Finch Consulting

Process Safety Best Practice Guide - Food & Drink

For Management and Health & Safety Professionals

Produced by
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Table of Contents:

0. Introduction/1. Scope/Business Case/Leadership & Culture

0. Process Safety for the Food & Drink Industry

What is Process Safety?

Process Safety is about understanding the hazards and risks associated with a process/plant and how best to keep the risks as low as reasonably practicable (ALARP). It aims to prevent incidents such as fires, explosions, toxic releases, and equipment failures that could cause harm to people, the environment, and assets. It involves principles of engineering, operational practices, and organisational behaviour to ensure safe and reliable operations.

It deals with the prevention and control of events that have the potential to release hazardous materials or energy.

Key elements of Process Safety include:

- Hazard identification and risk management.
- Safe design and operation of equipment.
- Employee training and engagement.
- Emergency preparedness and response.
- Regulatory compliance and incident investigation.

Why is Process Safety required for the Food & Drink Industry?

The food and drink industry faces unique process safety challenges due to its reliance on a variety of hazardous substances, complex processes, and strict quality standards. Implementing process safety is critical for protecting employees, consumers, the environment, and business continuity.

Hazards which are found at Food and Drink sites include:

- Combustible dusts like sugar, flour, spices, grains.
- Ammonia from refrigeration systems
- Natural gas for ovens, fryers, etc.
- Cleaning agents and sanitisers.
- Gas cylinders under pressure.

The Food & drink industry is subject to strict regulations and standards such as FDF/FSA regulations and Process Safety ensures compliance with these regulations.

1. Scope of the Process Safety Best Practice Document

- These documents are applicable for the below markets but can also be applicable to other industries:
  - Food manufacturing (e.g., dairy, bakery, snacks, beverages).
  - Processing plants for raw materials (e.g., meat, grains, fruits, vegetables).
  - Storage and distribution facilities for food and drink products.
- For process safety in the food and drink industry, best practice guidelines generally should be used whenever there is a need to assess, mitigate, and manage risks associated with the handling, processing, and storage of materials and equipment.
- This best practice document will have a comprehensive coverage of all safety- related aspects, and it will provide a structured approach to managing risks, maintaining regulatory compliance, and ensuring the safety of people, products, and the environment. This document serves as a vital resource for continuous improvement and maintaining high safety standards.
- The best practice documents can be used for all stages of production, from raw materials to packaging and distribution.
- The topics below describe the business case required for Process Safety and how important Leadership and Culture is for keeping processes and people safe.

Focus Areas of the Best Practice document

1.1 Focus Areas

The following topics will be described in further detail in separate chapters.

- Hazard Identification & Risk Management
- Engineering Design & Process Safety
- Energy and Process Safety
- Human Factors
- Training & Competency
- Emergency Planning, Incident Response & Process safety

1.2 Business Case for improved Process Safety

This business case outlines why process safety management (PSM) is essential, recommends a tailored PSM framework, evaluates alternatives, and provides an implementation plan. By adopting this approach, the organisation will enhance safety, ensure compliance, protect its reputation, and achieve operational efficiencies.

What are we suggesting?

- Finch propose the implementation of a comprehensive Process Safety Management (PSM) framework to address key risks in the food and drink industry. The framework will include and will go into more detail in further sections (other techniques can also be included):
- Hazard Identification & Risk Management
- Engineering Design & Process Safety
- Energy and Process Safety
- Human Factors
- Training & Competence
- Emergency Planning, incident response and Process Safety

Why are we suggesting it?

- Within the food and drink industry there are unique hazards in the industry like combustible dusts (flour, sugar, etc) and these can have serious consequences for people, assets and environment if the hazards aren't controlled correctly.
- Meeting regulatory standards such as the HSE is critical to ensure the sites can continue to operate since if the client isn't being compliant then the HSE can shut down production.
- Prevents workplace injuries, fatalities and regulatory fines.
- Reduce costs from recalls, downtime and equipment damage.
- Protect brand reputation and raise consumer trust.

What are the alternatives?

Comprehensive PSM framework (recommended above): A structured proactive approach which embeds safety into every aspect of operations which mitigates risks, ensures compliance and supports sustainable business growth. While PSM is the recommended approach, the other alternatives available are:

- Reactive safety measures: address incidents as they occur without proactive risk management. This would incur higher costs due to frequent disruptions, injuries, regulatory penalties and reputational damage.
- Basic compliance only: implement the minimum measures required by regulators but this does not address underlying risks are enhance continuous improvement. This provides limited effectiveness and missed opportunities for efficiency and risk reduction.

How will it be implemented?

One way Finch can support with the implementation of the Process Safety framework is split it into 3 phases below:

- Phase 1: Assessment and Planning (3-6 months): Conduct a baseline risk assessment to identify hazards and benchmark the current practices against industry standards and develop an action plan to have a clear understanding of the gaps required to be closed.
- Phase 2: System Design and Deployment (6-12 months): Support in developing policies and procedures for risk management, equipment maintenance and emergency planning. Train employees at all levels in process safety awareness and technical competencies. We can support in the upgrade of equipment to ensure it meets safety standards. This will mean a functional PSM framework can be integrated into daily operations.

- Phase 3: Monitoring and Continuous Improvement (Ongoing): Finch can schedule regular audits, inspections and drills to identify areas of improvement and support with established KPIs to help track process safety performance. Leaders need to own these processes to ensure improved ongoing safety culture (see next page for in depth pointers of Leadership and culture). This should ensure a sustained safety performance.

Recommendations

Investing in a comprehensive Process Safety Management framework is critical for the food and drink industry to ensure the safety of employees, consumers, and the environment. While there are upfront costs, the long-term benefits (including compliance, operational efficiency, and brand protection) far outweigh the risks of inaction. We recommend immediate approval and allocation of resources to implement the proposed plan. Other benefits are highlighted on the below to help support with the client's business case of Process Safety.

1.3 Benefits of Process Safety

- Reduced workplace injuries, illnesses, and fatalities.
- Compliance with safety standards, reducing legal liabilities and penalties.
- Avoidance of costly penalties and legal actions with agencies such as the HSE.
- Smoother audits and inspections with the HSE.
- Improved stakeholder confidence in regulatory adherence.
- Strengthened employee morale and trust through safer working conditions.
- Prevention of costly recalls and lawsuits.
- Enhanced consumer confidence in product safety and brand reliability.
- Competitive advantage in a market that values transparency and responsibility.
- Lower operational disruptions and unplanned downtime with improvements to asset longevity and efficiency.
- Reduced insurance premiums due to improved risk management.
- Reduced environmental impact and alignment with sustainability goals.
- Positive public relations due to environmentally responsible practices.
- Reduction in waste from production errors or rework.
- Improved coordination and efficiency across departments.
- Enhanced reputation as a safety-conscious and responsible organisation.
- Attraction and retention of talent due to a culture of safety.
- Improved investor confidence and opportunities for partnerships.
- Access to broader markets and improved credibility in global supply chains.
- Consistency in quality and safety across international operations.

