A year in review

HIGH HAZARDS AND PETROLEUM AND GEOTHERMAL TEAM

February 2026

Te Kāwanatanga o Aotearoa
New Zealand Government

WORKSAFE
Mahi Haumaru Aotearoa

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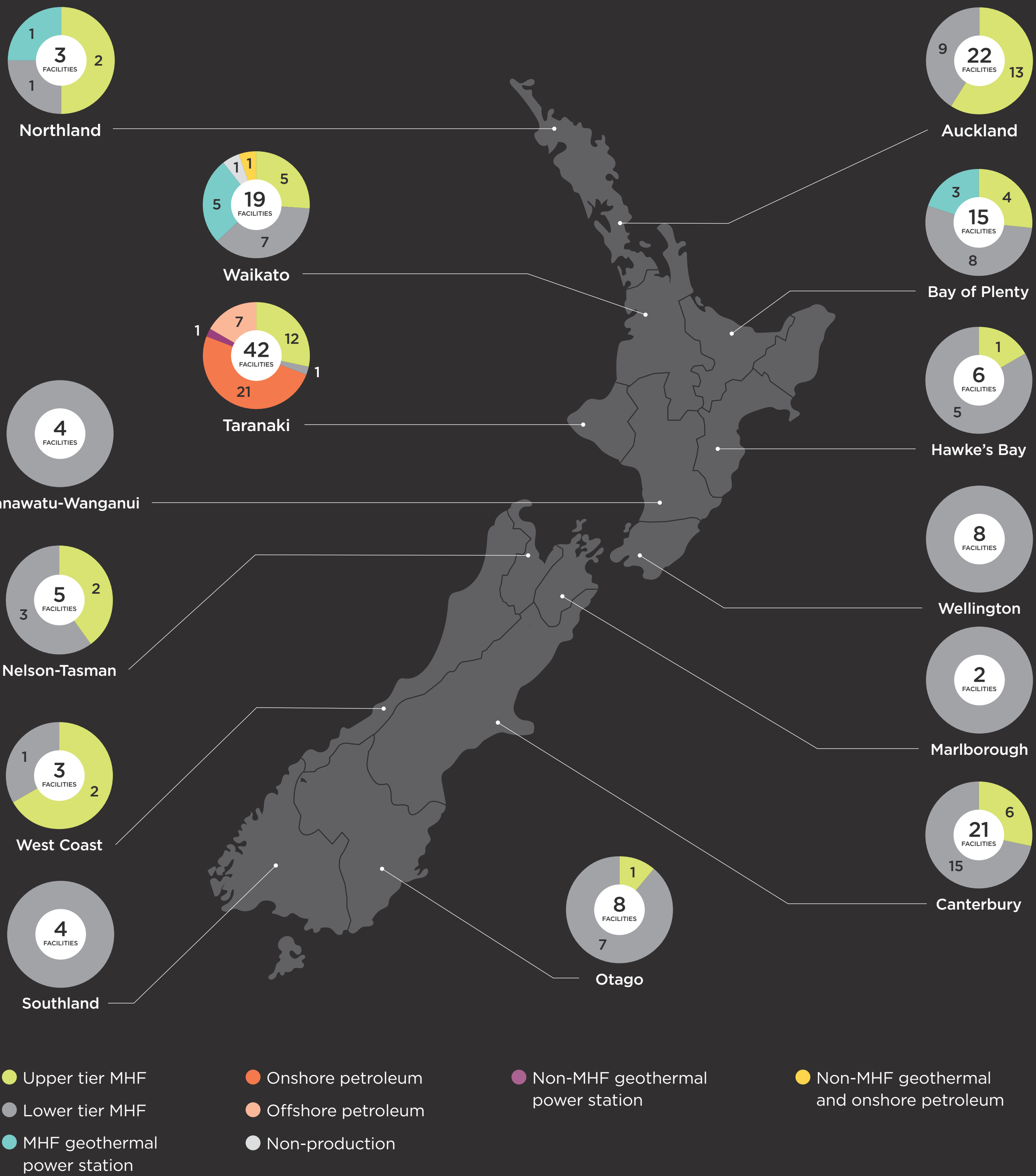

FOREWORD

As Acting Chief Inspector of High Hazards, I am pleased to present the High Hazards, Petroleum and Geothermal team year in review report, and focus for year ahead. This report includes case studies, data on notifiable incidents and regulatory insights from our high hazards team. It reflects a year of significant progress, collaboration, and learning across New Zealand's most complex and high-risk industries.

Our work continues to be guided by our commitment to preventing catastrophic harm and ensuring that duty holders manage risks so far as is reasonably practicable. This year, we have seen encouraging improvements in safety case quality, incident reporting, and industry engagement. The insights shared in this report, including regulatory trends, inspection outcomes, emerging technologies and sector wide initiatives demonstrate the depth and breadth of our regulatory approach.

The Health and Safety at Work (Major Hazard Facilities) Regulations 2016 (MHF Regulations) focus on process safety, requiring operators to implement robust systems to prevent major incidents. A core requirement is for major hazard facilities operators to demonstrate that all risks associated with potential major incidents are understood and controlled so far as is reasonably practicable. Designated major hazard facilities must detail hazard identification, risk assessment (including likelihood and consequences), and the control measures implemented, with a strong emphasis on managing all aspects of risk control through a safety management system. The regulations also implicitly address demanning of sites and the crucial element of safety culture through a focus on human factors and effective management systems.

The safety management system is required to manage all aspects of risk and must involve engagement with workers in its preparation and review. Any changes to site manning levels, being a significant operational change, would necessitate a review of the safety assessment and a safety case (appliable to designated upper tier major hazard facilities) to ensure the facility's safety is not compromised and that all safety-critical elements, including human performance, are adequately resourced and managed. While not explicitly using the term 'safety culture' in the legislation itself, the requirement for worker engagement and a comprehensive, living safety management system fosters a proactive approach to safety, ensuring that personnel at all levels understand their roles and responsibilities in preventing major accidents. Operators can find guidance on fulfilling these duties in the suite of documents available on the WorkSafe New Zealand MHF guidance website. In this report, we explore further considerations in terms of demanning, and safety culture as it applies to high hazards facilities.

We have placed particular emphasis on ageing infrastructure, remote operations, and the integration of artificial intelligence in safety critical systems. These themes reflect the evolving nature of high hazard work and the need for adaptive, forward thinking regulatory approaches.

Our inspectors have worked closely with operators to strengthen emergency preparedness, improve safety culture, and promote shared learning from incidents.

I want to acknowledge the professionalism and dedication of our inspection teams, as well as the openness and responsiveness of industry operators. The collaborative efforts highlighted in this report, whether through joint exercises, working groups or proactive safety improvements, are a testament to what can be achieved when regulators and operators work together.

Looking ahead, our focus remains on ensuring the completion of revised safety cases, enhancing regulatory assurance, and supporting innovation without compromising safety. We encourage all readers to reflect on the lessons and opportunities presented in this report and to continue striving for excellence in risk management.

Thank you for your ongoing commitment to safety.

Karen Davidson
Acting Chief Inspector High Hazards

1.0 Review of the past year

1.1 Safety cases

In the past year, WorkSafe's High Hazards Energy and Public Safety team reviewed twenty revised petroleum, major hazard facility, and major hazard facility geothermal safety cases.

The numbers of safety cases accepted annually for petroleum, major hazard facility and major hazard facility geothermal sites since the beginning of the safety case regime are shown in Figure 1.

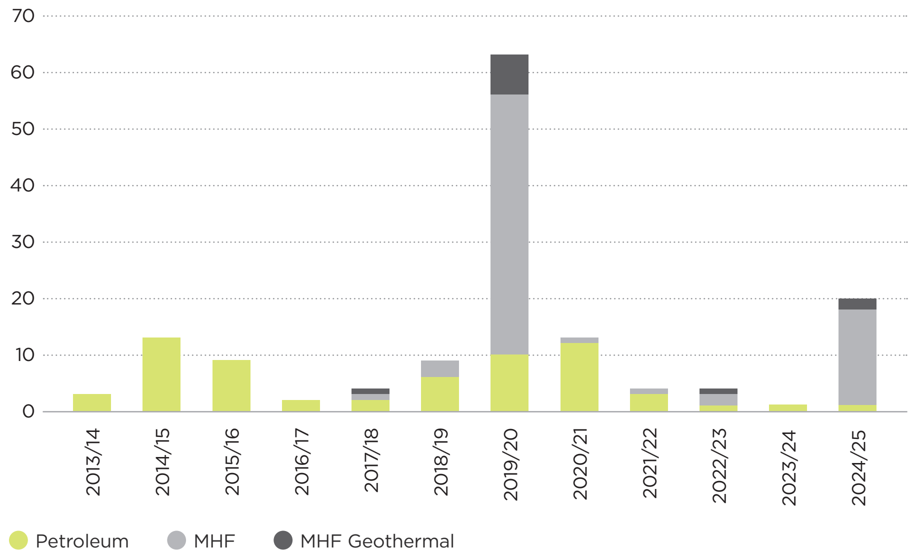

FIGURE 1: Safety cases accepted each year for petroleum, major hazard facility and major hazard facility geothermal sites

The focus for inspectors over the last year has been the review of revised safety cases submitted throughout the period, and on-site verification to ensure all elements of the safety case are in place and working effectively. Our inspectors also focus on future inspection topics identified in safety case assessments, site inspections and incident follow-up.

1.2 Site inspections

Sites are prioritised for inspection based on our assessment of the quality of the safety case, the number of future inspection topics, a qualitative assessment of the safety management system, the time since the last inspection, and reported incidents or complaints.

Last year, 105 high hazard site inspections were undertaken across a range of industries (Figure 2).

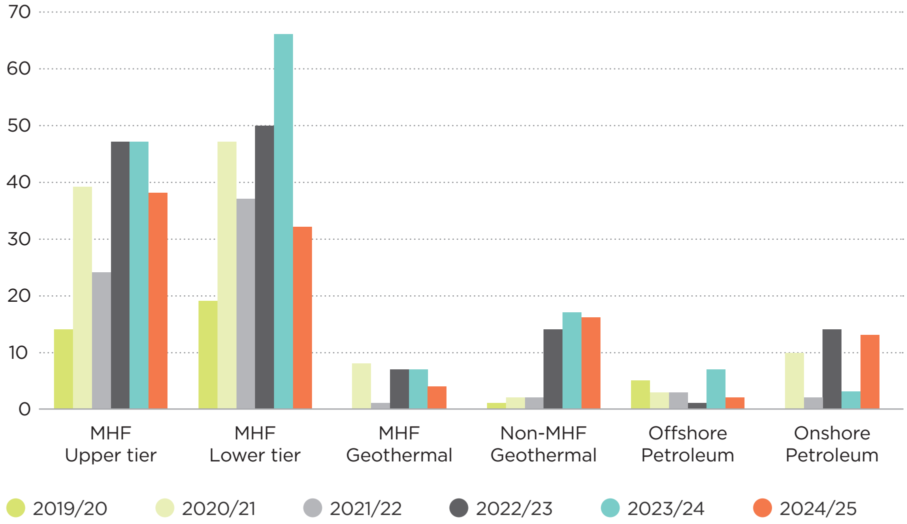

FIGURE 2: Site inspections completed by high hazard site type and financial year

1.3 Regulatory insights

PFAS firefighting foams: Post-transition compliance and risk management for high hazard sites

Geoff Taylor
Manager
Major Hazard Facilities

INTRODUCTION

The phase-out of PFAS (Per- and polyfluoroalkyl substances) firefighting foams represents a major regulatory and operational shift for high hazard facilities across New Zealand. These foams, once widely used for their effectiveness in suppressing flammable liquid fires, are now prohibited due to their persistence in the environment and associated health risks. This article outlines the current regulatory position, and the duties operators must meet under the Health and Safety at Work Act 2015 (HSWA) and its regulations.

REGULATORY STATUS AFTER 3 DECEMBER 2025

The transitional period for PFAS firefighting foams ended on 3 December 2025. Key points:

- all PFAS firefighting foams are prohibited, except where the Environmental Protection Authority (EPA) has granted permission for continued use of C6 fluorotelomer foams under section 95A of the Hazardous Substances and New Organisms Act 1996
- legacy C8 foams are banned entirely
- training use of PFAS firefighting foams remains prohibited at all times
- there is no mechanism for extension of these deadlines.

EPA PERMISSIONS

The EPA has issued a limited number of permissions for critical infrastructure sites. These permissions:

- apply only to C6 foams
- include strict environmental conditions
- do not alter obligations under HSWA and its regulations.

Operators must ensure:

- clear internal communication about whether a permission exists and what it covers
- emergency plans reflect the reality of permissions and alternative firefighting strategies.

FIRE AND EMERGENCY NZ POSITION

Fire and Emergency New Zealand (FENZ) has confirmed it will not use PFAS firefighting foams under any circumstances. This decision is based on:

- health and safety risks to firefighters
- environmental contamination risks
- practical challenges in ensuring full containment during emergencies.

Implication: Operators cannot rely on FENZ to deploy PFAS firefighting foams during an incident. Emergency plans must account for this and ensure alternative suppression strategies are viable. FENZ will still respond to all incidents at facilities where PFAS firefighting foam remains in use in fixed foam systems but will expect the site owner to operate those systems as part of their own emergency response plans and procedures.

As the lead agency in an emergency, FENZ will make the necessary tactical decisions to deal with the situation in conjunction with the facility owner, in line with its mandated objectives under section 10 of the Fire and Emergency New Zealand Act 2017 to protect and preserve life; prevent or limit injury; prevent or limit damage to property and land; and prevent or limit damage to the environment.

