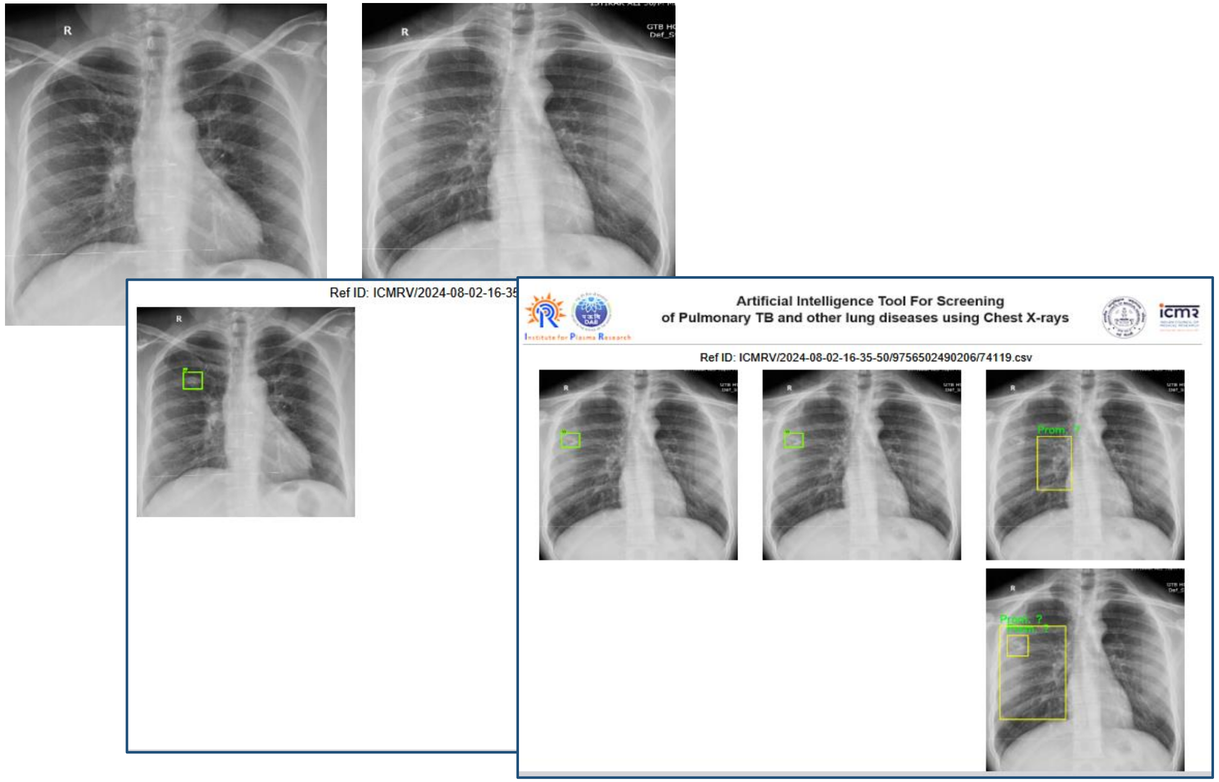




Input Image,
Size – 2014 x 2014 px
Quality – Poor

Output Image,
Size – 600 x 600 px
Quality – Good

AI Generated CXR images for Lung Nodules



DeepCXR: Software Development and Validation

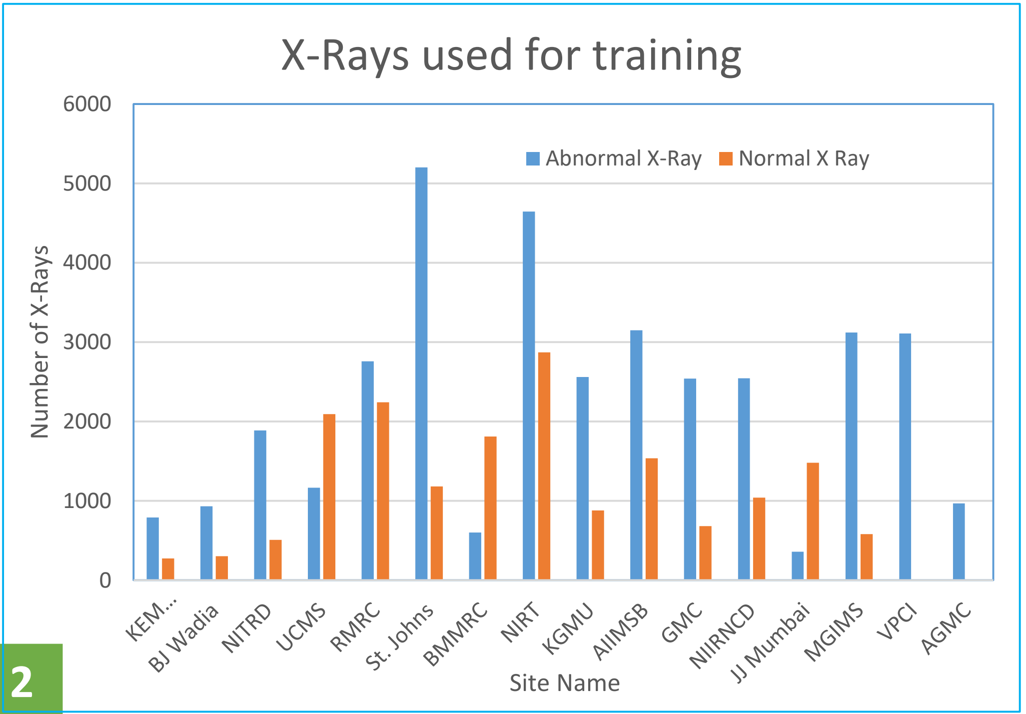
- ***~ 50 AI models training & testing .***
- The software first installed in ICMR Delhi ***remotely .*** Software Validated on chest X-Rays (captured via hand held devices) of ***people from Saharia Tribe, one of the remotest region in Madhya Pradesh.***
- ***DeepCXR is ensemble of AI models.***
- ***One of the feature of the AI software is it can be made available on cloud server and as stand alone mode thus usable in remote areas .***

- **Classifies Normal/Abnormal Chest X-Rays**
- **Trained on datasets from 10 different states, 18 different sites**
- **Covers more than 23 variations of abnormalities**
- **Sensitivity/Specificity of 97 % and 96 % on validation dataset.**

View of Data set for Training & validation- Phase -1

Total Training Dataset

Normal		Abnormal	
Adult	Paediatrics	Adult	Paediatrics
12008	5492	31995	4505
17500		36500	
Total No. of X-Rays : 54000			



Total Validation Dataset

Normal – Phase 1		Abnormal – Phase 1		Abnormal – Phase 2 (Prospective)	
Adult	Paediatrics	Adult	Paediatrics	Adult	Paediatrics
10514	3170	6499	964	7640	1211
		7463		8851	
13684		16314			
Total No. of X-Rays : 29998					

DeepCXR validated on multiple Indian datasets. Finally Independent validation on prospectively CXR images from Medicine Department/Chest clinic of participating centers was carried out .

DeepCXR : *Approved by DHR - MoHFW*

DeepCXR approved by expert panel of HTA , Dept. of Health & Research – ICMR – MoHFW as AI screening Tool for larger population of India .
ICMR recommends DeepCXR for National Program – NTEP India

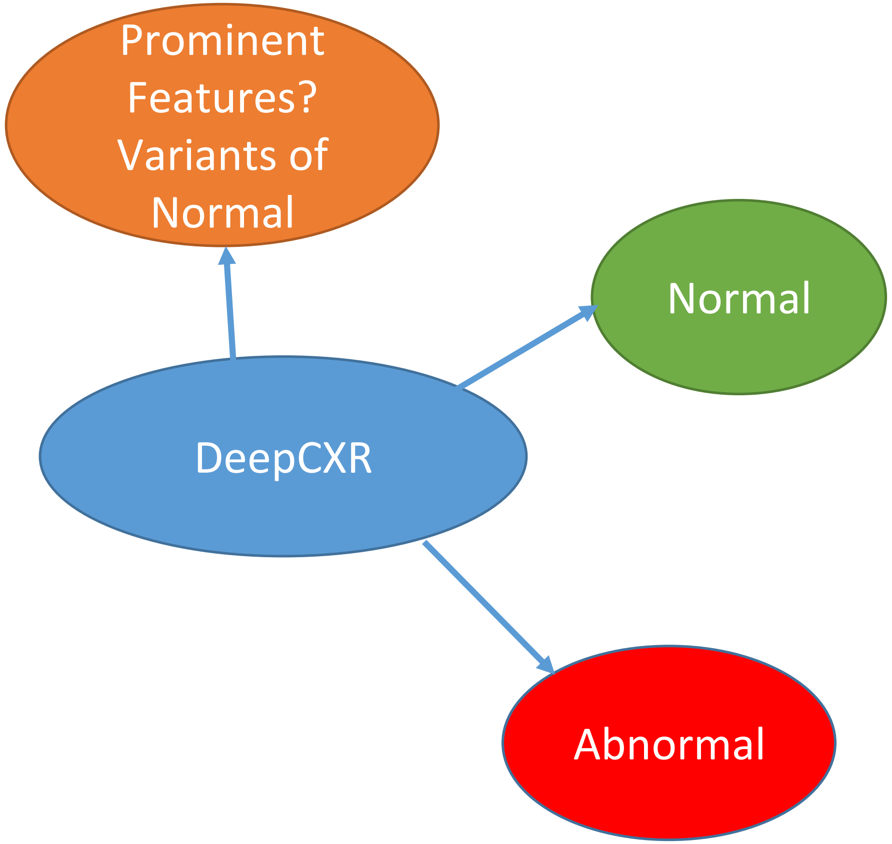
Methodology for implementation – CTD – MoHFW initiated

SOP by IPR & CTD for deployment for Indian states with the aim to :

- Use AI tech.-DeepCXR to Automate Screening/detection of Pulmonary TB and other lung diseases using Chest X-rays --Timely Intervention , save life, reduce health care cost .

- Enable screening in Industries, mines, remote India to support early detection of risk in lungs , thus improving occupational health for larger population of India .

- Integrate & operate smoothly : urban & in resource constraint setup of semi urban and remote India - PHCs , CHCs & others : Portable Hand held X ray system ,



DeepCXR : *India innovation Summit – New Delhi 2025*

Underlining the new Innovations rolled out under the program, Smt. Patel stated that "ICMR has validated three indigenous handheld X ray devices, which makes it possible to reach vulnerable population groups for TB screening. Hand-held devices offer advantages of low weight, portability, and low radiation exposure and are being used in the 100-day accelerated programme." She also added that "ICMR partnered with Institute of Plasma Research, Ahmedabad, to develop DeepCXR, a tool for artificial intelligence-based reporting chest X ray films. AI tools are expected to be a gamechanger in detecting presumptive TB patients and quick initiation of treatment.

DeepCXR : India innovation Summit – New Delhi 2025

DeepCXR in News

pib.gov.in/PressReleasePage.aspx?PRID=2112158

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ddnews.gov.in/en/india-innovation-summit-tb-cases-hit-record-26-07-lakh-in-2024-incidence-down-17-7-since-2015/

Highlighting innovations, Patel revealed that ICMR has validated three indigenous handheld X-ray devices, enabling more accessible TB screening for vulnerable populations. Additionally, AI-based tools like DeepCXR are enhancing the speed and accuracy of TB detection, and indigenous molecular diagnostic tests, such as PathoDetectTM, are expanding the capacity for early detection of drug resistance.

newindianexpress.com/nation/2025/Mar/18/india-steadily-progressing-to-eliminate-tuberculosis-by-2025-unio

WebAdvisor — We tested this page and blocked content coming from potentially dangerous or risky sites. Only if you're sure it comes from safe sites.

...ar 18, 2025 8:39 PM | E-PAPER — INDIAN EXPRESS

...TION WORLD STATES OPINIONS CITIES BUSINESS SPORT GOOD NEWS MO...

programme.

...nered with the Institute of Plasma Research, Ahmedabad, ...intelligence-based reporting chest

business-standard.com/health/india-takes-lead-in-global-fight-against-tuberculosis-says-icmr-125031800792_1.html

BS HOME HEALTH — LATEST NEWS INDIA NEWS OPINION

"AI-enabled chest X-ray interpretation through DeepCXR, developed in partnership with the Institute of Plasma Research, Ahmedabad, is expected to be a game-changer in detecting presumptive TB cases quickly and initiating

biospectrumindia.com/news/92/25848/icmr-strengthens-strategies-for-faster-and-more-accurate-diagnostics-of-tuberculosis.html

Home News Opinion Pharma Special Healthcare Start-ups Bio-Med Bio Interactions States

"ICMR has validated three indigenous handheld X-ray devices, which makes it possible to reach vulnerable population groups for TB screening. Hand-held devices offer advantages of low weight, portability, and low radiation exposure and are being used in the 100-day accelerated programme."

"ICMR partnered with Institute of Plasma Research, Ahmedabad, to develop De... ...porting chest X-ray films. ICMR has also validated CyTb skin test ... Institute of India against Interferon gamma release ... GRA is expensive and it may not be ...

indiatoday.in/health/story/india-faced-highest-number-of-tuberculosis-cases-in-2024-2695254-2025-03-18

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...wered chest X-ray analysis (DeepCXR): Developed with the Institute of ...bad, this tool speeds up TB detection.

effective alternative to the expensive

health.economictimes.indiatimes.com/news/policy/ntep-steadily-progressing-to-eliminate-tb-by-2025-mos-health-anupriya-patel

hworld.com — News Exclusives Leaders Speak Events Awards Webinars

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tribuneindia.com/news/india/india-has-major-task-of-eliminating-tuberculosis-5-other-diseases-vk-paul/

The Tribune — Trending Videos India World Sports State City Opinion Diaspora

"ICMR has partnered with the Institute of Plasma Research, Ahmedabad, to develop DeepCXR, a tool for artificial intelligence-based reporting chest X-ray films. AI tools are expected to be a gamechanger in detecting presumptive TB patients and quick

DeepCXR : *Occupational Health & safety*

Occupational Health

- **Pre-Employment Screening --Detect existing lung conditions before job placement**
- **Periodic Health Surveillance**
  - **Annual or biannual chest X-rays can be quickly analyzed by DeepCXR.**
  - **Tracks lung health changes over time to detect early disease.**
- **Early Detection of Lung Diseases**

Benefits of DeepCXR in Industrial Settings

Category	Benefit
Operational	Faster CXR interpretation, scalable for large workforce, reduces radiologist workload
Safety	Early disease detection, reduces workplace morbidity, informs hazard control
Compliance	Standardized reporting, supports audits and regulatory requirements
Worker Health	Preventive care, long-term monitoring, improves quality of life

DeepCXR : *Deployment & Integration : NTEP – MoHFW – India*

DeepCXR : ISO 13485 & ISO 27001

Institute for Plasma Research

ISO 13485 MDQMS

MRD Lab, Institute for Plasma Research, is **ISO 13485:2016 certified** for **AI-based medical software (Deep CXR)** for its Medical Device Quality Management System covering design to deployment.

CERTIFICATE OF COMPLIANCE

ICS

INTERNATIONAL CERTIFICATION SERVICES PVT. LTD.

This is to certify that the

MEDICAL DEVICES - QUALITY MANAGEMENT SYSTEM of

INSTITUTE FOR PLASMA RESEARCH (MRD LAB)

Bhat Village, Near Indira Bridge, Gandhinagar - 382428, Gujarat, India.

has been assessed and registered as complying with the requirements of the following International Standard:

ISO 13485 : 2016

The Medical Devices - Quality Management System applicable to:

Scope: Design and Development, Testing, Deployment and Upgradation of the AI (Artificial Intelligence) Based Software as Medical Device (SaMD) for Chest X-Ray (Deep CXR) as a Screening/Diagnostic Tool.

Registration No.	:	RQMD91/12220
Registered Date	:	30th August, 2025
Issue Date	:	11th September, 2025
Expiry Date	:	29th August, 2028

IAF

NABCB

QMS 009

Director

International Certification Services Pvt. Ltd.

Accredited by National Accreditation Board For Certification Bodies, India.

Validity of this certificate is based on periodic audits of the management system defined by the above scope and is contingent upon prompt, written notification of significant changes to the management system and/or its components thereof shall be immediately communicated to ICS.

Further clarifications regarding the scope of this certificate and the applicability of ISO 13485:2016 requirements may be obtained at www.icsasian.com/ www.icspl.org

22/23, Goodwill Premises, Swastik Estate, 178 CST Road, Kalina, Santacruz (E), Mumbai – 400 098, Maharashtra, India. Tel.: 022-42200900

ISO 27001 ISMS

MRD Lab, Institute for Plasma Research, is compliant with ISO/IEC 27001:2022 for its Information Security Management System

Covering Secure Development, Testing, and Maintenance of Chest X-ray Software (DeepCXR).

DGCS

DELTA 300 GLOBAL Certification Solutions

CERTIFICATE

MRD LAB

INSTITUTE FOR PLASMA RESEARCH

Bhat Village, Near Indira Bridge, Gandhinagar – 382428, Gujrat, India

This is to certify that the Management system of the above organization has been assessed and found to comply with the requirements of the management system & standards detailed below

ISO/IEC 27001:2022

(INFORMATION SECURITY MANAGEMENT SYSTEM)

Scope of Activities

Secure Development, Testing and Maintenance of Chest X-ray Software (DeepCXR)

(SOA DOC NO. IPR 1.1, REV 00, ISSUE DATE 01.02.2025)

Certificate Number - DGCS/IS/0150/IN25

Initial Registration Date: 27.04.2025	Date of this Certificate: 27.04.2025
Date of 1st Surveillance: 26.04.2026	Date of 2nd Surveillance: 26.04.2027

Recertification Date: 26.04.2028

Validity of the certificate is subject to successful completion of surveillance audit on or before due date, in case surveillance audit not conducted this certificate shall be suspended/cancelled.

NABCB

IS 011

IAF

Director

Certificate Verified at: dgcsindia.com/iafcertsearch.org

This certificate remains the property of DGCS and shall have to be returned back when it has ceased to valid, for whatsoever reason Information about this Certificate can be inquired at the offical website of certification (www.iafcertsearch.org)

Delta 300 Global Certification Solutions Pvt. Ltd.

DGCS: Plot No. 319A, 1th Floor, Palam Extention, Near DDA Community center, New Delhi 110045, India

Delta300 Global Certification Solutions Pvt. Ltd. Delta300 Global Certification Solutions Pvt. Ltd.

CERTIFICATE*CERTIFICATE*CERTIFICATE*CERTIFICATE

DeepCXR : Deployment : NTEP , India

Institute for Plasma Research

Deployment as Pilot —> Himachal Pradesh, May 2024

Sites Upload CXR Images

AI Reports Download

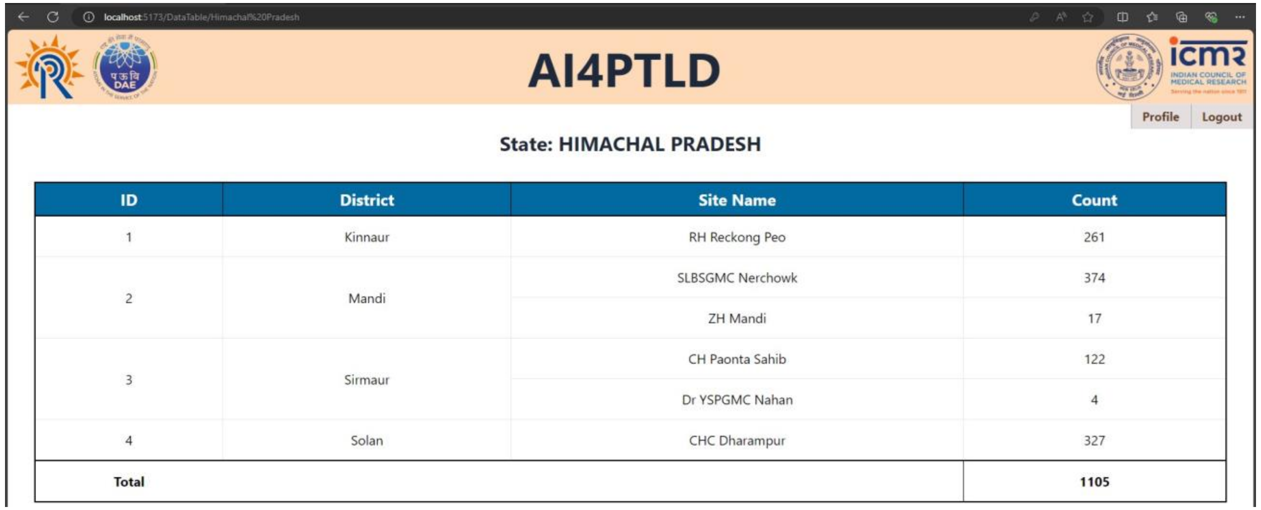
Image Upload

Med Cloud Server at IPR (www.medcloud.ipr.res.in)

Image Download

AI Reports Upload

Dashboard for Image Stats

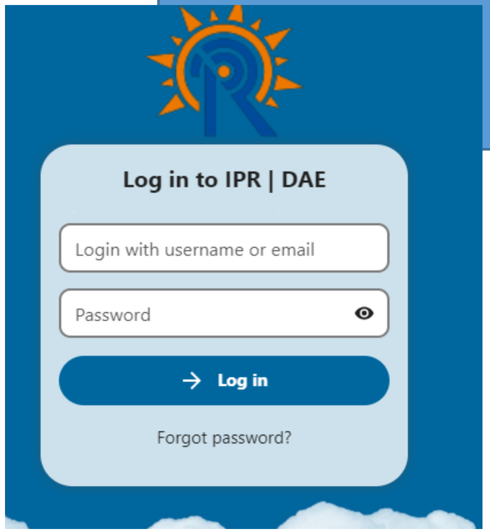

AI4PTLD

Profile Logout

State: HIMACHAL PRADESH

ID	District	Site Name	Count
1	Kinnaur	RH Reckong Peo	261
2	Mandi	SLBSGMC Nerchowk	374
		ZH Mandi	17
3	Sirmaur	CH Paonta Sahib	122
		Dr YSPGMC Nahan	4
4	Solan	CHC Dharampur	327
Total			1105

Med Cloud Login Portal



IPR Team with CTD : all installation, training & trouble shooting with sites are done remotely.

Medcloud running round the clock .

AI4PTLD

Admin Dashboard

- View Reports
- Verify Users
- Manage Users
- Permissions

Profile Logout

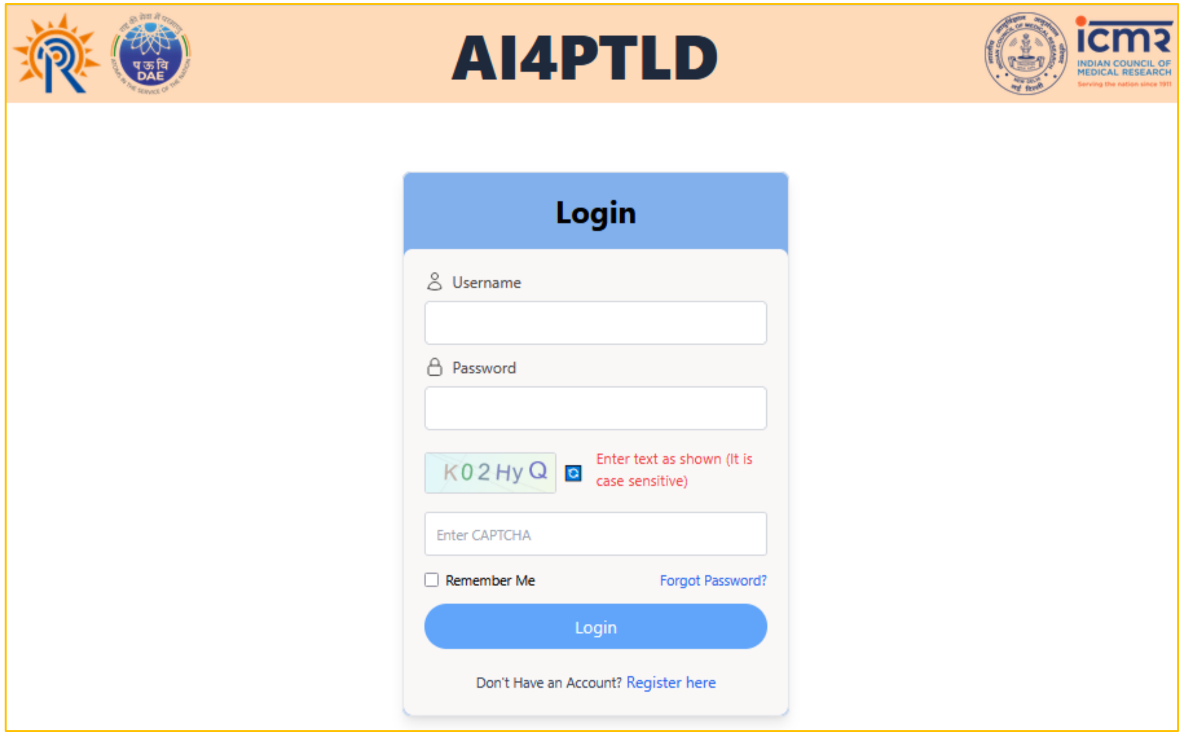
State Reports

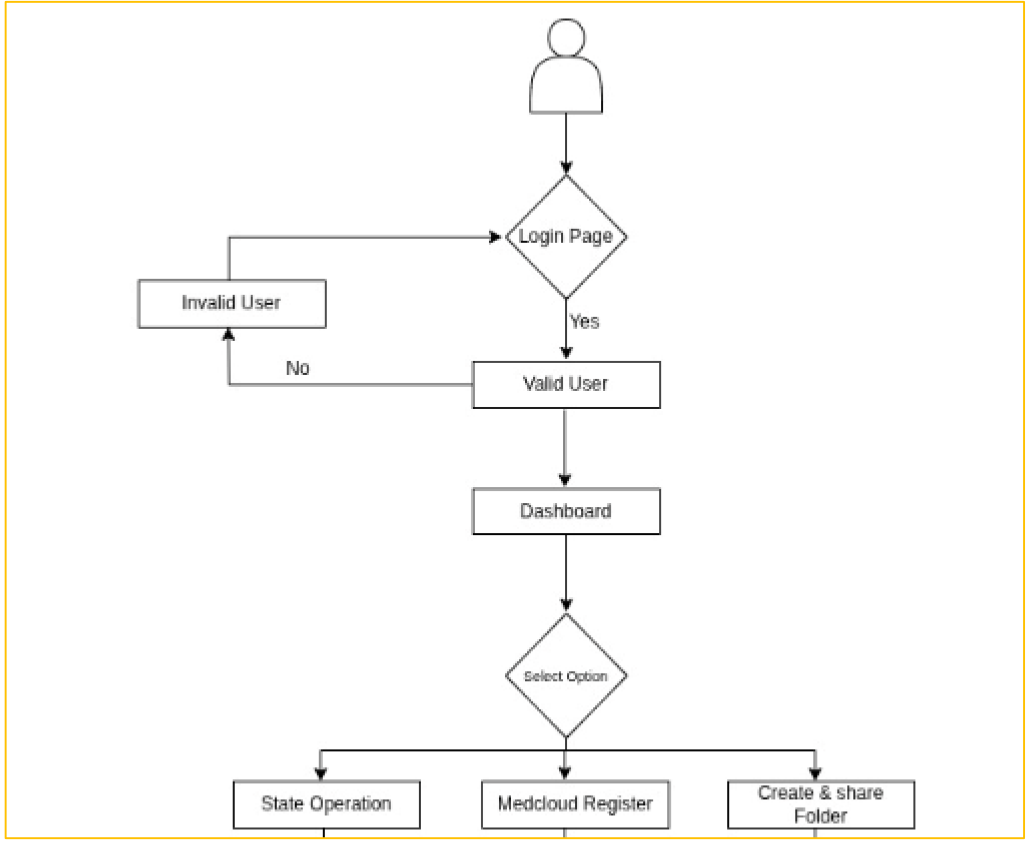
Start Date dd/mm/yyyy End Date dd/mm/yyyy Filter Reset Download PDF

SR No.	State
1	Uttar Pradesh
2	Maharashtra
3	Andhra Pradesh
4	Gujarat
5	Punjab
6	Karnataka
7	Chhattisgarh
8	West Bengal
9	Rajasthan
10	Haryana
11	Madhya Pradesh
12	Delhi
13	Jharkhand
14	Himachal Pradesh
15	Tamilnadu
16	DNH_DD
17	Uttarakhand
18	Telangana
19	Kerala
20	Ladakh
21	Andaman & Nicobar Islands
22	Goa
23	Bihar
24	Arunachal Pradesh
Total Reports:	63347

Status : **Total of 63,347 CXR images are processed and reported back to site by DeepCXR as on 15/12/2025**

DeepCXR : *Usage : NTEP – National Program – India*



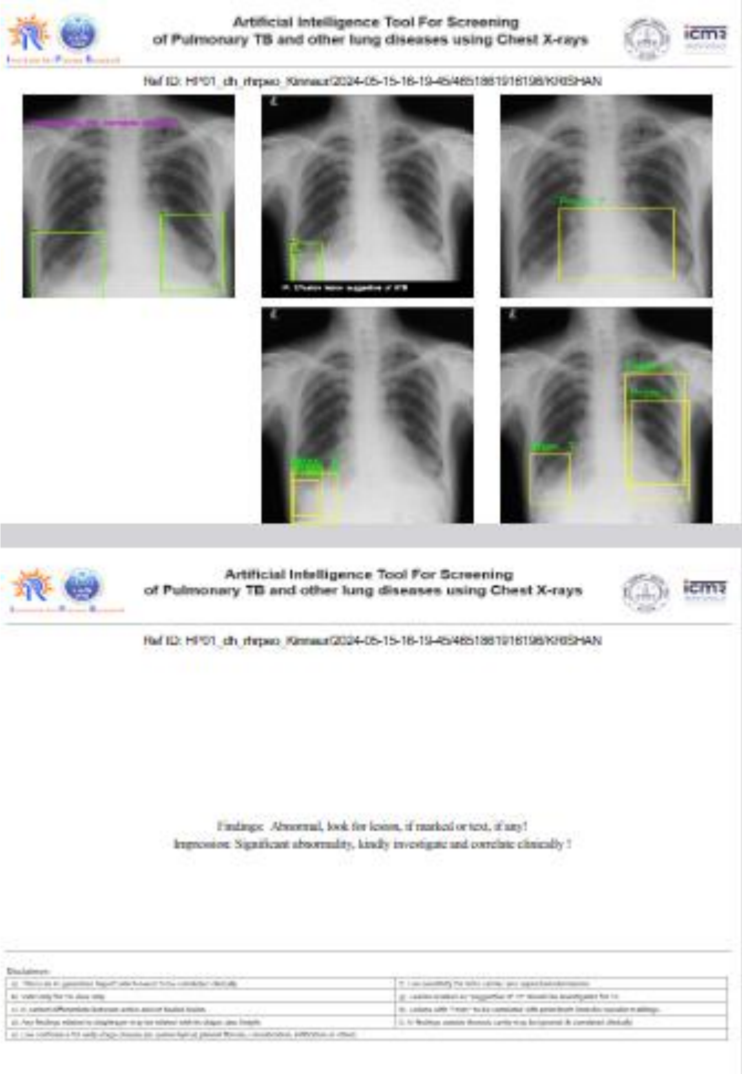


Dash board : monitoring .

Round the clock monitoring of operation of DeepCXR at the backend of Medcloud

Automated process for creation of credentials & medcloud registration . Site name , state , district

DeepCXR : Artificial Intelligence (AI) for Automatic Screening/detection of Pulmonary TB and other lung diseases using Chest X-rays



Artificial Intelligence Tool For Screening
of Pulmonary TB and other lung diseases using Chest X-rays

Artificial Intelligence Tool For Screening
of Pulmonary TB and other lung diseases using Chest X-rays

Findings: Abnormal, look for lesion, if marked or text, if any!
Impression: Significant abnormality, kindly investigate and correlate clinically !

Disclaimer:

CXR image as Received and DeepCXR - AI Generated Report
For Kinnaur – Himachal Pradesh

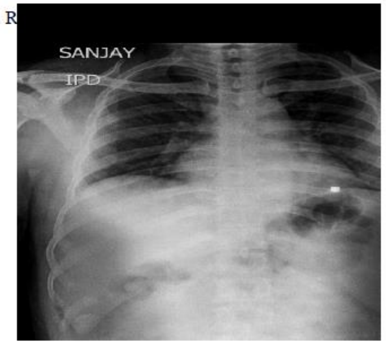
DeepCXR : Artificial Intelligence (AI) for Automatic Screening/detection of Pulmonary TB and other lung diseases using Chest X-rays

Institute for Plasma Research

Artificial Intelligence Tool For Screening
of Pulmonary TB and other lung diseases using Chest X-rays

Ref ID: DN001/2025[redacted]

Impressions: Over Exposed film, No gross lesion seen. R



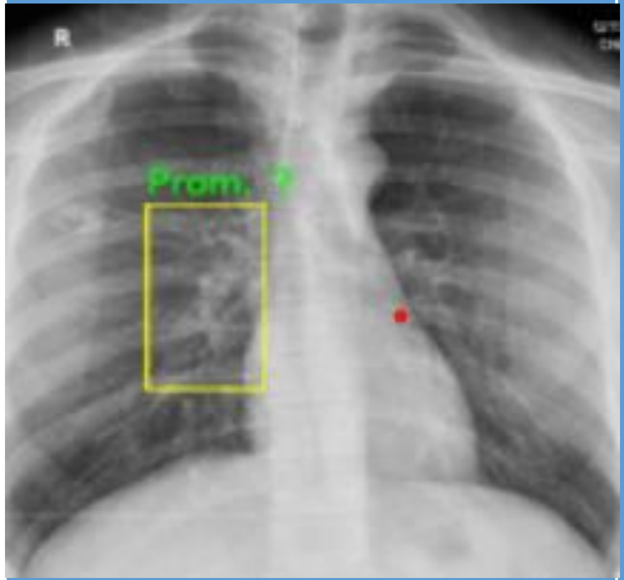
Institute for Plasma Research

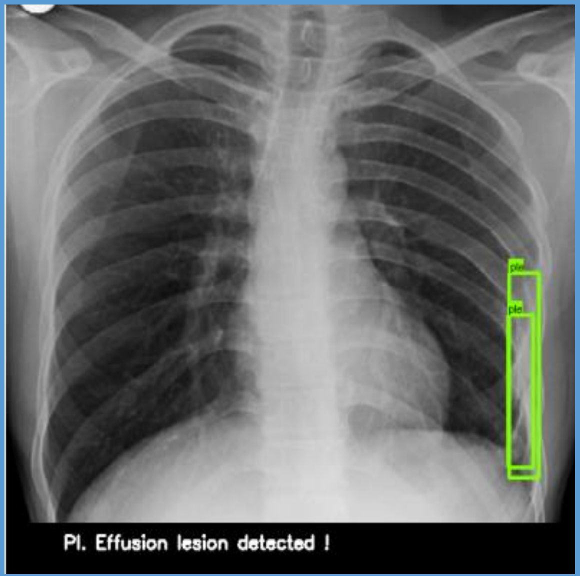
Artificial Intelligence Tool For Screening
of Pulmonary TB and other lung diseases using Chest X-rays

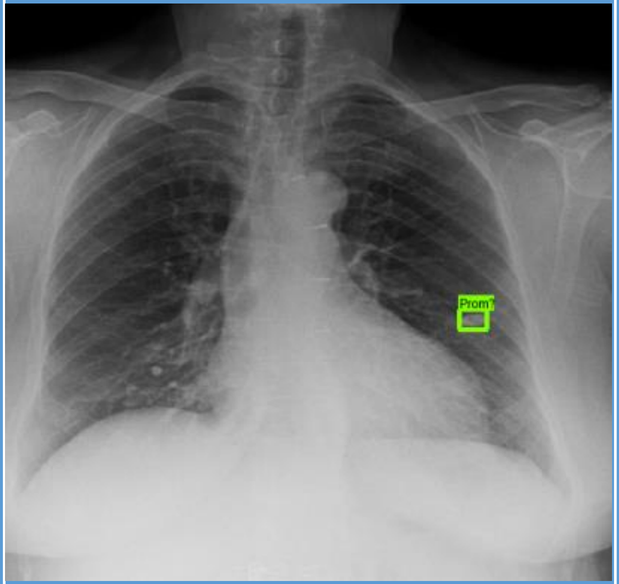
Ref ID: DN001/[redacted]

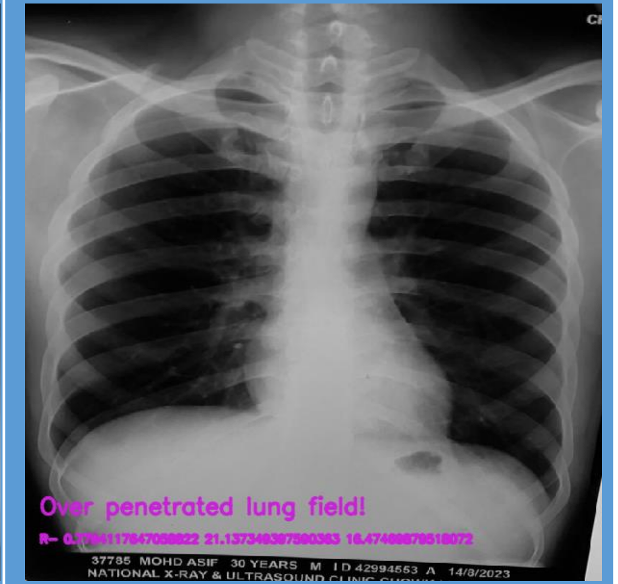
CXR image as Received and DeepCXR - AI Generated Report
For DNH

DeepCXR : *A robust AI Tool to handle Handling Extreme Cases*









Easy to identify lesions	Early stage mild Pleural Effusion	Calcification of very small size	Over Penetrated Lung Fields

"This isn't just about diagnosing patients who show symptoms; it's about finding those hidden cases who would otherwise remain undetected by using Chest X-rays, enhanced with AI, an effective method for screening individuals who may have TB but may not have the classical symptoms of TB," Dr. Vinod Paul, Member of Niti Aayog wrote in an Opinion article in *Business Line* on March 5, 2025.

AI-based tools like DeepCXR are enhancing the speed and accuracy of Chest abnormality detection.
A single tool for both adult and pediatrics population

DeepCXR provides AI generated report and needs final clinical correlation.
No patient data is being used by software which may yield false positive for asthma/smoker patients.

Acknowledgement (collaboration)

We Thank

- ICMR Delhi Hd qtr & NIRT Chennai for the MoU between IPR & ICMR for IPR AI Deep CXR software for AI4TB program of India.
- ICMR NIRT Chennai , Ahmedabad Civil Hospital for the Chest X-ray images and data for AIBacilli
- ICMR Delhi for collaboration ,validation and order of IPR digitizers .
- CTD , Delhi , DDG , ADDG TB , STOs & DTOs on going implementation of DeepCXR .

Thank You !!