1.4 Leadership & Culture for improved Process Safety

Strong leadership is the foundation of a successful process safety strategy. Leaders set the tone for the organisation and are responsible for ensuring that safety is prioritised at all levels.

Process Safety culture refers to the shared attitudes, values, and behaviours that determine how process safety is prioritised and managed within an organisation. A strong process safety culture ensures that safety is integrated into all aspects of operations.

Below highlights ways where management and employees can get involved with improving process safety:

Management Involvement:

- Ensure management commitment to process safety through active participation, prioritising safety investments, and encouraging a strong safety culture.
- Align safety goals with business objectives to emphasise its importance.
- Demonstrate personal commitment by adhering to safety practices.
- Actively participate in safety meetings, audits, and incident reviews.
- Provide adequate funding, staffing, and tools for implementing and maintaining process safety systems.
- Invest in training, equipment upgrades, and technologies to reduce risks.
- Use Key Performance Indicators (KPIs) to track safety metrics and drive improvement.
- Encourage innovation to address safety challenges and improve processes which should include cross-function collaboration.

Employee Engagement:

- Foster an open environment where employees are encouraged to voice process safety concerns and participate in safety improvement initiatives and to also report hazards, near misses and unsafe conditions.
- Have an environment where everyone learns from past incidents and near-misses to prevent recurrence.
- Proactive Mindset- employees and leaders need to focus on identifying and mitigating process safety risks before they lead to incidents.
- All employees adhere to regulatory standards and internal safety policies.
- Ensure all key employees like operations and maintenance get involved in HAZIDS, HAZOPs for improved understanding of processes.
- Safety culture surveys should be conducted to gauge employee perceptions of leadership commitment.
- Ensure all employees don't become complacent and should always have a sense of chronic unease especially if no incidents have occurred recently.

2.0 Hazard Identification and Risk Management

2.1 Introduction to Hazard Identification and Risk Management

Effective hazard identification and risk management are critical for ensuring safe operations in the food and drink industry. This guide outlines a systematic approach to identify hazards, assess risks, and implement strategies to mitigate those risks. The below objectives are critical for a good hazard identification and risk management system:

- Identify hazards & risks: Recognise potential sources of harm in food and drink operations.
- Assess Risks: Evaluate the likelihood and consequences of hazardous events.
- Manage & Control Risks: Implement controls to reduce risks to acceptable levels.
- Review Controls: continuously review the controls and ensure they are functioning/working.
- Ensures Compliance: Align with regulations such as the HSE, and ISO standards.
- Protects Stakeholders: Safeguard employees, consumers, and the environment.

Risk Management Cycle

2.2 Scope of Hazard Identification & Risk Management

Covers all processes, equipment, and activities, including:

- Raw Material Handling: Contaminants, allergens, and storage conditions.
- Processing: High-temperature equipment, pressurised systems, and chemical use.
- Packaging and Storage: Ergonomic hazards, combustible dust, and mechanical risks.
- Cleaning and Maintenance: Chemical exposure and lockout/tagout (LOTO) failures.
- Refrigeration and Utilities: Ammonia leaks, compressed gases, and energy sources.
- Distribution and Transportation: Risks during loading, unloading, and transit.

2.3 Steps for Hazard Identification

Typically, Hazard Identification can be split into 3 main steps as seen below:

- Step 1: Form a Hazard Identification Team
  - Include personnel with expertise in operations, engineering, safety, and maintenance.
  - Ensure representation from all relevant areas, such as quality assurance and logistics.
- Step 2: Gather information
  - Process flow diagrams (PFDs) and piping and instrumentation diagrams (P&IDs).
  - Material Safety Data Sheets (MSDS) for chemicals used.
  - Equipment specifications and maintenance records.
  - Incident history, near-misses, and regulatory guidelines.
- Step 3: Use Systematic techniques (Finch can supply templates and support)
  - Checklists: Identify common hazards specific to food and drink processes (e.g., combustible dust, pressurised systems).
  - What-If Analysis: Pose hypothetical scenarios to identify potential deviations (e.g., "What if the refrigeration system fails?").
  - Hazard and Operability Study (HAZOP): Analyse process deviations (e.g., incorrect temperatures during pasteurisation).
  - Failure Modes and Effects Analysis (FMEA): Identify equipment failure risks and their potential impacts (e.g., conveyor belt malfunctions).
  - Task-Based Assessments: Observe workers performing tasks to identify ergonomic and operational hazards (Human Factors will be covered in more detail in Section 5).

2.4 Common hazards in Food and Drink Industry

Hazard	Potential Risks Controls	Controls
Combustible Dust	Explosions from dust (e.g., flour, sugar)	Dust collection systems, regular cleaning, explosion venting
Ammonia Refrigeration	Toxic leaks, fire risks	Leak detection systems, proper ventilation, training
High - Temperature Processes	Burns, equipment fires	Insulation, safety interlocks, temperature alarms
Chemical Handling	Burns, respiratory issues, contamination	Proper storage, training, PPE, MSDS access
Pressurised Systems	Explosions, equipment failure	Pressure relief valves, regular maintenance
Ergonomic Risks	Musculoskeletal injuries	Ergonomic design, rotation of tasks, training
Slips, Trips, Falls	Injuries from wet floors or obstacles	Non - slip flooring, good housekeeping

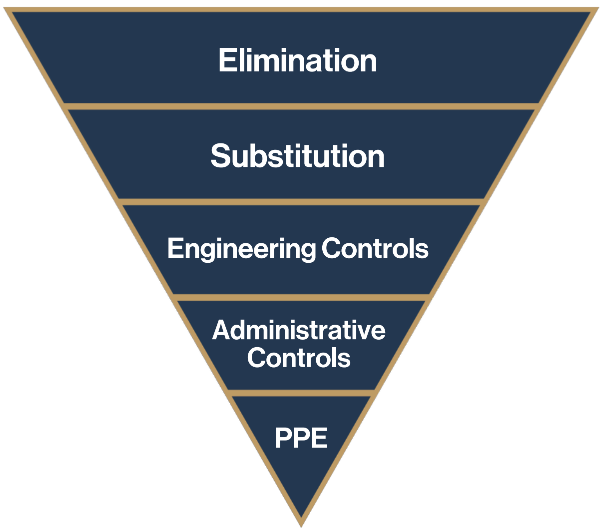
2.5 Steps for Risk Management

Step 1: Risk Assessment For each identified hazard, evaluate:

- Likelihood: The probability of the hazard occurring (e.g., frequent, occasional, rare).
- Severity: The potential consequences (e.g., minor injury, major injury, fatality, environmental damage).
- Risk Level: Use a risk matrix to prioritise hazards (e.g., low, medium, high, critical).

