Dams Safety NSW

Guideline

The meaning of 'so far as is reasonably practicable' (SFAIRP)
Table 1. Document change history

<table>
<thead>
<tr>
<th>Version</th>
<th>Approved date</th>
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</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

Contents

1. Introduction and purpose of this document ................................................................. 2
2. Context .......................................................................................................................... 2
3. Background ..................................................................................................................... 3
4. SFAIRP versus ALARP .................................................................................................. 3
5. Management of Risks ‘So Far As Is Reasonably Practicable’ .......................................... 5
6. How is ‘Reasonably Practicable’ Defined? .................................................................... 5
7. An Objective Test for ‘Reasonably Practicable’ ............................................................ 5
8. Determining what is Reasonably Practicable ................................................................. 6
9. SFAIRP and risk assessment .......................................................................................... 7
10. SFAIRP Process ............................................................................................................ 8
    10.1. Establish Critical Hazards ................................................................................... 9
    10.2. Identify all practicable measures ....................................................................... 10
    10.3. Identify reasonably practicable measures ......................................................... 11
    10.4. Implement reasonably practicable measures ....................................................... 12
11. Continuous improvement ............................................................................................. 13
Appendix 1 Abbreviations ................................................................................................. 14
Appendix 2 Acknowledgement and bibliography ............................................................. 14
1. Introduction and purpose of this document

Dams Safety NSW is an independent regulator established under the Dams Safety Act 2015 (the Act). Dams Safety NSW is responsible for ensuring that dam owners achieve compliance with the Act and the Dams Safety Regulation 2019 (the regulation).

Dams Safety NSW "declares" those dams which have a potential to threaten downstream life, or cause major property, environmental, or public welfare damage. Owners of declared dams must comply with the requirements of the Act and regulation.

Dams Safety NSW publishes guidelines to help declared dam owners comply with the requirements of the legislation. As they are intended to be an aid to industry compliance, the guidelines themselves do not contain compulsory requirements and compliance with the dam safety legislation may be achieved by adopting other methods if they fit better with a declared dam owner's systems.

The regulation requires declared dam owners to develop and implement a safety management system that includes a risk management framework and a risk treatment process that: ‘…must identify risk reduction measures that are to be implemented to eliminate or reduce risks, but only in so far as is reasonably practicable. In determining whether it is reasonably practicable to implement a risk reduction measure, a cost benefit analysis may be carried out taking into account all relevant matters including the following:

(a) the likelihood of the risk occurring,
(b) the degree of harm that may result from the risk,
(c) the availability and suitability of the relevant risk reduction measure,
(d) the cost of the relevant risk reduction measure.’

The regulation requires owners of declared dams to reduce risks ‘so far as is reasonably practicable’ (SFAIRP).

Dam owners should already be familiar with safety obligations and duties and the concept of reducing risks ‘as low as reasonably practicable’ (ALARP). Despite sharing the common phrase ‘reasonably practicable’, the meaning and implication of ‘ALARP’ and ‘SFAIRP’ is different.

The purpose of this guideline is to provide dam owners, and those involved with dam safety management, with a clear understanding of SFAIRP and what it means in the context of dam safety management.

Note: Dams Safety NSW has published guidance on cost-benefit analysis in a separate guideline: ‘Cost-benefit analysis for dams safety’.

2. Context

The regulation requires owners of declared dams to develop and implement, a dam safety management system. The regulation stipulates that the safety management system must set out the procedures for ensuring compliance with ISO 55001:2014 Asset Management – Management Systems – Requirements. Section 6 of ISO 55001:2014 identifies the processes and methods to be employed in managing the asset over its life cycle. The actions to address risks and opportunities associated with managing the asset, considering how these risks and opportunities can change with time, need to be documented by establishing processes for the elements identified in Table 2.
### Table 2 Components of Risk Management System

