ASHRAE Hellenic Chapter

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ENERGY IN BUILDINGS

EMEA 2024

Europe, the Middle East & Africa

FRIDAY - SATURDAY

NOVEMBER 22-23, 2024

@ 9:00-18:00

@ ATHENS GREECE

SESSIONS:

- SUSTAINABILITY
- HEALTH & SAFETY
- DECARBONIZATION
- TECHNICAL SOLUTIONS
- DIGITAL ENVIRONMENT
- POLICIES & LEGISLATION
- ENERGY EFFICIENCY FIRST
- RESILIENCE TO CLIMATE CRISIS

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GEP Health and Safety Advisors

"Workplace Safety for Energy-Efficient Retrofitting Projects"

Alexandros Sofianopoulos, Chief Operations Officer | GEP Group

Agenda

List of Topics

- ✓ Introduction to Retrofitting & Safety needs
- ✓ Safety Challenges and Risks
- ✓ Hazard Identification and Control Measures
- ✓ Training and Safety Culture
- ✓ Case Studies
- ✓ Q&A

Introduction to Energy-Efficient Retrofitting

Modifying or upgrading existing buildings to improve energy efficiency and reduce environmental impact.

Examples of retrofitting measures:

- Adding insulation to walls, roofs, and floors.
- Upgrading HVAC (heating, ventilation, and air conditioning) systems.
- Installing energy-efficient windows and doors.
- Implementing renewable energy sources like solar panels.

Benefits: reduces operational costs, complies with environmental standards (net zero by 2050) and enhances building value.

Importance of Workplace Safety

Why safety is critical in retrofitting

- Workers are exposed to construction-like environments in existing buildings, sometimes with occupants present.
- Avoiding injuries improves productivity and maintains project timelines.
- Safety contributes to long-term cost savings by reducing incident-related costs.

Link to regulatory compliance and reputation management.

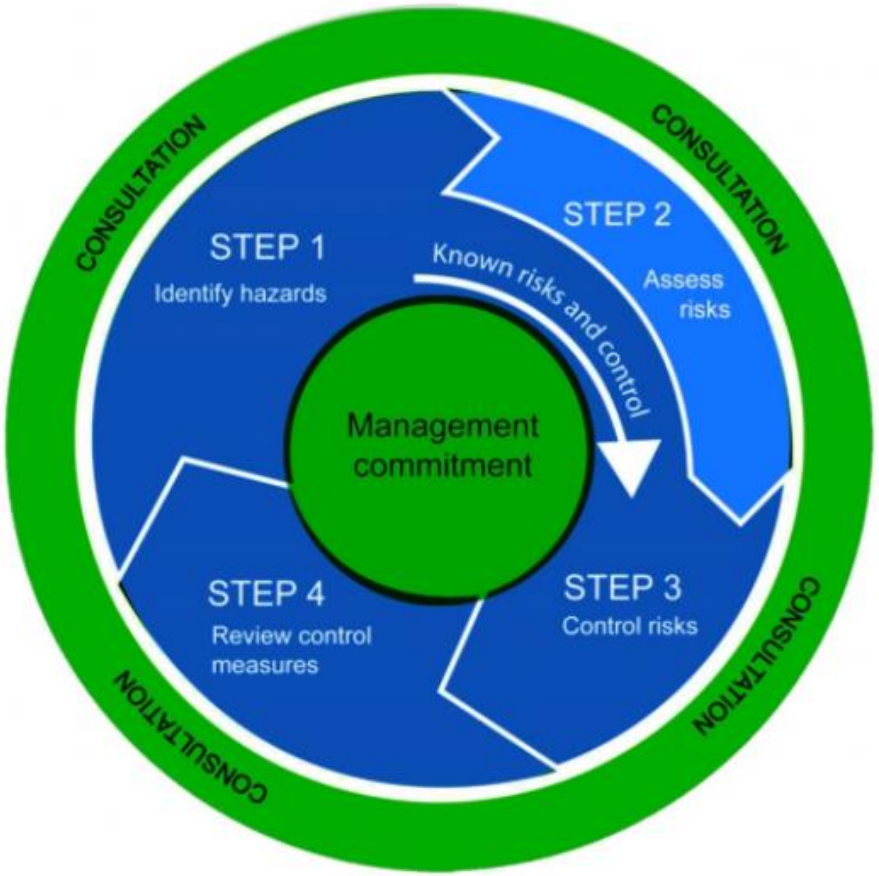
Key Safety Challenges in Retrofitting

- Working in occupied buildings where retrofitting must be non-disruptive.
- Working at heights in outdoor areas exposed at extreme weather conditions.
- Older infrastructure can hide hazards, such as weak structures, asbestos and outdated wiring.
- Working in confined spaces and difficult-to-access areas (e.g., attics, crawl spaces).
- Lifting and managing installation of heavy equipment in already established structures.

Risk Assessment Basics

Overview of risk assessment steps

1. **Identify hazards** specific to the job
2. **Evaluate the risks** (likelihood and impact).
3. **Implement control measures** to mitigate risks.
4. **Review and update** as conditions change.



Identifying Hazards

- Falls
- Electrocution
- Chemical and toxics exposure
- Confined Spaces
- Struct by incidents
- Use of Cranes
- Use of Forklifts
- SIMOPS
- Slips and trips

Falls risks in retrofitting projects

1. Inadequate Access and Egress

- **Scaffolding and Ladders**: Often, retrofitting requires temporary scaffolding or ladders, which may be unstable or set up in tight spaces. This can increase the risk of falls if not properly installed or maintained.
- **Rooftop Access**: Accessing rooftops or elevated areas in older buildings can be challenging if safe access points are limited.