Role of Digital Safety System Management and Mobile Application in Enhancing Industrial Safety

Soham Mahapatra, Kirit Patel,
Kirti Mahajan
Data Acquisition and Control Division
Institute for Plasma Research

Contents

- Digital Safety System Management
- Mobile Application for Safety Checklist

Digital Safety System Management

- Gas Inventory Management Software at IPR
  - Safety Aspect
  - Improve Availability
  - Enhance Operational Efficiency
  - Supply chain management

Gas Inventory Management System

Bhopal Gas Tragedy –

Route Causes:

- Corporate negligence
- Systematic safety failure
- Cost cutting compromises
- Lack of maintenance
- Lack of public awareness

Gas Inventory Management System

- Safety Aspect
  - ✓ Centralized inventory of cylinders and gases is fed in the system.
  - ✓ System records the type of gas, volume filled, cylinder serial number etc.
  - ✓ Last hydrostatic test done and next due date.
  - ✓ Last PESO license taken and renewal date
  - ✓ Cylinder storage location
  - ✓ IPR lab maps along with footprint area

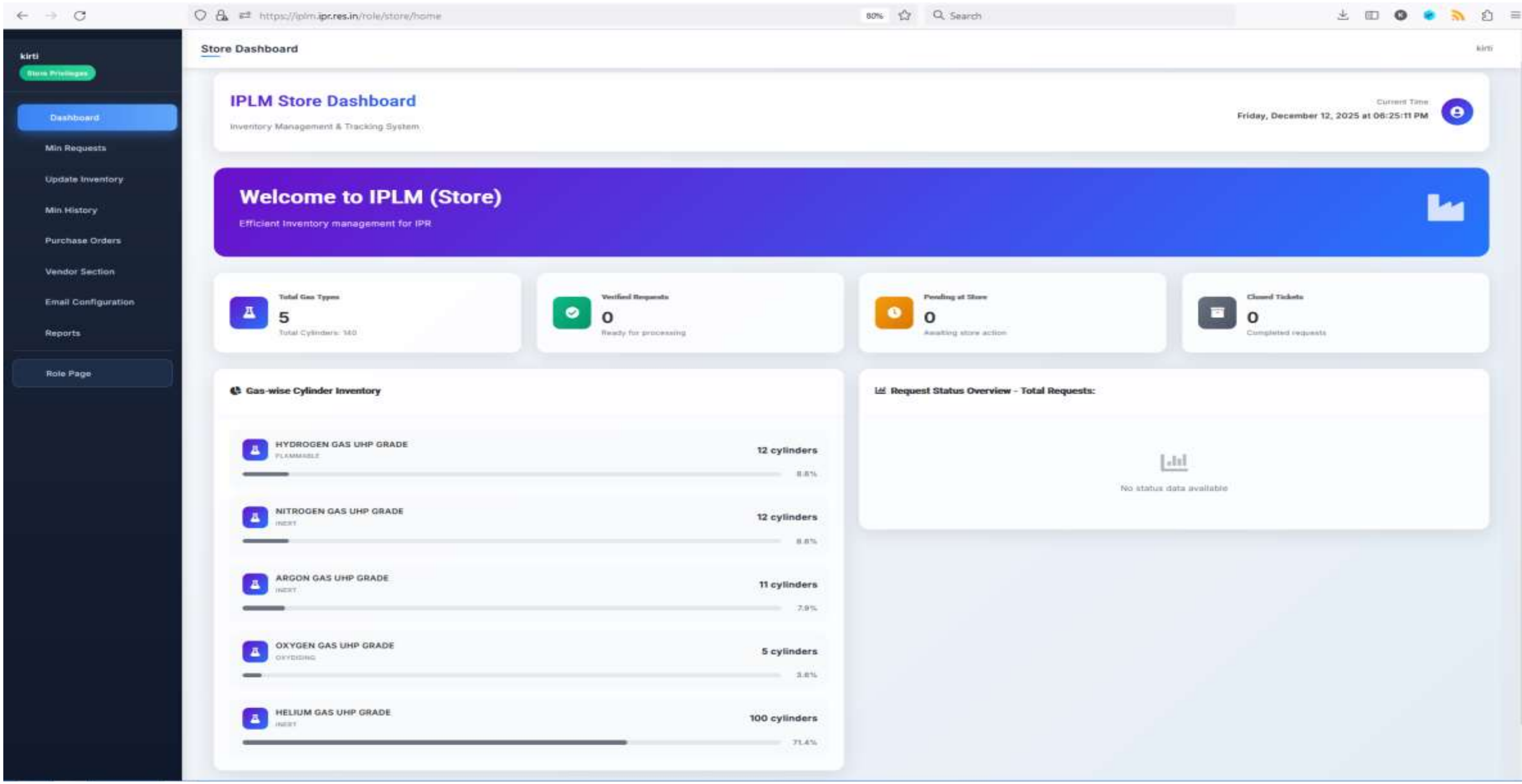
Gas Inventory Management System

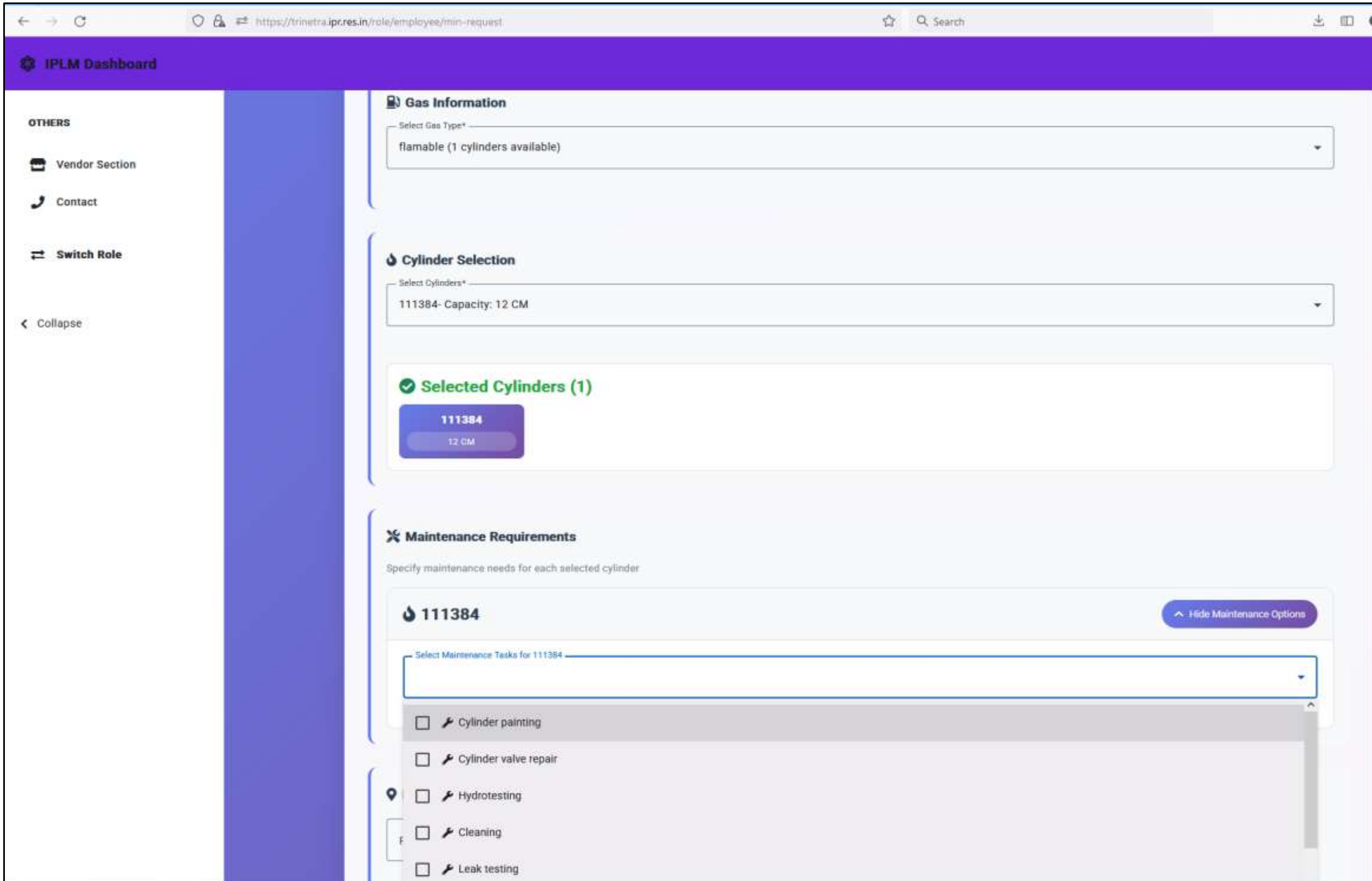
- Transparency and availability of information
  - System has open access to all employees
  - Management/Safety officer/Regulatory can check following
    - Number of cylinders stored per square area is not exceeding the defined limit
    - Licensed status.
    - Maintenance status

Gas Inventory Management System

- Timely Renewal of license and gas refill
  - Advance reminder for renewal of license
  - Refill is not permitted without a valid license
  - Digitization and Centralization ensures no cylinder is left unattended
  - The software not only addresses the safety concern but also develops the statistics of gas consumption – supply chain management.

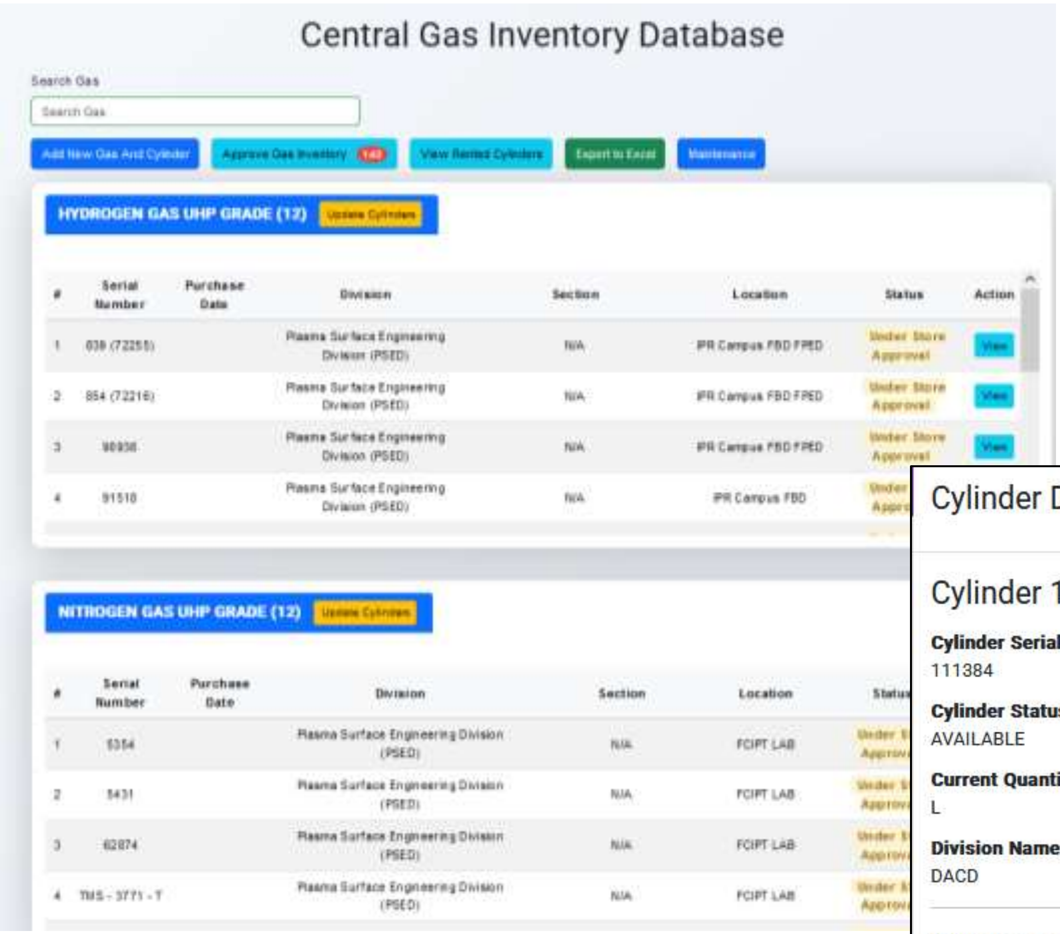
Digital Safety System Management Snapshots

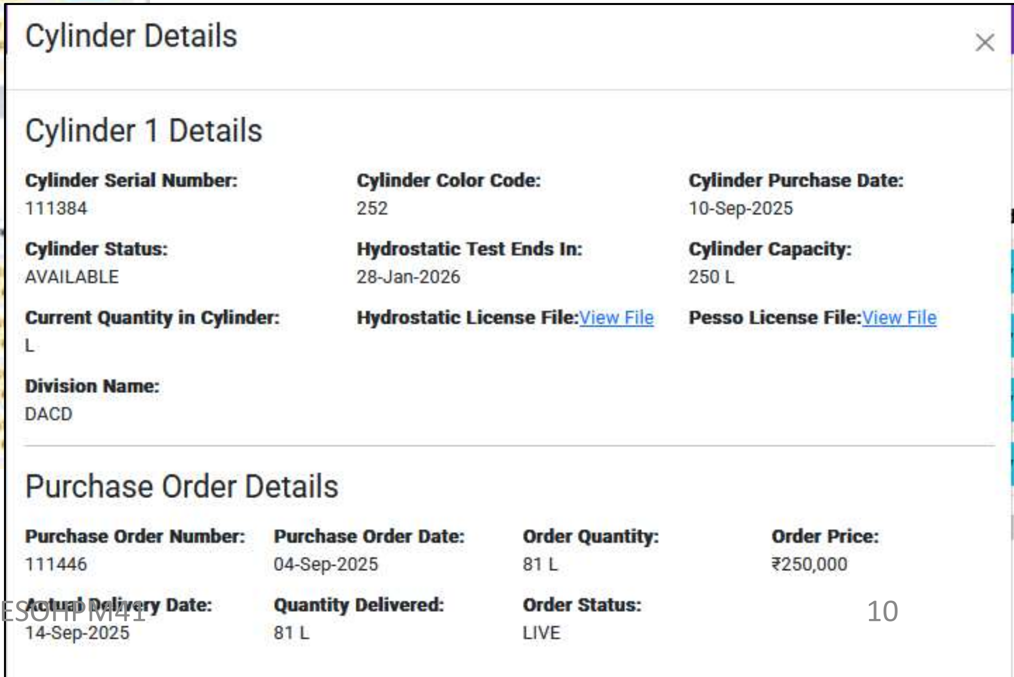




The system will be extended for other safety equipment inventory and maintenance records

Digital Safety System Management Snapshots



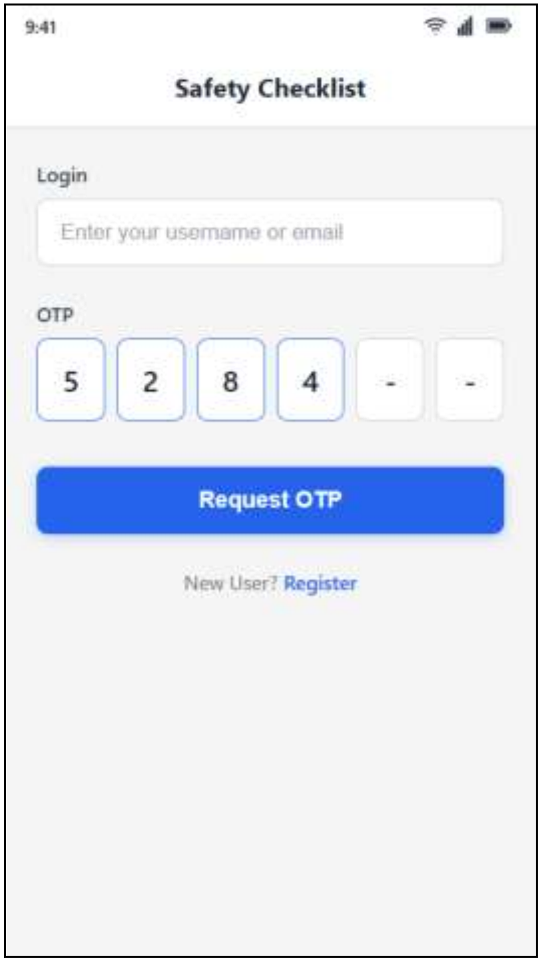


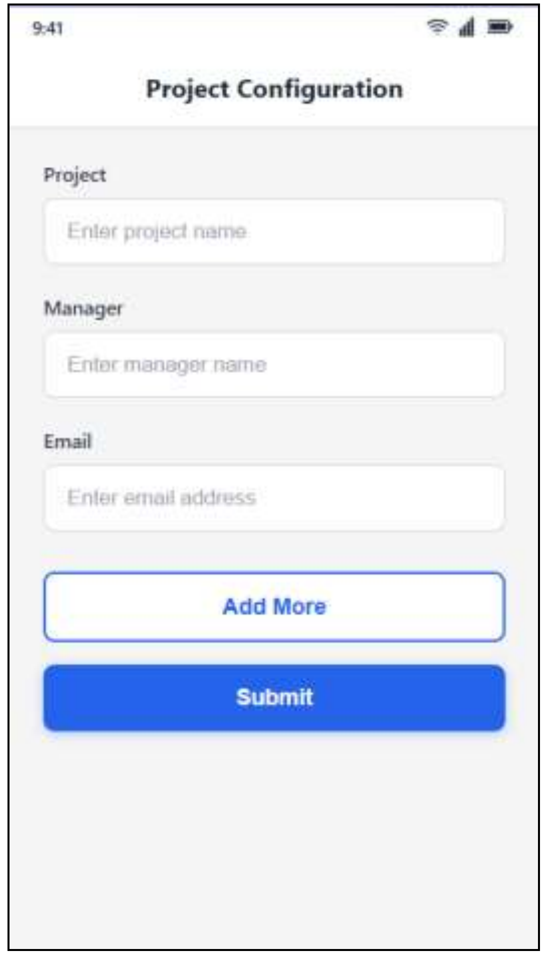
Mobile Application for Safety Checklist

- To-do list ‘what to do’ and a checklist ‘how to do’ it.
- Customization as per the Industry needs
- Ensures safety protocols are consistently followed and easily accessible
- Real time reporting and centralized monitoring
- Enhance Accountability and Tracking
- Enhance collaboration and communication among teams.
- Centralize data storage, easy to retrieve and compliance check
- Integrates with other safety system
  - As an interlock
  - A proactive action can be triggered

Mobile Application for Safety Checklist

Login Screen

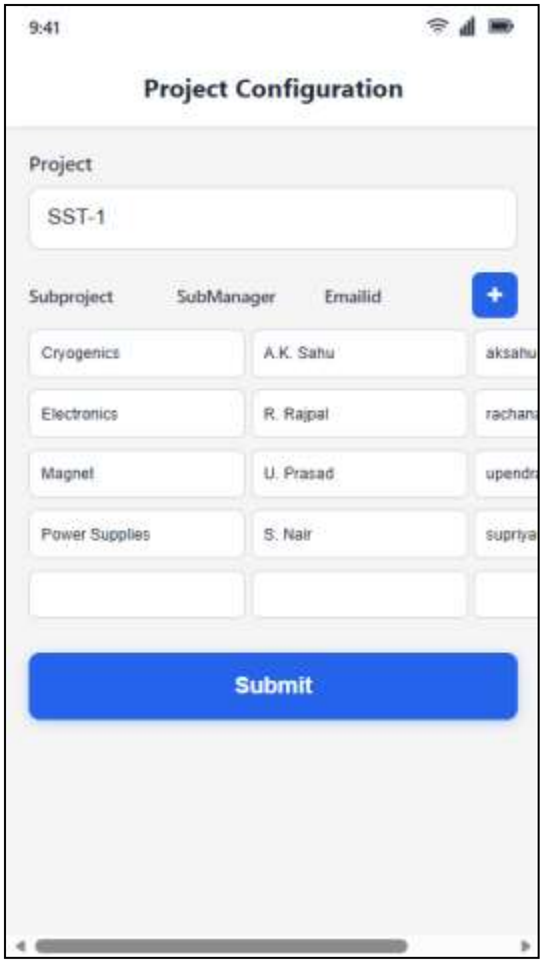




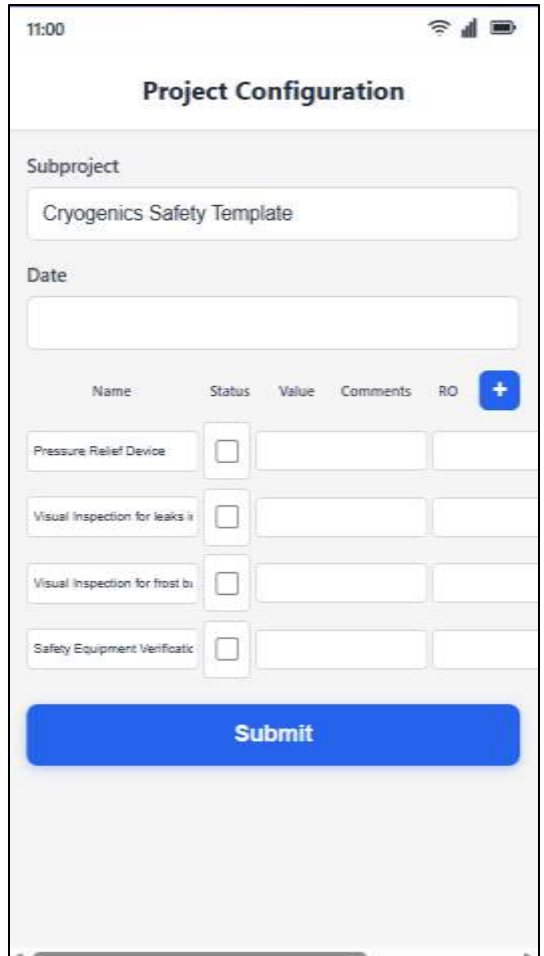
-Projects
- Project Managers

Mobile Application Safety Checklist

- Define Project Hierarchy

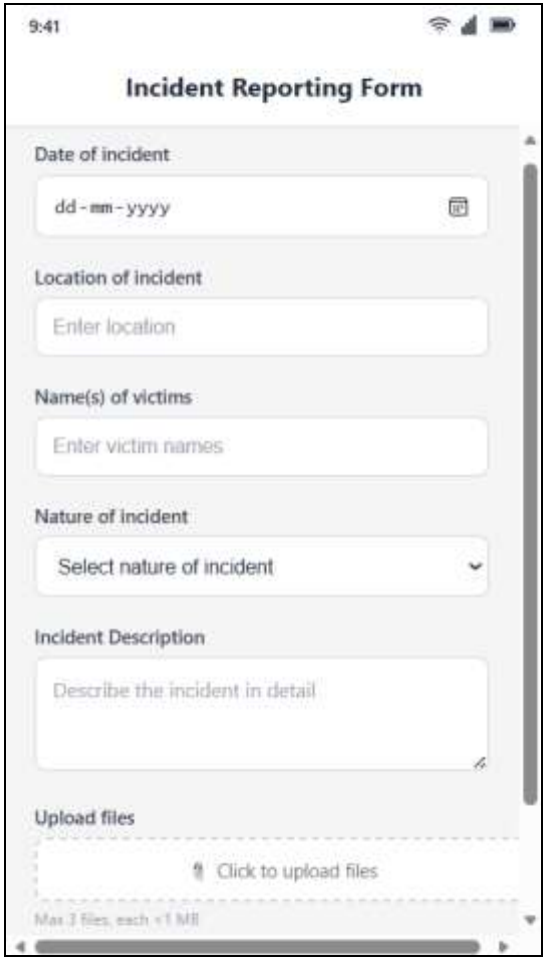


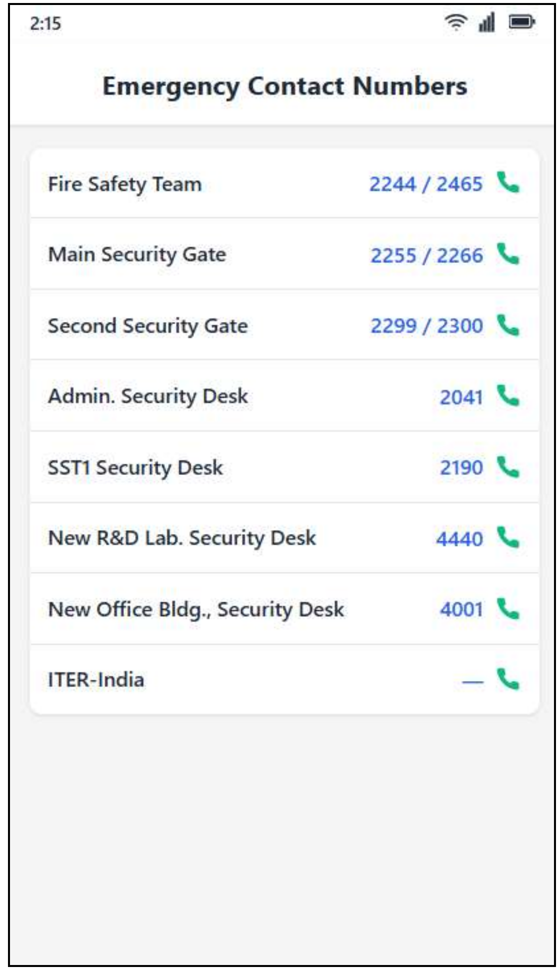
- Customize Safety Checklist

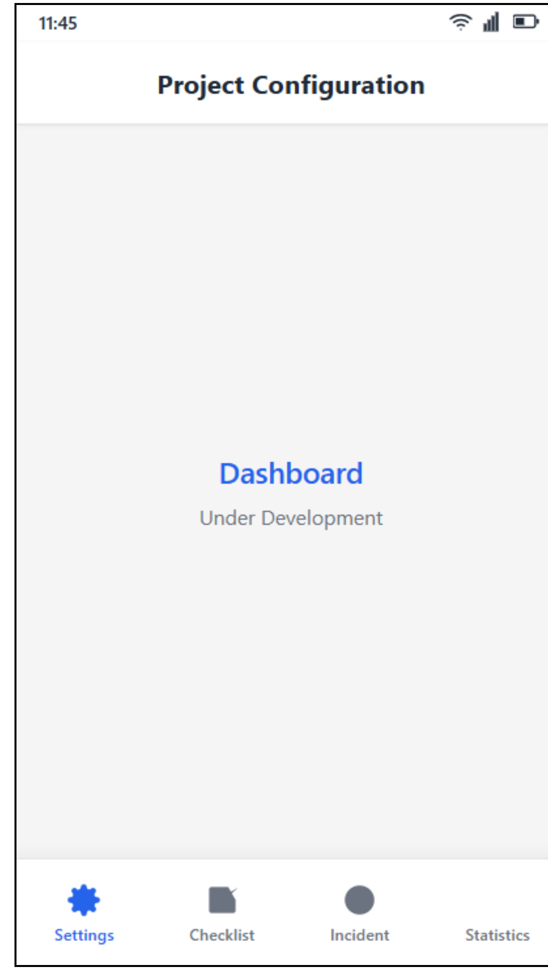


- Assigns Responsibilities
- Role based access to RO

Mobile Application Safety Checklist







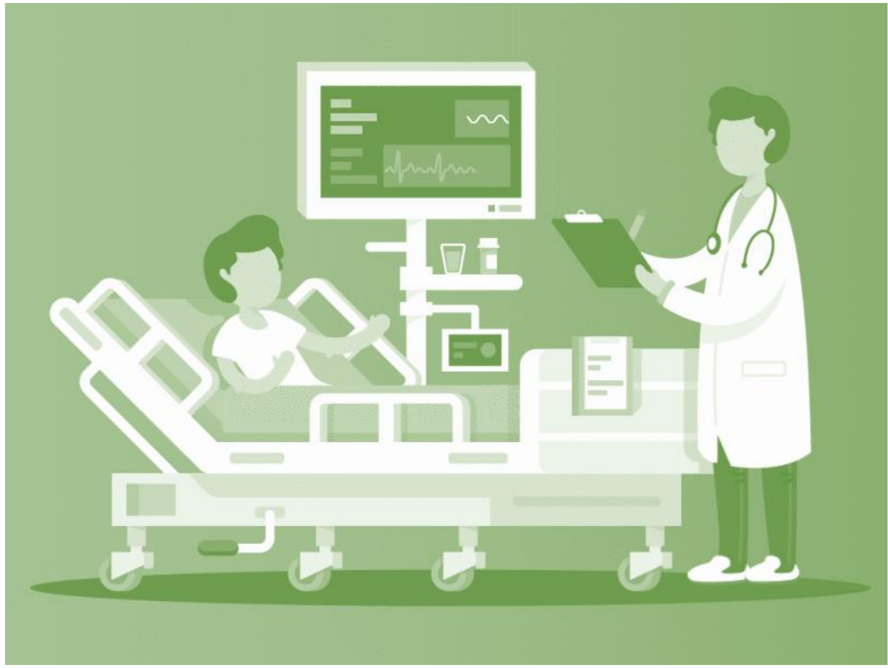
Todo - Linking of incident with safety checklist

Mobile Application Safety Checklist

Further Enhancement

- No WiFi signal in IPR labs
  - Resolving with in-memory database
- Security Audit of the application

Thanks You



Caring for the Carers – Hidden Dangers in Indian Healthcare

“Every day, when a doctor, a nurse, or a ward assistant walks into a hospital, they promise to protect someone else’s life… but very often, they walk out risking their own.

The people who heal us are silently getting hurt—and most of these injuries never make it to the headlines.”

Occupational Health Hazards in Healthcare

- Occupational health hazards in healthcare are the risks that **doctors, nurses, technicians, sanitation staff and support workers** face while doing their daily work.
- These hazards can harm their **physical health, mental wellbeing, and sometimes even their families.**
- Healthcare is a noble profession, but it is also one of the **riskiest workplaces**—not because of **machines or heights**, but because of **constant exposure to diseases, stress, violence, long hours, and emotional exhaustion**.

WIZZOKRAFT SOLUTIONS

Occupational Health Hazards in Healthcare

Today, I want to talk about Occupational Health, which simply means: Keeping the worker safe while they do their job.“

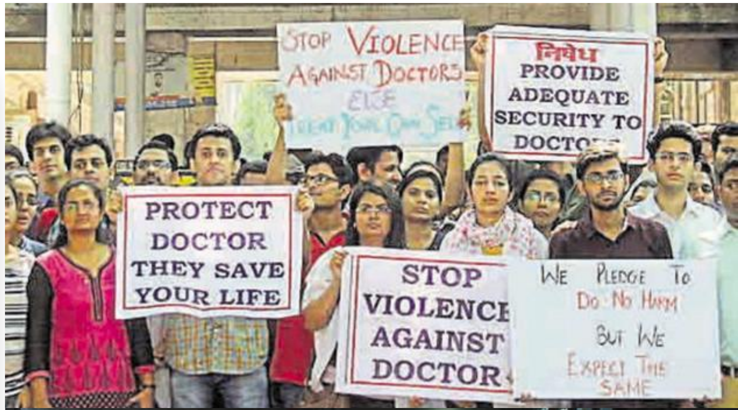
1. Physical Hazards: Violence & Safety -> The most discussed hazard in India right now.

- These are dangers that can physically hurt you instantly. In India, the biggest physical threat recently **hasn't been machinery, but violence.**

Examples (2024-2025):

- **Violence Against Doctors**: We cannot forget the **tragic RG Kar Medical College** incident in Kolkata (August 2024), where **a trainee doctor** was attacked on duty. This sparked a nationwide movement for safer working conditions.
- **Patient/Relative Attacks**: More recently, in November 2024, a senior oncologist in Chennai was stabbed seven times by a patient's son. These aren't just news stories; they are occupational hazards. The lack of security checks and safe "duty rooms" is a direct risk to your life.
- **Fire Safety**: Just last month, in October 2025, the **Jaipur SMS Hospital** fire tragedy highlighted how old wiring and blocked exits in our government hospitals can turn deadly for both staff and patients.

Physical safety isn't just about slipping on a wet floor; in India, it’s about having security guards, CCTV cameras, and fire exits that actually work.



Occupational Health Hazards in Healthcare

What YOU can do:

- The "Exit Strategy": Never let yourself be cornered in a room. Always position yourself between the patient/relatives and the door.
- De-escalation: If a family is shouting, lower your voice. Do not argue back. Acknowledge their anger ("I understand you are worried...").
- Don't be a Hero: If a situation turns physical, leave immediately. Your safety comes first.

What to Demand (System):

- "One Patient, One Attendant" Policy: Crowds fuel mob violence. Hospitals must strictly enforce limiting visitors, especially in the ER/Casualty.
- Code Purple/Grey: A standardized alarm system. If you press a button, security should arrive within 60 seconds.

Occupational Health Hazards in Healthcare

2. Biological Hazards : The "Needle" Risk.

This refers to **germs—viruses and bacteria,** that you catch from patients.
Doctors and nurses are constantly around sick patients. A **single needle prick, coughing patient, or contaminated surface can infect them.**
The "Needle Stick" Reality: The most common way this happens is through Needle Stick Injuries **(NSIs).**

- Recent studies from **Kochi and Dehradun (2024-2025)** show that nearly **30%** of healthcare workers suffer a needle stick injury every year. It's not just a prick. It's a doorway for **HIV, Hepatitis B, and Hepatitis C.**
- In many of our busy **government hospitals**, we still **recap needles by hand** or overfill the yellow disposal bins. This simple act of "rushing" is a major hazard.
- **COVID-19 wards (2020–23 but impact continues):** Thousands of healthcare workers got infected because of long hours in PPE, overexposure, and unavailability of protective gear during early waves.
- **Dengue surge in Delhi, UP & Kolkata (2024):** Lab technicians and nurses faced high exposure while handling blood samples.

"Our frontline healers walked into danger before the nation even understood its seriousness."

SHARP OBJECT

Occupational Health Hazards in Healthcare

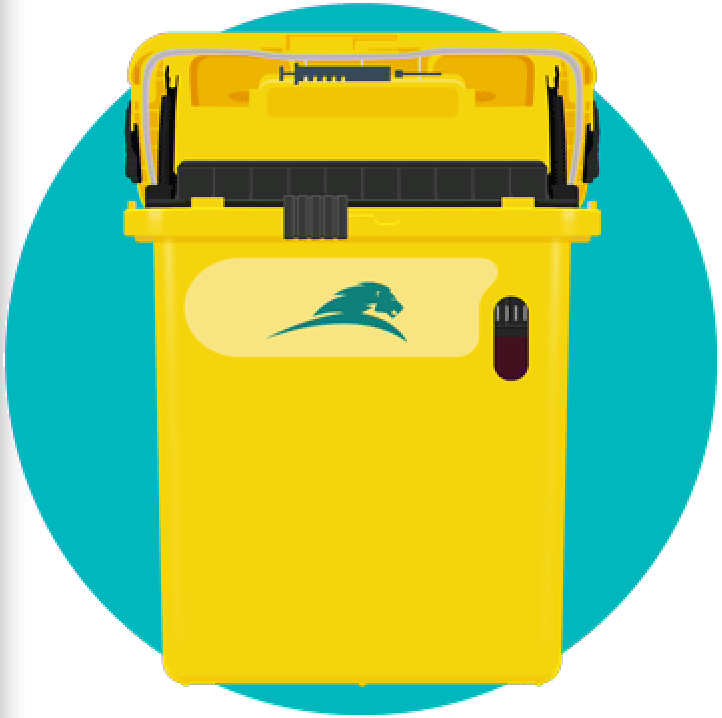
WIZZOKRAFT SOLUTIONS

What YOU can do:

- **Strictly No Recapping**: Never try to put the cap back on a used needle. Drop it directly into the White/Blue puncture-proof container.
- **Report It**: If you get pricked, do not hide it out of fear or shame. Report it immediately so you can start PEP (Post-Exposure Prophylaxis) to prevent HIV/HIV transmission.
- **Ensure full vaccination** for all healthcare workers (Hepatitis B, Influenza, COVID boosters).
- **Strict use** of PPE kits, gloves, masks, and shields as per risk level.
- **Follow hand hygiene protocols** — 'Five Moments of Hand Hygiene'.
- **Install needle-disposal bins** at every ward and OT.
- **Regular infection-control training.**

What to Demand (System):

- Accessible Sharps Bins: The yellow/white bin shouldn't be in the next room; it should be on the trolley next to the patient.



Occupational Health Hazards in Healthcare

3. Chemical Hazards : The Invisible Fumes

Often ignored by nursing staff.

Handling strong medicines and cleaning liquids that can slowly poison you over time.
Example:

- Chemotherapy Drugs : In Indian cancer wards, nurses often **mix chemotherapy drugs without proper fume hoods** or thick protective gowns.
- A 2024 study showed that many nurses handling these **"antineoplastic" (cancer-fighting) drugs** reported **skin rashes, hair loss, and dizziness** because they were inhaling the drug vapours.
- Disinfectants: The strong smell in the OT is not just "hospital smell"—it's a chemical that can cause **asthma and skin allergies** if ventilation is poor.

If you can smell the chemical strongly, you are likely inhaling too much of it. Masks and ventilation are mandatory, not optional.

"Hospital cleaners keep wards spotless for us—but what protects them?"

Occupational Health Hazards in Healthcare

What YOU can do:

- **Mask Up**: A simple surgical mask is often not enough for mixing chemo drugs or using strong disinfectants like Glutaraldehyde. Use an N95 mask or a proper respirator if available.
- **The "Smell Test":** If you can smell the chemical strongly, the ventilation is poor. Open windows if possible, or take frequent breaks outside the room.
- Store chemicals with clear **labels & follow SDS** (Safety Data Sheets).
- Shift to **low-toxicity disinfectants** where possible.

What to Demand (System):

- **Spill Kits:** Every ward must have a "Spill Kit" (absorbent pads, heavy gloves) to clean up chemical/drug spills safely, rather than using a regular mop.

Occupational Health Hazards in Healthcare

4. Ergonomic Hazards : The "Back-Breaking" Work ➤ The silent career-shortener.

Injuries caused by how you move, sit, or lift.

Example:

- Nursing Staff Burden: A study from **Rajasthan (2023-2024)** found that nearly **70% of nurses suffer** from chronic **back or knee pain**.
- Why? In India, we often **lack mechanical patient lifts**. Nurses and ward boys manually lift heavy patients from stretchers to beds. Doing this **20 times a day destroys the spine.**
- Surgeons: Standing **for 6-8 hours in awkward postures for surgery** leads to severe **neck issues** (cervical spondylosis) at a young age.

"Protect your back." Ask for help when lifting patients. Don't be a hero.
“Healthcare workers heal our pain while silently carrying their own.”

Occupational Health Hazards in Healthcare

What YOU can do:

- **The "Team Lift":** In India, we lack mechanical hoists. Never lift a heavy patient alone. Always call a Ward Boy or a colleague. "1-2-3-Lift" prevents sudden jerks.
- **Adjust the Height:** Before performing a procedure or surgery, take 10 seconds to adjust the table height to your elbow level. Don't hunch over for 2 hours.
- **Rotate duties** to avoid repetitive strain.
- Teach correct **posture during** lifting, suturing, or equipment handling.
- Allow **micro-breaks** during long procedures.

What to Demand (System):

- **Functional Wheels:** Stretchers and wheelchairs with broken wheels require 3x the force to push. Report broken equipment to maintenance immediately.

Occupational Health Hazards in Healthcare

5. Psychosocial Hazards : The Burnout Epidemic-The hazard we don't see until it's too late.

Damage to your mental health caused by work stress.

The Indian Reality (2025 Context):

- **36-Hour Shifts** : The RG Kar incident brought light to the inhumane 36-hour shifts junior doctors perform.
- **Moral Injury** : Indian doctors often face "moral injury"—the stress of wanting to help patients but being unable to because of a lack of resources (no ICU beds, no oxygen).
- **Burnout Stats** : Post-pandemic studies in 2024-2025 indicate that over 50% of resident doctors in India show signs of clinical depression or severe burnout.
- Surgeons in major hospitals like AIIMS and Apollo reporting musculoskeletal pain because of long surgeries.
- **Radiation exposure** concerns among radiology technicians in several district hospitals where old X-ray machines are still being used.

Occupational Health Hazards in Healthcare

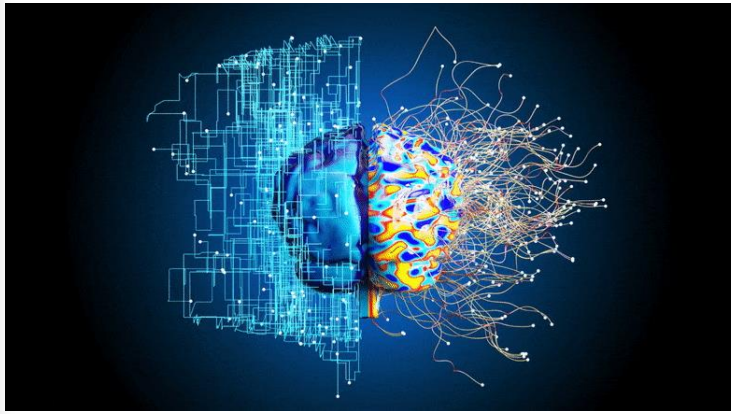
6. Emerging Hazards (AI & Digital Fatigue)

With digital systems and telemedicine, **screen time has increased**.

More screen time = more eye strain, headaches, and mental fatigue.

Examples

- Telemedicine teams in Karnataka and Maharashtra reporting digital burnout due to continuous calls during COVID and dengue seasons.



Occupational Health Hazards in Healthcare

What YOU can do:

- **Buddy System** : Find a "work buddy." Check in on each other. A simple "Did you eat today?" or "That was a tough case, are you okay?" can save a life.
- **Disconnect** : When your shift is over, try to physically and mentally leave the hospital. Do not check patient updates on WhatsApp unless you are on call.
- Follow the **20-20-20** rule: every 20 minutes, look at something 20 feet away for 20 seconds.
- **Limit continuous** telemedicine shifts.
- Encourage **blue-light filters** and screen breaks.

What to Demand (System):

- Safe Duty Rooms: Management must provide a secure room with a lock and a clean bathroom for staff to rest during 24+ hour shifts.