HSWA AND HAZARDOUS SUBSTANCES DUTIES

Under HSWA and the Health and Safety at Work (Hazardous Substances) Regulations 2017, operators must:

- identify and manage risks associated with hazardous substances, including PFAS residues and alternative foams
- protect workers and other persons by eliminating or minimising exposure to hazardous substances
- maintain safe systems of work, including training and emergency preparedness
- comply with storage, handling, and disposal requirements for any remaining PFAS firefighting foam or contaminated waste
- provide clear information and instruction so workers understand hazards and controls.

MAJOR HAZARD AND PETROLEUM FACILITIES DUTIES

The prohibition of PFAS firefighting foams triggers additional obligations under the Health and Safety (Major Hazard Facilities) Regulations 2016 and the Health and Safety at Work (Petroleum Exploration and Extraction) Regulations 2016, including:

- Safety case revision: A revision to a safety case may be required to reflect the prohibition or continued use under EPA permission, and include risk assessments for alternative firefighting strategies and any residual PFAS hazards.
- Review safety assessment: Reassess the adequacy of existing safety assessments in light of changes to firefighting capability.
- Management of change (MoC): Document changes to firefighting systems, foam types, and emergency response arrangements. Critically assess the performance of alternative foams to ensure they meet fire suppression requirements for site-specific hazards.
- Safety management system updates: Revise procedures, training, and maintenance plans for new firefighting media and disposal requirements.
- Emergency plan review: Ensure plans account for FENZ's position and outline coordination with emergency services.

RISK MANAGEMENT AND WORKER SAFETY

Operators must continue to manage risks to workers and other persons under HSWA and its regulations. This includes:

- eliminating or minimizing exposure to PFAS where possible
- ensuring emergency response arrangements do not compromise health and safety
- communicating changes clearly to all personnel and contractors.

KEY ACTIONS FOR OPERATORS

- Confirm foam inventories and compliance status.
- Communicate EPA permissions internally and externally.
- Transition to fluorine-free alternatives where possible.
- Assess alternative foam performance in MoC processes.
- Review safety cases and safety assessments.
- Update SMS documentation and training.
- Align petroleum safety obligations with new firefighting strategies.

CONCLUSION

The prohibition of PFAS firefighting foams marks a significant shift in firefighting practices at high hazard sites. Operators must ensure compliance across multiple regulatory frameworks, protect workers and communities, and maintain effective fire safety capability without reliance on PFAS-based products. This requires proactive planning, robust risk management, and close coordination with emergency services.

Audit and review

INTRODUCTION – MANAGEMENT SYSTEMS AND PROCEDURES

Major hazard facilities have the potential to have a catastrophic incident that affects the communities around them. These sites have comprehensive health and safety management systems to ensure that doesn't happen. They also need to ensure that their safety management systems and procedures continue to be fit for purpose and are being followed. Therefore, the systems should describe how it will be audited and reviewed.

An audit is the process of checking that the safety management systems are effective, understood, and implemented. It can also include an evaluation of the degree of compliance against the defined performance standards. Audits check that:

- the activities are actually occurring
- the activities are being performed to a suitable standard
- the systems, procedures, controls are achieving the desired results.

An effective audit programme should consider the following levels of audits:

- first level – monitoring – site level assurance
- second level – internal audit – group level audit/head office
- third level – external/independent audit – for example higher level audit such as insurance audits.

Internal or external audits are a key part of these procedures. The monitoring, audit and review of the safety management systems provides a means of prioritising action items, and improvements, with higher priority being given to higher risk issues. Progress on action items identified should be formally tracked through to closure.

A periodic process safety management audit is a critical process aimed at validating facility adherence to safety procedures and ensuring regulatory compliance.

Monitoring is an important aspect of the audit programme even though it is not traditionally called audit.

A review is the ongoing process of evaluating whether the entire safety management system and the performance standards within it remain adequate, fit-for-purpose, and in line with current good practice. The audit provides assurance of the integrity of both the safety management system and the technical elements of process safety management within it. The review closes the continual improvement loop.

Liam Gannon
Principal Inspector
Major Hazard Facilities

> "From a helicopter, all we see are forests. If we want to see if the forest is healthy, we must land the helicopter and look at the leaves and twigs."

Professor Trevor Kletz
Once compared auditing to inspecting a forest.
This highlights the need for detailed investigation and auditing.

INDEPENDENT AUDIT

Auditing is the most common way to check the performance of safety management system elements against their performance standards. The safety management system must include a system for managing these audits such as qualifying auditors, scheduling, documenting results and tracking recommendations or actions.

Auditing should look at both implementation and functionality of the systems:

- Does the major hazard facility have a system that meets the required standard?
- Does the major hazard facility follow its own system procedures and are they effective?

An audit provides assurance of the integrity of both the safety management system and the technical elements of process safety management within it.

An effective audit will help make sure that all the management and technical elements of the safety management system are in place and are functioning effectively.

AUDIT INDEPENDENCE

Audits should be carried out by trained and experienced people who are independent of the system being audited. This means people who are outside the span of control of the worker responsible for the procedure or system being audited. For individual safety management system elements, audits should be carried out by workers with no direct responsibilities for that element.

However, if the safety management system as a whole is being audited, the auditor should be independent of the major hazard facility.

If an organisation runs multiple major hazard facilities, there could be advantages to having workers from other facilities carry out audit. They understand the substances, processes, plant and culture while still being sufficiently independent to give an impartial view (provided the reporting line is high enough in the organisation).

WHAT SHOULD AN AUDIT PLAN CONTAIN?

Refer to the Major hazard facilities good practice guidelines (specifically to section 10 and 11 of the safety management system guide).

In addition to the comprehensive audit of the whole safety management system, there should be periodic and random sub-system audits of key elements or a component of the system to provide ongoing assurance. For example, permit to work, management of change, and emergency planning. Useful guidance material on these elements (and others), and audit considerations for the elements can be found under the SEVESO Inspection Series publications.

AUDIT OBJECTIVES

The audit's primary objective is to demonstrate the adequacy and adherence of the facility's process safety management procedures and practices. Process safety management audits help verify the organisation is following the appropriate regulations, identifying any areas where improvements can be made, and providing recommendations. An audit should:

- check compliance – confirm that the organisation is adhering to regulatory requirements. It verifies that all necessary elements of process safety management are in place and are being properly executed

- find weaknesses – assists in uncovering weaknesses or shortcomings in the organisation's process safety management program and its implementation. This might involve gaps in documentation, training programs, and how the various policies and procedures are implemented at a facility
- assess risk – evaluates the effectiveness of the organisation's risk assessments.
- review documentation – relevant documents, records, and procedures are examined to ensure their accuracy, completeness, and effectiveness. The goal is to verify if the documented practices align with the written procedures and their implementation.
- employee engagement – assess the level of employee involvement in the process safety management system. It evaluates whether communication, training opportunities, and active participation in process safety activities are in place.

Following each audit, a comprehensive report must be issued, documenting any findings observed. In response to these findings, a detailed plan of action is required for resolution.

KEY SUCCESS FACTORS

Key success factors help determine the effectiveness of the organisation's process safety management system. They identify the critical elements or areas that contribute to achieving the desired outcomes and goals of process safety:

- accuracy and availability of documentation – the efficacy of an audit is heavily reliant on the accuracy and ready accessibility of documentation. Outdated procedures hinder an audit's value
- experience and skills of audit team – assembling an audit team with diverse skills is vital, including at least one senior member with extensive audit experience
- technical skills and insights of contributors – the technical proficiency and insights of contributors, particularly experienced personnel, significantly influence the quality of information gathered during the audit
- duration available for preparation of audit – adequate planning time is crucial for a successful audit. Rushing into an audit without proper preparation jeopardises the thoroughness of document reviews and on-site activities. Planning well in advance allows for a comprehensive approach, minimising the risk of oversight
- schedule of audit – scheduling the audit at a strategic time is key to its success. Avoiding periods of high workload or holiday months ensures that the audit team operates at full capacity and that site personnel can fully engage without distractions, maximising the effectiveness of the audit, that is, don't try to complete an audit during or leading up to the annual shutdown, unless it was specially reviewing shutdown readiness or shutdown execution
- ability of contributors to provide honest answers to questions – the ability of contributors to provide candid responses is foundational to the audit's purpose. The focus should always be on identifying opportunities for improvement and addressing potential issues proactively.

MANAGEMENT COMMITMENT

Management commitment is essential for effective process safety audits. Without it, audits often become a superficial 'tick-the-box' exercise with little to no lasting impact. Active and visible leadership is the bedrock that allows an audit's findings to translate into meaningful, long-term safety improvements.

HOW MANAGEMENT COMMITMENT ENSURES EFFECTIVE AUDITS

- Sets the tone for a safety culture: when senior management visibly prioritises safety, it sends a powerful message that employee well-being is a core company value, not just a regulatory requirement. A committed management team empowers workers to speak up during audits without fear of reprisal.
- Provides necessary resources: Management must allocate sufficient funds, staffing, and time to perform audits thoroughly and to resolve the issues they uncover. In contrast, a lack of budget to resolve audit findings is cited as a major barrier to a successful audit program.
- Ensures accountability and follow-up: Managers are responsible for holding themselves and all levels of the organisation accountable for implementing and closing out corrective actions. Without this accountability, audit findings can be forgotten, and the same systemic failures may recur.
- Drives continuous improvement: Management must treat audits as a strategic tool for continuous improvement, not just a compliance check. By actively reviewing audit results, management can identify trends and make data-driven decisions to strengthen the safety management system.
- Reinforces audit credibility: When managers and senior leaders participate in audits, it adds credibility to the process and ensures that the findings are taken seriously throughout the organisation. By walking the talk, managers reinforce that safety is non-negotiable.

REFERENCES AND FURTHER READING

The IChemE Safety Centre Guidance – Lead Process Safety Metrics Supplementary guide – risk-based audit programme.

WorkSafe New Zealand major hazard facilities good practice guidelines (specifically to section 10 and 11 of the safety management system guide)

A Comprehensive Guide to Periodic Process Safety Management (PSM) Audits in Facilities

SEVESO Inspection Series publications

Corporate governance for process safety
Guidance for senior leaders in high hazard industries

A quote to consider, to conclude:

"If you put good people in bad systems, you get bad results."

Stephen Covey
Audits help to identify and improve 'bad systems' that lead to poor safety outcomes.

Remote operations in high hazard facilities

Increasingly, remote operations of high hazard facilities are thought to be more efficient by duty holders, to streamline operations and achieve efficiency gains. This represents a fundamental change in operation and emergency response considerations.

The move to a remote model does not eliminate risk. Rather, it significantly alters the entire risk profile of a facility.

Remote operation of high hazard facilities often involves the use of advanced technologies to control and monitor their processes from a distant location, without the need for a constant on-site human presence, which is seen as a benefit.

There are both advantages and disadvantages to this example. Remote operations offer substantial benefits in safety, efficiency, and cost, but they simultaneously introduce a new, complex class of digital and systemic vulnerabilities with a particular focus on the critical considerations for emergency response.

The safety of the entire operation becomes critically dependent on the integrity of the digital systems that now control and monitor it. A system failure, a malicious cyber-attack, or a lapse in remote oversight could create a physical hazard in the unmanned facility, leading to an uncontrolled disaster.

For example, an attack that manipulates a control system could lead to a physical event, such as a fire or toxic release, at a facility where no one is present to intervene. This is a crucial differentiation from traditional safety management.

Remote operation also fundamentally changes how emergency responses are managed. While it can speed up some parts of the process, it can also create dangerous delays.

Emergency response must be a key consideration when a facility becomes remotely operated. Effective emergency preparation for remotely operated facilities requires a proactive, multi-layered approach that accounts for the unique challenges it presents. The foundation of any plan is a thorough hazard assessment to identify what could go wrong at a specific facility, from hardware failures, system failures and natural disasters.

The inherent remoteness of some facilities poses significant logistical and communication challenges for on-site first responders. Assumptions for detection and response need to be revisited, for example. A clear and well-defined communication strategy is key. During an emergency, communication systems are often the first to fail, making it essential to have multiple, redundant methods for sharing information, such as texts, emails, and public address systems.

In summary, consideration should be given to:

- remote isolation technology that works under stress
- robust, redundant systems to survive the first failure
- a zero-trust cybersecurity framework because attackers will find the weakest link
- integrated emergency response plans tailored to remote realities
- scenario-based emergency response training that forces teams to practice, not just plan.

Nick Dawtry
Manager
Petroleum and
Geothermal

Safety culture in high hazard industries: more than compliance

Safety in high-risk industries is neither a box to be checked or a wall poster. It is what separates escaping catastrophe and returning home safely.

It's important that workers are involved in health and safety matters – it's the law. A strong health and safety culture isn't just about compliance; it's also about how we approach the work we do. Culture safeguards individuals, whereas compliance is to meet the requirements of the law. Although regulations need to be met, they set the foundation and are one part of effective health and safety. When we see a strong safety culture, safety is prioritised over production, even when no one is looking.

It is important to note that a robust safety culture is felt rather than merely recorded. It is not measured by flashy reports or procedures, but rather through everyday actions on the job. Safety is a priority for the organisation and not merely a slogan when leaders set an example of safe behaviour without cutting corners, even when deadlines are approaching.