2. Unstable or Weak Surfaces

- **Old Roofing Materials**: Retrofitting may involve working on older roofs that weren't designed for additional equipment or traffic, making them prone to collapse or damage.
- **Floor Openings**: There may be unguarded openings in roofs, floors, or balconies as part of the original structure, which could pose a fall hazard if not properly covered or marked.

3. Improvised Work Platforms

- **Nonstandard Equipment**: Due to space constraints or structural limitations, workers may use makeshift work platforms or inadequate equipment for height access, increasing fall risks.
- **Aerial Lifts**: Retrofitting can require the use of aerial lifts or other mobile platforms, which come with risks if operated in uneven terrain or close to obstacles.

Falls risks in retrofitting projects

4. Lack of Fall Protection Systems

- **Absence of Guardrails**: Older buildings may lack guardrails, anchor points, or other permanent fall protection measures.
- **Improper Harnessing**: In retrofits, especially smaller projects, fall protection equipment might be improperly used or omitted, especially if the workforce is undertrained or unfamiliar with the building's specific challenges.

5. Crowded or Restricted Workspaces

- **Increased Clutter and Congestion**: Energy-efficient retrofitting can bring additional equipment, materials, and teams into restricted spaces, which raises the risk of tripping and falling, particularly near edges or on ladders.

6. Weather and Environmental Conditions

- **Slippery Surfaces**: Retrofitting often involves rooftop or exterior wall work, where rain, snow, or ice can create slippery surfaces and increase the likelihood of falls.
- **Poor Lighting**: Retrofitting sometimes extends to working hours that involve low-light conditions, making it harder to see edges, obstacles, or surface hazards.

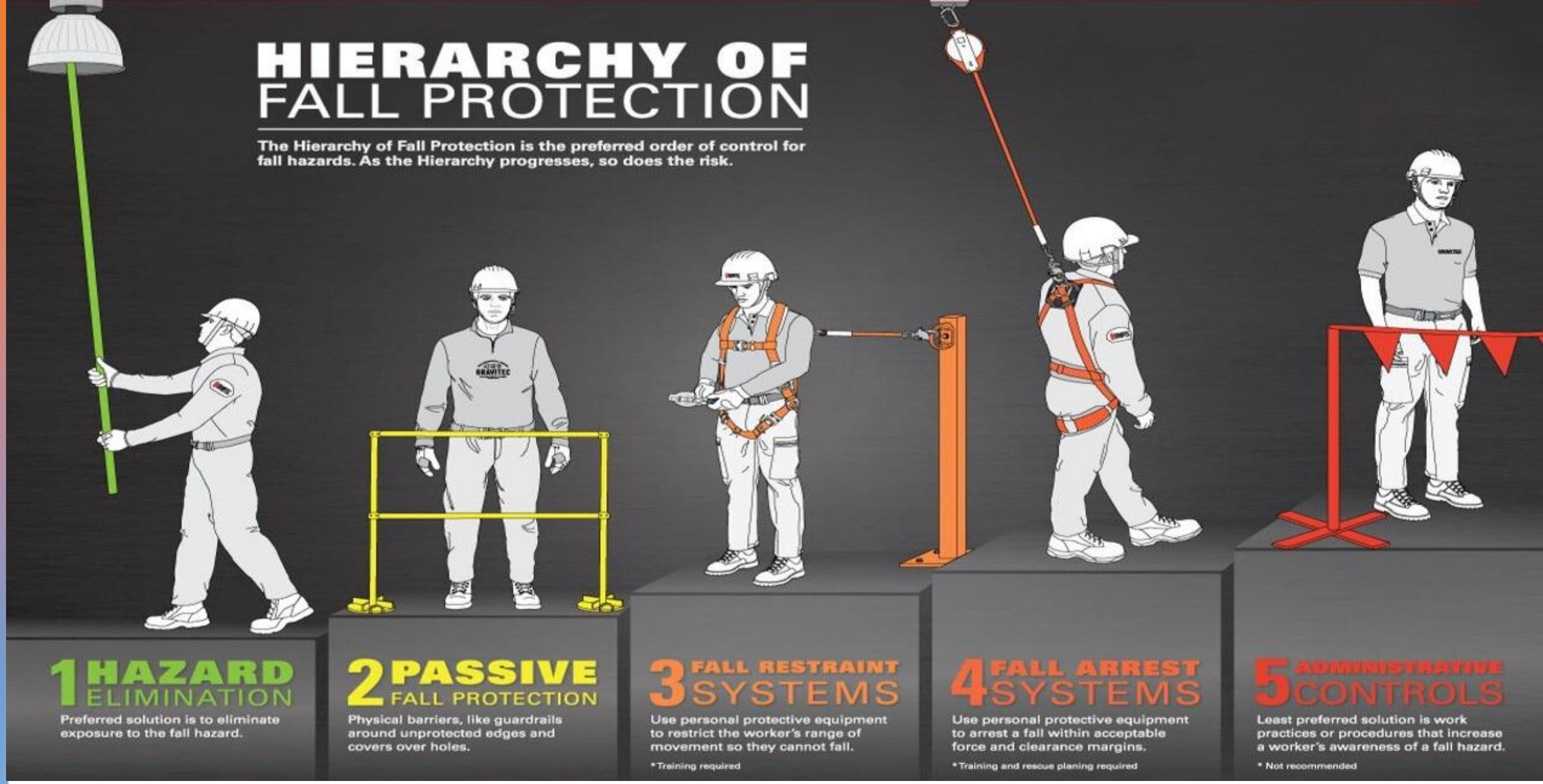
Fall Protection in Retrofitting

Safety gear: harnesses, guardrails and nets.

