

# Safety in Design

## Malcolm Barker

Principal Dams Engineer  
GHD Pty Ltd  
PO Box 668,  
Brisbane 4000, QLD, Australia

## Simon Casey

Manager – Risk Manager  
GHD Pty Ltd  
180 Lonsdale St  
Melbourne 3000, Vic, Australia

## Introduction

The safety of a dam and appurtenant structures applies to all stages in the life cycle commencing with the inception stage; through the planning and design stages; followed by the construction and commissioning and ongoing operation and maintenance stages; and in certain cases, decommissioning.

Workplace Health and Safety statistics have shown a significant reduction in LTIs (lost time injuries) and fatalities over the last 5 to 10 years following the introduction of regulations for safe working places, particularly in the construction industry. Although legislated in many jurisdictions, a common question asked by practitioners is - “Is Safety in Design really necessary and if so, what are the benefits?”

What are the requirements for Safety in Design (SiD) and how does regulation influence the process of embedding safety as a fundamental plank in all designs? In Australia, there has recently been national harmonisation of the fundamental principles of SiD but there are subtly varying legislations, some yet to be passed, which enforce the use of SiD procedures in individual states. Since 2003 in Queensland, designers have had an obligation to design a structure intended to be used as a workplace that is without risk to persons when it is being used for the purpose for which it was designed. This has led to the development of SiD processes that aim to eliminate harm to people wherever possible and where elimination is not possible, requires the management of risk to be “As Low as Reasonably Practicable” or ALARP. The duty of care of professional designers, owners, contractors and operators is to ensure a “safe” environment using the ALARP principle and this applies even in the absence of legislation.

The purpose of this paper is to:

- Present the requirements for Safety in Design;
- Outline the roles and responsibilities for Safety in Design for the various parties involved in a project;
- Present the process and tools currently being used within industry for Safety in Design.

## 1. Requirements for Safety in design

“The only two certainties in life are death and taxes” (Benjamin Franklin 1789). Regarding the latter, we have very little control unless we are politicians, however, regarding the former, we have a responsibility as designers, constructors, manufacturers, owners and operators to “*ensure, so far as is reasonably practicable, that the health and safety of other persons is not put at risk from work carried out as part of the conduct of the business or undertaking*” (WH&S 2011).

### 1.1 Some Australian Statistics

During 2006 to 2007 there were 936,000 people employed in the Australian construction industry, which equates to about 9% of the Australian workforce. The following statistics relate to claims and accidents in the construction industry during that period:

- 14,130 Serious workers’ compensation claims.
- 39 claims per day or 22 claims per 1000 employees on average.
- Labourers had the highest number of claims with 39 serious claims per 1000 employees.
- The construction industry had the 4th highest incidence rate of all industries.
- 50 construction fatalities occurred compared with 11 from July to December 2009

The types of serious injuries that occurred were characterised as follows:

- 23% involved the back, 13% the hand and 9% the knee
- 41% involved manual handling
- 13% involved falls on the same level

By way of comparison, there were 1,464 people killed in road crashes during 2008 in Australia. While the life loss in the construction industry is relatively low, it is clear that the use of health and safety legislation and guidelines are proving to be effective in reducing injuries and deaths in the workforce.

## 1.2 UK Experience

An analysis of 91 randomly selected incidents was completed in 2004 for the UK Health and Safety Executive (HSE) to give evidence of the opportunity for designers to have made a contribution to safety that could have prevented an accident happening (HSE 2004). The results for the various contributions to each event in the entire design are presented on Table 1 and summarised on Table 2.

