Department of **Energy, Mines, Industry Regulation and Safety**

GOVERNMENT OF WESTERN AUSTRALIA

WorkSafe Western Australia Petroleum Safety

GUIDE

Demonstration of risk reduction so far as is reasonably practicable (SFAIRP)

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Reference

WorkSafe Western Australia, 2024, Demonstration of risk reduction so far as is reasonably practicable (SFAIRP): Guide. Department of Energy, Mines, Industry Regulation and Safety, Western Australia, 27 pp.

This publication can be available on request in other formats for people with special needs.

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Foreword

Western Australia's work health and safety (WHS) legislation came into force in March, 2022. This resulted in the amendment of the various petroleum Acts and the repeal of the associated regulations so that all onshore and offshore petroleum, pipeline and geothermal energy operations are now subject to the requirements of the:

- *Work Health and Safety Act 2020* (the WHS Act)
- Work Health and Safety (Petroleum and Geothermal Energy Operations) Regulations 2022 (WHS PAGEO Regulations).

A key responsibility for the WorkSafe Group (WorkSafe) of the Department of Energy, Mines, Industry Regulation and Safety continues to be the ongoing risk management and safety requirements for the onshore and offshore petroleum, pipeline and geothermal energy operations. To support these requirements, the guides previously developed have been updated to provide support and assist operators to meet their commitments under the WHS Act and WHS PAGEO Regulations.

Application

This Guide is a non-statutory document provided by WorkSafe to assist persons subject to duties under the WHS Act and requirements to conduct audits of the safety management system as prescribed by the WHS PAGEO Regulations.

It has been developed to provide advice and guidance to operators to meet the WHS Act and the WHS PAGEO Regulations requirements administered by WorkSafe.

Who should use this Guide?

You should use this Guide if you are:

- the operator of onshore or offshore petroleum, pipeline or geothermal energy operations under the *Work Health and Safety Act 2020*, and
- responsible for hazard identification and risk management and the management of risks so far as is reasonably practicable (SFAIRP).

WHS legislation

Under the WHS Act, the WorkSafe Commissioner is responsible for performing the functions and exercising the powers of the regulator. Each safety document must be submitted for acceptance by the regulator.

WorkSafe assists the regulator in the administration of the WHS Act and the WHS PAGEO Regulations, including the provision of inspectors and other staff to oversee compliance with the legislation.

For facilities outside Western Australian waters, the WHS Act does not apply and guidance should be sought from National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). If a vessel does not fall under the definition of "facility" in the Act, operators should contact the Australian Maritime Safety Authority and Department of Transport.

No petroleum or geothermal operations can be conducted on any onshore or offshore petroleum, pipeline or geothermal energy operations unless the facility has an operator registered in accordance with the requirements of WHS PAGEO Regulations.

The WHS PAGEO Regulations provided for transitional provisions in relation to facility operators and safety cases in place or submitted before the commencement of the WHS legislation.

Contents

1 Introduction

WHS PAGEO Regulations Subdivision 3
Contents of safety cases

This Guide provides operators with assistance to meet their obligations for reducing the risks associated with facilities and operations so far as is reasonably practicable (SFAIRP).

For the purpose of this Guide, the term “safety case” is used to cover all of the safety documents referred to in the WHS PAGEO Regulations.

The term “facility” covers offshore and onshore facilities and pipelines, including above ground structures.

The objective of this Guide is to provide clarity on areas of the legislation which may be ambiguous or open to interpretation.

1.1 Worker involvement

WHS PAGEO Regulations r. 38
Involvement of workers

It is appropriate that relevant workers who have been involved in the hazard identification and risk assessment consultations leading up to the demonstration of risk reduction SFAIRP are also included in this phase of the process of risk management.

As well as including the subject matter experts in the risk management process, include workers with direct knowledge of the activities under consideration and the effectiveness of the controls that are being considered to reduce the level of risk. Workers who have firsthand experience with performing the work on a regular basis are best placed to be involved in the risk management process.

Those workers involved in this phase can then provide feedback for the general workforce to ensure a better understanding of the need for risks to be reduced SFAIRP. This inclusion and consultation promotes a positive safety culture where workers are involved and are aware of safety issues and their own responsibilities.

1.2 Human factors

When identifying the hazards in operations and the workplace generally, it is important that the human factor is taken into account, assessed as to the risk applicable and appropriate controls put in place to manage the risk.

Human factors focuses on understanding how human performance is shaped by conditions within the system.

Integrating human factors into safety management systems is important for achieving error-tolerant systems. Safety case documentation should clearly demonstrate how human factors have been considered in the management of risk. It should include and demonstrate how various aspects of human performance in the areas of prevention, initiation, detection, control, escalation, mitigation and emergency response have been considered when identifying, assessing and controlling for hazards and major accident events (MAEs).

Safety case documentation that does not demonstrate the consideration of human factors may not be sufficient to demonstrate the risks associated with hazards and MAEs and how they have been reduced SFAIRP.

For further information, refer to the *Guide: Human factors fundamentals for petroleum and major hazard facility operators* and the *Human factors self-assessment guide and tool for safety management systems at petroleum and major hazard facility operations*.

1.3 Linked guides

The following guides have been developed to provide information to assist operators in effective hazard identification, risk assessment and management, as well as the development of the formal safety assessment of a safety case.

- *Hazard identification*
- *Risk assessment and management including operational risk assessment*
- *Human factors fundamentals for petroleum and major hazard facility operators*
- *Human factors self-assessment guide and tool for safety management systems at petroleum and major hazard facility operators*
- *Identification of major accident events, control measures and performance standards*

These five guides, together with this Guide, form an inter-related suite of information for effective hazard identification, risk assessment and management including identification of MAEs and control measures.

2 SFAIRP descriptions and demonstration

WHS PAGEO Regulations r. 109

Managing risks to health and safety

WHS PAGEO Regulations Subdivision 3

Contents of safety cases

Under the WHS PAGEO Regulations 2022, risks to health and safety must be eliminated so far as is reasonably practicable. If it is not reasonably practicable to eliminate risks, the risks must be minimised so far as is reasonably practicable (SFAIRP). This involves the assessment of risk against the requirements needed to control that risk to a tolerable level.

