



Major hazard facilities

ANNUAL ANALYSIS REPORT





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Reference

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Introduction

Aim

The Department of Energy, 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 facility (MHF) audits and reported dangerous goods incidents for the financial year 2023-24. 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

Western Australia (WA) has some of the biggest, costliest and most complex industrial plants in the world. They supply vital energy, minerals and chemicals that are essential to modern living. Their outputs and exports make immense contributions to WA's economy, enable major downstream businesses, employ thousands of people and support hundreds of local businesses.

Large plants that handle explosives, flammables or toxic resources like liquefied natural gas, liquefied petroleum gas, ammonia, ammonium nitrate, chlorine, cvanide and other similarly hazardous materials are classified as MHFs. Specialist inspectors from the WorkSafe Petroleum Safety and Dangerous Goods Directorate regulate MHFs, with a particular focus on the prevention of major incidents. As a proactive measure, an annual analysis of the findings from site audits and reports is published.

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 utilise 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 under the Dangerous Goods Safety Act 2004, with a particular focus on the prevention of major incidents. This is because MHFs have a 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 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 (DGOs).

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

Welcome to the 2023-24 edition of the MHF Annual Analysis Report. There have been continuous developments through the last financial year, with some changes to operators, plants expanding and plants ramping down. This has largely been well planned with only the minor issues to keep everyone on their toes.

The next MHF forum is scheduled for November 2024. The focus for the upcoming forum will be on the lessons learnt from recent incidents of note. Largely, we are assigning the presentations to industry representatives, with some updates from myself and inspectors. I encourage MHF operators to attend, look for some ideas on improvements and network with colleagues outside of your usual industry.

Green hydrogen, ammonia and biofuels continue to increase in interest. It is vital to minimise risk to people, property and the environment from these developing fuel sources. In May 2023, we published a Dangerous Goods Safety Guide: Storage, handling and production of hydrogen 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.

This is the first report since the audit findings were revised to Non-compliance – priority, Non-compliance and Potential non-compliance. This appears to have had the desired effect, in moving the continuous improvement style of observation away from a finding to the observation area. Note that four of last year's audits resulted in only observations, with no non-compliances recorded - something that was previously very infrequent. If you have any feedback on the change of process, feel free to contact one of my inspectors.

This is also the first year of revising the regulatory regime with our dangerous goods pipelines now being overseen by the Critical Risks team. Due to the risks associated with pipelines, we are aiming to move more towards an outcome-focused regime from straight compliance. It is still early on, but I note with interest the observations to date.

Please use this report as an opportunity to review your operations against those of 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 5, 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 1 MHF audit finding summary

MHF audit findings

Audit findings are provided in the following three terms, plus observations:

Non-compliance – priority

The non-compliance presents a concerning risk of imminent harm to people, property or the environment from dangerous goods and/or increases the probability of a major incident occurring.

Prompt corrective action is required to mitigate the risk.

Non-compliance

The non-compliance does not satisfy the criteria for a priority non-compliance. Timely corrective action is required.

Potential non-compliance

This finding relates to issues identified during the audit which do not appear compliant with the legislation, but sufficient grounds have yet to be established to support non-compliance.

Observation

Observations may or may not have direct relevance under the remit of the audit but have been noted in the interest of sharing information that may be of value to the operator.

In 2023-24, a total of 80 findings from 20 audits were recorded by MHF DGOs. Four of these audits recorded no findings, only observations. Two audits included one Non-compliance priority.

Findings were assigned as Non-compliance – priority (NC-P), Non-compliance (NC), and Potential non-compliance (PNC) (Figure 1). As observations are not considered findings they have not been included in this analysis.

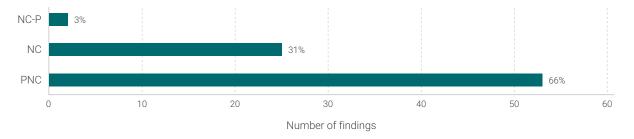


Figure 1 Audit findings 2023-24

MHF audit finding classification

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

Differing from the previous annual reports, the category of Documentation and knowledge management was not overrepresented this year and has been included in the analysis.