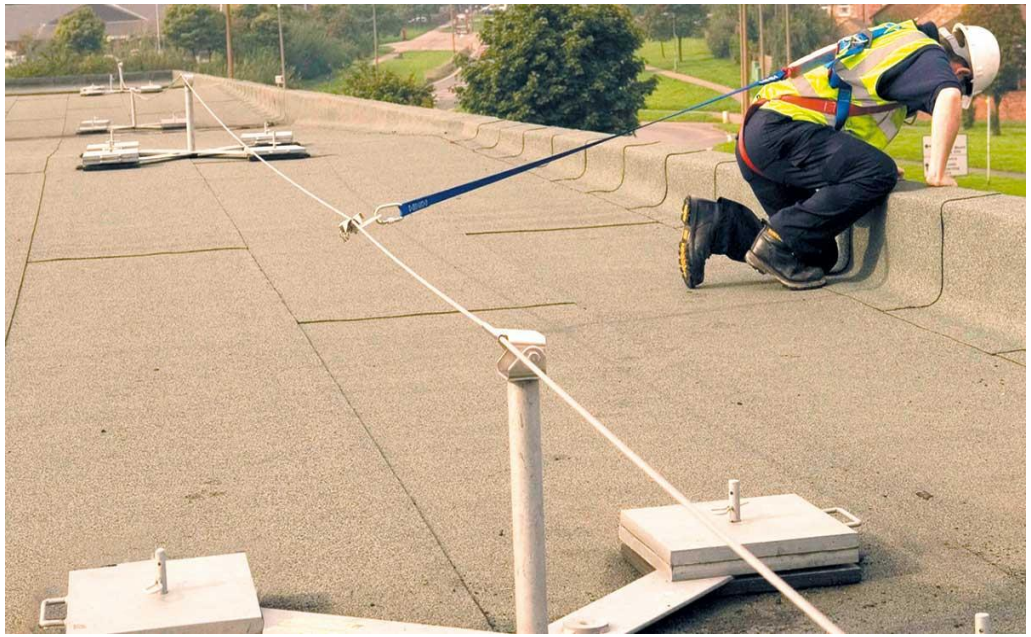
Installation and inspection of protection equipment **prior** to work.

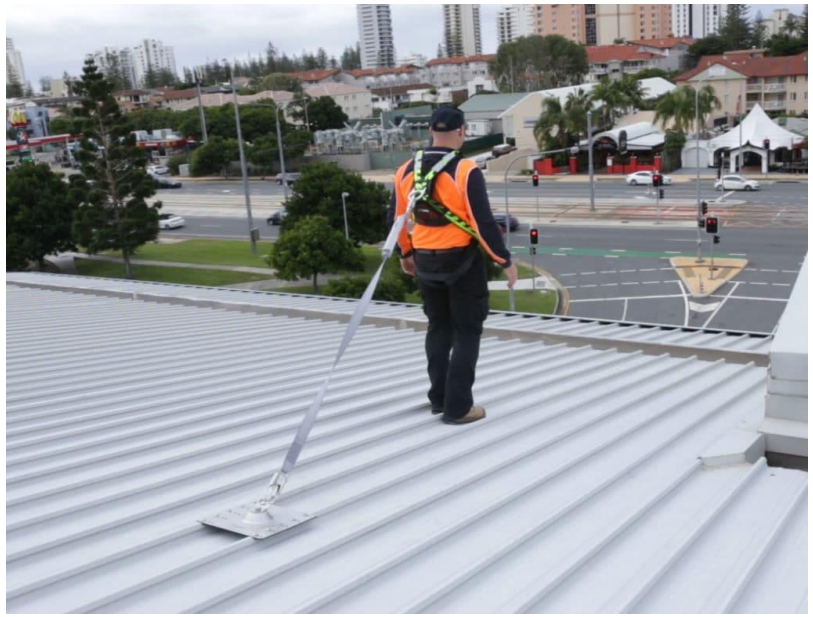
Importance of training workers on equipment use and height safety.

Workforce Medical fitness to work at heights.


HIERARCHY OF
FALL PROTECTION
The Hierarchy of Fall Protection is the preferred order of control for fall hazards. As the Hierarchy progresses, so does the risk.
1 HAZARD ELIMINATION
Preferred solution is to eliminate exposure to the fall hazard.
2 PASSIVE FALL PROTECTION
Physical barriers, like guardrails around unprotected edges and covers over holes.
3 FALL RESTRAINT SYSTEMS
Use personal protective equipment to restrict the worker's range of movement so they cannot fall.
*Training required
4 FALL ARREST SYSTEMS
Use personal protective equipment to arrest a fall within acceptable force and clearance margins.
*Training and rescue planing required
5 ADMINISTRATIVE CONTROLS
Least preferred solution is work practices or procedures that increase a worker's awareness of a fall hazard.
* Not recommended

Realistic cases





Electrical risks in energy retrofitting projects

1. Contact with Live Electrical Components

- **Exposed Wires**: During retrofitting, workers may encounter exposed wires or connections, especially if they're modifying old electrical systems.
- **Live Panels and Switchgear**: Retrofitting may require modifications to existing electrical panels or switchgear, which could be live if not properly de-energized, posing shock or electrocution risks.