SAFETY PROTOCOLS DURING HAZARDS		
LETTER	**ACTION**	**MEANING**
S	Safety First	Check your exit route and PPE before touching the patient
A	Ask for Help	Whether lifting the patient or handling the angry mob, never do it alone
F	Follow Protocol	Follow all the safety protocols imparted during regular trainings
E	Express Issues	Report injuries, accidents, broken equipments etc. Silence changes nothing

A safe hospital is the one where every nurse, every doctor, every technician, and every ward attendant returns home safely at the end of the day.
When we protect our healers, we protect the future of healthcare."

Thank You!

Jai Hind

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Questions ???

Identification of Occupational Health & Safety requirements and Safety important function & classification of Fusion machine components design

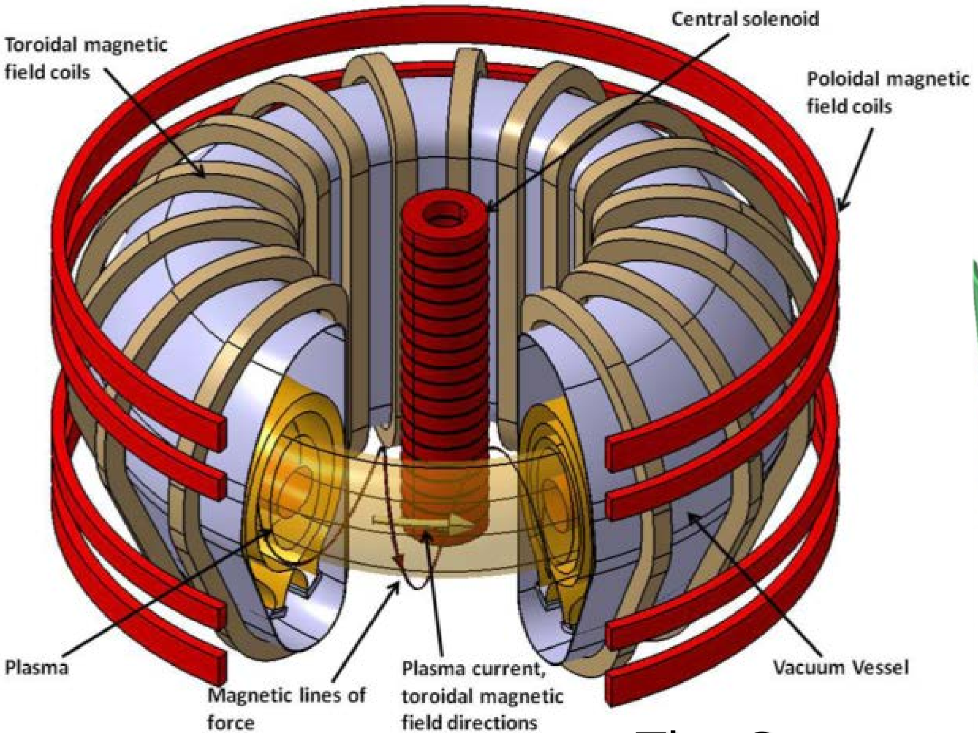
Anil Kumar Bhardwaj

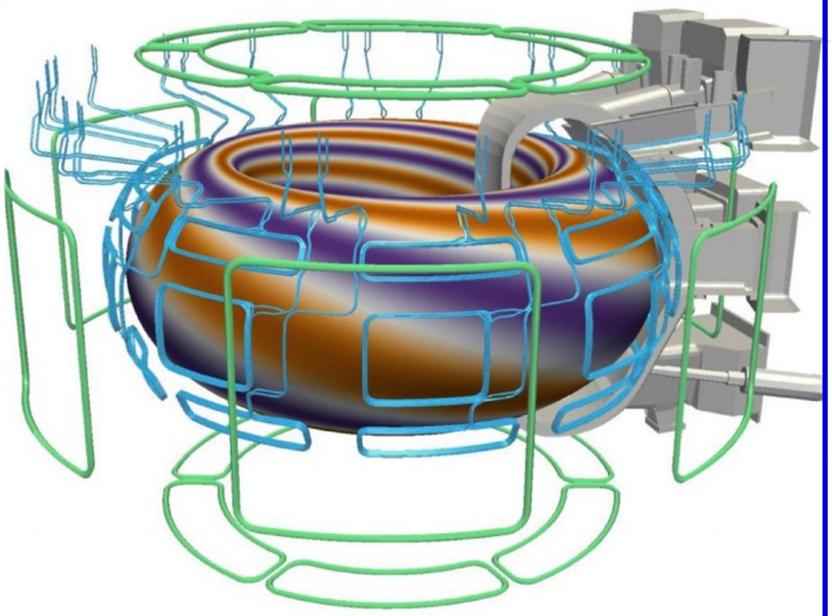
Outline

- Overview of Fusion Device –ITER
- Indian contribution in ITER
- Safety considerations of Fusion Reactor
- Safety Management System
- Occupational Health and Safety (OHS) for Fusion Reactor
- Process of OHS Design requirements
- Regulatory requirement for design of Lifting Adopters for ITER Cryostat Components (An Example)
- Nuclear Safety(NS) Requirements
- INB Order Safety Requirements PIA and PIC and it's implementation
- Protection Important Activities (PIA) and Technical Control
- PIA and it's technical control in Manufacturing and assembly of Cryostat – An Example

Overview of Fusion Device -ITER (1/4)

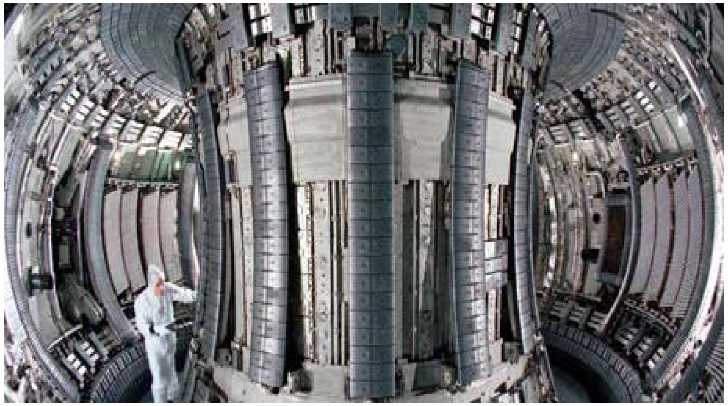
ITER is a Toroidal Magnetic Confinement Device (called TOKAMAK) to hold and heat Plasma (the 4th state of matter) to Fusion Temperature.





The Concept of Tokamak

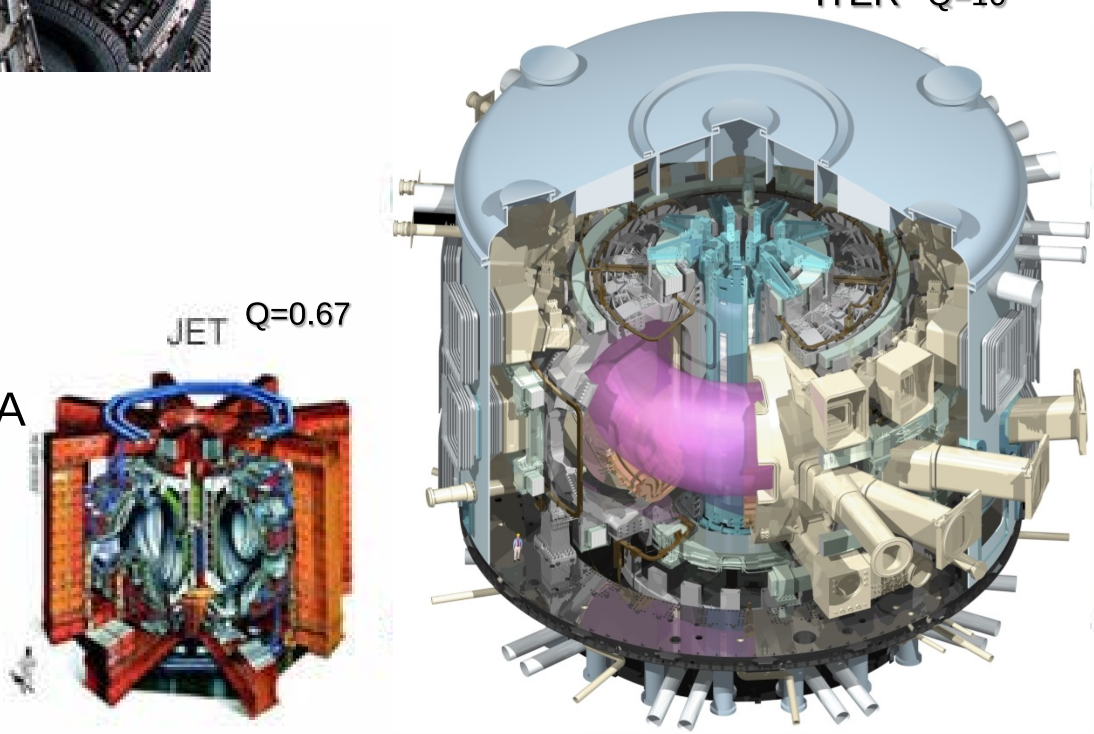
Overview of Fusion Device -ITER (2/4)



Interior view of Joint European Torus (JET) in UK which demonstrated 16MW of Fusion Power 1996.

ITER Q=10

JET Q=0.67

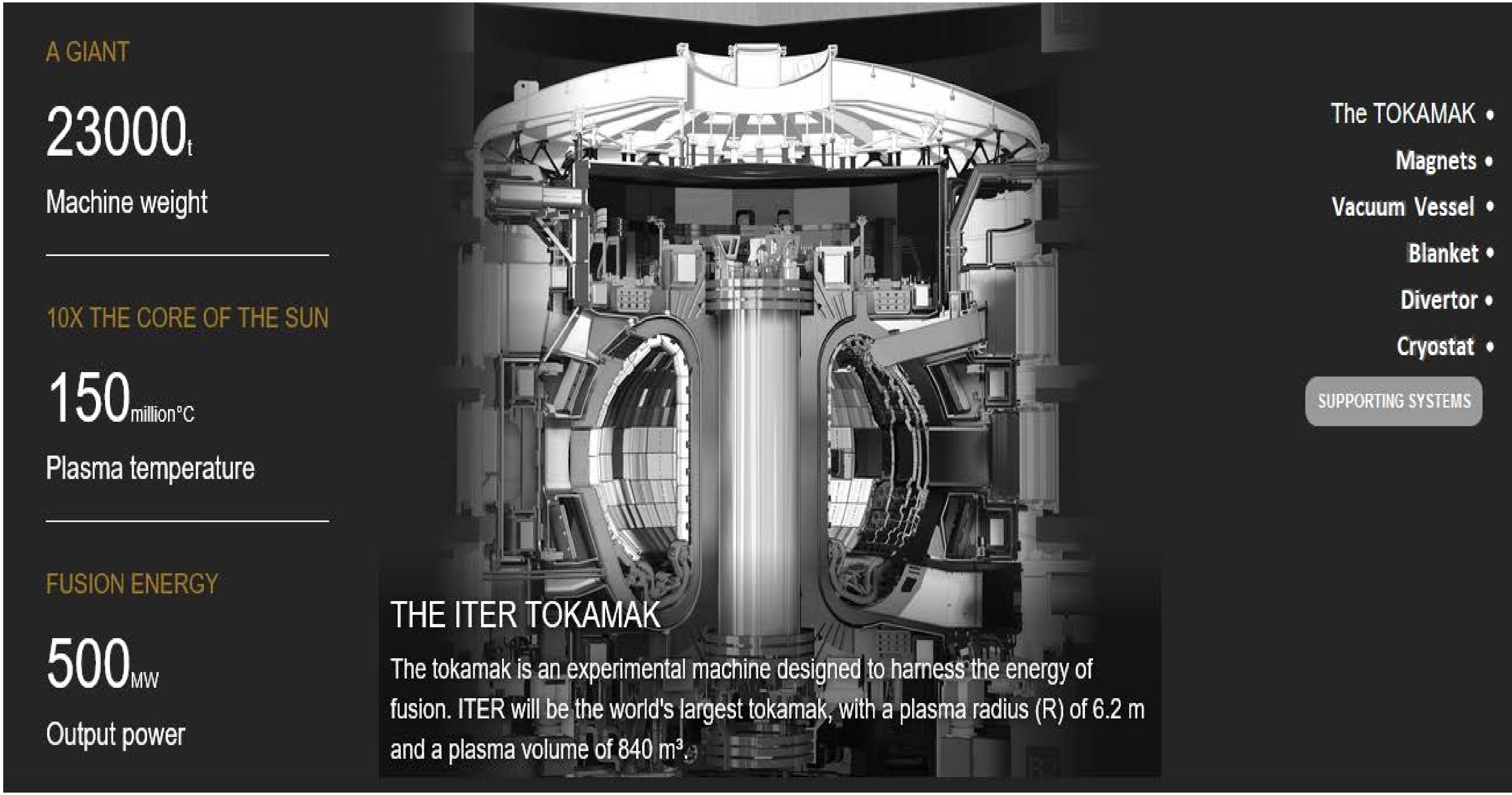


Relative Dimensions of ITER and JET

Key Parameters

Major radius: 6.2m
Minor radius: 2.0m
Toroidal Field:5.3Tesla
Max. Plasma Current: 15MA
Installed Heating
Fusion Power:500MW
Auxiliary heating power: 73MW
Fusion gain Q=10,
Burn time=400S

Overview of Fusion Device -ITER (3/4)

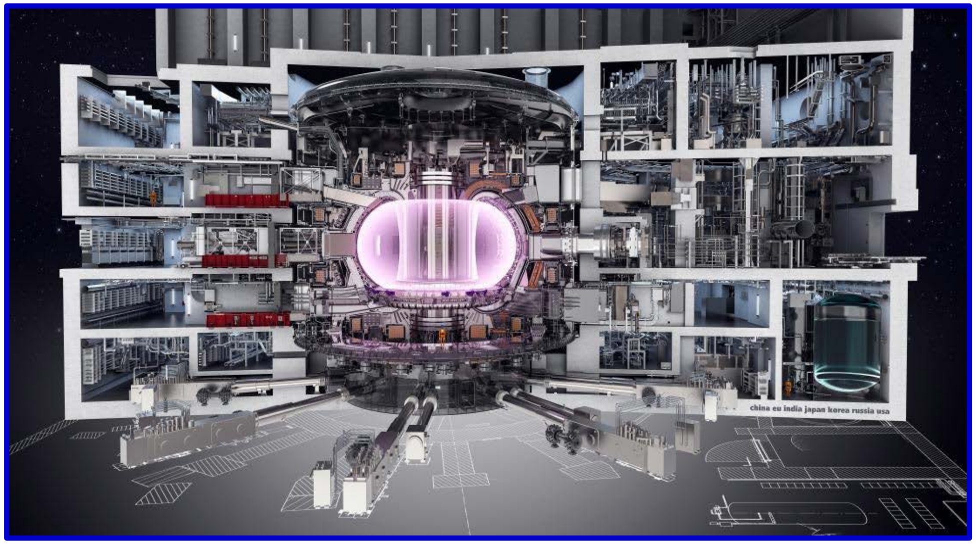


Largest and the most complex Tokamak machine to be ever built

Overview of Fusion Device -ITER (4/4)

Key Goals

- Produce 500MW of Fusion Power for pulses of 400 Sec with input of 50MW power for Plasma Heating (Q≥10),
- Demonstrate Integrated Operation of Technologies for a Fusion Power Plant,
- Achieve D-T Plasma in which the reaction is sustained through internal heating for long pulses (>1000 Sec),
- Test Tritium Breeding,
- Demonstrate the Safety Characteristics of a Fusion Device



ITER will maintain burning fusion plasmas for long periods of time. And will test the integrated technologies, materials, and physics regimes necessary for the commercial production of fusion-based electricity.

Indian contribution in ITER (1/2)

Indian contribution in ITER (2/2)

ICRH System

Ion cyclotron source test facility, Combiner, Technology, HPS, RF switch, SSPA etc

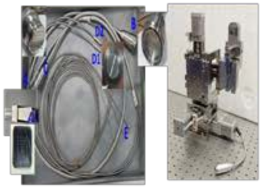
ECRH System

MW, 170 GHz CW gyrotron facility at ITER India laboratory and The commissioned 6 MW main high-voltage power supply for the gyrotron cathode circuit at ITER India.

DIAG System

THz Spectrometer (FTS) 70 GHz – 1000 GHz

8m circular waveguide TL developed, with ID 72 mm



40-channel fiber bundle & prototype magnetic field compatible motor

Stepper Motors exposed to Magnetic Field

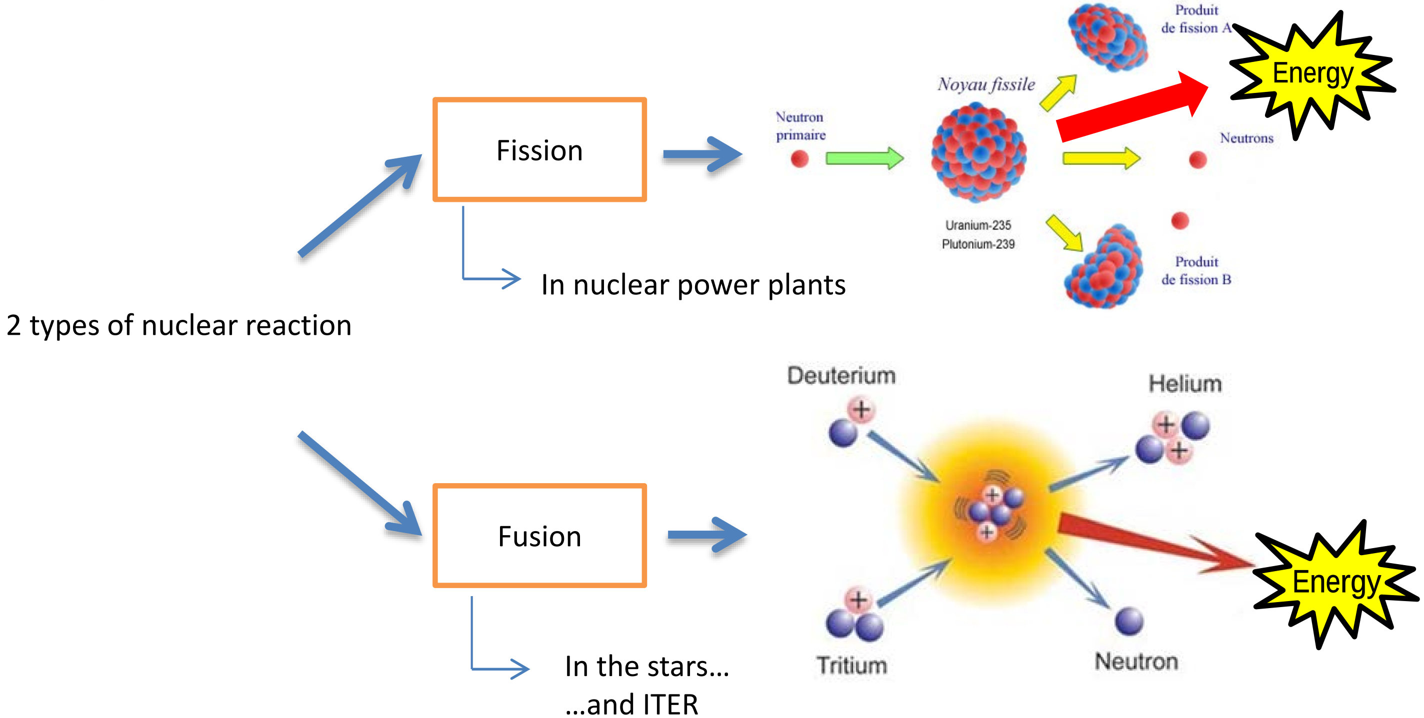
POWER SUPPLY

Power supply test bed, EC, IC and DNB power supplies

CD-CL Prototype Cryoline Lab

15 MW CWS ITER-India

Safety considerations of Fusion Reactor



Unlike the Fission, Fusion is not causing run away or Melt-down situation.

However occupational hazards in fusion environments area to be considered for e.g Radiation, tritium, cryogenics, electricity, magnets, pressure, and emergency systems

So, It important of manage the safety considerations from design to final commissioning of the Reactor through safety management system in line to local/global regulatory requirements

Safety Management System (1/2)

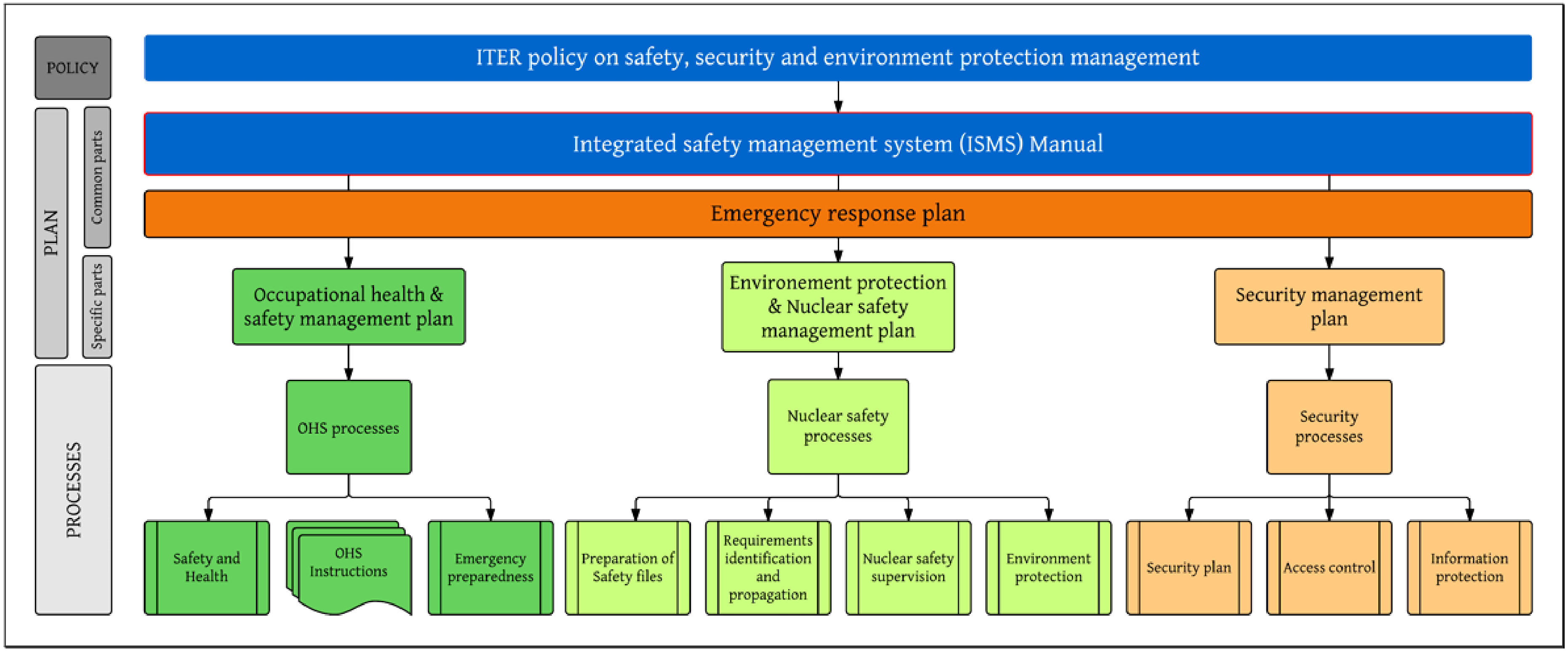
The Functions of Safety Management System :

- Ensure compliance with the legislative and regulatory requirements for Nuclear Facility and prescription and decisions established by the Nuclear Safety Authority (Local/Global)
- Ensure compliance with Organizational Policy on safety, security and environment protection management
- Ensures that the requirements relating to the protection of interest are systematically taken into account in any decision concerning the installation; It aims to meet the IAEA Safety Requirement.

Integrated Safety Management System that focuses on:

- ✓ Environmental protection
- ✓ **Occupational health & safety**
- ✓ **Nuclear safety**
- ✓ Security

Safety Management System @ITER (2/2)



OHS for Fusion Reactor

Radiation Protection

- ALARA (As Low As Reasonably Achievable)
- Shielding for Neutron and gamma (concrete, steel, borated materials)
- Dose monitoring through access control
- Remote handling for activated components
- Ventilation and containment barriers

Tritium Safety

- Tritium confinement
- Continuous tritium air monitoring
- Gloveboxes and protected atmospheres for tritium work
- Detritiation and controlled ventilation systems
- Restricted-access tritium handling spaces

Cryogenic Safety

- Oxygen Deficiency Hazard (ODH) monitoring
- Proper ventilation and emergency ventilation
- Quench protection systems for superconducting magnets
- Selection of Material to avoid embrittlement
- Safe handling procedures for liquid helium and deuterium

Magnetic Field Safety

- Exclusion Zones for Strong magnetic field
- Personnel restrictions (pacemakers, implants)
- Use of non-magnetic tools and fixtures
- Securing ferromagnetic materials to prevent projectile hazards
- Monitoring for Magnetic field and adequate signage

Electrical & High-Voltage Safety

- Electrical interlock systems
- Grounding and bonding per IEC/IEEE standards
- Arc-flash hazard assessment and PPE requirements
- Safe discharge mechanisms for capacitors and coils
- Restricted access during energization

Vacuum & Pressure System Safety

- Pressure/vacuum vessel design per ASME/PED
- Leak detection (helium mass spectrometry)
- relief valves, rupture disks for Overpressure protection
- Controlled venting procedures
- Safe operation of cryopumps and vacuum chambers

Emergency Systems & Monitoring

- Comprehensive plant safety monitoring (ODH, radiation, fire, hydrogen)
- Audible/visual alarms with redundancy
- Emergency shutdown systems
- Well-defined evacuation routes
- Regular training and emergency drills

OHS requirements

Definition: *Every element related to one or several in the construction, Installation and commissioning of Fusion device (ITER) Hazard(s) and from which the lack of consideration may threat the worker health and safety.*

Project Requirements for OHS for the fusion Reactor:

Preventive measures shall be considered in the ***design phase*** *to reduce the frequency or the probability of an event and that should establish the rules to follow for the construction, installation and utilization of equipment in order to protect people and equipment from OHS risks.*

Principles:

- ***Local Regulations*** *of Occupational Health and Safety code and all the necessary measures shall be implemented in order to ensure the safety and protect the physical and mental health of workers.*
- *The necessary measures are identified and integrated within the design by the technical responsible team.*
- ***Safety group*** *facilitate this activity by documenting the Hazards with OHS Design Requirements.*

Process of OHS Design requirements

Preparation of OHS Design Requirements

Propagation of OHS Design Requirements

Integration of OHS aspects in Design

Lesson learned & design changes incorporation

Preparation of OHS Design Requirements

Hazard List:

Organization shall identify the sources of potential harm from the Plant design description documents.

Type of hazard: Work activity related hazards

Geographical isolation

Associated failure mode(s):

Performing operations in hardly accessible area

Lone worker doing hazardous operation

Arduous Physical activity / Extreme effort

Associated failure mode(s):

Repetitive ... postures

Use of ex...

Body mo...

Type of hazard: Infrastructure, facility and equipment

Hazardous mechanical properties (sharp, spiked,...)

Associated failure mode(s):

Contact with sharp/pointed/rough material agent

Kneeling on, sitting on, walking on, leaning against a sharp object

Liquid retention

Associated failure mode(s):

Partial or full immersion

Moving parts - machinery

Associated failure mode(s):

Being caught or carried away by something or by momentum

Being trapped or crushed in/under/between elements

Path irregularity (obstacle, unevenness,...)

Associated failure mode(s):

Struck, crash on or against

Irregularity / unev... passageway

Use of extre... postures

Vehicles, means of ...

Type of hazard: Physical properties	
Ambient pressure (not atm)	
	Associated failure mode(s):
	Work in hypobaric conditions
	Work in hyperbaric conditions
Electricity	
	Associated failure mode(s):
	Direct contact with live parts : Electric shock due to the difference of potential
	Flash / arc exposure
	Indirect contact with live parts : Electric shock due to the difference of potential
Electromagnetic field	
	Associated failure mode(s):
	Uncontrolled movement of ferromagnetic objects
	High level of electromagnetic field exposure

Sources of OHS Design Requirements

The OHS requirements related to each hazard are detected through the analysis of the regulations and documentation associated to this hazard. .

The sources of documentation are presented below (non-exhaustive list) for ITER

- European and French regulations

French Labour Code – Part 4 (www.legifrance.gouv.fr);
European commission (ec.europa.eu)
European agency for safety and Health at work (osha.europa.eu)
ICPE nomenclature (www.ineris.fr)

- Standards

Harmonised standard (ec.europa.eu/growth/single-market/european-standards)
Mandatory standards
Standards (ISO, IEC, NF,…);

- Sound engineering practices:

INRS http://www.inrs.fr/
Official websites such as http://travail-emploi.gouv.fr/mot/travailler-mieux-1051
Industrial best practices;

- Benchmark:

CERN;
JET;
Other country regulations.

OHS Design Requirements identification

- Applicable requirements to be Identified from the sources detailed before, based on OHS analysis, past practice and experiences in construction projects
- Every element related to one or several Hazard(s) and from which the lack of consideration may threat the worker health and safety shall be considered as an occupational health and safety requirement.
- The threat on the worker H&S has to be understood as an (unwanted) event of which the likelihood and the level of consequences are not acceptable regarding the risk acceptance matrix as defined.

OHS Design Requirements recording

The OHS Design requirements applies to all activities, systems, components, buildings and organizations Presenting a risk of OHS nature which would be designed, manufactured and used, operated, activated under the organization responsibilities.

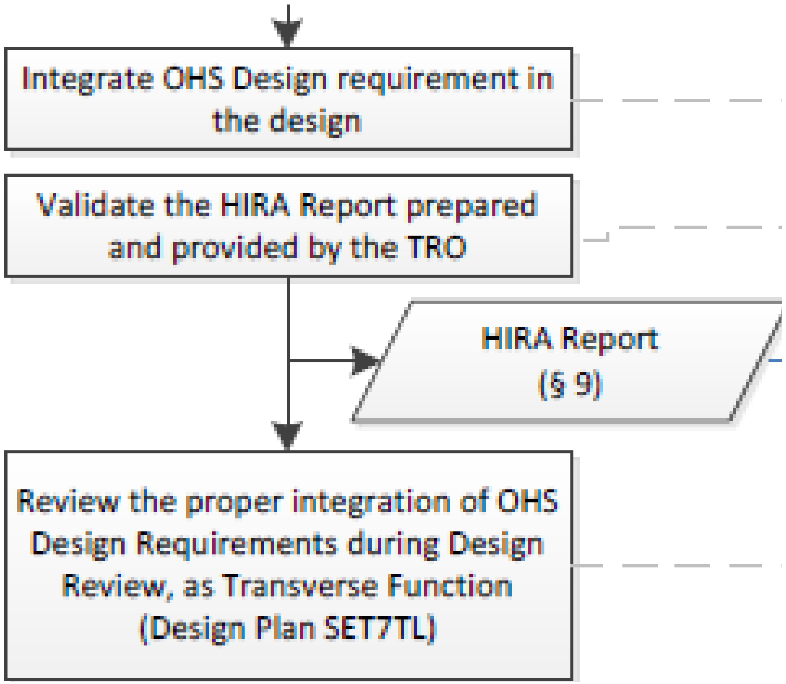
The creation of this kind of document might be triggered by recurrent questions, on demand or when the Safety Division consider that it is required.

Examples of topics are listed hereafter:

- Fire;
- Electromagnetic field;
- Storage of load and manual handling;
- Electricity;
- Machinery;

For example an instruction on the fire safety may specify requirements related to the escape routes (path irregularity), the evacuation of smoke (Dust / Airborne pollution / Smell), the ignition sources (electricity) and the combustible storage (Flammable material).

Integration of OHS aspects in Design



- Identify in their technical specifications or requirement documents all necessary measures and solutions to ensure the health and safety of the final user on the final system.
- To ensure in their design compliance with applicable legislation in order to prevent any injuries or illnesses.
- This is demonstrated by the provision of Design Compliance Matrices (during the design) and Design Verification Plans and Reports

Hazard Identification and Risk Assessment (HIRA)

To carry out a risk assessment according to the HIRA procedure.

The HIRA process outputs notably:

- Hazards linked with the system;
- Mitigation measures legally required;
- Mitigation measures required in order to obtain a tolerable level of risk

The OHS Design Requirements facilitate the two last points from this list.

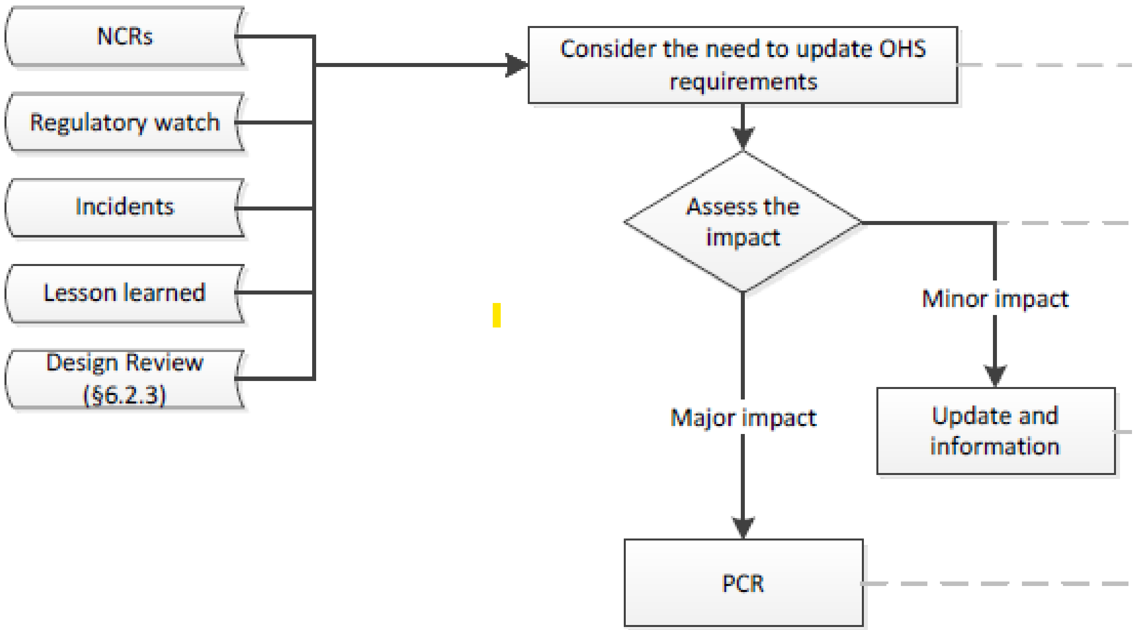
Design Review

The Design Review procedure imposes the participation of an IO/Health and Safety representative in the Review Panel. The Design Plan applies.

The IO/H&S representative has notably to review:

- ✓ The proper consideration of H&S aspects in the design;
- ✓ The completion of the HIRA process;
- ✓ The proper identification and consideration of OHS Design Requirements

Lesson learned & design changes incorporation



- ✓ Based on the project progresses and regulatory watch, NCR and Incidents
- ✓ Lesson Learned to be propagated and OHS design requirements may need to be modified accordingly.
- ✓ Before modifying an OHS Design Requirement document, the impact of the change shall be assessed.

Regulatory requirement for design of Lifting Adopters for Cryostat Components- An Example

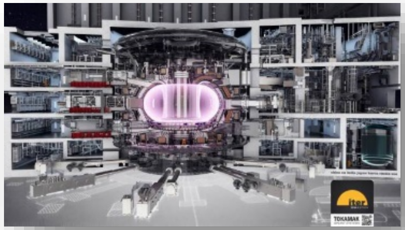
- **Regulatory requirements (EU Machinery Directive) have been considered in Design of Lifting Beam for Cryostat Main Section (Base Section: Weight-1250 T)**

The Load applied on Base Section is derived from EU Machinery Directive 2006 / 42 / EC. ANNEX 1 of the EU Directive is pertaining to the essential health and safety requirements relating to the design and construction of machinery.

Static state coefficient value recommended is 1.5 and subsequently dynamic test coefficient 1.1 is to be applied on maximum working load condition. Accordingly, the load applied on Base Section is calculated as: 1g X 1.5 x 1.1 = 1.65g ≈ 2g.

Lifting Operation of Base Section in Tokamak Pit

Nuclear Safety for ITER



ITER is a Nuclear Installation "INB 174"

- Needs to keep Risks As Low As Reasonably Practicable (ALARA)
- Needs to Demonstrate compliance with French Nuclear Regulation "INB Order" and Regulator [Authorizations]

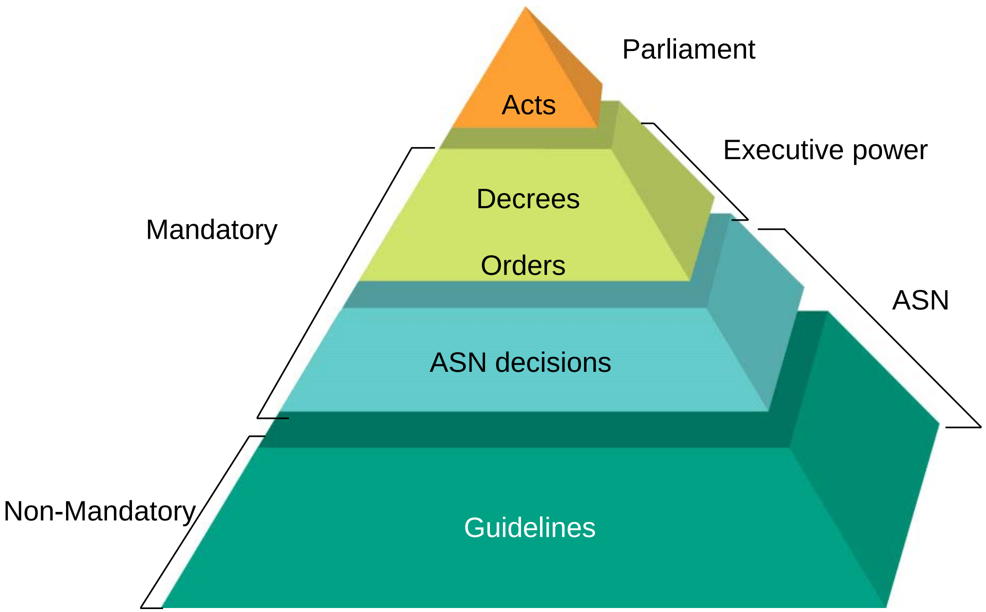
Demonstration of Nuclear Safety

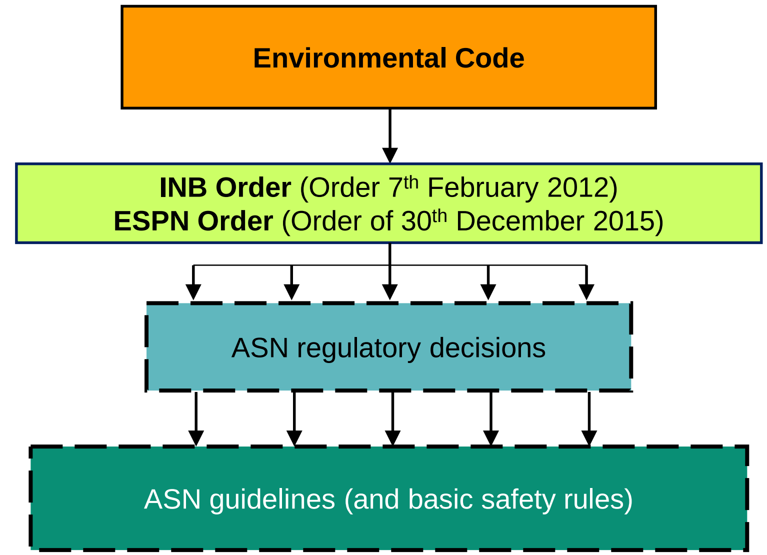
- Follows the *Defense-In-Depth Principle*
- Relies on Safety Functions and multiple Confinement Barriers of Nuclear Material
- Covers Design, Construction, Manufacturing, Installation, Operations, Decommissioning Phases

Nuclear Safety is the First Priority

- ITER Organization as Nuclear Operator has the prime responsibility for Safety
- ITER Policy on Safety Security and Environment Protection Management
- Regulatory Requirement that Contractors involved in Activities (PIA) and Components (PIC) supporting Safety Demonstration, designated as External Actors/Interveners, implement and apply the ITER Policy
- **Some Requirements of "INB Order" are applicable to External Interveners**

Overview on Nuclear Regulation for ITER





INB order establishes the general rules relating to the **design**, **construction**, **operation, final shutdown, dismantling, maintenance** and surveillance of INBs in order to protect the interests mentioned as per Environmental Code (**security, public health and sanitation, protection of nature and the environment**)

INB ORDER ESTABLISHMENT PHASES

Nuclear Safety for ITER

Environmental Code:

*"The nuclear safety is the set of <u>technical provisions</u> and <u>organizational measures</u> related to <u>the design, construction, operation, maintenance, shutdown and decommissioning of **basic nuclear installations**</u>, as well as the transport of radioactive substances which are adopted with a view to **<u>preventing accidents or limiting their effects</u>**.*

Basic Nuclear Installation is derived from French "Installation Nucléaire de Base". The acronym "INB" is often used.

