



Government of **Western Australia**  
Department of **Mines, Industry Regulation and Safety**

## **Petroleum safety and major hazard facility – guide**

**ALARP demonstration**

**February 2020**

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## Contact

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

Further details of safety publications can be obtained by contacting:

Safety Regulation Group – Regulatory Support

Department of Mines, Industry Regulation and Safety

100 Plain Street

EAST PERTH WA 6004

Telephone: +61 8 9358 8001

NRS: 13 36 77

Email: [SafetyComms@dmirs.wa.gov.au](mailto:SafetyComms@dmirs.wa.gov.au)

## **Guides**

A guide is an explanatory document that provides more information on the requirements of legislation, details good practice and may explain means of compliance with standards prescribed in the legislation. The government, unions or employer groups may issue guidance material.

Compliance with guides is not mandatory. However, guides could have legal standing if it were demonstrated that the guide is the industry norm.

This Guide has an operations focus and is set out in the context of risk assessment and legislative requirements of all responsible persons. Consequently, each operation needs to understand its limitations and skills base.

The Guide is based on current experience and is not claimed to be complete.

## **Who should use this Guide?**

You should use this Guide if you are responsible for hazard identification and risk management and the management of risks to a level that is as low as reasonably practicable (ALARP) or in the case of a major hazard facility so far as reasonably practicable (SFARP).

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# 1 Introduction

This document has been developed to provide assistance and guidance to licensees and operators to meet the Western Australian petroleum safety and major hazard facility legislation administered by the Department of Mines, Industry Regulation and Safety (the Department).

The legislation covered by this Guide is listed in Appendix 1.

## 1.1 Scope and objective of this Guide

This Guide has been developed to provide licensees and operators with assistance in adhering to the requirement to maintain the risks associated with their facilities to a level that is as low as reasonably practicable (ALARP), or in the case of major hazard facilities so far as reasonably practicable (SFARP) as specified under Western Australian legislation administered by the Department.

For the purpose of this Guide

- the term “safety case” is used to cover all of the safety documents referred to in the respective regulations
- the term ALARP is used to cover both “as low as reasonably practicable” and so far as reasonably practicable” unless the reference is specifically for major hazard facilities

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

Under the Dangerous Goods Safety (Major Hazard Facility) Regulations 2007, reference is made to a “major incident” whereas petroleum legislation refers to “major accident events” (MAEs). Reference within this Guide is made to MAE which will encompass the term “major incident”.

The Dangerous Goods Safety (Major Hazard Facility) Regulations 2007 refers to “harm to people, property and the environment” (which includes the general public) whereas petroleum legislation refers to “occupational safety and health of all people”. Where specific reference is made to both the petroleum safety and major hazard facility regulations both descriptions will be included, otherwise for generic references the term “safety and health” will encompass the additional requirements of property and environment in this Guide.

The objective is to provide clarity to both industry and Department personnel on areas of the legislation which may be ambiguous or open to interpretation.

The following appendices are included:

Appendix 1 Legislative provisions

Appendix 2 References and acknowledgements

Appendix 3 Glossary of terms

Appendix 4 Further information

## 1.2 Definitions and abbreviations

Definitions and abbreviations are included in Appendix 3 Glossary of terms.

### 1.3 Use of standards

There are a number of standards that can provide guidance and assistance to licensees and operators for completion of their hazard identification and risk assessments and demonstrate that the levels of risk are ALARP. Examples are:

- ISO 17776 *Petroleum and natural gas industries – Offshore production installations – Major accident hazard management during the design of new installations*
- AS/NZS 2885.6 *Pipelines – Gas and liquid petroleum Part 6: Pipeline safety management*
- AS IEC 61511.1 *Functional safety – Safety instrumented systems for the process industry sector*

Licensees and operators should reference the current versions of these publications to support the requirements of the safety case and how hazard identification, risk assessments and management, as well as demonstration of ALARP or SFARP, needs to be conducted effectively within their organisations.

### 1.4 Linked guides

The following guides have been developed to provide information to assist licensees and 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*
- *Major accident events, control measures and performance standards*

Figure 1 is an example of the overall formal safety assessment process which may be used by licensees and operators to identify and manage the hazards and risks within their organisations and meet the requirements of the relevant regulations.