The two Non-compliance – priority findings were both related to Asset integrity and management.

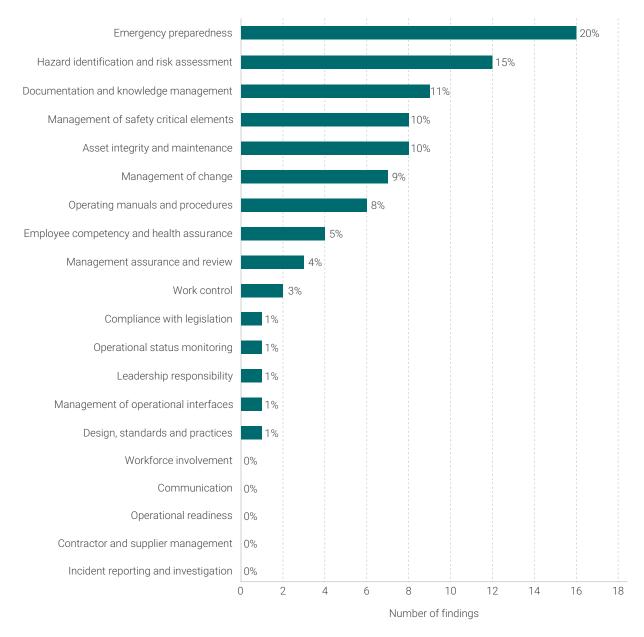


Figure 2 Audit findings classification

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.

Human factors audit finding analysis

A human factors analysis was done on 46 audit inspection findings from the past year, which identified human factors as a contributor. The results below show the identified themes from the analysis.

Usable procedures were the most common theme identified contributing to 32 of the 46 audit inspection findings. One finding was classified as NC-P, 10 as NC, and 21 as PNC. For example, this included findings for changing procedures too frequently and consequently causing confusion for workers, procedures that were not up to date, unclear procedures, poorly documented procedures and not being able to find documents when asked.

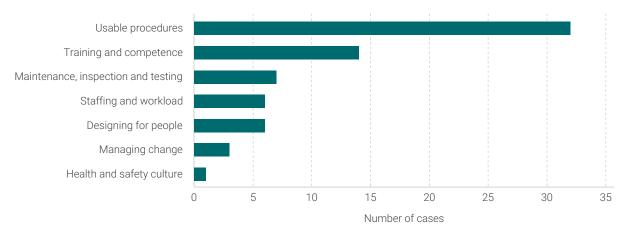


Figure 3 Audit human factor themes



Section 2 MHF dangerous goods incident summary

MHF dangerous goods incidents

There were 61 dangerous goods incidents reported to the department in 2023–24 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.

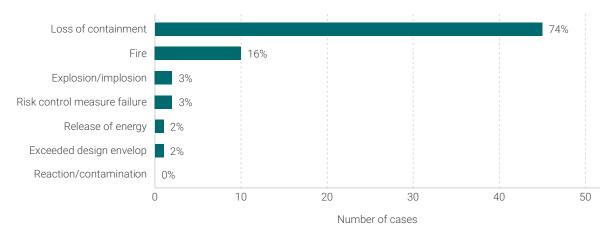


Figure 4 Dangerous goods incident classification



MHF dangerous goods incident outcomes

The impact of each incident has been assessed and classified in Figure 5.

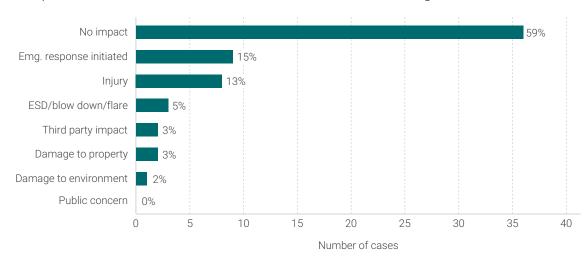


Figure 5 Dangerous goods incident outcomes

Eight of the 61 incidents involved injuries, harming 11 people. Two incidents caused damage to property and one to the environment.