In meeting the requirements of minimising risk SFAIRP, operators should:

- define SFAIRP in the context of their facility and operations
- define how they are going to demonstrate that their residual risk meets their definition of SFAIRP including the risk tolerability criteria specific to their operation
- demonstrate that they have taken into account the human factor elements identified through the risk assessment process
- assess their major accident event (MAEs) such that their risks are shown to be reduced SFAIRP
- define how they are going to continually check and review that the requirements are met.

A safety case must show how an operator meets, or will meet, the requirements of the WHS PAGEO Regulations in controlling hazards that have the potential to cause a major accident event (MAE) and affect the health and safety of persons at or in the vicinity of the facility.

The operator must identify the necessary safety critical elements to minimise the risks associated with associated MAEs and demonstrate that those risks have been minimised so far as is reasonably practicable.

2.1 What is ‘reasonably practicable’?

WHS Act Section 18

What is reasonably practicable in ensuring health and safety?

WHS PAGEO Regulations r. 109

Managing risks to health and safety

The term ‘reasonably practicable’ means what could reasonably be done at a particular time to ensure the health and safety measures identified during hazard and risk assessment are in place and are effective.

In determining what is reasonably practicable, the operator must consider all relevant matters including:

- the likelihood of the hazard or the risk concerned occurring
- the degree of harm that might result from the hazard or the risk
- what the person concerned knows, or ought reasonably to know, about
  - the hazard or the risk
  - ways of eliminating or minimising the risk
- the availability and suitability of ways to eliminate or minimise the risk
- after assessing the extent of the risk and the available ways of eliminating or minimising the risk, the cost associated with the available ways of eliminating or minimising the risk, including whether the cost is grossly disproportionate to the risk.

Figure 1 shows how identified controls may be assessed to determine whether or not they are ‘reasonably practicable’.

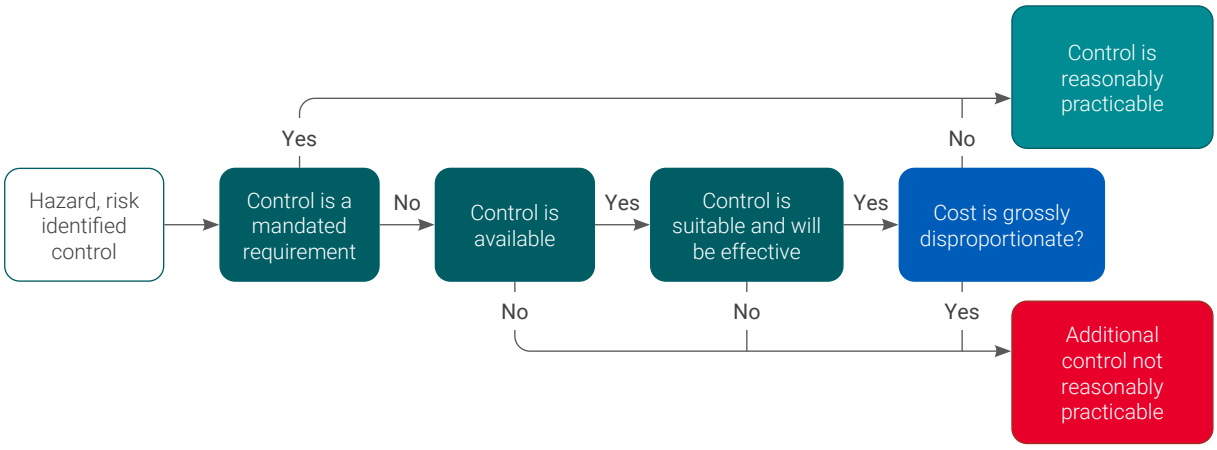


Figure 1 Is a specified control reasonably practicable?

3 Formal safety assessment SFAIRP description

WHS PAGEO Regulations r. 32(3)
Formal safety assessment

The WHS PAGEO Regulations outline specific requirements that operators need to cover within the formal safety assessment (FSA) for the facility.

Figure 2 is an example of the overall FSA process which may be used by operators to identify and manage the hazards and risks within their operations and meet the requirements of the WHS PAGEO Regulations.

Safety critical elements, (risk control measures e.g. barriers) as shown in Figure 3, need to be employed to manage major accident events (MAEs), are effective and maintain their integrity during the entire lifecycle of a facility.

The FSA, which forms part of the safety case, must describe how all hazards with the potential to cause an MAE have been assessed and controls identified that minimise the risks SFAIRP.

Demonstration of risk reduction SFAIRP can be covered in the FSA by documenting the prevention, detection, control and mitigation measures that are in place. This includes various aspects of human performance in the areas of prevention, detection, control, and mitigation when controlling for hazards and MAEs. These categories are defined in Table 1.

