



22

Major hazard facilities

ANNUAL ANALYSIS REPORT

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Reference

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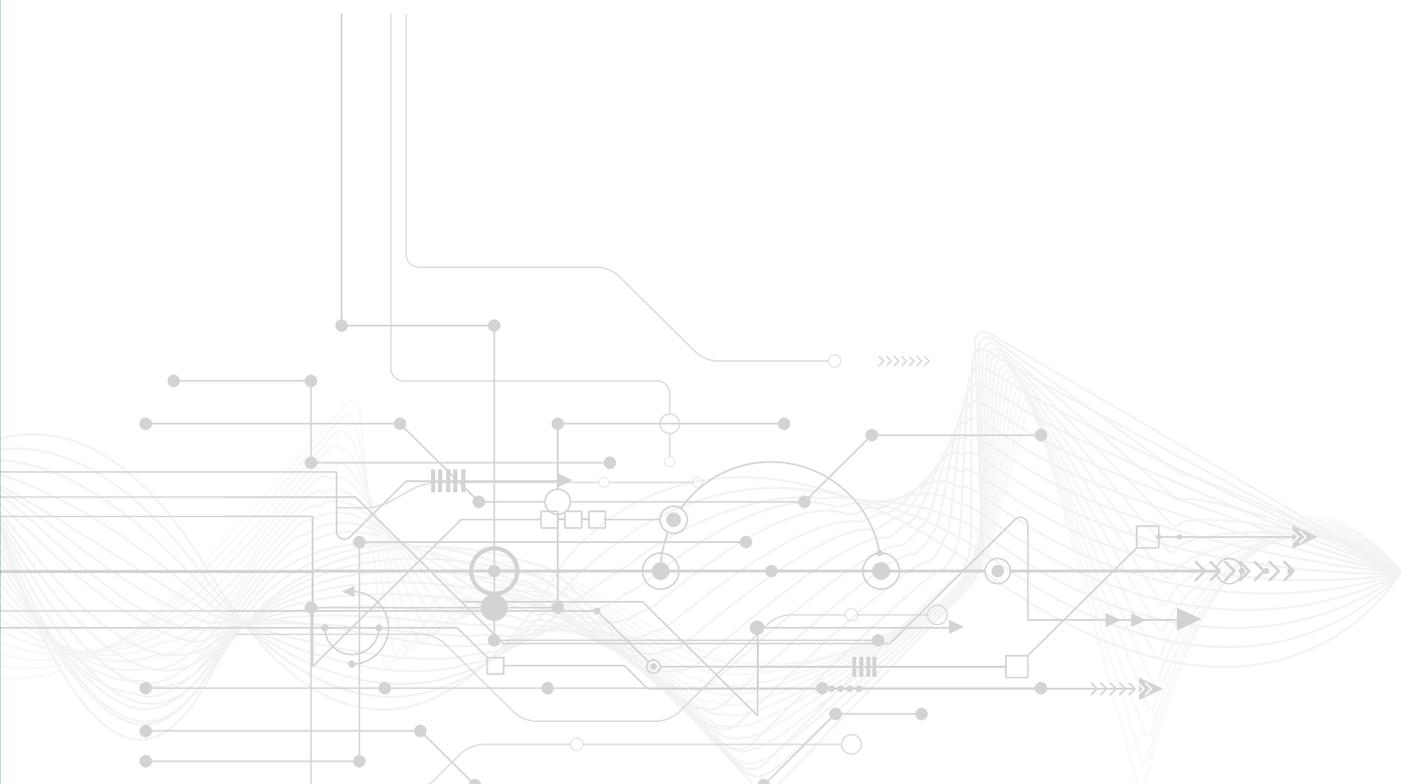
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Section 1 Introduction

Aim

The Department of Mines, Industry Regulation and Safety (the Department) is committed to supporting positive safety outcomes for industry and the public.

This analysis report summarises and classifies the findings from major hazard facilities (MHFs) audits and reported dangerous goods incidents for the financial year 2022-23. Over time, this data is expected to provide trending insight into safety and compliance issues at MHFs and serve as an additional information source for the continuous improvement of operations.

Areas of focus and concern identified by the Chief Dangerous Goods Officer (CDGO) are included to facilitate the various industries to achieve optimal protection for people, property and the environment.

Scope and legislative framework

The Department regulates MHFs in Western Australia (WA) under the *Dangerous Goods Safety Act 2004* (Act) and the Dangerous Goods Safety (Major Hazard Facilities) Regulations 2007 (MHF Regulations).

The MHFs are recognised as being of considerable significance to the State economy. Products from these facilities are essential in ensuring the functioning of industry and society in WA and are also exported around the globe. MHF products are critical for appropriate water treatment processes, enable fertiliser production, the supply of modern battery materials and clean fuels. Future larger scale clean energy ventures, such as green hydrogen projects, are likely to be classified as MHFs.

Currently, there are 22 classified MHFs covering multiple industries within WA. These facilities include the storage, processing or production of:

- compressed and liquefied natural gas
- liquefied petroleum gas
- anhydrous ammonia
- ammonium nitrate
- refined petroleum
- chlorine
- sodium hypochlorite
- titanium dioxide
- sodium cyanide
- refined nickel and cobalt
- nickel sulphate.