Communication is crucial for safety, even more so in high-risk working environments where silence can be dangerous. A genuine safety culture depends on open, two-way communication and understanding. Workers must feel safe to raise their concerns, without fear of repercussion or being ignored, and leaders should listen and respond. The best insights into risks often come from those closest to the hazards: the people who face them every day. When that voice is ignored, warning signs are overlooked, and this can lead to serious consequences.

Safety culture goes beyond preventing accidents – it is also about wellbeing. When workers feel supported, respected, and heard, their mental and physical health improves. Fatigue, stress, and disengagement are just as hazardous as faulty equipment. A strong safety culture creates an environment where people can bring their whole selves to work, knowing they are valued not only for what they produce but for who they are.

Ultimately, safety culture is about trust. Workers must trust that their voices matter, leaders must trust that investing in safety pays off, and everyone must trust that going home safely each day is the highest priority. In high-hazard industries, safety culture is not optional. It is the foundation of sustainable performance.

Donna Wong
Principal Inspector
Petroleum and
Geothermal

Hydrogen Working Group – advancements with hydrogen technology and legislation

WorkSafe's hydrogen working group was created to provide oversight of the hydrogen sector as it becomes more prevalent as an emerging technology and a renewable and sustainable energy source in New Zealand.

WorkSafe's role has been mainly working with industry to assist with the installation of hydrogen re-fuelling stations and pipelines, in particular, the challenges with our legislation.

These being the Health and Safety at Work (Hazardous Substances) Regulations 2017, the Gas (Safety and Measurement) Regulations 2010, Electricity (Safety) Regulations 2010.

MBIE are currently fast-tracking amendments to enable the legislation, which has involved consultation and consideration of submissions by industry stakeholders and government. Submissions are closed and currently being considered by MBIE. It is expected to see the amendments made by early-mid 2026. More information can be found on the MBIE website Hydrogen

Our government has four key priorities to enable market-led hydrogen investment:

- create an enabling regulatory environment
- reduce barriers for consenting hydrogen projects
- promote a cost-effective and market-led transition to a low-emissions economy
- support access to international investment and markets.

Updates from the Hydrogen Council NZ can be found on their website.

As we move forward, the key focus from a health and safety regulatory perspective will include fast tracking the amendments to the legislation and to ensure risk management controls for Hydrogen projects are effective.

Lyn Osmers
Acting Manager
Hazardous Substance

Artificial intelligence (AI) in high-hazard industries – harnessing innovation with responsibility

David Lai
Specialist Inspector
Major Hazard Facilities

Artificial intelligence (AI) is reshaping the process-safety landscape, offering transformative potential. However, as its influence grows, it also brings challenges and uncertainties. This highlights the need for robust governance, particularly in high hazard industries where failure can result in catastrophic consequences to life, assets, and the environment.

Unlike traditional automation systems, AI introduces adaptive decision-making through techniques such as machine learning and deep learning, providing unexplored potential and benefits for high hazard industries. For example:

- **Predictive equipment monitoring**: AI can monitor equipment conditions to predict failure modes before escalation. When integrated within an AI management system with clear objectives, risk controls, and mechanism for continuous improvement, this capability could enhance operational safety.
- **Safety instrumented system optimisation**: AI can support the optimisation of safety instrument system performance by analysing alarms, operator response times, historical process conditions. However, AI must never override safety instrument system logic without approved human intervention and validated system changes.
- **Enhanced hazard analysis**: When used to support, not replace, human judgment, AI tools can improve the efficiency of processes such as hazard identification and layer of protection analysis. According to AIChE's 2024 guidance AI has the potential to be a 'game-changer', if implemented thoughtfully.
- **Monitoring and detection**: Real-time risk assessment using sensor-driven data analytics and flagging of irregularities, or abnormal trends before escalation.
- **Response and control**: Proactive intervention recommendations based on pre-defined safety parameters, real-time key safety measures, or previous incident or near-miss patterns.
- **Insight and decision support**: AI-driven trend analysis to uncover hidden risks or patterns in human decisions that may be flawed such as biases, discrimination, or poor reasoning. AI can then provide organisations with insights to help address these issues, but the final interpretation and corrective actions must involve human judgment.

Without effective controls and proactive risk identification, AI may introduce hidden risks and vulnerabilities that must be addressed to ensure the safe and responsible integration.

AI systems can behave unpredictably. They can change how they operate over time and make decisions that are difficult to understand or trace. This creates a potential conflict with established safety standards like IEC 61508 and IEC 61511, which require that all safety-critical systems be clearly defined, tested, and fully transparent.

If not properly managed, AI systems could unintentionally compromise the integrity of protective functions, confuse operators, or create new failures that are hard to detect. As AI capabilities continue to evolve, industries must adopt new methods to validate, oversee, and manage the risks it brings, ensuring that AI systems remain safe, reliable, and trustworthy at all times.

While AI presents significant opportunities to enhance safety in high hazard industries, in order to fully realise these benefits, it must be implemented with caution, robust governance, and adherence to established safety principles. AI should be regarded as a support tool, not a substitute for human expertise, and must operate within clearly defined, auditable, and transparent frameworks.

Ensuring human oversight, rigorous testing, and continuous monitoring is essential to maintain trust, reliability, and safety throughout the AI system's lifecycle. When governed effectively, AI can contribute meaningfully to improving operational safety without introducing new or unforeseen risks.

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Published 6 April 2023

Passive fire protection: a cornerstone of process safety

See Keat (SK) Lu
Specialist Inspector
Major Hazard Facilities

Passive fire protection (PFP) often remains unnoticed until it is needed most. It acts as the silent guardian in the fire safety framework as a key component in process safety, contributing towards containing fire, preventing escalation of fire event, and buying precious time for emergency responders performing safe evacuation and for firefighters to do their job.

INTRODUCTION

Passive fire protection (PFP) is a critical line of defence in process safety, designed to prevent and mitigate fire risks in industrial settings and minimize subsequent damage. These systems are essential for safeguarding lives and protecting assets by containing fires, preventing structural collapse, and limiting the spread of heat and flames, which also helps in demonstrating regulatory compliance.

PFP involves incorporating fire-resistant materials and design features that operate without human intervention. Its purpose is to prevent or delay the spread of fire, maintain a facility's structural integrity, protect vital process plant equipment, and safeguard personnel.

The key distinction is that PFP relies on the inherent properties of materials specified during design and implemented throughout construction and the plant's lifecycle. Unlike active fire protection (which requires activation), PFP is always in place and ready to function when exposed to fire, provided it is fit for purpose, well-maintained, and in acceptable condition.

Common examples of passive fire protection are:

- fire-resistant coatings (intumescent and cementitious)
- firewalls and fire barriers, for example, fire door
- fire resistant insulation for piping and vessels
- fireproof enclosures and cable trays.

WHY PASSIVE FIRE PROTECTION

Catastrophic events in high hazard industries such as hydrocarbon processing, chemical manufacturing, petrochemical operations, and storage warehouses have provided important insights into the effective application and management of passive fire protection.

As shown in table 1, incident records demonstrate that fire risks remain persistent across high hazard environments.

Maintaining effective process safety in these settings requires a multilayered approach, that integrates both active and passive safety systems to prevent catastrophic events and mitigate their impact. One critical and often underemphasised component of this safety strategy is passive fire protection.

> "Passive fire protection is built to be forgotten
> – until it saves lives."
>
> Author unknown

LOCATION	YEAR	COMPANY	PROCESS	CATASTROPHIC EVENT	FATALITIES (F)/ INJURIES (I)
Point Comfort, Texas (US)	2005	Formosa Plastics Corporation	Manufacturing of plastic resins and petrochemicals (Olefins unit)	Fire and Explosion	I: 16 workers
Passive fire protection related findings: The CSB (Chemical Safety Board) case study noted that some steel supports were not fireproofed and collapsed. This caused the failure of pipes designed to carry flammable hydrocarbons to the unit's flare system, where they could be safely burned in the atmosphere. Without this safety system in place, pressurised flammable gases continued to feed the fire, which burned for five days. CSB Issues Case Study of Formosa Plastics Point Comfort, Texas, Fire and Explosions: Unprotected Piping, Non-Fireproofed Structures, Lack of Automatic Shutoff Valves Noted as Causes; Flame-Resistant Clothing Recommended					
San Juan Ixhuatepec, Mexico City, Mexico	1984	Pemex State Oil Company	LPG storage and distribution	Boiling liquid expanding vapour explosion	F: 600 people I: 7,000 people
Passive fire protection related findings: Many causes contributed to the disaster, including the design of the terminal (for example, inadequate spacing of tanks, ineffective gas detection, lack of passive fire protection systems), destruction of the firefighting system by the explosions, improper maintenance of safety equipment, and a large number of people living close to the terminal. Thirty Years Ago – An LPG Tragedy					
Piper Alpha (UK)	1988	Occidental Petroleum (Caledonia) Ltd	Offshore oil and gas processing	Oil platform explosion and fire	F: 167 workers
Passive fire protection related findings: The firewalls could have stopped the spread of a fire but were not built to withstand an explosion. The initial blast blew these down, and the subsequent fire spread unimpeded. Piper Alpha, UK – FABIG					
Wilton, Teeside (UK)	1995	BASF	Warehouse Storage	Propylene Warehouse Fire	No injuries or ill health were reported
Passive fire protection related findings: The warehouse was equipped with a range of fire safety features including fire doors, operated both by fusible links and smoke detection, which failed to close during the fire. Existing warehouses and their materials of construction should be checked for potential hazards which could result from the impact of a fire or features which could encourage the spread of a fire (fire testing of construction materials). BASF, Wilton, Teeside 9 October 1995					

TABLE 1: Examples of catastrophic events in high hazard industries with findings on passive fire protection

ROLES OF PASSIVE FIRE PROTECTION IN PROCESS SAFETY

As shown through the findings from incident investigations in Table 1, passive fire protection has a key role to play in process safety management. Passive fire protection works closely with several elements within the process safety framework, including but not limited to:

Mitigating escalation of fire (process safety elements – risk management)

A small fire can rapidly escalate into a major disaster if not contained. Therefore, the purpose of passive fire protection is to:

- resist extreme heat for extended periods, in event of jet fire or pool fire
- prevent structural collapse, particularly relevant for the steel structures prone to suffer significant loss of strength quickly under heat impingement
- protect vessels, storage tanks, process piping and pipelines from over-pressure or rupture due to heat impingement.

Enhancing survivability of safety critical systems (process safety elements – asset integrity)

In high hazard industries, processes often rely on survivability and continued functioning of control system elements like emergency shutdown valves and other safety-critical components during a fire event. Application of passive fire protection can:

- extend operational capability of safety systems (such as emergency shutdown valves) during fire events
- offer protection of cabling from heat impingement to maintain circuit integrity and prevent fire spread along cable route, through fire resistant insulation of cables
- ensure safe shutdown and depressurisation of systems, through application of passive fire protection coatings on flare piping and associated flare equipment within fire exposed envelope to ensure safe flaring during emergency depressurisation.

Protection of occupants and emergency responders (process safety elements – emergency response)

Passive fire protection aids with containment and delays fire propagation, it also provides:

- additional time for safe evacuation
- protection for emergency response crews to execute firefighting and rescue operations
- shielding of muster stations and escape routes.

This time buffer can often be the difference between a contained fire incident and a catastrophic event.

Supporting demonstration of regulatory compliance

Effective passive fire protection systems support demonstration of regulatory compliance towards minimised risk of catastrophic events in accordance with health and safety regulations while also meeting insurance requirements and potentially lowering insurance premiums.

CHALLENGES OF PASSIVE FIRE PROTECTION

Although passive fire protection offers significant advantages as part of risk management process, similar to other control measures, several challenges exist.

CHALLENGES	DESCRIPTION	EXAMPLES
Environmental conditions	Degradation from exposure to sunlight and moisture can cause passive fire protection to deteriorate over time.	Corrosion under fireproofing due to ingress of moisture compromising the effectiveness of passive fire protection.
Material compatibility	Poor adhesion or chemical incompatibility with substrates.	Incompatible coating on stainless steel (substrate) causing the coating to separate, peel, or flake off.
Maintenance and inspection	Difficult access, damage, lack of awareness.	Passive fire protection is embedded in walls, or structural elements, making routine inspection and maintenance difficult. Maintenance crews may unknowingly damage or compromise passive fire protection during maintenance and inspection activity.
Installation	Incorrect application, complex structures.	Irregular or complex geometries can make it difficult to apply uniform coatings, especially under windy or damp environments. Incorrect installation can compromise fire resistance capability.
Cost	High capital and operation cost make passive fire protection expensive.	Fireproofing large pipe racks and vessels incurs significant capital and operational expenditures.
Certification	Inappropriate materials.	Using materials meant for protection of cellulosic fire instead of materials certified for jet fire and hydrocarbon fire application as passive fire protection for pipe/vessel in hydrocarbon industry.
Design and integration	Gaps in coordination among engineering disciplines, for example, coverage issues at joints.	Penetrations in firewalls left untreated due to poor design coordination.

TABLE 2: Examples on challenges of passive fire protection

MITIGATION STRATEGIES ON CHALLENGES OF PASSIVE FIRE PROTECTION

Although there are known challenges with installing and maintaining passive fire protection, these issues do not justify dismissing its use.

Instead, consideration should be given to following mitigation strategies to address those challenges.