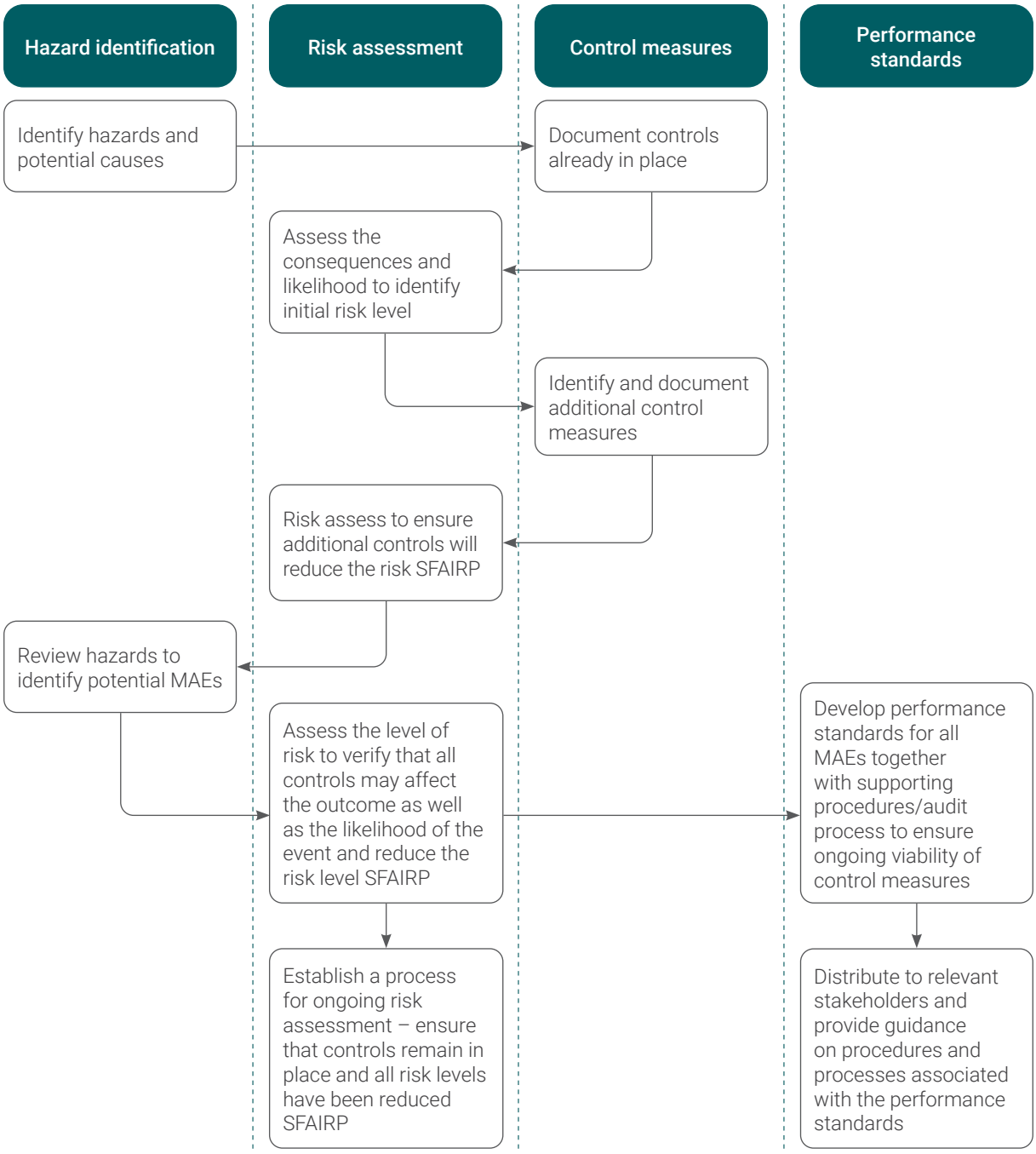


Figure 2 Formal safety assessment process

Table 1 Categories of control measures

Elimination	Measures to stop a cause from being realised as a major accident (e.g. use of interlocks and measures that eliminate the likelihood of a release).
Detection	Measures to identify a situation where the prevention measures have failed (e.g. leak detection, maintenance and asset integrity).
Reduction	Measures to prevent or control the size of an incident and limit the extent/ escalation potential (e.g. emergency shutdown and ignition prevention, training and competency of emergency responders).
Mitigation	Measures to protect people from harm following an incident (e.g. safe escape and evacuation from work areas, respiratory protective equipment and associated training).

Examples of the measures in place can be provided under each of the above categories to support the demonstration that risks associated with each hazard have been minimised SFAIRP. These examples should be covered briefly and reference particular procedures, documentation (including the document title and document number) or the section of the operations description for more detail.

Table 2 Examples of control measures under each category

Elimination	
Regulations and design standards	Include details of legislative requirements and the design basis memorandum document number for reference purposes.
Leak detection	Include overview of leak prevention measures in place and reference any specific documents, giving their title and document number.
Impact protection	Relates to risk of loss of containment – provide examples in place to protect facility and equipment from this type of damage.
Facility security	Prevents unauthorised access to facilities and effective egress in the event of an emergency.
Detection	
Control system	Give a brief overview of the distributed control system /supervisory control and data acquisition or other monitoring system in place on the facility.
Integrity management	Include examples of corrosion monitoring, cathodic protection and facility inspections, including coating inspections.
Detection systems	Describe the leak and fire detection systems in place.
Reduction	
Emergency shutdown equipment	Briefly describe the location and functionality of the emergency shutdown and purging systems on the facility.
Isolation	Briefly describe isolation points for the facility and any specific equipment.
Ignition control	Describe equipment and procedures in place for minimising the probability of igniting any flammable substance in hazardous or non-hazardous areas.
Overpressure protection	Describe the measures in place to prevent over-pressurisation of equipment; for example, following the failure of a pressure control device.
Mitigation	
Escape and evacuation routes	Describe how the escape and evacuation routes are conveyed to people on site and the process in place to ensure training, etc. for this.
Emergency response plan	Overview of the emergency response plan in place for a facility (include title and document number for reference purposes).
Emergency equipment	Overview of what emergency equipment is available, how it is maintained and inspection requirements.
Communications	Describe the types of communication equipment available to people at the facility.

Procedural safety measures may also be listed in this area of the FSA. These may include:

- training and competency
- permit to work system
- safe work method statements or job hazard analysis forms
- safety-critical task analysis
- human reliability and error analysis techniques
- inspection and maintenance procedures
- operating manuals
- pipeline integrity management plans
- asset management plans.

