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**Major hazard facilities**  
*Analysis report*

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## Reference

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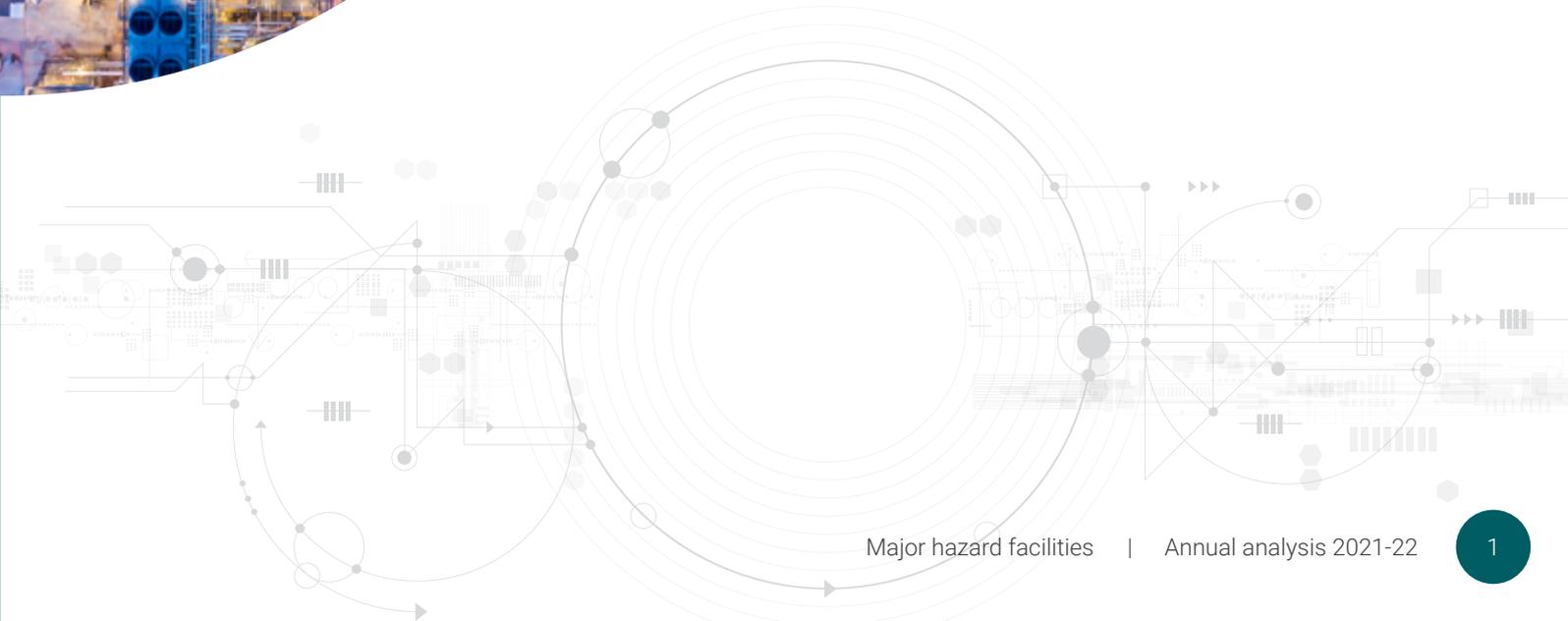
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# Section 1: Introduction

## Aim

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

This inaugural analysis report summarises and classifies the findings from major hazard facilities (MHFs) audits and reported dangerous goods incidents relating to MHFs for the financial year 2021-22. Over time, this data is expected to provide trending insight of safety and compliance issues at major hazard facilities 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 are included to facilitate the regulator and industry in working together to achieve optimal protection for people, property and the environment.

## Scope and legislative framework

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

MHFs store and/or process of large amounts of hazardous substances. Consequently, MHF operators utilise a variety of safety measures to minimise risk from events that may cause injury to people or damage to 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.

Currently, there are 23 classified MHFs, covering multiple industries within Western Australia. These facilities include the processing or production of:

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

## Introduction from the Chief Dangerous Goods Officer

The MHFs in WA are recognised to be of significance to the State economy. Products from these facilities underpin the mining and petroleum sectors and are exported around the globe. MHF products are critical for appropriate water treatment processes, enable fertiliser production, the supply modern battery materials and clean fuels. Future clean energy ventures, such as green hydrogen projects, are likely to be classified as MHFs.

On a typical day, these facilities require approximately 5,700 operational staff on-site, plus support staff in head offices and contractors.