2. Overloaded Circuits and Equipment

- **Circuit Overload**: New energy-efficient systems can strain outdated electrical infrastructure, causing overloaded circuits, tripped breakers, or electrical fires.
- **Temporary Power Sources**: Workers might rely on temporary power solutions like extension cords and power strips, which, if overloaded, can also lead to fires or electrical faults.

3. Arc Flashes and Electrical Explosions

- **Faulty Connections**: In retrofitting, poor or loose connections can lead to short circuits and arc flashes, which are hazardous to personnel and equipment.
- **Switching Operations**: Working on or near switchgear with energy-efficient upgrades can lead to arc flash incidents, especially if there are improper lockout/tagout (LOTO) procedures.

Electrical risks in energy retrofitting projects

4. Electrical System Compatibility Issues

- **Compatibility with New Systems**: Some energy-efficient systems (e.g., LED lighting, HVAC systems) may not be compatible with older electrical infrastructure, leading to system faults, overheating, or equipment malfunctions.
- **Inverter and Transformer Risks**: For renewable energy retrofits (e.g., solar installations), inverters and transformers introduce additional high-voltage risks and require proper handling and grounding.

5. Faulty or Inadequate Grounding

- **Improper Grounding**: Older buildings may have grounding issues, which could lead to increased risks of shock or equipment damage if not properly addressed in the retrofit.
- **Floating Neutrals**: Electrical systems that lack grounding or have floating neutrals can cause unpredictable currents, posing shock risks to workers and equipment.

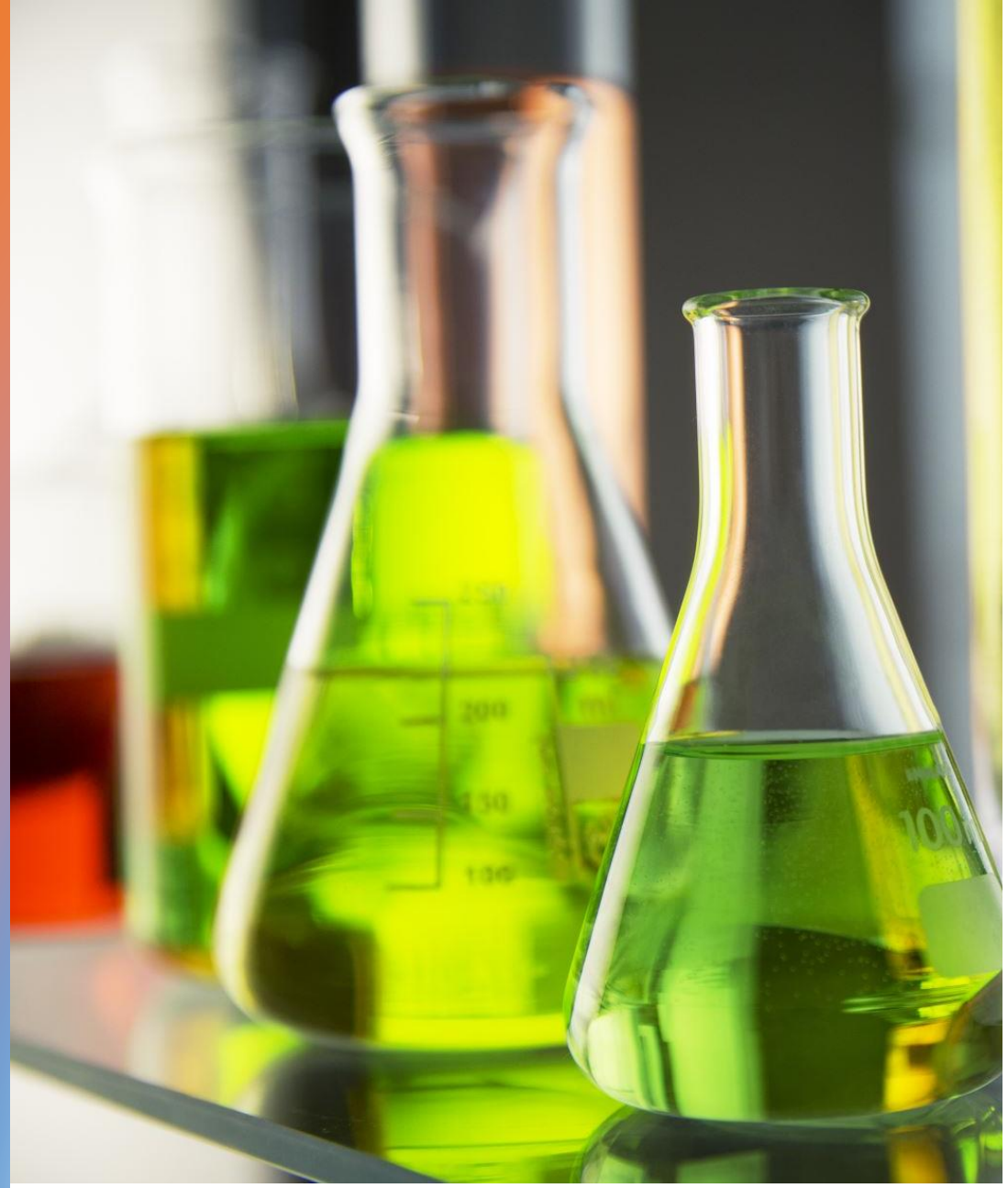
6. Environmental Factors

- **Moisture and Water Ingress**: Retrofitting often exposes electrical components to the elements, where moisture can lead to short circuits, shock hazards, or corrosion.
- **Dust and Debris**: Dust from construction can settle in electrical panels, leading to insulation breakdown and increased risk of electrical faults or fires

