engineering new zealand
te ao rangahau

PRACTICE NOTE 4
HEALTH AND SAFETY BY DESIGN

April 2023

PURPOSE

The purpose of this Practice Note is to raise awareness of the engineer's obligations as a designer under the Health and Safety at Work Act 2015 (the Act) and their ethical obligations as Engineering New Zealand members for Health and Safety by Design, including:

- an introduction to the concepts of Health and Safety by Design
- an overview of the designer duties imposed by the Act
- responsibilities of practitioners, including engineers and consultants, when designing plant, substances, or structures. The Act imposes duties on these parties as well as on principals.
- ethical obligations.

While the Act refers to the 'designer', for the purposes of this document, we refer to the designer as 'the engineer.'

Other stakeholders, including regulators (at national and regional levels), have needs and expectations. WorkSafe and Waka Kotahi (among others) publish strategies alongside guidance, providing insight into performance issues. The engineer should understand the industry context when designing.

This document is not a source of legal advice nor a comprehensive guide to the obligations under the Act or for Health and Safety by Design. Engineers should always apply professional judgment and seek legal advice if they have questions or concerns about their obligations.

Note: this Practice Note is not a definitive guide to the Health and Safety at Work Act 2015.
For details of the Act and supporting guidance go to worksafe.govt.nz

HEALTH AND SAFETY BY DESIGN

What is Health and Safety by Design?

Health and Safety by Design (HSbD) describes the consideration at the design stage of health and safety and the prevention of harm, including chronic illness, during all phases of a project or system lifecycle[1] to improve health and safety outcomes. HSbD activities consider the technical, human, and ergonomic factors associated with the project's construction, operating lifecycle, and deconstruction.

Indicators that design activities are achieving their purpose will be evident in the fabrication, construction, operator safety, ease of maintenance, efficiency, productivity, and eventual demolition of the structure or process, as well as ensuring the public's safety throughout the project lifecycle.

Timing

Consideration of health and safety at the very beginning of a project is a powerful tool that can drive fundamental design choices. Eliminating and minimising safety hazards as early as possible in the project lifecycle is more effective, cheaper, and easier, than doing so retrospectively.

HSbD uses foresight and knowledge of foreseeable events, including operational activities and situations that can arise during the structure or system lifecycle.

The engineer uses that knowledge to identify potential hazards, assess risks, modify the design or develop preventions to create a healthy and safe design for all those interacting with the created asset.[2]

The Act places obligations on designers of structures, plant, equipment and substances to eliminate risks to the health and safety of persons 'so far as is reasonably practicable' and, where it is not reasonably practicable to eliminate risks, to minimise those risks so far as is reasonably practicable.

Effective use of Health and Safety by Design

To do this effectively, practitioners, designers, and engineers need to consult with those who best understand the nature of the asset's use, operation and maintenance activities, and potential changes in use over the asset lifecycle and work together to identify the hazards, assess the risks, and determine how they can be eliminated or minimised in the design.

Examples of elimination of health and safety risks using the design process could include:

- revised site selection
- avoiding hazardous construction methods
- automating processes
- providing safe access for maintenance
- incorporating permanent protection
- eliminating post-tensioned concrete.

1 HSbD is still sometimes referred to as Safety in Design (SiD).
2 For the purposes of this document, the term 'engineer' refers to the engineer(s) designing the project.

Examples of minimisation of health and safety risks using the design process could include:

- prefabrication
- assembly vs welding
- reducing operating voltages
- ignition prevention
- fire and gas detection
- effective boiler blowdown systems
- automated emergency shutdown
- firefighting systems
- bunding explosion protection
- substituting alternative plant
- substitute hazardous materials & substances.[3]

Characteristics of Health and Safety by Design

Health and Safety by Design characteristically:

- is an intentional and deliberate process undertaken to consider what can practicably be done in the design to eliminate hazards, reduce risks or otherwise minimise the potential for harm throughout the product or asset lifecycle
- obtains the correct technical inputs, such as a Basis of Design, and ensures the design team has the right skills and competencies for the project area
- understands the legal framework which the design must satisfy, which may include but is not limited to the Health and Safety at Work Act, Building Act, Hazardous Substances and New Organisms Act, Electricity Act, Gas Act, Plumbers, Gasfitters, and Drainlayers Act, and their associated regulations
- understands the New Zealand and applicable international standards and best practice guides as they apply to the assets being designed
- solicits information about the nature of work and the hazards that arise from that work from those best placed to understand how a revised design can be healthier and safer to construct, commission, operate and maintain.
- understands the hazards and risks to health and safety that the design process can eliminate and minimise. Each engineering discipline has recognised techniques that assist in identifying hazards and assessing risks (eg HAZOP, LOPA, HAZID, FMECA, FTA)
- focuses on atypical hazards, which the constructors, operators, maintainers, and demolishers would not consider 'business as usual' or everyday hazards
- modifies the design to eliminate and minimise hazards and manage risks across the lifecycle by addressing them early in the design when it is cheaper and easier to do so
- communicates the remaining hazards and risks not able to be addressed early in the design to later design stages and through to the construction, commissioning, operation, maintenance, and demolition stages
- documents design decisions for assurance and recording purposes and to meet the requirements of the Act[4]
- implements the agreed processes and management plans, such as the Project Execution Plan (PEP).

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3 Note: Section 6 of the Health & Safety at Work Act's General Regulations regards substitution as a means of minimisation rather than elimination because the substitutions themselves are unlikely to be completely free of risk.