## Formal safety assessment process

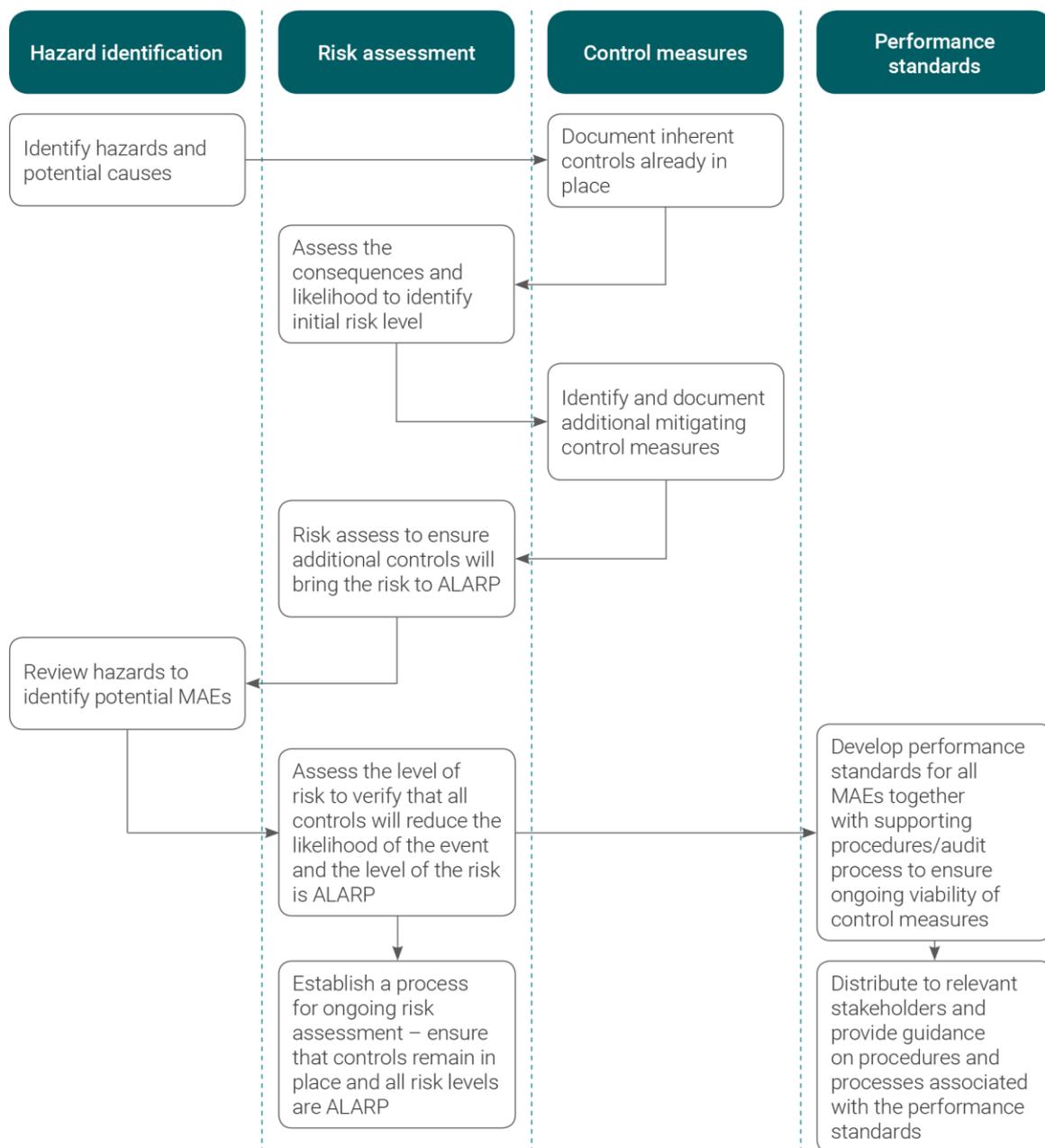


Figure 1 Formal safety assessment process

## 1.5 Workforce involvement

It is appropriate that relevant members of the workforce who have been involved in the hazard identification and risk assessment workshops leading up to the demonstration of ALARP are also included in this phase of the process of risk management.