MHFs store and process large quantities of dangerous goods. Consequently, MHF operators use a variety of safety measures to minimise risk from events that may cause injury to people or damage property or the environment. The Department regulates MHFs with a particular focus on the prevention of major incidents, as these have high potential for significant societal impacts.

MHF operators are expected to engage in an ongoing learning and improvement process under the safety report framework. The broad industry-wide data in this analysis report can assist in informing MHF operators on areas of risk by providing the information on incident types, the impact of incidents and areas of deficiency found by dangerous goods officers.

The data in this analysis should be used to strategically review operational policies and procedures and to drive improvements to protect people, property and the environment.

Introduction from the Chief Dangerous Goods Officer

This is my first opportunity to write to MHF operators since my return to the CDGO role earlier this year. I have spent the last three years within WorkSafe General Industries regulating under the *Occupational Safety and Health Act 1984* and *Work Health and Safety Act 2020*. It is a pleasure to return to regulating safety on petroleum and dangerous goods sites, and the high focus on safety these industries demonstrate.

I would like to thank the speakers and attendees for the MHF forum held in June this year. This was the first forum since COVID-19 placed restrictions on public gatherings. Even with the long break between forums, it was encouraging to see such a strong turnout and passion for process safety. These forums have a strong networking component and I hope all of the attendees managed to find new contacts – after all, safety is a team event.

Green hydrogen, ammonia and biofuels continues to increase in interest. It is vital to minimise risk to people, property and the environment from this developing fuel source. In May 2023, we published a [Dangerous Goods Safety Guide](#) to provide industry with guidance on our expectations for the storage, handling and production of hydrogen. Early engagement is key with these alternate fuel facilities, as even for non-MHFs we are applying a performance based regulatory approach with demonstration that the risks have been reduced so far as reasonably practicable (SFARP). We have already licensed some of the smaller facilities, with the expectation that more and larger facilities are not far off.

For our own continuous improvement, we now have three assigned specialist roles within the Directorate:

- Principal Inspector – Human Factors: Justine McGillivray
- Principal Investigator: Kristin Priest
- Green and Alternate Fuels General Manager: Steve Emery

You have likely already come across Justine and Steve. Kristin has been with the Department for 16 years. She has spent the last decade investigating serious and fatal incidents across the dangerous goods, mining and petroleum industries.

Other changes are underway, such as reviewing audit findings definitions. The process will not be changing, nor the expectation that the operator consider the findings and respond with the most appropriate action.

The MHF regulatory team will be undergoing some slight changes later this year. They will now also be regulating dangerous goods pipelines, so for those MHFs that import or export through pipelines, expect more detailed engineering queries.

Please use this report as an opportunity to review your operations against your peers who may be operating in a different industry, but have similar risks and consequence management. The analysis and focal points for the coming year are presented in [Section 4](#) and I encourage you to consider these in the context of your operation.

I look forward to a productive and safe year.

Iain Dainty
Chief Dangerous Goods Officer

Section 2 MHF audit finding summary

MHF audit findings

Audit findings are provided in terms of opportunity for improvement, minor non-compliances and major non-compliances.

Opportunity for improvement (OFI)	<p>A finding that, while the dangerous goods officer believes the legislative, safety report or safety management system requirement are being met, it would be sensible for some form of improvement action to be taken to minimise the risk so far as reasonably practicable (SFARP).</p>
Non-compliance (NC (Major / Minor))	<p>There is insufficient evidence to prove compliance with a legislative, safety report or safety management system requirement. The dangerous goods officer has formed the opinion that corrective action is required.</p> <p>Major – the non-compliance presents an elevated risk and corrective action needs to be taken to mitigate the risk within a short timeframe.</p> <p>Minor – the non-compliance requires corrective action to be taken in a timely fashion.</p>

In 2022-23, a total of 99 findings from 17 audits were recorded by MHF dangerous goods officers. These findings were assigned as OFI, NC-Major and NC-Minor (Figure 1).

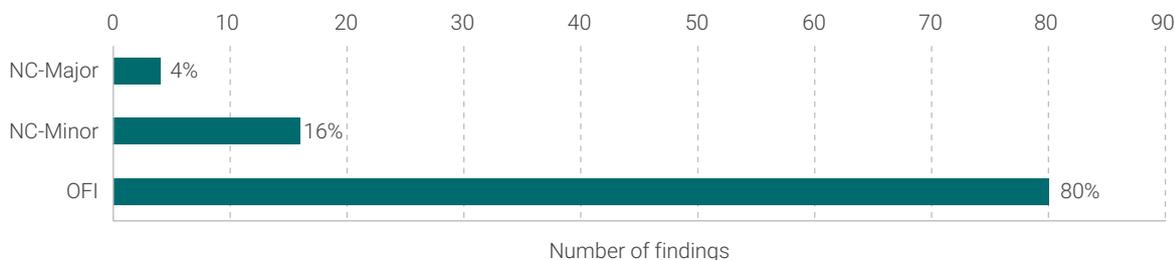


Figure 1 Audit findings 2022-23

MHF audit finding classification

Audit findings are categorised under 20 headings of faults based on the Energy Institute (EI) process safety framework and are shown in Figure 2.