**Table 1. Matrix of Designer Contributions to each incident**

What Designer Did		What designers could have done				
		Very little	A bit more	Major Contribution	A lot more	Critically significant
		0-2	4	6	8	10
What was necessary	A	1	0	0	0	0
Something	C	4	5	2	0	0
Not enough	E	1	10	6	4	1
Not nearly enough	G	0	2	4	7	2
Nothing	J	0	3	6	6	20

**Table 2. Summary of Designer Intervention by Category**

Rating and Total Number	Recommended Consideration
6	Designer not implicated
25	Designer could improve
11	Designer may be implicated
42	Designer prosecution supportable

The analysis of the 91 randomly selected incidents showed the following:

- Almost a half of all cases reported are likely to be the subject of further investigation of one or more of the designers because they failed to take enough action when the action could have made a major contribution to accident prevention;
- In 17% of the cases, the designers could have done a lot more but failed to take the opportunity to do so;
- Every one of these could have resulted in a fatal accident to at least one site operative;
- In 1 in 4 instances the accident could have resulted in multiple fatalities to members of the public;
- Designers had not adequately considered the site conditions nor the difficulty of the construction process;
- Generally poor communication was a contributory factor with designers rarely providing adequate information to contractors about significant aspects of their design. Clearer information was needed too about the kind of information that would be of use to a contractor;
- The industry evolved “*design risk assessment*” to aid in the process of information transfer, however, designers usually retrofitted poor quality contractor risk assessments to their final design. Many did engage in design decisions that accounted for constructability and maintainability but did not recognise these for what they were, which was a correct response to statutory duty;
- Further incidents were due to earlier poor design that left a structure difficult to maintain, refurbish or modify;
- Frequently it was these later modifications that resulted in death due to falls from height or collapse of structural elements.

The outcome of the analysis clearly showed that the thinking behind the provision of Regulations was sound and that designers can and should do more with the key change being to design structures that are safer and healthier to build, operate, maintain and demolish.

## 2 Legislative Requirements for Safety in Design

The roles and responsibilities for Safety in Design (SiD) will vary for each country according to the legislation in place. Where SiD principles are included within legislation, this means that it is no longer sufficient to assume that compliance with a code or standard is enough. Designers need to demonstrate that they have identified the risks in their design and where a particular code/standard is not appropriate, to eliminate these risks. A systematic risk based approach should be used to determine the right solution and reduce the risks as low as reasonably practicable while ensuring the clients are aware of the residual risks. The current legislation within Australia and the impact on SiD are discussed below.

Within Australia, the Queensland Work Health and Safety Act 2011, imposes a duty on a person to ensure health and safety, which requires the person:

- (a) to eliminate risks to health and safety, so far as is reasonably practicable; and
- (b) if it is not reasonably practicable to eliminate risks to health and safety, to minimise those risks so far as is reasonably practicable.

The Act defines reasonably practicable as follows:

*In this Act, **reasonably practicable** in relation to a duty to ensure health and safety, means that which is, or was at a particular time, reasonably able to be done in relation to ensuring health and safety, taking into account and weighing up all relevant matters including:*

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

The As Low as Reasonably Practicable (ALARP) principle was incorporated in the 2003 Australian National Committee on Large Dams (ANCOLD) Guidelines for Risk Assessment (ANCOLD 2003) for both quantitative and qualitative risk assessments. According to the Guideline, risk is required to be reduced to the tolerable limit and thereafter in accordance with the ALARP principle, stated as follows:

*ALARP Principle - risks should be as low as reasonably practicable. This requirement arises from the legal duty to reduce risks to life to the point where further risk reduction is impracticable or requires action that is grossly disproportionate in time, trouble and effort to the reduction in risk achieved (HSE, 1999a). This principle informs the balance between equity and efficiency, with the balance deliberately skewed in favour of equity.*

The Queensland Work Health and Safety Act 2011 does not, as some would promote, require a positive demonstration of safety due diligence, which requires a risk management paradigm shift from a hazard-based approach to a precaution-based analysis.