4 Section 39 of the Act states: "(4)The designer must give to each person who is provided with the design for the purpose of giving effect to it adequate information concerning— (a) each purpose for which the plant, substance, or structure was designed; and (b) the results of any calculations, analysis, testing, or examination referred to in subsection (3), including, in relation to a substance, any hazardous properties of the substance identified by testing; and (c) any conditions necessary to ensure that the plant, substance, or structure is without risks to health and safety when used for a purpose for which it was designed or when carrying out any activity referred to in subsection (2)(a) to (e)." and "(5) The designer must, on request, make reasonable efforts to give current relevant information on the matters referred to in subsection (4) to a person who carries out, or is to carry out, any of the activities referred to in subsection (2)(a) to (e)."

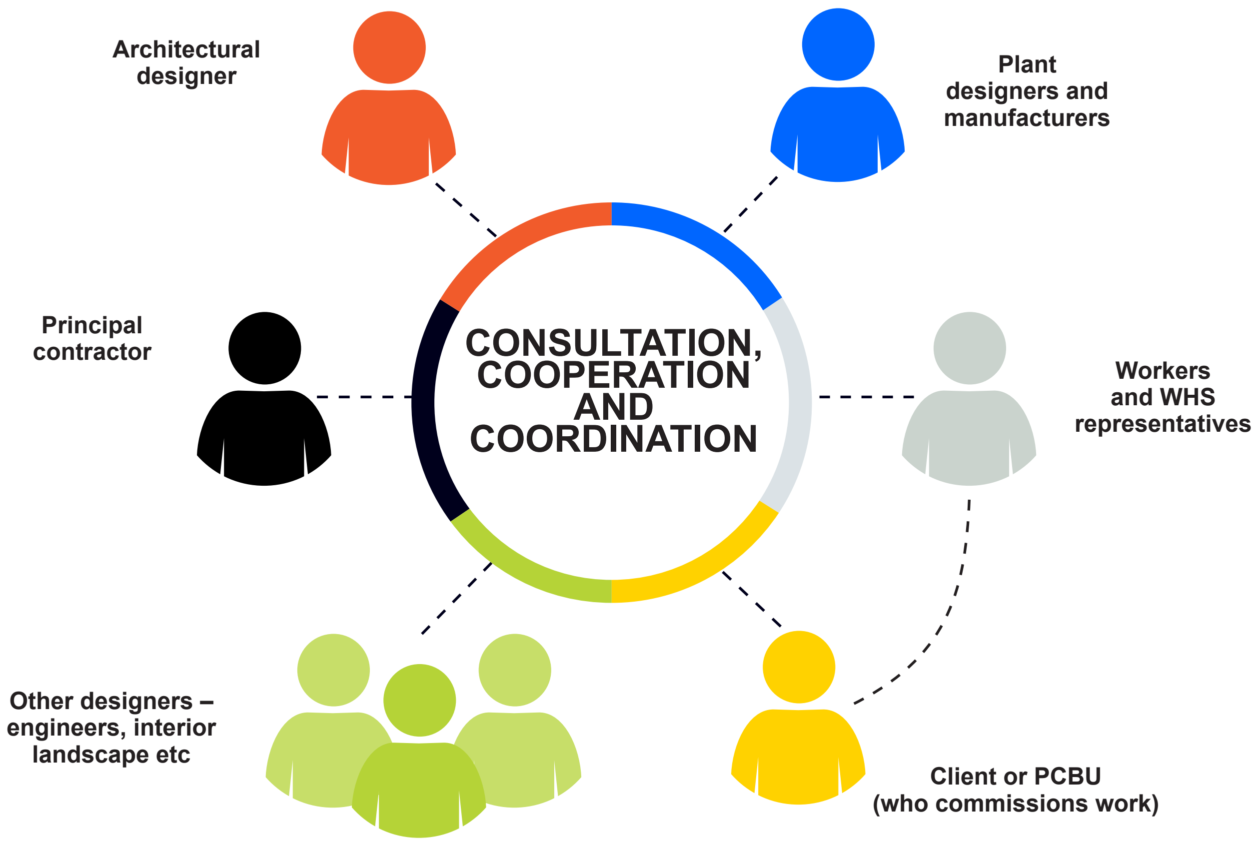
Communication

Interested parties (stakeholders) should be considered and consulted during the design process. The engineer needs to understand the client's relationships as a Person Conducting a Business or Undertaking (PCBU) and support the flow of information.

Construction, pre-commissioning, and commissioning are high-risk phases of project work where active communication is particularly important.

Work should not compromise the public's safety or that of construction personnel, adjacent property, or equipment. Communication should extend to such parties when necessary.

Figure 1: Consultation and co-operation (Safe Design Australia, 2018)



Risk Register and Construction Safety Plan

The alignment of all PCBUs and other stakeholders to understand and eliminate or minimise the risks during construction are crucial goals of the HSbD process. To communicate and document such risks and mitigations, the engineer should consult with stakeholders to complete a Risk Register. The construction contractor will need the Risk Register to inform its preparation of the Construction Safety Plan and work method statements.

Where a hazard or mitigation of the associated risk may not be obvious to the construction contractor, the engineer may need to provide the contractor with a project or activity-specific safety plan from which to develop their own Construction Safety Plan. Supporting documents might include approved standard operating procedures (SOPs), simultaneous operations procedures (SIMOPS), and other documents, forms, and guidelines.