To provide a more nuanced comparison of the audit findings, Figure 2 shows the breakdown of findings with the dominating “documentation and knowledge management” set removed. Documentation and knowledge management is over-represented in the audit findings as these are readily identifiable and common compared to faults in the other categories.

The three major non-compliance findings were in the areas of management of safety critical controls, compliance with legislation, and operating manuals and procedures.

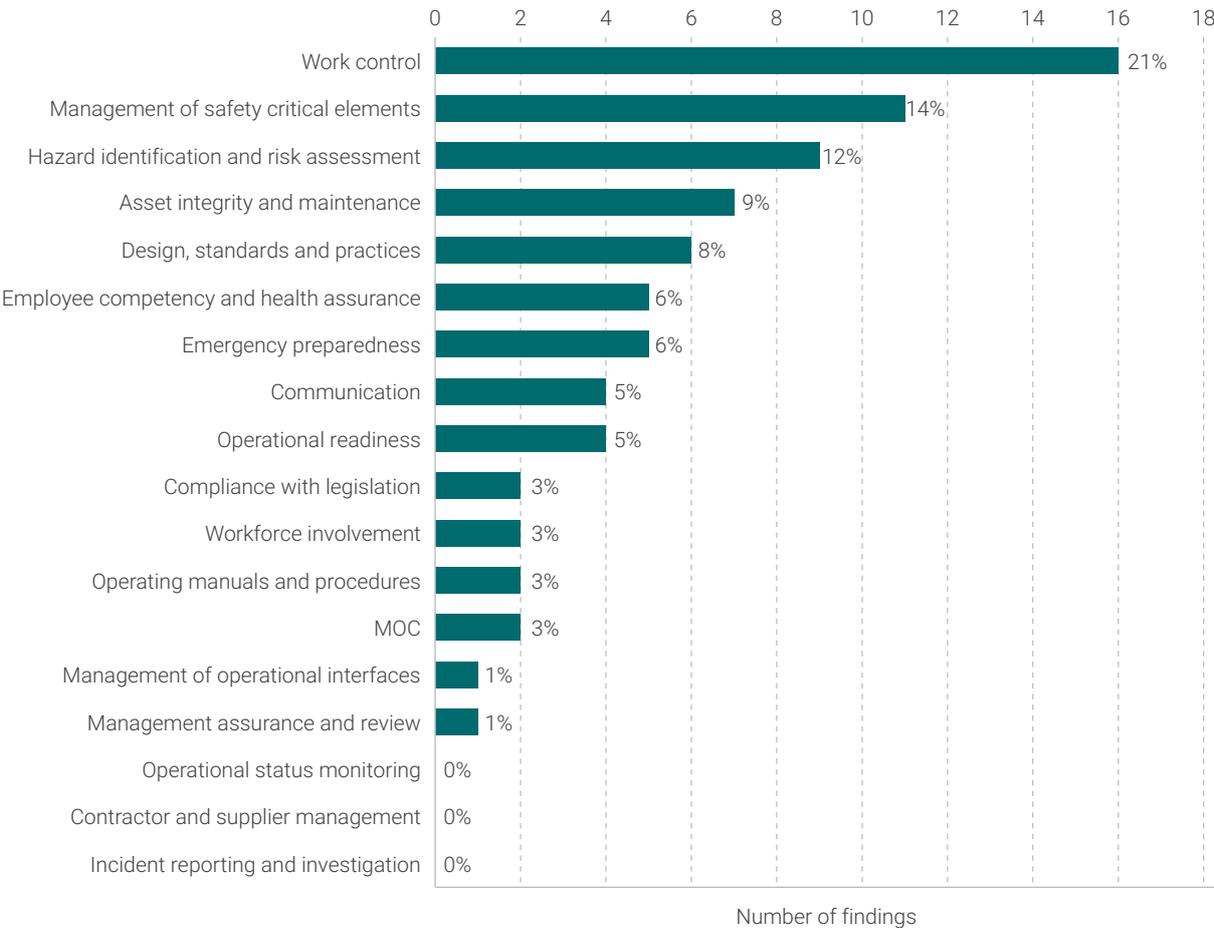


Figure 2 Audit findings classification without dominating set

Note: Not all classification areas receive the same level of attention and a direct comparison of the number of findings per heading may be misleading. For example, the CDGO requested certain areas be targeted, and it is expected that those targeted areas will be over-reflected in the findings.

Section 3 MHF dangerous goods incident summary

MHF dangerous goods incidents

There were 75 dangerous goods incidents reported to the Department in 2022-23 in relation to MHFs.

None of these incidents were considered sufficiently serious to warrant a forensic investigation with the potential for high level enforcement action. However, as these incidents involved the loss of control of a dangerous good, they all had the potential to escalate to serious consequences. Appropriate remediation and control measures were therefore implemented.

Classification of incidents include:

- loss of containment (LOC)
- fire
- risk control measure failure
- explosion or implosion
- release of energy
- exceed design envelope
- reaction or contamination.