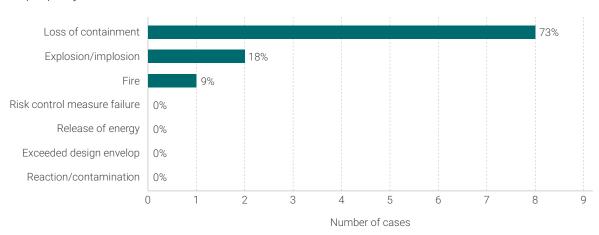


Figure 6 Dangerous goods incident outcomes which resulted in harm or damage

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.

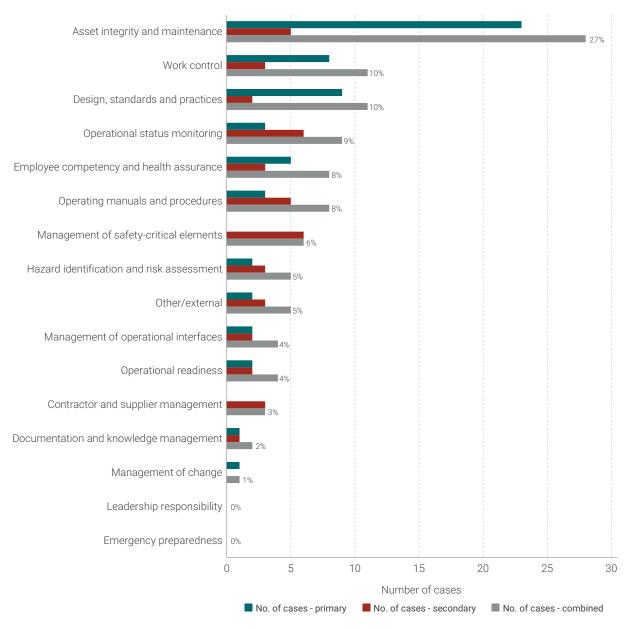


Figure 7 Incident causes 2023-24

The chart below shows the incident causes filtered to those which resulted in harm to people.

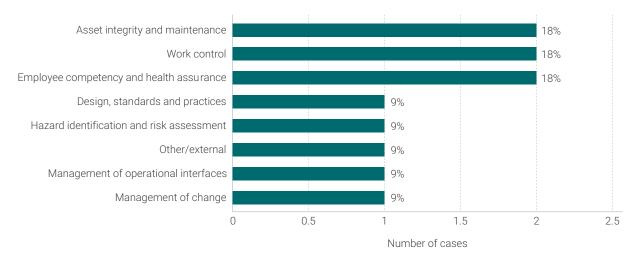
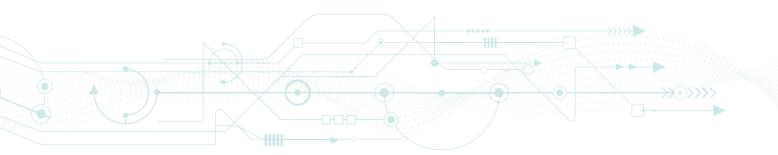


Figure 8 Incident causes resulting in harm to people



MHF incident causes - seven year summary

The figure below shows the yearly classification of incident causes since 2017–18.

