Sugar mill safety

Code of Practice

2024

Workplace Health and Safety Queensland
worksafe.qld.gov.au

Queensland Government

This Queensland code of practice has been approved by the Minister for State Development and Infrastructure, Minister for Industrial Relations and Minister for Racing under section 274 of the *Work Health and Safety Act 2011*.

This code commences on 23 September 2024.

It replaces the *Sugar industry Code of Practice 2005* and the *Sugar mill safety supplement* to the *Sugar industry Code of Practice 2005.*

PN13048

Contents

Foreword

The *Sugar mill safety Code of Practice* is an approved code of practice under section 274 of the *Work Health and Safety Act 2011* (the WHS Act).

An approved code of practice is a practical guide to achieving the standards of health, safety and welfare required under the WHS Act and the *Work Health and Safety Regulation 2011* (the WHS Regulation).

Under section 26A of the WHS Act, a person conducting a business or undertaking (PCBU) must:

- comply with an approved code of practice; or
- manage hazards and risks arising from the work carried out as part of the business or undertaking in a way that is different to the code but provides an equivalent or higher standard of work health and safety than the standard required in this code.

A code of practice applies to anyone who has a duty of care in the circumstances described in the code. In most cases, following an approved code of practice would achieve compliance with the health and safety duties in the WHS Act in relation to the subject matter of the code. Like regulations, codes of practice deal with particular issues and do not cover all hazards or risks which may arise. The health and safety duties require duty holders to consider all risks associated with work, not only those for which regulations and codes of practice exist.

Codes of practice are admissible in court proceedings under the WHS Act and WHS Regulation. Courts may regard a code of practice as evidence of what is known about a hazard, risk or control and may rely on the code in determining what is reasonably practicable in the circumstances to which the code relates.

An inspector may refer to an approved code of practice when issuing an improvement notice. This may include issuing an improvement notice for failure to comply with a code of practice where equivalent or higher standards of work health and safety have not been demonstrated.

Code terminology

This code includes references to the legal requirements under the WHS Act and WHS Regulation. These references are not exhaustive and are included for convenience only. They should not be relied on in place of the full text of the WHS Act or WHS Regulation.

The words '**must**', '**requires**' or '**mandatory**' indicate that a legal requirement exists that must be complied with.

The world '**should**' is used in this code to identify the standard required in this code. PCBUs can only manage the identified hazard or risk in a different way if doing so provides an equivalent or higher standard of work health and safety.

The word '**may**' is used to identify an optional course of action.

References to other legislation

This code includes references to the *Electrical Safety Act 2002* (ES Act) and *Electrical Safety Regulation 2013* (ES Regulation). These references are not exhaustive and are included for information only. They should not be relied on in place of the full text of the ES Act or the ES Regulation. While this code includes information about electrical safety it is not an approved code under the ES Act.

Scope and application

This code provides practical guidance on how to manage health and safety risks associated with sugar mill operations. It should be read in conjunction with the WHS Act, WHS Regulation and other relevant codes of practice.

This code applies to sugar mill operations within mill premises (including the movement of cane bins between the tippler entry and exit points).

Where the guidance or requirements outlined apply equally to cane rail operations, this is noted at the outset of the relevant section of this document. Information on workplace health and safety that is specific to cane rail operations is provided in the *Cane rail safety* supplement.

This code does not cover cane growing and harvesting, or sugar manufacturing processes outside of the mill premises.

Australian standards

This code includes references to Australian Standards, which set out guidelines for safe work practices and procedures. Unless otherwise specified, these are included for information only.

Legislation

Legislation that is relevant to sugar milling operations includes:
(a) *Work Health and Safety Act 2011* (the WHS Act).
(b) *Work Health and Safety Regulation 2011* (the WHS Regulation).
(c) *Electrical Safety Act 2002* (the ES Act).
(d) *Electrical Safety Regulation 2013* (the ES Regulation).