Step 2: Mitigation Strategies - Apply the Hierarchy of Controls to manage risks:

- Elimination: Remove the hazard entirely, if feasible.
  - Example: Replace highly flammable materials with safer alternatives.
- Substitution: Use less hazardous materials or processes.
  - Example: Substitute toxic cleaning agents with eco-friendly options.
- Engineering Controls: Modify processes or equipment to reduce exposure.
  - Example: Install dust collection systems for flour milling operations.
- Administrative Controls: Develop procedures and training to minimise risks.
  - Example: Implement standard operating procedures (SOPs) for handling hazardous chemicals.
- Personal Protective Equipment (PPE): Use PPE as a last resort.
  - Example: Provide gloves and goggles for workers handling corrosive chemicals.



Hierarchy of Controls

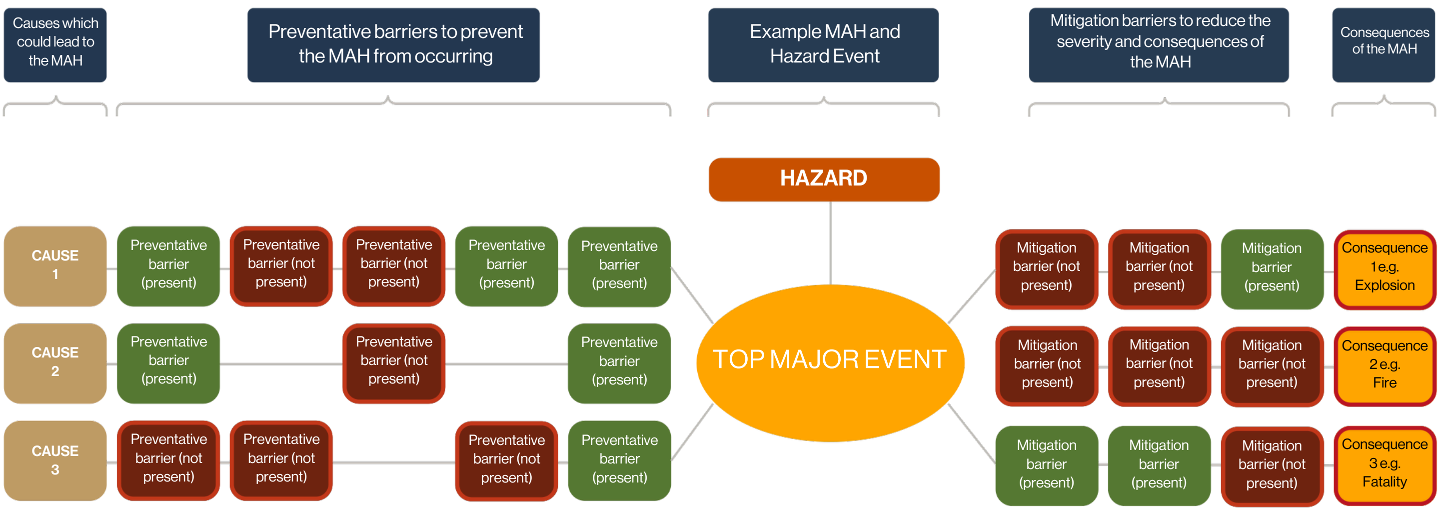
Step 3: Emergency Preparedness
- Develop Response Plans: Address potential scenarios, such as chemical spills or equipment malfunctions.
- Conduct Drills: Practice emergency responses, such as fire evacuations or ammonia leak containment.
- Provide Training: Ensure employees know how to respond effectively.

Step 4: Monitoring and Continuous Improvement
- Set KPIs: Measure performance, such as the number of incidents, near-misses, and completed training sessions.
- Conduct Audits: Regularly review processes to identify new hazards or gaps in controls.
- Investigate Incidents: Analyse root causes of accidents or near-misses to prevent recurrence.

2.6 Tools and Techniques which can be used for Hazard and Risk Management

Below are some of the key tools and techniques used for Hazard and Risk Management:

- Risk Analysis Tools: Use of HAZID, HAZOP or FMEA for structured risk analysis to ensure all risks and hazards are identified. Finch can support in all these risk analysis tools.
- Risk Matrices: Visualise and prioritise risks in terms of risk ranking to ensure the high hazard risks are addressed first.
- Bowtie Diagrams: Map causes, consequences, and controls for critical major events similarly to the example given below. Finch can assist clients in producing Bowtie diagrams.
- Incident Databases: Learn from past incidents to prevent future occurrences.



2.7 Integration with Process Safety Management (PSM)

Hazard Identification and Risk Management is a core element of PSM and should be integrated with other components, which are described in other sections of this document and include:

- Engineering Design
- Understanding Energy and Process Safety
- Human Factors
- Training and competency
- Emergency planning and incident response

2.8 Benefits of Effective Hazard Identification and Risk Management

The below are key benefits of effective use of Hazard Identification and Risk Management:

- Enhanced Safety: Reduced injuries, fatalities, and near-misses.
- Regulatory Compliance: Alignment with the HSE and ISO standards.
- Operational Efficiency: Fewer disruptions due to incidents or equipment failures.
- Cost Savings: Lower costs from fines, downtime, and legal liabilities.
- Reputation Protection: Prevent product recalls and protect consumer trust.

2.9 Summary

By systematically identifying hazards and implementing effective risk management strategies, the food and drink industry can create safer workplaces, ensure regulatory compliance, and achieve sustainable operations. This proactive approach protects employees, consumers, and business continuity while fostering a strong safety culture.

Finch can support our clients with carrying out key risk assessments including HAZID, HAZOP, FMEA and can support our clients with their actions/recommendations which come out of these assessments to ensure their risks are as low as reasonably practicable (ALARP).

3.0 Engineering Design and Process Safety

3.1 Introduction

- In the food and drink sector, engineering design is vital not only for operational efficiency but also for ensuring the safety of people, plant and the environment. Integrating process safety into engineering design can help mitigate major accident hazards.
- This section will cover inherently safe design, the hierarchy of control (with regards to process safety), give examples of best practise and discuss process safety methods of evaluating engineering controls and mitigation.

What does "inherently safe" mean?

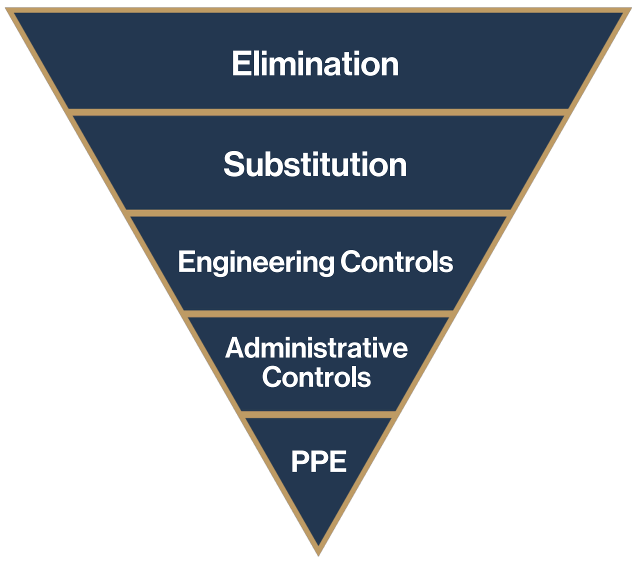
- In process safety the idea of inherently safe is a proactive approach of eliminating or reducing hazards at the design level, rather than controlling or mitigating it with "add-on" equipment or procedures.
- This increases reliability of control and reduces the reliance on humans (see the human factors best practice section).