CHALLENGES	EXAMPLES OF MITIGATION STRATEGIES
Environmental conditions	– Use durable, certified materials. – Apply protective topcoats.
Material compatibility	– Use materials compatible with the substrate (seek recommendation from manufacturer)
Maintenance and inspection	– Ensure accessibility during design. – Implement rigorous inspection and maintenance programs. – Training on the importance and handling of passive fire protection systems.
Installation	– Use competent external/internal resources in implementing passive fire protection. – Establish clear work plan from preparation to installation. – Clear requirements on QA/QC checks. – Adhere to manufacturer's recommendations.
Cost	– Risk-based assessments to determine the extent of passive fire protection application.
Certification	– Use fit for purpose, tested, approved and certified materials.
Design and integration	– Coordinate early with all disciplines.

TABLE 3: Examples of mitigation strategies on challenges of passive fire protection

CONCLUSION

Passive fire protection is one of the foundational elements of process safety in high hazard industries. While it operates silently in the background, its role in containing fires, protecting lives, and preserving infrastructure cannot be overstated. Therefore, it is important to consider passive fire protection during early project stages. Through embedding passive fire protection within a holistic process safety culture, organizations can not only demonstrate compliance but can also ensure the long-term sustainability and safety of their operations.

REFERENCES

Fireproofing Structural Supports
Process Safety Beacon by Centre for Chemical Process Safety, May 2010

Fireproofing Practices in Petroleum and Petrochemical Processing Plants
American Petroleum Institute Recommended Practice 2218

Recommended Practice for the Design of Offshore Facilities Against Fire and Blast Loadings American Petroleum Institute Recommended Practice 2FB

Codes of Practice
Code of Practice for the Specification and Application of Intumescent Coatings for the Fire Protection of Structural Steel Fire Protection Association New Zealand

Passive Fire Protection: Performance Requirements and Test Methods
Offshore Technology Information (OTI) 606 by Health & Safety Executive

Benefits of regulation for chemical accident prevention, preparedness and response

New Zealand has a legal framework to address the prevention, preparedness and response to chemical accidents. This includes specific regulations for hazardous substances, major hazard facilities, mining and quarrying, and petroleum and geothermal. The main driver for establishing the current framework was the tragic Pike River Mine incident in November 2010, which resulted in the preventable deaths of 29 men.

While acknowledging other workplace tragedies have occurred since 2010 such as Whakaari/White Island in December 2019, there are challenges in ensuring that the perceived importance of such regulation remains high in the absence of further significant chemical incidents in New Zealand.

Many engineering and safety professionals working in high hazards and extractives industries will be familiar with the prevention paradox cycle – the human brain simply struggles to value non-events, or events with very low probability, and instead responds to actual events and visible outcomes. This leads to the potential devaluing of the legal frameworks the further we get from actual and relatable events, even while significant chemical incidents continue to occur frequently overseas – see our quarterly newsletters for a sample of those.

A useful document called Benefits of regulation for chemical accident prevention, preparedness and response: presenting the case for senior policymakers and other stakeholders has recently been published on the OECD website.

The document's purpose is to provide background information to support the case for why regulations in this field are important and how effective regulations can be developed and maintained. It provides a robust overview of these matters and summarises benefits not limited to health and safety, such as the environment, the economy, and the individual company. It also includes information that connects New Zealand regulations to the legal instrument that we are party to at the OECD.

Although the document is primarily aimed at policy makers, it is quite readable and may be useful to operators and others that might be contemplating the origins of the system, and where we go from here.

Ben Huggins
Specialist Inspector
Major Hazard Facilities

WorkSafe's attendance at Fire and Emergency New Zealand's bulk fuel fire exercise

Several major hazard facility operators and members of WorkSafe's Major Hazard Facilities team participated in Fire and Emergency New Zealand's simulation exercise of a bulk fuel tank on fire at a tank farm. We promoted the participation of major hazard facility operators in this and future exercises.

The exercise used virtual reality simulation to show a farm tank on fire. Catastrophic chemical emergencies such as this are rare. Exercises like this provide invaluable experience for major hazard facility operators to understand the realities of a major incident and improve their emergency plans.

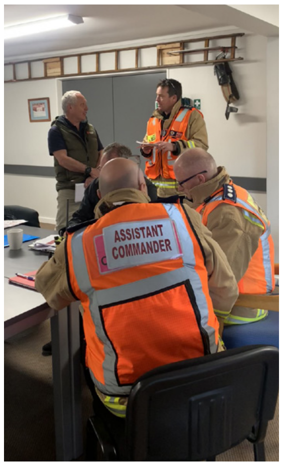
At this exercise, major hazard facility operators were able to observe and participate in discussions and decision-making scenarios on:

- tactics
- how to use limited resources
- what assets can be saved or not
- how to contribute to communication with the media and surrounding community.

This gave operators a taste of the real-time challenges that they and emergency responders may face, and an understanding of the complexity and duration of a large scale major hazardous substances incident.

The practical experience will help operators be better prepared for an emergency. We know that good emergency planning increases the chance of a prompt and effective response, which can reduce the impact of the emergency on communities and improve outcomes for affected businesses.

WorkSafe continues to work closely with Fire and Emergency and other government agencies involved in emergency management, through attendance at Fire and Emergency's National Hazardous Substances Coordination Committee. We actively promote engagement between major hazard facility operators and emergency services, public health, and civil defence agencies to help those operators ensure the safety of their workers and communities in an emergency.



Example of collaboration in the geothermal sector

INDUSTRY-WIDE SAFETY IMPROVEMENTS FOLLOWING 2023 GEOTHERMAL POWER PLANT INCIDENT

In 2023, a significant safety incident occurred during the commissioning of a steam header system at a geothermal electricity generating site. The event involved an uncontrolled ‘two-phase flow’; a situation where both steam and water move through a pipe in an unpredictable manner. This led to extensive plant damage, including twisted steel beams and broken welded brackets. Fortunately, no workers were injured, but under different circumstances, the result could have been serious harm.

WorkSafe’s high hazard inspectors responded promptly, working closely with the business and contracted design engineers. Rather than relying solely on formal enforcement, WorkSafe sought to understand the root causes and support improvements.

As a result of this collaborative approach:

- the business committed to developing a comprehensive, multi-disciplinary geothermal industry guideline. This document will capture good practices for design, construction, commissioning, operation, and maintenance, helping to mitigate risks associated with two-phase flow events
- the guideline will be relevant for both existing and new geothermal facilities
- significant engineering changes were made at the affected facility
- the business-initiated discussions with other geothermal operators to align on engineering design standards and shared learnings at an industry group meeting.

This incident is a strong example of how open engagement and shared learning can drive industry-wide improvements in safety. The business’s proactive response and willingness to share lessons learned have contributed to a safer geothermal sector for everyone.

Hazardous Substances team updates

SUB-MAJOR HAZARD FACILITIES

In 2016 the Health and Safety at Work (Major Hazard Facilities) Regulations 2016 outlined specific requirements for managing major hazard facilities. Since then, approximately 62 facilities notified WorkSafe to change their designation after reducing their threshold quantity and therefore are no longer required to notify WorkSafe as a facility or require a safety case.

Although these sites are no longer designated as Major Hazard Facilities (MHF’s), the risk can in some cases remain as the quantity threshold is still high, however, doesn’t trigger the MHF requirements.

WorkSafe refers to these businesses as sub-MHF sites and they are regularly inspected and monitored by the Hazardous Substances Inspectors team in High Hazards, HHE&PS. These companies must manage their risks as a PCBU under the Health and Safety at Work Act 2015 (HSWA) and the Health and Safety at Work (Hazardous Substances) Regulations 2017, and other related legislation. They must continue to monitor their hazardous substance quantities as an increase in their threshold quantities would require them to notify WorkSafe to become a facility.

The Hazardous Substances team inspection focus is also aligned with the HSWA and Hazardous Substances regulations as the business doesn’t have a safety case. This can mean the inspection may be more focused on a particular topic, and at a frequency of at least an annual inspection.

MARITIME NEW ZEALAND DESIGNATION

Maritime New Zealand became the responsible health and safety regulator on Aotearoa's 13 major ports on 1 July 2024. Most health and safety events that take place at major ports fall under Maritime NZ's responsibilities.

Maritime's extended designation under the Health and Safety at Work Act covers the port areas inside their boundary fence where access is restricted by a security gate, and adjacent buildings, installations, structures or equipment used in connection with the port's operation or administration.

The port profiles identify:

- securely fenced area (the boundary) as a **green line**
- buildings, installations, other structures, or equipment adjacent to the port and used in connection with the port's operation or administration as a **green polygon**
- major hazard facilities to identify where Maritime NZ and WorkSafe's designations apply, as a **blue polygon**.

Port profile maps

WorkSafe will retain regulatory responsibility for:

- major hazard facilities on ports
- granting, varying, and cancelling authorisations and exemptions under the Health and Safety at Work Act
- oversight of inland ports across New Zealand, and
- any activity explicitly named in legislation or regulations such as the Gas Act, Electricity Act, and Hazardous Substances and New Organisms Act.

Clear lines of responsibility and co-operation between WorkSafe New Zealand and Maritime New Zealand are outlined in a new Memorandum of Understanding (MOU).

1.4 Notifiable incidents

Notifiable incidents, known to high hazard industries as near-misses or precursor events must be reported to WorkSafe under section 24(1) of the Act, regulation 70 of the Petroleum Exploration and Extraction regulations, regulation 33 of the Major Hazard Facility regulations, and regulation 35A of the Geothermal Energy regulations.

Figure 3 shows the number of notifiable incidents at high hazard sites between July 2017 and June 2025. The number of notifiable incidents reported indicates an improved understanding by operators to notify as per their legislative requirements. Increased notifications from operators indicates better awareness of their health and safety responsibilities under the Act and regulations.

In the past 12 months (July 2024 – June 2025), 296 notifiable incidents were reported, slightly more than the year before (284) and roughly similar to the 5 years before that (average of 289).

WorkSafe inspectors will continue to review reporting arrangements as part of our inspection approach. It is essential that operators monitor their processes for notifiable incidents as these are important indicators of failures in risk management. Having identified and reported incidents, operators should also rigorously investigate the causes of the incident and take appropriate action to rectify failures and prevent their reoccurrence.

Emphasis on quality investigations and insights from notified incidents will continue in 2025/26 as we are finding that we are often reviewing these with the duty holder to ensure correct root causes are identified.

We will continue to take an increased interest in major hazard facility-related Health and Safety at Work Act 2015 incidents where there is actual or potential serious harm along with those with scope for significant process safety learning.

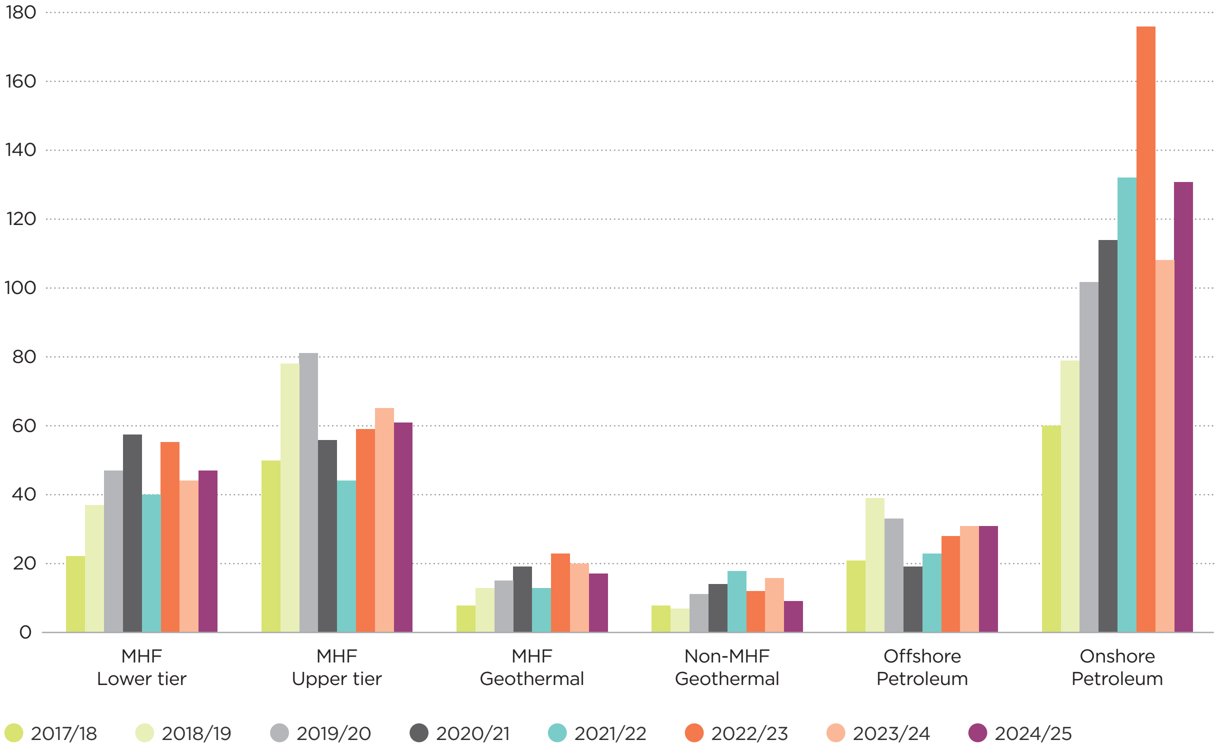


FIGURE 3: Notifiable incidents reported by high hazard site type between July 2017 and June 2025

Figures 4 and 5 show the legislative categories for notifiable incidents reported to WorkSafe over the last eight years to June 2025.

The data shows that in the 2024/25 year, 72% of notifiable incidents involved damage to, or failure of, a safety-critical element that required intervention to ensure it will operate as designed, very similar to the previous three years.