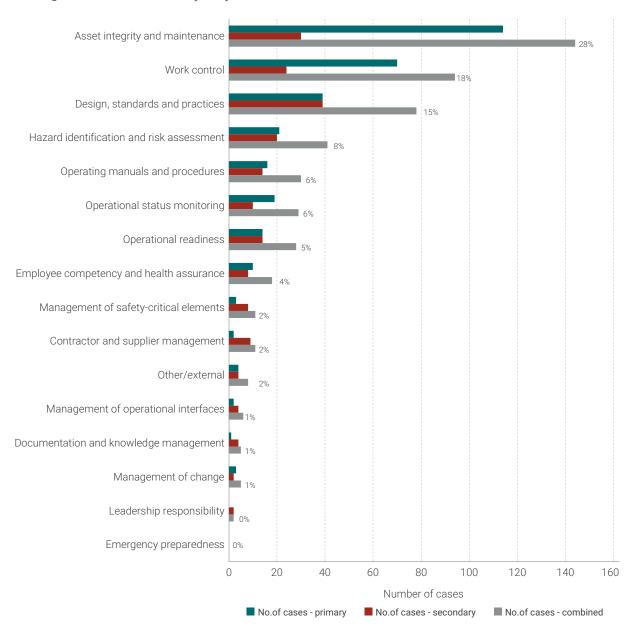


Figure 9 Incident cause analysis 2017-2024

Human factors incident analysis

In the past financial year, a total of 29 incidents were identified as having human factors contributors. The chart below shows the classifications of these incidents.

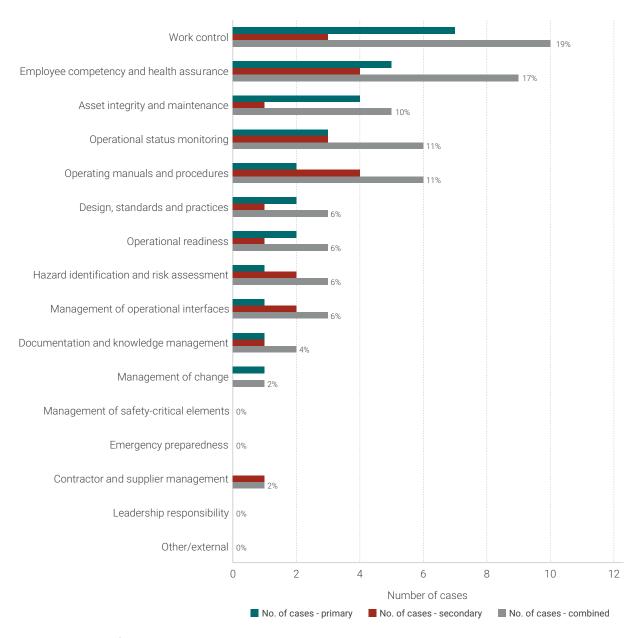


Figure 10 Human factors contribution – Incident cause analysis

To conduct a human factors analysis, the causes with the highest combined number of cases were selected for review of the incident report findings. These causes are Work control, Employee competency and health assurance, Operational status monitoring, and Operating manuals and procedures. Twenty-three incidents fell into one of these four categories. Three of these incident reports had insufficient information, so an analysis of human factors was performed on 20 incident reports to look for recurring human factors. The results showing the frequency of the themes is in Figure 11 on the following page.

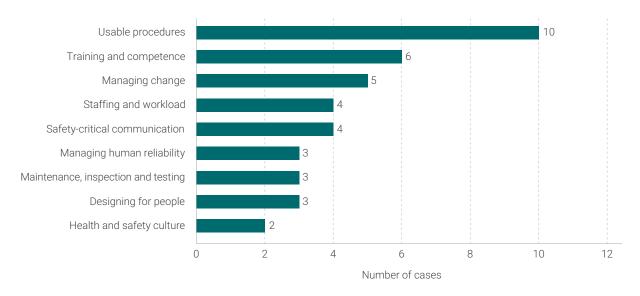


Figure 11 Incident - Human factors themes

The main themes from the human factors analysis were:

- **Usable procedures** procedures with errors, not implementing control measures as outlined in the procedure, complex procedures that were hard for workers to understand, and procedures not being followed.
- **Training and competence** completing tasks incorrectly, workers having long periods of time between performing tasks, and a lack of training on how to respond in circumstances that are different from normal.
- Managing change not completing risk assessments when elements of a task or project change, not having planning protocols in place for if any changes need to be made to the task, not modifying the way work is done when there is a change in the operation (e.g. shutdowns or maintenance).



Section 3 Dangerous goods pipeline inspection summary

The 2023–24 financial year saw a change of approach to the regulation of dangerous goods pipelines. This included some changes to the submission requirements for pipeline registration, and the branch or team performing the periodic inspections.