An example of best practise for inherently safe design is within a Cleaning in place (CIP) system. Due to the nature of the materials handled (caustics) as well as the temperatures, interactions for people should be minimised to as few as possible. Best practise typically shows that inherent safety is achieved by:

- Eliminating manual chemical dosing by using an automatic dosing system.
- Reducing stored amount of cleaning chemicals via an on-demand system.
- Simplifying pipe design and ensure good labelling to prevent misconfiguration.
- Using automated temperature controls and a pressure relief system to prevent going over limits.
- Using leak detection systems where possible as an early identification system.

3.2 Hierarchy of control

- Many of us will be familiar with the hierarchy of control and use it on a frequent basis. In this section we will discuss what implications this has on process engineering.
- **Eliminate or Substitute:** Usually the substances or hazards that are within a system cannot be changed as they are required for the process. There are some situations like hydraulic systems, or some additives which can be replaced with non-hazardous alternatives. Whether or not this is possible should be assessed and documented even if the answer is it is not possible.
- **Engineering Controls:** From a process design perspective engineering controls can be as simple as adding a properly sized relief valve to protect against over pressure, or it can be complex such as replacing a conveyor system for grain with a pneumatic system to reduce airborne dust generation.
- One common pit fall of engineering controls is the gap between machine, manufacturer and the supplier. Frequently, items such as explosion panels or bursting discs are designed specifically for a certain substance, and if these requirements have not been correctly set it will mean the controls are not functional.
- **Administrative Controls and PPE:** These are not part of the engineering design so will not be discussed here in detail.



Hierarchy of Controls

3.3 Specification of machines

As discussed, there are many challenges when ordering machines, and some machines require additional specification where process safety hazards exist. Doing this at the specification stage will not only reduce the overall risk but will also save money.

What situations should process safety be involved in machine specification?

Technically, this is any scenario where there could be reactions with substances, or any consequence where fire and/or explosion or another major accident hazard such as large pollution events could occur. In practise it can be harder to identify so here are some best practise examples:

- Where flammable or potentially explosive dusts, fluids or gases are handled.
- Ovens, Industrial Boilers or Oxidisers.
- Where harmful, toxic or corrosive substances are handled.
- Systems which operate at 2 bar or above.

What are the main specification considerations?

We recommend that the specification for a machine involving process safety has at least these sections (not exhaustive):

- Process limits: such as production rate, pressure limits, temperature limits, cleaning requirements etc.
- Safety Requirements: identify key safety requirements such as emergency stops, pressure reliefs or other engineering controls. Recommend that inherent safety is mentioned in this section.
- Material Compatibility: Mention and include SDS of all substances to be used.
- Maintenance and Serviceability requirements: including calibration of any relief valves.
- Additional exercises: Consider requesting a joint HAZOP with the manufacturer.

Ensuring Safety Requirements are met

At various points throughout the ordering and final commissioning of a machine, there are opportunities to ensure that the safety requirements are working as they are designed. These should be carried out at both Factory Acceptance Tests (FATs) and Site Acceptance Tests (SATs). These can be applied in a variety of ways such as:

- Validation Plan – For functional safety tests of instrumentation systems. A thorough plan can ensure there is no fault masking.
- Pressure Tests – for pressurised systems and vessels with a safer medium such as water or air. Note: Testing with air should only be done for lower pressure of systems due to the hazards associated with this and check compatibilities of water/air with the substance being used in the pressurised systems.

Once the machine is operational, best practise is to carry out routine inspection and maintenance on these critical safety items to ensure they are still operating as designed. This may range from a functional check (for items like interlocks and guards) to more in depth checks like independent calibration.

Example Safety Considerations / Requirements

To provide some guidance, here is a list of potential safety considerations / requirements and scenarios where they can be used:

- Sizing of relief valves or bursting discs – demonstrated by suitable calculations. The sizing should be able to relief the pressure suitably but also remain subsonic.
- Set points of regulators, including whether due to safety a standby is required.
- The requirement for any bypasses to allow for maintenance, or alternatively standby / duty arrangements for items such as pumps which have limited running hours.
- Consider whether valves should be Normally Open or Closed, and whether they return to this state during power loss. This includes the mark-up of P&IDs such that Normally-Open / Normally-Closed position are set.

3.4 Examples of Safety Equipment and Use

Safety Requirement	Purpose	Example of Use
Pressure Relief Systems	Protect equipment from overpressure, preventing ruptures or explosions.	Relief valves on steam boilers to release excess pressure safely.
Interlocks	Prevent operation under unsafe conditions.	Door interlocks on high-speed mixers to stop operation when the guard is open.
Over-Temperature Protection	Automatically shuts down or adjusts equipment if temperatures exceed safe limits.	Thermal cut-off switches in ovens to prevent overheating and potential fires.
Guarding	Physically prevents access to dangerous moving parts or hazards.	Fixed guards around rotating shafts on packaging machinery to prevent entrapment.
Fail-Safe Systems	Ensure the system defaults to a safe state in the event of a failure.	Fail-closed valves on gas pipelines to ovens to stop flow if power is lost.
Chemical Containment	Prevents release of hazardous chemicals to the environment or workspace.	Bunded areas for bulk storage tanks of cleaning chemicals to contain leaks.
Ventilation Systems	Removes hazardous fumes, dust, or vapours from the work area.	Local exhaust ventilation (LEV) systems over fryers to capture oil vapour.
Fire Detection and Suppression	Detect and extinguish fires before they escalate.	Automatic CO_2 fire suppression systems in electrical control rooms.
Proximity Sensors	Detect the presence of people or objects near hazardous areas.	Light curtains on robotic arms to stop movement if someone enters the work zone.
Load Monitoring Systems	Prevent overloading of equipment, reducing risk of mechanical failure.	Load cells on lifting equipment to prevent exceeding safe weight limits.
Isolation and Lockout	Prevent unintended start-up during maintenance or repairs.	Lockout/tagout systems on mixers during blade replacement.
Leak Detection Systems	Detect leaks of hazardous substances early to minimise risk.	Gas detectors in ammonia refrigeration systems to identify leaks.