The continued safe operation of these facilities is vital for the future of Western Australia.

The 2021-22 financial year brought some significant changes, not least the introduction of Work Health and Safety (WHS) legislation. Every operator is affected by this change and needs to understand their obligations under the new legislation. For the MHF operators, it is vital to understand the interaction between the *Dangerous Goods Safety Act 2004* and the *Work Health and Safety Act 2020* and how to comply with both.

Psychosocial hazards and risks are of particular importance, from both a WHS point of view and a process safety point of view. Both reference points rely on the integrity, competence and capability of people doing their job, hence events which adversely impact the reliability of the human operator are a direct safety concern, irrespective of the legislative framework. From our analysis of the previous year, one thing I would like to highlight is that all the incidents that happened and the issues the inspectors identified were well known hazards, easily identified and able to be addressed beforehand. None were new or unusual. And yet they were undetected and unaddressed. The data reinforces the point that no one in our industry can afford to be complacent, we must be vigilant to self-deception, there are always undetected hazards and that there is always something that needs to be improved. I hope that the data in this report provides all with assistance in identifying some of these unforeseen hazards.

I am proud, as I am sure you are, to be part of an industry sector that continually strives to improve and learn, with a strong ethos of active prevention of accidents. Our safety record speaks for itself and is a consequence of our efforts. The data here also reflects those efforts and should provide all with an aspirational goal to keep up the efforts and endeavour to do even better. I look forward this year to the Department and industry continuing to work together to build on the safety successes achieved so far.

Stephen Emery  
Chief Dangerous Goods Officer

# Section 2: Audit finding analysis

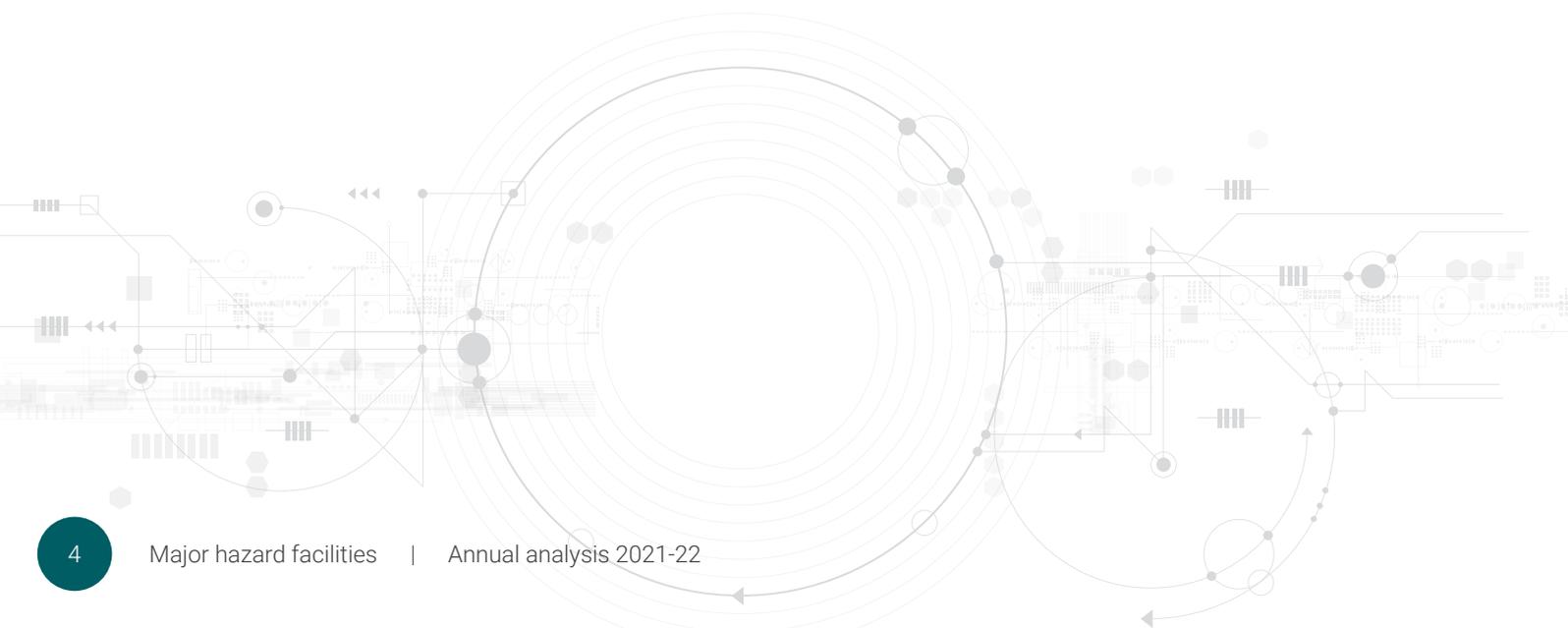
Audit findings are assigned as an opportunity for improvement, major non-compliance and minor non-compliance. These are defined as below.