Electrical Safety

- **Risk Assessment and Mitigation Plans**: Perform risk analysis based on existing single line diagrams.
- **Equipment Maintenance and Inspections**: Frequency, documentation, and checks.
- **Training Programs**: Educating employees on safe practices and hazard recognition.
- **Safe Work Procedures**: Lockout/tagout (LOTO) systems, testing procedures, and PPE. Compliance with ISO 50110 requirements
- **Emergency Response Plans**: Protocols for responding to electrical incidents.
- **Types of PPE**: Insulated gloves, helmets, eye protection, and arc-rated clothing.
- **PPE Selection and Maintenance**: Ensure the right PPE is used, based on job requirements

Electrical Safety



Exposure to chemicals and dusts

- **Common Hazardous Substances**: Asbestos, silica, volatile organic compounds (VOCs), lead, and other substances from insulation materials, adhesives, sealants, and older building components.
- **Volatile Organic Compounds (VOCs):** Found in paints, adhesives, sealants, and finishes; can lead to respiratory irritation and long-term health risks.
- **Lead and Asbestos**: Often present in older structures; exposure can lead to severe respiratory and neurological issues.
- **Cleaning Agents and Sealants**: Chemicals used for cleaning or sealing during retrofitting can release hazardous fumes if not handled properly.
- **Refrigerants:** Common types include Hydrofluorocarbons (HFCs), Hydrochlorofluorocarbons (HCFCs), and natural refrigerants like ammonia (NH_3) and carbon dioxide (CO_2).Flammability, toxicity and asphyxiation are the most common risks

Exposure to chemicals and dusts

Silica Dust: Generated from cutting or drilling concrete, stone, or brick. Long-term exposure can cause silicosis, a chronic lung disease.

Construction and Demolition Dust: Can contain a mix of harmful particles (e.g., lead, asbestos, or fiberglass dust) that may irritate the respiratory tract.

Fiberglass and Insulation Materials: Dust from insulation can cause respiratory issues and skin irritation.

Controls and measures

Risk Assessment: Identify hazardous materials before starting work (e.g., assess presence of asbestos, lead paint).

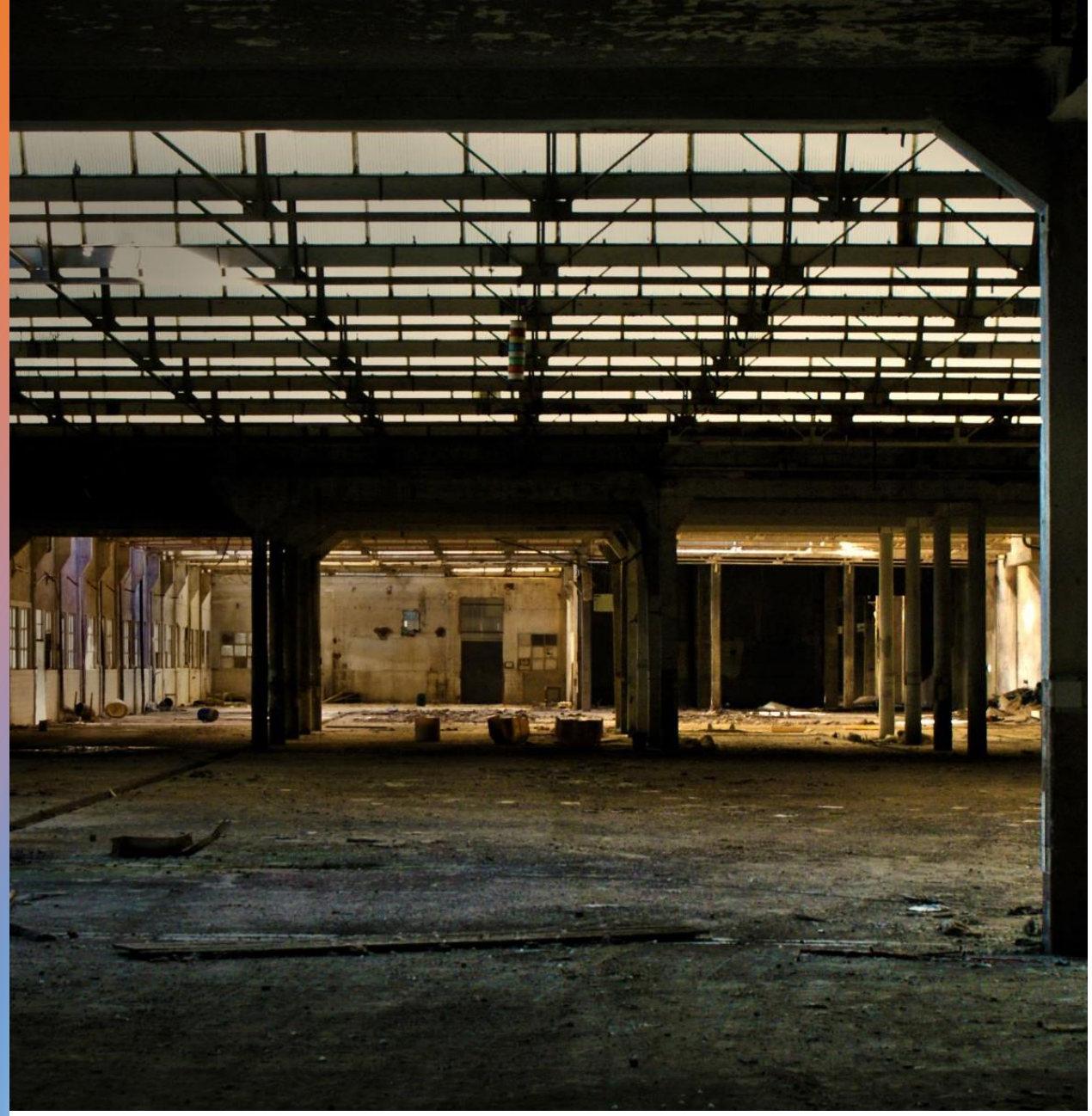
Training and Awareness: Educate workers on the hazards of specific chemicals and dust, and the proper use of PPE based on Safety Data Sheets information.