The Precautionary Principle (PP) was originally developed in the context of environmental protection and is essentially about the management of scientific risk. It was defined in Principle 15 of the United Nations Conference on the Environment and Development (UNCED) in 1992 as:

*“where there are threats of serious or irreversible environmental damage, lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent degradation.”*

The PP has been included in the UK Health and Safety Executive Reducing Risks, Protecting People (HSE 2001) decision making process where Clause 90 states:

*“the precautionary principle describes the philosophy that should be adopted for addressing hazards subject to high scientific uncertainty, and rules out lack of scientific certainty as a reason for not taking preventive action.”*

HSE further state in Clause 91:

*“Our policy is that the precautionary principle should be invoked where:*

- there is good reason, based on empirical evidence or plausible causal hypothesis, to believe that serious harm might occur, even if the likelihood of harm is remote; and*
- the scientific information gathered at this stage of consequences and likelihood reveals such uncertainty that it is impossible to evaluate the conjectured outcomes with sufficient confidence to move to the next stages of the risk assessment process.”*

HSE requires the use of the ALARP principle in ensuring that the residual risks within the tolerable region of risk are not unduly high and in the preface to the HSE 2001, the statement is made:

*“We have also taken the opportunity to dispel any perception that we were moving away from a risk-based approach. The new version emphasises the role of risk assessment, both quantitative and qualitative, in the decision-making process and expands on the role of good practice in determining the control measures that must be put in place for addressing hazards.*

It is the author’s opinion, therefore, that hazard based risk assessment is a requirement to ensure that the risks are captured in the Safety in Design and treated in accordance with the ALARP principle, which is the pragmatic approach adopted by the Queensland Government, ANCOLD and other states within Australia for managing health and safety risks in the design process for the work place.

### 3 Understanding Safety in Design

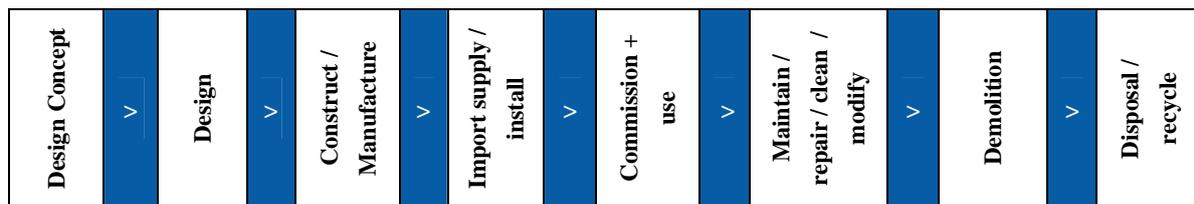
#### 3.1 What is Safety in Design

Safe design is a process defined as:

*“The integration of hazard identification and risk assessment methods early in the design process to eliminate or minimise the risks of injury throughout the life of the product being designed. It encompasses all design including facilities, hardware, systems, equipment, products, tooling, materials, energy controls, layout, and configuration” (AS&CC 2006)*

SiD is aimed at preventing injuries and disease by considering hazards as early as possible in the planning and design process. A safe design approach considers the safety of those who construct, operate, clean repair and demolish an asset (the building, structure, plant or equipment) as well as those who work in or with it. Designers are in a unique position to reduce the risks that arise during the life cycle of the asset during the design phase.

A typical lifecycle for a design is shown on Figure 1 for which a safety in design approach begins in the conceptual and planning phases through to the possible final disposal with an emphasis on making choices about design, materials and methods of manufacture or construction required to enhance safety.



**Figure 1 Life Cycle of Design Products** (Adapted from Work Cover NSW, 2009. Safe Design of Buildings and Structures)

Safe design will always be part of a wider set of design objectives, including practicability, aesthetics, cost and the functionality of the product. Safe design is the process of successfully achieving a balance of these sometimes competing objectives, without compromising the health and safety of those potentially affected by the product over its life.

#### 3.2 Who Influences Safety in Design

A range of parties influence the design function at varying phases of the design process including but not limited to the following:

- Design professionals such as architects, engineers, industrial designers;
- Suppliers (including manufacturers, importers, plant-hire), constructors, installers and trades/maintenance personnel;
- Other groups who make design decisions, such as clients, developers, builders, owners, job managers, health and safety professionals and ergonomics practitioners;
- Contractors who have a bearing on the safe working practices, particularly where innovative techniques are to be used;
- Personnel who should work or be affected by the plant, building or structure;
- Government regulators and inspectorates.