HEALTH AND SAFETY AT WORK ACT 2015

The Act has far-reaching obligations for design engineers and those carrying out Construction Management and Contract Administration (CMCA) duties during construction. The obligations apply equally to sole practitioners, small practices, and large organisations.

Stakeholders, including the client, design engineer, manufacturer, importer, supplier, constructor and commissioner, have specific obligations under the Act. Engineers may have a direct or indirect relationship with any of these parties and should actively work with them to identify hazards and manage health and safety risks.

Officer

The Act defines an Officer as a person in a PCBU who exercises significant influence over the management of the business or undertaking, for example, a Chief Executive. The engineer is not usually in such a position unless they are a sole practitioner or partner. Engineers who are officers should familiarise themselves with their particular obligations under the Act.

Worker

Apart from any specific design obligations, the Act places obligations on all workers. Particularly when visiting a construction site, the engineer, as a 'worker', must:

a. take reasonable care for their own health and safety
b. take reasonable care that their acts or omissions do not adversely affect the health and safety of other persons
c. comply, as far as the worker is reasonably able, with any reasonable instruction that is given by a PCBU to allow the PCBU to comply with the Act or regulations, and
d. co-operate with any reasonable policy or procedure of a PCBU relating to health or safety at the workplace that has been notified to workers.

PCBU

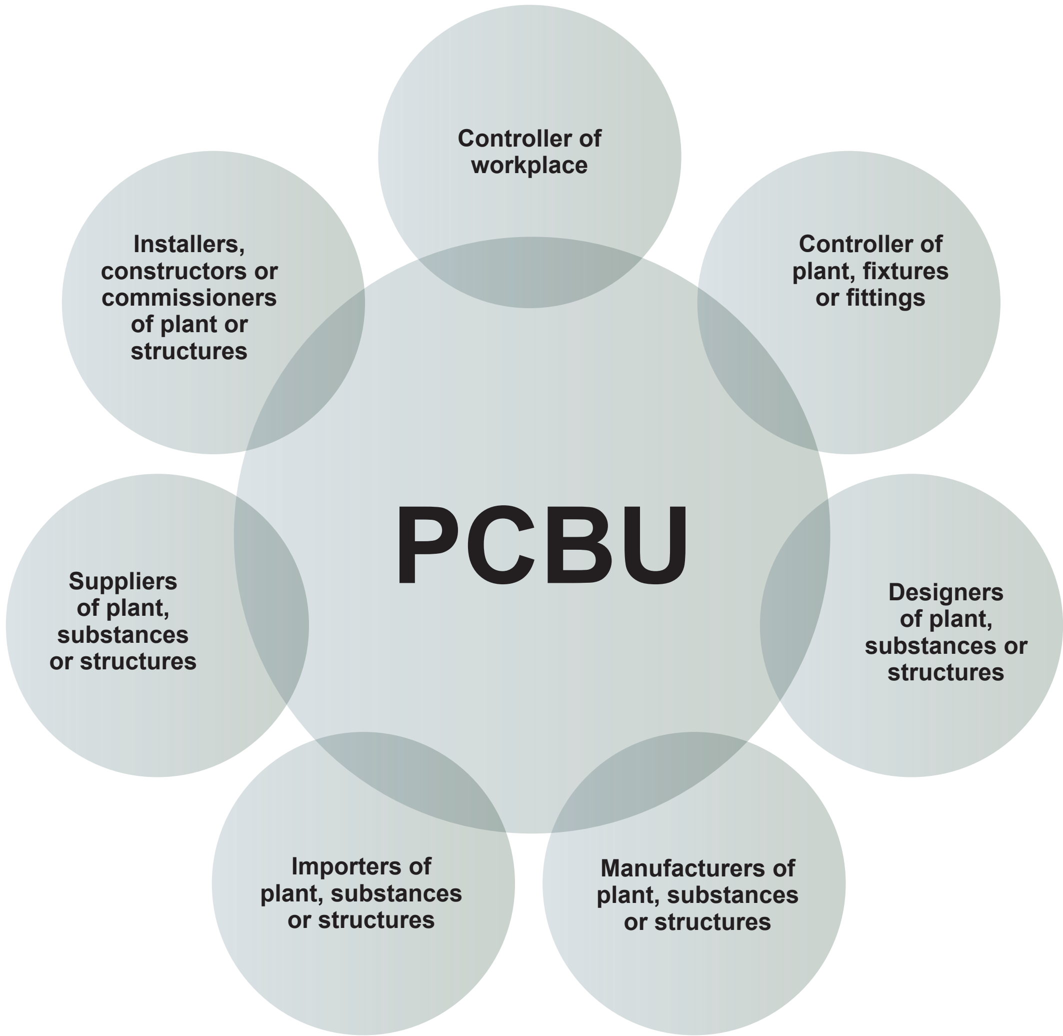
The Act uses PCBU to describe all forms of modern working arrangements, commonly called 'businesses.' A PCBU must ensure the health and safety of its workers and others affected by its work. The Act imposes specific duties on PCBUs who manage or control a workplace, or design, manufacture, import, supply, construct or commission any plant, substance or structure.[5]

Other than in the case of sole practitioners or partners, individual engineers are not usually themselves PCBUs but are employees of a PCBU and act as agents through whom that PCBU fulfils its duties under the Act.