3.1 Demonstrate risk reduction SFAIRP

WHS PAGEO Regulations r. 32(3)
Formal safety assessment

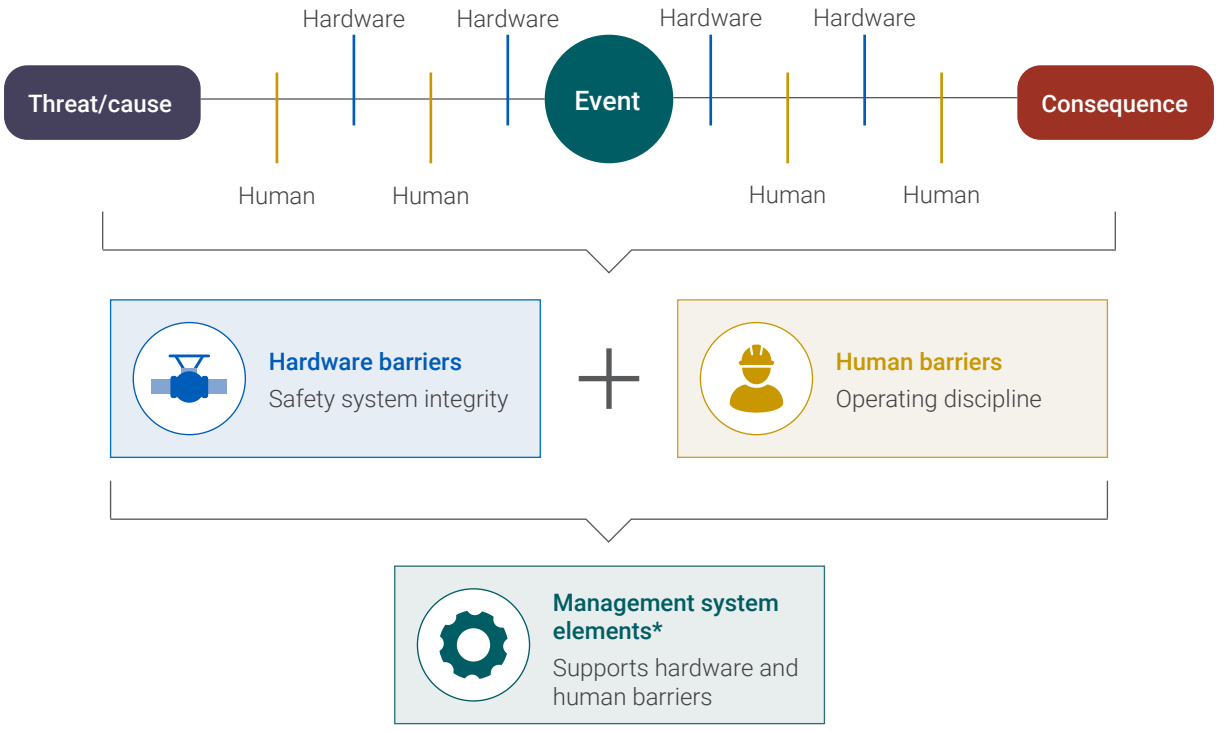
WHS PAGEO Regulations r. 109
Managing risks to health and safety

Within the FSA, an operator must demonstrate that:

- risk associated with each potential MAE hazard has been minimised SFAIRP, and
- methodologies used in the FSA are appropriate and adequate.

The influence of human factors and performance-shaping factors on human performance where humans act as risk control measures or barriers should be identified and controlled when minimising the risk of MAEs SFAIRP.

When providing evidence that the risks are minimised SFAIRP, a fundamental requirement is to demonstrate that the hazard identification and risk assessments carried out have been systematic and detailed as this provides the foundation on which to base the control measure selection. Risks are required to be periodically reviewed to ensure that they still meet the SFAIRP criteria by ascertaining whether further or new controls need to be introduced to take into account changes over time. This may include new knowledge about the risk, the availability of new methods and technologies for reducing or eliminating risks or when reliability of controls is less than initially thought.



** i.e. processes and procedures within the management system elements*

Figure 3 Types of barriers and supporting SMS elements (Source: Standardization of barriers definitions, IOGP Report 544)

4 Safety management system SFAIRP description

WHS PAGEO Regulations r. 32(4)(f)
Safety management system

WHS PAGEO Regulations r. 110
Hierarchy of control measures

The WHS PAGEO Regulations place an overarching duty to eliminate risks to health and safety SFAIRP by using the hierarchy of control. If it is not reasonably practicable to eliminate these risks, they must be minimised SFAIRP.

The safety management system (SMS) must provide for the continual and systematic identification of hazards to health and safety of workers arising from all activities that take place in connection with the operation and minimise risks SFAIRP.

While the SMS is not required to identify all the individual health and safety risks, it must contain details of policies, procedures and processes that provide the continual and systematic identification, assessment and minimisation of all health and safety risks SFAIRP. Risks to health include risks to physical and psychological health.

The SMS provides ongoing identification and management of risks SFAIRP for all activities and operations over the life of the facility, how this is achieved, maintained and the way deviations are managed to ensure they achieve a risk profile that is reduced SFAIRP.

An indication of the content for hazard identification for the SMS is as follows.

Indication of content detail for hazard identification

All potential risks will be systematically managed over the life of the facility and operations. This will involve a process of hazard identification, risk assessment and determination of control measures to minimise risks SFAIRP.

As outlined in the FSA of this safety case, a number of risk assessment processes may be required, including hazard identification studies, hazard operability studies and quantitative risk assessments contribute to the hazard identification and risk management. Regular operational risk reviews are conducted, which result in an update of the hazard register, MAEs and performance standards. To meet this objective the operator:

- develops, implements and maintains a hazard identification and risk assessment process which results in a prioritised corrective action register;
- ensures the hierarchy of controls are used to minimise and manage operational risks. These are:
  - elimination of hazard at source
  - substitution of materials/process
  - enclosure/isolation of materials/process
  - engineering methods
  - work practices
  - administrative control
  - training/education
  - personal protective equipment
- at each step consults with workers and their health and safety representatives
- involves and trains all workers, including subcontractors, in the hazard identification and risk assessment process so that day-to-day hazards are identified and control measures are determined and implemented
- demonstrates that the risk of high or significant hazards are reduced SFAIRP.

Following the hazard identification, an assessment of the risk needs to be completed, including details of the methodology applied in assessment of the risks in the SMS.

Indication of content detail for assessment of risk

Where a hazard is identified, the risk of injury or harm to a person, damage, loss or activity interruption at the facility is assessed.

In assessing the level of risk:

- identify all injury, disease or organisational loss potential and consequence
- determine the actual risk taking into consideration the realistic frequency of potential occurrence, the duration of the event and the loss severity or consequence
- prioritise control requirements for identified risks.