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



For the financial year, a total of **145 findings** from 17 audits were recorded by MHF DGOs. These findings were assigned below.

- 
122 (84%) were opportunity for improvement
- 
3 (2%) of were major non-compliance
- 
20 (14%) of were minor non-compliance



## Audit findings categories

Audit findings were categorised under 20 headings of faults, based on the Energy Institute (EI) process safety framework. These include:

- documentation and knowledge management
- management of safety critical controls
- work control
- emergency preparedness
- employee competency and health assurance
- management of change
- operational status monitoring
- design, standards and practices
- compliance with legislation
- operating manuals and procedures
- asset integrity and maintenance
- hazard identification and risk assessment
- incident reporting and investigation
- leadership responsibility
- management of operational interfaces
- operational readiness
- workforce involvement
- communication
- contractor and supplier management
- management assurance and review.

# Audit findings analysis

The breakdown of the 145 audit findings is presented below. The top six audit findings categories have been included. The three major non-compliance findings were in the areas of management of safety critical controls, compliance with legislation, and operating manuals and procedures.

*Note: Not all classification areas receive the same level of attention and so a direct comparison of the number of findings per heading may be misleading. For example, the Chief Dangerous Goods Officer (CDGO) requested certain areas be targeted, and so it is expected that those targeted areas will be over-reflected in the findings. Another expected over-finding is for Documentation and knowledge management issues, as these are usually both readily identifiable and common.*

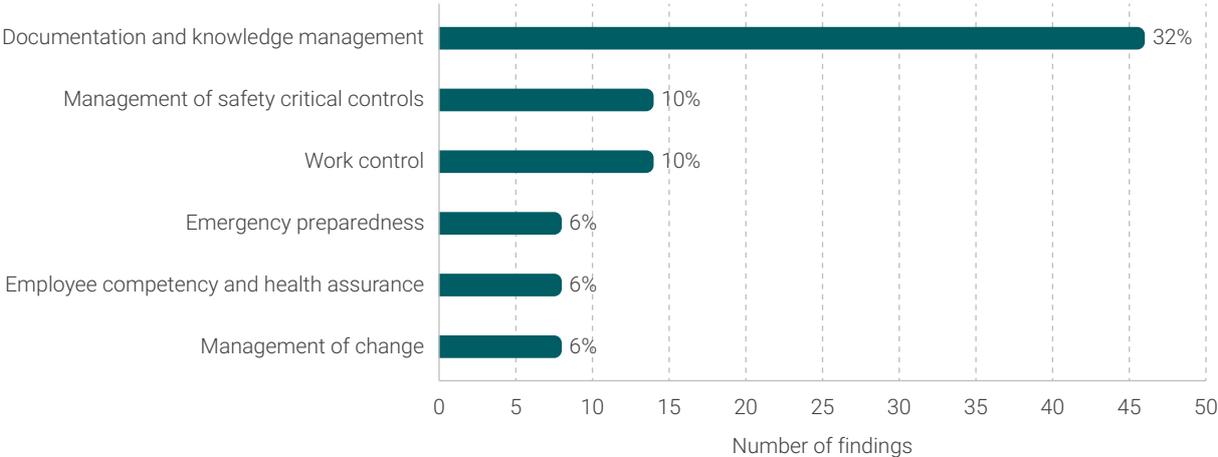


Figure 1 Number of findings per EI heading (top six)

Figure 1 shows a significant number of findings under the Documentation and knowledge management heading (32% of all audit findings), which covers issues arising such as document review out of date, incomplete test records and drawing not updated. The majority of the Documentation and knowledge management findings were classified as opportunities for improvement, where the DGO believed the operator had areas of concern that could be improved.

To provide a more thorough comparison of the other audit findings, Figure 2 shows the breakdown of findings when the dominating Documentation and knowledge management set is removed. The top five audit findings per Energy Institute heading have been included.