<table>
<thead>
<tr>
<th>Risk Management System component</th>
<th>ISO 31000 element¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazard Identification</td>
<td>Risk Identification</td>
</tr>
<tr>
<td>Criticality Assessment and Failure Mode and Effects Assessment (FMEA)</td>
<td>Risk Analysis</td>
</tr>
<tr>
<td>Risk-Informed Decision Making (RIDM) process</td>
<td>Risk Evaluation</td>
</tr>
<tr>
<td>Framework for planning of risk reduction pathways adopting a SFAIRP approach</td>
<td>Risk Treatment</td>
</tr>
<tr>
<td>Framework for monitoring and review of the risks associated with the safety of a declared dam</td>
<td>Monitoring and Review</td>
</tr>
</tbody>
</table>

#### 3. Background

The Australian Committee on Large Dams (ANCOLD) Guidelines on Risk Assessment (ANCOLD, 2003) has been the Australian dams’ industry standard for risk assessment for the past 15 years and advocates the application of the ALARP principle as the test for reducing the risk ‘as low as reasonably practicable’. ANCOLD 2003 cites the concept of ALARP having a central place in Australian law, both common law and statute law. The validity of this statement is not questioned; however, it is important to recognise and distinguish a difference in meaning between ALARP and SFAIRP.

The example in statute law cited in ANCOLD 2003 is the Victorian Occupational Health and Safety (Major Hazard Facilities) Regulations 2000 (Government of Victoria, 2000). Section 304(1) of this regulation states:

> “The operator of a major hazard facility must adopt control measures which eliminate or, if it is not practicable to eliminate, which reduce so far as is reasonably practicable, risk to health and safety.”

A search for the two terms in current NSW legislation² returns thirty (30) hits for SFAIRP compared to zero ALARP. A similar search of the Federal Register of Legislation³ identified 1,120 items containing SFAIRP compared to 47 items with ALARP. The ALARP items identified largely relate to the petroleum industry (offshore and submerged lands) with more than 50% marked as “amended”. Accordingly, the intent of the NSW Government to align and provide consistent language for “reasonably practicable”, as applied to dam safety, with all other NSW legislation is evident when adopting the SFAIRP approach.

#### 4. SFAIRP versus ALARP

There has been some confusion regarding the difference between SFAIRP and ALARP. The UK Health and Safety Executive (HSE) considers that duties to ensure health and safety SFAIRP and duties to reduce risks ALARP call for the same set of tests to be applied. However, the HSE highlights that SFAIRP and ALARP are not always interchangeable because legal proceedings will have to employ the particular term cited in the relevant legislation. As noted above, in NSW the legislation cites SFAIRP.

The two approaches may set out to achieve the same outcome, that is, to demonstrate due diligence with regard to safety, but the implication that having achieved ALARP will forensically

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¹ Reference to ISO 31000:2009 is recommended for further guidance on risk management.
satisfy SFAIRP post-event is potentially mis-placed. The processes required to demonstrate each approach is different, especially for high consequence, low likelihood events such as those faced in dam safety management.

- ALARP asks what the risk is associated with the hazard and then can that risk be made as low as reasonably practicable.
- SFAIRP asks what the available practicable measures are and then tests which are reasonable based on the common law balance (of the significance of the risk versus the effort required to reduce it).

The possibility of the results of the two processes being identical is extremely unlikely; some commentators state ‘nil’. In view of the requirements for SFAIRP under the regulation, this distinction between SFAIRP and ALARP is a critical issue for dam owners (and the others involved with dam safety management).

The top loop in Figure 1 describes the traditional hazard-based, risk-focussed analysis. If the technical risk targets set to avoid unwanted events were achieved, the hazards of concern would not eventuate in the analyst’s lifetime. The bottom loop describes the precautionary legal process applied by the courts. This is necessarily hindsight-biased, since the courts are only involved in the minority of events when matters have gone wrong. After the event, the perceived hazard of concern is fact and certain. Consequently, the courts are generally not concerned with how often matters went well.

This means that, from a court’s viewpoint, prior-to-the-event estimates of rarity for high consequence events were presumably flawed and that, prima facie, those who made such estimates have provided ‘beyond reasonable doubt’ proof of negligence.

Figure 1. Hazard vs precaution-focused risk management

The courts assess the situation through the consultation of post-event expert witnesses who, with the benefit of hindsight, have a comparatively straight-forward task of explaining what could have been done to prevent the failure event. The notion of risk is only used by the court to test the measures suggested by such experts and assess (after the event) and whether implementation of the measures was reasonable in view of the knowledge at the time of the decision (before the event).