The Act places an obligation on the PCBU who employs the design engineer to, so far as is reasonably practicable, ensure that the plant, substance, or structure is designed to be without risks to the health and safety of persons. Risks that cannot be eliminated must be minimised so far as is reasonably practicable. A designer PCBU has obligations under the Act if it designs any structures, plant or substances to be used, or which could reasonably be expected to be used, at work.

5 Refer to Sections 39-43 of the Health and Safety at Work Act 2015.

Figure 2: PCBU interactions (Swenson & Associates)

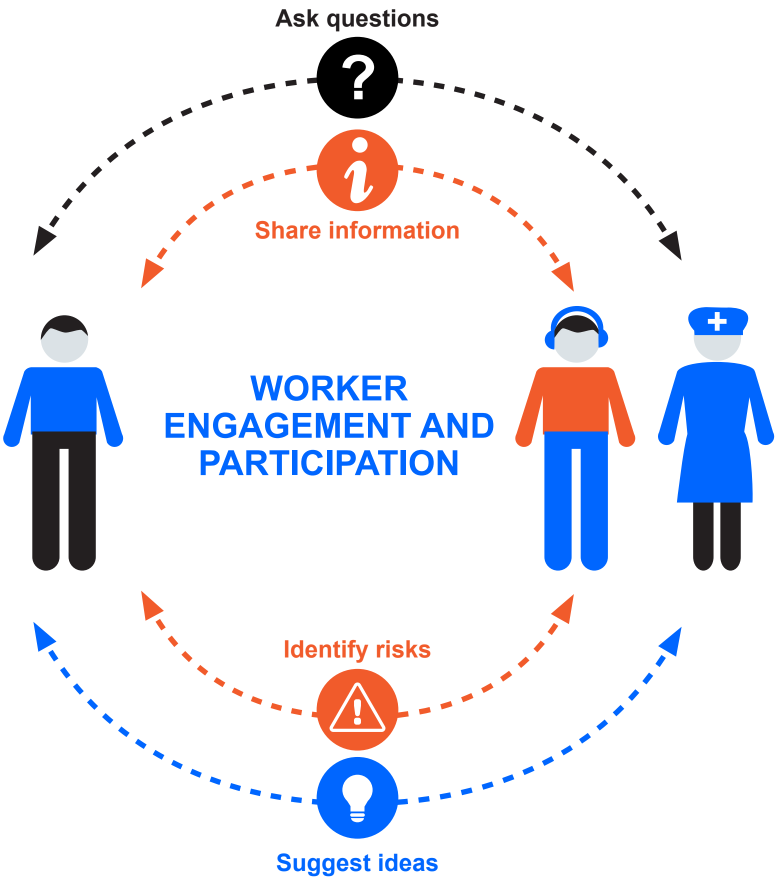


Worker engagement

Part 3 of the Act, supported by regulations and WorkSafe guidance, outlines worker engagement, participation and representation requirements. A meaningful, structured process is required to share appropriate information to allow workers to provide input.

Workers' input will assist in addressing the divide between the 'real' and the 'imaginary' – how work is done and the hazards and risks they are exposed to in their work that might be eliminated or minimised in the design. The design engineer may not have much influence and control over the client's organisation or its workers. Still, they may need to access an organisation's information and workforce to fulfil their design obligations for design.

Figure 3: Worker engagement (WorkSafe, 2017)



What is 'Reasonably Practicable'?

'Reasonably Practicable' is defined in the Act as "that which is, or was, at a particular time, reasonably able to be done concerning ensuring health and safety, considering and weighing up all relevant matters, including:

1. the likelihood of the risk occurring
2. the degree of harm that might result
3. what the person concerned knows, or ought reasonably to know about:
    a. the hazard or risk, and
    b. ways of eliminating or minimising the risk
4. the availability and suitability of ways to eliminate or minimise the risk, and
5. after assessing the extent of the risk and the available ways to eliminate or minimise it, the cost associated with these, including whether the cost is grossly disproportionate to the risk."

Tips for meeting obligations under the Act

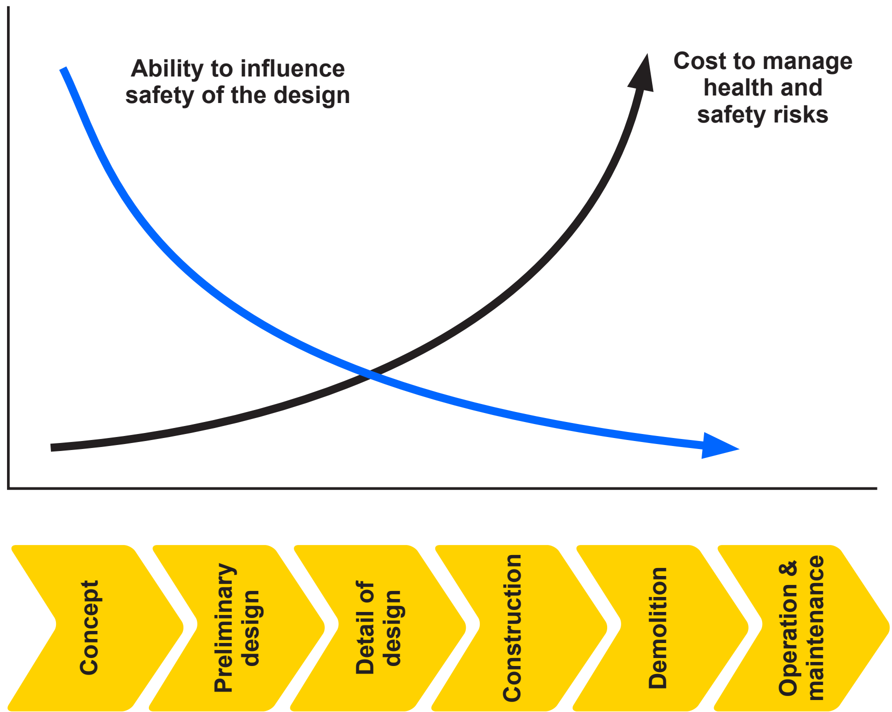
The following points aim to assist engineers in meeting their PCBU obligations under the Act, using the principles of HSbD:

1. Doing HSbD well can be complex. The future is uncertain, and the operation of assets can be complicated. Take the time to understand the complexity of the operations, situations, and events that can arise. Don't jump straight into the design. Visiting existing sites and talking to workers to understand and document the workers' perspectives and issues will vastly improve early decision-making to improve safety and the overall design.

2. The Act requires the engineer to contemplate 'that which is, or was, at a particular time reasonably able to be done.' It means that engineers should prioritise things they can address early in the design process and document decision-making as the project progresses.
3. Consideration for health and safety includes the prevention of chronic illness. So, concern for materials, fibres, liquids, and hazardous substances used in the construction, manufacture, use, maintenance, refurbishment, cleaning and disposal must be considered. The best way to eliminate these risks is to carefully select materials and substances early in the design process.
4. The engineer should contemplate what should be known about operations, the associated hazards and risks, and how to minimise them in the design. Talk to others, look at industry data about the nature of accidents, and consider how associated risks were eliminated or minimised in similar contexts.
5. The requirement for the engineer to demonstrate that they have reduced risk so far as is reasonably practicable requires them to step through each design element and only consider the cost once the other factors are understood. The engineer must document what they know about the availability and suitability of potential controls.
6. The engineer must demonstrate that they have reduced risks so far as reasonably practicable and then engage with the end user, client, or owner to communicate the remaining hazards or safety risks they identified but could not eliminate in the design. Recording what they know at each stage of design helps fulfil the requirements of the Act.
7. The management of HSbD throughout the asset lifecycle is important. The engineer should consider how the handover process will be managed between the:
    - designers
    - client
    - construction contractor
    - those who commission the asset, and
    - its operators and maintainers.

The process needs to be formalised to ensure that the party left owning the residual risks is aware of what they are inheriting. For example, if the designer hands over its HSbD output to the Client because the designer is not involved in the construction phase, what will the designer do to ensure the Contractor sees the information? It is important to formally document the transfer of residual risks and who is responsible for managing them.

Figure 4: Symberski chart of influence for construction safety planning (SiteSafe, 2019)



ETHICAL OBLIGATIONS OF THE ENGINEER

Code of Ethical Conduct (2016)

The Engineering New Zealand Code of Ethical Conduct (2016) identifies the duty of engineers to "Take reasonable steps to safeguard health and safety: You must, in the course of your engineering activities, take reasonable steps to safeguard the health and safety of people."

Practical considerations

The following points offer practical considerations when identifying the hazards or assessing the risks.

Figure 5: Hazard vs Risk

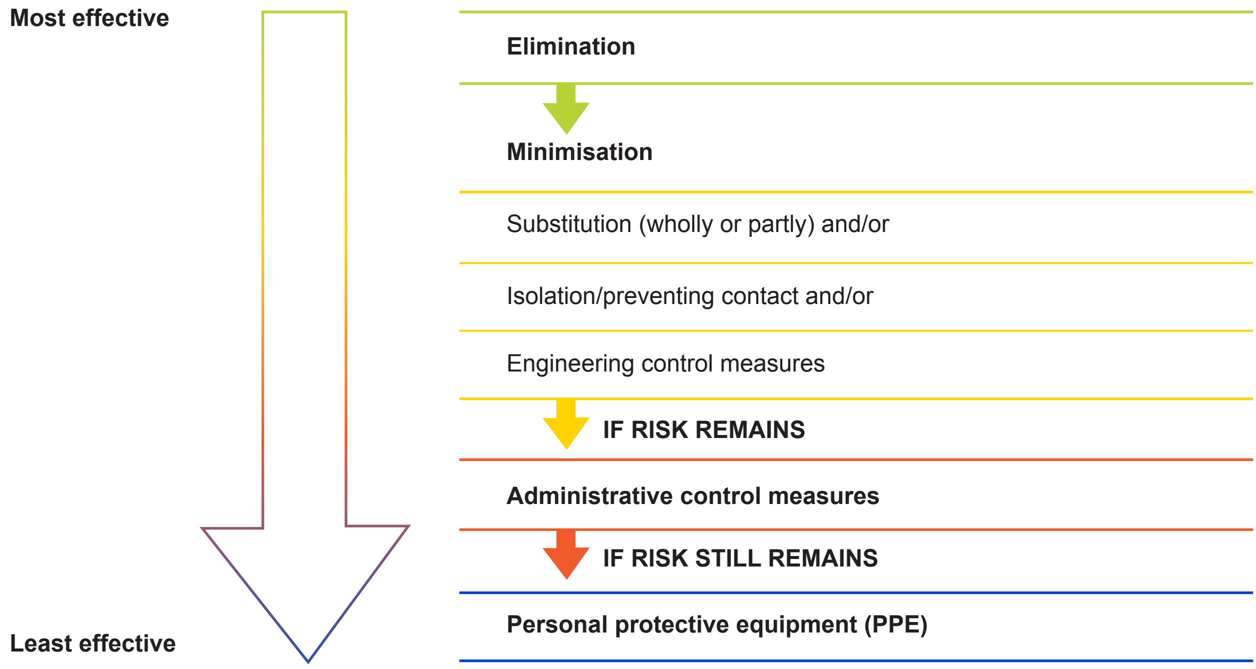
- A design should seek to eliminate and minimise risks to health and safety. If the engineer judges a control to be reasonably practicable, they should implement it regardless of the level of risk. Remember, controlling risks early in the design process is cheaper and easier than remedying a design later.
- While an unusual or rare hazard may not be considered credible, others may be plausible, and the design must control the associated risks sufficiently. Disagreements on which hazards are credible may arise, and industry accident data may help resolve uncertainty. The engineer must inform the client of all hazards identified, risks assessed, and additional controls needed.
- Controls used for similar hazards or risks elsewhere in similar applications are considered 'reasonably practicable' unless the engineer can demonstrate that they are unavailable, unsuitable, or would introduce new hazards with more severe risks.
- The time required to implement controls is insufficient justification for not applying controls. If necessary, the engineer, contractor or client should seek additional time. Parties cannot contract out of their obligations under the Act.
- A client's inability or unwillingness to fund risk controls are not justifiable reasons for avoiding suitable controls. Unless the engineer can demonstrate that the cost is grossly disproportionate to the benefit provided, the engineer should advise the client to seek additional funding or resources. Such a request typically needs to be escalated to the Officers of the client organisation, and the engineer should make clear to all concerned the potential consequences of non-compliance.
- The Act requires eliminating risk and, failing that, minimisation of risk. When identifying a hazard and managing the associated risk, use the hierarchy of controls in Figure 6. Choose controls from as high on the hierarchy as possible, then assess residual risk. If the residual risk is still too high, the engineer should apply additional controls until they have reduced the risk as far as reasonably practicable.