As well as including the subject matter experts in the ALARP process, include members of the workforce with direct knowledge of the activities under consideration and the effectiveness of the controls that are being considered to reduce the level of risk. Those members of the workforce can then create feedback for the general workforce to ensure a better understanding of the need for ALARP. This inclusion and consultation promotes a positive safety culture where workers are involved and are aware of safety issues and their own responsibilities.

## 2 ALARP descriptions and demonstration

The definition of ALARP and the ALARP principle has been explored by organisations such as the Health and Safety Executive and Oil and Gas UK where there is consensus on the application and demonstration of ALARP.

Licensees and operators need to:

1. define ALARP in the context of their industry and operation
2. define how they are going to demonstrate that their residual risk meets their definition of ALARP including the risk tolerability criteria specific to their operation
3. assess their major accident event (MAEs) such that their risks are shown to be ALARP
4. define how they are going to continually check and review that the requirements are met.

A safety case must show how a licensee or operator meets, or will meet, the requirements of regulatory provisions relevant to the control of MAE risks; in particular, those risks to health and safety of people at or near the facilities that are ranked at intermediate and above.

### 2.1 Formal safety assessment ALARP description

Licensees and operators should refer to the regulations covering their facilities and activities to identify the specific requirements to include in their formal safety assessment.

The formal safety assessment of the safety case must describe how all hazards with potential to cause a MAE have been assessed and controls identified that reduce the risks to ALARP.

Some regulations require completion of specific studies to be summarised in the formal safety assessment. For example:

- a fire and explosion risk analysis (FERA) that identifies control measures necessary to reduce the risks associated with fires and explosions to a level that is ALARP
- an evacuation, escape and rescue analysis (EERA) that identifies control measures necessary to reduce the risks associated with emergencies to a level that is ALARP.

Demonstration of ALARP can be covered in the formal safety assessment by documenting the prevention, detection, control and mitigation measures that are in place. These categories are defined in Table 1.

Table 1 Categories of control measures

<b>Prevention</b>	Measures to stop a cause from being realised as a major accident (e.g. measures that eliminate the likelihood of a release).
<b>Detection</b>	Measures to identify a situation where the prevention measures have failed (e.g. leak detection).
<b>Control</b>	Measures to prevent or control the size of an incident and limit the extent/escalation potential (e.g. emergency shutdown and ignition prevention).
<b>Mitigation</b>	Measures to protect people from harm following an incident (e.g. safe escape and evacuation from work areas).

Licensees and operators can then provide examples of the measures in place under each of the above categories to support their claim of ALARP demonstration. Examples should be covered briefly and reference particular procedures, documentation (including the document title and document number) or the section of the facility description for more detail.

Table 2 Examples of control measures under each category

<b>Prevention</b>	
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 – give 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.
<b>Detection</b>	
Control system	Give a brief overview of the distributed control system (DCS)/supervisory control and data acquisition (SCADA) 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.
<b>Control</b>	
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.
<b>Mitigation</b>	
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 formal safety assessment. These may include:

- training and competency
- permit to work system
- safe work method statements or job hazard analysis forms
- inspection and maintenance procedures

- operating manuals
- pipeline integrity management plan
- asset management plan.

## 2.2 Safety management system (SMS) ALARP description

The SMS must provide for all health and safety risks (not just MAEs) and ensure systems are in place that manage these risks to a level that is ALARP.

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 reduction to ALARP of all health and safety risks. The SMS provides ongoing identification and management of risks to ALARP 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 ALARP.

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 ALARP.

As outlined in the formal safety assessment of this safety case, a number of risk assessment processes including hazard identification studies (HAZIDs), hazard operability studies (HAZOPs) 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 licensee:

- Developed, implemented 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
- Involves and trains all employees and 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 to ALARP.

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 employees including shift-workers and where they are located (e.g. remote or isolated areas)
- systems of communication for employees in isolated or remote locations to enable contact for assistance
- information available on safety data sheets (SDS) 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 bring the risk ranking to ALARP 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 the operator's section of the SMS with the title and document number.