Matters considered include:

- type of hazard
- size and layout of the workplace
- frequency potential of the hazard
- consequence of injury, damage or loss likely to occur as a result of being exposed to a hazard
- number of workers including shift-workers and where they are located (e.g. remote or isolated areas)
- systems of communication for workers in isolated or remote locations to enable contact for assistance
- information available on safety data sheets or product sheets relating to first aid measures.

Hazards associated with specific tasks are assessed using experienced workers. Each identified hazard is assessed against a risk matrix to obtain a risk ranking. Upon identification that additional control measures need to be implemented to reduce the risk SFAIRP actions are raised and entered into a database that monitors the progress of work completed so that the additional controls can be implemented against the risk. Once implemented, the control measures are monitored for effectiveness on a regular basis through auditing of operations.

Any of the operator's internal documents covering these processes should be listed as a reference in this section of the SMS with the title and document number.

5 Risk-related decision making framework

The regulator recommends three assessment techniques for risk-related decision making:

- best practice
- engineering risk assessment
- precautionary approach.

Operators should identify the assessment technique appropriate to their facility and operations.

The risk-related decision making framework has been adapted from NOPSEMA's ALARP Guidance Note. The framework takes the form of three different decision context (A, B & C). Initially the decision context needs to be determined.

Figure 4 describes three different decision contexts that aid in assigning the context type to a given decision. However, in reality, there is a continuum of context ranging from simple to complex.

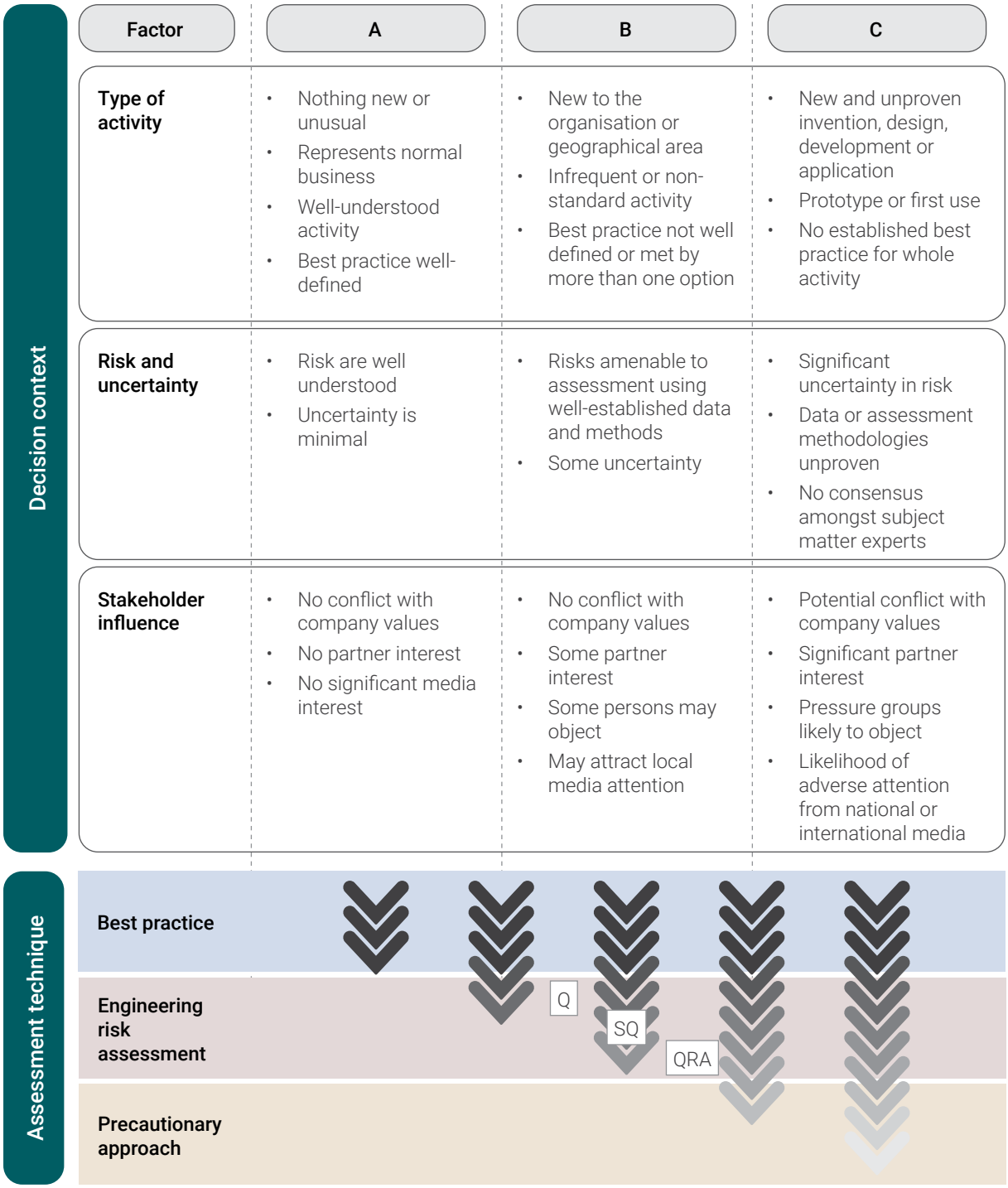


Figure 4 Risk-related decision making framework

For a Factor A decision, the risks are well understood and the decision will be determined by the application of recognised good practice. In cases where good practice may not be sufficiently well defined, an engineering risk assessment may be required to guide the decision.

For a Factor B decision, which involves greater uncertainty or complexity, the decision will not be made entirely by established good practice. While any applicable good practice will have to be met, an engineering risk assessment is needed to ensure that risks are reduced SFAIRP. MAEs are rarely managed solely through compliance to best practice.

As an additional caution, operators who are making Factor A decisions based predominantly on codes and standards should ensure they understand how the codes and standards act to minimise risks. Without this knowledge it is difficult to identify when change (planned or otherwise) will undermine the effectiveness of that standard or code as a control measure.

The following examples give an application of the framework for illustration purposes – three facilities, three different outcomes.