- Avoid risk shuffling, where one hazard or risk is eliminated or minimised, only to create a new hazard or risk in the same or another part of the system lifecycle. An example might be opting for prefabricated construction. Although prefabrication might mean eliminating a 'working at height hazard' and shifting the fabrication risks off-site, new hazards of 'working under heavy load', 'heavy lifting' and 'propping' are introduced. The replacement hazards may well amount to a lower risk than having people working 20m up in the air, but the hazard has not been 'eliminated', merely altered.
- Communicate the remaining residual risks to the client or end-user in their own language and organisational framework. Ask them about their risk assessment and how they intend to communicate those remaining hazards and risks to constructors, commissioning personnel, operators, and maintainers.
- Controls that are part of normal processes or fall outside the hierarchy of controls should be recorded as assumptions (eg 'meets code requirements, use a competent engineer, engage a competent builder').

In addition to the final design, the engineer should provide the following to inform later project lifecycle phases:

1. communication of hazards and risks the engineer did not eliminate (ie residual risks)
2. assurance documentation regarding knowledge of the nature of operations, hazards, and risks, and
3. description of how the hazards and risks have been eliminated or minimised by the design.

Figure 6: Hierarchy of controls (WorkSafe, 2017)



EXAMPLES OF HEALTH AND SAFETY BY DESIGN

Example 1 – Parapets and working at heights

A client is building a large warehouse for use as a storage depot. The architect designs a small parapet to run around the edge of the roof of the building, with the parapet height ranging from 50mm – 500mm above roof level.

The parapet heights do not meet any requirements for edge protection. Those needing access to the roof area to maintain the gutters etc will face a significant hazard and an increased risk of falling, resulting in injury or fatality.

To control the risk, the client will incur additional maintenance costs whenever personnel access the roof. Safety measures required for workers who access the roof might include:

- anchor points and permanent lines installed in the roof structure
- formal annual inspection of anchor points to confirm they are still sound
- warning notices on the access door to the roof advising of the pitch and associated risks
- training required for staff working in harnesses.

By collaborating with the client's contractor and identifying the issue at the design stage, the parapet height could be increased to at least 1,100mm. The increased height would reduce the need for any of the above measures during the lifetime of the building. The increase in parapet height may not be possible due to height-to-boundary issues. Still, the HSbD process allows the engineer to recognise opportunities to eliminate hazards early in the design process.

New HSbD workshop capture record

Project name	Random warehouse
Date	01/02/2023
Design phase[6]	Concept design
Workshop lead	Antoni Gaudi
Client	Property Developer
Attendance	Gaudi (Architect) Isambard Brunel (Engineer) The Contractor Property Developer

Purpose of Health and Safety by Design

1. Understand the operations, activities, and situations.
2. Consider the hazards that arise from those operations, activities, and situations.
3. Modify the design to eliminate or minimise the hazards.
4. Communicate remaining risks downstream.
5. Document any decisions for assurance purposes.

Notes:

- Check all assumptions on the following pages before beginning.
- Avoid repeating the assumptions in the table below.
- If there is nothing to put into a cell, then enter 'not assessed'.