Duty holders

The following persons have duties to ensure health and safety in the workplace (see the WHS Act for further information):

- PCBU, whether as employers, self-employed persons or otherwise
- person with management or control of a workplace
- person with management or control of fixtures, fittings or plant at a workplace
- person who designs plant, substances or structures
- person who manufactures plant, substances or structures
- person who imports plant, substances or structures
- person who supplies plant, substances or structures
- person who installs, constructs or commissions plant or structures
- officers
- workers
- other persons at workplaces.

Registrable plant and registrable plant design must be registered with Workplace Health and Safety Queensland. See Schedule 5 of the WHS Regulation for more information.

1. Introduction

1.1 About this Code of Practice

The Sugar mill safety Code of Practice 2024 (including the *Cane rail safety* supplement) is intended to be used by persons with health and safety duties under the *Work Health and Safety Act 2011* (the WHS Act), including:

- A **person conducting a business or undertaking** (PCBU) has the primary duty under the WHS Act to ensure, as far as reasonably practicable, that workers and other persons are not exposed to health and safety risks arising from the business or undertaking.

- **Officers**, such as company directors, must exercise due diligence to ensure that the business or undertaking complies with the WHS Act and the WHS Regulation. This includes taking reasonable steps to ensure that the business or undertaking has and uses appropriate resources and processes to provide and maintain a safe work environment.

- **Workers** must take reasonable care for their own health and safety and that they do not adversely affect the health and safety of other persons. So far as the worker is reasonably able, the worker must comply with any reasonable instruction. Workers must cooperate with any reasonable policy or procedure relating to health and safety at the workplace.

The Sugar mill safety Code of Practice 2024 describes methods for controlling major hazards associated with sugar mill operations, to safeguard the health and safety of workers, the public and others.

The Sugar mill safety Code of Practice 2024 includes the *Cane rail safety* supplement. This document addresses risks specific to cane rail operations.

Hazards that are addressed by this code of practice are considered to be typical in a sugar milling environment and should be assessed by operators as part of the risk management process, as outlined in Section 3 - Risk Management.

1.2 How this document is organised

This document should assist sugar mill operators to develop a hazard register for the sugar mill, assess the risks associated with those hazards, and implement appropriate controls.

This code includes an outline of sugar milling operations, and specific hazards associated with milling processes. The code identifies key factors that should be considered as part of the risk management process in sugar mills. The code is organised into the major hazard areas for sugar mills, including general workplace hazards, plant, biological substances, hazardous chemicals and substances, and work environment. Within the hazard-specific sections the document is generally structured in the following format:

1. **the major hazard area** i.e. substances
2. **the specific hazard** i.e. hazardous chemicals
3. **control measures for the specific hazard**.

(an outline of control measures appropriate for the specific hazard)