ITER has two nuclear safety functions:

- **Confinement of chemical and radioactive materials**
- **Limitation of radiation exposure**

The ITER Facility shall **comply with the French regulations** regarding Nuclear Safety, Radiation Protection and Environmental Protection according to **Article 14 of the ITER Agreement**

Article 14

Public Health, Safety, Licensing and Environmental Protection

The ITER Organization shall observe applicable national laws and regulations of the Host State in the fields of public and occupational health and safety, nuclear safety, radiation protection, licensing, nuclear substances, environmental protection and protection from acts of malevolence.

The **INB classification** is due to:

- **Tritium inventory** (>27g)
  Nuclear fuel for ITER
- **Radioactive waste**
  ~ 41,700 Tons (operation + dismantling)

Overview of the Project Lifecycle

Design
- Compliance matrices
- Document reviews
- Design reviews

Manufacturing
- Compliance matrices
- Gate reviews
- **Manufacturing and Inspection Plans (MIPs)**

Construction
- Compliance matrices
- Gate reviews
- **Inspection and Test Plans (ITPs)**
- Generic PIAs

Operations
- General operating rules
- Procedures
- …

Maintenance

Final shutdown

Dismantling

Demonstration of compliance with Defined Requirements and applicable procedures
Technical Control for each PIA
Surveillance by the Nuclear Operator

Propagation of the Defined Requirements

During Design phase, the following steps are taken by ITER

DAC	• **DAC** Files (357DQ4) • **Preliminary Safety Report (RPrS)** (3ZR2NC)
PR	• Project Requirements (27ZRW8)
Def Req	• **Defined Requirements** (MNA8J4)
SRD	• System Requirements Documents (SRDs)
Gates	• Gate Reviews (PDR, CDR, FDR)
DCM	• **Design Compliance Matrices** • Design Compliance Matrix Procedure (473LQM)

INB Order Safety Requirements PIA and PIC

The INB Order defines several important concepts and sets the associated requirements:

- Identification of **<u>Protection Important Activities (PIA)</u>** and **<u>Protection Important Components (PIC)</u>** based on the **<u>RPrS</u>** and the authorization basis
- Identification of **<u>Defined Requirement:</u>** Requirement assigned to a PIC so that it fulfills with the expected characteristics the function provided for in the RPrS, or requirement assigned to a PIA so that it meets its objectives with regards to the RPrS
- A **<u>Technical Control</u>** to be performed for each **PIA**
- A **<u>Surveillance</u>** of External Interveners in order to ensure that they apply ITER's Policy for protecting the interests, the activities they perform and the goods of services they supply comply with the defined requirements, they comply with the provisions made for the implementation of the INB Order
- The management of **<u>Deviations and Non-Conformities</u>** to the Defined Requirements

PIC = SIC + EIC + CMC

Protection Important Components = **Safety Important Components** + **Environmental Important Components** + **Crisis Management Components**

PIC are derived from the Safety Demonstration.

PIC = A system, structure or component implementing or ensuring the implementation of a function required by the nuclear safety demonstration

Safety Demonstration: All the elements contained or used in the safety reports which justify that the risks and consequences of radiological or non-radiological accident are as low as possible under economically acceptable conditions

PIC are always associated to Defined Requirements.

Support Systems of PIC are also PIC.

Protection Important Components

INB Order Article 2.5.1 – Protection Important Component (PIC):

The operator identifies the Protection Important Components, the related Defined Requirements and keeps the list updated.

PR SRD

- Project Requirements (PR) (System Requirements Documents (SRDs)

DAC

- Folder-DAC/RPrS final formatted as submitted to the public enquiry version indice 3.0
- Preliminary Safety Report (RPrS)
- Safety Important Functions and Components Classification Criteria and Methodology)
- **SIC-1 and SIC-2 : graded approach**

PIC

- Lists of Protection Important Components (PIC list) (EN)

INB Order Implementation

1. The ITER Policy on Safety, Security and Environment Protection Management

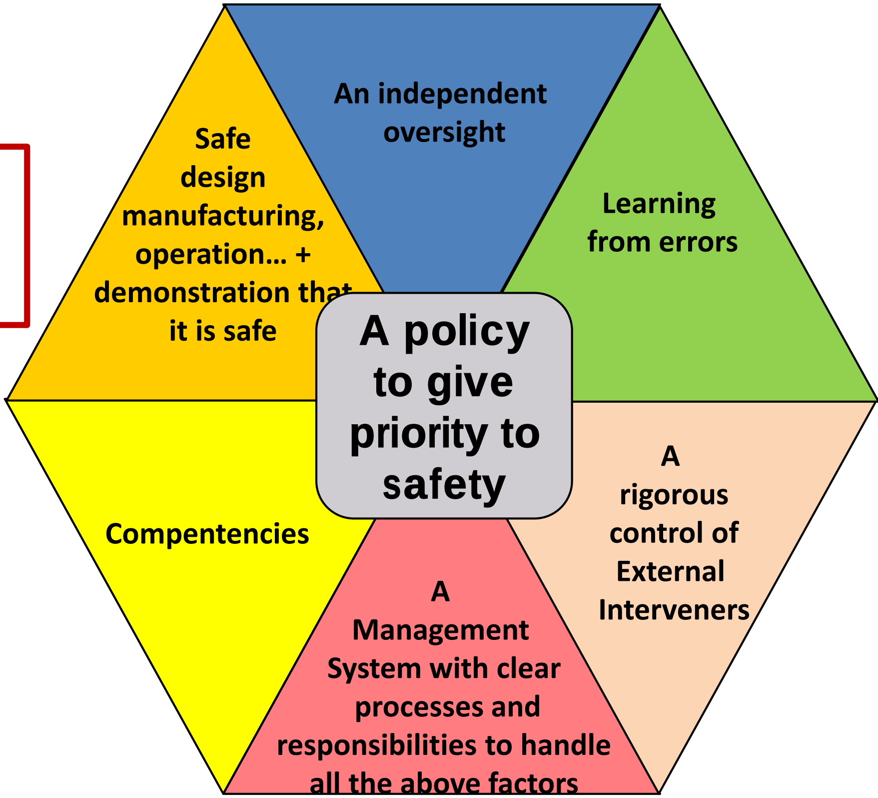
Summary

The ITER Organization's first priority, over and above its progress in research activities related to the ITER operation, is to protect its "interests[1]" by preventing accidents and by limiting their consequences related to nuclear safety.

In order to achieve these objectives, the ITER Organization shall carry out four strategic activities:

1. **Ensure that the first priority is given to nuclear safety**
2. **Ensure the protection of the workers and security, public health and sanitation, and the protection of nature and the environment for non-radiological events**
3. **Establish an Integrated Management System (IMS)**
4. **Implement the ITER Policy on Safety, Security and Environment Protection Management, and apply it to all Domestic Agencies and External Contractors**

The Operator establishes and undertakes to implement a Policy for the protection of the interests mentioned under the Environmental Code



2. ITER Integrated Safety, Environment and Security Management System (ISMS) Manual

INB Order Article 2.4.1 - The operator defines and implements an integrated management system that ensures that the requirements relating to protecting the interests mentioned under Article L. 593-1 of the Environmental Code (security, public health and sanitation, protection of nature and the environment) are systematically taken into account in any decision concerning the installation.

↓

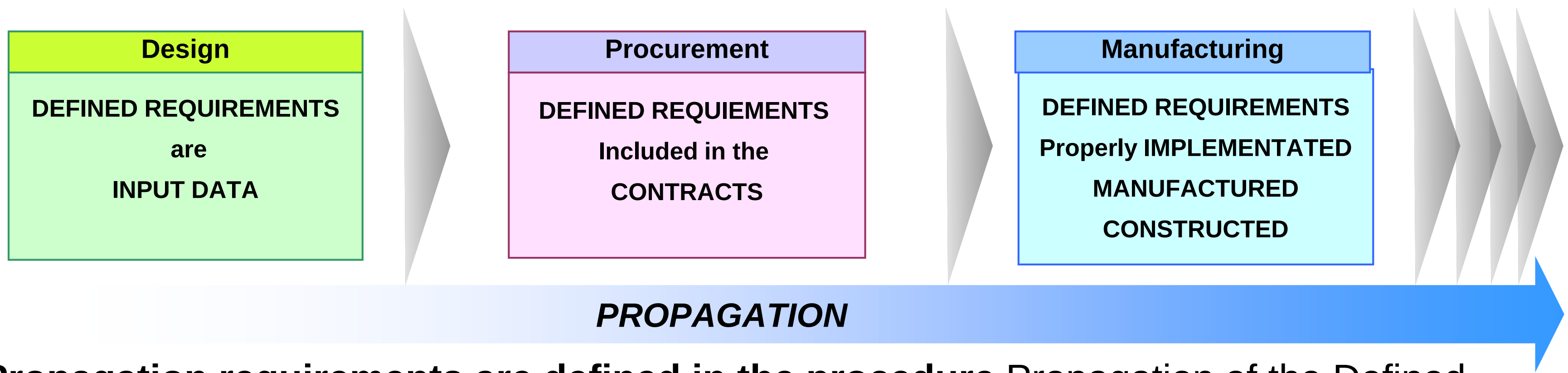
The purpose of the ITER Integrated Safety Management System (ISMS) is to comply with this requirement

3. The main plans, procedures and working instructions organized in the ITER Management and Quality Programme (MQP)

Defined Requirements for PIC and PIA

Defined Requirements: Requirement that has been assigned to a Protection Important Component (PIC) **or** a Protection Important Activity (PIA) so that it may perform the function provided for in the safety demonstration (from INB order Article 1.3).

They shall be propagated to all stakeholders and complied with at each stage.



Propagation requirements are defined in the procedure Propagation of the Defined Requirements for Protection Important Components Through the Chain of External Interveners :

- The propagation of the **Defined Requirements** starts at the design phase.
- The **Defined Requirements** must be propagated and **<u>respected until the end of operation</u>**.
- During manufacturing and construction, it must be checked they are properly implemented.
- The final dossier must include the “compliance matrix” for the **Defined Requirements** verified by the Nuclear Operator.

Protection Important Activities (PIA) and Technical Control

INB Order Article 2.5.2 – PIA
The operator identifies the **Protection Important Activities (PIA**), the related **Defined Requirements** and keeps the list updated.

The generic high-level PIA and associated Defined Requirement are provided in the List of ITER-INB Protections Important Activities
The Guideline for Identification of the Protection Important Activities (PIA) can be helpful to assess which activities should be considered as PIA.

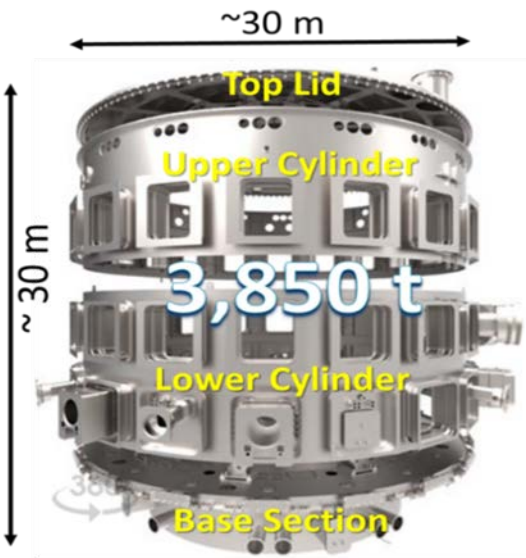
PIA for design phase
Preparation of manufacturing specifications for tools and equipment involved in PIAs

INB Order Article 2.5.3:
Each **Protection Important Activity** undergoes **Technical Control,** to ensure that:

- the activity is carried out **in compliance with the Defined Requirements** for the activity and, if necessary, for the protection-important components concerned;
- appropriate corrective and preventive actions have been defined and implemented.

Parties carrying out Technical Control for a Protection Important Activity are distinct from the parties who accomplish the activities.

PIA in Manufacturing of Cryostat- An Example



PIC

PIA

List of ITER-INB Protections Important Activities

5.2.2 Lifecycle: Construction/ manufacturing

PIA's	Defined Requirements
Detailed construction design and working drawings	– Compliance with the defined requirements of PIC's and PIA's
Construction/ manufacture in factory	– Compliance with the technical specifications.
Assembly carried out in factories.	– Compliance with the manufacturing and surveillance plans
Reception of PIC for handover to the ITER Organization at the ITER Site	– Conservation of the PIC capacity to fulfil its defined requirement. – Compliance with the IO reception procedure
Storage of PIC at the ITER Site	– Conservation of the PIC capacity to fulfil its defined requirement. – Compliance with the preservation plan
Individual acceptance tests on components	– The test shall allow to assess if the PIC meets its defined requirements

Preliminary PIAs

Material for manufacturing	Chemical Analysis , Mechanical Testing
Manufacturing	*Weld data Package (WPS, PQR, WPQ, NDE)*
Final Documentation (Acceptance Data Package)	Acceptance of Complete Manufacturing file

Management of impurities in Material:
Co:0.05Max,Nb:0.01Max, Ta:0.01Max
→ Radiation safety

Structural integrity:
→ Confinement

Technical Control of PIA in Manufacturing of Cryostat- An Example

Guideline for Identification of the PIA (SBYJXD v1.4)

At manufacturing and/or fabrication/assembly level, the activities or operations are in most of the cases defined by procedures and/or standards; but the procedures and/or standards do no establish by themselves if the activities are Protection Important Activities or not.

Consequently, at each stage, the contractors must analyse if the operation is (or not) a PIA.

This is notably done in the MIP, where the activities listed in the MIP are classified "PIA"or "non-PIA" by the contractors; this classification is later checked by the IO SRO, representative of the nuclear operator, who is finally responsible of deciding whether or not an operation is a PIA.

PIA

Metrology of BS

Welding of LC in PIT

NDE (UT) of Weld Joint

MIP

ITER Requirements for Producing an Inspection Plan

PIA or not PIA

Defined Requirement

Technical Control

Surveillance / Supervision

Records / NCR

Seq. No.	Operation (Manufacture, Inspection, Tests, etc.)	PIA/TC	Applicable Documents (Ref. No.)	Rev. No.	INSPECTION BODY's INTERVENTION POINT					Doc.	Records (Report, NCR, QC data and etc.)	Remarks
					Sub-Supplier	Sub-Supplier	IO/DA		ANB			
00200	**Material inspection for materials to be used for Segment fabrication**											
00201	Material inspection for filler material • Review mill certificate • Acceptance Test Report • Check material with dimension & identification marking		POS (ITER-VM-0801-02)		N/A	WP	DR		DR	R		
00202	Material inspection for shield block • Check material with dimension, identification marking and appearance				N/A	WP	DR		DR	R		

Conclusion

- **Safety management system shall be established at design stage for the Nuclear Fusion Machine**
- **All the Nuclear safety and OHS considerations shall be identified, integrated and implemented from the design stage to later stages**

References

- ITER Integrated Safety, Environment and Security ManagementSystem (ISMS) Manual (IDM:4HCWJU)
- Order of 7 February 2012 setting the general rules relative to basic nuclear installations, called “INB Order” (IDM:7M2YKF)
- Procedure for Occupational Health and Safety Hazard Identification and Assessment (IDM:AJLQRF)

न्यूक्लियर पावर कॉर्पोरेशन ऑफ इंडिया लिमिटेड
Nuclear Power Corporation of India Limited

Safety by Design and Beyond- Emerging Trends in Occupational Safety at NPCIL

Prateek Agrawal

Executive Director (CP & CC)

NPCIL

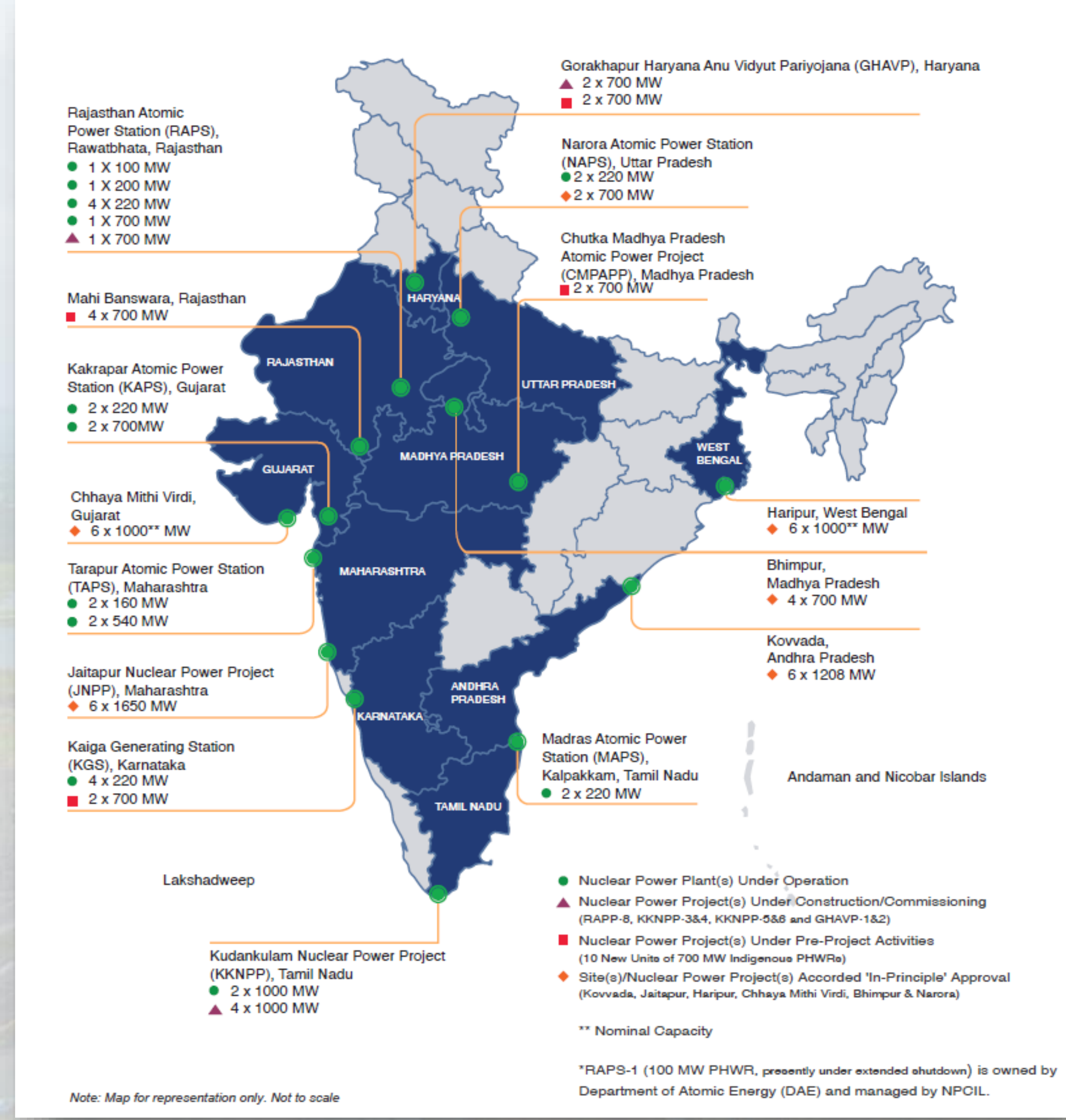
न्यूक्लियर पावर कॉर्पोरेशन ऑफ इंडिया लिमिटेड
Nuclear Power Corporation of India Limited

Safety First
is
Safety Always

About NPCIL

- Formed on September 17, 1987 as a PSE of DAE, fully owned by the Government of India
- Expertise in multiple reactor technologies - PHWR, BWR & PWR
- Large expansion plans based on indigenous PHWRs and LWRs with foreign cooperation

NPCIL's Presence



Reactors in Operation

24 Reactors (8780 MW)

[excluding RAPS-1 (100 MW)]

Reactors under Construction

7 Reactors (6100 MW)

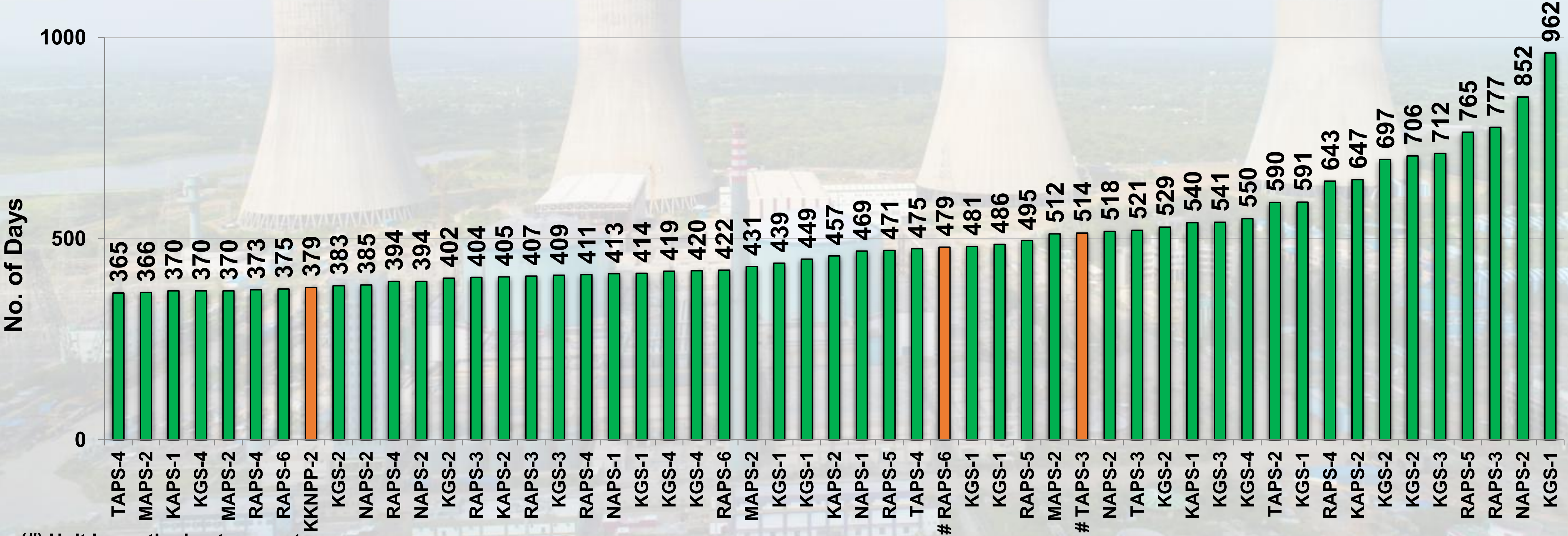
Reactors at Pre-Project Activities Stage

10 Reactors (7000 MW)

On progressive completion of these projects, nuclear power capacity in the country will reach <u>22380 MW by the year 2031-32</u>

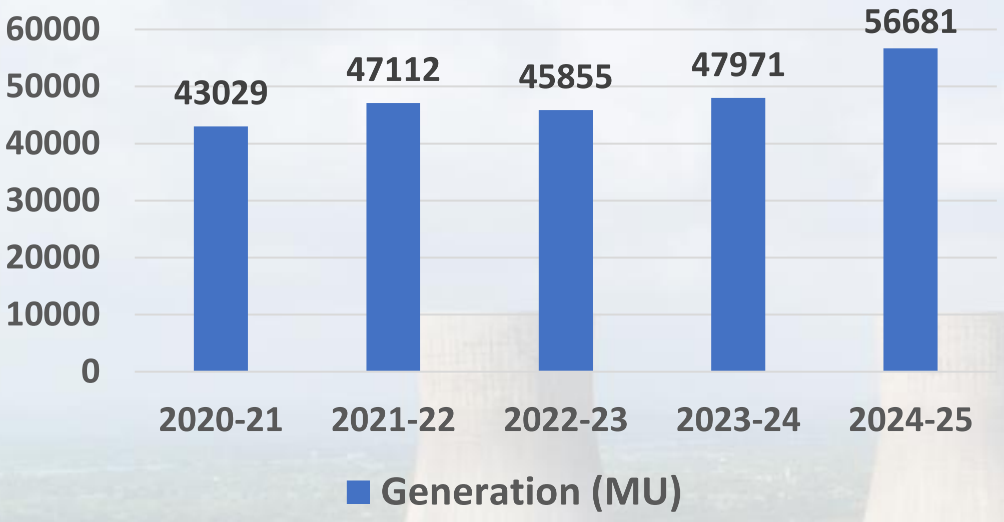
Landmark Achievements

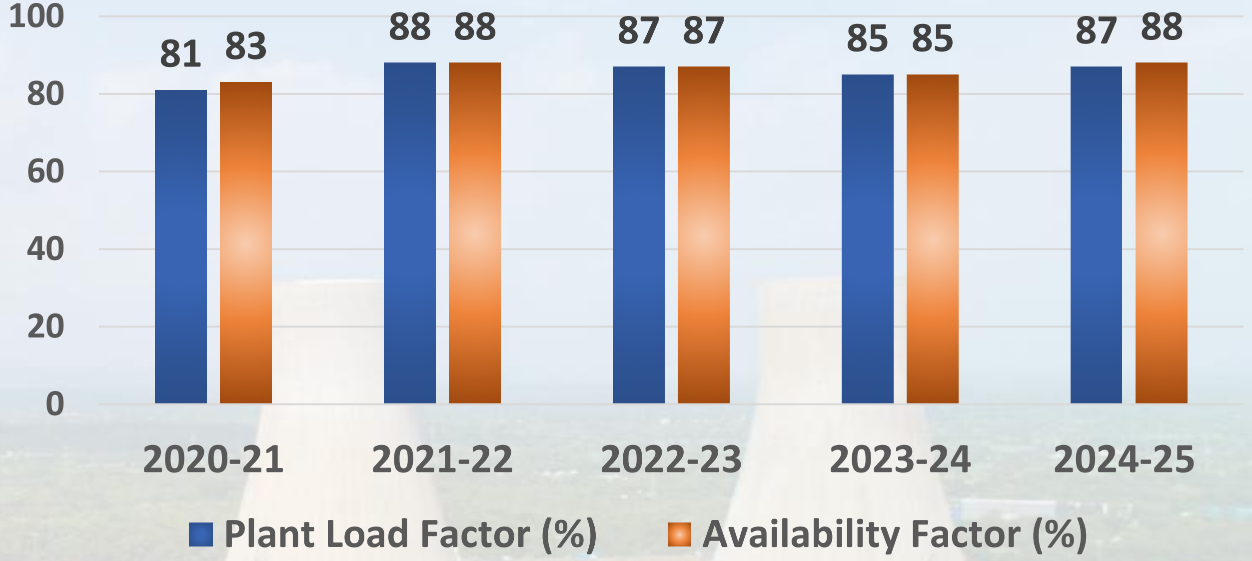
- **Completion of over 50 years of operation of TAPS-1&2, oldest reactors in operation in the world today.**
- **World record of continuous operation of 962 days by KGS-1 in 2018** (presently 2nd highest, behind Darlington-1)
- **Continuous Operation of more than a year (365 days), 53 times so far.**



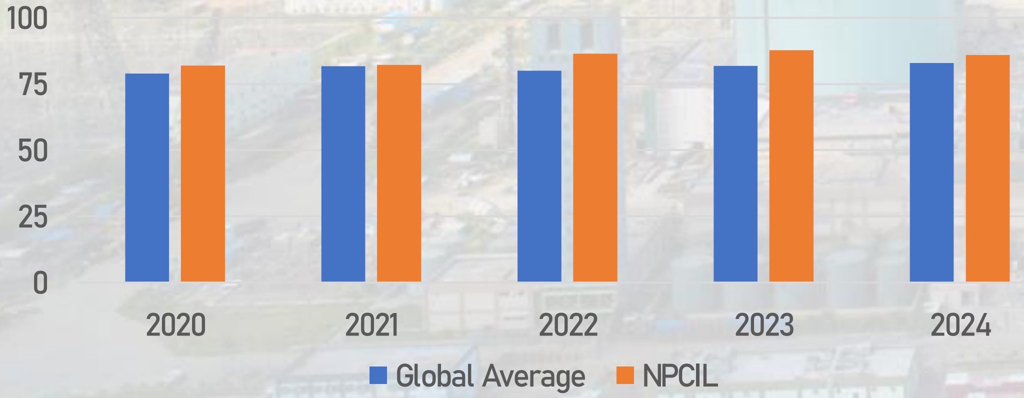
(#) Unit is continuing to operate

Performance of NPCIL's Fleet (last five years)





Comparison with Global Performance – Capacity Utilisation (PLF)



Capacity Addition :

- 2100 MW (KAPS-3, KAPS-4, RAPS-7)
- Increase of ~ 31% (from 6780 MW to 8880 MW)

Avoidance of CO_2 Equivalent Emissions :

Total Since Inception : ~ 803 Million Tons (933 BU)
Annual (2024-25) : ~ 49 Million Tons (56 BU)

Projects Under Construction (6100 MW)

Projects Under Construction	Capacity (MW)
Indigenous Pressurized Heavy Water Reactors (PHWR)	
RAPP-8, Rawatbhata, Rajasthan	700
GHAVP-1&2, Gorakhpur, Haryana	2 x 700
Light Water Reactors (LWR) with Foreign Cooperation	
KKNPP-3&4, Kudankulam, Tamilnadu	2 x 1000
KKNPP-5&6, Kudankulam, Tamilnadu	2 x 1000

Projects Under Construction (6100 MW)

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Projects at Pre-Project Activities (7000 MW)

Projects	Capacity (MW)
Pressurised Heavy Water Reactors (PHWR)	
Kaiga-5&6, Kaiga, Karnataka	2 x 700
GHAVP-3&4, Gorakhpur, Haryana	2 x 700
Chutka-1&2, Chutka, Madhya Pradesh	2 x 700
Mahi Banswara-1&2, Mahi Banswara, Rajasthan*	2 x 700
Mahi Banswara-3&4, Mahi Banswara, Rajasthan*	2 x 700

*The Government in September 2024 has approved implementation of Mahi Banswara 1 to 4 (4X700 MW) project by Anushakti Vidhyut Nigam Ltd (ASHVINI), a Joint Venture of NPCIL (51%) and NTPC Ltd (49%).

Future Plans

- Key focus on deployment of indigenous 700 MWe PHWRs in fleet mode
- Large capacity LWRs with foreign collaboration - for faster capacity addition, to meet the energy demand and speed up decarbonisation efforts.
- Setting up of Bharat Small Reactors (BSRs) for de-carbonization of hard-to-abate industries with private investment
- Development & setting up of Bharat Small Modular Reactors (BSMRs), being jointly developed with BARC
- NPCIL aims to contribute 50+ GWe by 2047.

  Safety will always be an overriding priority

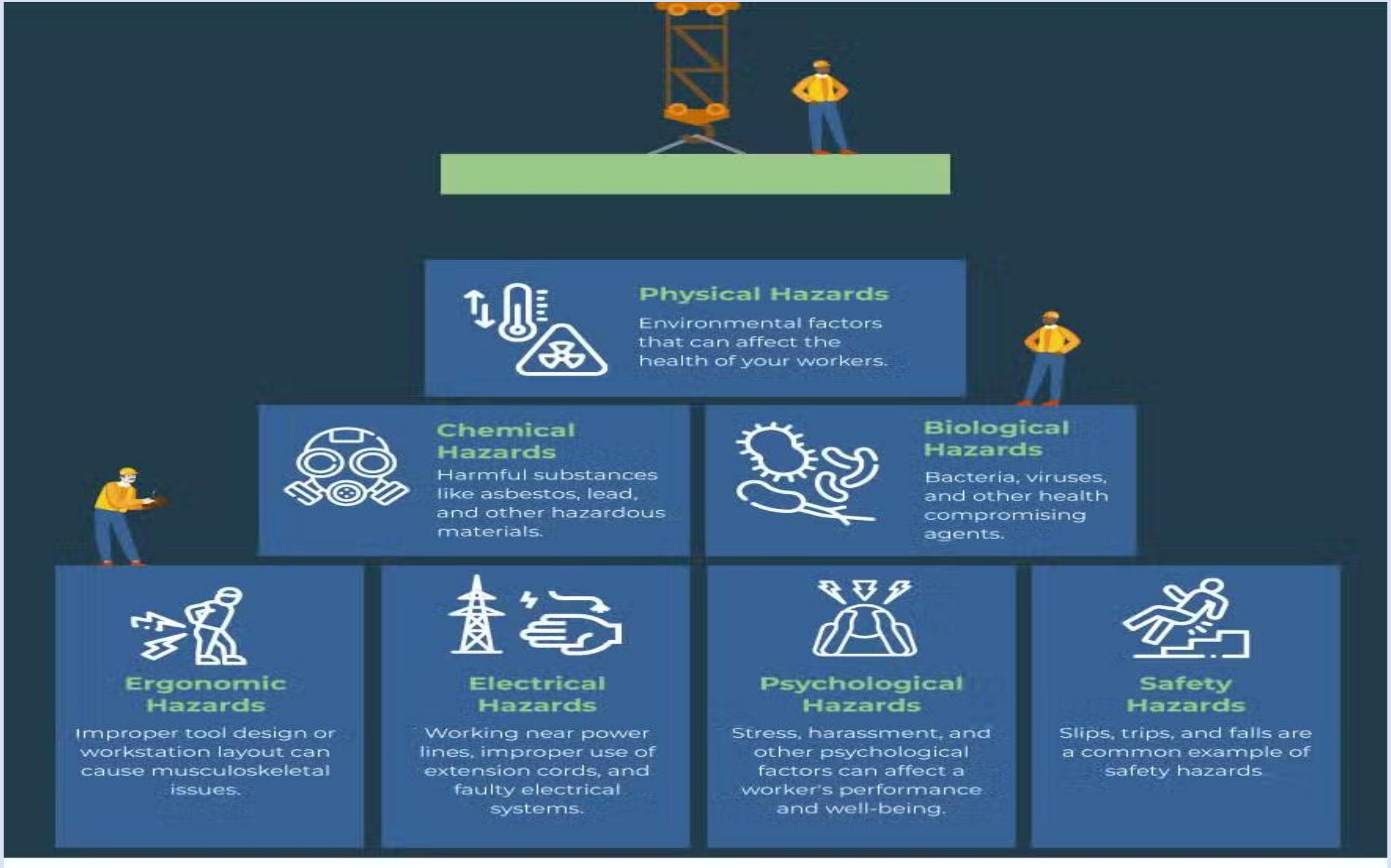
सामान्य मिथक

- एक मिनट में क्या हो जायेगा ?
- जुगाड़ से काम चलता है.
- बॉडी स्ट्रेच करके काम चला लो.
- हेलमेट से सिर भारी हो जाता है.
- सेफ्टी गागल से दिखाई नहीं देता.
- सेफ्टी देखना इंडस्ट्रियल सेफ्टी ग्रुप का काम है.
- हाउसकीपिंग सर्विस मेंटनेंस वाले का काम है.
- क्रिम्पिंग टूल नहीं है, प्लायर से काम चला लो.

10 Rules for workplace Safety

- You are responsible for your safety and for safety of the others.
- All accidents are preventable.
- Do not take shortcuts. Always follow the rules.
- If you are not trained, don’t do it.
- Use the right tools & equipment and use them in right way.
- Address the risks before you approach your work.
- Never wear loose clothes or slippery footwear.
- Do not indulge in horseplay while at work.
- Practice good housekeeping.
- Always wear PPEs

Common Safety Hazards



Safety Hazards

- **Industrial hazards may be defined as any condition that may cause injury or death to personnel or loss of product or property**

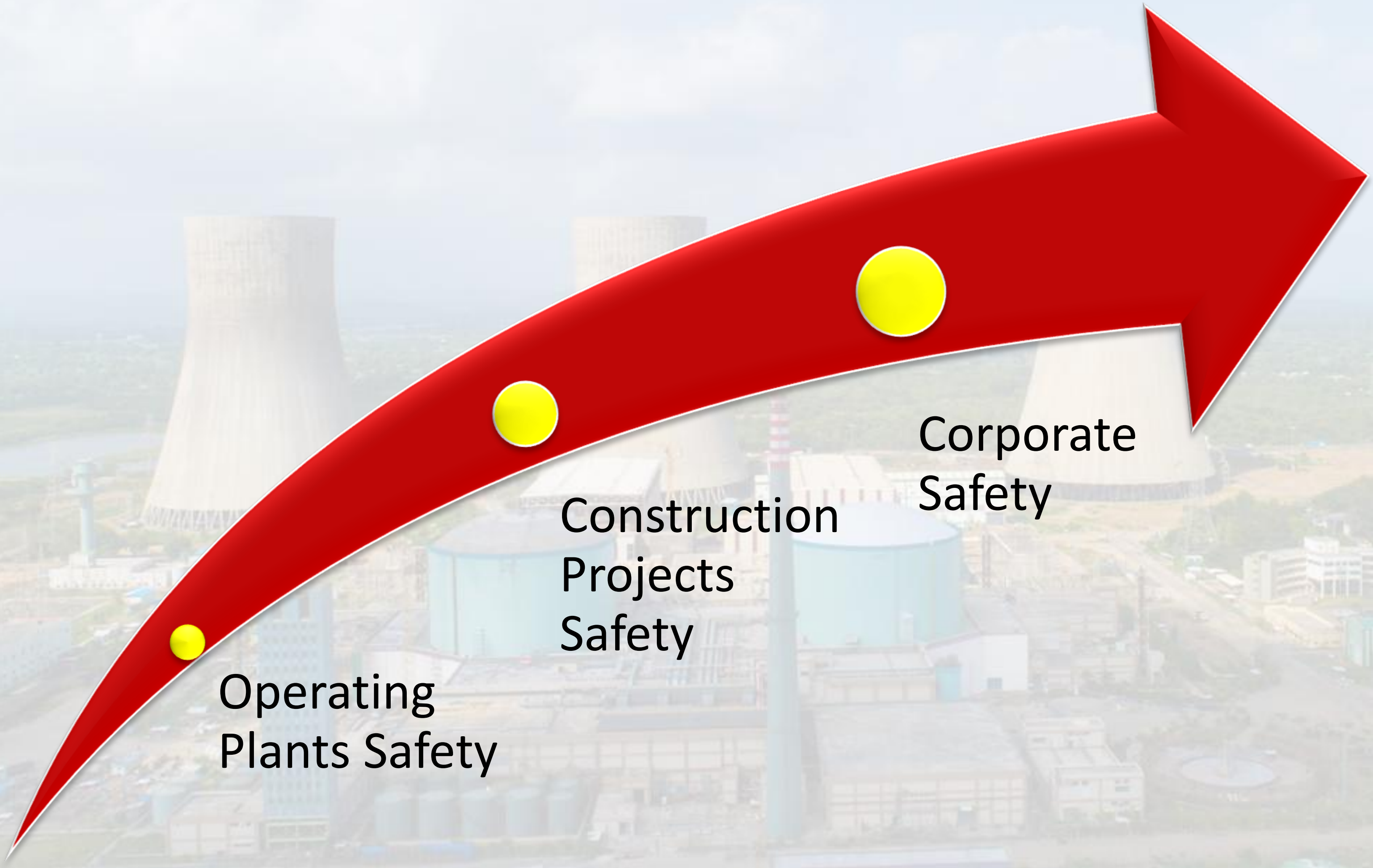
The Fatal Four

- **Falls: from roofs, scaffolding, ladders, leading to fatalities and serious injury.**
- **Struck-By: Being hit by falling objects or heavy equipment.**
- **Caught-In/Between: Crushing injuries from heavy machinery, collapsing trenches, or being trapped between materials.**
- **Electrocutions: Shocks, burns, and electrocution from live wires, faulty equipment, or improper grounding.**

Other Major Hazards

- **Machinery/Equipment Hazards: Unguarded moving parts, poor maintenance, improper use.**
- **Chemical Exposure: Solvents, Chlorine, toxic dusts (like silica), asbestos.**
- **Ergonomic Risks: Heavy lifting, repetitive motions leading to musculoskeletal injuries.**
- **Noise & Vibration: Hearing loss, vibration-related disorders.**
- **Fire & Explosion: Flammable materials, electrical faults, hot work.**
- **Trench/Excavation Collapse: Unprotected trenches can bury workers.**

Industrial & Fire Safety Management in NPCIL



Safety Organization

- Safety Policy
- Safety Manual
- Safety Organization at Corporate Office and Site
- Qualified Safety Professionals
- Reporting to the Occupier
- Apex and Sectional Safety Committees
- Contactors Safety Organization
- Responsible Line Managers

Safety Functions at Operating Plants & Construction Projects

Safety Enforcement & Surveillance

Hazard Identification and Risk Assessment

- Plant Safety Inspection
- SRD Management System
- Job Hazard Analysis
- Safe Work Procedures and Checklists

Safety Monitoring and Measurement

- Noise survey
- Illumination survey
- Temperature measurement
- Toxic and flammable gas measurement
- Oxygen measurements

Safety Enforcement & Surveillance

Penalties

- Work stoppage
- Monitory penalties

Work Permit System

- Confined space entry
- Working at height
- Electrical safety
- Cutting and welding
- Fire barrier breach
- Blasting Works
- Excavation Works etc.