Noting that petroleum pipelines licensed under the Petroleum Pipelines Act 1969 do not fall within the scope of dangerous goods pipelines.

Dangerous goods officers inspected 29 of the 126 registered pipelines, with an intent to inspect all pipelines within 5 years. As a result of the inspections, the following observations were made.

- At times the ownership and battery limits between the pipeline exporter/supplier and importer/receiver, or the interface of two adjoining pipelines, was not always explicit. This was observed in procedures, drawings and field markings.
- The relationship and clear responsibilities at these interfaces can also lack sufficient clarity with respect to the assumptions being made. Areas of concern included items such as maintenance of emergency shut-down valves outside of the pipeline limits, pipeline pressure control by suppliers and/or operators, cathodic protection operation, and compound signage and upkeep at shared locations.
- The application of the various parts of the approved code of practice, Australian Standard AS 2885 Pipelines – Gas and Liquid Petroleum and the associated pipeline management principles is generally well understood and applied by the pipeline owners.



Section 4 Human factors analysis summary

Looking at human factors in audit findings and incident investigations provides insight into how workers interact with systems, identifying areas where safety can be improved and assist in understanding the underlying causes of incidents. By placing a greater emphasis on human factors, operators can develop targeted interventions to minimise risks and prevent future incidents. A proactive approach fosters a safer work environment, enhances operational efficiency, and promotes a culture of continuous improvement.

The three recurring themes identified provide insight on how operators can manage these human factors more effectively.

Usable procedures

- Ensure that procedures are accurate, up to date and checked regularly.
- Ensure that all procedures are fit for purpose and easy to obtain when needed.
- Include photographs/diagrams in procedures where appropriate, to make procedures clearer and more concise.
- Implement job aids for safety-critical tasks, such as checklists.
- Discuss with operators whether the current process of completing tasks, matches the
 procedures. If deviations are occurring, consider conducting a safety-critical task analysis
 to identify performance shaping factors and controls to enhance human performance of
 the task.

Training and competence

- Provide training in risk awareness and completing risk assessments.
- Ensure the delegated competent individual completes all safety checks correctly.
- Keep records of inductions and training, and ensure training materials are accurate and up to date.

Managing change

- Document change management plans and communication of change plan.
- Document risk assessments for change process and include the impact of human factors.
- Ensure when there is change to usual operating periods (e.g. shutdowns or maintenance) that the change is managed with appropriate risk assessment and controls, in addition to ensuring there is adequate supervision during these times.

Other examples of causes that were identified from the incidents included a lack of supervision, not communicating vital information when required and placement of equipment, which increased the likelihood of error and having a poor health and safety culture.



Section 5 Analysis from the Chief Dangerous Goods Officer

Our review of the year's observations shows several items of note, detailed below. Noting that these items overlap in certain aspects, they will require an integrated approach if improvements are to be made.

Over the coming year, I ask all of the MHF operators to place extra focus in these areas, and determine how it could be relevant to your operation, and where you can make improvements.

I will be asking dangerous goods officers to consider these items when they attend your facility for audits and inspections.

Asset integrity and maintenance

Asset integrity and maintenance continues to remain a concern. The results for the last year show asset integrity and maintenance contributed to:

- all priority non-compliances for the year
- 27 per cent of all reported incidents
- 18 per cent of incidents which caused harm.

Little improvement has been noted over the last seven years, with asset integrity and maintenance identified as a cause in 28 per cent of incidents since 2017.

You may recall that asset integrity and maintenance has been identified as a significant factor in the previous annual reports, and the annual letters from previous CDGOs. As a whole, industry operators should be well aware of the issues and potential consequences of aging plant, including the newer plants. Yet, we haven't seen any encouraging results showing a decrease in incidents related to plant integrity.

Exposure to dangerous goods

The vast majority of reportable incidents (74%) related to loss of containment, which does not include escalation from the release. Eight of the 11 incidents which caused harm were due to loss of containment directly, including exposure to toxic gases and contact with corrosives. The remaining incidents which caused harm were escalations from the loss of containment, being either a fire or explosion.