The regulation requires a positive demonstration of due diligence; that is, a demonstration that all reasonable measures are in place so that dam safety risks are eliminated or minimised ‘so

4 ‘Near enough not safe enough’, Richard Robinson, Engineers Australia, January 2014
far as is reasonably practicable’ or SFAIRP. This demonstration cannot be achieved through the application of the risk management standard alone.

It is therefore necessary for all persons involved in dam safety management, including dam owners, to consider the implications of the adoption of SFAIRP.

5. Management of risks ‘SFAIRP’

The foundation principles of reducing risk to SFAIRP is to achieve the best possible safety outcomes, to the extent that is ‘reasonably practicable’.

As noted in Section 2, the regulation requires a dam safety management system to be established by declared dam owners. Clause 13(1)(e) of the regulation requires declared dam owners to set out the procedures for ensuring compliance with AS ISO 55001:2014, which applies the definition of risk given in ISO 31000. ISO 31000:2009 establishes principles for effective risk management and a framework for integrating the process for managing risk in an organisation.

Although Dam Safety NSW considers that ISO 550001 and ISO 31000 provide good practice for dam owners in the management of risk, the regulation has additional and specific requirements for risk management in respect to dams safety. Compliance with ISO 55001 and/or ISO 31000 is not sufficient to meet these requirements and the specifics of the regulation must be taken into account. Furthermore, as noted above, demonstration of due diligence cannot be achieved through the application of the risk management standard alone.

6. How is ‘reasonably practicable’ defined?

In the context of dam safety, ‘reasonably practicable’ means that which is, or was at a particular time, reasonably able to be done to ensure safety of the dam and to eliminate, or minimise, any risks to public safety and to environment and economic assets, taking into account and weighing up all relevant matters including:

(a) the likelihood of the hazard or the risk concerned occurring
(b) the degree of harm that might result from the hazard or the risk
(c) what the dam owner (or other person concerned) knows, or ought reasonably to know, about the hazard or risk, and the measures that can be taken to eliminate or minimise the risk
(d) the availability and suitability of the measures to eliminate or minimise the risk and
(e) after assessing the extent of the risk and the available measures for eliminating or minimising the risk, the cost associated with the available measures for eliminating or minimising the risk, including a cost benefit analysis.

7. An objective test for ‘reasonably practicable’

The test for what is reasonably practicable is an objective test. A duty holder is to be judged by the standard of behaviour expected of a reasonable person in the duty-holder’s position who is required to comply with the same duty.

There are two elements to what is ‘reasonably practicable’. A dam owner must first consider what can be done – that is, what is possible in the circumstances for ensuring safety of the dam and to protect the public, environment and economic assets. The dam owner must then consider whether it is reasonable, in the circumstances to do all that is possible.

This means that what can be done should be done unless it is reasonable in the circumstances for the dam owner to do something less. The capacity to pay is not a consideration; the duty to
ensure safety SFAIRP isn’t lower for a dam owner due to their lesser financial position in comparison with other dam owners.

This approach is consistent with the objects of the Act which include the aim of ensuring that any risks that may arise in relation to dams (including any risks to public safety and to environmental and economic assets) are of a level that is acceptable to the community.

8. Determining what is reasonably practicable

To identify what is reasonably practicable all the relevant matters must be considered and weighed up and a balance achieved that will provide the highest level of protection that is both possible and reasonable in the circumstances. Some matters may be relevant to what can be done, while others may be relevant to what is reasonable to do.

No single matter determines what is (or was at a particular time) reasonably practicable to be done for ensuring dam safety. In applying the concept of reasonably practicable, it is important that dam owners, and dam safety management practitioners, pay careful consideration to all the facts and identify and account for everything that may be relevant to the hazards, risks or means of eliminating, or minimising, the likelihoods of the risks occurring (or, in some cases, the consequences).