#### 3.3 How to get the most out of Safety in Design

Designer’s earliest decisions fundamentally affect the health and safety of people who come into contact with their design over the life cycle of the asset. These decisions may influence later design choices, and considerable rework may be required if it is necessary to unravel earlier decisions. As shown on Figure 2, it is important to address health and safety from the very start of a project in order to provide the greatest influence in safety. Changing the design philosophy is a lot more than design field changes or costs associated with

accident management and clean up. Figure 2 also demonstrates that while the greatest ability to influence safety on a project occurs at the early stages of a project, safety improvements continue through to start up followed by operation and maintenance. The designer needs to consider how safety can best be achieved in each of the lifecycle phases.

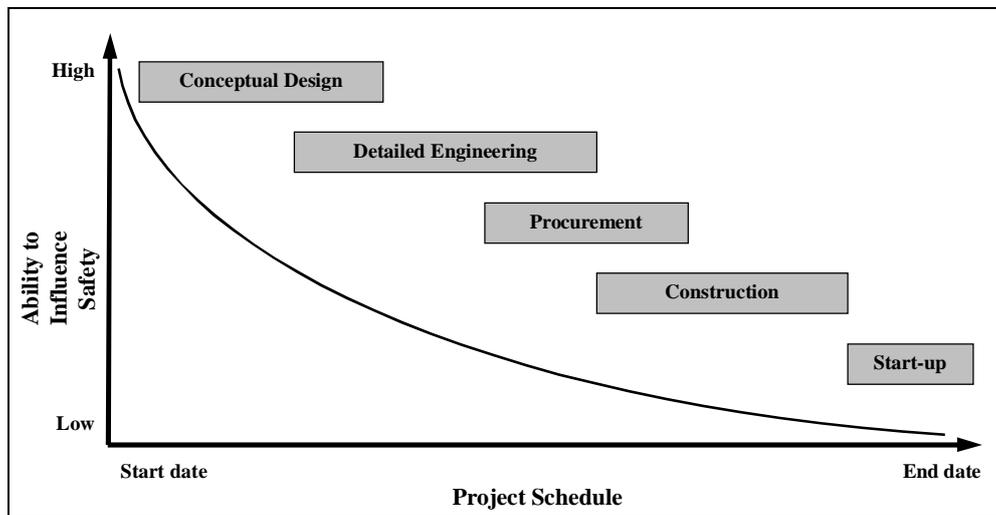


Figure 2 Ability to influence safety on a project (Szymberski, 1997)

### 3.4 Benefits of Safe Design

Some of the potential benefits of safe design include the following.

- Better understanding of the design requirements and limitations;
- Prevention of injury and disease;
- Improved usability of structures;
- Improved productivity;
- Reduced costs;
- Better prediction and management of production and operational costs over the lifecycle of a structure;
- Compliance with legislation;
- Innovation, in that safe design demands new thinking.

## 4 Principles of Safety in Design

The key elements that impact on implementing SiD are shown on Figure 3 and discussed below.