Safety Requirement	Purpose	Example of Use
Alarm Systems	Alert operators to abnormal conditions requiring immediate attention.	High-pressure alarms on pasteurisers to warn of equipment malfunction.
Emergency Stop (E-Stop)	Provides a means to immediately halt machine operation in case of danger.	Emergency stop buttons on conveyor belts to prevent injuries from entanglement.

3.5 Assessing the safety of design

At each stage in the lifecycle of plant you may wish to assess the process safety of a design, whether that is ensuring that the manufacturer has designed the system correctly, whether its ensuring there are no further ways of improvement, whether it relates to changes or modifications to the plant or procedures, or as the plant nears its end of life. This process is key to ensuring the risks remain As Low As Reasonably Practicable (ALARP). As you gain more knowledge or as technology changes, understanding of potential hazards updates and hence the controls should also be reviewed. There are a few methods you can use to achieve this:

- Hazard Identification and Risk Assessment – Process Safety tools such as HAZID or HAZOP are useful to assist in systematically identifying where hazards exist and the controls that are in place. Further down the lifecycle a simpler Process Hazard Reassessment (PHR) can be undertaken to reduce costs but still gain similar benefits.
- LOPA (Layers of Protection Analysis) – A LOPA study is useful for checking whether the existing safeguards provide a sufficient risk reduction or whether further controls are required. They can be very useful when used in conjunction with failure rate, near miss or incident data.
- Root Cause Analysis / Failure Mode Analysis – If there is a failure of equipment, or an incident a root cause analysis should be undertaken to review whether additional controls are required and to validate feedback.
- Link with non-process safety issues – Frequently other areas such as environmental issues (leaks, emissions etc) or health issues (excess dust, fumes etc) show an early indication of process safety having gaps. Ensuring reviews take place wholistically, and feeding these back into other studies will reduce risk not only with regards to process safety, but also on environmental and health impacts.

3.6 Common Mistakes

- Not identifying all hazards – It can be common that some hazards such as reverse flow, or lock-in pressure can be missed due to incorrect hazard identification.
- Poor ventilation and house keeping – When associated with flammable fluids and dusts this can cause an increased hazardous area.
- Unsafe handling and storage of dusts / flammable fluids – Frequently the process can be designed so that it is inherently safe, but the storage and handling of the substances can be forgotten.
- Missed maintenance – if maintenance is missed on certain components this can lead to degradation which can have consequences such as safety valves not operating, increased temperatures etc.
- Missed calibration – certain safety devices require calibration or replacement. Some of these include pressure safety valves and bursting discs. Missing the dates can cause them to fail to operate.
- No Management of Change – If management of change is not controlled then it can cause unintended consequences to safety systems or introduce new hazards that were not considered.
- Emergency Plans and Drills – Any machine or process that is covered under this guide should also include associated emergency plans. Whether this is just their location, or whether it requires isolation procedures and drills to be included is dependent on the equipment.
- Poor Asset Management – Any corrosion, fatigue or other types of damage to pipework or vessels can cause a weakness which may lead to a loss of containment or explosion event.
- Inadequate training or competency – Throughout the process competent personnel should be included in the process safety as well as the operation. For Process safety this frequently involves including an independent third party as chair.

3.7 Summary

Finch can support as an independent body for assessing the safety of design for different systems and support the client from design, purchasing machinery all the way through to commissioning.

4.0 Energy & Process Safety

4.1 Introduction to Energy and Process Safety

Energy plays a vital role in food and drink manufacturing, powering essential processes such as heating, cooling, mixing, conveying, and packaging. However, energy sources, whether thermal, electrical, or chemical, also introduce significant process safety risks. If not managed correctly, these hazards can lead to fires, explosions, control failure, and equipment failures leading to potential serious workplace accidents.

This guide provides best practices for identifying, assessing, and mitigating energy-related process safety risks. It aims to help businesses:

- Understand the hazards associated with energy sources in manufacturing.
- Implement effective safety controls to prevent accidents.
- Ensure compliance with DSEAR, ATEX, HSE and Industry guidance.
- Foster a culture of safety within the industry.

By following these guidelines, food and drink manufacturers can improve workplace safety, operational efficiency, and regulatory compliance, reducing the likelihood of major incidents and downtime.

4.2 Understanding Process Safety Risk Posed by Energy

The generation or use of energy can take many forms in the food and drink manufacturing process, and each can present unique and significant safety hazards if not correctly identified and managed. Understanding these risks is key to preventing incidents such as fires, explosions, electrical faults, and equipment failures. Each type of energy used in manufacturing carries unique hazards that must be identified and controlled.

Thermal and Chemical Energy Hazards

- Heat Sources: Ovens, fryers, boilers, and steam systems operate at high temperatures, posing burn risks and potential fire hazards.
- Steam and Hot Fluids: Steam leaks or pipe failures can cause serious scalding injuries and high-pressure explosions.
- Overheating and Ignition: Poor maintenance of heat exchangers or burners can lead to overheating, ignition of flammable materials, or fire spread.
- Flammable Liquids and Vapours: Solvents, ethanol, and certain cleaning agents can evaporate, forming explosive atmospheres if ventilation is inadequate.
- Fuel Gas Leaks: Improperly maintained natural gas or LPG systems pose a risk of accidental ignition and explosions.
- Reactivity Issues: Some chemicals used in food processing may react with incompatible substances, producing toxic gases or runaway reactions.

Compressed Gas Hazards

- High-Pressure Gas Releases: Failure of CO_2, nitrogen, or air systems can cause high-velocity gas leaks, leading to asphyxiation risks or projectile hazards.
- Cylinder Handling Risks: Incorrect storage or movement of gas cylinders can result in rupture, leaks, or uncontrolled releases.

Electrical Energy Hazards

- Static Electricity: Accumulated charge from conveyor belts or powdered food ingredients can ignite flammable atmospheres, leading to explosions.
- Equipment Failure: Overloaded circuits or poorly maintained machinery can lead to unexpected shutdowns, fires, or mechanical failures.
- Control System Failure: Loss of power can lead to major process upsets which can pose significant hazards from process equipment.

4.3 Assessing and Controlling Energy Related Hazards

Energy-related hazards in food and drink manufacturing are not only posed by fuel sources but include risks associated with steam, cooling, electricity, compressed air, refrigeration systems, and mechanical equipment. Effective risk assessment techniques, such as HAZOP, LOPA, and fault tree analysis, help identify potential hazards and mitigate the risk they present. These process safety tools can help document existing control measures from engineering solutions like automated shut-downs and overpressure protection, administrative controls such as training programs and standardised operating procedures, and the use of personal protective equipment where necessary. An additional benefit of using hazard identification is the potential to implement inherent safety into your process for example assessing the fail-safe requirement for key solenoid valves in the event compressed air is lost or determining if process control equipment requires a battery backup to ensure safe operating parameters or instrument calibrations are not lost in the event of power failure. Conducting thorough risk assessments, implementing structured safety measures, and learning from past incidents are essential in maintaining a safe working environment and preventing energy-related accidents.