## 2.3 ALARP demonstrations

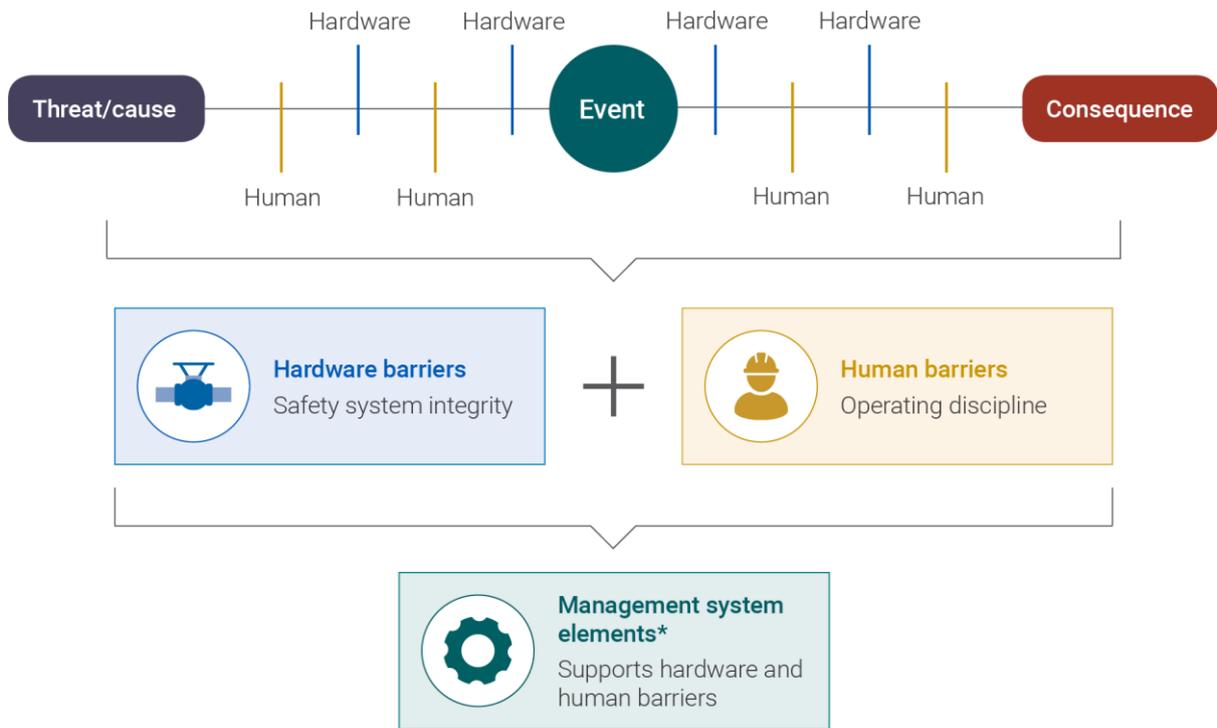
The regulations impose an overarching duty to eliminate or reduce all risks to ALARP. However, the regulations only require demonstrations of meeting the above duty for hazards with the potential to cause MAEs.

ALARP demonstrations are an objective test. ALARP is an engineering tool to demonstrate meeting legal obligations and broadly tolerable risk targets need to be referenced.

The hierarchy of controls shown in Section 2.2 should always be considered, with the ideal solution being to avoid a hazard altogether.

MAEs are managed through risk control measures (barriers) and the various safety management system elements ensure that these measures, as shown in Figure 2, are effective and maintain their integrity during the entire lifecycle of a facility.