When weighing up all matters to be taken into account in determining what is reasonably practicable:

- the greater the likelihood of a hazard or risk eventuating, the greater the significance this factor will play
- the greater the degree of harm that would likely result if the hazard or risk eventuated, the greater the significance this factor will play
- knowledge about the hazard or risk, or any ways of eliminating or reducing the hazard or risk, must be determined objectively by reference to what the person concerned knows, and what a reasonable person in the duty-holder’s position with the same duty should know. What the person knows or reasonably ought to know is commonly referred to as the state of knowledge. The state of knowledge may provide several ways to control a hazard or risk, and the depth of this knowledge will be of significance.
- ways to eliminate or reduce the hazard or risk should be regarded as being available, if the necessary equipment or physical means required to achieve it is available on the open market, or feasible to manufacture. Similarly, a work process (or change to a work process) to eliminate or control a hazard or risk should be regarded as being available, if it is feasible to implement. Further, a way to eliminate or reduce a hazard or risk should be regarded as suitable if:
  - it is feasible to implement in the specific circumstance and
  - it is effective in eliminating or reducing the likelihood or degree of harm from a hazard or risk and
  - it does not introduce new and higher risks, having regard to all the circumstances and
  - it is a practical measure given the circumstances in which the hazard or risk exists.

If there are no available or suitable ways to eliminate a hazard or risk, it is necessary to consider all available and suitable ways of reducing the risk, so far as is reasonably practicable.

In relation to the cost of eliminating or reducing the hazard or risk, there must be a clear presumption in favour of safety. Once the likelihood and degree of harm from a hazard or risk is understood, and the availability and suitability of a relevant safety measure to eliminate or reduce the hazard or risk is established, the safety measure should be implemented unless the cost of doing so is disproportionate to the benefit (in terms of reducing the severity of the hazard or risk) that it would be clearly unreasonable to justify the expenditure.
In determining whether a particular level of expenditure is reasonable in the circumstances, the dam owner must have regard to the:

- likelihood and degree of harm associated with the hazard or risk and
- the reduction of the likelihood and/or degree of harm that will result if the control measure is adopted.

The greater the likelihood of the hazard or risk concerned eventuating, and/or the greater the degree of harm that would result if the hazard or risk eventuated, the less weight should be given to the cost of eliminating the hazard or risk.

If the degree of harm is significant, e.g. death or serious injury is highly likely, then it is extremely unlikely that the cost of eliminating or reducing the risk would ever be so disproportionate to the risk to justify a decision not to implement an available and suitable control measure.

Moreover, the question of what is ‘reasonably practicable’ is to be determined objectively, and not by reference to the duty-holder’s capacity to pay or other particular circumstances.

9. SFAIRP and risk assessment

Section 4 described the differences between SFAIRP and ALARP. Figure 2 describes the approaches of SFAIRP and ALARP in an alternative way, providing further insight to the differences of approach. The legal approach which results in risks associated with the hazard being eliminated or minimised so far as is reasonably practicable (SFAIRP) is described by the left-hand side of the loop. The hazard-based loop, shown by the right-hand side, attempts to demonstrate that the hazard or risk is as low as reasonably practicable or ALARP. But there are significant warnings to be heeded with each step of this approach as noted in blue and discussed below.

Figure 2. Precaution vs hazard-based approaches to risk management

1. Hazard analysis and risk calculations are inherently unrepeatable. Two independent risk experts assessing the same circumstances or situation rarely conclude the same answer.

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(unless identical assumptions and processes are deliberately used, in which case the assessment is not independent). Risk calculations and characterisations to enable a comparison of risk criteria are not perfect. ANCOLD 2003 provides clear guidance on the risk management processes to be followed; however, there is still room for interpretation and two assessors may vary in their respective determinations.

2. Risk criteria are inherently subjective. Most risk criteria are based on statistical analyses, such as flood hydrology, which are subject to change dependent on the sample set, or how the sample set should be treated.

3. If the risk associated with a hazard is below the safety threshold, there is a tendency to say that nothing further needs to be done, which is always problematic with low frequency, high severity events. The overall situation is perhaps best summarised by Chief Justice Gibbs of the High Court of Australia (Turner v. The State of South Australia 1982):

   Where it is possible to guard against a foreseeable risk, which, though perhaps not great, nevertheless cannot be called remote or fanciful, by adopting a means, which involves little difficulty or expense, the failure to adopt such means will in general be negligent.