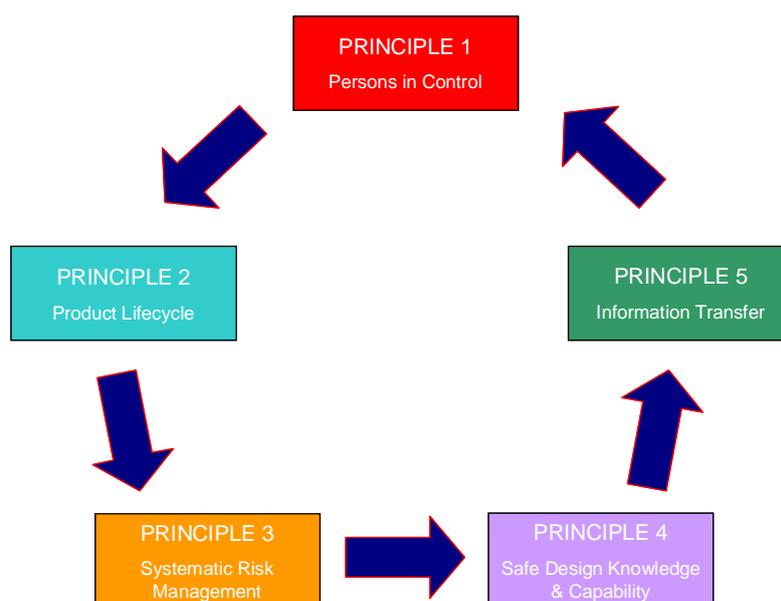


Figure 3. Principles of Safety in Design

**Principle 1: Persons with Control** – persons who make decisions affecting the design of products, facilities or processes are able to promote health and safety at the source.

**Principle 2: Product Lifecycle** – safe design applies to every stage in the lifecycle from conception through to demolition. It involves eliminating hazards or minimising risks as early in the lifecycle as possible.

**Principle 3: Systematic Risk Management** – the application of hazard identification, risk assessment and risk control processes to achieve safe design.

**Principle 4: Safe Design Knowledge and Capability** – should be either demonstrated or acquired by persons with control over design and should reflect the knowledge that a competent designer would be expected to have.

**Principle 5: Information Transfer** – effective communication and documentation of design and risk control information between all persons involved in the phases of the lifecycle is essential for the safe design approach.

## 5 Stages in Safety in Design

There are essentially 3 key stages in the design process that may be affected by the principles of SiD as follows:

- **Concept Design** This may include feasibility or option studies.
- **Functional Design** This may include preliminary design.
- **Detailed Design** This includes full documentation to allow construction to commence and should include consideration of the procurement, construction, start up and ongoing operation and maintenance of the project.

At each stage of the design process risk identification should take place to eliminate risk or where this is not possible reduce risk as low as reasonably practicable through the implementation of control measures.

Typical SiD requirements and examples of safe design considerations for these stages are shown on Table 3.

**Table 3. Safety in Design Requirements**

Design Stage	SiD Requirements	Example's of Safe Design Considerations
<b>Concept</b>	Identification of critical health and safety related risks that may affect the viability of the project.	<ul style="list-style-type: none"> <li>- Site geology e.g. soft soils</li> <li>- Contaminated land</li> <li>- Emissions from development</li> <li>- Proposed use zoning</li> </ul>
<b>Functional</b>	Identification of reasonably foreseeable safety risks with a design project associated with the construction/manufacture, installation, commission/use, maintenance/repair, demolition and disposal.	<ul style="list-style-type: none"> <li>- Specification of materials with high durability and low maintenance requirements</li> <li>- Hazardous area classification</li> <li>- Redundancy - Introduction of duplicates to allow safe continued operation in the event of failure</li> <li>- Providing permanent safe access to roofs, plant rooms and windows for maintenance and repair purposes such as stairs or walkways with guardrails</li> <li>- Taking into consideration ergonomic principles e.g. avoid designing construction activities that require work in restricted spaces or designs that require repetitive or prolonged movements to complete task</li> </ul>
<b>Detailed</b>	Focusing on ways in which a design can be modified to eliminate or reduce issues that may affect the ongoing safety of persons involved in constructing, using, maintaining or demolishing the design product.	<ul style="list-style-type: none"> <li>- Eliminating the need for installing temporary barriers, by integrated guardrail system along roof edges</li> <li>- Inclusion of construction access into building fabric e.g. removable panels</li> <li>- Lifting lugs installed to facilitate the movement of heavy items</li> </ul>

## 5 Safety in Design Approach

An approach that can be used for safety in design is as follows (GHD 2009):

### 5.1 Establish the Context for the Design

Confirming how all of the stakeholders should work together is an integral part in establishing the risk management process. The client has similar responsibilities to the designer in the design process in relation to transfer of information and making safety decisions since the client has a responsibility to provide a safe workplace for the people who should be using the completed design.