When providing evidence that the risks are reduced to a level that is ALARP, a fundamental requirement is to demonstrate initially 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 ALARP 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

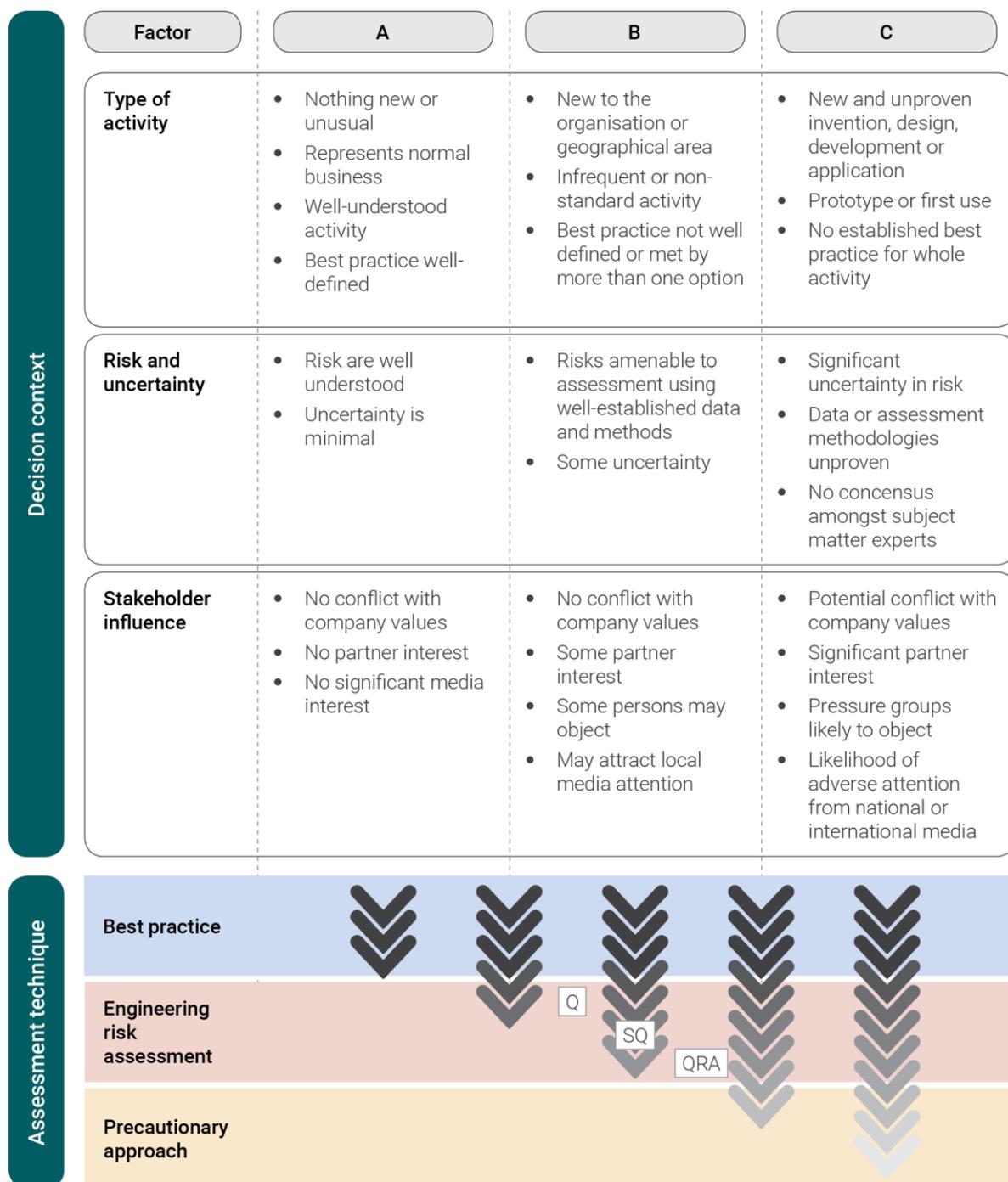
**Figure 2** Types of barriers and supporting SMS elements  
 (Source: Standardization of barriers definitions, IOGP Report 544, April 2016)

### 3 Risk-related decision making framework

The Department recognises three assessment techniques for risk-related decision making:

- best practice
- engineering risk assessment
- precautionary approach.

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



Q – qualitative    SQ – semi-quantitative    QRA – quantitative risk assessment

Figure 3 Risk-related decision making framework

Figure 3 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.