Regular Monitoring and Air Quality Testing: Measure airborne contaminant levels, especially in enclosed spaces.

Emergency Preparedness: Establish protocols for managing accidental exposures or spills.

Controls and measures

Ventilation:	Use local exhaust ventilation systems to remove airborne contaminants at the source.
Isolation and Containment	Set up barriers or negative pressure enclosures to limit dust spread.
Wet Methods	Use water suppression for activities like drilling or cutting to reduce dust generation
Use of PPEs	Selection of efficient respiratory protection depending the exposure , FFP1 – 3, Half/Full face masks



Confined space Safety

A confined space is an area that:

- Is large enough for a worker to enter and perform work.
- Has limited or restricted means for entry or exit.
- Is not designed for continuous occupancy.

Examples in Retrofitting: Boiler rooms, HVAC ducts, crawl spaces, utility vaults, and storage tanks

Confined Spaces Hazards

Atmospheric Hazards:
Oxygen Deficiency: Caused by displacement or consumption of oxygen, which can lead to asphyxiation.
Toxic Gases: Exposure to gases like carbon monoxide, hydrogen sulfide, and ammonia can cause severe health risks or death.
Flammable Vapors: The accumulation of flammable gases can create explosion risks.

Confined Spaces Hazards

Physical Hazards:

Limited Egress: In emergencies, restricted access can delay or prevent a quick escape.

Engulfment: The risk of being engulfed by materials like sand or granular substances.

Electrical Hazards: Exposed wiring or electrical equipment increases the risk of electric shock.

Controls and Measures

Proper Ventilation: Ensure ventilation to dilute harmful gases and maintain oxygen levels.

Gas Monitoring: Use detectors to continuously monitor oxygen levels and presence of toxic or flammable gases.

Safe Work Procedures: Implement protocols for entry, working, and exiting confined spaces (PTW), with appropriate PPE.

Training and Awareness: Equip workers with knowledge on the specific hazards and emergency procedures related to confined spaces.

Emergency Preparedness: Establish an emergency rescue plan with trained personnel and specialized equipment to respond rapidly if issues arise.

Struck by Risks in energy retrofitting projects

Falling Tools and Materials

- **Unsecured Tools**: Workers at heights may accidentally drop tools or equipment, which can strike individuals working below.
- **Loose Building Materials**: Old materials being removed (like bricks, insulation, or roof tiles) may fall if not properly secured or if scaffolding isn't adequately maintained.
- **Mechanical Equipment**: Use of cranes, lifts, or hoists to move heavy materials can lead to dropped loads if equipment is mishandled or malfunctions.

Moving Vehicles and Heavy Equipment

- **Forklifts and Aerial Lifts**: In retrofitting projects, heavy equipment and vehicles are often used in tight or confined spaces, increasing the risk of workers being struck by these vehicles.
- **Delivery Trucks**: Materials frequently need to be brought to the site, often in crowded conditions. Workers can be struck by trucks or other vehicles if visibility is low or traffic control isn't properly managed.

Struck by Risks in energy retrofitting projects

Suspended Loads

- **Hoisting Materials**: Materials lifted by cranes or other hoisting equipment can swing or drop unexpectedly, putting workers at risk of being struck.
- **Failure of Lifting Equipment**: Improperly rigged or overburdened lifting equipment may fail, causing heavy loads to fall unexpectedly.

Power Tools and Equipment

- **Nail Guns and Fasteners**: Nail guns and other power-driven tools are often used in retrofits, with the potential for fasteners to ricochet or misfire, injuring nearby workers.
- **Cutting Tools**: Saws, grinders, and drills can create flying debris, which may strike workers if protective measures or PPE aren't in place.

Struck by Risks in energy retrofitting projects

Flying Debris from Demolition Work

- **Deconstructing Old Components**: Retrofitting often involves partial demolition of walls, roofing, or insulation, which can result in debris flying or falling, especially in windy or unpredictable environments.
- **Dust and Particles**: Smaller particles and dust created by power tools or cutting operations can also be a hazard if they strike the face or eyes.