### 5.2 Identify Foreseeable uses of the design

The designer should identify the client's main objectives and outcomes of the design. This information is important to establish the intended and foreseeable uses of the design. For example a competent designer should expect that a building that has windows would require that the windows to be cleaned.

### 5.3 Complete the Safety in Design Risk Assessment

The Safety in Design risk assessment is normally undertaken in a workshop environment and includes, where possible, the Client, designers, contractors, fabricators and plant operators. The following steps are typical for a Safety in Design Risk Assessment, which should be developed and updated regularly during the design stages.

- **Hazard Identification**

Identify design-related hazards associated with the range of intended uses, including any foreseeable misuse of the product.

Hazard identification should not be limited to one or two people's experiences of situations and can include the following (AS&CC 2006):

- Research to help in the identification of hazards and assessment of risks and controls,
- Consultation with all parties involved in the project including where possible contractors familiar with the construction works and fabricators/suppliers of the equipment being proposed.
- Guidance material including codes of practice, technical standards or industry protocols
- Hazard identification and risk assessment tools. These should be selected based on the context of the safety in design analysis and include the following:
  - Hazard and Operability studies (Hazop)
  - Event Tree analysis (ETA)
  - Fault Tree Analysis (FTA)
  - Fault Mode Effects analysis (FMEA)
  - Preliminary hazard Analysis (PHA)
  - Human Reliability Analysis (HRA)
  - Construction Hazard Assessment Implication Review (CHAIR)

- **Assess the Risk of harm**

- Define the risks arising from design related hazards
- Identify and evaluate any existing controls
- Develop the initial risk rating for which typical rating tables are shown below.

It must be noted that Safety in Design is different from most other safety assessments because we are dealing with the Client's safety rather than our own individual safety. As such it is important for designers to consider wherever possible the Client's and other stakeholders' risk tolerance, eg through utilising their risk matrix for evaluating risks.

**Table 4. Consequence Rating Table**

Risk Consequence	Design Consequence Descriptors
E - Catastrophic	Could result in fatality or irreversible severe environmental damage required to be notified under jurisdiction requirements.
D - Critical	Could result in permanent total disability or reversible environmental damage required to be notified under jurisdiction requirements.
C - Severe	Could result in permanent partial disability, injuries or illness that may result in hospitalisation of persons or environmental damage can be mitigated and is required to be notified under jurisdiction requirements.
B - Major	Could result in injury or illness resulting in one or more lost work day(s) or environmental damage can be mitigated and is not required to be notified under jurisdiction requirements where restoration activities can be accomplished.
A - Minor	Could result in injury or illness not resulting in a lost work day or minimal environmental damage not required to be notified under jurisdiction requirements.

**Table 5. Likelihood Rating Table**

Likelihood Descriptor	Design Likelihood Descriptors
5 - Almost Certain	Industry experience suggests design failure is almost certain to occur during the life of the product.
4 - Likely	Industry experience suggests design failure is likely to occur during the life of the product.
3 - Possible	Industry experience suggests design failure is possible some time during the life of the design.
2 - Unlikely	Industry experience suggests design failure is unlikely to occur in the life of design.
1 - Very Unlikely	Industry experience suggests design failure is very unlikely. It can be assumed failure occurrence may not be experienced,

**Table 6. Safety in Design Typical Initial Risk Rating Table**

RISK MATRIX		CONSEQUENCE				
LIKELIHOOD		Minor	Major	Severe	Critical	Catastrophic
		A	B	C	D	E
Very Unlikely	1	Low	Low	Medium	Medium	Medium
Unlikely	2	Low	Low	Medium	Medium	High
Possible	3	Low	Medium	High	High	High
Likely	4	Medium	Medium	High	High	Extreme
Almost Certain	5	Medium	High	High	Extreme	Extreme