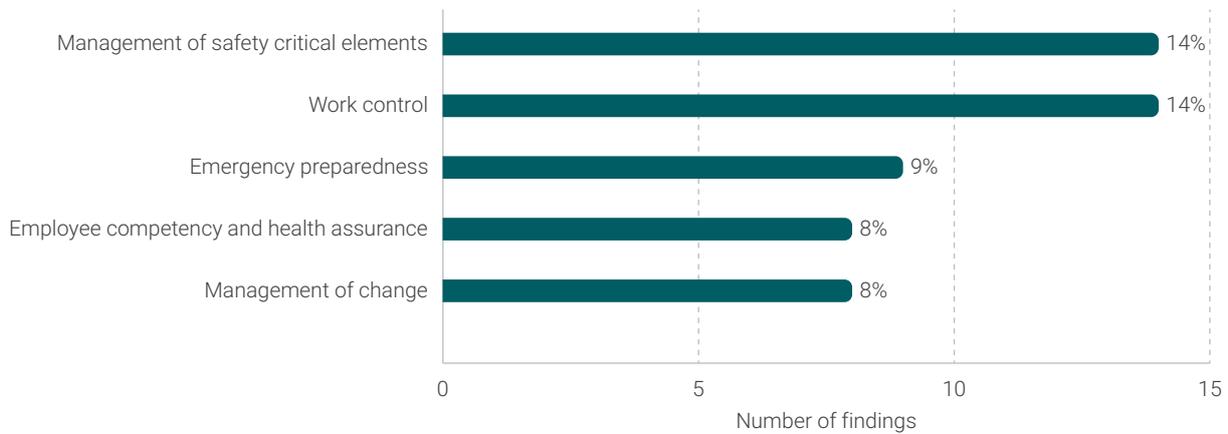


Figure 2 Number of findings per EI heading (top five) excluding Documentation and knowledge management set

Figure 2 shows that of the remaining findings, there are two dominant categories, which when combined account for approximately one third of these findings. These are: management of safety critical controls (SCC) (e.g. issues with performance standards, safety critical controls) and work control (e.g. issues with permit to work, isolations, supervision).

Of the findings classified as management of SCC, the following broad issues were identified:

- insufficient detail in describing the functional requirements in performance standards
- lack of detail in defining quantitative criteria in performance standards
- insufficient communication showing which procedures and work orders are safety critical
- no system to review the results of assurance tests to confirm compliance (e.g. not meeting the specification, issues raised but not actioned).

From the work control classification:

- controls stated in the permit not implemented
- no clearly defined responsibility and accountability for a permitted work program
- insufficient detail on the competency of the permit authorities, isolation validators.

As audit findings from previous years may be used to determine target areas for future audits, a subsequent increase in those targeted classifications may reflect the heightened scrutiny rather than an emerging issue.

# Section 3: Dangerous goods incident analysis

## MHF incidents

There were 38 dangerous goods incidents reported to the Department in 2021-22 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
- fire
- risk control measure failure
- explosion or implosion
- release of energy
- exceed design envelope
- reaction or contamination.