A total of 22 unplanned incidents (other than false alarms) requiring emergency plans to be implemented occurred, an increase over last year. Within major hazard facilities, 13 incidents that did not cause but had the potential to cause a major incident occurred.

There were 13 incidents involving the fall or release from a height of any plant, substance, or thing, 9 occurring within the petroleum and geothermal regime. While such incidents may not necessarily lead to a major incident, they are of concern due to most being assessed by us as General high potential incidents (credible potential to cause significant adverse effect on the safety or health of up to five people).

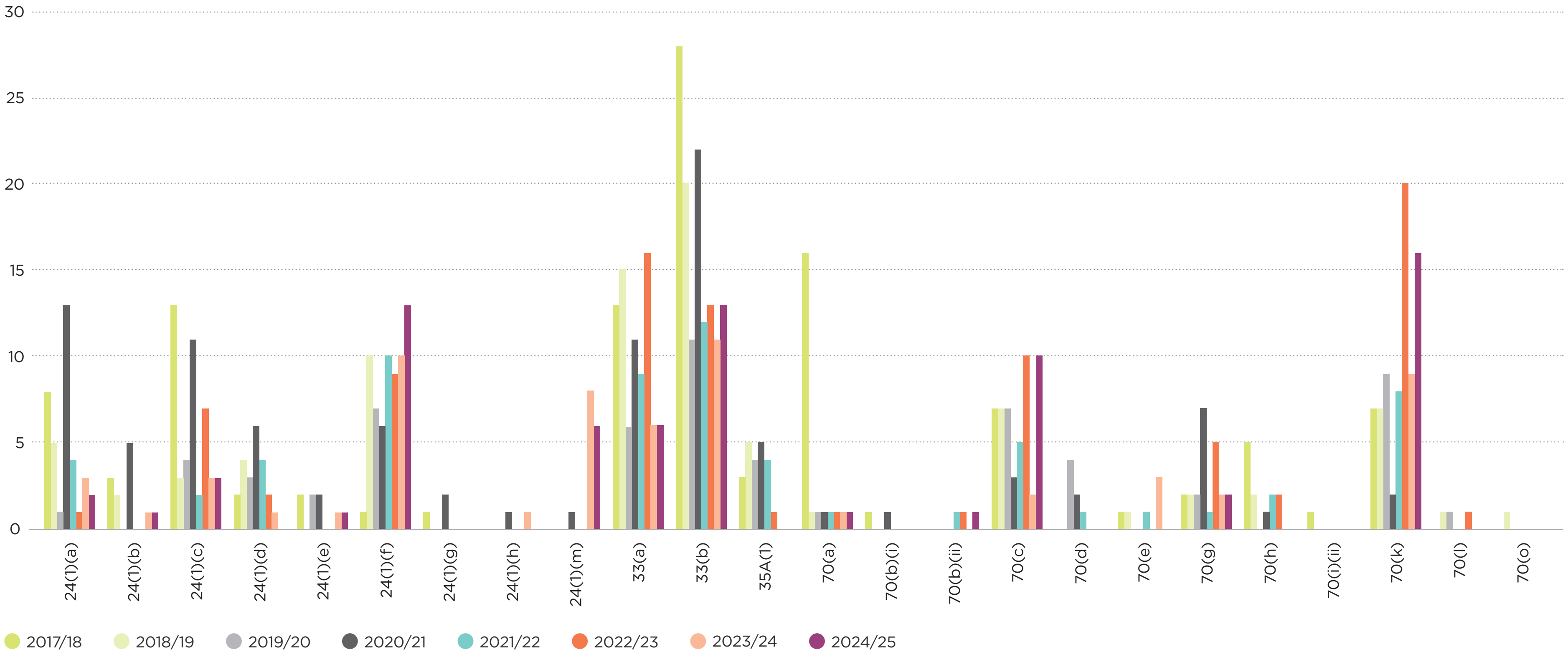


FIGURE 4: Legislative categories for notifiable incidents reported by high hazard sites between July 2017 and June 2025 (excludes damage to, or failure of, a safety-critical element that requires intervention)

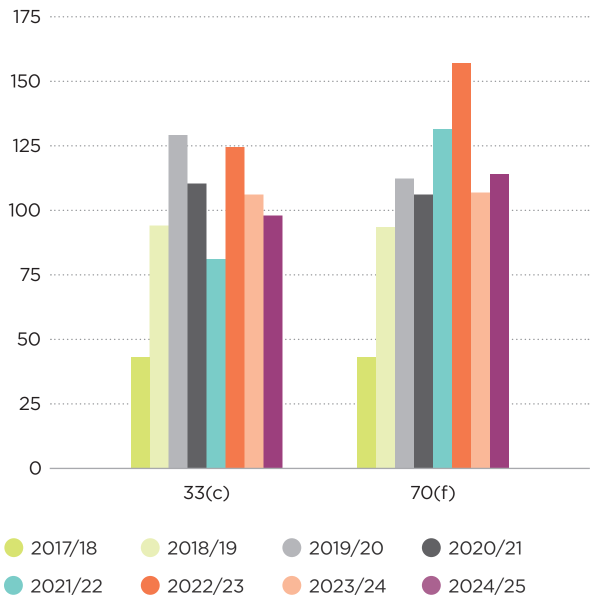


FIGURE 5: Legislative category for notifiable incidents, reported by high hazard sites between July 2017 and June 2025 of damage to, or failure of, a safety-critical element that requires intervention to ensure it will operate as designed

1.5 Petroleum and geothermal regulatory notifications

Operators have regulatory requirements to notify WorkSafe prior to conducting certain operational petroleum and geothermal activities.

The Petroleum Exploration and Extraction (PEE) regulations require that notifications are submitted within specified timeframes before starting the notifiable operations. The notifications are received by WorkSafe and reviewed by petroleum and geothermal inspectors. Inspectors may follow up with operators as required.

The Geothermal regulations require that notifications of operational activity and bore manager applications are made to WorkSafe.

Figure 6 shows the legislative notification categories made to WorkSafe for the five years between July 2017 and June 2025. The data shows that most notifications received are well operation and well workover/interventions in the petroleum sector, and geothermal bore consents within the geothermal sector.

From the period July 2019 to June 2024 a steady increase in well operation notifications can be observed because of several drilling/workover campaigns being conducted in the shallow geothermal and petroleum sectors.

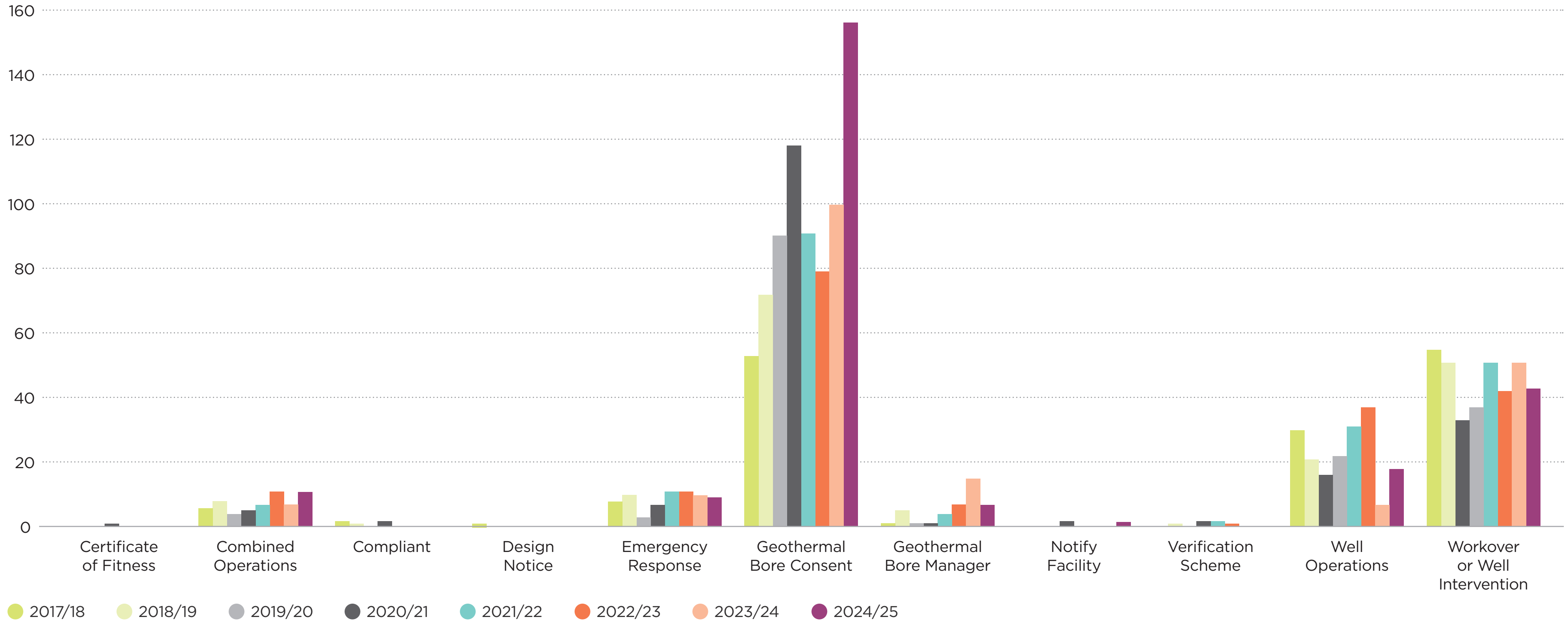


FIGURE 6: Petroleum and geothermal regulatory notifications between July 2017 and June 2025

1.6 High potential incidents

The High Hazards team has adopted the following definition of a high potential incident:

> 'An event, or a series of events, that causes or has the potential to cause a significant adverse effect on the safety or health of a person.
>
> A general high potential incident is defined as: an event, or a series of events, that has the credible potential to cause significant adverse effect on the safety or health of up to five people.
>
> A significant high potential incident is defined as above, however for more than five people.

High potential incidents – what are they?

The incident must have occurred at a major hazard facility, petroleum, or geothermal installation to be counted in this measure.

The High Hazards team has a four-step process to assess high potential incidents:

1. Incoming notifiable incidents are compared against a list of incident examples and definitions in a prescriptive assessment.
2. If a notifiable incident relates to one or more of the prescriptive events in step one, and could meet the definition of a high potential incident, it is then evaluated on the risk of harm by considering the potential consequences and likelihood based on the potential outcomes of a credible escalation scenario.
3. The outcome of the high potential incident assessment is then recorded in the database.
4. High potential incident assessments are reviewed by WorkSafe management with the outcome recorded in the database.

Learning from incidents

A selection of notifiable incident cases received by WorkSafe over the past year is included in this report. Below is a summary of these incidents along with lessons operators may wish to consider where relevant to their organisations.

INCIDENT DATE	INDUSTRY SECTOR	ACTIVITY/OPERATION	INCIDENT TYPE
Jul 2024	Non-MHF Geothermal	Drilling ops – lifting and hoisting	Dropped object

Incident summary:
When breaking out a cement head configuration, the crew broke off a 3m (97kg) pup joint and placed it on the hydraulic catwalk system (HCS). The crew then went on to place the cement head onto the skate above the 3m pup. At this point the cement head pin end contacted the pup joint causing it to be forced out of the HCS skirt and fall 8m to the ground landing directly below the HCS. The pup joint struck the HCS base and then a solid exclusion barrier that was in place around the HCS before settling on the ground.

Considerations:
This incident involving a hydraulic catwalk system (HCS) highlighted several procedural and operational shortcomings. The HCS was not designed to carry more than one item at a time; however, the crew deviated from established procedures and loaded a second item onto the system. This decision introduced unnecessary risk and was not communicated effectively to the driller, who was unaware of the additional load.

The crew's decision to place a second item on the HCS directly contradicted documented procedures, which clearly state that only one item should be loaded at any time. This deviation reflects a lapse in procedural compliance and situational awareness. Additionally, there was a failure to correctly define and verify the exclusion area beneath the HCS. As a result, in the event of a dropped object, there was no assurance that the object would land within a designated safe zone, increasing the potential risk to personnel.

This incident emphasizes the importance of strict adherence to operational procedures, especially those related to equipment limitations and load handling. It also highlights the critical need for clear communication among crew members and with key personnel such as the driller. Furthermore, it reinforces the necessity of correctly establishing and monitoring exclusion zones to protect workers from dropped object hazards. Moving forward, enhanced training, procedural reinforcement, and pre-job safety assessments must be prioritized to prevent recurrence and ensure a safe working environment.

Jul 2024	Onshore Petroleum	Normal operations	LOPC – hydrocarbon gas

Incident summary:
Gas vented from the pressure/vacuum breaker on a produced water tank due to unstabilised condensate being run-down to it. The plant, a gas storage facility, was in extraction mode at the time.

Considerations:
The incident highlights several critical lessons in design assurance, commissioning, and operational readiness. Firstly, the original design's omission of a safeguarding mechanism for low temperature in the Stabilisation column represents a key oversight. Despite HAZOP challenges, it was not implemented based on stable operations, but the escalation potential warrants that such safeguards should have been included regardless of past performance.

Secondly, during commissioning in 2021, a low temperature alarm was installed but incorrectly configured, reflecting a poor understanding of the significance of maintaining column temperatures within the specified 30–35°C range. Setting the alarm at 0°C—a value aligned with ambient conditions rather than process requirements—undermined its protective function.

There was also an inconsistent understanding across teams regarding the scope of the project and operating modes. The technical team assumed rundown to storage was an established and understood mode, focusing efforts on process safety upgrades, while others believed this was a new configuration requiring additional attention.