Number	Operation, Activity, or Situation	Hazard	Who is at risk?	Lifecycle phase	How does the design already mitigate this risk?	Potential severity[7]	Estimated likelihood	What changes can be made to the design to eliminate or minimise the hazard?[8]	Are these changes available and suitable?	If not, why not?[9]	Communication	Action
eg	*Cyclists using bridge*	*Cyclist collides with a pedestrian or another cyclist on bridge*	*Users*	*Operations*	*n/a*	*Minor harm*	*Probable*	*Dismount barriers (E) and signage (A), or* *Cycle-only lanes (A), or* *Direction lanes (A),*	*All are available and suitable, though A controls are weak.*	*Cost of any/all not grossly disproportionate to the risk.*	*Designer to incorporate 'dismount' barrier (E) & sign (A)*	*By end of preliminary design*
1	Workers accessing the roof	Falling (edge) hazard	Users, pedestrians below	Construction, operation, maintenance, deconstruction	n/a	Fatality	Possible	E Erect a permanent 1.1 m high physical barrier around the edge (the hazard) to protect everyone, including the public. E Install permanent attachment points. A Devise operating procedures, then train all people accessing the roof. Monitor that they actively follow the procedures. A Have accident recovery mechanisms in place and ensure staff are trained in case of an incident or accident.	Permanent attachment points are not as good as a physical barrier. Someone can still access the roof without the knowledge, training or equipment and be exposed to the falling hazard. They also increase the need for access control, training, equipment, maintenance, and inspections. Designing and installing the barrier avoids much of this and significantly reduces maintenance costs over the lifecycle of the building. The administrative controls require constant training and updating.	n/a	Erecting a barrier in the form of a parapet was chosen to reduce maintenance and staff training costs.	Architect and engineer to design parapet

6 The NZCIC Design Guidelines refer to Design Stages as: establishment, concept design, preliminary design, developed design, detailed design, procurement, construction administration and observation, and post completion.
7 Estimated severity and likelihood given the current design and assumptions in place. Use your own risk rating, or use:
Severity: Multiple fatalities, Fatality, Major harm, Minor harm; **Likelihood:** Certain, Probable, Possible, Remote, Improbable, Impossible
8 Hierarchy of controls: E = Engineering control; A = Administrative control
9 If cost is grossly disproportionate to the risk, an explanation is required.

Example 2 – Major hazard facility fire risk

A client is building a separation loop for a petroleum facility. The separation loop uses a reboiler to reheat condensate, allowing it to be further separated into its component fluids and gases. A conventional design burns natural gas to heat the tubes containing the flammable condensate fluid.

The conventional design introduces an ignition source near the flammable condensate, potentially causing extensive damage or injury in the case of a tube failure. If the bundle is damaged during maintenance, the tubes can be weakened and fail. Deterioration of the fire tubes from exposure to high temperatures could also cause failure. The engineer must select materials to meet the specific operating conditions and specify regular inspections to ensure integrity.

The client will incur additional infrastructure costs in fire and explosive protection when operating the plant. Other safety measures required for the site could include:

- additional firefighting/firewater infrastructure
- additional fire barrier or explosive barrier construction
- larger exclusion zones
- training required for staff
- additional emergency shutdown functionality.

Removing the ignition source could reduce the need for many of the above control measures. By collaborating with the client and identifying the issue at the design stage, the engineer could identify an alternative type of reboiler, such as a steam-heated boiler. This may not be possible due to a lack of steam services on site for tie-in and/or restrictions on implementing a completely new system. Nevertheless, the HSbD process allows the engineer to recognise such opportunities early.[10]

10 This simplistic example doesn't capture consideration and management of any new risks from the steam-based alternative. After selecting the steam boiler, the HSbD process is not over. The steam system's impact on people and processes could also be significant and needs to be considered.

New HSbD workshop capture record

Project name	Separation loop for petroleum facility
Date	08/03/2023
Design phase[11]	Concept design
Workshop lead	Rudolf Diesel
Client/Owner	Property Developer
Attendance	Sir Christopher Wren (Architect) Rudolf Diesel (Engineer) The Contractor Property Developer

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1	Damage to plant during maintenance	Potential fire or explosion from an ignition source near the flammable condensate.	Operators, maintenance workers, factory staff	Operations	n/a	Multiple fatalities	Possible	E Change the reboiler heating method from natural gas to steam. E Position the reboiler away from other equipment and personnel work areas with a significant exclusion zone. E Have fire detection systems and design the vessel shell for a fire scenario. A Devise operating procedures, then train operations, maintenance and subcontractor staff. Monitor that they actively follow the procedures. A Practice recovery activities if an incident or accident occurs. Use fire barriers and foam firefighting systems.	The engineering controls are suitable. Installing the reboiler away from other equipment is relatively easy. The client is looking at life-cycle costings for natural gas vs steam reboilers. The administrative controls require constant training and updating.	The client decided on changing to a steam heater based on life-cycle costings.	n/a	Steam heater to be purchased and installed.

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11 The NZCIC Design Guidelines refer to Design Stages as: Establishment, Concept design, Preliminary design, Developed design, Detailed design, Procurement, Construction administration and observation, and Post completion.
12 Estimated severity and likelihood given the current design and assumptions in place. Use your own risk rating, or use:
Severity: Multiple fatalities, Fatality, Major harm, Minor harm; **Likelihood:** Certain, Probable, Possible, Remote, Improbable, Impossible
13 Hierarchy of controls: E = Engineering control; A = Administrative control
14 If cost is grossly disproportionate to the risk, an explanation is required.

Example 3 – Flowmeter electrical hazard

A client is installing new flowmeters on their site. Due to the site location, the cables are to run from the PLC (programmable logic controller) cabinet "CJB-1" through two intermediate cabinets, "CJB-2" and "CJB-3", to the electromagnetic flowmeters in the field. The client's standard flowmeter uses a 230 V AC signal, defined as 'low voltage' in the Electricity (Safety) Regulations 2010.