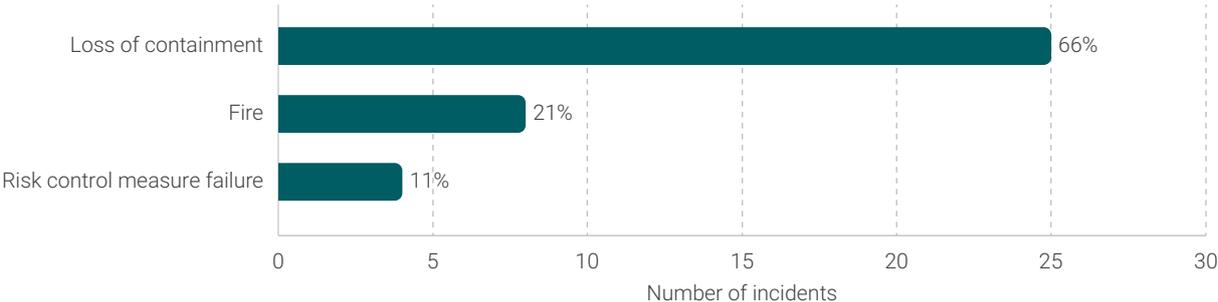
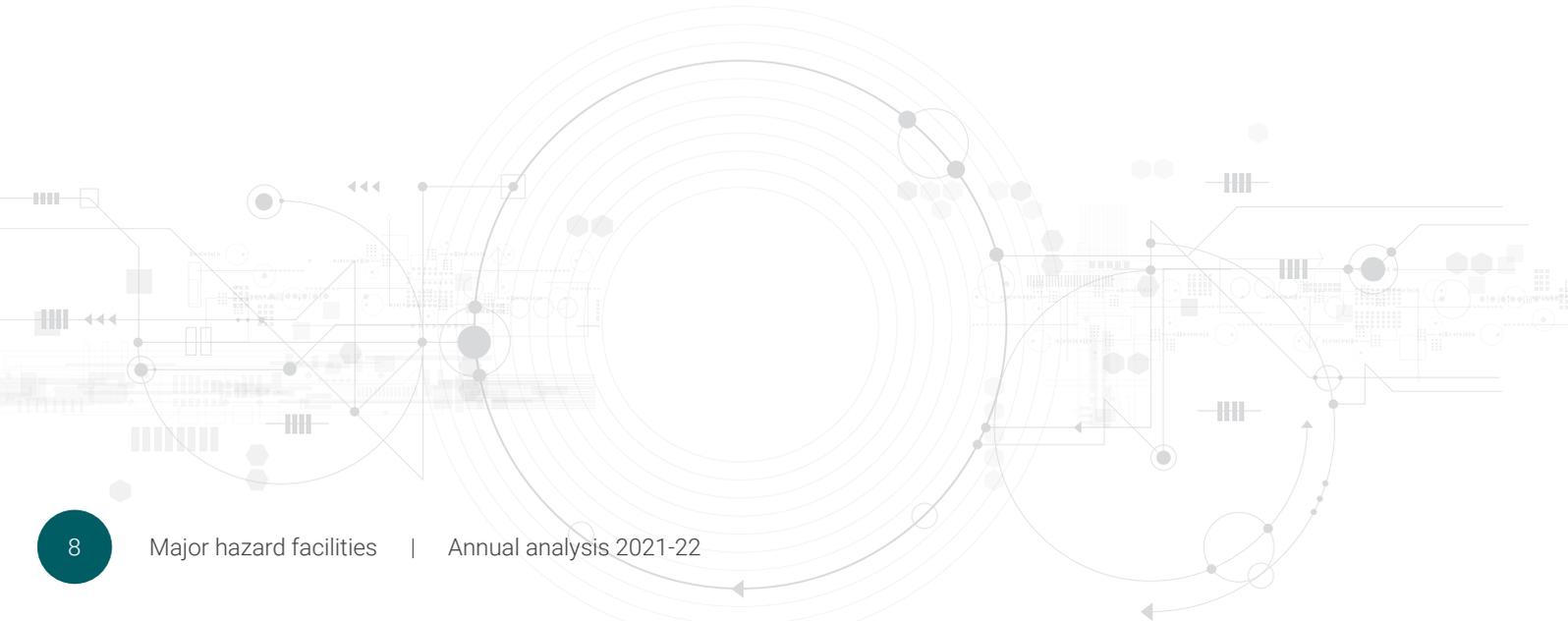


Figure 3 Major hazard facilities incidents (top three)

Of the 38 incidents, 25 (66%), were a loss of containment type incident (Figure 3).



# MHF incident outcomes

Classification of incident outcomes were:

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

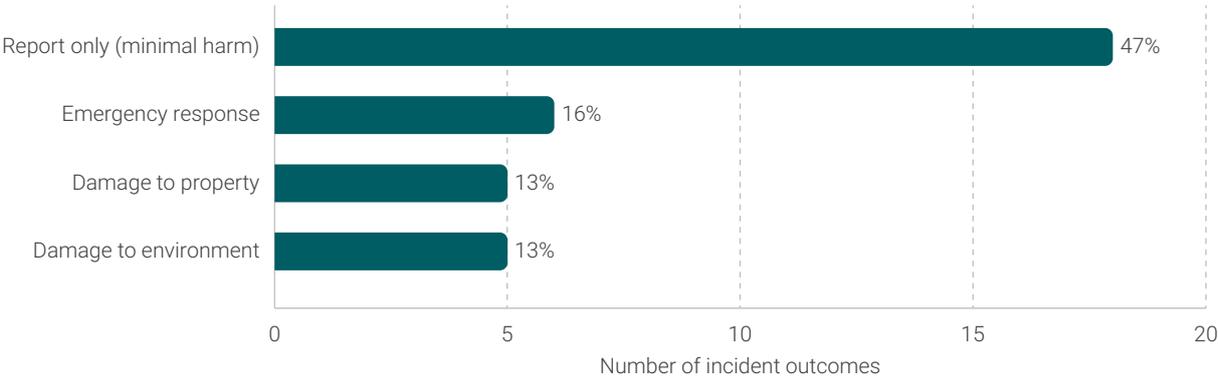
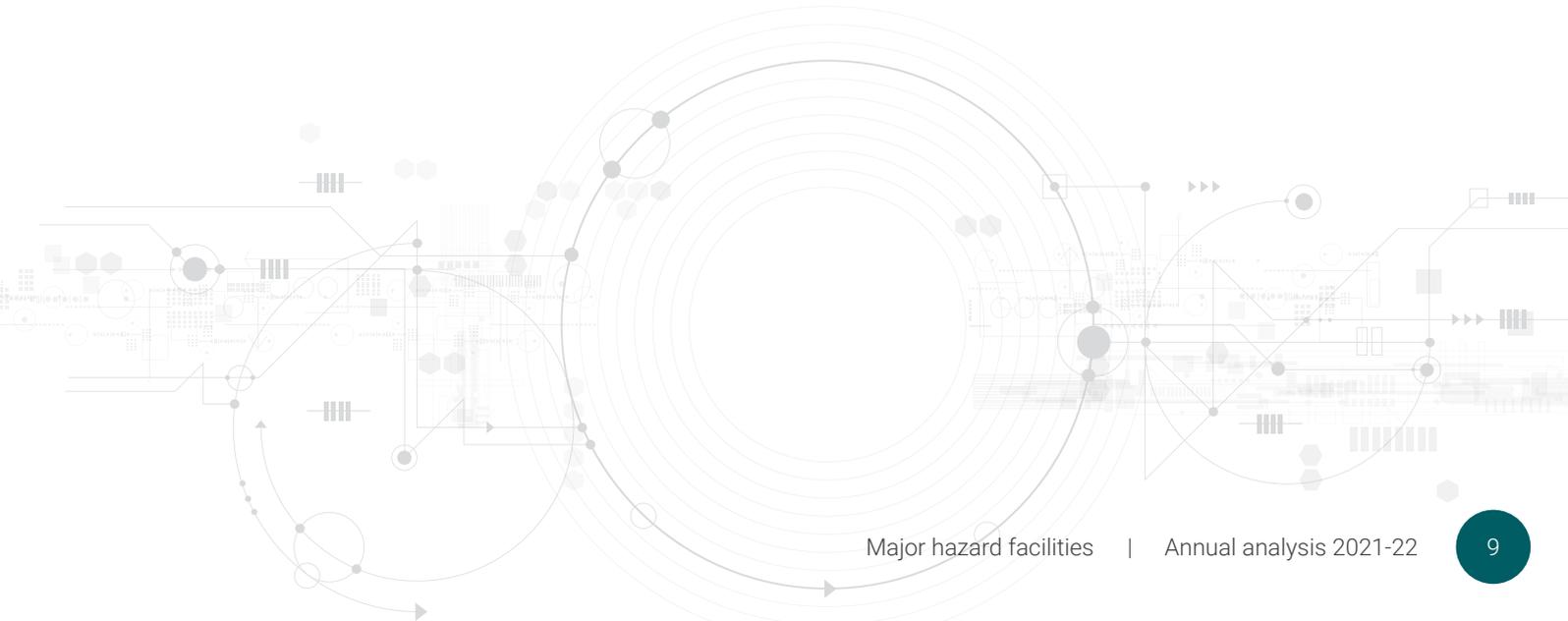


Figure 4 Number of major hazard facilities incident outcomes (top four)

Over half of all incidents resulted in some degree of injury, damage or response (Figure 4). This is a high proportion, considering all had the potential to escalate.

Three of the 38 incidents directly injured workers. Two of these injuries were the result of skin contact with caustic substances, and one involved an adverse reaction to vapours. Several of these injuries involved workers requiring medical care and the potential for ongoing trauma.



## MHF incident causes

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

- asset integrity and maintenance
- design, standards and practices
- operating manuals and procedures
- work control
- contractor and supplier management
- operational readiness
- hazard identification and risk assessment
- employee competency and health assurance
- management of safety critical elements
- leadership responsibility
- document and knowledge management
- operational status monitoring
- management of operational interfaces
- management of change
- emergency preparedness
- other/external.