Furthermore, the operational readiness process was narrow in focus, concentrating on recent changes and maintenance status without verifying the effectiveness of existing safeguards, such as the operational trip or the state of the 3-way valve.

Lastly, although rundown to the storage tank had been technically available since 2021, the infrequent use of this mode meant operations personnel lacked recent practical experience, contributing to a knowledge gap that increased risk.

A more integrated approach to design validation, commissioning, and readiness review is essential to ensure safe operation under all potential modes.

INCIDENT DATE	INDUSTRY SECTOR	ACTIVITY/OPERATION	INCIDENT TYPE
Jul 2024	**Bulk storage**	**Maintenance – E&I**	**Electric shock**

Incident summary:
While replacing the PLC Module backing board with new PLC Modules a worker received a minor electric shock. Isolation at the isolator had been carried out as per the site permit system and electrical drawings supplied, with the isolation test-proved-tested as per policy. During the replacement there was found to be 1 circuit that had been removed from the circuit breaker, with feed from another power supply. This had not been detailed on any drawings or extra signage stating that there were 2 electrical supplies in the cabinet.

Considerations:
During these recent electrical cutover works, a significant oversight was identified in the isolation and permit planning processes. The established methodology for proving isolation relied solely on testing the load side of the isolator, which incorrectly indicated that the panel was de-energised. However, a specific terminal within the panel remained live due to its feed originating from a different Distribution Board – an arrangement not captured in the provided drawings.

This incident highlighted a critical flaw: the isolation verification process did not include a comprehensive check for residual or alternate sources of current across the entire panel. A more thorough approach, such as using a volt stick or similar voltage detection device to scan the panel before work commenced, would have revealed the live terminal and prevented the near miss. Furthermore, the inaccuracy of the drawings was not identified or addressed during permit planning. The lack of detailed validation of existing documentation posed a hidden but substantial risk, which was not mitigated.

Going forward, isolation procedures should include a full panel check for voltage using reliable, non-contact devices in addition to standard isolator testing. Permit planning must incorporate a risk assessment related to potential inaccuracies in drawings, with contingency plans for validation or field verification prior to any live work. These measures are essential to improve electrical safety, reduce reliance on potentially outdated documentation, and prevent similar incidents in future operations.

Aug 2024	**Onshore Petroleum**	**Forklift use**	**Dropped objects**

Incident summary:
A crew member was operating a loader fitted with tines and pipe clamps. While transporting a load of drill pipe, three 4" Range 3 drill pipes were lost from the loader forks. The pipe clamp failed to hold the drill pipes, and several rolled off the forks and fell to the ground from a height of approximately 2m. No other personnel were present in the operational area at the time, and no equipment was damaged.

Considerations:
This incident highlights critical safety and operational lessons regarding the handling of drill pipes using a forklift equipped with a pipe clamping appliance. Firstly, it was observed that pressurizing the clamps to their maximum operating pressure can result in the clamps securing only the rear pipe. This may cause the main hooks to lift off the fork tines, creating a hazardous situation where three of the four drill pipes are no longer adequately restrained and are at risk of rolling.

Secondly, the equipment's design inherently causes the fork tines to tilt forward when the boom is elevated. If the operator does not manually adjust the tilt to a rearward position, it significantly increases the likelihood of drill pipes rolling forward off the forks.

The operator's failure to tilt the tines rearward was a contributing factor. This is a basic control action essential to safely transporting cylindrical loads like drill pipes.

Finally, there was a general lack of awareness among operators regarding the limitations and behaviour of the pipe clamping appliance when used in conjunction with the forklift. This knowledge gap underscores the need for more comprehensive training and operational checks specific to the equipment's configuration.

To mitigate these risks, operators must be thoroughly trained in the specific operational characteristics of the forklift and clamping system. Equipment design limitations should be clearly communicated, and operational procedures must emphasize proper pipe securing and fork tilt management during lifting and transport.

INCIDENT DATE	INDUSTRY SECTOR	ACTIVITY/OPERATION	INCIDENT TYPE
Aug 2024	**Onshore Petroleum**	**Maintenance – equipment testing**	**Pressure relief failure**

Incident summary:
In an Amine Regeneration System during scheduled bench testing two pressure safety valves (PSV) failed to lift at the cold differential test pressure (CDTP).

Considerations:
The Pressure Safety Valves (PSV) had been in continuous service for one year since its last inspection and testing in August 2023. During this period, there were no recorded pressure excursions exceeding 110% of the set pressure, indicating that the valves had not been exposed to abnormal operating conditions that might have triggered activation.

Upon removal and inspection of the PSVs, there was no clear mechanical failure or damage that would indicate a specific root cause for any potential malfunction. However, a likely contributing factor to the issue was the disc in each PSV becoming adhered to the nozzle. This sticking may have been facilitated by residue from amine liquid or antifoam chemicals, which are known to create tacky or sticky deposits over time.

This incident highlights the importance of chemical compatibility and the potential impact of process fluids on PSV reliability. Even in the absence of overpressure events, chemical fouling can compromise valve performance and response. It underscores the value of regular inspection and maintenance schedules, particularly for valves exposed to chemical-laden service environments. Consideration should be given to material upgrades or protective coatings for PSVs operating in similar conditions, and periodic function testing may be beneficial even if no overpressure events have occurred.

Aug 2024	**Offshore Petroleum**	**Well workover**	**Injury – limbs and extremities**

Incident summary:
An electrician was undertaking electrical checks of an electric submersible pump (ESP) cable on an ESP spooler unit. He reached inside the cable drum between the spool support and the drum spoke to fit the earth probe of the tester unit onto the cable armour. At the same time, another worker activated the ESP spooler control lever causing the cable drum to rotate. The electrician's hand was caught between the drum and support resulting in a fracture of his right hand.

Considerations:
This incident highlights several critical gaps in risk management, operational controls, and communication that must be addressed to prevent recurrence. Firstly, there was a lack of effective engineering controls and physical barriers, which could have provided a fundamental layer of protection against unintended operation or access to hazardous zones. This absence significantly increased the potential for harm.

Secondly, the review process for the Hazards and Risk Control (HARC) sheet was insufficient. Key stakeholders, including those involved in the operation, had not fully reviewed or updated the HARC to reflect the actual risks associated with the specific task—particularly the involvement of a third-party operator with authority to operate the spooler unit. As a result, critical hazards were neither identified nor mitigated.

Additionally, there was inadequate monitoring of compliance with relevant standards, work instructions (WIs), and procedures. The existing documentation did not address the risks associated with third-party operation of the equipment, and the HARC lacked specificity for the particular spooler unit in use. This represents a failure in ensuring that procedures are both complete and appropriately tailored.

Lastly, poor communication and situational awareness compounded the risk. There was no clear notification or discussion that an external party would be operating the equipment, leaving team members unaware and unprepared for changes in operation.

Going forward, a rigorous review of risk assessments, clear communication protocols, and strict adherence to updated procedures must be enforced, especially when third-party operators are involved.

INCIDENT DATE	INDUSTRY SECTOR	ACTIVITY/OPERATION	INCIDENT TYPE
Aug 2024	Non-MHF Geothermal	Rigging down	Dropped object

Incident summary:
While rigging down a crane (not under load) the cable became slack then suddenly dropped – dropping the crane hook approximately 5m although not touching the ground and not disconnecting.

Considerations:
During the rig-down of a crane (not under load), a significant incident occurred where the crane cable became slack and then suddenly dropped, causing the crane hook to fall approximately 5m. Although the hook did not touch the ground or disconnect, this event posed a serious safety risk and highlighted several critical failures.

Firstly, the cable had jumped off the pulley, but this was not identified or corrected before operation. This oversight indicates a failure to ensure the correct and safe functioning of the crane cable system. Such mechanical issues, if left undetected, can lead to sudden and unpredictable equipment movements.

Secondly, the incident revealed the absence of a detailed, standardised procedure for rigging down the crane. A clear, step-by-step procedure would have guided operators to verify the cable's alignment and tension and ensure that all components were operating within safe parameters.

Lastly, even if procedures did exist, they were not effectively followed or enforced. This points to a breakdown in operational discipline and highlights the importance of both having robust procedures and ensuring all personnel are trained and accountable for following them.

Moving forward, it's essential to implement or review existing crane setup and rig-down procedures, include checks for cable alignment and integrity, and ensure strict adherence through training and supervision. This will significantly reduce the risk of similar incidents and enhance overall safety.

Oct 2024	Upper Tier MHF	Product loadout	Tanker/tank car overfill

Incident summary:
A chemical truck was being loaded with 33% HCl solution for off-site sales. During filling of the last compartment on the trailer unit, the compartment was overfilled and there was an overflow for almost two minutes. The overflow resulted in acid fuming at the load-out station and on the adjacent roadway. The truck driver responded by activating the pump stop pull-cord and closed the load-out hose valve. He was likely exposed to a serious risk to health or safety arising from the HCl fumes, although no injury or impairment occurred. The event had the potential to be a major incident.

Considerations:
This incident highlights several key areas for improvement in operational safety and process control during truck loading. Firstly, the applicable Standard Operating Procedures (SOPs) lacked clarity on the level of monitoring required during the loadout process. As a result, the driver did not adequately supervise the operation and failed to stop the pump when the compartment reached full capacity.

Secondly, the driver was unfamiliar with the truck being used, which likely contributed to the failure to identify critical load indicators or take corrective action promptly. Proper training and familiarisation with all vehicles used for loading should be a standard requirement.

A significant gap was also identified in the availability of real-time loadout information. The absence of visible indicators such as pump status, flow rate, and volume meant the driver had limited situational awareness during loading.

Finally, the reliance on administrative controls alone was a major vulnerability. Although engineering controls such as a high-level cut-off (Scully probe) had been identified, they were not yet implemented. This reliance on manual intervention increases the risk of human error.

To prevent recurrence, SOPs must be updated to specify monitoring requirements, drivers must be trained on all vehicle variants, and real-time loadout data must be made accessible. Most critically, engineering controls like automatic cut-offs should be prioritised and installed without delay to provide robust safety safeguards.

INCIDENT DATE	INDUSTRY SECTOR	ACTIVITY/OPERATION	INCIDENT TYPE
Nov 2024	Onshore Petroleum	Normal operations	LOPC – HC gas

Incident summary:
A gas leak occurred on a wellhead flow line from a threaded connection on a block valve. This leak resulted in an estimated 5m^3 of gas released to atmosphere. At the time of the leak, the plant was in Injection mode, and this well was not flowing. The block valve below the leak was in the closed position. The leak was detected, and the site initiated an ESD.

Considerations:
This incident highlighted several critical issues in valve selection and installation practices. Firstly, the wrong type of valve was selected for the application, which contributed directly to a leak. Specifically, although the valve handles were in the closed position, the design of the Monoblock valve allowed the ball to remain slightly open. This design flaw enabled leakage past what appeared to be a fully isolated point.

Further contributing to the failure was the poor mechanical integrity of the threaded connection between the needle valve and the Monoblock valve. The connection had only minimal thread engagement—approximately three threads—with two of these threads found to be severely damaged. This limited engagement compromised the sealing capability and mechanical strength of the joint.

Additionally, evidence suggests the threaded connection between the double block valves was damaged during installation, likely due to galling. This damage would have been visible during assembly and should have been identified and addressed by a competent technician at the time. The failure to detect and rectify these issues during installation reflects a lapse in quality control and inspection standards.

Overall, this incident underscores the importance of selecting appropriate valve types for the application, ensuring proper thread engagement during assembly, and maintaining rigorous inspection protocols to identify installation damage early. Future prevention measures should include enhanced training for technicians, stricter component inspection criteria, and a thorough review of valve specifications prior to procurement.

Oct 2024	Upper Tier MHF	Normal operations	Human error

Incident summary:
An isolation valve upstream of a pressure transmitter was identified as closed during a plant walk-through by the business unit manager. The pressure transmitter was part of a safety critical element system related to an industrial direct process (IDP) Hydrochloric (HCL) acid furnace burner management system and had the purpose of tripping the furnace if hydrogen feed pressure at the furnace was greater than 10 kPa. No high-pressure events had occurred however the pressure transmitter would not have identified high pressure and implemented a furnace trip if it was needed.

Considerations:
This incident highlighted critical gaps in the management of Safety Critical Element (SCE) instrument isolation valves. To prevent recurrence, the PCBU identified the need to improve controls that ensure these valves are maintained in the correct position. Proposed actions include adding all SCE instrument isolation valves to the managed lock list, removing valve handles, fully removing certain valves, or installing limit switches to provide position feedback.

A key contributing factor was the absence of these valves in the Industrial Direct Process (IDP) pre-start checklist. As a result, their incorrect position went undetected during the start-up process. Furthermore, inconsistencies were identified across other chemical plant pre-start checklists, with SCE isolation valves not always included or clearly specified.

This incident underscores the importance of rigorous and consistent checklist procedures for safety-critical systems. All SCE instrument isolation valves should be reviewed and appropriately integrated into managed systems, whether through physical modifications, automated monitoring, or procedural controls. Additionally, all relevant checklists must be reviewed and standardized to ensure that critical components are consistently checked prior to start-up. These improvements will help strengthen safety assurance and reduce the risk of similar events in the future.