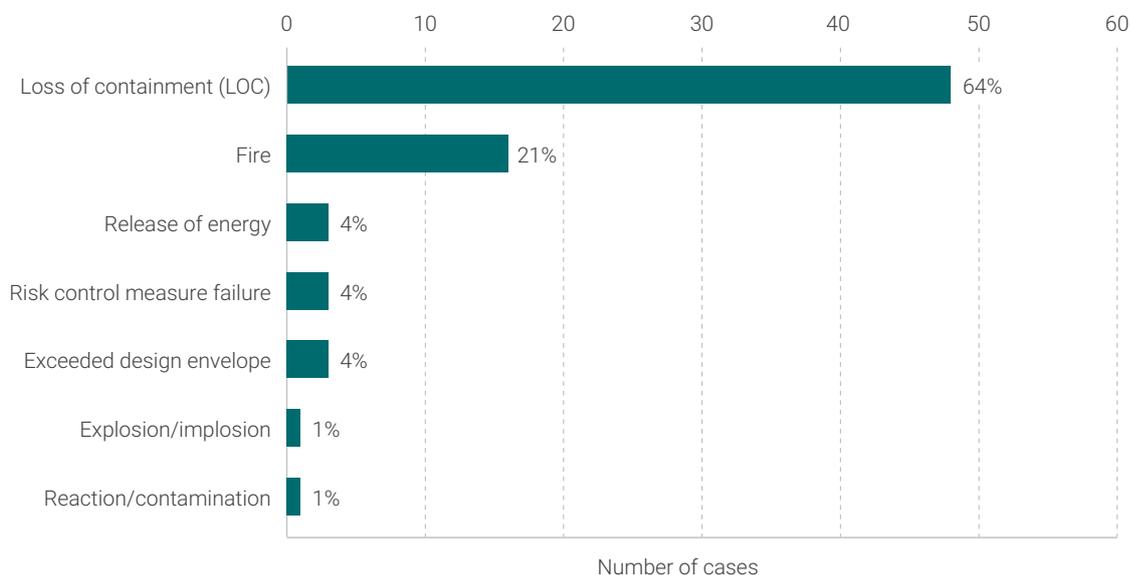


Figure 3 Dangerous goods incident classification

MHF dangerous goods incident outcomes

The impact of each incident has been assessed and classified into the following:

- report only (minimal harm)
- emergency response
- damage to property
- damage to environment
- injury
- public concern
- third-party impact
- emergency shutdown / blow down / flare.

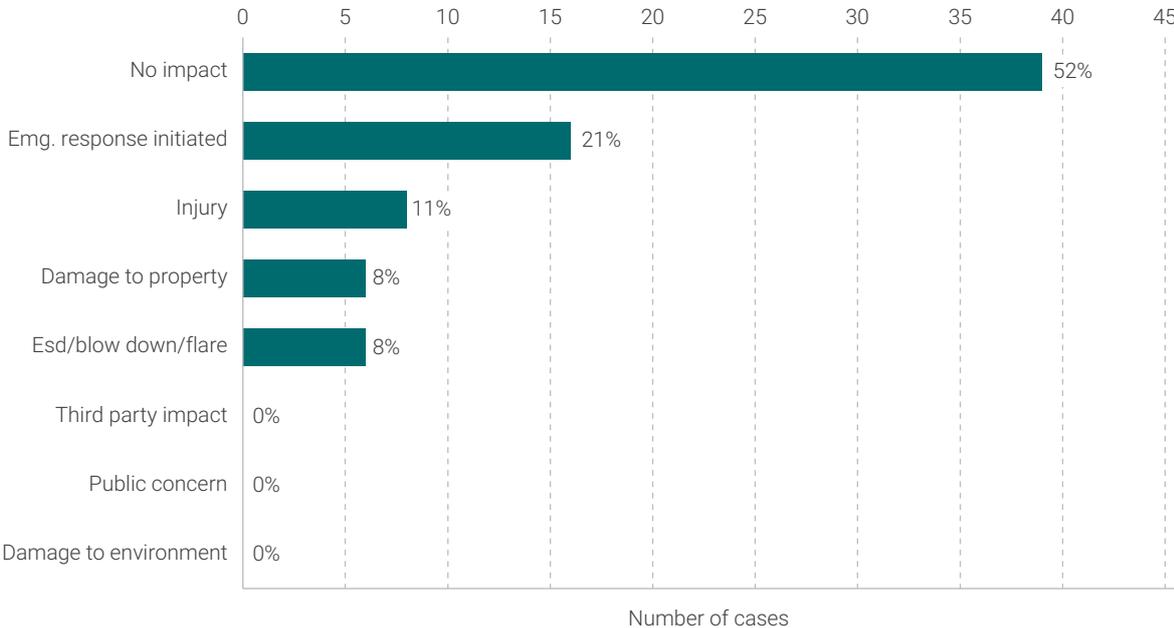


Figure 4 Dangerous goods incident outcomes

Eight of the 74 incidents involved injuries, harming 13 people.

MHF incident causes

The primary cause(s) of the incidents have been classified under 16 broad headings (based on regulatory requirements) to provide some detail for areas of review. A secondary incident cause has also been assigned where appropriate (Figure 5).