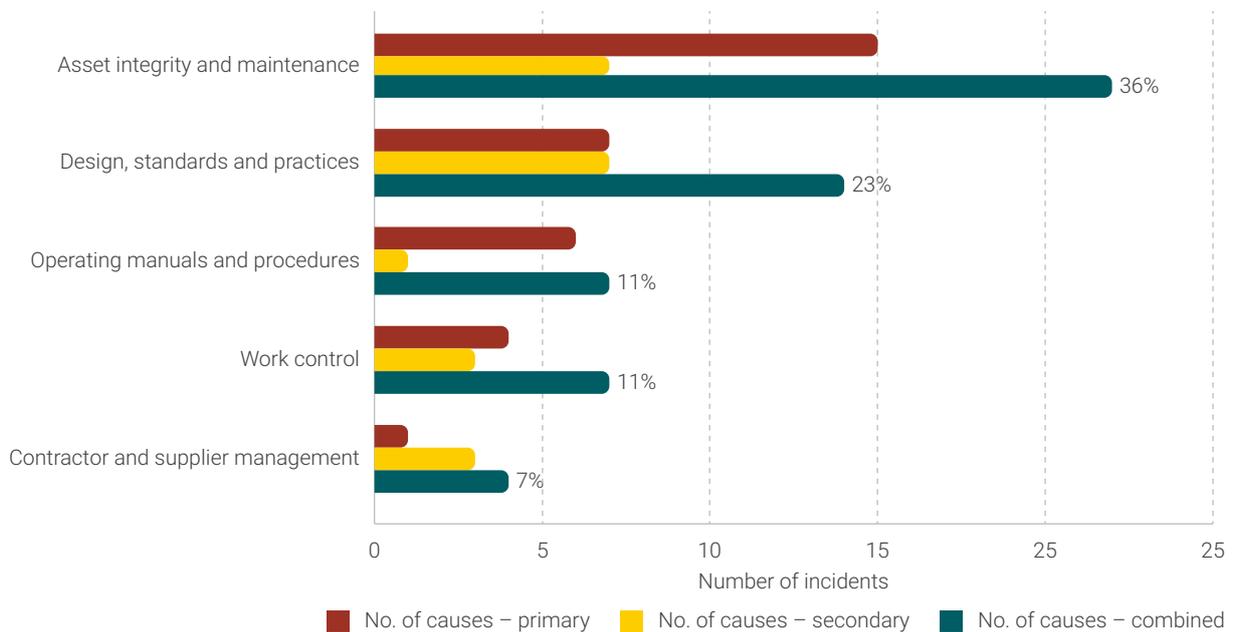


Figure 5 Causes of incidents (top five)

Filtering the incident causes to those which resulted in injury, damage to property or damage to the environment, shows Asset integrity and maintenance as the dominant cause for incidents that cause harm. Examples of incidents in the Asset integrity and maintenance category included maintenance procedures not followed, vibration, and issues associated with aging assets.

The five incidents that relate to the Asset integrity and maintenance category generally involved a nominal small loss of containment on existing and well-established plant. Even so, the incidents were sufficient to cause harm.