Safety Enforcement & Surveillance

Material Handling Equipment

- Inspection, testing and certification by Competent persons

Occupational Health

- Certifying Surgeon
- First-aid Centre and Ambulance
- Pre-employment and periodic medical examination

Safety Review

Management Field Rounds

Station Operation Review Committee

Apex & Sectional Safety Committees

Safety Review Committee for Operations

Safety Review Committee for Projects and Design

Fire Protection

Fire Prevention

- Fire resistant building materials
- Control of ignition sources
- Control of transit storage of combustibles
- Fire barrier breach permit

Fire Detection & Suppression

- Addressable fire alarm system
- Active Fire Protection System

Fire Mitigation

- Passive Fire Protection System

Manual Fire Fighting

- Fire Squad
- Fire Brigade

Construction Safety Management

Contractors Safety Management

- Contractors' Safety Officers and Safety Supervisors
- Responsible Line Managers
- Safety Professionals
- Induction Training
- Authorization for Electrical works, works at height, Riggers, Crane Operators and Signalmen

Enforcement

- JHAs
- Safe Work Procedures
- Scaffolding certification
- PPEs
- Work Permit System

Key Performance Indicators

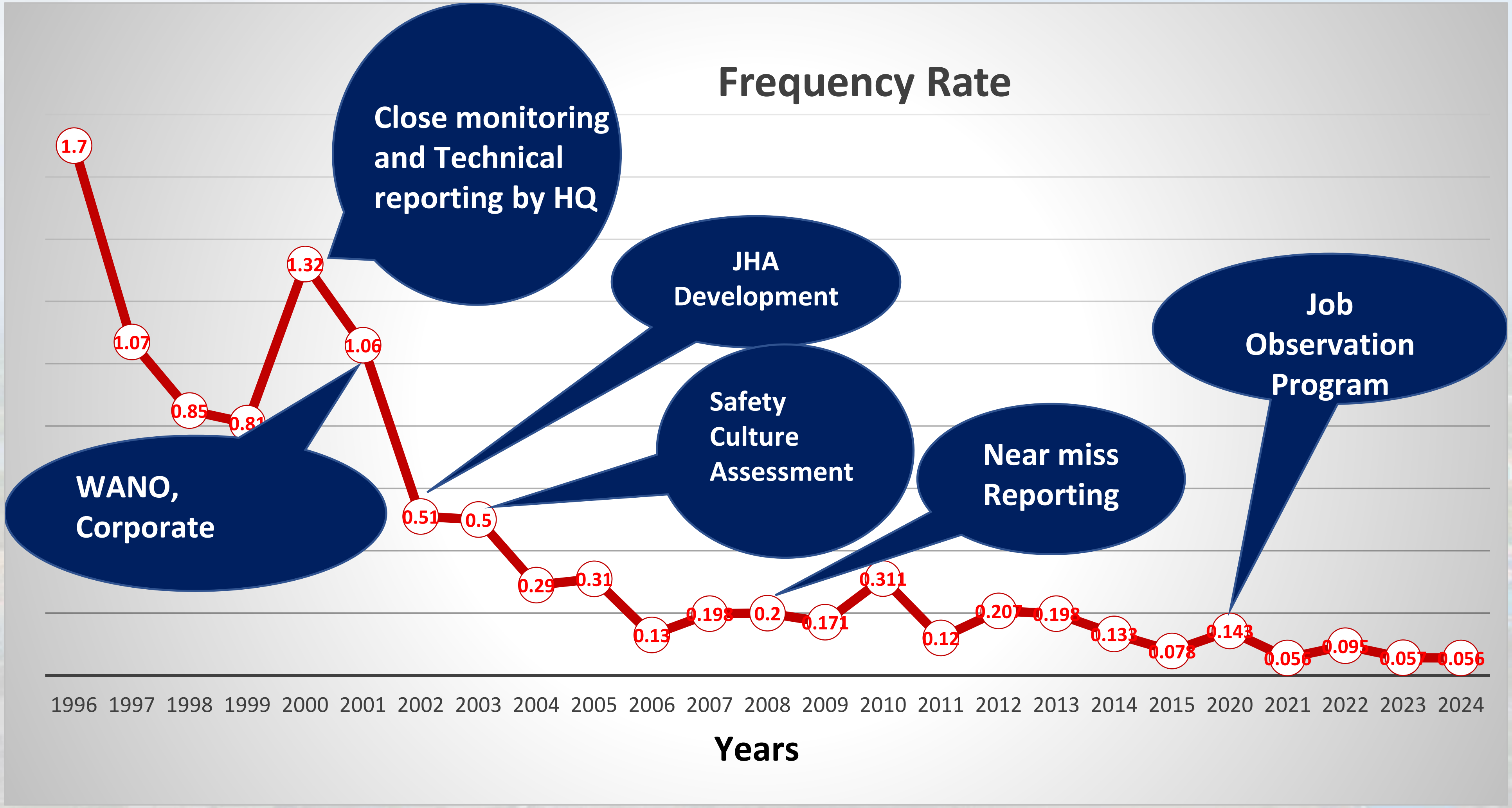
Leading Indicators

- Near miss reporting, LLEs
- Safety Training
- Plant Safety Inspection
- Job Observation
- SRDMS
- Management Field Round
- Safety Culture Assessment

Lagging Indicators

- Frequency Rate
- Severity Rate
- Injury Index
- Incident rate
- Fire Incidents

Performance Trending



Modernization to Make Industry Safe

- New Safety Gadgets
- Mechanisation
- Better Supervision
- Trending Behaviour Analysis
- Corrective Actions

Vertical Fall protection System on ESL Tower

Mock up systems

DO-Mock Up RPV Inlet/ Outlet nozzle shield plug installation mock up

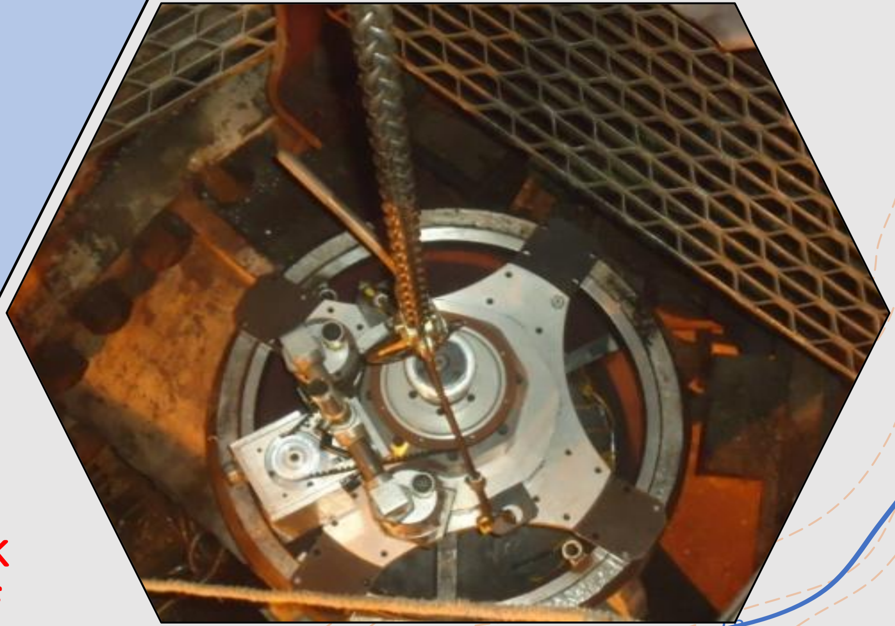
DO-Mock Up of Automatic Welding Machine with the help of outsourcing agency

MACHINE AUTOMATION:

The cutting of stainless steel material is a difficult job and requires special process. In this case an automated cold cutting technique was adopted. The cutting of existing pipeline was carried out by using automatic orbital cutting machine. The use of automation techniques helped to reduce any error, and minimizing human intervention along with any possibility of fire hazard

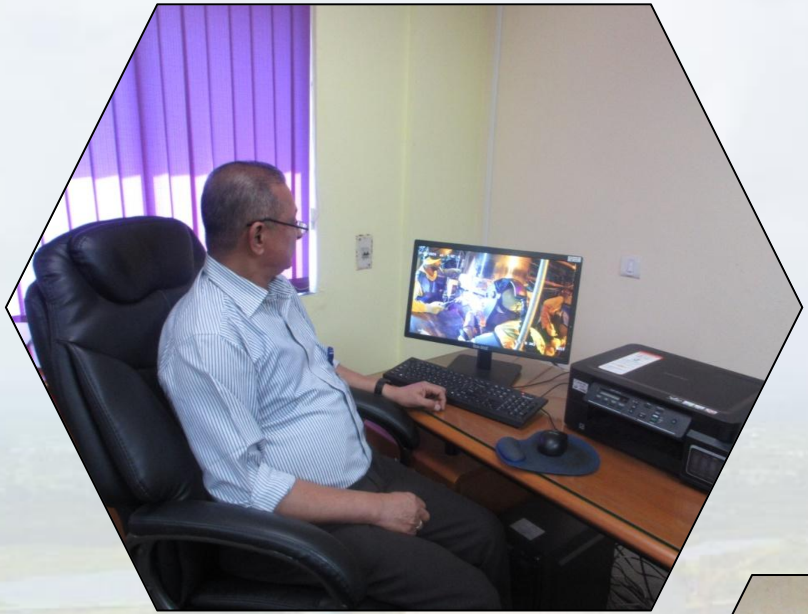
ID MOUNTED BEVELING MACHINE:

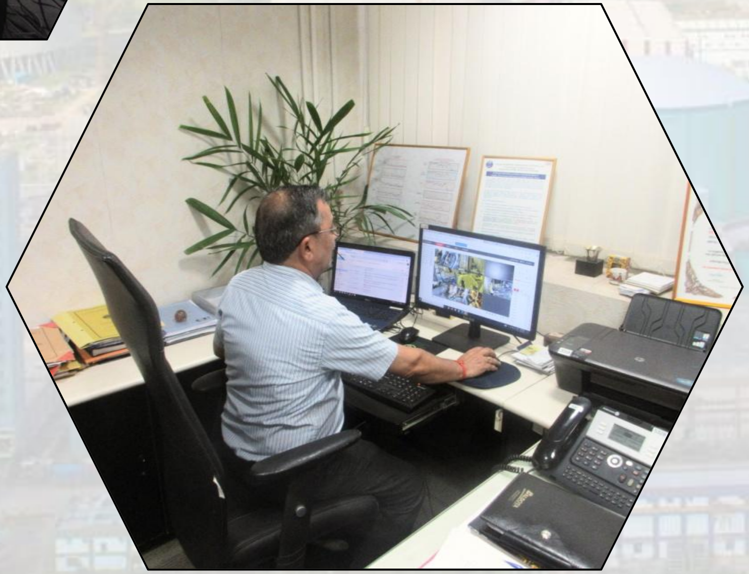
To carry out weld joint edge preparation, an automatic ID mounted beveling machine was used



Go for automation decrease the risk for worker. (Substitution method of hazard analysis)

Remote monitoring System





FULL SCALE MOCK-UP:

The area inside drywell is a high background dose hazard and having limited space. So trials and practice run of all machines was to be performed at outside area.
To achieve this, a full scale mock up model of one recirculation line loop was erected at outside area. This helped the workers to familiarize with the machine operation to identify any hazards of the workplace.

Full Scale Mock-up for Reactor 24 Inch Recirculation Pipe Line

Practise decreased the field challenges so the practised should be done on full scale model or in real scenario. the area related issue can be solved . This will decreased injury at work place.

Full Scale Mock-up of Typical location 24 inch Recirculation pipe

Safety Training using VR headset

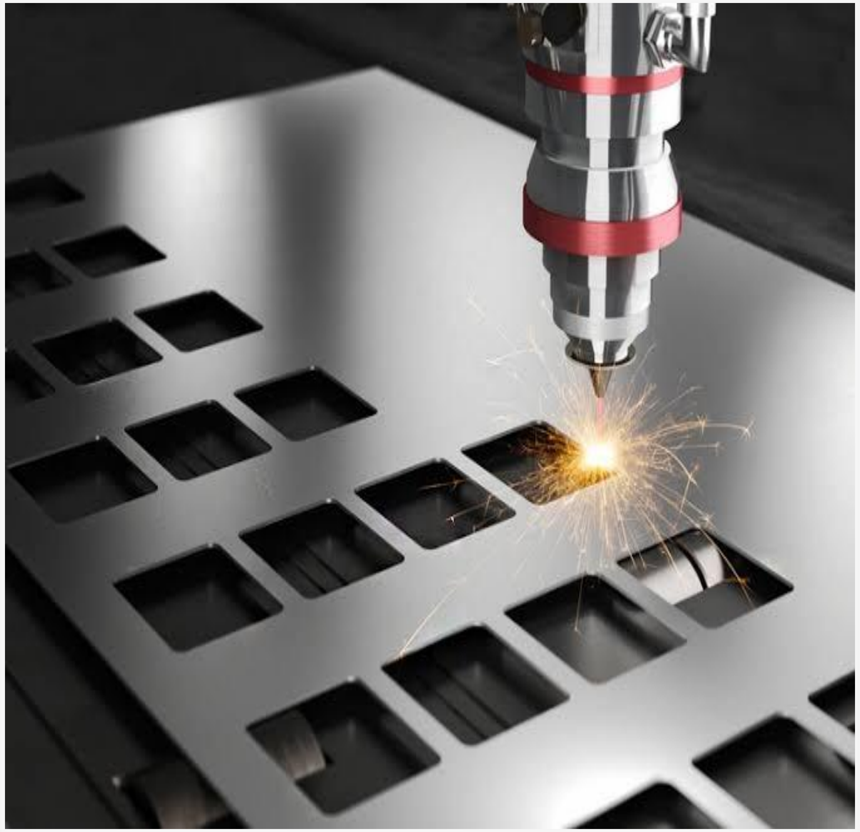
- VR (Virtual Reality) / AR (Augmented Reality) supported sets (training kits) simulating construction hazardous situations for the training.

Advantages:

- Customized Learning Platforms address particular gaps identified from construction workers.
- Includes interactive modules, e-questionnaires, and video tutorials which effectively engage the trainee with the modules.
- Provides continues tracking the progress of training and ensure the attention by using the feedback loop.

Other Equipments

Mobile scissor Platforms



Laser Cutting

IT applications for Construction Site

- Bluetooth-enabled Smart helmets, Industrial Internet of Things(IIoT)-enabled digital vests etc. are examples.

<u>Advantages</u>

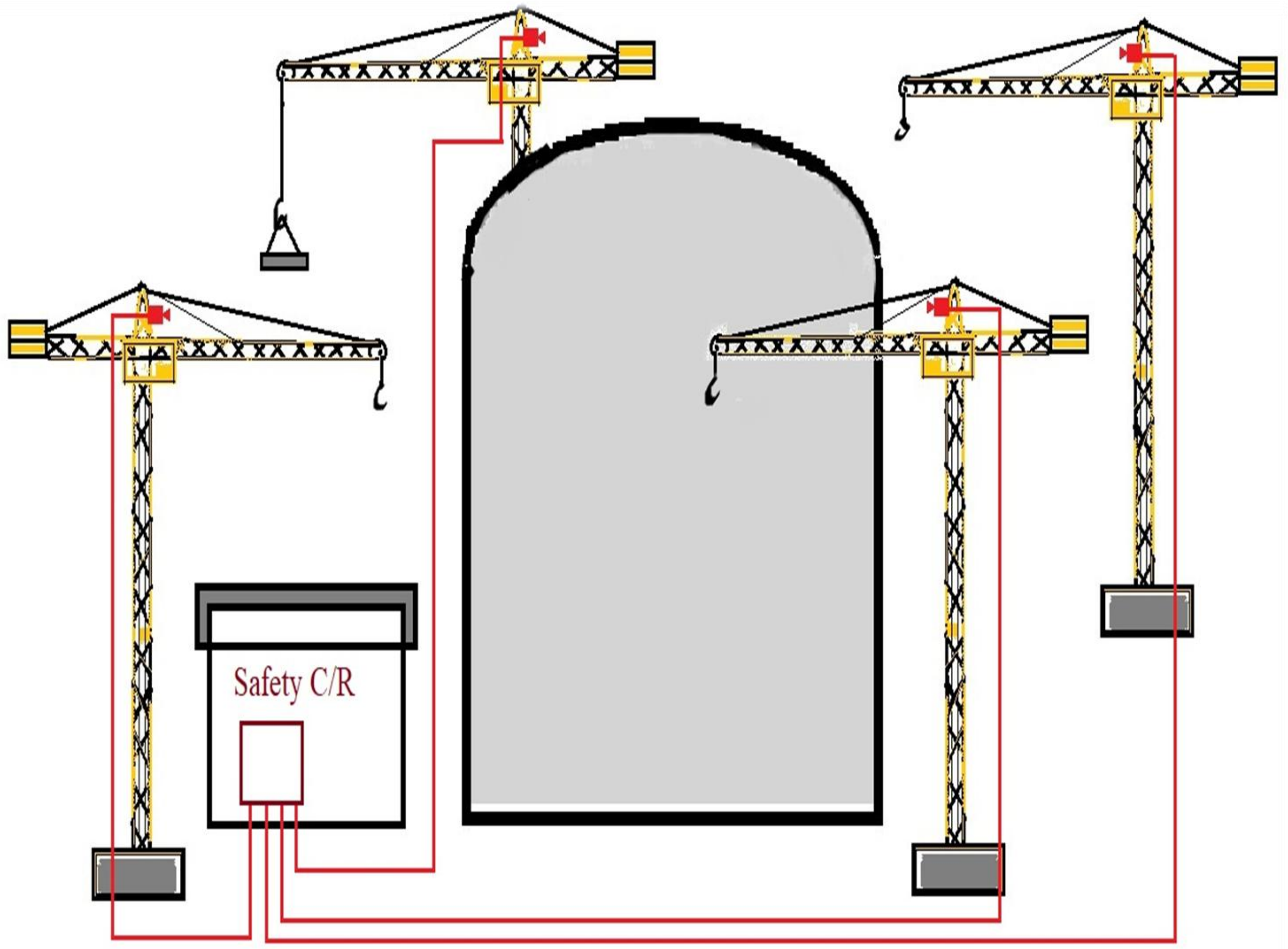
- Smart vests help to monitor the vital parameters of the worker and give alarms if some parameters cross the set points.
- It gears up communication in emergency and help to fast mobilize safety services.

Fixed Devices for Area Monitoring

- Area monitoring cameras work at construction sites through a combination of real-time surveillance, remote access and auto-alerts.

<u>Advantages</u>

- Real-time site surveillance.
- Security monitoring.
- Effective site coverages.
- Saving time and energy.



Drones

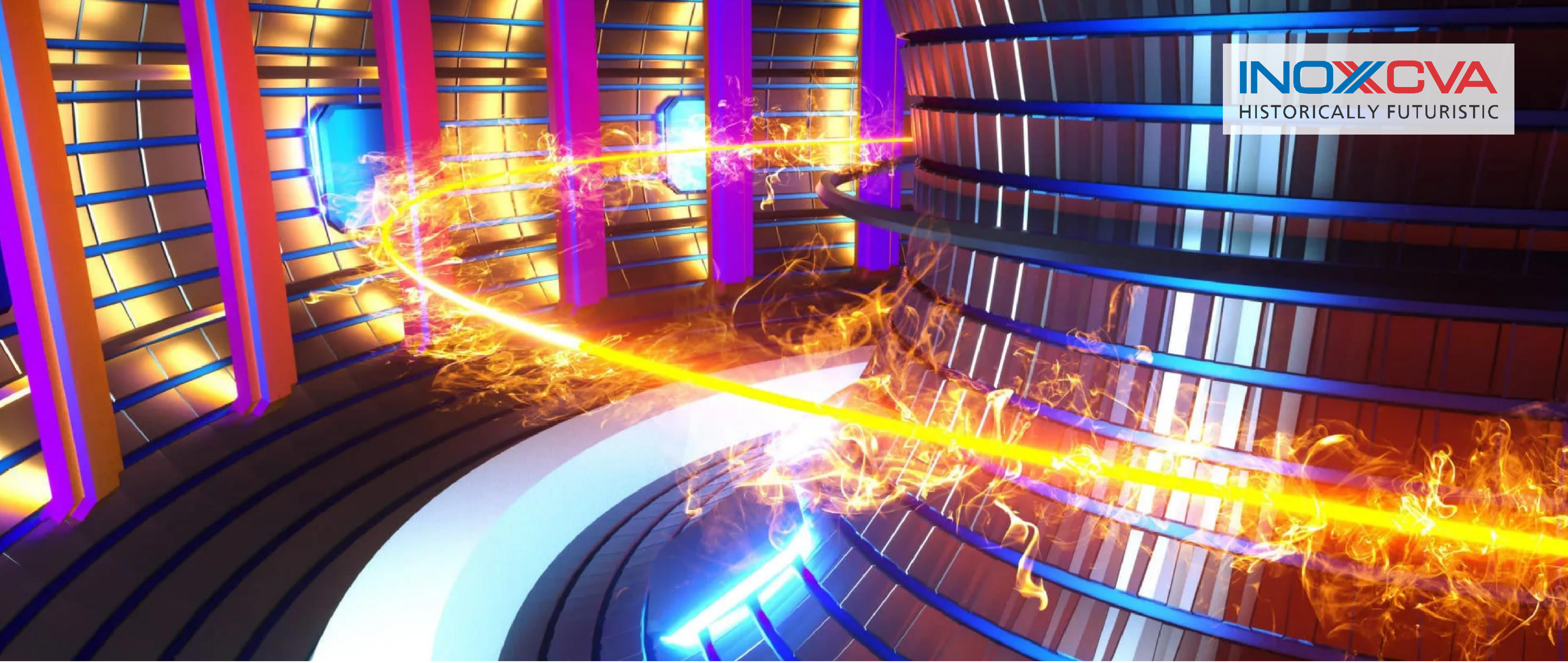
Drones equipped with sensors & AI tools to identify risk prior to the accident.

<u>Advantages</u>

- Remote and detailed aerial inspections, real-time site monitoring and more accurate documentation by reducing human intervention & entry to hazardous area.
- Transmit aerial real time views and support visual storage.
- Site surveying and topography mapping like detecting unstable terrains, pits, marshes and flooded areas without risk of personal entry.

Thank You!

Stay Safe!!



Recent Trends in Occupational Health and Safety Management

Sanjaykumar Gajera

INOXCVA: An Overview

- Established in 1992, a privately held company with consistent profitable business, backed by the INOX group
- With operation in India, Brazil & Europe, and service support associates across the globe, INOXCVA offers the widest range of products across the cryogenic value chain, ensuring top quality, performance & timely delivery
- Leading in market share in India for industrial gas storage and distribution as well as LNG end-to-end solution
- Only Indian company providing cryogenic research equipment to the global scientific research projects
- Working continuously towards Clean Energy initiatives in LNG, Liquid Hydrogen & Fusion Energy

Industrial Gas

LNG

Cryo-Scientific

INOX: A True-blue Indian Multinational

Designed, Engineered and Made In India

Making For The World

5000+ customers across 100+ countries

3 countries with INOXCVA operations

30 sales & service support locations

100 countries accomodating INOXCVA clients

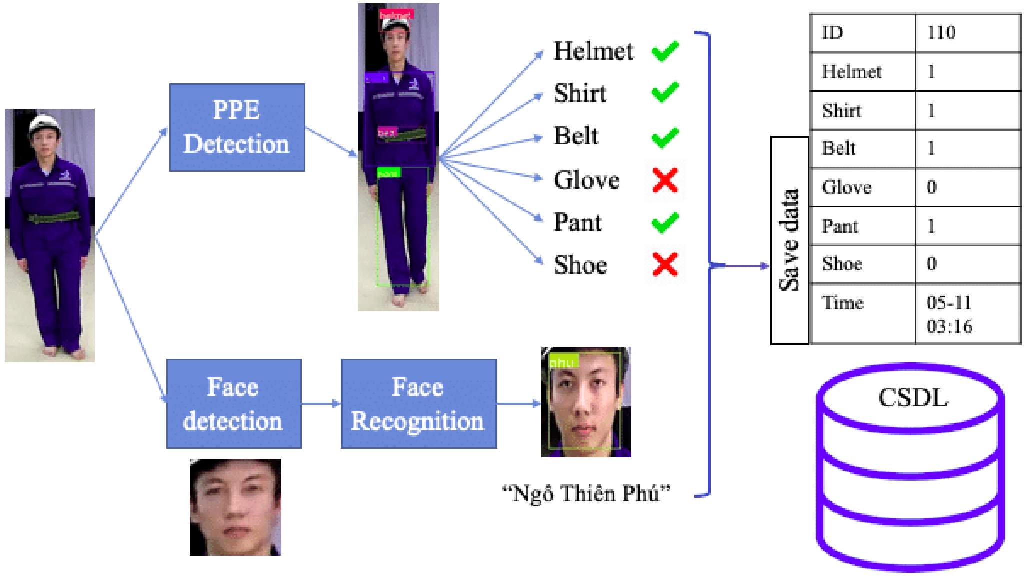
● Sales & Service Support ★ INOXCVA Operations ◆ INOXCVA Customers

Contents

Predictive risk management – Data driven safety programs and real-time analytics

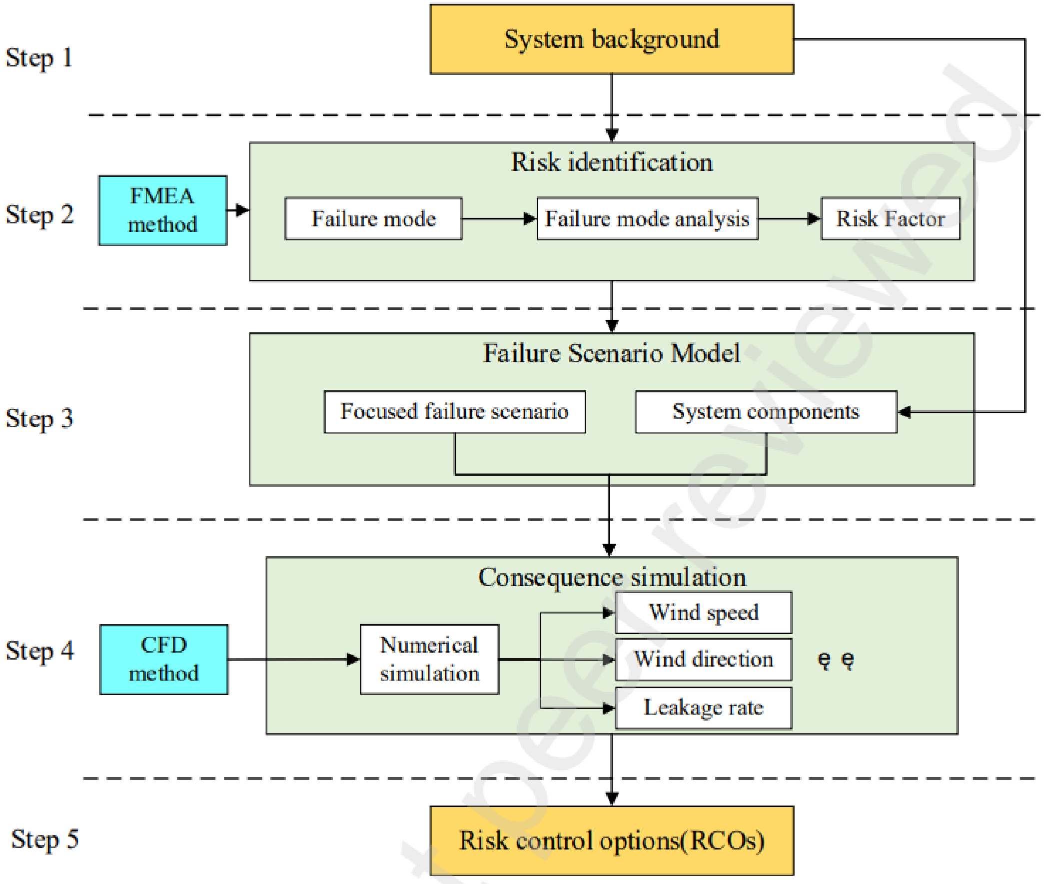
- AI analyzes historical and live data from multiple sources (equipment health, environmental conditions, worker behavior) to forecast risks—allowing HSE teams to anticipate and prevent accidents before they happen. Predictive models highlight “red zones” and patterns leading to incidents.

- Advanced computer vision detects PPE usage, unsafe behaviors, and hazards such as unstable scaffolding or missing barricades, issuing immediate alerts for breaches, thus reinforcing compliance and injury prevention. E.g. Road traffic management & Vehicle speed control



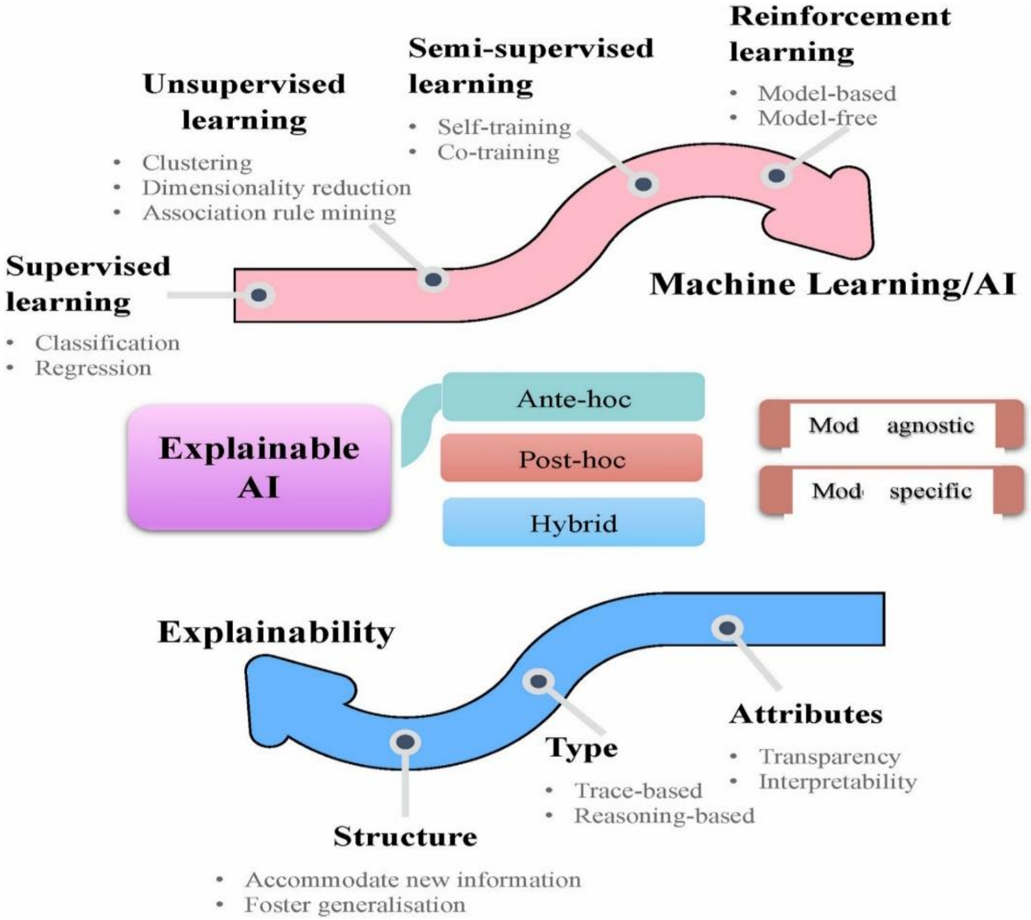
Predictive risk assessment for cryogenic leaks

- New frameworks utilize AI and advanced analytics to forecast leakage and accident risks in offshore LNG (liquefied natural gas) transfer systems.
- These models evaluate leak probabilities, simulate emergency scenarios, and guide the development of rapid response plans—enabling much faster and more accurate risk mitigation for cryogenic operations
- Systems like Cryoguard employ real-time data analytics and machine learning to monitor cryogenic systems, achieving high (>90%) accuracy in identifying simulated and real-world hazard scenarios before incidents occur.
- Early warnings from these platforms support rapid corrective actions, reducing severe incident rates in cryogenic environments.



AI-Powered risk assessment and incident forecasting

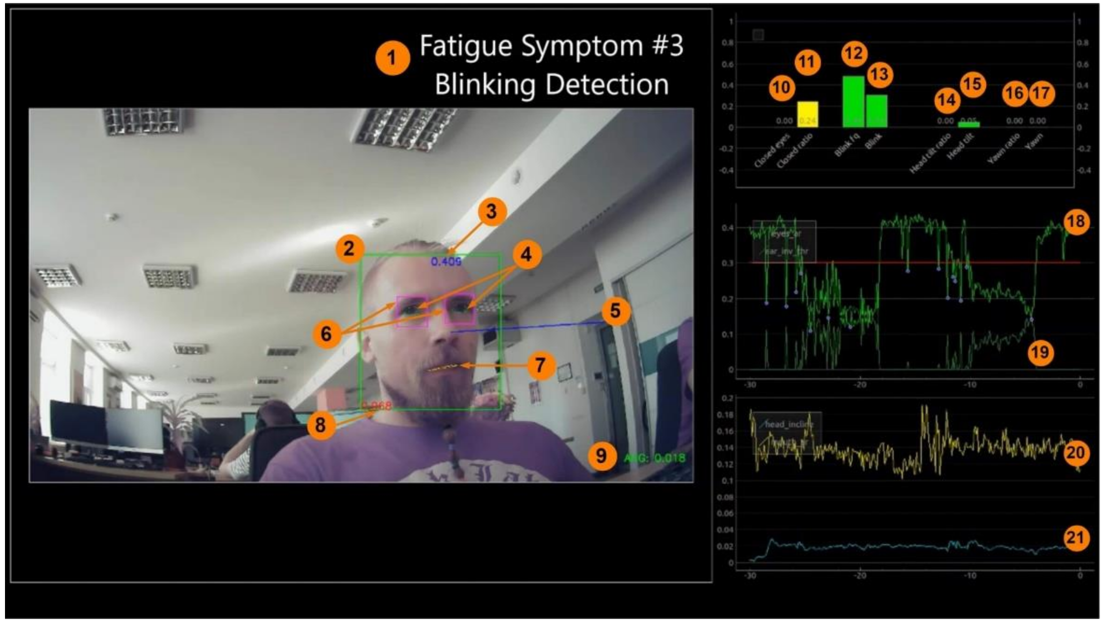
- Apply machine learning to analyze years of incident data for predictive risk modeling.
- Allocate preventive resources based on AI-generated risk scores for specific locations or processes.
- Automate safety compliance checks using AI-enabled solutions for faster response.

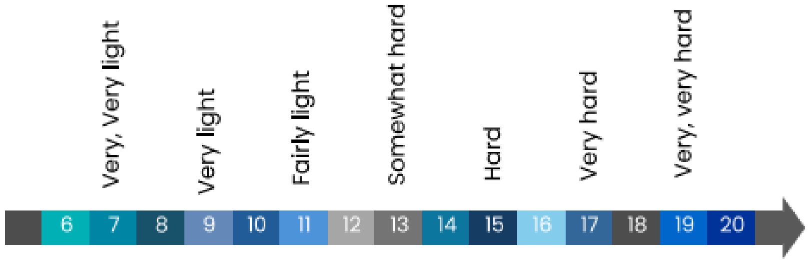


AI Powered -Wearable safety technology for monitoring

- Equip workers with smart helmets that detect fatigue and hazardous exposure levels.

- Prospects such as multi-sensor fusion for more accurate fatigue predictions, transfer learning for broader model applicability, integration with safety intervention systems and alerts, and the development of ethical, privacy-preserving frameworks to encourage widespread industrial adoption. Standardized benchmarking and regulatory alignment are advocated to support sustainable, equitable use of AI-driven fatigue monitoring.

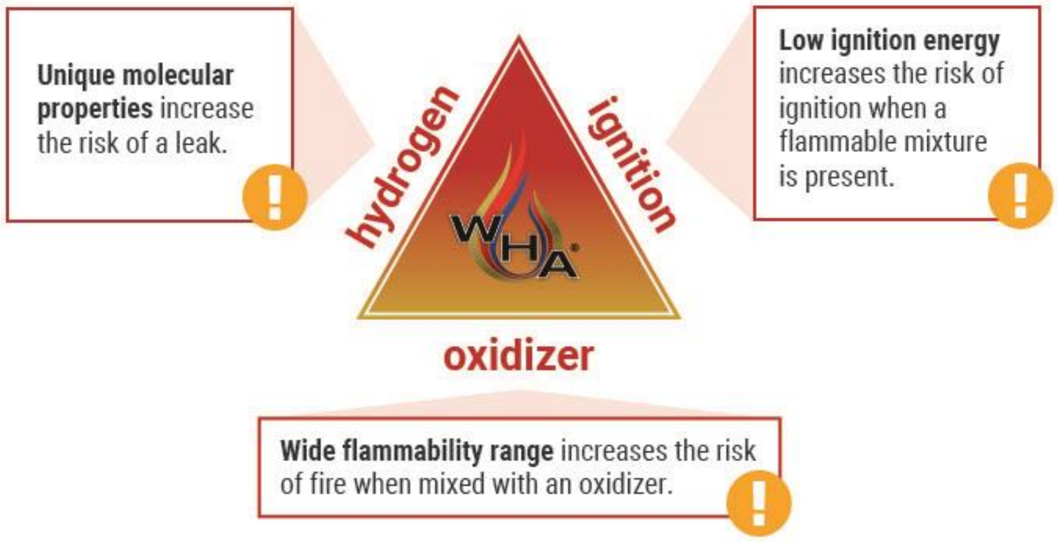


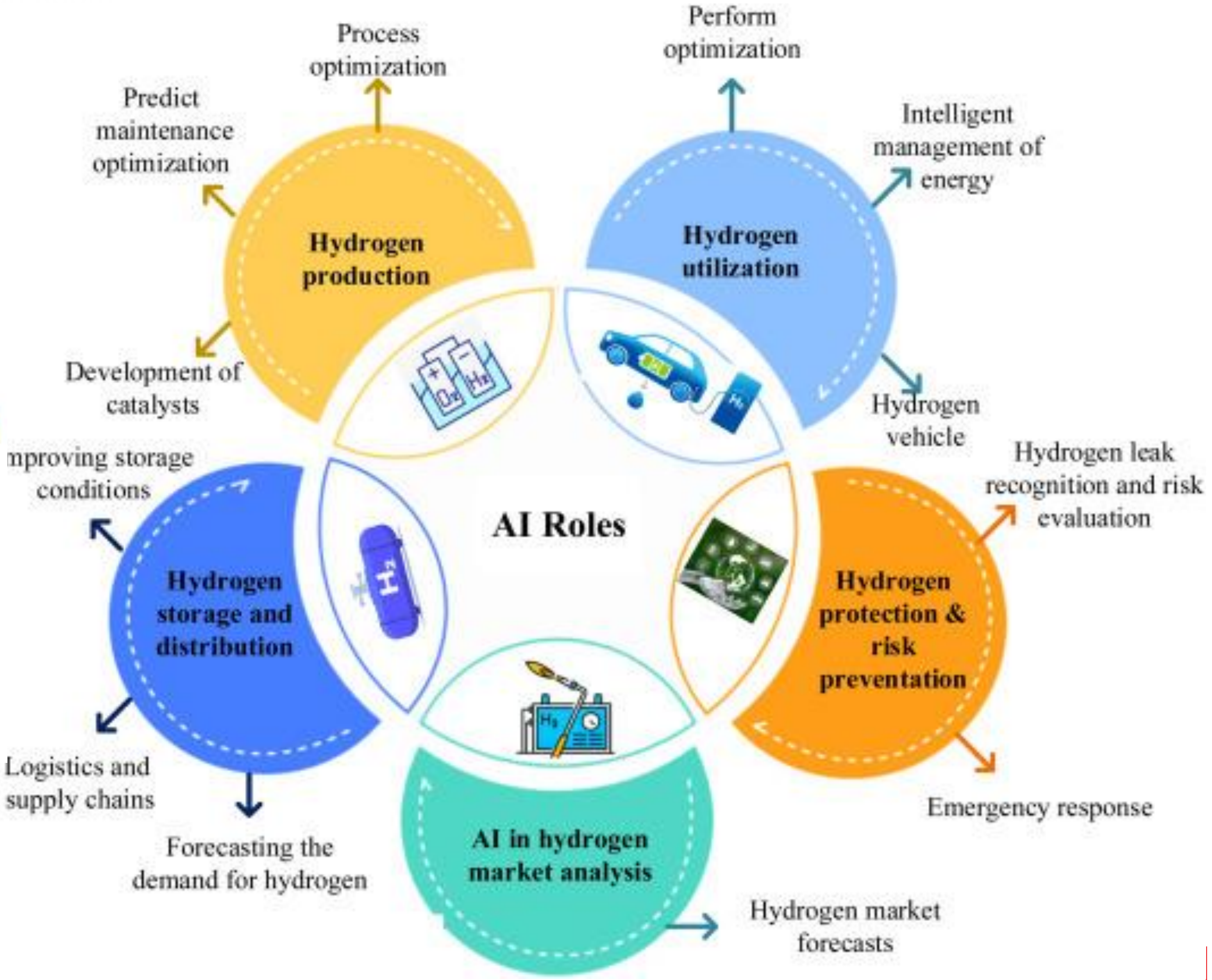


Borg Score	Classification
6 – 9 (60bps)	Low
10 – 13	Moderate
14 – 17	High
18 – 20 (200bps)	Very High

Data driven Safety for hazardous cryogen handling

- Innovative applications of AI and random models can predict the consequences of liquid hydrogen, including oxygen phase changes and explosive potentials, supporting rapid emergency decision-making in cryogenic safety. similarly, LNG applications can be controlled.