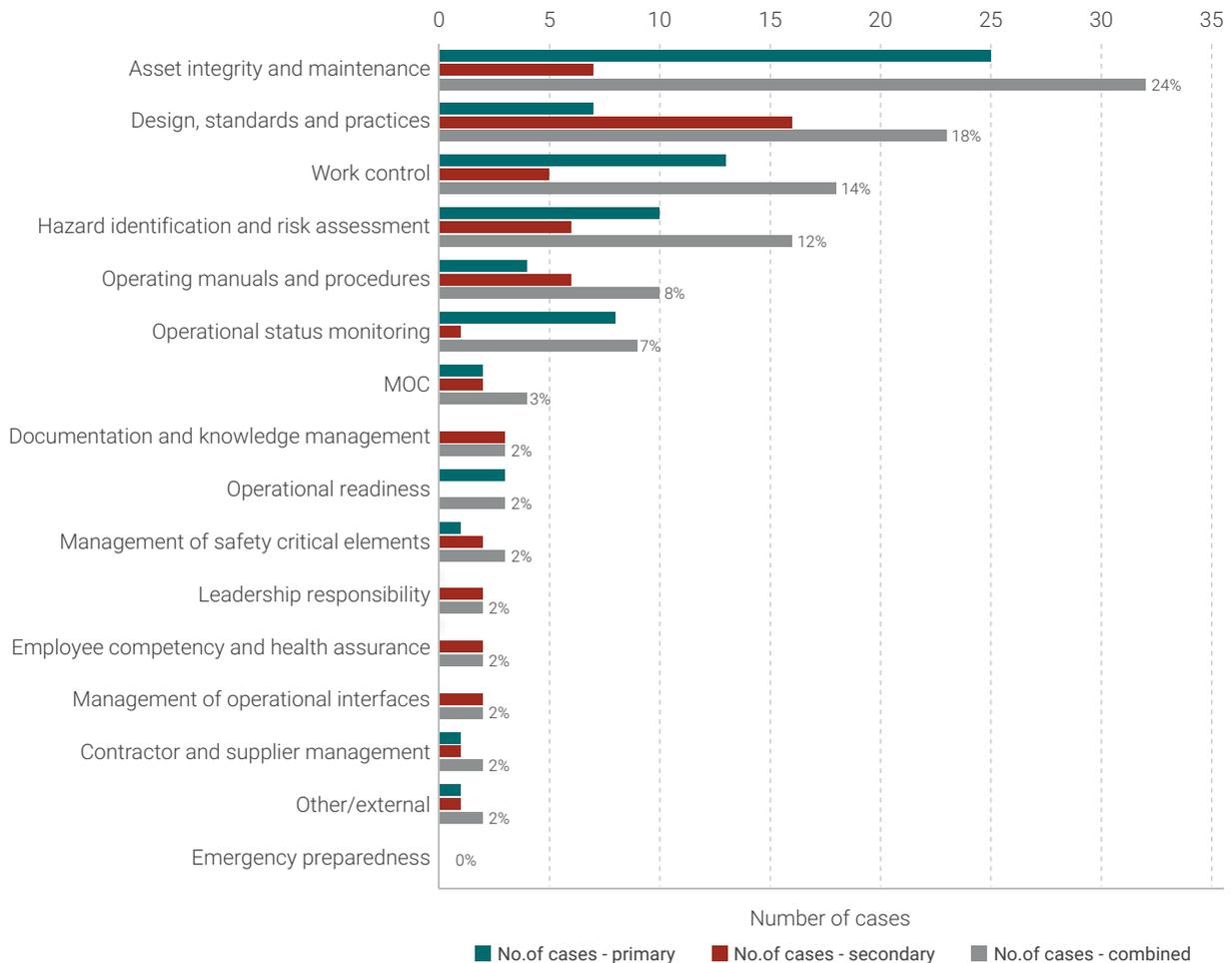


Figure 5 Incident causes

Figure 6 shows the incident causes which resulted in injury, damage to property or damage to the environment.

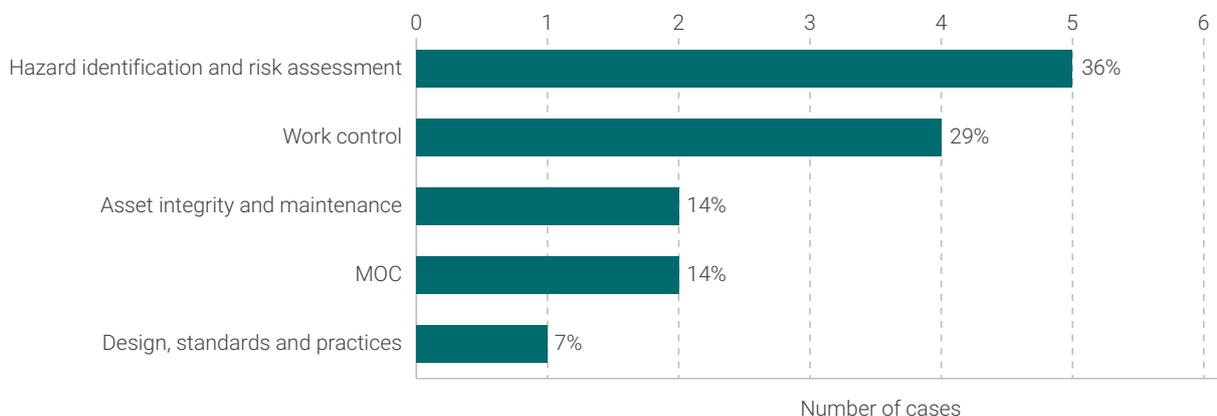


Figure 6 Incident causes resulting in harm

MHF incident causes – six year summary

Figure 7 shows the yearly classification of incident causes from 2017-18 to 2022-23