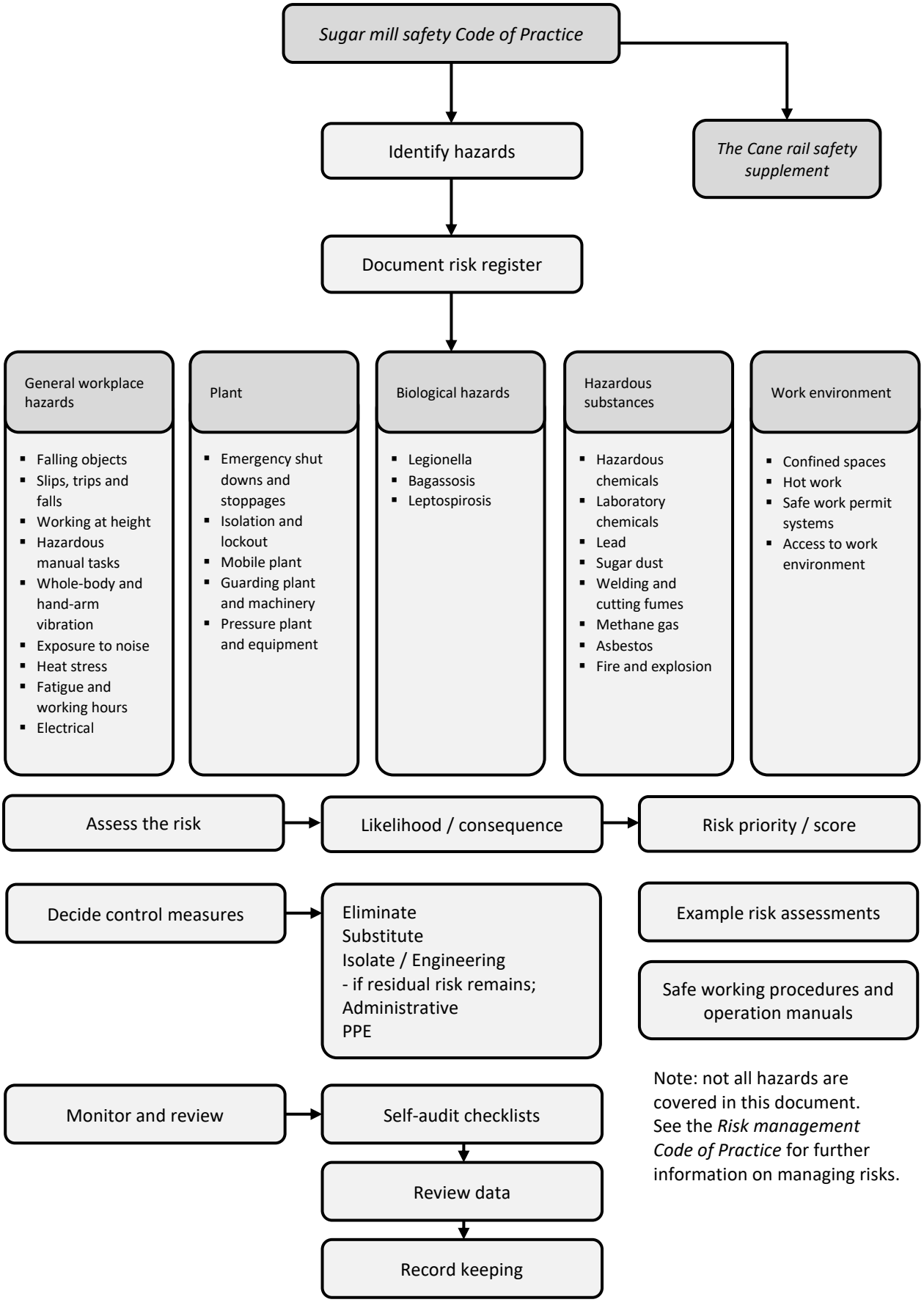

Figure 1: Risk register and controls

1.3 What is reasonably practicable?

WHS Act section 18: 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 standard of 'reasonably practicable' in health and safety duties applies to a PCBU. Other duty holders are required to meet different standards, for example officers must exercise 'due diligence' and workers and others at a workplace must take 'reasonable care'.

The question of what is reasonably practicable is determined objectively (that is, by what a reasonable person in the position of the PCBU would do in the circumstances) - not by reference to a PCBU's capacity to pay or other individual circumstances. A PCBU cannot expose people to a lower level of protection simply because it is in a lesser financial position than another PCBU facing the same hazard or risk in similar circumstances.

Further information on what is 'reasonably practicable' is provided in the Safe Work Australia Guide - *How to determine what is reasonably practicable to meet a health and safety duty*.

2. Sugar milling operations

A sugar mill is a large factory used to produce raw sugar and other products from sugar cane. Mills consist of a range of industrial plant such as boilers, storage and processing vessels, shredders and crushing mills and a large range of maintenance equipment.

Mills operate in two distinct modes, crushing and non-crushing, both of which introduce a range of specific and general hazards to persons conducting a business or undertaking (PCBU), workers and others.

In essence, a sugar mill can be broken into the following processes.