Structural Instability

- **Collapsing Sections**: During retrofits, parts of older structures may collapse if weakened or improperly handled, posing a risk of falling debris.
- **Vibration from Power Tools**: Drills, jackhammers, or other tools can cause vibrations that destabilize parts of the structure, creating falling hazards.

Compressed Gas and Pressurized Systems

- **Pressurized Lines and Pipes**: Retrofitting often involves work around existing systems, including HVAC or compressed air lines, which can rupture or explode, causing fragments or particles to be ejected.
- **Releasing Stored Energy**: Incorrect handling of pipes or tanks containing pressurized gas or liquids can lead to sudden releases that might strike nearby workers

Struck by Risks control measures

Engineering Controls

- **Tool Tethering and Securing Materials**: Use tool lanyards and tethers for all tools and materials used at heights to prevent accidental drops. Secure loose materials to scaffolding or other stable structures to avoid falls.
- **Guardrails and Toe Boards**: Install guardrails and toe boards on elevated work areas to prevent materials from falling off edges.
- **Barriers and Exclusion Zones**: Use physical barriers or cordon off areas below or around elevated work zones to keep unauthorized personnel out of high-risk zones.

Administrative Controls

- **Pre-Task Planning and Risk Assessment**: Conduct a risk assessment before starting work to identify struck-by hazards. Plan tasks with these risks in mind, ensuring appropriate safety measures are in place.
- **Work Zone Management**: Establish clear work zones, especially for areas with moving vehicles and equipment. Implement traffic controls such as signage, barriers, and designated pedestrian paths to reduce the risk of workers being struck by vehicles or equipment.
- **Use of Spotters**: Assign trained spotters to guide vehicle or equipment operators when working in tight spaces or around pedestrian zones.
- **Scheduling and Sequencing**: Coordinate tasks to minimize the number of workers in high-risk areas, especially below elevated work or in the vicinity of heavy machinery. Schedule work that involves potential flying debris (e.g., demolition) when fewer people are on-site.

Struck by Risks control measures

Personal Protective Equipment (PPE)

- **Hard Hats and Eye Protection**: Require all workers to wear hard hats and safety glasses to protect against falling objects and flying debris.
- **High-Visibility Clothing**: Ensure workers in areas with vehicle traffic or moving equipment wear high-visibility vests or clothing to remain visible to operators.
- **Face Shields and Respirators**: For tasks that involve flying debris, such as grinding or cutting, face shields can offer additional protection. Respirators may also be required if dust is a concern.

Training and Communication

- **Worker Training**: Train all workers on struck-by hazards specific to retrofitting projects and ensure they understand the proper use of tools, equipment, and PPE.
- **Safety Briefings**: Hold regular safety meetings and pre-task briefings to communicate potential struck-by hazards for the day and remind workers of site-specific safety protocols.
- **Effective Communication Systems**: Use radios or hand signals for communication between teams, especially when visual contact is limited (e.g., in confined areas or when operators are in vehicles).

Struck by Risks control measures

Vehicle and Equipment Safety

- **Inspection and Maintenance**: Regularly inspect and maintain vehicles, cranes, forklifts, and other heavy equipment to ensure they're in safe working condition and free of defects.
- **Backup Alarms and Mirrors**: Ensure all vehicles and equipment are equipped with functioning backup alarms, mirrors, and cameras where possible, to improve operator visibility.
- **Speed Limits and Operational Restrictions**: Set and enforce speed limits for vehicles and equipment operating on-site, especially in pedestrian zones or confined areas.

Lifting and Hoisting Controls

- **Proper Rigging Practices**: Ensure materials are properly rigged and secured when using cranes or hoists to prevent accidental drops or swinging loads.
- **Load Capacity Awareness**: Train operators to understand equipment load capacities and never exceed them, reducing the likelihood of equipment failure or dropped loads.
- **Spotters for Lifting Operations**: Use spotters to keep the area clear and monitor load movements, minimizing the risk of unexpected strikes by suspended materials.

Use of Cranes Risks

Certified and medically fit operators
Underground risks
Overloading
Mechanical Failure
Boom Collapse
Power Line Contact
Swinging Loads
Weather conditions

Use of Crane Risks - Controls and Measures

Operator Training, Certification and Health Surveillance : Ensure operators are well-trained, certified, and familiar with equipment-specific guidelines.

Pre operation equipment inspections: Conduct regular inspections and maintenance to detect and address potential mechanical issues.

Lifting plans development: Lifting capacity, load transfer to the ground, lifting accessories, wind resistance influence, load lifting route to be planned prior activities commencement.

Clear Communication: Use standard signals or radios to maintain clear communication between operators and spotters. Language barriers to be considered as well.

Define Safe Zones: Restrict access to lifting areas and provide adequate signage or barriers around crane and forklift operation zones.

PPE: Require workers to wear appropriate PPE, such as hard hats and high-visibility vests, in areas where cranes and forklifts are active.