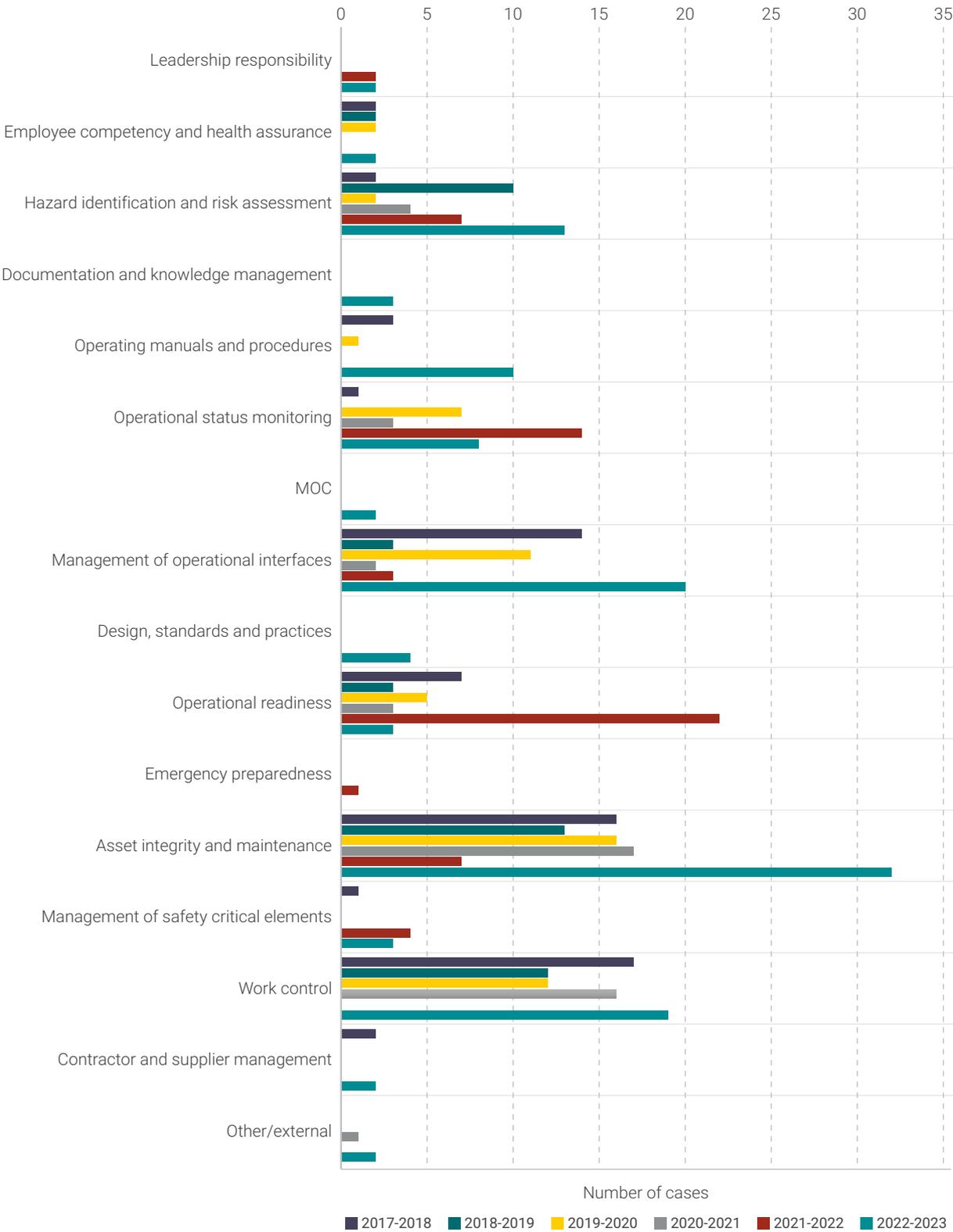


Figure 7 Breakdown of notifiable incidents by year

Section 4 Analysis and CDGO focus areas

MHF analysis

Our review of the MHF audit and dangerous goods incident data shows several items of note. Over the coming year, MHF operators are requested to place extra focus in these areas and determine how it could be relevant to their operation, and where they can make improvements.

Dangerous goods officers will be considering these items when they conduct MHF audits and inspections.

Number of incidents and injuries

There was a significant increase in the number of incidents from 38 to 75 from 2021-22 to 2022-23, with an equivalent increase in incidents causing injuries from three to eight, harming 13 people. The majority of these involved chemical burns, but also included respiratory exposure and hearing damage.

With 1-in-10 reportable incidents involving an injury, the injury rate is increasing proportionally to the number of incidents.

CDGO comments

As with all dangerous goods, the impact on people from relatively minor exposure can have long lasting physiological and psychological impacts. The causes of these incidents require extra focus if we are to drive the number of incidents and injuries lower.

Work control

Work control includes inadequacies with permits to work, authorisation of work, isolations, on-site risk assessments and supervision.