**Table 7. Safety in Design Typical Initial Risk Rating Table**

Design Reference	Hazards	Design Life Cycle Stage	Risk Description	Existing Control Measures	Initial Risk Rating		
					C	L	RR

- Eliminate Hazards and Control Risks**  
 Using the hierarchy of controls detailed on Table 8, eliminate or reduce risks by using recognised appropriate standards relating to the design and record justifications in a Safety in Design Risk Assessment similar to that shown on Table 9. Many health and safety issues identified may be related to work practice and are not covered by standards. Controls for these hazards should be developed in consultation with appropriate stakeholders.

The initial focus should be to eliminate the identified risks by amending the design. Where this is not practicable, designers are required to reduce the risk to so far as reasonably practicable. This requires the designer to consider what they know, or ought reasonably to know, about the risk and any ways of reducing the risk.

Identify and assess Potential Control Measures where further risk management is required to treat risks so far as reasonably practicable. Record the decision and justification as to whether the potential control measures are to be implemented or rejected. Potential Control Measures should be identified where existing controls (eg codes or standards) do not eliminate or reduce the risk so far as reasonably practicable. Recognised codes and standards, which regulate the design of buildings and structures, may be used initially to eliminate or reduce risk.

The person responsible for the control measures should be recorded with a decision or status of the risk.

**Table 8. Hierarchy of Risk Control Measures**

Eliminate the Hazard	<b>ELIMINATE</b> - Get rid of the hazard out of the workplace.
Change the Way the Work is Done	<b>SUBSTITUTE</b> - Try to replace or change plant, substances or materials to lower the risk from the hazard.
	Try to <b>ISOLATE</b> the hazard
	<b>ENGINEERING CONTROL</b> - Design and install equipment to counteract the hazard
	<b>ADMINISTRATIVE CONTROL</b> Arrange work so people spend less time around the hazard and monitor their understanding of the hazard and the controls
Personal Protective Equipment	<b>PPE</b> Have people wear protective equipment and clothing while near the hazard

**Table 9. Safety in Design Control Measures and Residual Risk Rating Table**

Potential Control Measures (Elimination, Substitution, Isolation, Engineering Controls, Administrative Controls, PPE)	Responsibility	By When	Decision / Status	Residual Risk Rating			Comments
				C	L	RR	

- Dealing with Residual Risks**

The residual risk is the level of risk that should be remaining and transferred at the completion of design after all Control Measures have been successfully implemented.

Control Measures should be applied according to feasibility and to the point where the cost is not disproportionate to the risk reduction achieved. In order to decide which risks are feasible for effective risk reduction, the designer will need to take into account:

- The controls already in place to minimise the consequences of the risks;
- The consequences and the costs of managing the risks versus leaving them untreated;
- Benefits and opportunities presented by the risks; including availability, suitability and cost of options which may also include innovative design solutions;
- The risks borne by other stakeholders.

The decision on when a risk has been reduced so far as is reasonably practicable is normally straightforward for the majority of risks but in some borderline cases can be a complex assessment.

- Monitor and Review**

The Safety in Design Risk Assessment should be maintained throughout the job, keeping the status of control measures and the residual risks at a current level. Review critical risks as part of the regular job management process and undertake a detailed review at critical design points (eg prior to commencing drawings, end of concept design, approved for tender/construction drawings).

The designer should review control measures to monitor whether risks have eliminated or the risk in the design reduced to “so far as reasonably practicable”, otherwise further control measures need to be implemented.