Even a minor exposure to a toxic gas, corrosive substance or thermal radiation can impact the individual and their families for extended periods. I encourage a renewed focus on all measures intended to isolate people from the damaging effects of dangerous goods, including pressure equipment integrity, fugitive emissions, vent location, purging procedures, and control of line breaks.

Usable procedures

With usable procedures being the most common human factors theme across both incidents and audit findings, it indicates that this is an area which operators should closely monitor.

One way in which operators can assess their procedures (and other human factors) is by using the Human factors: Usable procedures: Information sheet. The information sheet contains a checklist to assist operators in assessing whether current procedures and new procedures are developed in a way to optimise useability.

It is important to note that human factors often combine and interact, making it rare for an incident to have a single contributing factor. Consequently, there is no one-size-fits-all solution. Operators should focus on identifying the highest risks associated with human factors in their specific workplaces and address these proactively.

Pipeline and operator interfaces

Dangerous goods pipelines present a unique risk profile and typically include an interface between two operators. All MHF operators and pipeline owners need to ensure that there are no gaps in areas of responsibility for the operation, maintenance and emergency response requirements.

If you own or have a dangerous goods pipeline within the bounds of your MHF, I recommend that you review the agreements and communication with the other parties involved. All interface aspects should be clear and explicit in relation to responsibilities.



Appendix 1 Further information

In addition to the detailed analysis of MHFs, the following publications may also be of use:

Department of Energy, Mines, Industry Regulation and Safety

Significant incident summary – Offshore platform decommissioning near miss

The department has released a significant incident summary detailing the contributory factors and recommended control measures into an offshore incident in Western Australian waters. Two workers were cutting through a monopod's main leg (caisson) when the topside, which was rigged to a crane on a vessel, unexpectedly moved and detached from the supporting monopod and swung over the workers.

Significant Incident Summary No. 6 Offshore platform decommissioning near miss

Future fuels

With the current emphasis for the use of hydrogen as a fuel, and the limited industry standards the department is placing higher level of rigour on the licensing of hydrogen projects.

Dangerous Goods Safety Guide: Storage, handling and production of hydrogen

Other resources

Technical and organisational investigation of the Callide Unit C4 incident

CS Energy has published an independent investigation report and animation into the Callide power station incident. On 25 May 2021 an incident occurred at Unit C4 of Callide C power station resulting in the catastrophic failure of the unit. There were no fatalities, but the incident destroyed Unit C4's turbine generator and destabilised the Queensland power grid.

Callide Unit C4 recovery | CS Energy

Acetic acid release at the LyondellBassell La Porte complex

The US Chemical Safety and Hazard Investigation Board has released a safety video and investigation into the fatal loss of containment incident at the LyondellBassell La Porte Complex in Texas on 27 July 2021.

CSB Releases New Safety Video on Fatal Acetic Acid Release

Naphtha release and fire at BP-Husky refinery

The US Chemical Safety and Hazard Investigation Board has released its final report into the naphtha release and fire at the BP-Husky Toledo Refinery in Ohio on 20 September 2022.

Fatal Naphtha Release and Fire at BP-Husky Toledo Refinery: Investigation report



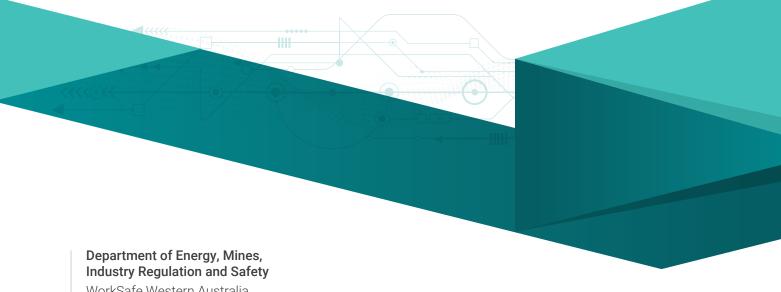
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