Mental health and psychological safety – Core program elements

- Recent research strongly supports programs that go beyond reducing risks and treating mental ill-health, advocating holistic approaches that proactively promote well-being, resilience, and supportive work cultures for all employees.

- Leading frameworks emphasize the “3 Ps”: Protection from psychosocial hazards, Promotion of psychological well-being, and Provision of resources and support for mental health needs.

- Best practices in 2025 include stress audits, regular assessment of psychosocial risks, targeted mental health first aid, and open reporting systems to flag hazards—yielding measurable reductions in absenteeism, turnover, and burnout.

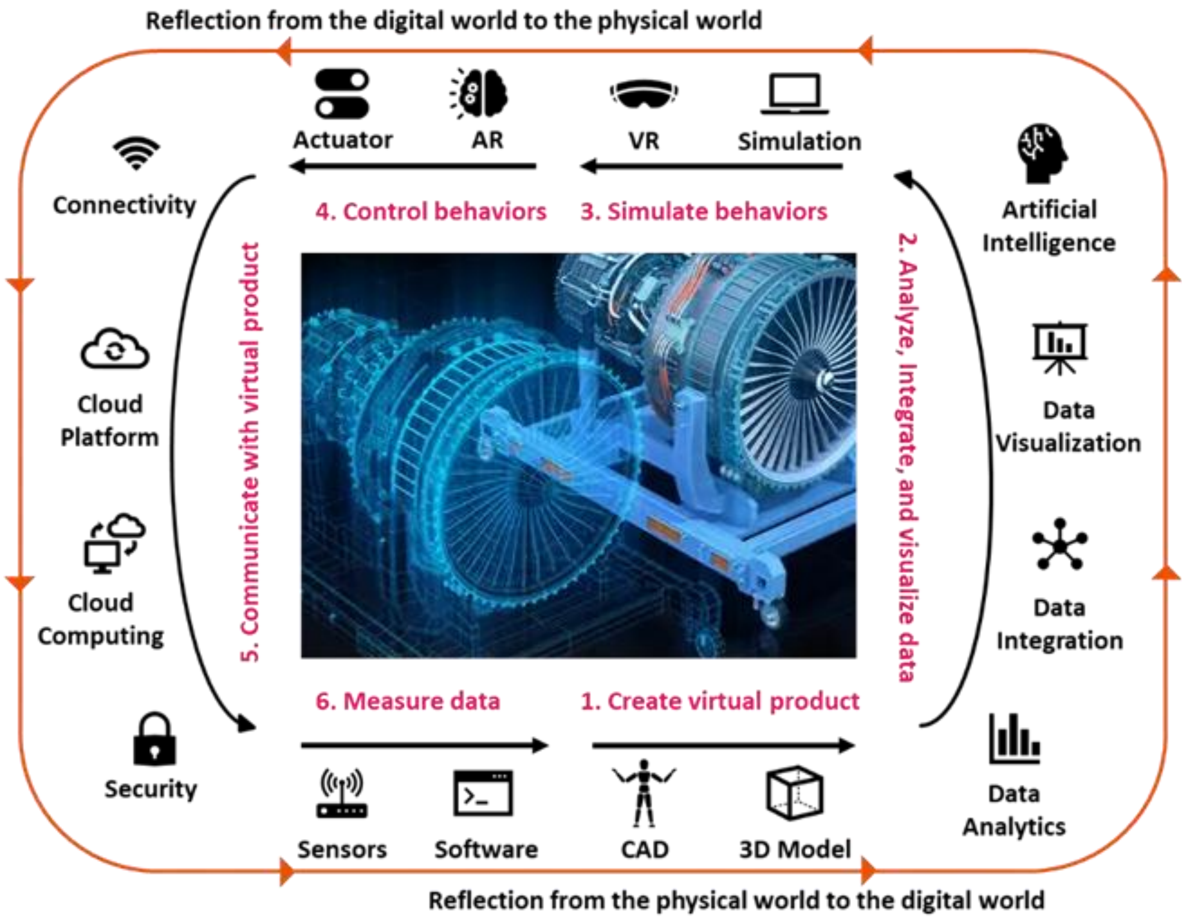
- Consensus highlights that psychologically safe teams report problems sooner, learn from mistakes, promote innovation, and maintain greater motivation, resilience, and health over time.

Digital twins for scenario simulation and safer process design

- Digital twins now enable dynamic, real-time safety insights in process industries by simulating and monitoring physical systems virtually, going beyond static assessments like HAZOP or LOPA.

- Recent advances in engineering, manufacturing, and facility planning show that digital twins support virtual prototyping, iterative design, and emergency drill simulations with full IOT data connectivity.

- Many platforms now integrate quantitative risk analysis(QRA), real-time environmental monitoring, and immersive AR/VR for operator training—rapidly establishing digital twins as a core safety tool in Industry 4.0 process design.



Adoption of VR/AR for immersive safety training

- VR-based safety training is rapidly scaling across industries (construction, manufacturing, oil & gas, emergency services) and is supported by robust performance analytics, enabling organizations to monitor trainee progress and customize programs.

- VR-based welder training provides a safe, cost-effective, and immersive environment for learners to repeatedly practice welding techniques, receive instant feedback, and build real-world skills—resulting in improved safety, skill acquisition, accessibility, and confidence compared to traditional training methods.

Cybersecurity risks in safety systems

- Safety-critical industrial systems (ICS, SCADA, and OT environments) are facing rising risks from advanced ransomware, AI-powered cyber-attacks, and targeted malware (like Triton/TRISIS, EKANS, INDUSTROYER/Crash Override) designed to disable safety instrumented systems or manipulate industrial process controls.

- The global encryption chip market is expanding rapidly—driven by the rise of connected devices, AI, data privacy mandates, demands from critical industries, and the shift to end-to-end encryption and zero-trust frameworks.

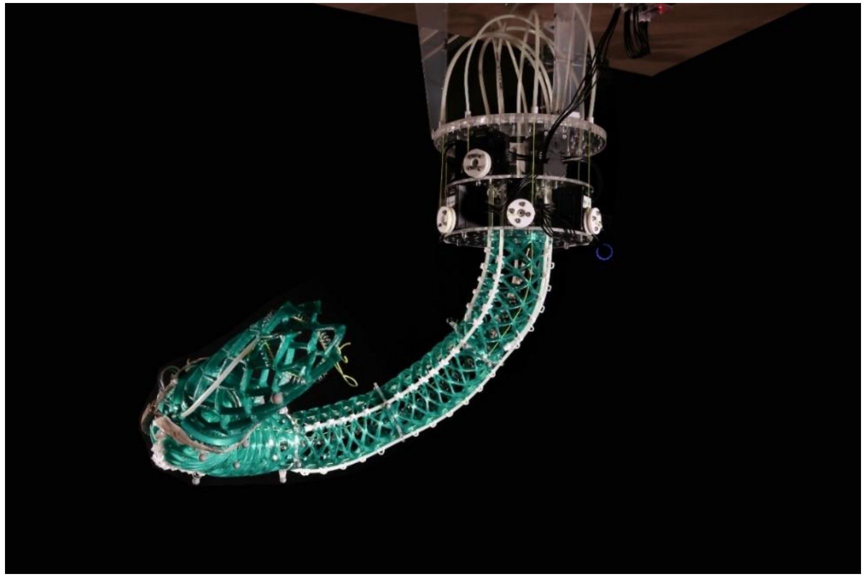
- Newest trends include energy-efficient chips for IOT/wearables, built-in cryptographic accelerators on SoCs, and specialized solutions for secure automotive, payment, and healthcare devices

Automation and robotics to reduce human exposure to hazards

- Enhanced Safety and Risk Mitigation: The primary driver is removing human workers from immediate danger—such as toxic, radioactive, or high-temperature zones—effectively eliminating exposure to extreme risks.

- Advanced Technological Capability: Robots are integrating AI, advanced sensors (LiDAR, thermal, gas detection), and autonomous navigation, allowing them to perform complex, data-rich inspections with high accuracy.

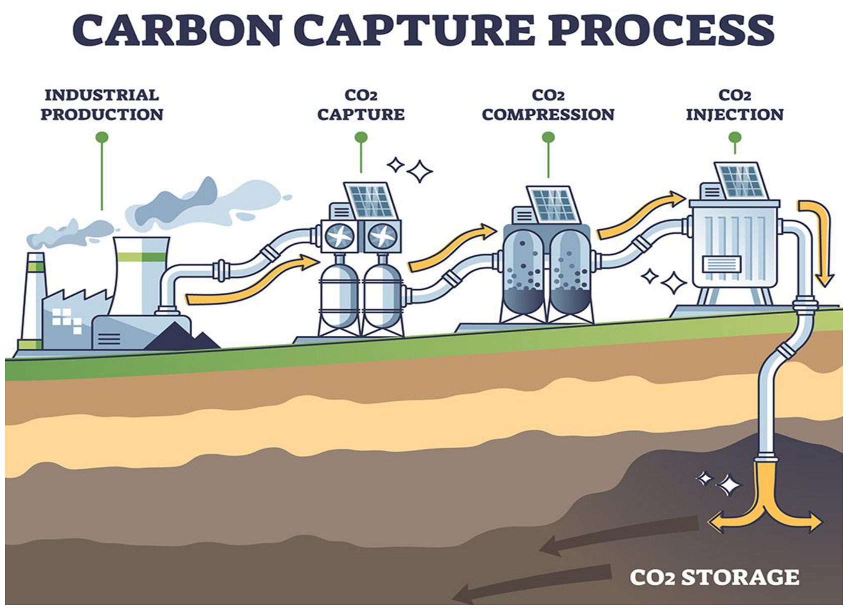
- Improved Operational Efficiency by designing them to be more flexible, fast and energy efficient: Beyond safety, robots enable 24/7 operations, reduce inspection times, lower costs associated with extensive human preparation (like scaffolding), and provide consistent data for proactive maintenance and better decision-making.



Understanding of Sustainability & ESG Reporting

- Recent studies emphasize adopting a holistic “One Health” approach that recognizes the interconnected impact of waste management practices on human, animal, and ecosystem health. This strategy integrates technical improvements (better segregation, waste burning) with policies, surveillance, and inter-sectoral collaboration to minimize occupational risks for waste workers and prevent disease transmission and environmental contamination.

- Leading practices highlight the harmonization of global ESG and sustainability standards (GRI, SASB, ISSB) to support comparability and responsible innovation. The focus is expanding to include biodiversity, circular economy practices, supply chain safety, and social impact, while digital health sectors demonstrate the value of secure, resilient, and patient-centered risk management for system reliability and stakeholder trust.

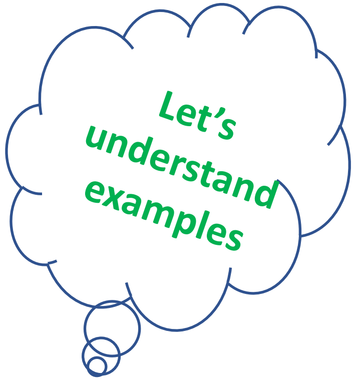


Understanding of Sustainability & ESG Reporting

- INOX India identifies most relevant ESG issues to guide its sustainability efforts. INOX emphasizing hazard identification, risk assessments and employee training certified with international standards ISO 14001:2015 & ISO 45001:2018 for the environment and occupational health and safety management.

- INOX has initiated online platform based on real health data assessment to improve health of employee suggesting dynamic inputs for health to each employee regularly.

- INOX striving through sustainability initiatives by implementing 1.68 MW windmill and 1.2 MW solar roof top system at Kalol plant to reduce carbon foot print and promoting renewable energy sources.



Infrastructure Sustainability

- The INOX Plant design focuses on energy efficiency and sustainability by utilizing solar energy, high-efficiency insulated glass windows, and a rainwater harvesting system.

- Innovative structural practices include using Ground Granulated Blast Furnace Slag (GGBS) to minimize cement usage, employing non-toxic paints for better indoor air quality, and utilizing Rockwool insulation with reflective sheets to regulate indoor temperatures.

- Additional features include motion sensors, high-efficiency air conditioning, LED lighting, and eco-friendly sewage drains for storm water management, enhancing both functionality and aesthetics.

Systematic multi-layered approach on safety

- Gas stations are equipped with advanced level and pressure measurement systems (both analog and digital) and temperature sensors (to detect fire or spillage).
- Continuous remote monitoring with SCADA/PLC screens is essential to track pressure, temperature, and flow parameters.
- Spool valves can be operated remotely to close all Emergency Shutdown (ESD) switches during an emergency.
- In addition, emergency push buttons and alarm systems are installed for rapid incident response.

Thank you

INOXCVA®
HISTORICALLY FUTURISTIC

30 YEARS OF EXCELLENCE
INOX

Fostering Safety Culture with an Effective Safety Management System

S. S. Prasad
Outstanding Scientist
Head, Industrial Hygiene & Safety Section
BARC Safety Council
BARC, Trombay – 400 085

Overview of the Talk

- What is Safety Culture?
- Origin of the term
- Why is Safety Culture Important?
- IAEA guidance- Assessment instruments
- IHSS, BSC Activities to Enhance Safety Culture

Culture

Definition of Culture –

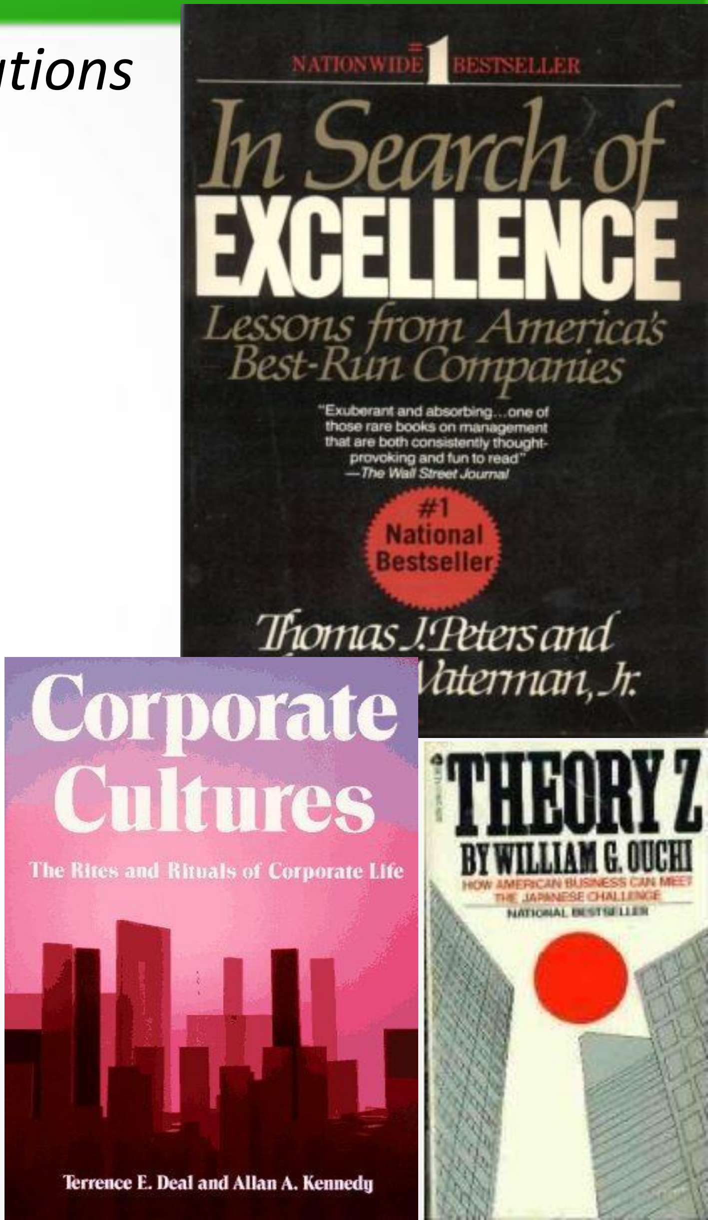
- *the beliefs, way of life, art, and customs that are shared and accepted by people in a particular society.*
- *the attitudes and beliefs about something that are shared by a particular group of people or in a particular organisation.*

The 1980's organizational culture theories

Focus on VALUES, ATTITUDES, and BELIEFS of members

Attempts to explain behavior *within organizations*

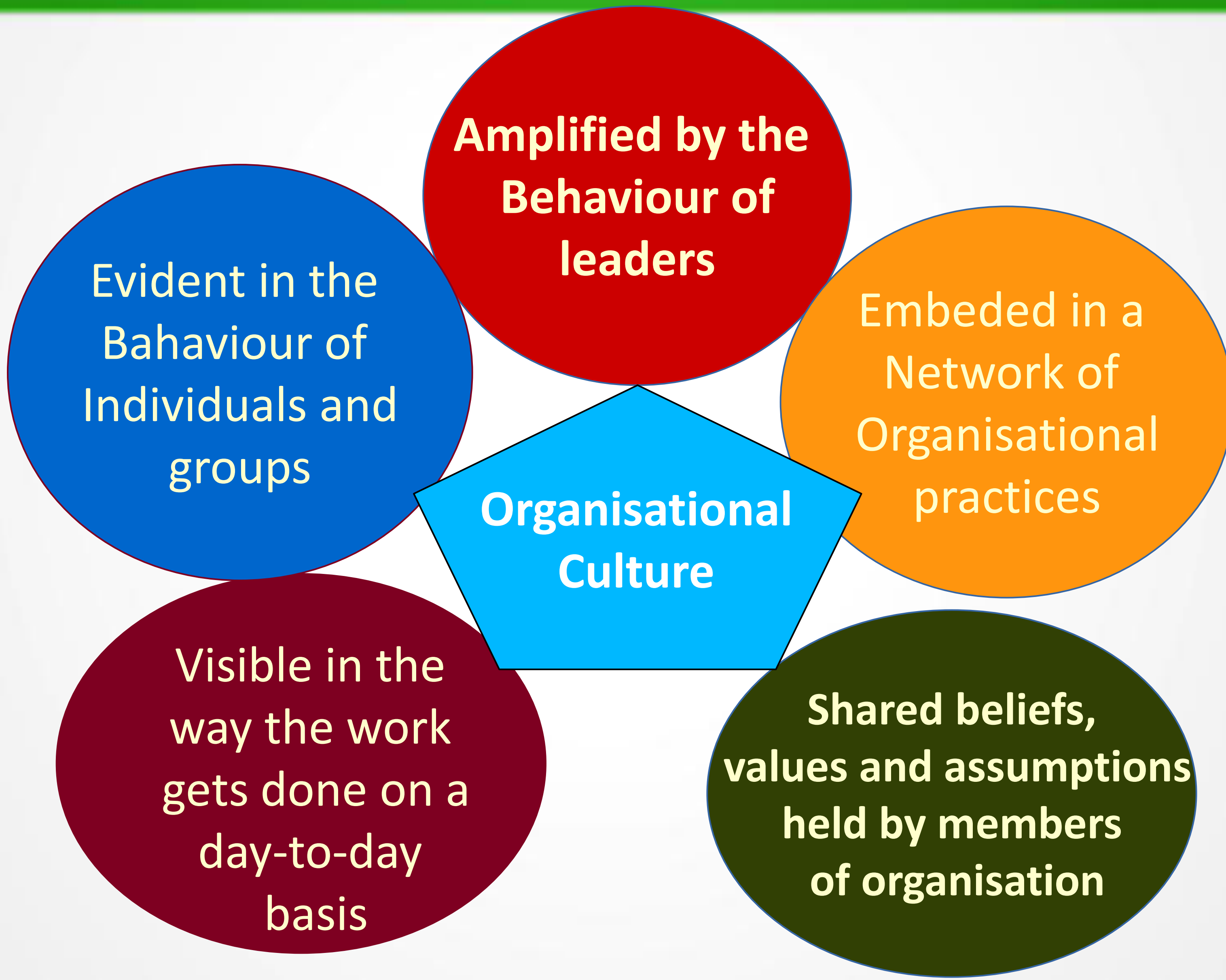
- For the first time Culture was used to explain why some companies were more successful than others.
- Companies did of course have cultures before this but now culture was considered a source of success.
- The importance of a strong and homogeneous culture was Emphasised
- Management's role was considered extremely important
- Culture is something to manage and control…..in order to reach 'excellence'...



Organisational Culture

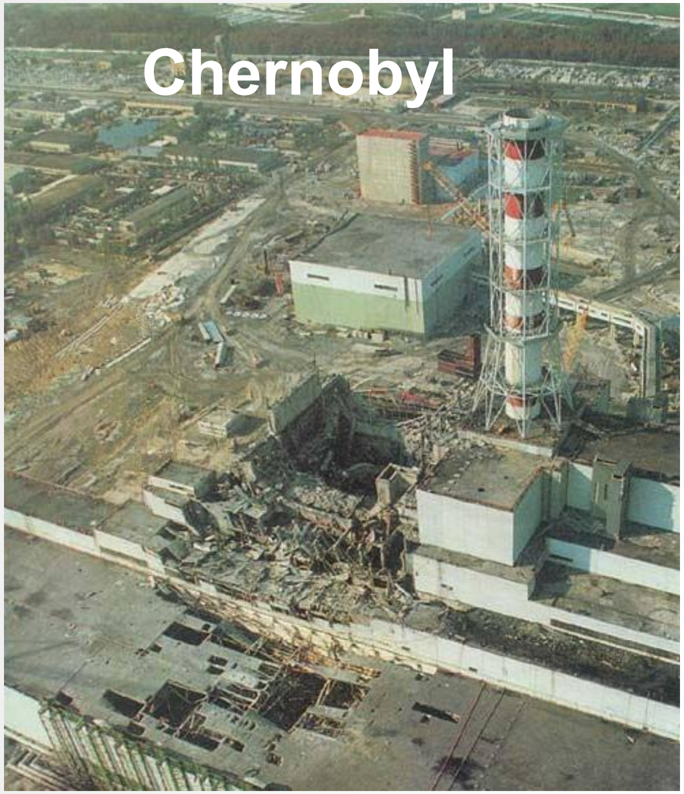
Organisational Culture is a communicatively constructed, historically based system of assumptions, values, and interpretive framework that guide and constrain organizational members as they perform their organizational roles and confront the challenges of their environment.

Organisational Culture



Safety Culture- Origin of the term.....

Penalty for fall in Safety Culture



From the aftermath, at IAEA - 1986

INSAG-1 – The Chernobyl Accident

*"A vital conclusion drawn from this behaviour is the importance of placing complete authority and responsibility for the safety of the plant on a senior member of the operations staff of the plant. Of equal importance, formal procedures must be properly reviewed and approved must be supplemented by the creation and maintenance of a "**nuclear safety culture**".*

The concept of the safety culture was formally introduced through INSAG-1 (1986) in the area of nuclear safety.

What is Safety Culture?

INSAG- 4

Safety Culture is the assembly of systems, characteristics, mindset and attitudes at the organizational and individual levels which assures that:

(a) as an overriding priority, nuclear safety issues receive the attention warranted by their significance; and

(b) **adequate resources**, information and actionable knowledge are **empowered at the decision / action points where safety issues are dealt with**.

Literal Meaning of Safety Culture

"a safety culture is an organisational atmosphere where safety and health is understood to be, and is accepted as, a high priority".

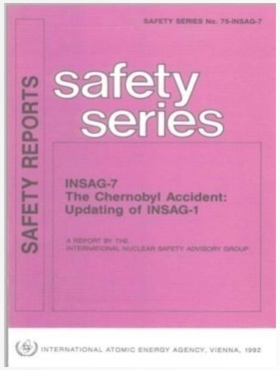
- **Safety culture is the extent to which safety is emphasized, both formally and informally, by an organization and its members.**

A positive safety culture is to encourage the development of values and behaviors that support the safe and secure use of nuclear materials.

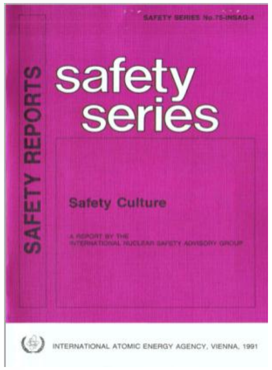
Safety Culture includes:

- Individual and collective commitment to safety on the part of the leadership, the management and personnel at all levels;
- Accountability of organizations and of individuals at all levels for Safety;
- Measures to encourage a questioning and learning attitude and to discourage complacency with regards to safety.
- Developing Leadership and management for safety.

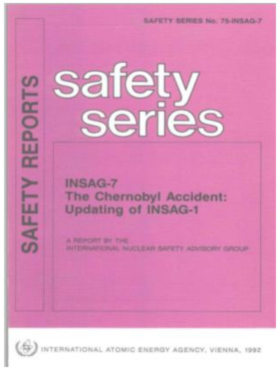
Subsequent IAEA Guidance – during the 90's



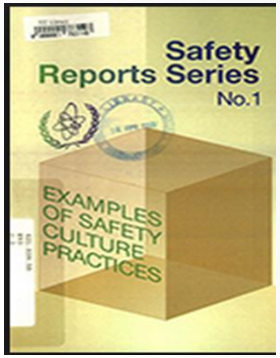
IAEA INSAG 1
1986



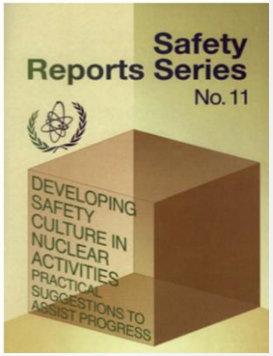
IAEA INSAG 4
1991



IAEA INSAG 7
1992



IAEA SRS 1
1998



IAEA SRS 11
1998

A definition-

*"Safety Culture is that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an **overriding priority, nuclear plant safety issues** receives the attention warranted by their significance".*

Aftermath of Chernobyl Accident-
National Responsibilities

Organizational Culture

- **Equipments**
- **Systems**
- **Procedures**
- **Controls**
- **Management**
- **People**

A socio-technical system

The subsequent publications of IAEA emphasized on Capacity building and Safety Culture

Post-Fukushima Activities –
Strengthening of Nuclear Safety

IAEA Ministerial Conference on Nuclear Safety Vienna, 20-24 June 2011

Chairpersons' Summaries

15. In spite of all recent efforts there is still room for improvement in understanding the concept of safety culture and implementing it effectively worldwide in the management of all NPPs.

2nd Extraordinary Meeting of the Contracting Parties to the Convention of Nuclear Safety

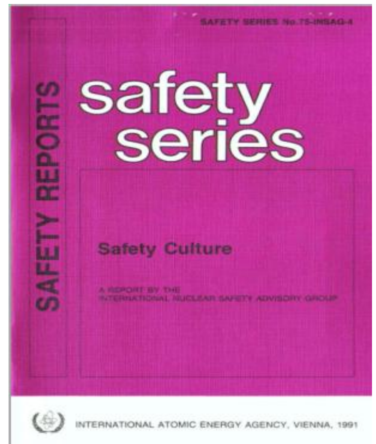
27-31 August 2012, Vienna, Austria

Issues to be considered:

- Safety culture and human and organizational factors were identified as crosscutting issues, which affect the consideration of external events, design, severe accident management, including operator training, the good functioning of national organizations and emergency preparedness and response.

IAEA Documents on Safety Culture

IAEA SRS 74 2012



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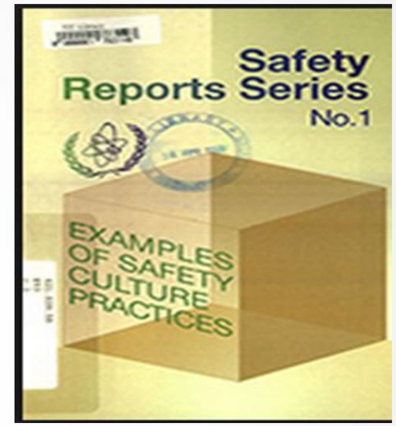

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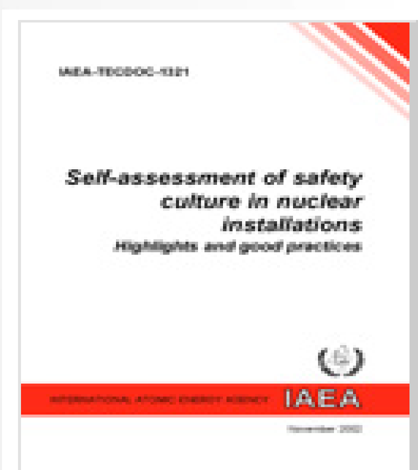
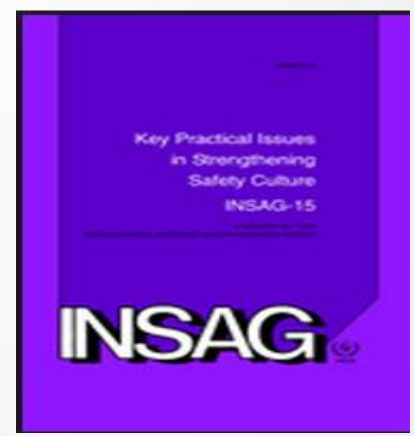


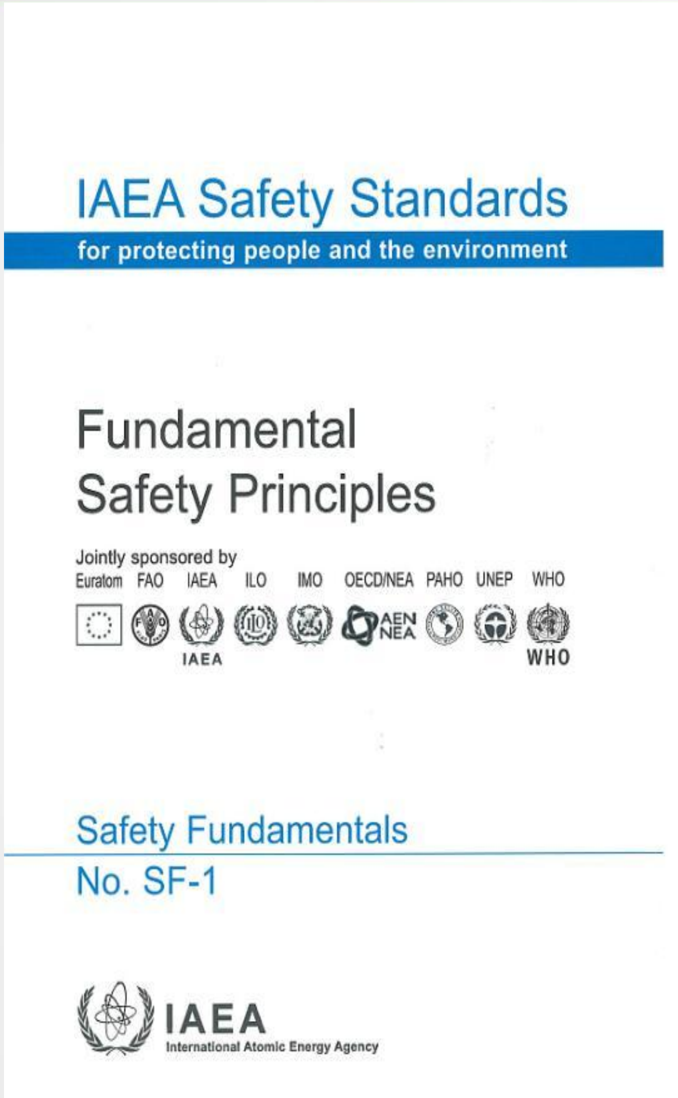
IAEA TECDOC 1321 2002

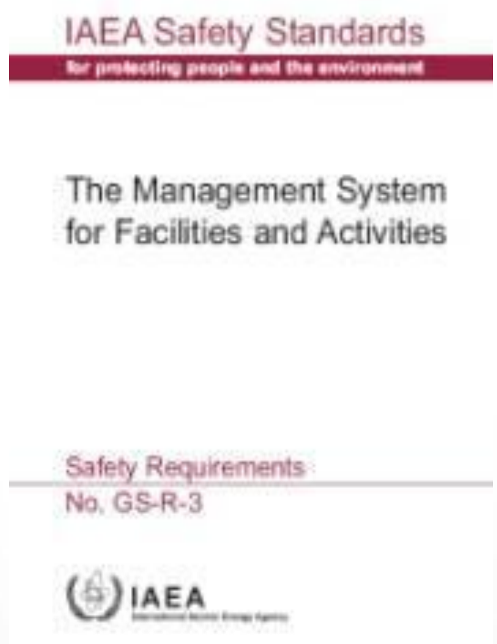
IAEA TECDOC 1707
2013

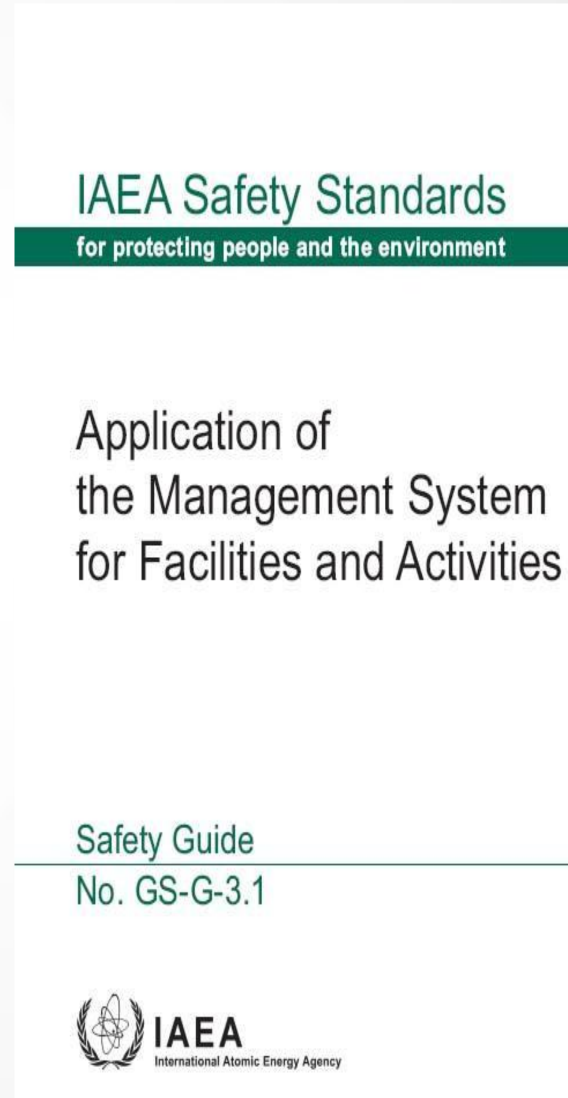


INSAG Series 15 2002

Global Reference for a High Level Of Nuclear Safety







IAEA Publications- Safety Culture

Document	Title
Safety Fundamentals No. SF-1	Fundamental Safety Principles
Safety Requirements No. GS-R-3	The Management System for Facilities and Activities
Safety Guide No. GS-G-3.1	Application of the Management System for Facilities and Activities
Safety Guide No. GS-G-3.5	The Management System for Nuclear Installations
Safety Series No. 75-INSAG-4	Safety Culture
Safety Series No. 75-INSAG-15	Key Practical Issues in Strengthening Safety Culture
Safety Report Series No. 11	Developing Safety Culture in Nuclear Activities
Safety Report Series No. 42	Safety Culture in the Maintenance of Nuclear Power Plants
Safety Report Series:	Safety Culture during Pre-Operational Phases
Safety Report Series:	How to Perform Safety Culture Self-Assessment - draft
Safety Report Series:	How to Continuously Improve Safety Culture - draft
TECDOC-1321	Self-assessment of safety culture in nuclear installations
TECDOC-1329	Safety culture in nuclear installations
TECDOC: 1707	Regulatory Oversight Of Safety Culture In Nuclear Installations

Why is Safety Culture Important?

- Operating experience has demonstrated nexus between safety culture and events - Safety culture affects safety performance
  - injury rates/accident rates

- Safety culture contributes to the safe and secure use of radioactive materials

  Results are supported across other industries
  - aerospace, healthcare, manufacturing, construction, agriculture, off-shore oil and gas, highway safety, aviation.

- BSC recognizes that licensees bear the primary responsibility for the safe and secure use of nuclear materials, while the BSC, as the regulator, must consider the importance of safety culture in its oversight programs

Benefits of Strong Safety Culture

- Safe work environment
- Improved morale through employee involvement
- More responsible and accountable employees
- Lesser events/ incidents
- Better productivity

IAEA - (GS-G-3.1) –
Safety Culture Characteristics and Attributes

Safety Culture Indicator

- General Attitudes to Regulations
- Safety Objectives and Responsibilities
- Impact of Regulators/ Response
- Organisation- Regulator interface
- Level of competence
- Exercise
- Incident reporting (including LLEs & NMs)
- Root Cause Analysis
- Compliance with safety recommendations
- Compliance with Surveillance schedule
- Performance Feedback
- Self assessment and improvement
- Number of LSC meetings
- Training and certification of staff
- Retraining/ Refresher Training
- Adherence to Procedures
- Revision of Safety Documents and Procedures
- Formal arrangement to get latest information about safety

What makes a good Safety Culture

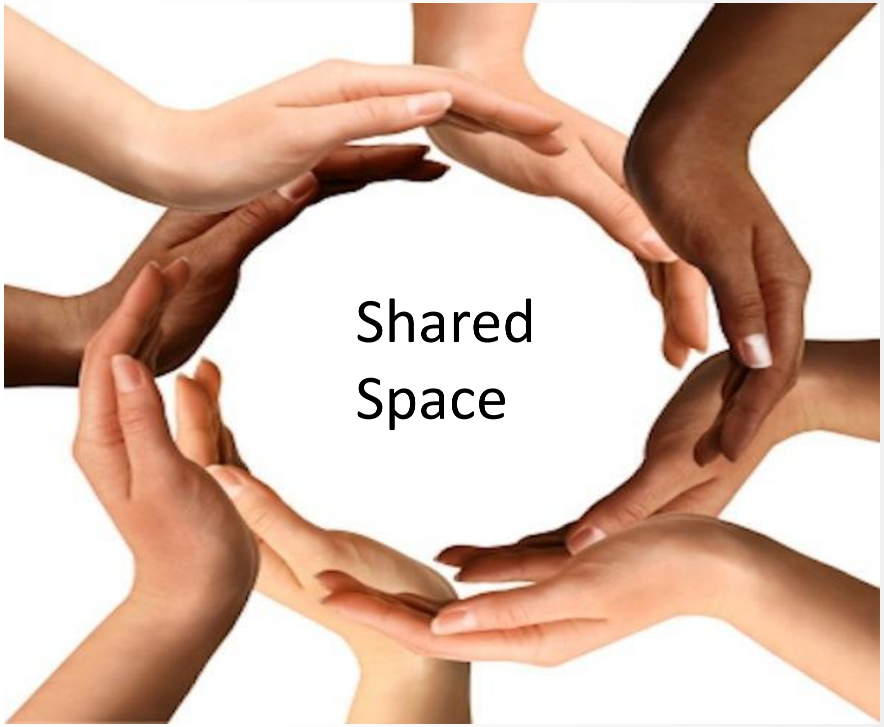
- Commitment at all levels
- Continuous improvement processes
- Training and information for all
- A system for workplace analysis, hazard prevention and control is in place.
- The environment is blame free.