4.4 The Transition to Green Energy

With the goal of sustainability net zero carbon, many industries including the food and drink industry will be looking to green energy sources. Many industries now find that Hydrogen will be a fundamental component of their manufacturing process. Hydrogen has the potential to reduce emissions from most forms of industrial combustion. However, it also poses substantial safety hazards.

Process Safety Considerations

- Flammability: Hydrogen has a wide explosive range (4-75% in air), requiring strict handling protocols.
- Embrittlement: Hydrogen can weaken metal structures, leading to failures in pipes and storage tanks.
- Leak Prevalence: Hydrogen's low density and viscosity also increase release rates and dispersion distances compared to typical fossil fuels.
- Leak Detection: Hydrogen is colourless and odourless, necessitating specialised detection systems.

Best Practice for Safety Implementation

Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) applies to workplaces where flammable substances are stored and handled, making it particularly relevant to the food and drink industry. Common hazardous substances include dusts such as flour and sugar in food manufacturing, vapours from solvent use or alcohol generated during brewing and distillation, gases such as ammonia, natural gas, and liquid fuels such as diesel. Substances such as these fall under the scope of DSEAR due to their potential to generate explosive atmospheres.

Ensuring compliance with relevant design standards, such as IGEM and PAS standards, is critical first step when integrating hydrogen into food manufacturing processes. Reviewing designs for hydrogen systems using process safety hazard identification tools such as HAZOP are ideal to ensure the design has considered failures and ensure adequate safeguards are in place to manage the hazards posed. Training programs should be implemented to educate staff on hydrogen safety, covering leak detection, emergency response, and proper handling procedures. A phased approach, including pilot projects, allows for gradual adoption while assessing safety and operational impacts.

4.5 Regulatory Compliance Implications

To comply with DSEAR, businesses must conduct thorough risk assessments and classify hazardous areas where explosive atmospheres may occur. DSEAR compliance can best be demonstrated using an explosion protection documents (EPD) outlining:

- Identification of flammable materials: Material Safety Data Sheets (MSDS) can be a good source of information typically outline key combustibility characteristics under sections 2 and 9. However, quality of MSDS's can vary drastically between suppliers therefore additional investigation into substances may be required.
- Hazardous Area Classification: The extent of potentially explosive atmospheres is determined using multiple factors such as use case of the flammable material, temperature, pressures, ventilation, etc. There are industry standards which can help calculate the extent of hazardous area such as BS EN 60079.10 or EI model code of safe practise 15.
- Risk Assessment: Hazardous scenarios generated by the flammable materials must be determined and the likelihood and severity of hazards must be evaluated. The control measures and basis of safety must be documented.
- Control Measures: the requirement for additional control measures may be required to further reduce the risks associated with hazardous substances such as improvements to ventilation, the use of ATEX-certified equipment, maintenance & inspection regimes and signage.

Regular DSEAR assessment reviews ensure ongoing compliance and risk management, reinforcing a strong safety culture within the organisation. Employee training is crucial in equipping workers with the knowledge to operate with hazardous materials safely and respond effectively to emergencies. Learning from past case studies and best practices allows businesses to refine their safety strategies and improve regulatory adherence, ultimately contributing to a safer working environment.

4.6 Summary

Energy is a critical area in food & drink manufacturing and can pose significant risk, necessitating the implementation of a robust process safety management framework. A well-structured approach allows businesses to systematically identifying hazards, implementing engineering and administrative controls, and continuously monitoring safety performance, addressing key questions such as: What can go wrong? What measures are in place to prevent this? How do we ensure these measures are effective? Being able to answer these questions is essential to achieving best practice by understanding risks, enhancing workplace safety, achieving regulatory compliance, and contributing to sustainable energy use in food and beverage manufacturing.

At Finch we support our clients in all aspects of process safety including hazard identifications and risk management ensuring our clients are well informed about the hazards present in their processes and guiding them towards best practice. Finch also support with DSEAR management, carrying out bespoke DSEAR assessments and continuing to assist after recommendations are issued to ensure clients maintain safety and achieve compliance.

5.0 Human Factors in Process Safety Management

5.1 Introduction to Human Factors

In the food and drink sector, managing process safety is vital to prevent accidents involving fire, explosion, and hazardous materials. While robust systems, equipment, and engineering controls form the foundation of safety management, human factors play a critical role in ensuring processes operate safely and reliably.

Understanding and addressing human factors help reduce errors, improve decision-making, and foster a proactive safety culture. This guide outlines the importance of human factors in Process Safety Management (PSM), with a focus on best practices, leadership roles, and continuous improvement to safeguard people, plant and processes.

5.2 What are Human Factors in Process Safety?

Human factors refer to the interactions between people, processes, equipment, and the working environment. These interactions influence human performance and, when not managed effectively, can lead to errors and accidents. In the context of process safety, human factors address:

- Human errors: Mistakes or lapses caused by factors including fatigue or stress, distraction, or inadequate training.
- Workplace and task design: How the environment, equipment, and procedures affect people's ability to perform tasks successfully.
- Organisational factors: Leadership, culture, communication, and policies that impact worker behaviours and attitudes.

Addressing human factors ensures employees can perform their roles safely, reliably, and efficiently, reducing the risk of process safety incidents.

5.3 Why are Human Factors critical in Process Safety Management?

Human Factors is critical in Process Safety Management due to the following:

- Mitigating Human Error: Human errors are a leading cause of process safety incidents. A well-designed system that considers human factors can prevent or mitigate the consequences of these errors.
- Compliance: Under UK regulations (e.g., Health and Safety at Work Act 1974 and COMAH regulations), employers must design safe systems of work that account for human limitations and ensure employees are competent.
- Operational Resilience: Human factors help organisations adapt to changes, manage emergencies, and maintain productivity in complex environments.
- Continuous Improvement: By addressing human factors, organisations can learn from near-misses and incidents to improve systems and reduce future risks.

5.4 Human Factors Framework for Process Safety Management

A structured approach to human factors involves identifying, assessing, and improving the key areas where people interact with processes and systems. The following framework ensures that human factors are systematically embedded into PSM:

5.4.1 Task Design and Analysis

- Objective: Ensure tasks are designed to minimise error and physical or mental strain.
- Conduct Task Analysis to identify high-risk activities where human errors are most likely to occur.
- Simplify complex tasks and standardise procedures to reduce variability.
- Use checklists for critical operations to ensure consistency and accuracy.
- Avoid overloading workers with excessive information or multitasking, as this increases the likelihood of errors.

5.4.2 Workplace and Equipment Design

- Objective: Ensure the work environment and tools support safe and efficient performance.
- Design equipment, machinery, and control systems to be intuitive and easy to operate.
- Apply ergonomic principles to reduce physical strain and improve usability (e.g., control panels, displays, and workstations should suit human capabilities).
- Minimise distractions, noise, and poor lighting that hinder concentration and performance.