Table 3 Examples of applying risk-related decision making framework

	Facility 1	Facility 2	Facility 3
Scenario	Standard temperature/ pressure pipeline in a mature oil and gas development area with no known unique environmental concerns and much existing similar infrastructure.	Normally attended facility which has some hydrocarbon processing equipment. There is nothing new or unusual about the equipment or process, but this is the first time a facility of this type has been installed and operated by this operator.	Normally attended facility with novel technologies and complex hydrocarbon processing equipment that requires frequent monitoring during the initial start-up phase of operations. The facility is offshore and has a large number of workers on board.
Decision type	Nothing new or unusual, company and external codes cover this application extensively, the best design, installation and maintenance approaches are known and well established over many years. The decision type is A.	Hydrocarbon processing facilities are not novel, but they are new to the operator and deviate from established company practice. Qualified engineering judgement and some risk-based assessment will be required to determine that the design risk is reduced SFAIRP. The decision type is B.	Some new and novel technologies are used and the number of potentially exposed workers is high. The impacts from any loss of containment are potentially very high. A precautionary approach to decision making is required. The decision type is C.
Risk reduction measures	Best practice standard control measures specified in design codes and adopted on the existing infrastructure are put in place.	Best practice standard control measures put in place for processing facilities and decisions made regarding increased monitoring and inspection.	The decision type means that much more effort is expended on examining risk reduction options and proving the design risk is reduced SFAIRP. Although costly, a standby vessel is incorporated into the design and operation philosophy for the facility.

The residual risks of MAEs determined by following an engineering risk assessment approach will be in one of the following category bands:

- **Intolerable risk**: If the risk is in this region then SFAIRP cannot be demonstrated and action must be taken to reduce the risk irrespective of cost.
- **Tolerable risk**: If the risk falls in this region, then a case-specific SFAIRP demonstration is required. The extent of the demonstration should be proportionate to the level of risk.
- **Broadly acceptable risk**: If the risk has been shown to be in this region, then the SFAIRP demonstration may be based on adherence to codes, standards and established best practice. However, these must be shown to appropriately control the risk, be up-to-date and relevant to the operations in question.

If risks are outside the broadly acceptable region, or measures in place do not represent relevant best practice, a case specific SFAIRP demonstration is required. This can be satisfied by the operator answering the following fundamental questions in relation to the identified MAEs.

- **Q1 – What more could be done to reduce the risks?** The answer to this question is qualitative. The operator should look at the risks from their operations and prepare a list of proportionate measures which could be implemented to reduce those risks. Only in a minority of circumstances will there be nothing further that could be done without shutting the plant down completely.
- **Q2 – Why has this not been done?** The answer to this question may be qualitative or quantitative depending on the predicted level of risk prior to the implementation of those identified further measures. If the measure appears reasonable based on engineering considerations, and it cannot be shown that the cost of the measure is grossly disproportionate to the benefit to be gained, then the operator is duty bound to implement that measure.

If current provisions do not demonstrate risk reduction SFAIRP, operators should identify the potential options required to demonstrate minimisation of risk SFAIRP (i.e. what more can be done to reduce the risks?). The options identified are detailed as part of the demonstration and a gross disproportionality argument made against those not implemented. This assessment should first consider the measures that will provide the highest risk reduction, not the cheapest to implement. Subsequently, the level of risk should be re-evaluated following the decision to implement any such risk control measure to ascertain whether broadly acceptable risks have been achieved, or whether additional risk control measures need to be implemented or assessed for gross disproportionality.

A Factor C decision will typically involve sufficient complexity, uncertainty or stakeholder interest to require a precautionary approach. In this case, relevant best practice will still have to be met and detailed engineering risk assessments will also be used to support the decision.

The chevrons in Figure 4 show the technique(s) to make the decision. Whatever the context, best practice must be met and the risks must not be intolerable. Where the line between each decision context is blurred (i.e. for A/B, B and B/C decision contexts) the arrow strength diminishes towards its base to show the reduced relevance of that technique for such a decision. Towards and in context C, the precautionary approach is likely needed to make the decision requiring engineering risk assessments.

Different types and dimensions of risk require different assessment techniques. For example, in order to demonstrate that risks have been reduced SFAIRP at a liquefied petroleum gas (LPG) tanker loading area forming part of a refining complex, it may be suitable to align to current industry practice. However, to demonstrate that risks across the entire complex have been reduced SFAIRP, quantitative engineering risk assessments may be appropriate.

6 SFAIRP demonstration techniques

6.1 Best practice

In most cases, best practice will mean adopting sound engineering design principles, and good operating and maintenance practices, which operators should always implement irrespective of situation-based risk estimates. However, this may not be sufficient and operators may need to adopt best practice or state-of-the-art technology. For example, the arrangements for storing liquefied natural gas are more stringent than some other extremely flammable liquids because of its potential to cause a major flash fire or explosion in the event of a significant release.

A site storing pressurised or liquefied toxic gas in an urban area, or in an environmentally sensitive location, may also need to adopt best practice or state-of-the-art technology.

New plant, installations or situations should conform to current best practice. Other potential options should be considered to determine whether further risk reduction measures are reasonably practicable.

The use of best practice at the design stage is essential to demonstrate that risks have been reduced SFAIRP. This should include use of sound design principles (e.g. inherent safety), codes, standards and guidance.

In applying modern standards to old assets, a gross disproportionality argument (for the risk control measures identified during the gap assessment) is acceptable to demonstrate doing less than modern authoritative best practice.

Designation of what the operator considers to constitute best practice is required.

6.2 Engineering risk assessment

SFAIRP demonstration through a risk assessment approach to prevention and mitigation may be necessary where:

- no or limited standard for best practice exists
- there is a high level of complexity and coupling
- operations are conducted on a scale beyond that captured by individual standards
- MAE scenarios are not adequately addressed by current practice
- the combination of discrete hazards is not foreseen in the best practice documents
- the situation assessed presents certain aspects that do not fit existing best practice.

Demonstrations that risks have been reduced SFAIRP following the engineering risk assessments should:

- demonstrate broadly acceptable risk for individual MAE scenarios
- demonstrate broadly acceptable risks from cumulative MAE scenarios by considering individual and cumulative impact (i.e. meeting the risk criteria).