That is, it does not matter how low the risk estimate is, if more can be done for very little effort, then the failure to do so will be negligent, in the event of an incident.

4. The temptation is to implement a measure that reaches the target risk threshold without formally considering the hierarchy of controls.

10. SFAIRP Process

Representing the left-hand side of Figure 2 in the form of a flow diagram (see Figure 3) provides the suggested process for applying the SFAIRP principle. The major steps of the process are discussed below.

**Figure 3. SFAIRP flow diagram**
10.1. Establish critical hazards

Establishing the critical hazards is the first step in the SFAIRP loop of Figure 2 and the recommended process to achieve this is a Failure Mode Effects and Criticality Analysis (FMECA), which provides the flexibility to deal with varying levels of knowledge regarding the performance and reliability of different dam components.

There are two primary approaches to conducting a FMECA: the “component” or “hardware” approach, and the “functional” approach. The “component” approach involves listing the individual components and the analysis of their possible failure modes to identify the effects on the system. The “functional” approach is based on the premise that every element of the system is designed to perform one or more functions which can be considered as outputs. The functional FMECA is performed by listing and analysing these outputs to determine their effects on the system. Although it may appear that the “component” approach might be best suited for analyses of dams, a hybrid approach which identifies the components, their functions, how they might fail to perform those functions and the effect of functional failure may be more appropriate. FMECA generally uses inductive logic techniques (What happens if there is an earthquake?) which can be applied at the design stage or operational stage, and at any level of detail.

The basic steps in a FMECA are:

1. define and understand the system.
2. break the system down into components, defined by their function.
3. analyse the potential failure modes of each component.
4. assess the consequences of each identified failure mode and the effect on the performance of the system.
5. assimilate the findings and determine the relative severity (criticality) of each failure mode.
6. document the analysis and the results and make recommendations as appropriate.

The application of FMECA for dams is not new but does require careful consideration. The technique was originally developed for systems that operate in an ‘active manner’ (create outputs such as pumping action), whereas dams function in a ‘passive manner’. Several other difficulties have been identified and adjustments to the basic process will be required for application in dam safety. Nevertheless, the basic concepts of defining a ‘system’ and ‘sub-systems’ has many benefits, including defining the system boundary which forces the analyst to reveal how the subsystems and components interact to meet the overall performance of the system.

Guidance on the application of FMECA for dam safety is available and commentary on the use of failure mode analyses (FEMA and FMECA) is provided in ANCOLD 2003. Other examples of FEMCA applied to dams and reservoir safety include:

- CIRIA\(^6\) has also proposed FMECA for the risk assessment procedure developed under the CIRIA Reservoirs and Risk Project (RP568) for application to UK reservoirs\(^7\)
- a similar method has been used for UK dams by Scottish Hydro-Electric\(^8\).

It has been commented that FMECA is more useful for ranking dams within a portfolio to determine the priorities for further investigations or works, because it is not considered compatible with considering individual or societal risk from dam failure. However, in applying SFAIRP the objective is not to assess the hazards or risks, but to identify the measures that can be taken to eliminate or minimise those hazards or risks.

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\(^6\) CIRIA is the Construction Industry Research and Information Association, a not-for-profit scientific research organisation in the UK
\(^7\) Risk and Reservoirs in the UK, Morris M, Samuels PG and Elliot C, January 2000 (http://www.syke.fi/download/noname/%7B72D1041E-305D-4201-B1B6-1F8C972942BE%7D/77226)
10.2. Identify all practicable measures

Having ascertained the ‘criticality’ of the system (and components thereof), the next step in the SFAIRP loop of Figure 2 is to identify all practicable measures that are available to eliminate or minimise each critical hazard following the Hierarchy of Controls.

The ‘hierarchy of controls’ is a tool that facilitates selection of the most appropriate means for eliminating or reducing the risk, by establishing the priority order in which hazard and risk controls should be considered. The principle behind the hierarchy of controls is that risk controls dependent on individual behaviour are less reliable and durable than risk controls that engineer or design out risks.