5.4.3 Training and Competence Development

- Objective: Ensure employees have the knowledge, skills, and attitudes needed to perform tasks safely.
- Provide training on hazard awareness, risk controls, and emergency procedures tailored to specific roles.
- Conduct regular competence assessments to identify gaps in skills and ensure learning is retained.
- Include human error prevention strategies in training, such as situational awareness and communication techniques.

5.4.4 Fatigue and Stress Management

- Objective: Reduce the risks associated with fatigue and stress, which impair decision-making and attention.
- Implement work-rest schedules that prevent excessive working hours and allow for recovery.
- Encourage breaks and provide adequate facilities for rest in long shifts.
- Address workplace stressors such as excessive workloads, poor communication, and inadequate resources.

5.4.5 Communication and Teamwork

- Objective: Foster clear, open communication and effective teamwork to improve safety outcomes.
- Use structured communication methods for handovers and reporting.
- Train staff on effective teamwork skills, including assertiveness, active listening, and conflict resolution.
- Conduct pre-task briefings and post-task debriefings to review risks, plans, and lessons learned.

5.5 Leadership's Role in Managing Human Factors

Leadership is a key driver of human factors management in process safety. Senior leaders and managers must:

- Set Clear Expectations:
  - Establish policies and systems that prioritise human factors within process safety management.
  - Define roles and responsibilities to ensure accountability at all levels.
- Promote a Safety Culture:
  - Foster an environment where employees feel empowered to report concerns, errors, and near-misses without fear of blame.
  - Lead by example, demonstrating a commitment to safety practices.
- Invest in Training and Resources:
  - Allocate sufficient time, budget, and expertise to support human factors initiatives.
  - Provide access to tools, technology, and equipment that improve performance and reduce error.
- Encourage Learning and Feedback:
  - Analyse incidents and near-misses to identify human factor contributors.
  - Use this information to continuously improve processes, systems, and training.

5.6 Measuring Human Factors Performance

To assess the effectiveness of human factors management, organisations should:

- Monitor Key Performance Indicators (KPIs):
    - Track trends in near-misses, human error incidents, and process safety breaches.
    - Measure staff participation in human factors training and feedback sessions.
- Conduct Safety Audits:
    - Evaluate how well human factors are integrated into systems, training, and operations.
- Collect Feedback:
    - Gather input from employees on task design, equipment usability, and workplace conditions.
- Learn from Incidents:
    - Use root cause analysis (e.g., Tripod Beta or Five Whys) to identify human factors contributing to incidents.
    - Implement corrective actions to address systemic issues.

5.7 Engaging External Expertise and Industry Standards

Organisations can benefit from the guidance provided by the Health and Safety Executive (HSE), IChemE, and the Energy Institute, among others. Finch Consulting's expert process safety team can provide customised training that ensures your employees competence remains up-to-date, industry-compliant, and tailored to the unique needs of the food and drink sector.

5.8 Leadership's Role in Driving Training and Competence

Leadership plays a critical role in promoting a process safety culture. Senior leaders and managers must visibly support and participate in training initiatives, reinforcing the importance of process safety management.

Effective training requires adequate resources, including time, budget, and expertise. Leaders should prioritise training investments as part of their safety strategy, recognising that competence strengthens overall safety performance.

Mentorship programmes allow experienced staff to share their knowledge with less experienced colleagues, enhancing practical skills and fostering a supportive learning environment.

5.9 Measuring Training and Competence Effectiveness

Employee feedback on training programmes provides valuable insights for continuous improvement. Regularly reviewing and adapting training based on feedback ensures ongoing alignment with best practices and regulatory expectations.

Analysing incidents and near-misses can highlight gaps in training and competence, informing targeted improvements to training content and processes.

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5.11 Summary

Training and competence are vital to effective process safety management in the food and drink sector. By embedding a culture of continuous improvement, supporting leadership involvement, and adhering to industry best practices, organisations can mitigate risk, protect employees, and enhance overall safety performance.

Competent, well-trained personnel not only ensure compliance but also drive operational excellence and resilience in the face of evolving challenges.

6.0 Training and Competency

6.1 Introduction to Training and Competency

The UK food and drink sector faces unique challenges in managing process safety, given its complex mix of chemical processes, machinery, and production systems.

Effective training and competence are fundamental to minimising risks, safeguarding employees, maintaining quality, and ensuring compliance with regulatory standards. This guide outlines best practices in training and competence for process safety management, drawing on advice from Finch Consulting's leading industry experts.

6.2 The Importance of Training in Process Safety Management

UK health and safety regulations require organisations to meet statutory training and competence requirements. Under regulations such as the Control of Major Accident Hazards (COMAH) and the Health and Safety at Work Act (HSWA), adequate training in process safety management is required where there is a potential for major accident hazards such as fire and explosion.

Employees must receive training tailored to their roles, covering areas such as hazard identification, control measures, process-specific risks, and emergency procedures. The HSE recommends that training should extend beyond theoretical concepts to encompass practical skills relevant to real-world operations.

A well-trained workforce can better anticipate and mitigate risks, reducing the likelihood of human error contributing to incidents. Effective training builds awareness, reinforces safety practices, and empowers staff to make informed, risk-based decisions.

6.3 Establishing Competence in Process Safety Management

According to industry guidance, competence in Process Safety Management involves the necessary skills, knowledge, and experience to perform tasks safely and effectively. Competence requirements will vary based on roles and levels of responsibility within the organisation. From leadership roles to front-line operators, possessing sufficient competence in Process Safety Management is mandated to ensure risks are suitably mitigated.

Best practice involves conducting regular competence assessments through observation, testing, and refresher courses to ensure staff remain proficient. Assessments should align with national standards such as those from the IChemE's process safety competence framework.

Role-specific competency models help identify the level of knowledge and expertise required for different positions within the organisation. For example, senior leaders need a strategic understanding of PSM principles, while operators must focus on day-to-day operational safety practices.

6.4 Developing an Effective Training Programme

Conducting a Training Needs Analysis (TNA) ensures that training efforts focus on actual skill gaps and organisational needs. This process identifies high-priority areas for competence development, enhancing both safety and operational efficiency. The TNA is a useful starting point to inform your Training Matrix, which is a tool used by organisations to track, manage, and plan employee training and competence development.

A Training Matrix typically takes the form of a grid, with employee names or roles listed on one axis and required training courses, certifications, or skills on the other. The matrix indicates which employees have completed specific training, need updates, or are scheduled for future sessions. A Training Matrix can help to ensure compliance with regulations, highlight skills gaps, and support targeted development plans. Training matrices are particularly valuable in high-hazard industries with its strict safety and operational requirements.

Training programmes should be customised for individual roles within the organisation. For example, maintenance staff require specialised training on safe machinery handling and hazard isolation, while production staff need a focus on handling flammable materials.