2.1 Cane handling

Cane handling describes the methods used to move cane billets into the milling section of the process. Billets are transported and stored using items such as:

- in field transporters
- road transport systems (such as multi-lifts, truck mounted elevator bins and semi-trailers)
- cane railway bins.

Guidelines produced by the Australian Sugar Milling Council provide supplementary guidance in relation to these elements of cane handling.

The cane billets are then transferred into the milling system by:
- trans-loaders (such as from road to rail)
- tipplers (tipping cane bins into carriers)
- direct tip into the carrier (by infield transporters and road transport).

Rail transfer methods use large hydraulic electric systems to push or pull rakes of bins into the tippler which tips them onto a ‘carrier’ (a moving floor conveyor). Most mills have storage yards for full bins waiting to be tipped, and empty bins waiting to be re-filled. Tipplers are a rotary device which hold the rail bin in place and turn it 180 degrees to empty its contents into the main conveyor (carrier).

Key sections
- Managing health and safety
- General workplace hazards
- Plant
- Work Environment

2.2 Factory operations

Processing sugar cane billets into the raw sugar product in a sugar mill involves the following stages of factory operations:

- **Milling**: The milling stage involves the initial breakdown of cane into its primary fibres by a large shredder. This fibre is then processed through a series of crushing mills to extract juice. Bagasse is a side-product of milling.

- **Clarification/evaporation**: The clarification stage involves a number of processes to remove contaminants from the juice, such as mixed juice incubation and the addition of lime and flocculant. The effet stage consists of using evaporators to boil the juice to reduce the water content.

- **Pan stage**: The pan stage involves using ‘seed crystals’ and other products with varying levels of sugar content to produce sugar crystals from the liquor. This involves the use of many storage tanks such as receivers (tanks which receive product from the pans), crystallisers (a series of tanks and stirrers which cool the product from the pan stage resulting in additional crystal growth before fugaling) and large transfer pipes and valves.

- **Fugal stage**: The fugal stage removes the remaining liquid product which surrounds the crystal, washes the crystal and delivers it into the final sugar system through a series of conveyors and a dryer. This stage involves the use of high grade and low grade centrifuges.

- **Final sugar**: Finally, the sugar crystals are dried and moved to large storage bins awaiting transport to sugar terminals or other areas (such as refineries). Dryers are large cylinders which are fluted and rotate to pass the crystal through at an even rate whilst dry, cool air is applied via ducted fans or large air conditioners.

Key sections
- Managing health and safety
- General workplace hazards
- Plant
- Hazardous substances
- Work environment

2.3 Steam and energy supply systems

Mills have traditionally been powered by steam-driven machinery and subsidised by electrical devices. However, many factories have moved to predominantly electric powered equipment. A standard sugar mill will still include equipment such as suspension or multiple fuel boilers, steam turbines, electrical generators and all of the associated distribution equipment for electric and steam power.

A range of equipment is associated with steam and electric energy including transformers, high and low voltage distribution systems, protection devices such as circuit breakers, steam relief valves, expansion joints and water traps.

Mills also have fluid power systems including hydraulic and pneumatic systems with extensive air distribution systems supplying general and instrument air.

Key sections
- Managing health and safety
- General workplace hazards
- Plant
- Hazardous substances
- Work environment

2.4 Associated operations

A range of facilities associated with sugar production are located on site including:
- laboratory and associated processes
- packaging lines
- engineering workshops covering areas such as rolling stock repair (for those mills with cane rail systems), general engineering and fabrication, and electrical
- administration areas
- molasses storage and distribution systems
- water supply and effluent systems
- mud, ash, bagasse and other by-product handling and storage.

Key sections
- Managing health and safety
- General workplace hazards
- Plant
- Biological substances
- Hazardous substances
- Work environment

3. Managing health and safety

Effective risk management involves identifying hazards and risks in the workplace, and then determining what needs to be done, so far as is reasonably practicable, to eliminate or minimise the health and safety risks arising from your business or undertaking.