Documentation is a means to an end and not the end in itself and the reporting of the SiD should include the following key information:

- The stage of project affected (i.e. construction, commissioning, operations and maintenance);
- Details of each hazard and the identified risk being managed;
- The existing control measures for each identified risk;
- The estimated severity of the consequence and the likelihood of each hazard.
- The decision and justification as to whether the potential control measures are implemented or rejected
- The residual risk remaining once the potential control measures are implemented
- All safety related decisions, including justifications for why Potential Control Measures are not selected, should also be included within the Safety in Design Risk Assessment;

#### 5.4 Communicate and Consult

The Safety in Design Risk Assessment is a means by which the residual risks that have been treated so far as reasonably practicable can be communicated to all parties at the end of the design. The Client or owner should be consulted at all stages of the design for effective management of risks and decisions on the implementation of control measures.

The following statement is made in the introduction to the Health and Safety Executive Construction (Design and Management) Regulations 2007 Approved Code of Practice (HSE 2007)

*“The effort devoted to planning and managing health and safety should be in proportion to the risks and complexity associated with the project. When deciding what you need to do to comply with these Regulations, your focus should always be on action necessary to reduce and manage risks. Any paperwork produced should help with communication and risk management. Paperwork which adds little to the management of risk is a waste of effort, and can be a dangerous distraction from the real business of risk reduction and management.”*

It is, therefore, expedient to ensure that the spreadsheets or reports developed for Safety in Design are easily managed and understood in order to enhance the communication for the management of risks in the design of projects.

### 6 What is the Impact for Designers

In complying with the requirements of safety in design legislation (where applicable), designers are to consider:

- Which risks are within their scope and control;
- Client Interaction – the risks being addressed generally relate to the client’s site and staff, and therefore the client needs to be involved in the process, i.e. direct input into risk identification (including workshops) and risk reduction/management;
- A systematic and formalised approach should be adopted to managing risks dependent on the type of risks;
- Where it is not reasonably practicable to eliminate a risk associated with a design’s lifecycle, then the risk should be reduced so far as reasonably practicable.

### 7 Conclusions

Safety in design covers all stages in the life cycle for which there are a number of people involved including the owner, designer, fabricator, constructor and operator. Each of these personnel are responsible for safety in design in various stages. We are living in a litigious world for which safety requires more than just following codes or standards.

These issues emphasise the importance of Safety in Design at all stages of a project’s life and the need for effective communication and consultation between all parties involved with the design, operation and maintenance of a project.

The author wishes to thank GHD for the opportunity to attend ASIA 2012 and to present this paper. The views expressed in this paper are those of the author and not necessarily those of GHD.

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#### The Authors

**Malcolm Barker** graduated with a BSc Civil Engineering from the University of Natal Durban South Africa. Malcolm has 35 years of civil engineering experience in the design, construction and safety of dams, hydropower projects and canals. He has participated in many dam projects in Australia, Canada, Zimbabwe, South Africa, Malaysia, Papua New Guinea and China. He has been involved in the design of Embankment, Rockfill, RCC and concrete dams and power stations and has

successfully played the role of Technical Team Leader in the prefeasibility and feasibility design of the Baleh HEP and the prefeasibility study of the Putai HEP, Serani HEP and Run of River HEP schemes in Sarawak, Malaysia. He has completed a number of safety in design reviews and qualitative and quantitative risk assessments for tailings and water storage dams. Malcolm has also served in different capacities in the Australian National Committee on Large Dams (ANCOLD).

**Simon Casey** Simon has nearly 20 years' experience as a Risk and Safety Consultant. Simon was a director of Qest Consulting prior to GHD acquiring the Qest business in 2005 when Simon became the company-wide manager of GHD's risk management consulting practice. Prior to moving into risk management, Simon was a Production Engineer for BP Exploration's North Sea operations. Simon has experience in Quantitative and Qualitative Risk Assessment techniques in the oil, petrochemical, mining and utilities industries and for Major Hazard Facility Safety Cases. Simon is GHD's technical authority for their SQRA® process, used by some of the world's largest mining and petrochem companies to assess major safety risks. In addition, Simon has specialist skills in Audit, Incident Investigation, Process Improvement, Project Risk Management, Decision/Options Analysis and Systems Development.