The results for the last year show that regarding work control contributed:

- 20% of audit findings, including two of the four major non-compliances
- 29% of the incidents which caused harm.

There was no noticeable decrease in work control-related incidents over the last six years.

CDGO comments

Although there has been a higher level of focus on human factors in the last couple of years, the data shows it remains a primary issue when considering audits and incidents. Human factors will remain a high focus for the coming year. We will be running another human factors forum later in the year, and I encourage you all to attend.

Further human factors analysis is provided in the following section.

Hazard identification and risk assessment

Hazard identification and risk assessment includes hazards not identified, risk assessment actions not implemented and inadequate risk assessments.

The results for the last year show hazard identification and risk assessment contributed:

- one major non-compliance, 10% of OFIs, but no minor non-compliances
- 36% of incidents which caused harm and 12% of all reportable incidents
- double the long-term average of those incidents which caused harm
- consistent trend of increasing reportable incidents over the last four years.

CDGO comments

The issues with hazard identification and risk assessment appears to be issues where procedures are followed, but gaps are appearing in the knowledge of the processes and the hazards they present. Running under a safety report regime, the operator must ensure that all hazards are understood and appropriate controls are in place.

Asset integrity and maintenance

Asset integrity and maintenance includes maintenance/inspection procedures not followed, deviation from schedules without assessment, inadequate inspection or testing, excessive corrosion/erosion rate, wear/tear and aging asset issues.

The results for the last year show asset integrity and maintenance contributed to:

- 19% of minor non compliances
- 24% of all reported incidents, and 14% of incidents which caused harm
- a spike in the number of related incidents.

CDGO comments

We are seeing more integrity-related incidents, though with low impact at the moment. The high representation of integrity incidents and non-compliances indicates that the systems are in place to manage this appropriately, but are falling down at the implementation phase. We anticipate the number and severity of incidents will continue to increase unless action is taken.

Human factors analysis of work control

Applying a human factors approach to incident investigation facilitates a better understanding of how workers interact with a system and where safety can be improved to minimise the risk of future incidents.

A human factors analysis was conducted for 15 incidents with work control classified as the primary cause and four incidents with work control as the secondary cause. Human factors themes were extracted from the MHF operators' investigation reports to identify the most frequently occurring aspects. The main themes from the human factors analysis were:

- **Usable procedures** – work procedures were inadequate for mitigating risk and did not account for situations such as operation failures; procedures were outdated and did not align with current processes or equipment; or a lack of standardised working methods
- **Staffing and workload** – lack of supervision or inadequate number of staff for the work activity; or complex and non-standard workloads
- **Training and competence** – insufficient training or competency for the work activity being undertaken
- **Designing for people** – system and interfaces were inadequate for communicating information to the user (e.g. absence of alarms or alerts)
- **Organisational learning** – lack of organisational learning from past incidents and no controls or changes being implemented to prevent recurrence.

Of the 19 total incidents, two were excluded due to insufficient information. The frequency of the major themes identified in the 17 work control incidents are in Figure 8.

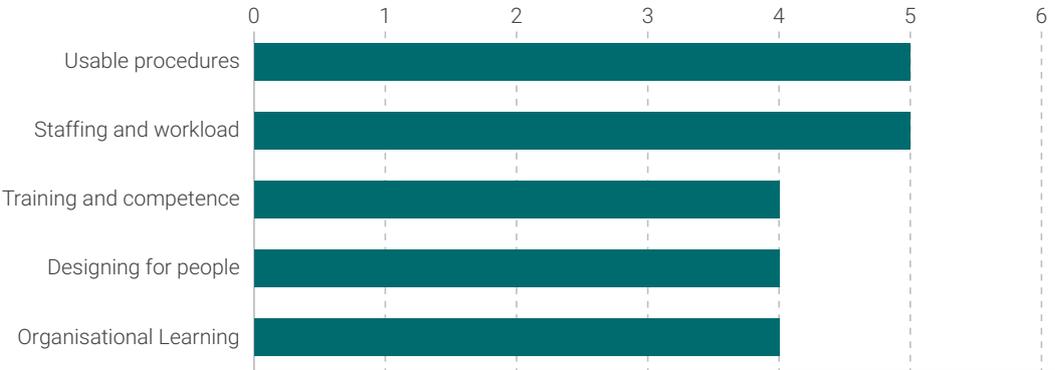


Figure 8 Human factors themes

The human factors analysis of incidents revealed a number of focus areas for MHF operators to reduce the number of incidents involving work control:

- conduct safety critical task analyses for work activities that depend on human performance to identify and implement barriers and safeguards to prevent and mitigate major incidents
- keep work procedures up-to-date through regular revisions with a focus on reducing the gap between work-as-imagined and work-as-done
- implement management of change processes for organisational and role changes to prevent misalignment of work and procedures
- assess human-machine interface systems to increase useability for workers and implement safeguards (i.e. alarms and alerts)
- review training competencies, ensure qualified staff are supervising, and implement non-technical skills training i.e., communication, decision-making in high pressure situations, leadership during emergency scenarios
- organisational commitment to safety and improvement by learning from past incidents and implementing new controls to mitigate the risk of reoccurrence.