Different risk assessment techniques can be employed individually, or simultaneously, to demonstrate risks have been reduced SFAIRP including:

- qualitative risk assessments
- semi-quantitative risk assessments
- quantitative risk assessment.

6.3 Precautionary approach

If an assessment, taking account of all available engineering and scientific evidence, is insufficient, inconclusive or uncertain, then a precautionary approach to hazard management is needed.

A precautionary approach replaces uncertain analysis by conservative assumptions resulting in a safety measure being more likely to be implemented. This approach should be commensurate with the level of uncertainty in the assessment and the possible danger.

The hazards that are assessed should include the worst-case scenario that can be realised, but not hypothetical hazards with no evidence that they may occur. While the approach adopted is expected to be proportionate and consistent, safety is expected to take precedence over economic considerations, meaning that a safety measure is more likely to be implemented. In this context, the decision could have significant economic consequences to an organisation in conjunction with the safety implications.

A precautionary approach may result in the implementation of risk reduction measures for which the cost may appear to be grossly disproportionate to the safety benefit gained. However, in these circumstances, the uncertainty associated with the risk assessment means that the risks associated with non-implementation cannot be shown to be SFAIRP with sufficient certainty.

6.4 Cost benefit analysis

Cost cannot be used as a reason for adopting controls that rely exclusively on changing people's behaviour or actions when there are more effective controls available that can change the risk through substitution, engineering or isolation.

The cost of controlling risk may be taken into account in determining what is reasonably practicable, but cannot be used as a reason for doing nothing. The greater the likelihood of harm occurring or the greater the extent of that harm, the less weight should be given to the cost of controlling the hazard or risk.

Any technically feasible control measure is reasonably practicable to implement, unless the costs involved are grossly disproportionate to the benefits of doing so. Affordability (i.e. whether a company is in a position to fund improvements) is not a factor in assessing whether the risk is reduced SFAIRP, although the cost of implementing the control measure is.

Any cost benefit analysis should be conducted by suitably qualified workers.

6.4.1 Costs

When reviewing a cost benefit analysis, the regulator will seek to ensure that all the appropriate costs have been included and to challenge where costs appear extraneous or excessive.

Costs of installation, operation, training and any additional maintenance can be included as well as any business losses that would follow from any shutdown of the plant undertaken solely for the purpose of putting the measure into place. All claimed costs must be those incurred by the operator. Costs incurred by other parties (e.g. members of the public) should not be counted.

In the case of non-recoverable costs, for example, if a measure implies lost production, only the lost production during the delay can be counted.

If lost production is actually deferred production (i.e. the life of the plant is based on operating time rather than calendar time), then it should only take account of interest on the lost production, plus allowance for operational costs during the implementation time, and potential increase in operational costs at the end of life. For example, oil or gas remaining in an oil or gas field while work is carried out on a platform should not be counted as lost production.

If the lost production costs are a strong influence on a decision not to implement, the operator should show that phasing or scheduling the work to coincide with planned downtimes (e.g. for maintenance) would not change the balance.

The costs considered should only be those necessary and sufficient for the purpose of implementing the risk reduction measure (i.e. no 'gold-plating' or deluxe measures).

Ongoing production losses as a result of the measure can be counted. For example, if things are slowed down, or the new plant requires more maintenance.

Any savings as a result of the measure (e.g. reduced operational costs, avoidance of damage and reinstatement costs if relevant) should be offset against the above costs. These are not considered safety benefits but are counted as 'cost savings' (i.e. they reduce the overall cost of implementing a measure).

The costs claimed should be shown to relate only to the measure being implemented for safety.

6.4.2 Benefits

The operator must ensure that all benefits of implementing a safety improvement measure are included and that the benefits associated with the measure are not underestimated.

The benefits should include all reduction in risk to the public, to workers and the wider community. Benefits can be broken down into prevented:

- fatalities
- injuries (major to minor)
- environmental damage (if relevant).

Benefits can include avoidance of deployment of emergency services and avoidance of countermeasures such as evacuation and post-accident decontamination, if appropriate.

All benefits of a measure should be included. If a risk reduction measure is identified for one type of accident, but reduces other risks as well (e.g. health and safety risks), all benefits should be counted.

Operators may need to treat reinstatement costs as a benefit rather than offsetting them against costs. This would be the case if the plant being reinstated were a safety-related plant (e.g. one that treats hazardous waste). This can represent a bias in favour of health and safety. This is because the cost of control measure reinstatement is easily quantifiable, whereas the benefits of reinstating the control measure are often far-reaching.

6.5 Avoidance of control reduction

Operators may on occasion wish to remove a risk control measure that they believe no longer reduces risk SFAIRP. An argument may be put forward that, for reasons such as the short remaining life of an asset, the reinstatement cost of a previously functioning risk reduction measure is grossly disproportionate to the risk benefit that it would achieve. This is commonly called reverse SFAIRP. In this case, the test of best practice must still be met and, since the risk reduction measure was initially installed, it must constitute best practice to reinstall or repair it, unless the underlying risk or hazard has changed.

Any decision to remove risk control measures should be subject to comprehensive risk assessment before the control is removed, and reverse SFAIRP arguments are not appropriate.

For further information, refer to the Office of the National Rail Safety Regulator *ONRSR Guideline: Meaning of duty to ensure safety so far as is reasonably practicable*.

7 Factors for success

In its consideration for minimising risk SFAIRP, in a safety case development and submission, the regulator expects operators to address at least the following factors:

- timeliness – the earlier an evaluation is undertaken, the greater the ability to reduce risks SFAIRP
- development of safety case content aligned to the requirements specified in the WHS legislation
- involvement of workers who know the facility or a very similar operation
- access to a wide range of reference material such as standards and safety alerts
- a sufficient level of detail explaining the means by which the suitability of the design, construction, installation, operation, maintenance or modification is appropriate to the facility
- evidence that the adopted control measures minimise risks SFAIRP
- evidence that the SMS provides for, and will continue to provide for, minimisation of risk SFAIRP, and that the SMS is comprehensive and integrated.