This process is known as risk management. Duty holders should use the risk management process:

- now, if the duty holder has not done it before
- when a change occurs (for example changing work procedures)
- after an incident or 'near miss' occurs
- at regularly scheduled times appropriate to the level of risk at your workplace.

This document does not identify all hazards within a sugar milling environment and duty holders should implement risk management systems which identify hazards and reduce associated risks by implementing appropriate controls. The management system should also have a method of monitoring and review, particularly after changes are made, so that the controls implemented for particular hazards remain effective.

Further guidance on the process of risk management is provided in the How to manage work health and safety risks Code of Practice, which is applicable to all workplaces in Queensland.

When managing health and safety in sugar mills, duty holders should consider the following issues as relevant to the risk management process.

Note: Section 3 of the Sugar mill safety Code of Practice provides information that is also suitable to cane rail operations in relation to:

- risk registers
- hierarchy of controls
- consultation
- workplace inspections
- recording incidents at the workplace
- training
- housekeeping
- safety signs
- emergency plans and procedures.

Section 3 of the *Cane rail safety* supplement provides guidance specific to cane rail operations in relation to the following:

- safety management plan
- inspection schedule
- locomotive training and competency
- fitness for duty
- rail emergency management
- maintaining records of rail incidents.

3.1 Risk registers

A risk register or list for all hazards at a workplace should be developed. Hazards can be classified under the following areas:

- biological hazards
- energy and electricity
- hazardous manual tasks
- plant
- hazardous chemicals
- work environment
- psychosocial hazards.

A number of hazards typical to the sugar milling process have been outlined in the following sections and a range of effective controls identified for each hazard. There is also a section on general workplace hazards and recommended control measures.

As each mill operates differently, it is necessary for each mill to assess the risk of identified hazards so that the most appropriate controls can be implemented within that operation. Several example risk assessments have been included in the appendices to provide guidance on this process.

3.2 Hierarchy of controls

WHS Regulation section 35: A duty holder, in managing risks to health and safety, must:

a) 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 - minimise those risks so far as is reasonably practicable.

WHS Regulation section 36: If it is not reasonably practicable for a duty holder to eliminate risks to health and safety, the duty holder must minimise risks, so far as is reasonably practicable, by doing one or more of the following:

a) substituting (wholly or partly) the hazard giving rise to the risk with something that gives rise to a lesser risk

b) isolating the hazard from any person exposed to it

c) implementing engineering controls.

If a risk then remains, the duty holder must minimise the remaining risk, so far as is reasonably practicable, by implementing administrative controls.

If a risk then remains, the duty holder must minimise the remaining risk, so far as is reasonably practicable, by ensuring the provision and use of suitable personal protective equipment.

The controls used to manage risks in sugar mills and cane rail operations can be ranked in the ‘hierarchy of control’ from the highest level of protection and reliability to the lowest.