Under the Regulations, to carry out 'Prescribed Electrical Work' workers must be registered and licensed for the type of work performed. 230 V AC Low Voltage (LV) systems are prescribed electrical work. Therefore, workers must be licensed to work on them (i.e., a registered and licensed electrician).

On the other hand, 24 V DC systems are defined in the Regulations as extra low voltage (ELV) and are not 'prescribed electrical work' if they "are intended solely for connection to, or are associated solely with, electricity supplies not exceeding extra-low voltage." Work on ELV 24 V DC with no 230 V AC Low Voltage components is 'general prescribed electrical work' under the Regulations and can be carried out by general maintenance staff.

Most electromagnetic flowmeter suppliers will offer 24 V DC options. Choosing an ELV instrument during the design phase will lower the hazard exposure of workers commissioning and maintaining the equipment and may save time and money for operations in the long run.

Other factors to consider are:

- having 230V AC signals present in a circuit make that cabinet 'low-voltage' (compared with 'extra-low voltage' 24V DC signals)
- greater safety controls are required by law for 'low-voltage' cabinets compared with 'extra-low voltage' cabinets
- it is best practice to always have two people present when opening a 230V cabinet
- higher voltages have a greater severity of electrocution and burns.

New HSbD Workshop capture record

Project name	Flowmeter install
Date	05/10/2023
Design phase[15]	Concept design
Workshop lead	Nikola Tesla
Client/Owner	A. N. Client
Attendance	Frank Lloyd Wright (Architect) Nikola Tesla (Engineer) The electrician Property Developer

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Number	Operation, Activity, or Situation	Hazard	Who is at risk?	Lifecycle phase	How does the design already mitigate this risk?	Potential severity[16]	Estimated likelihood	What changes can be made to the design to eliminate or minimise the hazard?[17]	Are these changes available and suitable?	If not, why not?[18]	Communication	Action
1	Installing and maintaining flowmeter equipment in electrical cabinets	Electric shock	Electrical engineers, electricians	Installation, operations (maintenance)	n/a	Major harm	Possible	E Installing circuit breakers and RCDs in accordance with AS/NZS 4836:2023 'Safe Working on LV and ELV Installations' and AS/NZS 3000:2018 'Wiring Rules' minimises the risk and severity of electrocution. E Also desirable to reduce the number of 230 V cabinets on site. E Utilise 24V DC to the maximum extent possible within control cabinets and circuits. Limit the use of 230V AC to lighting and small power, from a separate distribution board to the 24V DC control cabinet. A Help ensure contractors are aware of the hazard and wear appropriate PPE. Gloves and safety glasses may protect against burns. A Have two people present whenever working on a 230V cabinet. A Prescribed electrical work on LV systems is to be carried out by a licensed electrician. A Ensure a rigorous Lock Out – Tag Out system of isolation is in place.	The engineering controls are available and suitable. A combination of engineering and administrative controls should be used.	n/a	The electrical design engineer and client agree that utilising 24V DC ELV for power and control circuits wherever possible is the most appropriate solution, in combination with additional staffing, tools and PPE when working in a 230V cabinet.	Electrical system to be designed accordingly by electrical engineer, having regard to the principles of risk management in AS/NZS 4836. Safety procedures to be devised and implemented by engineer, electrician and the client.

15 The NZCIC Design Guidelines refer to Design Stages as: establishment, concept design, preliminary design, developed design, detailed design, procurement, construction administration and observation, and post completion.
16 Estimated severity and likelihood given the current design and assumptions in place. Use your own risk rating, or use:
Severity: Multiple fatalities, Fatality, Major harm, Minor harm; **Likelihood:** Certain, Probable, Possible, Remote, Improbable, Impossible
17 Hierarchy of controls: E = Engineering control; A = Administrative control
18 If cost is grossly disproportionate to the risk, an explanation is required.

ADDITIONAL RESOURCES

This practice note provides an overview of Health and Safety by Design. The links below are to some of the resources that can be sourced free of charge for further information.

1. Health and Safety by Design: an introduction – WorkSafe New Zealand
www.worksafe.govt.nz/topic-and-industry/health-and-safety-by-design/health-and-safety-by-design-gpg/#lf-doc-48060
2. Worker Engagement and participation – WorkSafe New Zealand
www.worksafe.govt.nz/managing-health-and-safety/businesses/worker-engagement-and-participation
3. Temporary Works Procedural Control – Temporary Works Forum
secure.chasnz.org/downloads/resources/TemporaryWorksProceduralControl_GPG_.pdf
4. Construction Health and Safety New Zealand (CHASNZ)
www.chasnz.org
www.chasnz.org/downloadable/improving-health-and-safety-outcomes-for-the-construction-sector-through-better-design-practice
5. Safe Design of Structures: Code of Practice – Safe Work Australia
www.safeworkaustralia.gov.au/system/files/documents/1702/safe_design_of_structures2.pdf
6. Health and Safety at Work Act 2015
www.legislation.govt.nz/act/public/2015/0070/latest/DLM5976660.html?search=qs_act%40bill%40regulation%40deemedreg_health+and+safety+at+work+act_resel_25_h&p=1&sr=1
7. Health and Safety at Work (General Risk and Workplace Management) Regulations 2016
www.legislation.govt.nz/regulation/public/2016/0013/latest/DLM6727530.html

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