Appendix 1 Glossary

The following terms are defined for the purposes of this Guide.

Key terms	Meaning
Facility	**Geothermal energy facility** – a place at which geothermal energy operations are carried out and includes any fixture, fitting, plant or structure at the place **Petroleum facility** – a place at which petroleum operations are carried out and includes any fixture, fitting, plant or structure at the place **Mobile facility** – includes an onshore drilling rig The term facility has been adopted throughout this document to cover offshore and onshore facilities and pipelines including aboveground structures associated with onshore pipelines.
FSA	Formal safety assessment
Geothermal energy operation	Means an operation to: • explore for geothermal energy resources • drill for geothermal energy resources • recover geothermal energy, or • is any other kind of operation that is prescribed by the regulations to be a geothermal energy operation for the purpose of this definition and carry on of such operations and the execution of such works as are necessary for that purpose.
Major accident event (MAE)	An event connected with a facility, including a natural event, having the potential to cause multiple fatalities of persons at or near the facility.
Operator	A person who has, or will have, the day-to-day management and control of operations at a facility and is registered as the operator of the facility under r.22(3).
Person conducting a business or undertaking (PCBU)	A PCBU is an umbrella concept capturing all types of working arrangements or relationships. A PCBU includes a company, unincorporated body or association and sole trader or self-employed person. Individuals who are in a partnership that is conducting a business will individually and collectively be a PCBU. A reference to a PCBU includes reference to the operator of a facility.
Performance standard	A standard established by the operator defining the performance required for a safety critical element typically defining the functionality, availability, reliability, survivability and interdependency of the safety critical element

Key terms	Meaning
Petroleum operation	Means an activity that is carried out in an area in respect of which a petroleum title is in force, or that is carried out in an adjacent area, for the purpose of any of the following: • exploring for petroleum • drilling or servicing a well for petroleum • extracting or recovering petroleum • injecting petroleum into a natural underground reservoir • processing petroleum • handling or storing petroleum • the piped conveyance or offloading of petroleum
Regulator	The WorkSafe Commissioner is the regulator under the *Work Health and Safety Act 2020*
Safety case	Documented provisions related to the health and safety of people at or in the vicinity of a facility, including identification of hazards and assessment of risks; control measures to eliminate or manage hazards and risks; monitoring, audit review and continual improvement. In this document a safety case covers all safety management systems, plans and other safety related documents referred to in WHS Act and WHS PAGEO regulations
Safety critical element (SCE)	Any item of equipment, system, process, procedure or other control measure the failure of which can contribute to an MAE
SFAIRP	So far as is reasonably practicable
SMS	Safety management system
WHS Act	*Work Health and Safety Act 2020*
WHS PAGEO Regulations	Work Health and Safety (Petroleum and Geothermal Energy Operations) Regulations 2022
Worker	Any person who carries out work for a person conducting a business or undertaking, including work as an employee, contractor or subcontractor (or their employee), self-employed person, outworker, apprentice or trainee, work experience student, employee of a labour hire company placed with a 'host employer' or a volunteer

Appendix 2 Further information

Petroleum safety guidance

Interpretive guidelines

- *Development and submission of a diving safety management system*
- *Development and submission of a safety case*
- *Development and submission of an onshore facility safety case – drilling operations*

Guides

- *Audits, review and continual improvement*
- *Bridging documents and simultaneous operations (SIMOPS)*
- *Dangerous goods and hazardous chemicals in petroleum, pipeline and geothermal energy operations*
- *Decommissioning and management of ageing assets*
- *Demonstration of risk reduction so far as is reasonably practicable (SFAIRP)*
- *Diving start-up notices*
- *Emergency response planning*
- *Facility design case*
- *Hazard identification*
- *Health and safety leading and lagging performance indicators*
- *Human factors fundamentals for petroleum and major hazard facility operators*
- *Human factors self-assessment guide and tool for safety management systems at petroleum and major hazard facility operations*
- *Identification of major accident events, control measures and performance standards*
- *Inspections – Land-based drilling rigs*
- *Involvement of workers*
- *Management of change*
- *Nomination of an operator*
- *Records management including document control*
- *Risk assessment and management including operational risk assessment*
- *Validation requirements*

Australian and international standards

- AS 2885 *Pipelines – Gas and liquid petroleum - suite of standards*
- AS IEC 61511.1 *Functional safety – Safety instrumented systems for the process industry sector*
- AS IEC 61882 *Hazard and operability studies (HAZOP studies) – Application guide*
- AS/NZS ISO 31000 *Risk management – Principles and guidelines*
- IEC ISO 31010 *Risk management – Risk assessment techniques*
- ISO 17776 *Petroleum and natural gas industries – Offshore production installations – Guidelines on tools and techniques for hazard identification and risk assessment*

Codes of practice

- *How to manage work health and safety risks*
- *Mentally healthy workplaces for fly-in fly-out workers in the construction and resources sector*
- *Psychosocial hazards in the workplace*
- *Workplace behaviour*

Other resources

WorkSafe WA

- *How to determine what is reasonably practicable to meet a health and safety duty: Interpretive guideline*
- *Incident notification: Interpretive guideline*
- *The health and safety duty of an officer: Interpretive guideline*
- *The meaning of 'person conducting a business or undertaking' (PCBU): Interpretive guideline*

Other agencies

- Centre for Chemical Process Safety (CCPS), *Guideline for initiating events and independent protection layers in layer of protection analysis*
- Health and Safety Executive (HSE) UK, *ALARP "at a glance"*
- Health and Safety Executive (HSE) UK, *Guide: Principles for Cost Benefit Analysis (CBA) in support of ALARP decisions*
- International Association of Oil & Gas Producers (IOGP), *Standardization of barriers definitions*, Report 544
- National Offshore Petroleum Safety and Environmental Management Authority's (NOPSEMA), *Hazard identification guidance note*
- National Offshore Petroleum Safety and Environmental Management Authority's (NOPSEMA), *Risk assessment guidance note*
- SafeWork SA, *ALARP vs SFAIRP (within the context of WHS legislation)*

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