Components of Safety Climate

- Importance of safety training
- Management attitudes towards safety
- Effects of safe conduct on promotion
- Level of environmental risk
- Effects of work pace on safety
- Status of the safety officer
- Effects of safe conduct on social status
- Status of the safety committee

Safety Culture- A Practical Perspective

- The **formation of shared understanding** is a significant component of safety culture enhancement
- Power dynamics can undermine motivation
- Shared space that recognizes, respects, includes, supports organizational learning
- Openness – free flow in sharing of thoughts and ideas



Ultimate goal of shared space

IAEA Recommendation-
Leadership and Management for Safety

- Safety has to be achieved and maintained by means of an effective management system.
- The management system has to ensure the promotion of a strong safety culture...”
- An important factor in a management system is the recognition of the entire range of interactions of individuals at all levels with technology and with organizations.
- Safety shall never be compromised by other requirement or demands.

“A safety culture that governs the attitudes and behaviour in relation to safety of all organizations and individuals concerned must be integrated in the management system.

IAEA Recommendation- Safety (Culture) Requirement GS-R-3

"The management system shall be used to promote and support a strong safety culture by:

- Ensuring a common understanding of the key aspects of safety culture within the organization;
- Providing the means by which the organization supports individuals and teams in carrying out their tasks safely and successfully, taking into account the interaction between individuals, technology and the organization;
- Reinforcing a learning and questioning attitude at all levels of the organization;
- Providing the means by which the organization continually seeks to develop and improve its safety culture."

Safety Management System (SMS)

- A structured framework designed to identify hazards, assess risks, and control safety issues.
- It ensures systematic identification and mitigation of safety risks.

Key Components of SMS

- ❑ *Policy development*
- ❑ *Risk assessment and management*
- ❑ *Safety performance monitoring*
- ❑ *Continuous improvement*

Link Between Safety Culture and SMS

- ❖ **Culture drives behavior:** *A positive safety culture influences how employees follow the guidelines set by an SMS.*
- ❖ **SMS strengthens culture:** *An effective SMS provides the tools, processes, and structure necessary to embed safety into everyday operations.*
- ❖ **Symbiotic relationship:** *Both reinforce and support each other.*

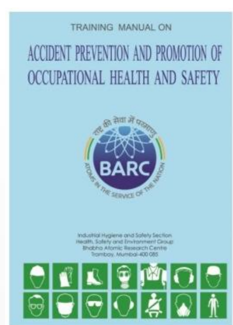
Proactive *vs.* Reactive Safety Management System

Proactive Safety Management

Preventing accidents and hazards before they occur.

- **Hazard Identification**
  - *Workplace Monitoring*
  - *Safety Inspections*

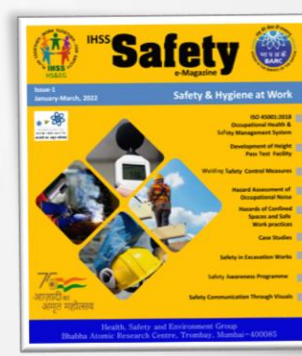
- **Risk Assessments**
  - *HAZOP, FTA, ETA*
  - *Health Monitoring*
- **Safety Training**
- **Safety Promotional Activities**
- **Safety Performance Monitoring**



Reactive Safety Management

Responding to accidents and incidents after they happen.

- **Reporting of Incidents**
- **Incident Investigation**
- **Corrective Actions & Compliance**



Key Elements of an Effective SMS

❑ **Leadership Commitment**:

Top management must lead by example and be actively involved in safety programs.

❑ **Clear Safety Policies**:

Establish clear and concise safety protocols.

❑ **Employee Involvement**:

Engaging employees in safety programs helps to strengthen the culture.

❑ **Continuous Training**:

Regular, up-to-date safety training.

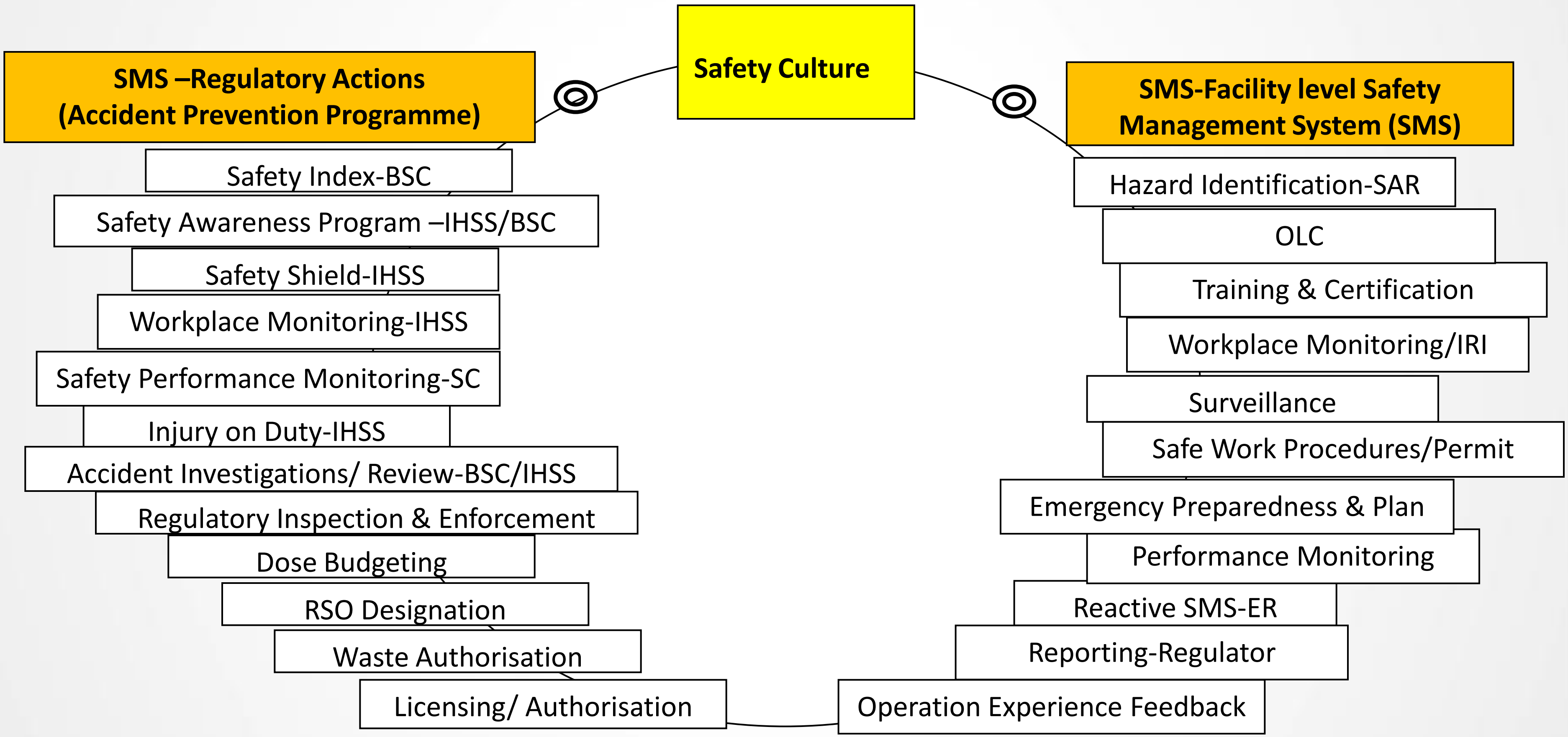
❑ **Incident Reporting and Investigation**:

Ensure a system for reporting and addressing safety issues.

WHAT can SMS do ?

- Inspire all employees to achieve high safety performance
- Empower employees to make decisions and seek improvements
- Reward employees based on individual and group performance
- Create a challenging but satisfying work environment
- Follow a clear set of values

Overview of the SMS



CONCLUSION...

- Concept of safety culture is evolving across industries.
- Safety Climate is something that can be measured.
- Focus on the areas of weakness identified through evaluation can address issues.
- A defined safety management system can help guide activities of continuous improvement
- BSC is continuing education and outreach efforts on this topic.


A well-designed organization is not a stable solution to achieve, but a developmental process to keep active.

Safety Culture

A Continuous Journey

Thank You...

Health and Safety Aspects in Auxiliary Systems of Future Fusion Reactors

Venkat N. Ramani

Aditya High Vacuum Pvt Ltd
218-219 GIDC Kathwada, Ahmedabad 382430, Gujarat.

AUXILIARY SYSTEMS OF FUSION REACTORS

1) TRITIUM PROCESSING, TRITIUM BREEDING BLANKETS, TRITIUM RECOVERY, DETRITIATION, TRITIATED WASTE HANDLING, VACUUM EXHAUST HANDLING, ...

2) FIRST WALL, DIAGNOSTICS, PLASMA HEATING SYSTEM, VACUUM PUMPING, REFRIGERNATION, WATER COOLING, PLASMA CONTROL SYSTEM INCLUDING MAGNET COILS, ...

DT fusion reactor (Ignition and continuous burning)

$D + T = 3He\ (3.7MeV) + n\ (14MeV)$

PHYSICAL CONTAINMENT &

SAFE CONFINEMENT OF TRITIUM

FURTHER TRITIUM ASPECTS

* Easy isotopic exchange reactions of tritium with hydrogen in water and hydro-carbons
* Safe confinement of contaminated parts
* Production of hazardous inorganic tritium
* Contamination by permeation and leakage
* Multi step contamination

Difficulty of extrapolation of limited experience and understanding

GENERAL FUSION SAFETY ISSUES

Operational safety issues are mostly owing to Tritium and neutron activated materials

The Fusion Process is inherently safe

–No chain reaction

–Reaction is thermally self-limiting

–Limited to a few second burn without re-fueling

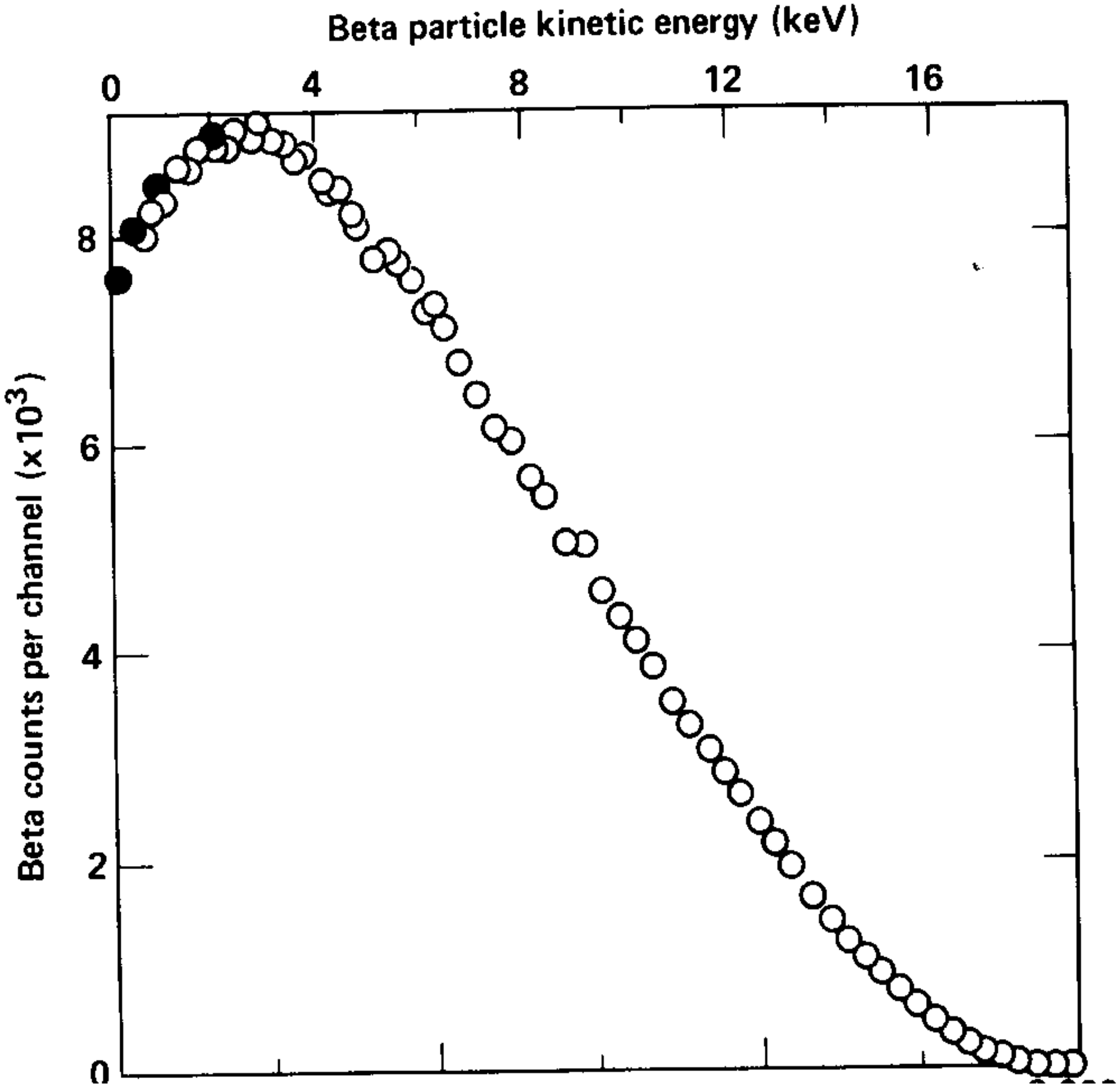
–Power/energy densities in the reactor and plasma are low

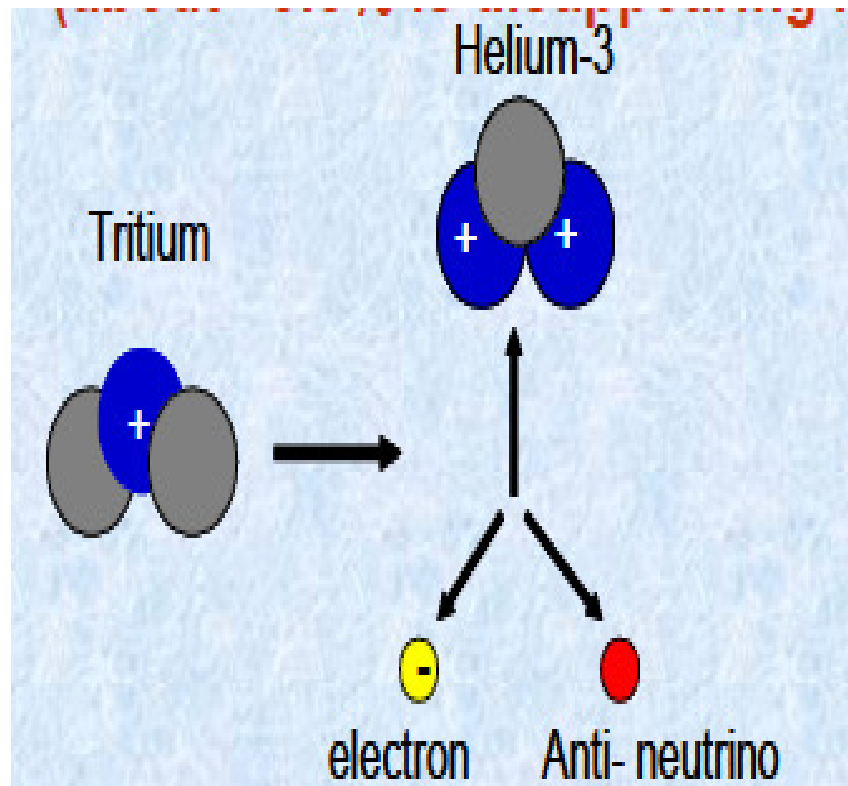
–Reaction products

- Helium (totally inert)

From the point of view of non-operational safety issues like- Man-made disasters, Fire, Air crash, Bombing, Terror attack, etc. also, Tritium radiation and Tritium contaminated materials remain the major issue.

TRITIUM AND ITS DECAY





Half life t1/2= 12.323 $\mp$0.004 years (about ~5.5% is disappearing in a year)

TRITIUM RADIATION - CONCERN

Maximum range of electron in Air : 6mm; in Metals ≤ 1mm
Shielding of tritium radiation is not an issue;
Direct exposure of organs need attention, however.
Electrons emitted to neighboring molecules would enhance some chemical reactions.
Effect of self irradiation would appear only at very high concentrations.
Decay heat of ~ 324 mW/1g could enhance T release from solid

Tritium is chemically very active and react with most of impurities, in particular water and hydrocarbon molecules, in air to make more hazardous.

TRITIUM
CONTAMINATION AND DECONTAMINATION

$$HT + H_2O = HTO + H_2 - \Delta G$$

$$HT + CH_4 = CH_3T + H_2O - \Delta G$$

$$2M + 2HTO = 2MTO + H_2 - \Delta G$$

**Penetration of low energy beta particle is not important;
If Tritum gets into the body, drink lots of water / beer, and it gets flushed out.**

TRITIUM ABUNDANCE

Natural Abundance : 3 x 10^{18} Bq

Remaining in Air : 2 x 10^{19} Bq

Required for a typical fusion reactor : 2 x 10^{18} Bq

Release from typical nuclear installations : 2 x 10^{16} Bq

1 gm of Tritium : 3.5574 x 10^{14} Bq

1 Bq : Quantity that produces 1 decay per second

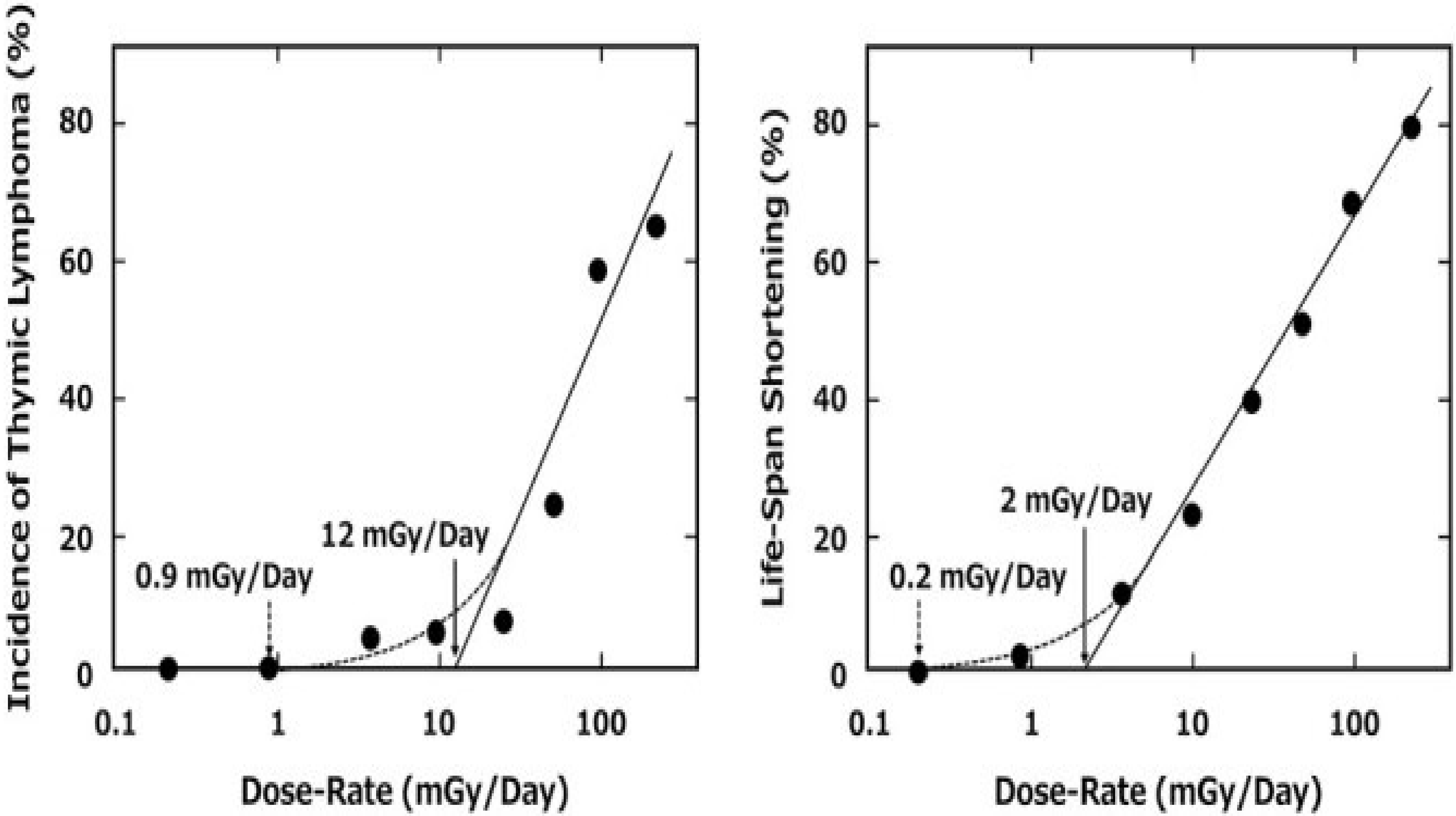
TRITIUM CAUSING DAMAGE

Tritium concentration allowed in drinking water : 700 Bq/liter in USA to 10000 Bq/liter in EU.
Safe (No effect) Radiation dosage : < 10 μGy/hr

A Few, scattered studies report on animals.
Significant Damage in body cells : > 27,000,000 Bq/liter
At Radiation dosage 1000 μGy/hr, ROS are generated due to internal heat generation and causing DNA damage.

1 Gray : Unit of Radiation dosage;
1 joule of energy deposited in a kG of body tissue

LIFESPAN SHORTENING DUE TO HTO



STUDIES ON MICE

TRITIUM ACCOUNTABILITY

CONTROLLED FUELLING

REMOVAL FROM WALL

EFFECTIVE RECOVERY

ACCOUNTABILITY IS GENERALLY POOR IN FUSION SYSTEMS

TRITIUM BREEDING IN BLANKETS

100% OF WALL CANNOT BE COVERED, AS PORTS ARE NEEDED FOR PUMPING, PLASMA HEATING ETC.

SHORTAGE OF FRESH FUELS; NEED TO RECYCLE

EFFICIENT RECOVERY NEEDED

Li_2TiO_3, $Li_{0.17}Pb_{0.83}$, Li_2BeF_4
Controlling composition and fine structure
UNEXPLORED TERRITORY

TRITIUM RECOVERY AND DETRITIATION

FIRST WALL MATERIALS

GLOVE BOX HANDLING

RECOVERY & SAFE CONTAINMENT OF TRITIUM

LIMITED UNDERSTANDING PREVAILS

Catalytic Reduction Method For Tritium Recovery from Tritiated Water Systems

Experimental and theoretical feasibility studies of a catalytic reduction method were carried out for application to the tritium recovery processes in fusion reactor systems. Experiments on the decomposition of water vapor were performed under the following conditions: temperatures of 350 to 650 K; an H_2O vapor concentration of 103 to 104 ppm; a mole ratio of CO to H_2O of 1 to 10. The catalyst used was a mixture of CuO, ZnO, and Cr_2O_3.

It has been demonstrated that this method using the zinc-stabilized catalyst can be adapted to recover tritium from tritiated water with a high conversion ratio (>0.999 per one path) at comparatively low temperature (450 K). The catalytic rate equation and the rate constants determined by this work can be used for designing a practical catalytic reduction bed for the decomposition process of the tritiated water.

Yoshida, Watanabe et al,
Nuclear Technology - Fusion, Volume 5, 1984

Tritium Removal from Tritiated Water Using Mesoporous Silica

The ability of various solid adsorbents to adsorb tritium from tritiated water was studied. The tritium removability and adsorption ability of mesoporous silica (MCM-41) were found to be larger than those of conventional microporous zeolites such as mordenite (MOR) and Linde-type A (LTA). The different adsorbents can be arranged in order of tritium removability and tritium adsorption ability as follows: MCM-41 > LTA(5A) > high-silica MOR ≈ low-silica MOR ≈ LTA(4A). The adsorbents can also be arranged in decreasing order of the separation factor (α) as follows: MCM-41 > LTA(5A) > low-silica MOR ≈ LTA(4A) > high-silica MOR.

Taguchi, Akai et al,
Fusion Science and Technology, Volume 60, 2011

Application of Pressure Swing Adsorption to Water Detritiation Process

Pressure swing adsorption (PSA) has been studied as a new water processing technique, detritiation of tritiated water, for a future fusion power plant. It will be a new tritium removal method having an additional function of isotope separation and quick dehydration, and it is expected to become the first stage of the system processing a large amount of tritiated water generated in a fusion plant. A series of the adsorption and dehydration experiments was carried out for a typical adsorbent of NaX zeolite as fundamental investigation to realize HTO/H2O separation system by PSA. It was clearly observed that break through time differs in H2O and HTO concerning the isotope separation function of NaX zeolite. It is certain that NaX zeolite can separate into the tritium concentrated water and the tritium reduced water by this difference of the break through time. The quick dehydration is attained by decompression and purge gas flowing. It was observed that a part of amount of the water released by the decompression was transferred by the purge gas, and the rest of water was adsorbed on the adsorbent again. After the re-adsorption phenomenon, the rest of water was gradually released by the diffusion. It is demonstrated that enlargement of pressure difference between adsorption and dehydration is effective to obtain high dehydration ratio. Furthermore, it was also verified that enough vapor removal capacity of purge gas is quite necessary to obtain high dehydration ratio.

Iwai, Yamanashi et al,
Journal of Nuclear Science and Technology, Volume 42, 2005

Zirconium Based Alloy Reactor Beds for Tritiated Water Handling

Application of a Zirconium based alloy reactor bed for tritiated water handling, namely the nature and extent of variation of the water vapour conversion rate of alloy during its use was extensively addressed.

Experimental results obtained from four different investigations are presented to summarily view the water vapour reduction behaviour and hydrogen isotope release by the alloy during the conversion. The ternary getter alloy -[Zr(V0.5Fe0.5)2], commercially known as St 737 (SAES Getters), is found to have good sorption properties for water vapour even at moderate temperatures (400 °C and less), and attractive sorption – desorption characteristics for hydrogen over a large and convenient working pressure range (up to ≈ 4 kPa). The four different conversion experiments performed

(i) by "BATCH" method; (ii) under "FLOW" conditions; (iii) by subjecting the alloy to high concentrations of oxygen up-take ("Poisoning"); and (iv) over nearly the "Full Usage" of alloy where both the conversion and interposed relaxation durations extended up to a few thousand hours, showed that the functional characteristics of the Zr-V-Fe alloy are relevant in all conditions

Venkat Ramani, Ghezzi and Binizzoni
Fusion Technology, Volume 27, 1995 - Issue 2T: Proceedings of the International Workshop on Physics and Technology of Tritium for Fusion Reactors. Varenna, Italy

Another Zirconium Based Alloy for Tritiated Water Handling

The results of $H2O$ sorption tests performed on different possible candidate alloys, by means of vacuum microbalance tecnique at a pressure of some hundreds Pa and at temperatures ranging from 300 to 400°C, from the tests a ternary Zr-Mn-Fe alloy appears to have promising features, combining good dissociation characteristics for $H2O$ with low hydrogen pick-up.

Boffitto, Conte and Gasparini
Fusion Technology, Volume 27, 1995 - Issue 2T: Proceedings of the International Workshop on Physics and Technology of Tritium for Fusion Reactors. Varenna, Italy

HEALTH AND SAFETY OF PERSONNEL

RESTRICTED TO WORKING PROFESSIONALS UNDER NORMAL CIRCUMSTANCES

GENERAL PUBLIC NOT INVOLVED

LIMITED LIABILITY

TRANSFERABILITY OF SAFETY CONCEPTS FISSION TO FUSION REACTORS

1) RADIOACTIVE INVENTORY BASED
HYPOTHETICAL RELEASE OF STORED RADIOACTIVE INVENTORY FAR EXCEEDS THAT OF FUSION
EVACUATION CRITERION FAR HIGH

2) CONCEPT OF DEFENCE IN DEPTH
REACTIVITY CONTROL; NO NEED TO CONSIDER CRITICALITY IN FPP
SINGLE INITIATING AND MULTIPLE FAILURE EVENTS

STRATEGIC DIFFERENCE DUE TO DIFFERENT PHYSICAL AND TECHNLOGICAL CHARACTERISTICS OF FISSION AND FUSION REACTORS

SUMMARY AND CONCLUSIONS

THE PROPONENTS OF FUSION ENERGY ALWAYS SAY IT AS "CLEAN", "SAFE", "UNLIMITED" AND "CHEAP" ENERGY – A "SUN IN EARTH"

THE REALITY IS HARSH

HOPE IS STILL THERE FOR A NEUTRON FREE, TRITIUM FREE FUSION REACTOR

$$D + T \rightarrow {}^{4}He + n + 17.6\ MeV \quad (1)$$
$$D + D \rightarrow {}^{3}He + n + 3.25\ MeV \quad (2)$$
$$D + {}^{3}He \rightarrow {}^{4}He + H + 18.6\ MeV \quad (3)$$

Fuel Neutronicity : (1) 0.80; (2) 0.66; (3) ~0.05

FUEL FOR (3) : HARD REACTION, RARE, NOT MUCH PRODUCED, NO BREEDING, BRING FROM MOON.

THANK YOU FOR YOUR KIND ATTENTION

Digitized Occupational Health Systems & Human–Robot Synergy: The Next Frontier in Employee Well-Being.

Dr. Prasad Madhukar Agavane

Certifying Surgeon, Medical Officer-F

In-charge- OHC, KAPS Hospital.

Kakrapar Gujarat Site,

NPCIL.

Why????

DIGITALISATION STATS IN INDIA

- **"Digital"** - what started as a **buzzword** across industries, is now an **imperative for India.**
- With **Highest Monthly Data Consumption Per Smartphone In The World.**
- **technology is already changing** the way industries operate and deliver, and the **way citizens consume.**
- Many studies have indicated that the **digital revolution will change the course of the Indian Economy.**
- Owing to an inherent advantage in the form of a plethora of **human resources skilled in Information & Technology (IT),**
- **India is making a giant leap forward in digitising its economy.**

What took us for Emergence & Need of Digitalisation ??

- ✓ Tectonic shifts seen in the uptake of digitalization due to the **COVID-19 pandemic.**
- ✓ Emergence of **tele-medicine for consultations and OPD** in an unparalleled manner.
- ✓ The trinity of **JAM – Jandhan bank accounts**, **Aadhaar-based identity**, and **mobile phone connections-adult** bank account coverage from a mere **14%** a decade ago **to 82%.**
- ✓ **Digital vaccination certificate** generated by the **CoWIN platform**, accessible directly through our **smartphone anytime anywhere**.

Aarogya Setu

मैं सुरक्षित | हम सुरक्षित | भारत सुरक्षित

DIGITALIZATION in India
Is it difficult or only a On Paper conceptual illusion?

Subject/Year	2014 (in Crore)	2022 (in Crore)
Smartphone Penetration (Users)	15.6	75
Internet Penetration (Users)	25.15	83.37
Aadhaar Enrollment	70	134.6
Number of UPI Transactions	0.1 (2016 Launched)	4500

Key public Health Digitalization offerings in INDIA

ABHA	➨ Ayushman Bharat Health Account (ABHA)
ABHA	➨ ABHA Application
Health Facility Registry	➨ Healthcare Professional Registry (HPR)
	➨ Health Facility Registry
DRUG REGISTRY	➨ Drug Registry

What is **Digitalisation** exactly?

- The digitalization of occupational health systems and healthcare data is a
  - **Transformative Process,**
  - **Leveraging Information And**
  - **Communication Technologies (ICTs)**

To Enhance

  - **Efficiency,**
  - **Accessibility, And**
  - **Quality Of Care.**

- This shift, often referred to as **Health 4.0** or **OHS 4.0**, brings significant benefits but also introduces new challenges, particularly regarding data security and regulatory compliance.

Digital Health Transformation

- Digital Health Technologies
- Human–Robot Synergy
- Predictive Analytics
- Regulatory Requirements
- Implementation Barriers

Digital Health Transformation

Digital Health Technologies:

Electronic Health Records, Telemedicine Platforms, Occupational Health Dashboards.

Human–Robot Synergy:

Collaborative Robotics, Automation In High-Risk Environments, Human Factors Engineering.

Predictive Analytics:

Machine learning models for Fatigue, Stress, Exposure and Illness Prediction.

Regulatory Requirements:

Alignment with Atomic Energy (Factories) Rules, 1996, ISO 45001, ILO-OSH, and National Occupational Health Standards.

Implementation Barriers:

Organizational, technical, and workforce readiness challenges.

Benefits of Digitalization In Healthcare- Patient Outcomes

- One of the main benefits of using digital technologies is **improving patient outcomes.**

This is in the form of

- **better care coordination,**
  - **individualized treatment regimens**, and
- **increased patient participation**.
- This includes **telemedicine and mobile applications** for health and wellness that let patients receive medical services remotely.
- Healthcare professionals can diagnose **patients quickly and keep track of their adherence to prescribed drugs.**

Benefits of Digitalization In Healthcare- Efficiency

- Digital technologies also help in **increasing efficiency and streamlining** healthcare processes.
- Due to the ease with which healthcare practitioners-
  - **can access patient data when using electronic health records (EHRs),**
  - **less administrative work is required, and**
  - **care coordination is enhanced**.
- Patients can use **automated online appointment scheduling and billing**.
- This **saves time and money and lowers the potential for manual errors**.
- As a result, **hospital staff** can **focus** on providing **patient care**, and **resources** can be used more **effectively**

Benefits of Digitalization In Healthcare- **Reduced Errors**

- One of the most cutting-edge technologies of today is **robotic process automation**.
- RPA solutions **automate manual procedures reducing errors and increasing security**.
- By automating administrative and clinical processes, there is **little room for errors.**

Benefits of Digitalization In Healthcare-

Lowered Costs-

- Converting manual tasks into digital ones **can reduce costs and ultimately conserve resources.**
- The use of electronic health records (EHRs) **lessens** the **demand** for **paper records** and the **related costs** of **maintaining** and **managing** them.
- **Advanced EHR** systems are used in medical facilities, and these **reductions may even** lead to **lower overall patient admission** costs.

Benefits of Digitalization In Healthcare- <u>Data-Driven Decision Making</u>

- Every day, **tons of data** are produced in the healthcare industry. Real-time data and **<u>healthcare analytics</u>** facilitate **better decision-making**.
- Patients who are at **high risk** of **readmission** or **contracting specific diseases** can be **identified** using **predictive analytics**.
- **Early intervention** by **healthcare professionals** can **stop unnecessary hospitalizations**.
- In order to pinpoint opportunities for improvement, **visualization** of **patient outcomes** and **population health trends** is helpful.
- In this way, **accurate** and **thorough data collection**, **storage**, and **analysis** can improve patient outcomes.

Benefits of Digitalization In Healthcare- **Provider Satisfaction**

- Digital solutions can **facilitate provider workflows and ease the burden of their tasks.**
- Many technologies, like **EHR**, **RPA, telehealth**, etc., help providers automate much of their workload, **giving them more time to work on what they do best**: providing care to patients.

Benefits of Digitalization In Healthcar- Patient Engagement

- **Patients may be more involved in their care when they have access to their own health information**.
- They can also **alter their lifestyles to improve their health and more effectively manage chronic diseases.**
- **Digital technologies help achieve this goal**.

Benefits of Digitalization In Healthcare-
<u>Big Data Analytics</u>

- When medical information is **gathered and preserved digitally**, it can be analyzed to spot patterns and enhance treatment.

- For instance, hospitals can use **data analytics** to **identify patients who are likely to require readmission and take precautions against it.**

Benefits of Digitalization In Healthcare- **Automating Tasks**

- **Entering patient notes into an electronic health records system can take up to one-third 1/3rd of a doctor's time.**
- The time of a doctor is a valuable resource, and this is not particularly effective.
- Digitization helps in automating day-to-day tasks of the provider.
- By automating these processes, medical professionals and clinical staff **will have less work to do and more time to devote to patient care.**

Benefits of Digitalization In Healthcare- Collaboration Between Providers

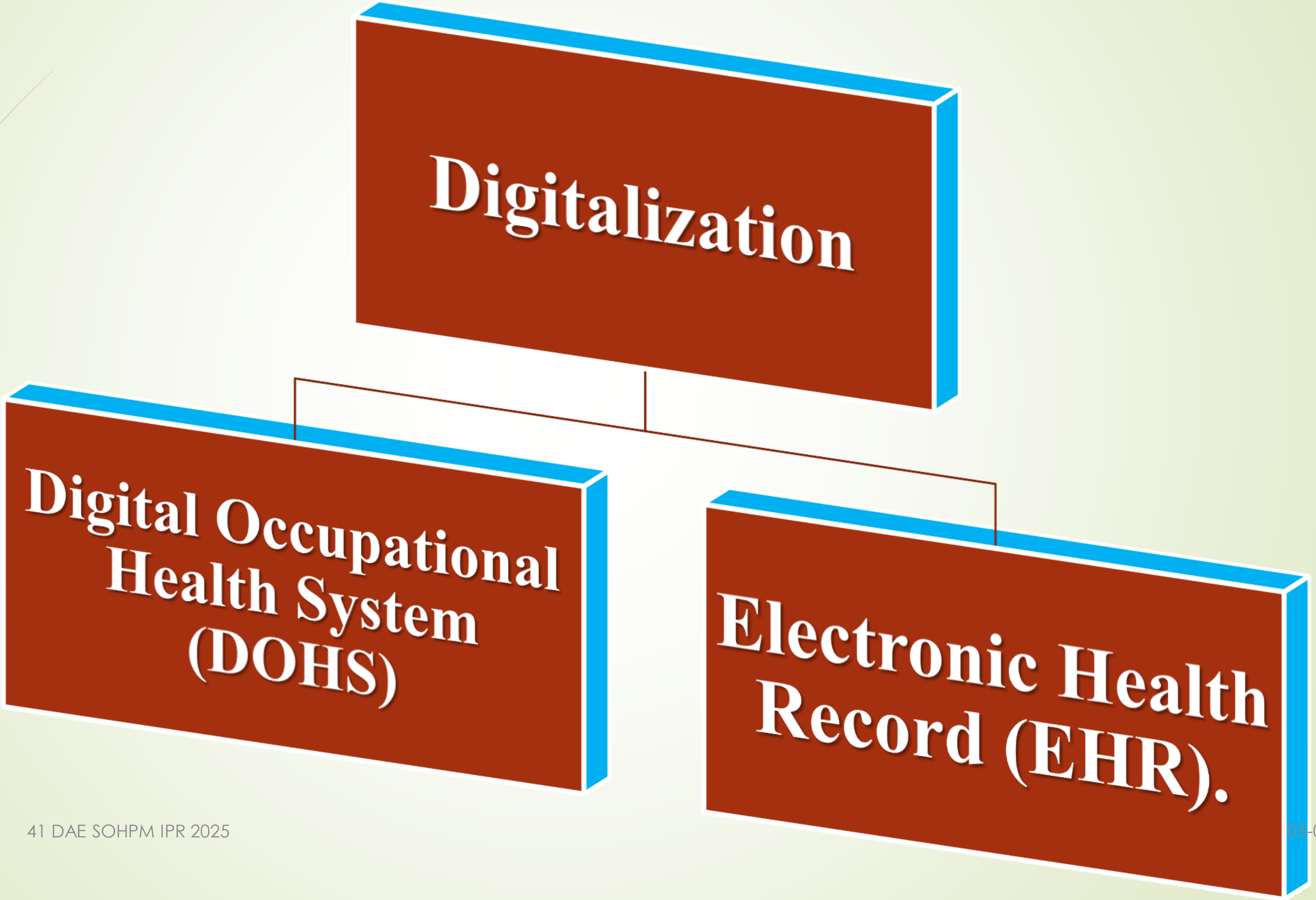
-

- In certain cases, providers **might need advice from other healthcare professionals.**
- To create the **patient's overall best medical plan, it is crucial that the many providers stay in touch with one another.**
- **Digitization helps providers communicate with each other, share health information, and devise treatment plans collaboratively**.

Benefits of Digitalization In Healthcare- Real-Time Information

- These days, **smartphones and wearables** are two of the most popular types of technology.
- **Modern smartwatches** are **capable** of taking **parameters, counting steps**, and **monitoring heart rate**.
- They are, therefore, **incredibly beneficial** to both **regular users** and their doctors.
- The doctor can monitor the patient's vitals and provide preventative care.
- Nowadays, **real-time data monitoring** allows doctors to **take preventative action** and **prevent** a **terrible event**.