INCIDENT DATE	INDUSTRY SECTOR	ACTIVITY/OPERATION	INCIDENT TYPE
Nov 2024	**Onshore Petroleum**	**Training (ESD operation)**	**LOPC – HC gas**

Incident summary:
The pressure vacuum relief valves (PVRV) fitted to storage tanks lifted when a plant ESD was initiated (for training purposes). This was caused by valve misalignment on the flare system. During site ESD, gas from a high pressure (HP) vessel was incorrectly directed to the low pressure (LP) flare header instead of the HP flare header. The LP flare header goes to the LP flare incinerator which isn't capable of dealing with such a volume of gas in its current configuration (burner valves configured for low gas rates). As a result, the LP flare system pressure rose sufficiently to lift the storage tank PVRV's.

Considerations:
A recent review identified several critical issues during isolation and de-isolation activities that highlight the need for stronger procedural controls and communication. Firstly, valves in the field were found to have incorrect tag numbers, and there is currently no formal auditing or verification process to ensure consistency between field valve tags and the Piping and Instrumentation Diagrams (P&IDs). This discrepancy led to an error in the isolation phase, which subsequently went unnoticed during de-isolation due to reliance on inaccurate tag numbers.

Secondly, time pressure significantly impacted the quality of execution. The isolation was conducted under pressure to issue the permit, and the de-isolation occurred at the end of a shift during a changeover, increasing the risk of oversight. These time constraints contributed to a lack of thorough checks and communication between teams.

Lastly, although the isolation procedure was changed and remained technically valid, the change was not documented with a 'Valid Change' stamp, as required by the Mechanical Isolation Procedure. This omission represents a breakdown in procedural compliance and highlights the importance of adhering to formal change management processes.

Moving forward, implementing a robust tagging verification process, reinforcing procedural compliance (especially around change management), and allowing sufficient time for critical activities will be essential to preventing similar issues. These improvements will support safer, more reliable operations.

Dec 2024	**Onshore Petroleum**	**Maintenance – inspection**	**LOPC – HC gas**

Incident summary:
While carrying out NDT external inspections in the 'hot zone' shell area of a de-ethaniser column, as a follow-up action from discovery of crack-like indications in a compensation pad of a pipe support on this column, a crack-like indication was identified on the nozzle and compensation pad of a manway nozzle. Further testing confirmed a crack and a number of small (2mm to 3mm long) gas leaks were observed emanating from the identified crack.

Considerations:
The investigation revealed that substandard fabrication practices, including improper welding and corrections to misalignment of components, likely introduced residual stresses and structural weaknesses. These flaws were not identified during initial quality checks, highlighting a gap in fabrication oversight and quality assurance procedures.

Additionally, the deterioration of the protective surface coating exposed the material to corrosive elements in the coastal operating environment. Without adequate protection, the component was susceptible to chloride stress corrosion cracking—a failure mechanism that occurs when tensile stress and corrosive environments combine.

This incident underscores the critical importance of rigorous fabrication standards, comprehensive quality inspections, and regular maintenance of protective coatings. Preventive actions should include enhanced contractor qualification processes, improved inspection protocols during fabrication, and implementation of more robust coating maintenance programs. By addressing these areas, future occurrences of similar failures can be significantly reduced, ensuring equipment reliability and operational safety.

INCIDENT DATE	INDUSTRY SECTOR	ACTIVITY/OPERATION	INCIDENT TYPE
Dec 2024	**Upper Tier MHF**	**Manual handling**	**Injury – limbs and extremities**

Incident summary:
While lifting a finished goods pail of Metall Etch 291L (containing 10% hydrofluoric acid) by its handle, a warehouse operator noticed that the lid was loose, and this had allowed liquid from the pail to spill out contacting his thumb. The site is a third-party storage (3PL) storage site with no unpacking or opening of customer packages and as such this PCBU does not check for pail lid security during normal processes. Customers are responsible for checking packaging of finished goods at their site prior to delivering to this 3PL site for storage. Normal handling of unopened UN specification pails does not require PPE.

Considerations:
A recent incident highlighted critical gaps in warehouse safety protocols and operational awareness. Firstly, the absence of a documented procedure requiring checks on pail security prior to handling led directly to the mishandling of a container and an injury to a worker. A robust procedure should also specify the appropriate type of protective gloves to be worn during manual handling, particularly for potentially hazardous materials. This oversight contributed to increased risk and exposure for warehouse personnel.

Secondly, the incident underscored a lack of situational awareness on the part of the warehouse operator. Improved training and regular reinforcement of hazard recognition skills are essential to ensure operators remain vigilant and responsive to their environment.

Lastly, the company's existing policies did not mandate routine checks on stored products, nor did they require the provision of suitable personal protective equipment (PPE) for warehouse staff operating under higher risk conditions. This deficiency significantly increased the likelihood of injury and potential environmental exposure.

To prevent recurrence, the company should update its standard operating procedures to include mandatory safety checks of containers, specify required PPE based on risk assessments, and enhance operator training programs. Additionally, routine inspections of stored materials and proactive provision of suitable PPE are essential steps toward creating a safer working environment.

Mar 2025	**Offshore Petroleum**	**Normal operations**	**Dropped object**

Incident summary:
On an offshore well, an annulus flowline spring-can pipe hanger failed mechanically resulting in three dropped objects: two springs and an end cap. The objects, weighing 5kg (each spring) and 8kg (end cap), came to rest on the well bay grating approximately 3.5m below. The spring-can pipe support is the first support on the annulus line from the tree. The two tension rods that hold the end cap and tension the springs have failed and the end cap and both springs have been ejected from the can.

Considerations:
The failure of spring-can hanger tension rods highlights several critical lessons in offshore asset integrity and maintenance. Primarily, corrosion had significantly weakened the rods, compromising their ability to resist internal forces generated by compressed springs and constant flowline movement caused by wave action. This degradation went undetected due to limitations in the existing maintenance and inspection programs, which failed to identify the extent of corrosion.

A key contributing factor was the absence of detailed, ongoing maintenance and inspection requirements in the manufacturer's guidelines. Without clear specifications or hazard identification related to spring can failures, operational risks were not fully understood or managed. This gap in documentation and proactive oversight left the components vulnerable to undetected deterioration over time.

Furthermore, the offshore environment inherently accelerates corrosion and mechanical wear, making robust and frequent inspections essential. The lack of tailored maintenance strategies for offshore conditions further exacerbated the issue, demonstrating the need for environment-specific asset management practices.

Future programs must incorporate comprehensive and proactive inspection regimes, with clear manufacturer guidance and risk assessments for all components, particularly in high-risk environments. This includes revising inspection frequencies, leveraging corrosion monitoring technologies, and ensuring hazard identification is integral to equipment design and lifecycle management.

INCIDENT DATE	INDUSTRY SECTOR	ACTIVITY/OPERATION	INCIDENT TYPE
Jan 2025	Upper Tier MHF	Maintenance – mechanical	Inadequate isolation

Incident summary:

There was a loss of containment of chlorine dioxide during a line break as part of maintenance activity. The line break was completed during a planned day shut and under the permit to work system. Three workers in the downwind area of the plant, outside of the exclusion zone, were exposed to high levels of chlorine dioxide gas. One of the workers was monitored at the local hospital following the event and was released the same day.

Chlorine dioxide acts as a respiratory tract and ocular irritant and can cause wheezing, coughing, shortness of breath, decreased pulmonary function, and nasal pathology.

Considerations:

This incident highlights critical gaps in procedural adherence, hazard control, and personnel readiness during a chlorine dioxide line shutdown in a bleach plant. Firstly, the flushing process was not carried out correctly due to operators relying on general knowledge rather than the specified procedure. Misinterpretation of shutdown notes and omission of procedure references led to inadequate flushing of the line, completing only 2 minutes of the required 25-minute flush.

Secondly, the exclusion zone was not effectively established due to failure to use a line break certificate, as required by procedure. This document included essential checks that help define the appropriate exclusion zone based on line contents and environmental factors. The oversight resulted in reliance on EMS personnel's standard judgment rather than site-specific risk assessment. A contributing factor was the lack of handover and documentation of prior best practices following the departure of the previous bleach plant engineer.

Thirdly, the newly appointed permit issuer lacked familiarity with the bleach plant layout and procedures. Although trained in chlorine dioxide hazards, they were not yet authorized for permit or certificate issuance in the specific area, impacting the quality of risk management decisions.

Lastly, the isolation plan did not adequately address the required verification of flushing effectiveness or identify areas unable to achieve zero energy, as required by procedures. This further compromised the effectiveness of the hazard control process.

These issues collectively underscore the need for procedural clarity, rigorous training, proper handover, and comprehensive risk management.

1.7 Case studies

Liquefied Petroleum Gas (LPG)

CASE STUDY: WHY GOOD LAND USE PLANNING MATTERS FOR SAFETY AROUND HAZARDOUS SITES

When we talk about ‘incompatible land use’, we mean situations where different types of land use don’t mix well – like putting homes, schools, or shops right next to industrial sites that handle dangerous substances. In New Zealand, this can be a big safety issue. If something goes wrong at one of these high-hazard facilities, the consequences can be much worse simply because more people are nearby.

This was exactly the concern WorkSafe had for two sites in Dunedin – one operated by Rockgas Limited and the other by Genesis Energy Limited. The LPG sites were originally built on the old coal gas works in the 1970’s which was then a semi-rural setting. Due to changes in land zoning classifications over the years by Dunedin Council, both sites had become increasingly surrounded by commercial and retail expansion. Inspectors were worried about what could happen if there was a serious incident.

Even though the companies weren’t doing anything wrong, and their sites had been in place prior to the establishment of the retail areas, the risks were considered high, and something needed to be done.

After identifying the risks WorkSafe was able, through a series of site visits and open honest conversations, to explore ways to reduce the risks as much as possible. Both Rockgas and Genesis were proactive, open-minded and genuinely committed to finding a solution.

Together, they came up with a two-step plan. Long-term, both companies are moving their major operations to new locations that are much better suited, away from sensitive areas like shops and homes. That work is already well underway. In the meantime, they’ve taken short-term steps to lower the hazard levels of the current sites. One major change was cutting down the amount of LPG stored on-site.

The Genesis site has gone from being a lower tier MHF to being under the MHF threshold. The 50 tonne above ground LPG tank has been decommissioned and they are now operating from a 20-tonne tank. Once their new Dunedin site is operational in the next couple of years, the original Genesis site will be completely decommissioned.

The Rockgas above ground 30-tonne LPG tank has been wrapped in a fire resistant ‘blanket’ to reduce the fire impingement risk for some time now as a first stage of improvement works. This tank will be replaced by two 4-tonne above ground tanks in the next year to reduce the quantity of LPG stored on site even further. This will allow Rockgas to continue to fill its customers’ 9kg bottles.

Overall, the outcome will be to replace three large above ground LPG bulk tanks with two smaller tanks, which considerably reduces the risk in this busy area.

This case is a great example of what can happen when businesses and inspectors work together. It also shows how important it is to think about safety in the land use planning stage. If incompatible land uses are allowed to become established in close proximity, fixing the problem can be expensive and complicated.

CASE STUDY: PROACTIVE COLLABORATION IN CATASTROPHIC HARM MANAGEMENT JOURNEY: A WIN-WIN STRATEGY

Over the past seven years, Z Energy (Z) has made significant investments to upgrade safety-critical infrastructure and systems across its terminal facilities. These upgrades reflect Z's commitment to operational integrity, regulatory compliance, and the protection of people and the environment. This investment reinforces Z's stand on safety and wellbeing where it is committed to providing workplaces that enable safe, productive, and engaging work for their team, partners, and the communities they serve.

Z facilities handle highly flammable and hazardous substances, and the team recognises the importance of robust safety systems to prevent major hazard events. Key upgrades have included:

- fire protection systems
- advanced leak detection technologies
- secondary containment systems.

These improvements align with evolving regulatory standards and significantly reduce the risk of incidents arising from equipment failure, natural disasters, or human error.

Z has maintained a proactive and collaborative relationship with the WorkSafe Major Hazard Facilities (MHF) team since its establishment. They've implemented key recommendations from the Buncefield Report, which have informed their approach to process safety and risk management. These learnings have also been shared across Ampol Group, of which Z is a part, supporting safety enhancements at similar facilities in Australia.

Z has also strengthened partnerships with Emergency Services, local communities and Iwi, to ensure that comprehensive emergency response procedures are in place and can be activated swiftly to minimise community impact in the event of an incident.

Z's engagement with WorkSafe is based on a constructive, two-way dialogue. This positively influenced Z's internal safety culture and improved the clarity and quality of risk control documentation. It has also helped define what constitutes acceptable practice and best practice within the industry.

Z remains committed to transparent communication with regulators and stakeholders, and to continuous improvement in safety performance across all its operations.

The WorkSafe MHF team would like to thank Z Energy for this article, and how they have engaged with WorkSafe since the introduction of the MHF Regulations.

See Keat (SK) Lu, Specialist Inspector, Major Hazard Facilities In collaboration with Z Energy






CASE STUDY: **PROACTIVE SAFETY IMPROVEMENTS IN NEW ZEALAND'S BULK LIQUID STORAGE INDUSTRY**

Applying international lessons to strengthen local operations

Terminals New Zealand (TNZ) has proactively reviewed the U.S. Chemical Safety Board's investigation into the 2019 Intercontinental Terminals Company (ITC) tank fire in Texas. The review identified a range of relevant improvement opportunities. Resulting actions are being tracked to closure through TNZ's safety management system, reinforcing its commitment to process safety excellence.

Promoting shared learning across the industry

TNZ encourages other bulk liquid storage operators in New Zealand to undertake similar reviews and apply relevant lessons in their own operations. This approach shows TNZ's commitment not just to improving its own practices, but to raising safety standards across the industry. It reflects proactive leadership and fosters a collaborative, strong safety culture with a shared focus on managing major incident hazards.