The hierarchy of controls illustrated in Figure 4 is applied in order from the most effective and desirable through to the least effective. Further explanation of each level follows:

- **elimination**: removal of the hazard or otherwise eliminating the risk of the hazard
- **substitution**: substituting the hazard that gives rise to the risk with a hazard that gives rise to a lesser risk
- **engineering** controls: Minimising the risk through engineering means
- **administrative** controls: minimising the risk through administrative means, such as the provision of appropriate training or adoption of safe work practices. An example could be amending the operating rules of a reservoir to drawdown the reservoir level to increase freeboard
- **Personal Protective Equipment (PPE)**: provision of some type of personal barrier between the risk source and individuals

In the context of dam safety, the provision of PPE is not really applicable but has been retained to emphasise the decreasing level of protection to public safety and effectiveness of the controls within the hierarchy (from top to bottom).

In some circumstances, it may be appropriate to remove an existing control, although any such decision needs to be carefully considered and all potential impacts assessed prior to removing the control. Examples of possible circumstances include:

- where another control has been implemented that more effectively reduces risk, rendering the initial control irrelevant or unnecessary or
- where it has been identified that an existing control is causing adverse effects or increases other risks.

As noted above, the removal of a control requires careful consideration and the process to be followed has been referred to by some commentators as ‘reverse SFAIRP’. A key test will be whether removal of the control means that the residual risk is no longer eliminated or minimised SFAIRP?
10.3. Identify reasonably practicable measures

The question of what is ‘reasonably practicable’ has been discussed in Section 6 and the principles for determining what is ‘reasonably practicable’ were discussed in Section 8.

The shift from ALARP to SFAIRP is to ensure that all reasonable, practicable measures are in place rather than to achieve a tolerable or acceptable level of risk of safety, which is the result of the hazard-based approach (ALARP). As Work Safe Australia notes in its "Interpretive Guideline – Model Work Health and Safety Act: The meaning of “reasonably practicable", this is an objective test.

There are two elements to what is ‘reasonably practicable’. A duty-holder must first consider what can be done - that is, what is possible in the circumstances for ensuring safety. They must then consider whether it is reasonable, in the circumstances to do all that is possible. This means that what can be done should be done unless it is reasonable in the circumstances for the duty-holder to do something less.

The level of risk resulting from the SFAIRP process might be as low as reasonably practicable but that’s not the test that’s applied by the courts after the event. The courts test for the level of measures, not the level of risk.

The High Court has considered precautionary reasonableness in the context of balancing cost against risk as reported in Sappideen and Stillman (1995) and described diagrammatically in Figure 5. Effort includes expense, difficulty and inconvenience and utility of conduct. Expense includes financial considerations, difficulty and inconvenience refers to the inconvenience of
taking alleviating action and utility of conduct refers to the other aspects of conflicting responsibilities such action incurs.

**Figure 5. Decision-making scales for deciding which measures are reasonably practicable**

Controls (or combination of controls) that can be justified, on the balance of the significance of the risk vs. the effort required to reduce it, can then be implemented. This decision can involve quantitative risk assessment (QRA) on a relative risk basis.

In situations where decision making, or the demonstration of the effort required to eliminate or minimise a hazard or risk SFAIRP is complex, a cost-benefit analysis (CBA) is recommended to aid the decision-making process. This provides monetary values to all costs and benefits allowing comparison in a common currency. The use of CBA should not provide the entire argument for justification of SFAIRP but is a tool to be used for dam safety decisions.

Dam Safety NSW has prepared a ‘Guideline for cost-benefit analysis for dams safety’ to assist dam owners with the approach and methodology to be undertaken for such analyses.

The proposition presented by Figure 5 is that if the test of reasonable practicability is arguable at a common law balance (the 50:50 tipping point), then the likelihood of being successfully prosecuted on a beyond reasonable doubt basis is very small.

The underlying principle of ALARP was the concept that a safety measure or benefit can only be ruled out as not ‘reasonably practicable’ where the sacrifice in money, time, trouble or other cost of the measure or benefit is ‘grossly disproportionate’ to that benefit.