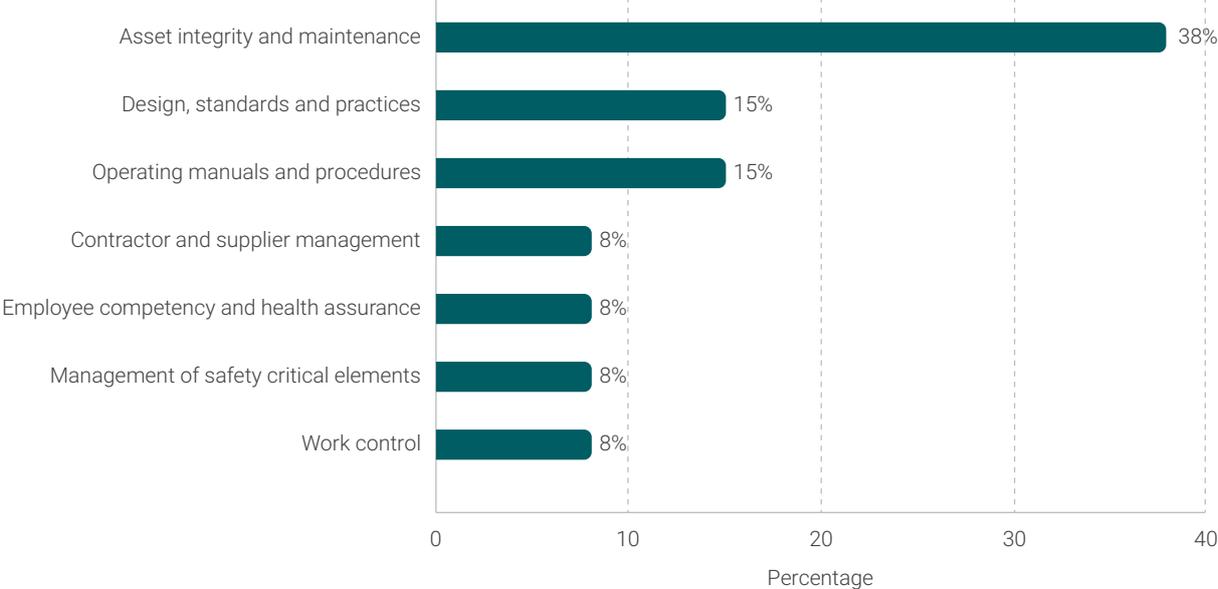
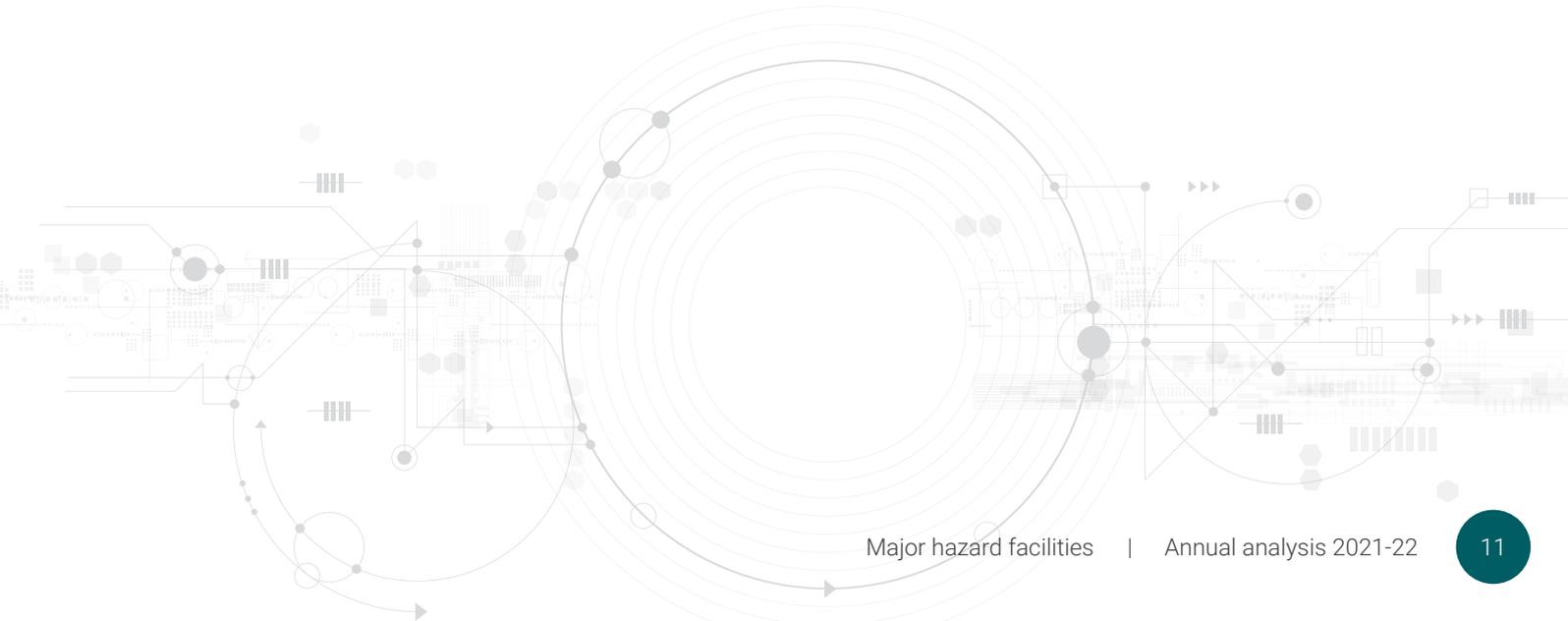


Figure 6 Incident caused when harm occurred by percentage



# Appendix 1: Further information

Accident and incident reports and investigations published globally may be useful sources to support training and instruction to workers.

## **The Beirut Port explosion investigation**

[Forensic analysis of the 2020 explosion at the Beirut Port, Lebanon by Forensic Architecture](#)

## **The Centre for Chemical Process Safety (CCPS)**

Provides summary [videos](#) on Significant Process Safety Incidents

## **The Chemical Safety and Hazard Investigations Board (CSB)**

Provides [investigation reports and videos](#) on serious chemical incidents

## **The European Commission**

The Minerva Portal of the Major Accident Hazards Bureau provides a [summary of accidents](#) under the Seveso Directive

## **2022 Aqaba toxic gas leak**

Chlorine isotainer mechanical impact and loss of containment at the Port of Aqaba, Jordan

[2022 Aqaba toxic gas leak - Wikipedia](#)



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