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 ALARP. 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 personnel 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 is ALARP. The decision type is B.	Some new and novel technologies are used and the number of potentially exposed personnel 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 is ALARP. 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 ALARP cannot be demonstrated and action must be taken to reduce the risk irrespective of cost.
- **Tolerable if ALARP risk:** If the risk falls in this region, then a case-specific ALARP 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 ALARP 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.

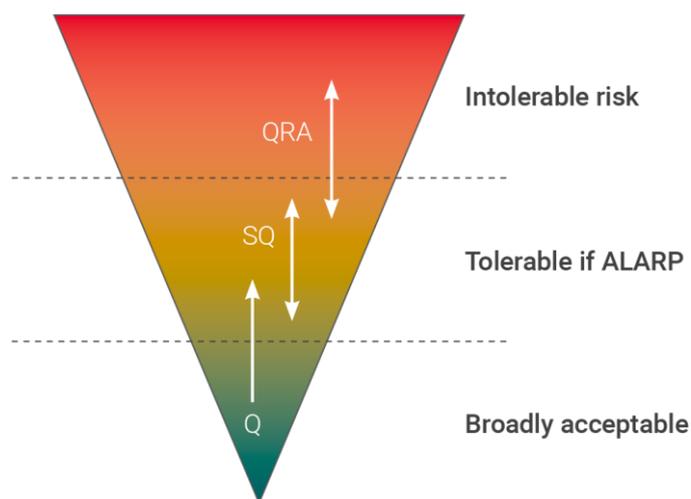


Figure 4 Determination of risk assessment method based on risk tolerance  
 Q – qualitative SQ – semi-quantitative QRA – quantitative risk assessment  
 (Source: Guidance on ALARP Decisions in COMAH, SPC/Permissioning/37, version 3)

If risks are outside the broadly tolerable region, or measures in place do not represent relevant best practice, a case specific ALARP demonstration is required. This can be satisfied by the licensee or 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 licensee or 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 licensee or operator is duty bound to implement that measure.

If current provisions do not demonstrate ALARP, licensees or operators should identify the potential options required to demonstrate risk reduction to ALARP (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 3 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, a liquefied petroleum gas (LPG) tanker loading area forming part of a refining complex may be suitable for ALARP demonstration by alignment to current industry practice. However, to demonstrate ALARP for the entire complex, quantitative engineering risk assessments may be appropriate.

## 4 ALARP demonstration techniques

### 4.1 Best practice

Operators must implement authoritative best practice irrespective of situation-based risk estimates.

In most cases, best practice will mean adopting sound engineering design principles, and good operating and maintenance practices. However, this may not be sufficient and licensees or operators may need to adopt best practice or state-of-the-art technology. For example, the arrangements for storing liquefied natural gas (LNG) 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 achievement of ALARP. 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 licensee or operator considers to constitute best practice is required.

### 4.2 Engineering risk assessment

ALARP demonstration through a risk assessment approach to prevention and mitigation may be necessary in the following cases:

- 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.

ALARP demonstrations made 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 facilitate the ALARP demonstration including:

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

### 4.3 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 ALARP with sufficient certainty.

### 4.4 Cost benefit analysis

Cost benefit analysis (CBA) may be required to demonstrate gross disproportionality of not implementing or adopting certain practices or risk control measures. However, there might be cases where gross disproportionality can be demonstrated qualitatively.

Something is reasonably practicable unless the costs are grossly disproportionate to the benefits. Affordability (i.e. whether a company is in a position to fund improvements) is not a factor in the ALARP argument, although the cost of implementing the improvement is.

All cost benefit analysis should be conducted by suitably qualified personnel.

#### 4.4.1 Costs

When assessing CBAs, the Department 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 licensee or 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 licensee or 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.

#### **4.4.2 Benefits**

The licensee or 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 members of 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 risks), all benefits should be counted.

Licensees and 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 safety. This is because the gross disproportionality factor is applied to all benefits prior to them being compared to the costs.

### **4.5 Avoidance of reverse ALARP**

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 ALARP. 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.

Reverse ALARP arguments are not appropriate in ALARP demonstrations. This does not prevent a suitably justified decision not to reinstate a risk reduction measure if the original reason for installing it changes.