For the purposes of the dams safety legislation, the measure of ‘reasonably practicable’ should be determined through the application of cost benefit analysis and sensitivity analysis to test the reasonableness of the SFAIRP position.

10.4. Implement reasonably practicable measures

Measures considered reasonably practicable should be implemented and effectively maintained. The documentation associated with the risk management process within the dam safety management system should make it clear to all stakeholders why a measure is in place and how it is effective. Documentation ensures the purpose of each measure is understood and that this understanding is not lost or misunderstood over time.

It is considered equally important that documentation is included to provide details why the discarded controls/measures have been considered not reasonably practicable at the time of the assessment. This avoids trying to recall the reasons during post-event scrutiny. Conditions
may have changed at the time of an event and the power of hindsight may cloud the rationale that was previously considered. It is also important that controls/measures that are not considered reasonably practicable are reassessed regularly (especially if circumstances change) to ensure they have not become reasonably practicable.

11. Continuous improvement

The decisions on what is required to ensure dam safety SFAIRP should be periodically reviewed, particularly when new risk controls/measures become available, or costs change, to determine whether additional measures are reasonably practicable. Similarly, the actual or the understood likelihood or consequence of an event may change which would require previous decisions to be reviewed and updated. For example, changes in hydrological assessments for a dam, economic development, or land use changes downstream of the dam will prompt a review to ensure that dam safety is maintained SFAIRP.

Declared dam owners are obliged to implement current dam safety measures where it is reasonably practicable to do so. As required by the regulation, earlier practices and assets should be compared against relevant modern standards, including those that were not in force when the asset was originally commissioned. This must be done across the life-cycle of the dam. Notwithstanding, Dam Safety NSW recognises that older dams may still meet SFAIRP requirements.

Continuous risk management learning or recent experiences - often referred to as ‘lessons learnt’ - should be used to enhance existing knowledge and capacity to achieve behavioural and cultural change and increased risk management performance.

Declared dam owners are encouraged to use lessons learnt from previous risk management decisions and apply these to current decision-making processes through critical incident debriefings, decision review processes and minutes of meetings. It is also important to learn from other organisations with similar service delivery goals and operating environments, in addition to considering the declared dam owner’s own incidents, near-misses and risk experiences.

Declared dam owners are encouraged to establish a process, as part of the risk management system, so these lessons learnt are communicated to relevant stakeholders, including Dam Safety NSW, who can help facilitate risk management learning through working groups, information sessions, learning events, newsletters and other publications. Declared dam owners are required to report incidents to Dams Safety NSW in accordance with section 19 of the regulation.
Appendix 1 Abbreviations

ALARP  As Low As Reasonably Practicable
ANCOLD  Australian National Committee on Large Dams
CBA  Cost Benefit Analysis
CIRIA  Construction Industry Research and Information Association, UK
FMEA  Failure Mode and Effects Assessment
FMECA  Failure Mode Effects and Criticality Assessment
HSE  UK Health and Safety Executive
ISO  International Organisation for Standardisation
NSW  New South Wales
PPE  Personal Protective Equipment
QRA  Quantitative Risk Assessment
RIDM  Risk-Informed Decision Making
SFAIRP  So Far As Is Reasonably Practicable

Appendix 2 Acknowledgement and bibliography

This guideline has been prepared with reference to a large number of documents, as acknowledged in the bibliography; however, particular recognition is given to the Office of the National Rail Safety Regulator (ONRSR) Guideline – Meaning of duty to ensure safety so far as is reasonably practicable and Engineers Australia Safety Case Guideline.

<table>
<thead>
<tr>
<th>Source</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWA (2013)</td>
<td>How to determine what is reasonably practicable to meet a health and safety duty, Safe Work Australia, May 2013</td>
</tr>
<tr>
<td>TfNSW (2017)</td>
<td>Risk tolerability, quantified risk assessment and its role in the assurance of change, Guide T MU MD 20000 GU, Transport for NSW (TfNSW), January 2017</td>
</tr>
<tr>
<td>Wilkinson (2014)</td>
<td>What’s the difference between ALARP and SFAIRP (apart from the spelling?), Peter Wilkinson, February 2014</td>
</tr>
</tbody>
</table>