Supporting regulatory goals and influencing industry practice

By embedding international insights into local safety systems, TNZ is not only supporting regulatory objectives but also raising the bar for industry practice. The initiative highlights the value of shared learning, clear risk ownership, and a sustained focus on continuous improvement – all of which contribute to safer, more resilient bulk liquid storage operations across New Zealand.

CASE STUDY: **BUNCEFIELD: A LASTING LESSON IN PROCESS SAFETY**

The explosion and fire at the Buncefield oil storage depot in Hertfordshire, UK, on 11 December 2005, remains one of the most significant industrial incidents in recent history.

The 20-year anniversary is a time for reflection on the disaster's impact, the subsequent recovery efforts, and the important safety lessons learned by industry and emergency services to prevent future accidents.

The incident led to significant property damage and injuries, prompting a thorough investigation by the UK Health and Safety Executive (HSE) and the Environment Agency, which culminated in reports and recommendations for companies to improve safety systems, procedures, and land-use planning to prevent similar events.

As regulators, we continue to reflect on this event not only for its scale but for the systemic failures it revealed – failures that are still relevant today.

This article revisits the Buncefield incident to reinforce key lessons for operators of major hazard facilities and petroleum installations, with a focus on regulatory expectations and the enduring importance of robust safety management systems.

What happened

At approximately 6:00am, a massive explosion occurred following the overfilling of a petrol storage tank. The tank's high-level switch failed, allowing fuel to overflow and form a large vapour cloud. This cloud ignited, causing a blast that registered 2.4 on the Richter scale, injured 43 people, and caused extensive damage to the site and surrounding areas.

Key regulatory lessons

1. **Criticality of independent safety systems**

   The failure of the tank's high-level switch – a last line of defence -was central to the incident. Regulators now emphasise the need for independent, diverse, and regularly tested safety-critical systems. Reliance on a single layer of protection is insufficient.

2. **Effective alarm management**

   The tank level gauge failed, so no alarm was activated. This highlights the importance of operator training, and clear escalation protocols to ensure timely and appropriate responses, when there is risk of instrument failure. This should be consideration at design stage, like having intelligence built into control system to detect alarm failure.

   Example. tank still being filled, inlet open, but tank level not rising.

3. **Maintenance, competence and testing regimes**

   The high-level switch had not been tested in accordance with its design intent, or functionality and configuration of the high-level switch understood by the maintenance personnel. Regulators expect rigorous inspection, testing, and maintenance schedules for all safety-critical equipment, with clear documentation and accountability.

4. **Organisational culture and competence**

   Investigations revealed a culture of complacency and poor communication between operators and contractors. Regulators now place greater emphasis on safety leadership, contractor management, and organisational learning.

5. **Permit to work and shift handover**

   Weaknesses in shift handover and permit-to-work systems contributed to the incident. These systems must be structured, auditable, and embedded in daily operations.

6. **Management of change**

   Management of change procedures were not adequately applied to bund projects. Bunds were not subject to an adequate inspection and maintenance regime.

7. **Land use planning and emergency preparedness**

   The scale of the explosion raised questions about the siting of high-hazard facilities near populated areas. Regulators have since strengthened land use planning controls and emergency response coordination with local authorities.

International regulatory response

The Buncefield incident prompted widespread regulatory reform:

- UK (HSE): Issued the Buncefield Standards Task Group reports, leading to tighter controls on overfill prevention, alarm systems, and secondary containment.
- EU: Influenced updates to the Seveso III Directive, reinforcing the need for public information, land use planning, and safety management systems.
- Australia and New Zealand: Incorporated lessons into MHF and petroleum regulations, particularly around safety case requirements, human factors, and barrier management.

Implications for New Zealand operators

Under the Health and Safety at Work (Major Hazard Facilities) Regulations 2016 and the Health and Safety at Work Petroleum (Exploration and Extraction) Regulations 2016, operators are required to:

- demonstrate effective control of major accident hazards through safety cases
- maintain robust systems for hazard identification, risk assessment, and control verification
- ensure ongoing competency of personnel and continuous improvement of safety systems.

The Buncefield incident serves as a stark reminder that compliance on paper is not enough. Safety must be lived, tested, and continuously challenged.

Conclusion

Buncefield was not just a failure of equipment – it was a failure of systems, culture, and vigilance. As regulators, we urge all operators to revisit their own operations through the lens of this incident. Ask the hard questions. Test your assumptions. And above all, never let routine dull your sense of risk.

References and further reading:

- Buncefield fire
- Bunchfield: Why did it happen?
- The Buncefield Investigation
- Land use planning advice around large scale petrol storage sites

Liam Gannon, Principal Inspector, Major Hazard Facilities

1.8 Industry working groups

Storage and logistics working group

The storage and logistics working group consists of MHF, Petroleum and Geothermal (P&G) and hazardous substances inspectors.

The aim of the group is to improve knowledge and consistency across inspectors, and identify common issues and good practice across the storage and logistics industry.

The group plans to meet periodically to share learnings and experiences from inspections and discuss areas of concern or that require more clarity or consistency. However, the group has not met this year due to competing priorities.

Once re-established, the focus will be on racking standards, separation distance requirements, fire suppression and gas detection.

Future topics are likely to include the building code requirements and performance monitoring specific to storage and logistics.

Liquefied Petroleum Gas (LPG) working group

The LPG working group was established to share knowledge between High Hazard inspectors and to coordinate a consistent approach with our LPG operators.

All High Hazard inspectors with responsibility for operators and facilities holding LPG are members of the group, alongside managers and representatives from WorkSafe's Hazardous Industries teams and Technical Specialist teams.

The industry group currently meets less frequently as MHF inspectors rightly prioritise safety case assessments.

Items of note that arose over the last year included lessons learnt from notifiable incidents at LPG facilities, fire protection for above ground bulk tanks, and sharing inspection/safety case findings.

LPG facilities made up just under 11% of all the notifiable incidents received over FY 24-25. Of these, the percentage of loss of containment events involving LPG was 23% over the same period. Since the start of FY 25/26 to the time this article was written (that is, July to October) this has increased to 50%. 61% the 31 LPG-related notifications received over FY24/25 occurred during maintenance activities, with all but two involving maintenance/testing of SCEs.

This report includes a significant good news story for the HHU, focusing on the actions being taken by two LPG PCBUs operating neighbouring facilities in Dunedin to de-risk that location in the medium term, with a longer-term objective to establish new sites elsewhere. The close collaboration between inspectors and the different teams within WorkSafe was aided by the LPG industry group, demonstrating its value and contribution to what will be an excellent outcome.

With New Zealand currently facing challenging economic conditions, all HHU inspectors over the next year(s) are focusing on ensuring PCBUs are maintaining their assets, so they continue to be safe to operate. This applies to LPG facilities as well. Compliance with AS/NZS 1596:2014 will also continue to be a focus on our planned inspections.

No engagement was had with GasNZ over the last financial year, but we remain open to future engagement opportunities.

The group will continue to work together on setting expectations for operators of high hazard facilities with LPG.

1.9 International regulatory engagement

2025 International Offshore Regulators' Forum

The 2025 International Offshore Regulators' Forum AGM (6–8 Oct) and Offshore Safey conference (9–10 Oct) were held in in St John's, Canada. It was hosted by the Canada-Newfoundland and Labrador Offshore Energy Regulator, Canada-Nova Scotia Offshore Energy Regulator and Canada Energy Regulator.

The AGM was attended in person by offshore energy health and safety leaders from almost all member countries, including Australia (Chair), Brazil, Canada, Denmark, Ireland, the Netherlands, New Zealand, Norway, Mexico, the United Kingdom and the United States.

The AGM discussed topics, such as decommissioning legislation, carbon capture and storage (CCUS), Artificial Intelligence (AI), cyber security and innovation that were high on most countries' agendas, whilst sharing the opinion that safety and environmental protection must remain the same or greater level of priority as they are now.

All areas of discussion were useful, but the standards required, and the approach for decommissioning of infrastructure, was particularly relevant to New Zealand. New Zealand has aging infrastructure with some approaching end of life, and decommissioning conversations around what is acceptable have already commenced.

The increasing use of AI in a systems-based safety culture was also extremely relevant. It raised issues about what regulatory controls are in place (or should be) to ensure that systems remain robust. This was seen as a challenge across all member countries, though some are further advanced. The ability to lever off the knowledge and current experiences from these countries is advantageous.

The theme of the safety conference was 'Offshore Safety Through Innovation'. It brought together global regulators and approximately 300 delegates from across the industry to explore how emerging technologies can enhance and advance safety in offshore operations.

The conference saw various presentations and panel discussions from the regulators and industry, as well as invited guest speakers. Over a dual parallel stream format, the conference covered several key themes:

- Why are we not learning from accidents?
- Operational safety and innovation
- Regulatory sandboxes: Capture versus collaboration
- Managing new technologies with old regulations
- Human factors and AI
- Managing new technologies with old regulations
- Aging facilities: Managing and predicting lifetime
- How new technology is impacting work in the offshore industry
- AI and emerging technologies be used in risk management, trending and operations
- The responsible use of innovative technologies and AI
- Managing risk in extreme environments
- Safety in the renewable energy industry.

WorkSafe are thankful for the opportunity to attend the 2025 International Offshore Regulators' Forum and meet interesting people and hear some thought-provoking presentations and to share ideas about the industry. The WorkSafe P&G team are already looking forward to next year's forum.

2.0
Our focus for the year ahead

IN THIS SECTION:

2.1 Major Hazard Facilities team – Inspection focus 2025/26

In 2025, the MHF team has returned to foundational principles with a 'back to basics' approach to inspections. This year's focus has been on reinforcing core safety practices and ensuring that both upper and lower-tier facilities are meeting regulatory expectations under HSWA and the MHF regulations.

Key inspection priorities have included:

- Safety assessments and controls: Ensuring that operators have completed and periodically reviewed safety assessments, with a particular emphasis on Major Accident Prevention Policies (MAPPS) and safety management systems for lower-tier sites.
- Critical controls and verification: confirming that appropriate controls are in place, supported by appropriate performance standards and verification processes, and especially for safety critical elements.
- Emergency preparedness: reviewing and exercising emergency plans to ensure they are current and effective.
- Worker engagement: promoting meaningful worker participation in safety management and decision-making processes.

As part of the second safety case cycle, we have also focused on resolving outstanding safety case Future Inspection Topics (FITS) and strengthening confidence in operator systems and practices.

2.2 Looking ahead: Safety case completion end of 2026

A key priority for the coming calendar year is the completion of the majority of remaining revised safety cases. This milestone is essential to ensure that upper tier MHFs have an appropriate and accepted revised safety case in place, forming the foundation for ongoing risk management and regulatory assurance.

2.3 Petroleum and Geothermal (P&G) team – inspection focus 2025/26

For 2025/26, the P&G team is focusing on the assessment of a large quantity of revised safety cases. Most facilities are in their third safety case revision, and a key focus is to ensure that safety assessments and So Far As Is Reasonably Practicable (SFAIRP) demonstrations have been revisited.

Similar key inspection priorities exist for the team as those detailed for the Major Hazard Facilities team. The following priorities have been added:

- Ageing infrastructure: assets approaching or have exceeded their intended design life. Timely and appropriate maintenance is of particular importance given more than half of all production facilities onshore/offshore are more than 20 years old, and some exceed 40 years.
- Maintenance deferrals: deferrals may be acceptable when done for a short period of time, when engineering or procedural processes are not feasible. It is expected that operators will review all their deferred maintenance activities to ensure risks, particularly Major Accident Hazard (MAH) risks, continue to be reduced to SFAIRP.
- Decommissioning: As late life assets approach end of life and cease production, a focus on the planning and execution of decommissioning will be undertaken through assessment of permissions documents and monitoring through inspection activities.

2.4 Hazardous Substances team – inspection focus 2025/26

The Hazardous Substances team continues with its 'risk-based' inspection focus, prioritising high-risk sites. These are defined as sites holding large quantities of hazardous substances (below LT MHF) with an inherent risk and the potential for a catastrophic incident.

The team also focuses on hazardous industries, such as waste oil, hydrogen, pyrotechnic and explosives, rocket launch, pipelines, bulk storage stationery container systems and monitor exemptions.

Inspectors undertake three types of inspections, 'pro-active', 're-active' and on occasion 'directed' inspections, note this excludes investigations. In that regard, we assist with an investigation as the Lead Inspector or as an SME or technical expert.

We undertake multiple inspections at our larger sites with a specific inspection topic, to ensure these requirements are adequately managed. This is generally two inspections a year at the same site. We aim to ensure the inspection is efficient, of value for the operator and aligned to WorkSafe's strategy.
Topics may include:

- officer due diligence
- process safety and safety critical controls
- contractor management
- exemptions, and
- compliance plans

We are also focusing on recurring non-compliance themes where appropriate such as:

- expired compliance certification including refusals
- inventory
- emergency response plans, and
- identification and management of hazardous areas, for example, site plans.

2.5 Looking ahead: future focus

We are reviewing our data intelligence and insights to inform and ensure our inspection focus is looking at the right things and aligned with WorkSafe's strategy. This may include analysis of non-compliances and enforcement action taken, what the failures are, as well as notifiable events including fatalities, identifying the root causation and remedial actions taken following an event.

We are also forecasting for any potential impacts with advanced technology, emerging risks and legislative amendments, for example, hydrogen.

2.6 Feedback

We are keen to know what you think and how we can provide better or more useful data next time. Please send any feedback to: hhu.mhf@worksafe.govt.nz

Notes

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