Use of Forklifts Risks

Certified and medically fit operators
Tip-Overs
Overloading
Pedestrian Collisions
Falling Loads
Poor Visibility and Blind Spots
Carbon Monoxide Exposure

Use of Forklifts Risks - Controls and Measures

- **Operator Training, Certification and Health Surveillance** : Ensure operators are well-trained, certified, and familiar with equipment-specific guidelines.
- **Pre-Operation equipment Inspections**: Conduct regular inspections and maintenance to detect and address potential mechanical issues.
- **Enhanced Visibility and Communication**: Use of lights and alarms, mirrors and cameras, Spotter Use in Congested Areas.
- **Designated Forklift Operating Zones**: Clear forklift paths and pedestrians' free zones definition, speed limits and stop signs placement.
- **PPE**: Require workers to wear appropriate PPE, such as hard hats and high-visibility vests, in areas where cranes and forklifts are active.

SIMOPS

SIMOPS (Simultaneous Operations) refers to situations where multiple activities occur concurrently, often in confined spaces or during complex projects like energy retrofits in buildings. In these scenarios, risks can escalate, especially in active sites where different trades and types of work overlap.

Examples :

- HVAC System Upgrade and Electrical Work
- Window Replacement and Insulation Installation
- Solar Panel Installation on Roof and Interior Electrical Upgrades
- Roof Insulation and Solar Reflective Coating Application
- Boiler Replacement and Plumbing Retrofit in Mechanical Room

SIMOPS Common Risks

Interference Between Activities: Different operations, such as welding and crane lifting, can interfere with each other, leading to accidents. For example, sparks from welding could ignite flammable materials being lifted or transported nearby.

Communication Failures: With multiple teams working simultaneously, communication gaps can lead to misunderstandings or accidents, especially if not everyone is aware of ongoing operations around them.

Confined Space Congestion: In confined areas, SIMOPS can increase congestion, complicating workflows and creating risks like entrapment, slips, or falls.

Increased Fire and Explosion Risks: Hot work activities like cutting, welding, or grinding near flammable materials, fuel storage, or gas lines elevate the risk of fire or explosion.

SIMOPS Common Risks

Equipment Conflicts: Conflicting equipment operations, like forklifts and cranes moving in the same area, can lead to collisions or dropped loads.

Exposure to Hazardous Substances: Multiple operations can increase the chance of exposure to hazardous chemicals, dust, fumes, or gases, particularly in poorly ventilated spaces.

Utility Overload and Malfunctions: SIMOPS can strain utilities, such as power, water, or compressed air systems, increasing the risk of outages or leaks.

Delayed Emergency Response: SIMOPS can complicate emergency responses, making it more challenging for rescue teams to access affected areas.

SIMOPS Risks Controls and Measures

Comprehensive Risk Assessments: Conduct risk assessments before starting SIMOPS, identifying potential interactions and hazards specific to overlapping activities.

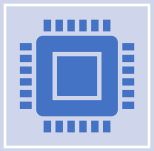
SIMOPS Coordination Plans: Develop a SIMOPS plan detailing which activities can occur together, highlighting high-risk combinations that should be avoided.

Use of SIMOPS Coordinators: Assign a SIMOPS coordinator responsible for overseeing and coordinating activities, managing potential conflicts, and ensuring that all teams adhere to safety protocols.

SIMOPS Risks Controls and Measures

Clear Permitting System: Implement a permit-to-work system that requires approval for specific high-risk activities (e.g., hot work, confined space entry) and integrates SIMOPS considerations.

Regular Safety Briefings and Updates: Conduct daily or weekly safety briefings for all teams to review potential SIMOPS risks, communicate schedule changes, and reinforce safety protocols.



Job Safety Analysis (JSA): Perform JSAs for each operation, paying close attention to the cumulative risks when tasks overlap. Include measures to control hazards specific to concurrent work.

Summary Table of Incident Types and Prevention Strategies

Incident Type	Causes	Prevention Strategies
Falls and Falling Objects	Lack of fall protection, unsecured materials	Use fall arrest systems, secure materials, define exclusion zones
Electrical Incidents	Contact with live wires, poor insulation	Implement LOTO, verify power off, electrical safety training
Chemical Exposure	Dust, harmful substances	Use PPE, ensure ventilation, conduct hazard assessments
Fire and Explosions	Ignition sources near flammable materials	Hot work permit, fire extinguishers, flammable storage protocols
Structural Hazards	Load misjudgment, lack of support	Engineering assessments, structural reinforcements
Confined Space Incidents	Poor ventilation, air quality issues	Use permits, monitor air, ventilation systems
Slip, Trip, and Fall Hazards	Clutter, uneven surfaces	Enforce housekeeping, secure cords, clear walkways
Equipment Incidents	Mishandling machinery	Operator training, spotters, regular inspections
Ergonomic Injuries	Repetitive tasks, heavy lifting	Ergonomic training, lifting aids, regular breaks
Heat/Cold Exposure	Temperature extremes	Climate monitoring, regular breaks, hydration
Coordination Failures (SIMOPS)	Poor planning, unclear zones	SIMOPS plan, real-time communication, work zone boundaries
Noise-Induced Hearing Loss	Prolonged exposure to loud noise	Hearing protection, limit time in noisy areas

Benefits of a Strong Safety Culture

Reduced Accident Rates & Improved Safety Outcomes

Enhanced Employee Morale & Job Satisfaction

Increased Productivity & Efficiency

Lower Costs & Financial Savings

Improved Compliance & Regulatory Adherence

Enhanced Reputation & Employer Branding

Long-Term Sustainability & Business Continuity

Greater Risk Awareness & Proactive Hazard Identification

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THANK YOU!

Q & A

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