Digitalization



Key Technologies Driving Digitalization
Electronic Health Records (EHRs).

EHR systems replace

- **Paper-based Records**,
- **Allowing** For **Seamless Storage-LIFELONG**,
- **Sharing** Of Patient **Health Information across different healthcare providers and institutions.**
- This ensures **Continuity Of Care and Reduces Administrative Burden And Manual Errors.**

Key Technologies Driving Digitalization

Telehealth and Remote Patient Monitoring (RPM).

- These technologies enable-
  - **Remote Consultations,**
  - **Diagnosis, And**
  - **Monitoring Via Video Calls,**
  - **Mobile Apps, And**
  - **Wearable Devices.**
- This expands **access to healthcare**, especially for individuals in **rural or remote areas**, and **supports the management of chronic conditions and mental health issues**.

Key Technologies Driving Digitalization

Artificial Intelligence (AI) and Data Analytics.

AI and machine learning algorithms analyze vast datasets from-

- **EHRs,**
- **wearables, and**
- **other sources-**

to provide;

- **Predictive Insights,**
- **Aid In Diagnostics,**
- **Personalize Treatment Plans, And**
- **Optimize Resource Allocation.**

Key Technologies Driving Digitalization

Internet of Things (IoT) and Wearable Devices

- **Smart** Personal Protective Equipment **(PPE)** and other wearable sensors monitor workers'
  - vital signs,
  - physical activity, and
  - exposure to hazards in real-time,
- **allowing for proactive interventions and accident prevention.**

Key Technologies Driving Digitalization

Cloud Computing.

This provides

- the infrastructure for **storing and processing large amounts of health data,**
- **facilitating real-time access** and
- **collaboration among healthcare professionals**.

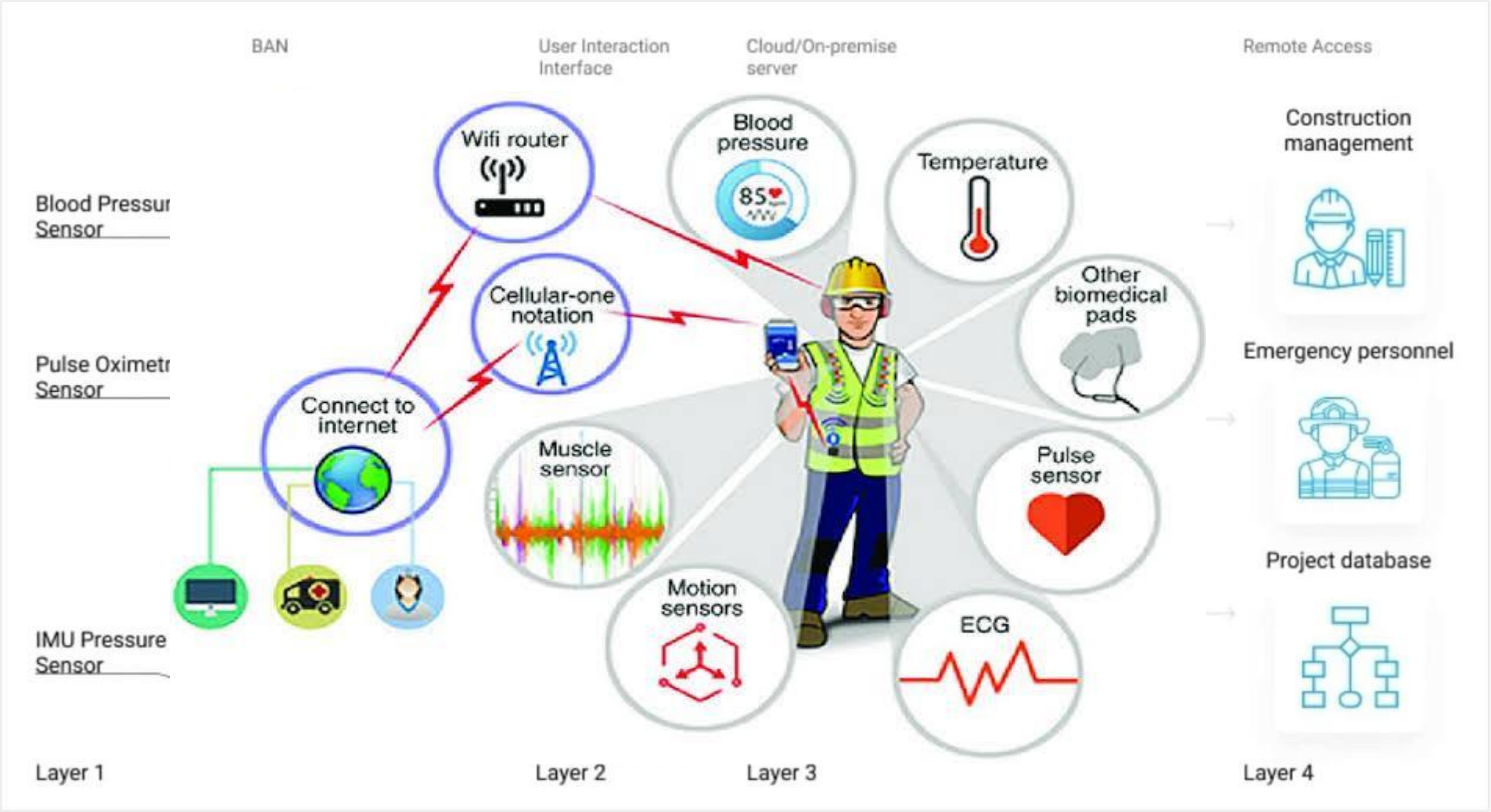
Digital Occupational Health System (DOHS)

Digital Occupational Health System (DOHS)

- Real-time Monitoring & IoT Integration
- Telemedicine and Virtual Consultations
- Wearable Health Monitoring
- Electronic Health Records (EHRs)
- Occupational health dashboards

Digital Occupational Health System (DOHS) Real-time Monitoring & IoT Integration:

- The **central platform for managing** all aspects of occupational safety and health.
  - Implementing **wearable devices.**
    - e.g., **smart badges,**
    - **health trackers for monitoring worker exposure (radiation, heat stress, noise, etc.),**
    - **physiological parameters, and**
  - **location in hazardous areas**.
  - Integrating **Internet of Things (IoT)** sensors within DAE facilities for real-time monitoring of environmental hazards and equipment status.


BAN
User Interaction Interface
Cloud/On-premise server
Remote Access
Blood Pressur Sensor
Pulse Oximetr Sensor
IMU Pressure Sensor
Wifi router
Cellular-one notation
Connect to internet
Blood pressure
85
Temperature
Other biomedical pads
Muscle sensor
Pulse sensor
Motion sensors
ECG
Construction management
Emergency personnel
Project database
Layer 1
Layer 2
Layer 3
Layer 4

Self-inflatable Personal Protective Equipment (PP

- Self ll protection primarily cor
- **we** heights or in dynamic env

and

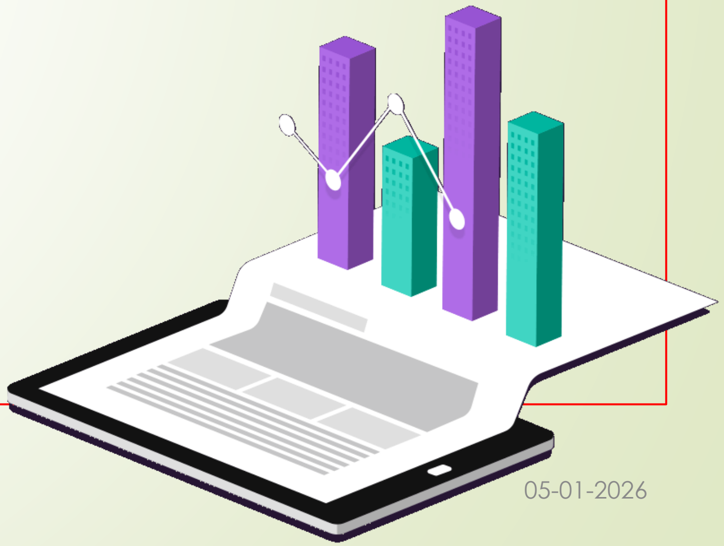
- **infl** est measures on cor

Safety and Risk Management:
Digital Hazard Reporting

- Mobile applications for instant reporting of
  - **Near-misses,**
  - **Incidents, And**
  - **Unsafe Conditions,**
  - **Enabling Quicker Response And Trend Analysis.**

Predictive Analytics:

- Using **AI and Big Data** to analyze;
  - **historic data (incidents, health checkups, operational logs)**
- **to predict high-risk areas or activities** and
- **prevent future accidents.**



Automated Compliance Checks: AUDITS

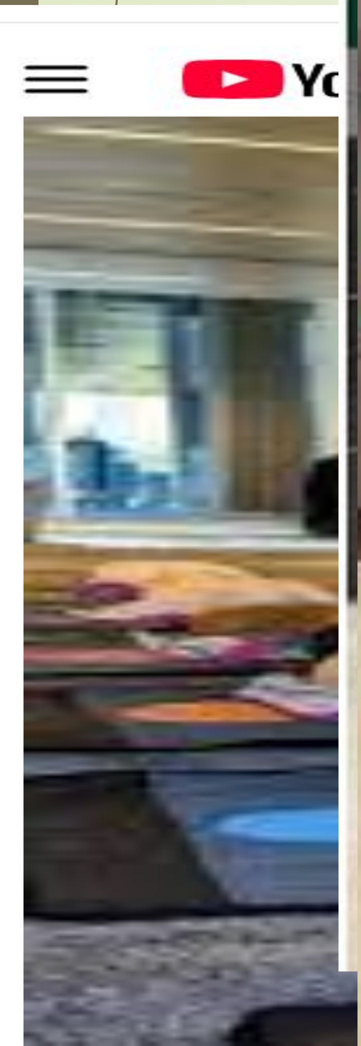
- Digital checklists and workflows
  - to ensure mandatory inspections,
  - training, and
  - equipment calibrations are completed on time, maintaining regulatory compliance.

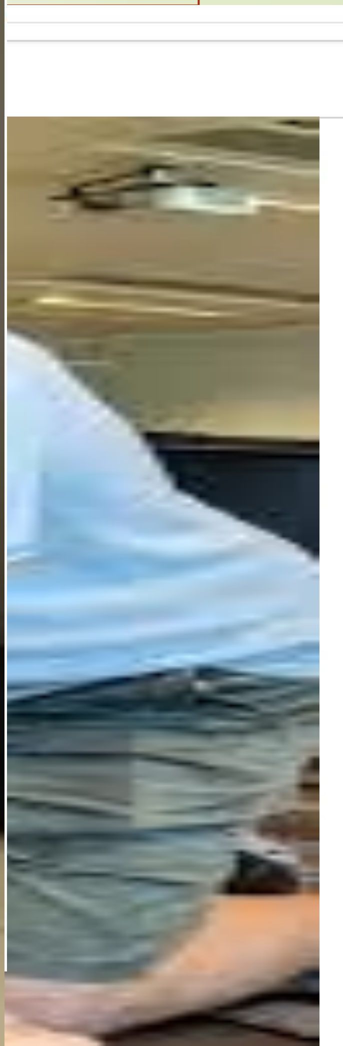
E-AUDITS or Online Audits?

Digital Training & Simulation:

- Virtual Reality (VR) / Augmented Reality (AR)

Digital Training & Simulation:





Digital Healthcare Data
(Electronic Health Records - EHR)
Centralized Electronic Health Records (EHR):

- Consolidating
- Medical History,
- Periodic Health Checkup (AME) Results,
- Specialized Radiation Exposure Records,
- Medication, And
- Treatment Plans Into A Single, Accessible Digital File.

- Increased accessibility to care
- Convenience for patients
- Access to distant specialists
- Improved continuity of care
- Reduced overhead costs for providers
- Streamlined administrative tasks
- Reduced spread of illness

prognoCIS By bizmatics

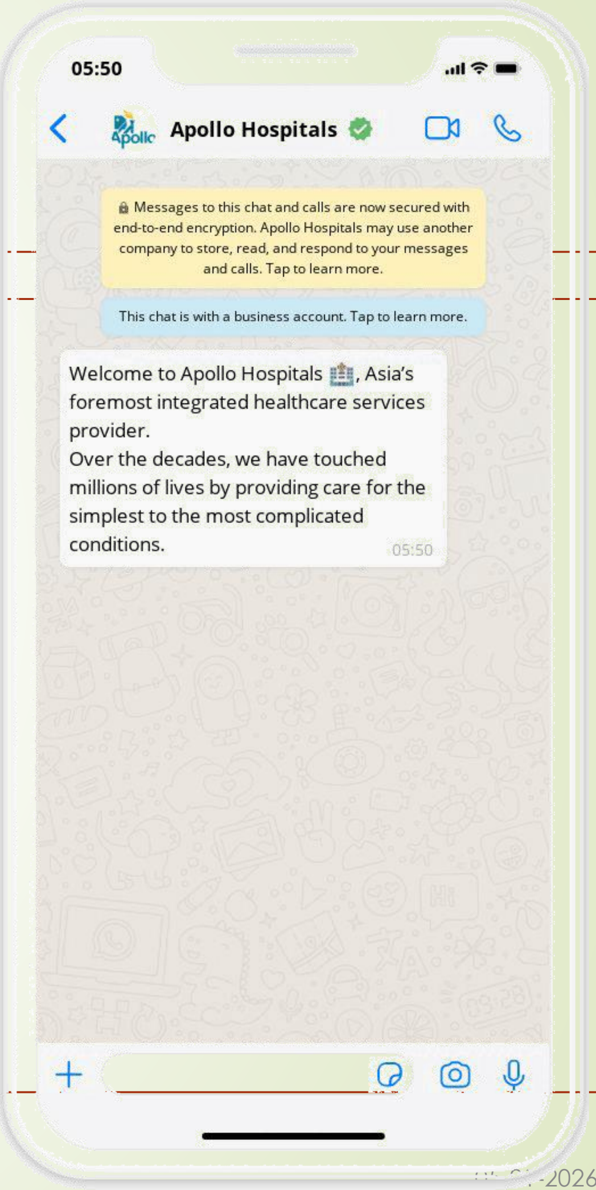
Automated Medical Surveillance

- Digital Scheduling And
- Automated Reminders For

Mandatory Periodic Health Checkups (AME) And

- Post- Follow-ups,
- Ensuring Compliance With

  DAE-specific Medical Surveillance Protocols.



Data Interoperability:

- Ensuring the EHR system can
  - securely and
  - efficiently exchange data

with other relevant DAE systems,

- such as **personnel databases and radiation monitoring systems**.

Human–Robot Synergy
Robotics and automation;

significantly

- **improve Precision,**
- **Reduce Ergonomic Strain** and
- **Minimize Direct Exposure to hazardous tasks**.

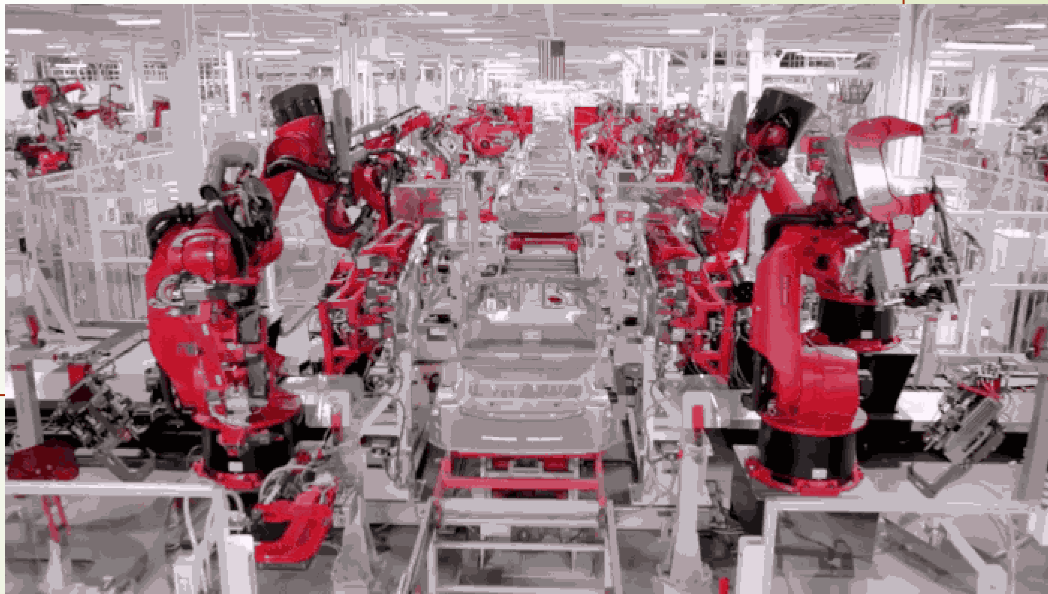
However, Human–Robot Interfaces require attention to:

- **Cognitive and Psychological** Load On Workers.
- Risk of **Robotic Malfunctions** or **AI-based decision errors**.
- **Ergonomic design** for collaborative operations.
- **Continuous Medical Surveillance** for Robot-Exposed Employees.
- **Proper integration of human factors**

  engineering ensures **safer,**

  more comfortable interactions

  between workers and robots.



Advantages of Human-Robot Interaction (HRI)

- Robotic automation is **cost-effective in the long run because robots can function through nights, on holidays, and on weekends.**
- The **quality of products** developed by the robots **is better than those produced by humans as they are accurate and free from any form of human error.**
- Robots **do not suffer from fatigue and are hence, much more productive and continue to work efficiently over long periods** than humans.

Sensors

- **Touch and impact sensors** detect when an employee is about to be injured and stop the machine before it happens.
- Digitalised workplaces that make **use of smart sensors**,
  - e.g. measure real time noise levels,
  - can set parameters with actionable data to fully ensure health and safety standards are met at all times.

Cobots & sustainable work life

- With **AI** making its way into manufacturing as the technology matures, **cobots can become truly collaborative and work productively with their human colleagues.**
- Employees can be fearful of the increased introduction of machines that work alongside humans.
- Therefore, cobotisation should be done in tandem with employees.

Intelligent PPE

- Through intelligent PPE,
  - such as earmuffs allowing speech and normal sound, but which observe e.g. the sound of explosion and prevent it to get into the the ear, we can reduce risks.

AI

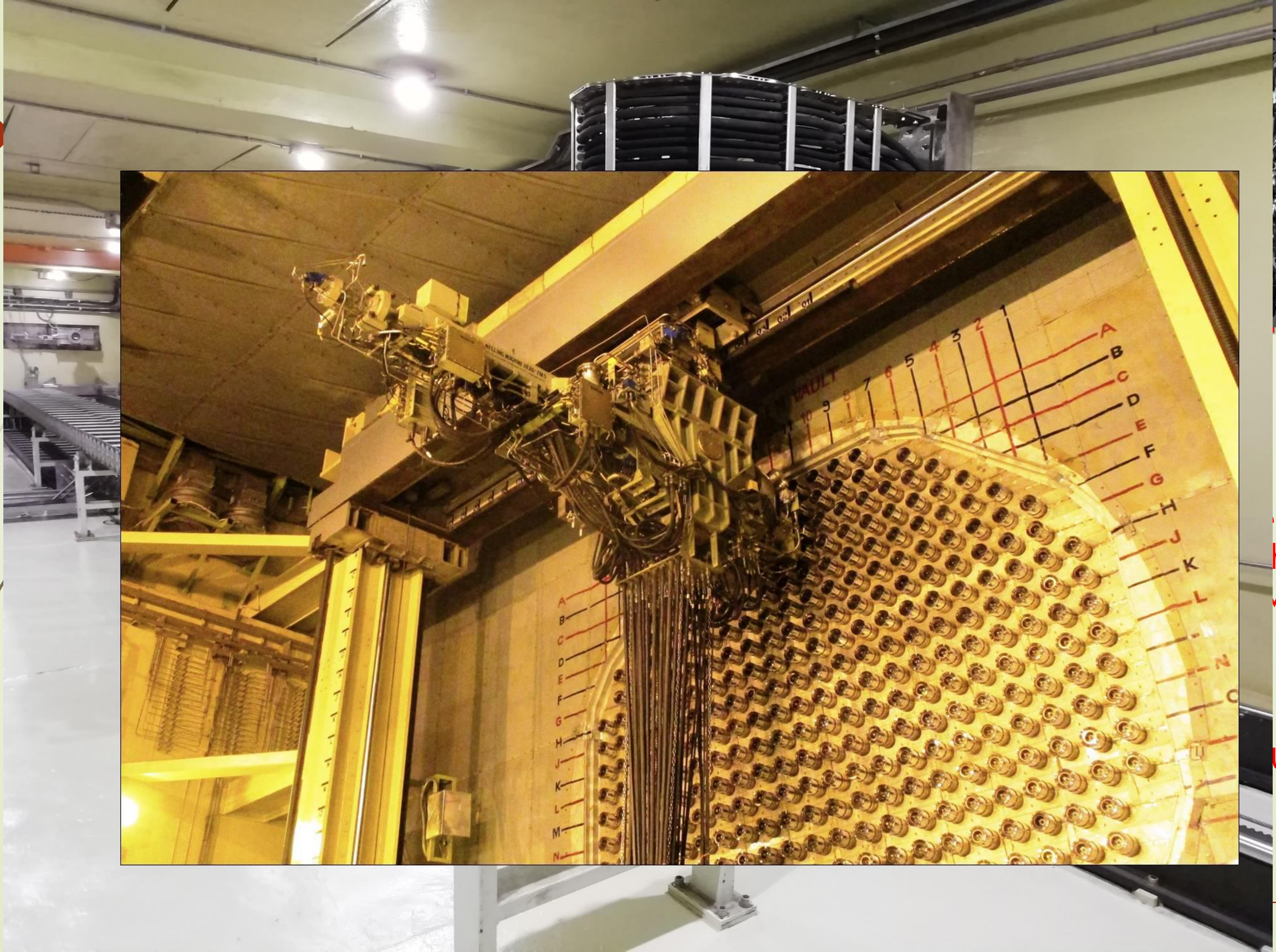
- The analysis of **Job Security Reports** which report on
  - **hazard locations**,
  - **slips**, or
  - **more serious accidents** at work is a large task.
- The artificial language processing **NLP (Natural Language Processing) is capable of processing thousands of digital documents**, **in any language**.
  - For large companies, this will produce a **Large Database Of Incident And Accident Reports**, across all of their sites.

<u>Autonomous Vehicles In Factories</u>

- Autonomous vehicles in factories are commonplace.
- **Evidence is pointing towards a reduction in accidents.**

Training for their implementation remains key.

- **The use of drones in industry is becoming more prevalent**.
- One way in which they are being used to the betterment of employees OSH is **moving items around production sites [illegible]ght.**



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Challenges and Concerns

Data Security and Privacy

The collection and storage of sensitive health information in digital formats increase vulnerability to data breaches, **cyber-attacks** (like ransomware), and unauthorized access. Robust cybersecurity measures are essential to protect patient confidentiality.

Interoperability & Standardization

A **lack of clear guidelines** and standardized data formats can make it difficult for different systems and institutions to seamlessly exchange information.

Ethical and Regulatory GAPS

There is a need for robust ethical frameworks and updated regulations to address issues such as algorithmic decision-making, workplace surveillance, and data governance.

Infrastructure GAPS

Rural and low-income areas often lack the necessary digital infrastructure (e.g., high-speed internet, hardware) to support advanced digital health solutions.

DIGITALIZED OHC
HI-TECH/ PAPERLESS OHC for AME

DIGITALIZED OHC
HI-TECH/ PAPERLESS OHC for AME

- REGISTRATIONS OR QR CODE ENABLED CARDS.
- ABCDE FORMS-AME OR PME FORMS.
- OHC AME with Hi-TECH machines-e.g.
  - STADIOMETER,
  - Computerised Vision Screen/ LED VSION MONITOR
  - DIGITAL ECG MACHINE
  - DIGITALIZED AUDIOMETRY
  - SOFTWARES aligned to regulators Annual reports et
  - Digitalized reminders of AME, Final reports etc.

न्यूक्लियर पावर कॉर्पोरेशन ऑफ इंडिया लिमिटेड
NUCLEAR POWER CORPORATION OF INDIA LTD.
(भारत सरकार का उद्यम/A Govt. of India Enterprise)
प्राथमिक उपचार एवं व्यावसायिक स्वास्थ्य औषधालय, ना.ऊ. भवन,
OHC, KAPS HOSPITAL
(चिकित्सीय सेवाएं/Medical Services)
दूरभाष/Tel. : 02626-25993920/25.

Date of AME
28/03/2025

ABCDE CARD

A) ADDRESS — PHONE NOs:
NAME : Shri XYZ — Office : 63994007
ADDRESS: D-18, KAPS, — Residence :
Mobile : 9969346046

B) BLOOD GROUP & Rh TYPE 'O' Positive — CHSS No.- 1523671-A

C) CLINICAL DETAILS
1) CLINICAL DIAGNOSIS : Nil
2) INVESTIGATION REPORTS : Hb-15.6 TLC-8480 DLC:P-50,L-40,M-04,E-05,B-01
FBG-87 Chol(T)-196 LDL-187 HDL-48 TG-152
Urea-27 ECG-biphasic T-wave (precordial leads).
3) CURRENT MEDICATION/S : Nil

D) DRUG/FOOD ALLERGIES Nil

E) OTHERS
1) DATE OF BIRTH : 02/09/1975.
2) MARKS OF IDENTIFICATION : Black mole on Lt side of chin.
3) NEXT OF KIN TO BE INFORMED IN EMERGENCY :
Name : Smt Santoshi Bhat (Spouse)
Address : As above.
Phone No.: 9987175324.
4) ANY OTHER IMPORTANT INFORMATION :
Family h/o HTN & malignancy-mother (Ca Oral Cavity).

ADVICE :
Follow-up at OPD for ECG abnormality(biphasic T-wave in precordial leads).
Opinion of Physician,
Regular exercise
SRD.

CERTIFYING SURGEON
KAPS HOSPITAL

EMPLOYEES RECORDS--PRE PME/AME

- ABCDE FORMS
- Employee will have to put his records with help of date on system.
  - e.g. Name,
  - Age,
  - Sex,
  - I/M,
  - Sections Work Profile,
  - any new complaints.
- Standard data from HR will be filled automatically from system.
- Employees category of AME will be auto filled i.e. CRW, DOW, ORW etc.

न्यूक्लियर पावर कॉर्पोरेशन ऑफ इंडिया लिमिटेड
NUCLEAR POWER CORPORATION OF INDIA LTD.
(भारत सरकार का उद्यम/A Govt. of India Enterprise)
प्राथमिक उपचार एवं व्यावसायिक स्वास्थ्य औषधालय, ना.ऊ. भवन,
OHC, KAPS HOSPITAL
(चिकित्सीय सेवाएं/Medical Services)
दूरभाष/Tel. : 02626-25993920/25.

Date of AME
28/03/2025

ABCDE CARD

A) ADDRESS — **PHONE NOs:**

NAME : Shri XYZ — Office : 63994007

ADDRESS: D-18, KAPS, — Residence :

Mobile : 9969346046

B) BLOOD GROUP & Rh TYPE 'O' Positive — CHSS No.- 1523671-A

C) CLINICAL DETAILS

1) CLINICAL DIAGNOSIS : Nil

2) INVESTIGATION REPORTS : Hb-15.6 TLC-8480 DLC:P-50,L-40,M-04,E-05,B-01
FBG-87 Chol(T)-196 LDL-187 HDL-48 TG-152
Urea-27 ECG-biphasic T-wave (precordial leads).

3) CURRENT MEDICATION/S : Nil

D) DRUG/FOOD ALLERGIES Nil

E) OTHERS

1) DATE OF BIRTH : 02/09/1975.

2) MARKS OF IDENTIFICATION : Black mole on Lt side of chin.

3) NEXT OF KIN TO BE INFORMED IN EMERGENCY :
Name : Smt Santoshi Bhat (Spouse)
Address : As above.
Phone No.: 9987175324.

4) ANY OTHER IMPORTANT INFORMATION :
Family h/o HTN & malignancy-mother (Ca Oral Cavity).

ADVICE :

Follow-up at OPD for ECG abnormality(biphasic T-wave in precordial leads).
Opinion of Physician,
Regular exercise
SRD.

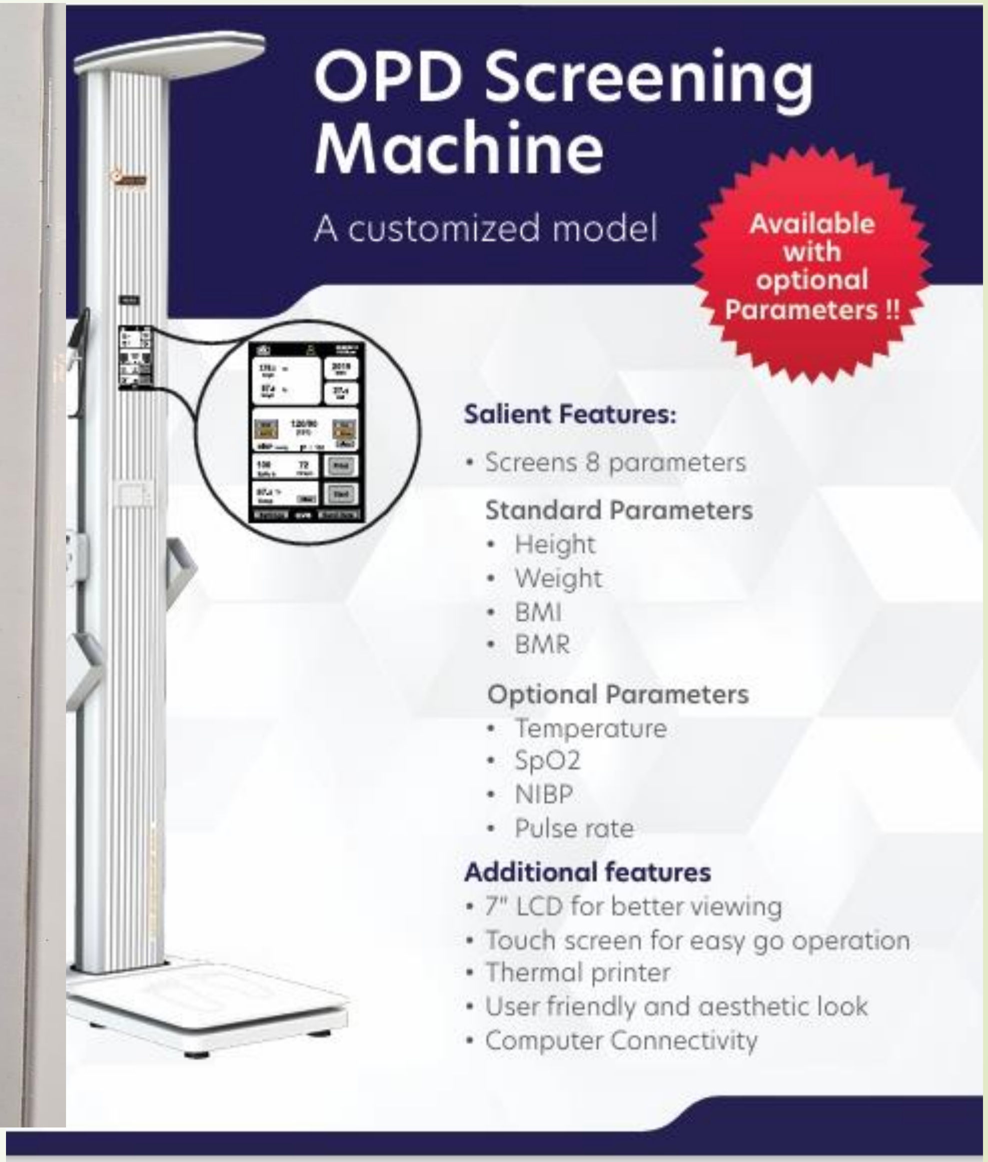
CERTIFYING SURGEON
KAPS HOSPITAL

EMPLOYEE NO WISE QR CODE FOR SCAN

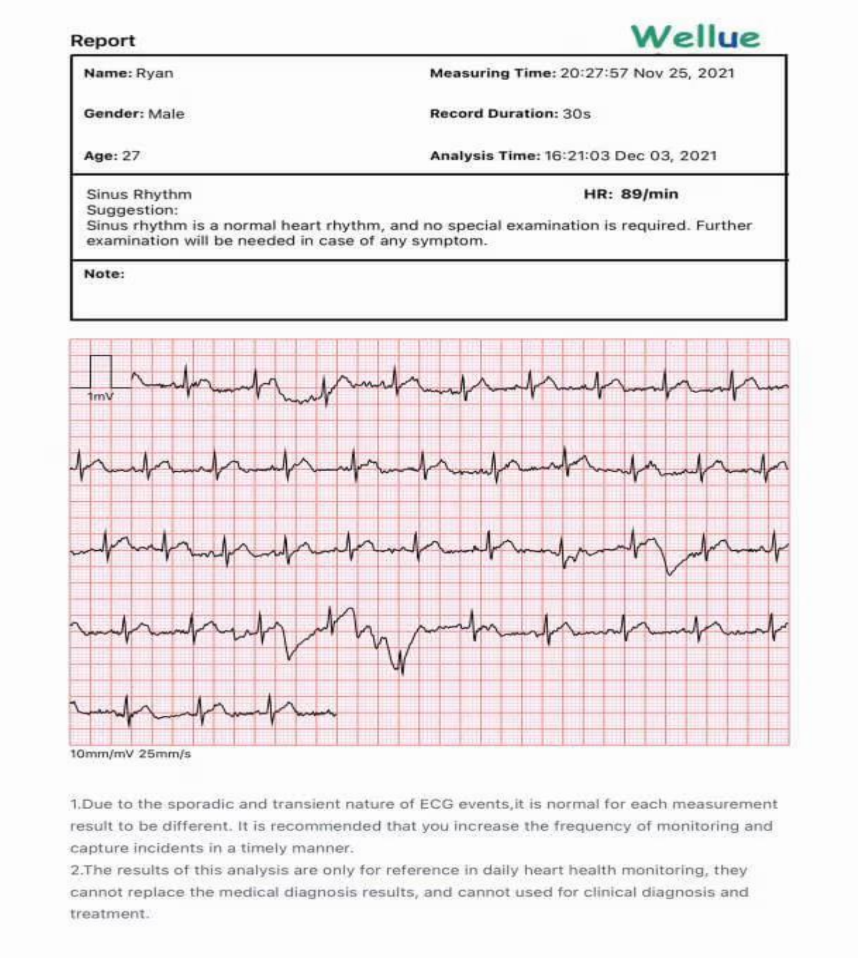
- **Why QR code?**
  - **For PME, Canteen etc.**
- For NEW candidates Details will be filled in ABCDE forms and same will be saved in **HMS software**.
- So at each sections like **Laboratory,**
- **X-rays Rooms, Digital ECG, Audiometry instead of name QR code will be scanned and data will be seen on system automatically** , so particular section will tag its inputs like **CXR, ECG, Laboratory reports etc. in AME. PME Forms**.

DIGITA
in OHC
etc

- **Digitalized S**



DIGITAL ECG MACHINE



Report

Wellue

Name: Ryan	**Measuring Time:** 20:27:57 Nov 25, 2021
Gender: Male	**Record Duration:** 30s
Age: 27	**Analysis Time:** 16:21:03 Dec 03, 2021

Sinus Rhythm **HR: 89/min**
Suggestion:
Sinus rhythm is a normal heart rhythm, and no special examination is required. Further examination will be needed in case of any symptom.

Note:

1mV

10mm/mV 25mm/s

1.Due to the sporadic and transient nature of ECG events,it is normal for each measurement result to be different. It is recommended that you increase the frequency of monitoring and capture incidents in a timely manner.
2.The results of this analysis are only for reference in daily heart health monitoring, they cannot replace the medical diagnosis results, and cannot used for clinical diagnosis and treatment.

LED Vision Charts
Cyber Chart

- Smart charts with random display function
- Contrast Sensitivity adjustment for most of the charts
- Adaptable to smaller rooms with precise adjustment of distan
- **External USB Port**
- External 3.5mm audio jack for audio output
- Exclusive Image gallery for various eye diseases
- Surgery Videos for educating patients
- Extensive Display modes for optotypes
- Reverse mode available for all charts
- Randomization of Charts
- Compensation for red green filter
- Catchy remote control with direct commands for all tests
- No Moving Parts

DIGITALIZED AUDIOMETRY

AERB C1C2 aligned AME SOFTWARES

- The AERB Category wise software or HOSPITAL MANAGEMENT SYSTEMS (HMS) are configured so:

ADVANTAGES-

- STANDARD MORBIDITY data will be auto filled or in drop downs which are of National importance for MOHFW online entry.
  - Daily- data of AME is ready.
  - AERB QUARERLY DATA is ready without calculations & errors.
  - YEARLY OCCUPATIONAL HEALTH report /C1C2 is ready on SINGLE CLICK.

1	Classified Radiation Workers (CRW)
2	Other Radiation Workers (ORW)
3	Workers in Dangerous Operations (WDO)
4	Canteen Workers (including contract employee)
5	Mine Workers
6	Fire Men
7	Others

Key Challenges and Mitigation Strategies
Data Security and Privacy

- **Challenge:** Healthcare data, especially in a sensitive organization like DAE, is **highly confidential** and a **target** for **cyberattacks**.
- **Mitigation:** Implement **robust encryption (at rest and in transit)**, **Multi-Factor Authentication (MFA)**, and **Role-Based Access Control (RBAC)**.
- **Adhere strictly to national data protection regulations and DAE's security protocols, including regular penetration testing.**

System Integration and Interoperability

- **Challenge:** Integrating the new DOHS and EHR with existing **legacy systems** (like **payroll**, **radiation dose records**, and **asset management**) can be complex.
- **Mitigation:** Adopt **open standards and APIs** (**Application Programming Interfaces**) for system communication.
- Prioritize a **phased implementation plan** starting with core functionalities.

Training and Adoption

- **Challenge**: **Resistance to change from long-time personnel and a need to train staff on new digital tools and data governance best practices**.
- **Mitigation**: **Conduct comprehensive**, **hands-on training** for all **users** (OH **staff**, **doctors**, **safety officers**, and **employees**).
- Emphasize the **user-friendliness** of the interface and the clear benefits to their daily work.

Regulatory and Ethical Concerns

- **Challenge: Defining clear legal** and **ethical boundaries** for using worker-generated health and location data, especially with real-time monitoring.

- **Mitigation:** Establish a clear **Data Governance Framework** with **policies** on **data ownership**, **retention**, and **anonymization** for analytical use. Ensure all **monitoring** is **conducted** with **transparency** and in **compliance** with **labor laws** and **ethical guidelines**.

NPCILs Steps for Digitalisation
Project Pragya-
ERP (Enterprise Resource Planning)

- June 2025.
- Strong Collaboration Between **NPCIL and Accenture.**
- Formally Launched Project Pragya - **NPCIL'S Largest Digital Transformation**. Initiative And A **Defining Milestone** In Our Journey To Become A **Future Ready**, **Digitally Empowered Organization**.
- Aims To **Build** A **Unified**,
  - **Intelligent**, And
  - **Scalable Digital Platform** To **Strengthen Decision-making**,
  - Enhance **Operational Efficiency**, And
  - Enable Seamless **Collaboration** Across All **Locations** And **Functions**.

This program will help-

- **Standardize And Harmonize Business Processes,**
- **Enable Real-time, Data-driven Decision-making.**
- **Strengthen Governance, Compliance, And Operational Control.**
- **Improve Productivity Through Automation And Streamlined Workflows.**
- **Build a digital foundation for scale, innovation, and future integration At the core of this transformation is our move to a modern digital backbone adopted globally by future-ready enterprises**.

Anticipated Benefits of Digitalization for DAE

- **Enhanced Safety**
- **Proactive Prevention**: Real-time data and predictive analytics shift the focus from reactive reporting to **proactive hazard mitigation**, significantly reducing occupational risks.
- **Operational Efficiency**
- **Streamlined Workflows**: Eliminating paper-based records, manual data entry, and redundant processes. This frees up OH personnel for core preventive and clinical tasks.
- **Data Quality & Accessibility**
- **Single Source of Truth**: Centralized EHR ensures all medical and exposure data is **complete, accurate, and instantly accessible** to authorized clinicians for better, faster clinical decisions.

Continues…

- **Compliance & Reporting**
- **Automated Audits:** Simplifies generation of reports required by national regulators (e.g., Atomic Energy Regulatory Board - AERB) and internal management, ensuring **robust accountability**.
- **Worker Well-being**
- **Personalized Health:** Digital tools can offer personalized health and wellness advice based on individual data, promoting a **culture of health and preventive care.**


THANK YOU
V MUCH