## 5 Factors for success

In its consideration for ALARP in a safety case development and submission, the Department expects licensees and operators to address at least the following factors:

- timeliness – the earlier an evaluation is undertaken, the greater the ability to reduce risks to a level that is ALARP
- development of safety case content aligned to the requirements specified in the safety legislation
- involvement of people 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 reduce risks to ALARP
- evidence that the SMS provides for, and will continue to provide for, reduction of risk to ALARP, and that the SMS is comprehensive and integrated.

## **Appendix 1      Legislative provisions**

### **Petroleum (Submerged Lands) (Management of Safety of Offshore Facilities) Regulations 2007**

r. 16 Facility description, formal safety assessment and safety management system

### **Petroleum (Submerged Lands) (Pipelines) Regulations 2007**

r. 29 Description of pipeline management system

### **Petroleum (Submerged Lands) (Diving Safety) Regulations 2007**

r. 7 Contents of DSMS

### **Petroleum and Geothermal Energy Resources (Management of Safety) Regulations 2010**

r. 10 Principal provisions of safety management system

r. 11 Risk assessment for major accident events

r. 12 Ongoing management of safety

### **Petroleum Pipelines (Management of Safety of Pipeline Operations) Regulations 2010**

r. 10 Pipeline operation description, formal safety assessment and safety management system

### **Dangerous Goods Safety (Major Hazard Facilities) Regulations 2007**

r. 23 Risk assessment, operator of major hazard facility to prepare

r. 27 Safety report, approval of by Chief Officer

## Appendix 2 References and acknowledgements

Development of this Guide has used:

- NOPSEMA suite of guidance notes
- 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*
- AS IEC 61511.1 *Functional safety – Safety instrumented systems for the process industry sector*
- AS/NZS 2885 *Pipelines – Gas and liquid petroleum (suite of standards)*

## Appendix 3 Glossary

**ALARP.** As low as reasonably practicable. Also includes the term “so far as reasonably practicable” (SFARP) for the purpose of this Guide.

**CBA.** Cost benefit analysis.

**DCS.** Distributed control system.

**EERA.** Evacuation, escape and rescue analysis.

**Facility.** The term facility has been adopted throughout this document to cover offshore and onshore facilities and pipelines including aboveground structures associated with onshore pipelines and major hazard facilities.

**FERA.** Fire and explosion risk analysis.

**HAZID.** Hazard identification study.

**HAZOP.** Hazard operability study.

**LNG.** Liquid natural gas.

**LPG.** Liquid petroleum gas.

**MAE.** Major accident event. An event connected with a facility, including a natural event, having the potential to cause multiple fatalities of persons at or near the facility (or as defined within the relevant legislation pertaining to a facility).

**Major incident.** An incident involving or affecting a Schedule 1 substance (Dangerous Goods Safety (Major Hazard Facilities) Regulations 2007) that causes serious harm to people, property or the environment. For the purposes of this document referred to as an MAE.

**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.

**Safety case.** This document covers all safety management systems, plans and other safety related documents referred to in WA legislation.

**Safety critical element.** Any item of equipment, system, process, procedure or other control measure which can contribute to an MAE if it fails.

**SCADA.** Supervisory control and data acquisition.

**SDS.** Safety data sheet.

**SFARP.** So far as reasonably practicable.

**SMS.** Safety management system.

## Appendix 4 Further information

Other guides available:

- *Audits, review and continual improvement*
- *Bridging documents and simultaneous operations (SIMOPS)*
- *Dangerous goods safety guide – Risk assessment for dangerous goods*
- *Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007 – guide*
- *Diving safety management system*
- *Emergency planning*
- *Hazard identification*
- *Involvement of members of the workforce*
- *Major accident events, control measures and performance standards*
- *Management of change*
- *Offshore facility safety case*
- *Pipeline management plan*
- *Pipeline operation safety case*
- *Records management including document control*
- *Reporting dangerous goods incidents – guideline (6<sup>th</sup> edition)*
- *Reporting of accidents, incidents and dangerous occurrences*
- *Risk assessment and management including operational risk assessment*
- *Safety management system*