Combining classroom instruction, on-the-job training, e-learning, and simulations allows for a more comprehensive and adaptable training approach. Practical and scenario-based exercises reinforce learning by simulating real-world challenges.

Competence should be treated as a continuous process rather than a one-time achievement. Regular training updates and refresher courses ensure staff remain informed about new processes, technologies, and regulatory changes.

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7.0 Emergency Planning & Incident Response

7.1 Introduction to Emergency Planning and Incident Response

Emergency planning refers to the structured process of preparing for potential incidents that could disrupt operations, pose risks to employees, and impact product safety. It includes proactive measures to prevent emergencies and detailed response strategies to manage incidents effectively.

Effective incident response protects employees, minimises downtime, and reduces environmental impact. A well-coordinated response ensures quick containment of hazards, protection of employees and the public, and preservation of the company's reputation. Proper training and clear communication are crucial for incident management.

7.2 Elements of an Effective Emergency Plan

7.2.1 Risk Assessment and Hazard Identification

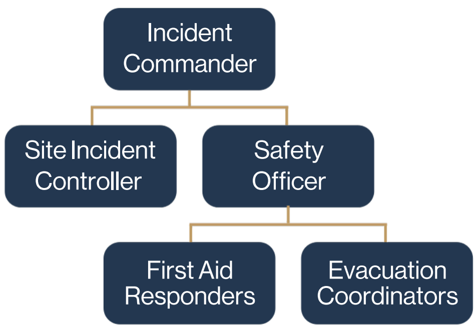
Understanding the potentially hazardous scenarios which are posed by your processes is essential in emergency planning as the steps taken in the event of some major accident hazards will differ from others. Techniques such as HAZOP, HAZID and Fault Tree Analysis help identify the hazardous scenarios and recognise vulnerabilities to enable the development of mitigation strategies.

The food and drink industry faces a variety of risks all necessitating specific risk mitigations measure and emergency responses. These risks include:

- Fire and explosion - due to the release and ignition of combustible gases and dusts.
- Hazardous material spills - chemicals used in cleaning, refrigeration, or processing.
- Toxic Release - such as ammonia release from refrigeration systems.
- Contamination incidents (microbial outbreaks, foreign object contamination, or allergen mismanagement).
- Environmental hazards (wastewater spills, ammonia leaks, or extreme weather events).

7.2.2 Emergency Response Team (ERT) Structure

The emergency response team (ERT) is essential in ensuring the emergency response is correct with the type of major accident hazard present and to ensure additional escalations do not occur. The main responsibility of the ERT is to maintain safety and ensure people are not exposed to additional risks after an incident has occurred.



ERT Typical Structure

An ERT should be established with clearly defined roles and responsibilities to ensure effective response to an incident and reduce the likelihood of confusion and miscommunications in a potentially stressful situation. Some examples of ERT roles are:

- Incident Commander: Leads emergency response and decision-making.
- Site incident controller: Provides critical information from the site to ERT.
- Safety Officer: Ensures compliance with safety protocols.
- First Aid Responders: Provide initial medical assistance.
- Evacuation Coordinators: Ensure employees are evacuated effectively if it deemed safe to do so.

7.2.3 Emergency Communication

Clear, efficient communication is vital in incident response and covers many aspects. Emergency notification systems should include:

- Alarm systems and public address announcements.
- Communication with emergency services (fire department, hazmat teams).
- Internal communication plans (radios, emergency contact lists).

Alarm systems and alarm responses should be clearly defined and communicated across the site. Some common issues which arise is the use of a singular alarm which is used for multiple hazardous incidents. For example, the use of a fire alarm being used to notify the site of an ammonia leak. This should be avoided as the response of the fire e.g. evacuation of the building may not be suitable for an ammonia leak.

Close communications strategies with emergency services are essential to ensure quick response in the event of an incident and to ensure the emergency services are familiar with the site and potential hazards present. Communicating specific hazards at your site would enable the emergency services the opportunity for specific training or equipment to manage and prevent escalation of an incident.

Internal communications are also vital to enable the ERT to effectively communicate and receive essential information from the site to enable them to make informed decisions. Implementing internal communication plans and continually updating the emergency contact lists can be critical in the ERT function.

7.2.4 Emergency Procedures and Action Plans

For each identified emergency scenario, there must be a well-defined action plan outlining the necessary response steps. Fire emergencies require clear evacuation routes and suppression measures, while chemical spills necessitate proper containment, personal protective equipment (PPE) usage, and safe disposal methods. In the case of food contamination, procedures should be in place for product quarantine, traceability checks, and, if necessary, product recalls. Toxic or asphyxiating gas releases, such as ammonia leaks or accidental emissions of carbon dioxide, require immediate containment measures, air quality monitoring, and proper ventilation strategies to protect workers and nearby communities. By standardising these response actions, businesses can minimise risk posed to people.

7.2.5 Resource Identification and Allocation

The resources required to respond to potential incidents on site must be evaluated and adequate resources must be available to maintain safety to mitigate the consequences of an incident, such as:

- Fire extinguishers, spill kits, PPE.
- First aid stations, emergency showers, eye wash stations.
- External support (emergency responders, industry specialists).

7.3. Incident Management

Incident management requires a well-structured command and control to ensure clear leadership and decision-making during emergencies. Proper documentation of incidents is essential for regulatory compliance, internal learning, and liability protection. Thorough investigations should be conducted to determine root causes and implement corrective measures to prevent recurrence. Coordination with external agencies such as emergency services and regulatory bodies is also critical to enhancing response effectiveness and ensuring legal compliance. Businesses should maintain strong partnerships with these stakeholders to facilitate a rapid and efficient response when needed.

7.4 Training, Drills, and Exercises

Regular training ensures that employees understand emergency procedures and can respond quickly and effectively in crisis situations. Each potential incident type should be covered in training, with refresher courses conducted periodically. Emergency drills and simulations provide hands-on experience, allowing employees to practice real response scenarios. Evaluations of these exercises can help identify areas for improvement, ensuring a continuously evolving and effective emergency response plan.

7.5 Business Continuity and Recovery Plans

A well-developed business continuity plan helps organisations quickly recover control of their processes and systems from emergencies and minimal additional hazards. Hazard analysis studies can be used to identify critical functions and help prioritise recovery efforts. Crisis communication strategies ensure accurate information is shared with employees, stakeholders, and the public, helping maintain trust and transparency. Recovery and restoration efforts should focus on facility safety assessments, product quality verification, and implementing corrective actions to prevent recurrence, ensuring that operations resume safely and efficiently.

7.6 Summary

Emergency preparedness is a critical aspect of process safety in the food and drink industry. By implementing robust risk assessment processes, structured response plans, and ongoing training, businesses can protect employees, maintain product safety, and ensure regulatory compliance. Continuous evaluation and improvement of emergency plans will strengthen overall resilience and readiness for potential incidents. Finch assist their clients with risk assessment and subsequent emergency planning and procedures ensuring our clients maintain emergency preparedness.