Finally, keep in mind that incidents are rarely identified as having one sole contributing factor. This highlights the importance of understanding the human factors systems approach and how the influence of various factors need to be considered.

Appendix 1 Further information

In addition to this analysis of MHF audits and MHF dangerous goods incidents, the following publications may also be of use.

Future fuels

With the current emphasis for the use of hydrogen as a fuel and limited industry standards available to define baseline compliance, the Department is placing a higher level of rigour on the licensing of hydrogen projects.

www.dmp.wa.gov.au/Documents/Dangerous-Goods/DGS_HydrogenGuide.pdf

Ammonium nitrate emulsion tanker trailer explosion

On 24 October 2022, a tanker trailer carrying an ammonium nitrate emulsion (ANE) caught fire then exploded on the Great Central Highway, approximately 150 kilometres east of Laverton.

The Department completed an investigation into the incident, with the final report and related information released to the public.

Incident investigation report

www.dmp.wa.gov.au/Documents/Dangerous-Goods/ANETankerExplosion_Report.pdf

Condensed report with key information for drivers and transport companies

www.dmp.wa.gov.au/Documents/Dangerous-Goods/ANETankerExplosion_Summary.pdf

Animation of the incident

youtu.be/Aon3svWMXBA

Incident alert

www.dmp.wa.gov.au/Documents/Dangerous-Goods/DGS_IncidentAlert_ANETanker.pdf

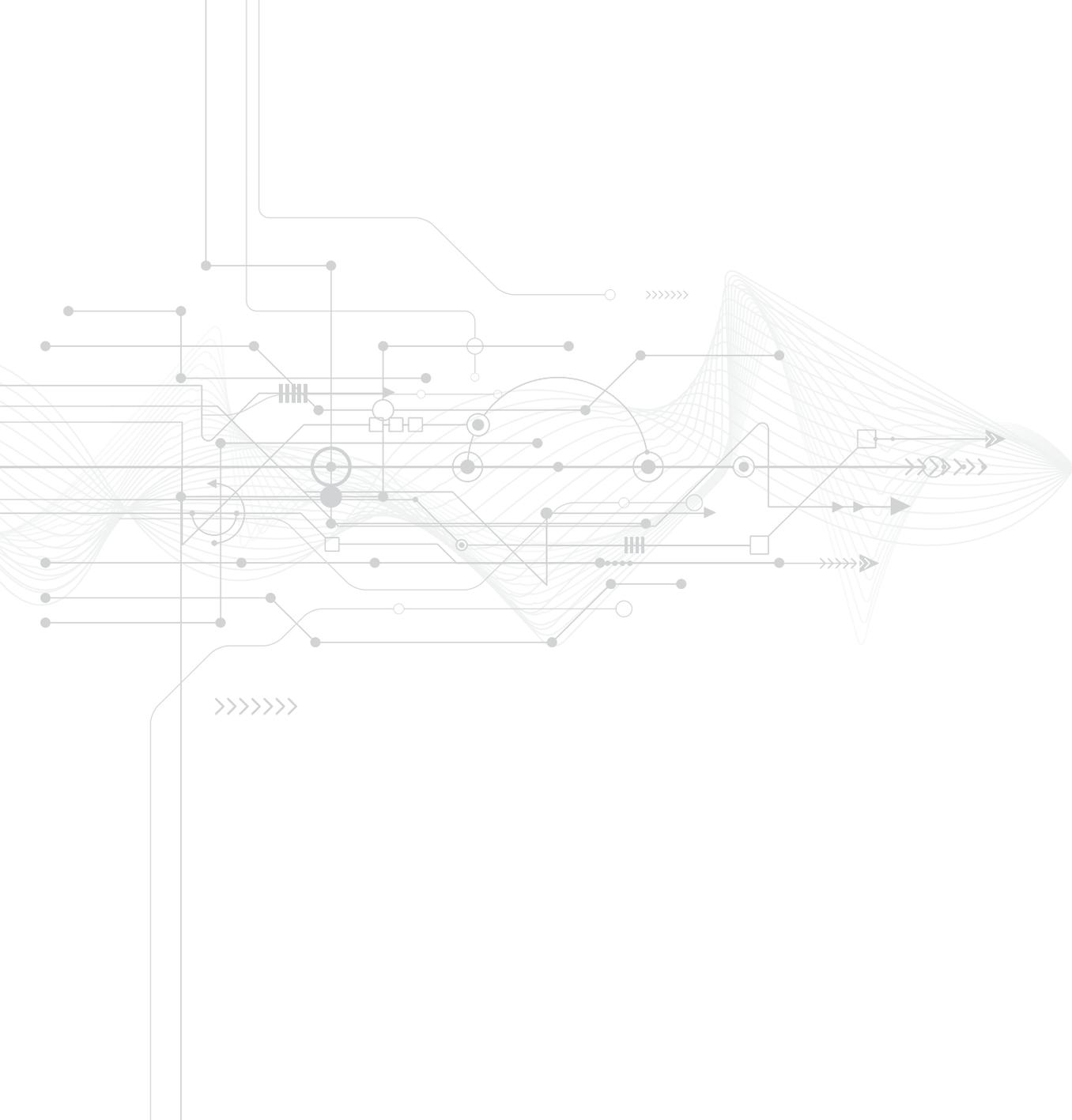
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