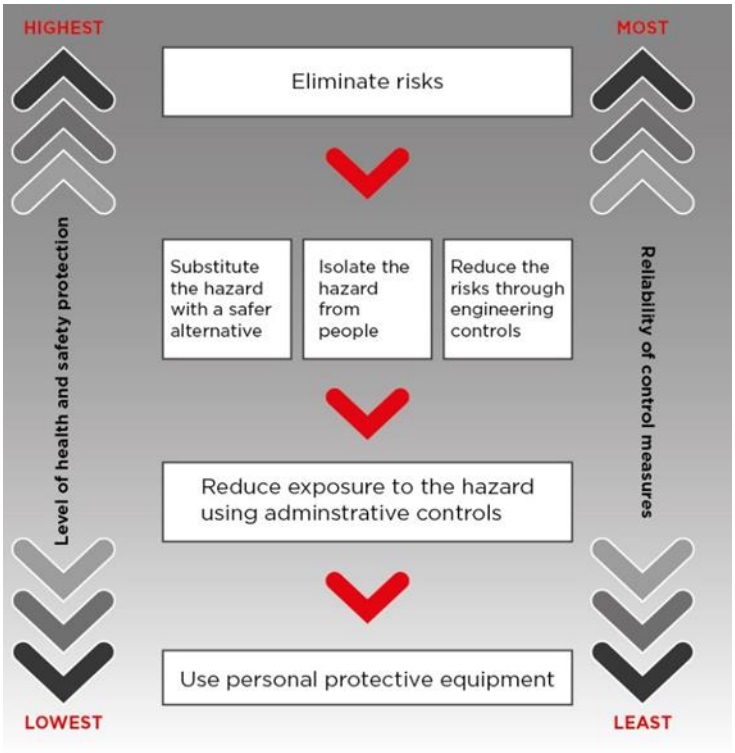

Figure 2: Hierarchy of controls

Duty holders must eliminate risks to health and safety so far as is reasonably practicable, as this is the most effective control. If eliminating the hazard is not reasonably practicable, duty holders must minimise the risk so far as is reasonably practicable by working through the other alternatives in the hierarchy.

Lower order controls, such as administrative controls and personal protective equipment (PPE) should never be used as the primary control measure when other higher order controls are available and effective. In practice, several control options are often used in combination.

3.2.1 Respiratory Protective Equipment (RPE)

WHS Regulation section 44(3): The PCBU who directs the carrying out of work must ensure that personal protective equipment provided is:

a) selected to minimise risk to health and safety, including by ensuring that the equipment is:

   i. suitable having regard to the nature of the work and any hazard associated with the work and

   ii. a suitable size and fit and reasonably comfortable for the worker who is to use or wear it; and

b) maintained, repaired or replaced so that it continues to minimise risk to the worker who uses it, including by ensuring that the equipment is;

   i. clean and hygienic; and

   ii. in good working order; and

c) used or worn by the worker, so far as is reasonably practicable.

Respiratory protective equipment (RPE) may be needed to protect workers from a number of hazards in sugar mills, including:

- asbestos
- bagasse
- hazardous chemicals
- lead
- legionella
- welding and cutting fumes.

RPE should never be used as the primary means for exposure control because higher order controls are more effective. However, in many cases it is appropriate to minimise remaining risks following the use of higher order controls.

> **Note**: A PCBU must not charge or impose a levy on a worker for the provision of RPE, or any other item of personal protective equipment.

Specific guidance on when RPE is an appropriate control measure can be found in the sections of this Code addressing the relevant hazards.

Duties for providing and using RPE

The WHS Act and WHS Regulation includes specific duties for providing and using RPE in the workplace.

Who	Duties	Provisions
Person conducting a business or undertaking (PCBU)	Correctly select RPE and ensure it is:: – able to protect against the identified hazard – the right fit for the worker who will wear or use the RPE.	WHS Regulation s.37(a) s.44(3)(i) s.44(3)(ii)
	Train workers in the right way to use and wear RPE	WHS Regulation s.44(4)(a)
	Make sure the RPE is used correctly, including by supervising how it is used	WHS Regulation s.37(c)
	Make sure RPE is working correctly before each use	WHS Regulation s.44(3)(b)
	Maintain the RPE	WHS Regulation s.37 s.44(3)(b)
	Store the RPE correctly	WHS Regulation s.44(3)(b) s.44(4)(b)
Workers	Use or wear RPE in accordance with any information, training or reasonable instruction given by the PCBU, so far as they are reasonable able	WHS Regulation s.46(2)
	Do not intentionally misuse or damage the RPE	WHS Regulation s.46(3)
	Let the PCBU know about: – any damage to the RPE – any defect with the RPE – any need to clean or decontaminate the RPE	WHS Regulation s.46(4)

Selection of RPE
When selecting RPE, the PCBU should make sure it meets the requirements of *Australian/New Zealand Standard (AS/NZS) 1715-2009 - Selection, use and maintenance of respiratory protective equipment.*

This includes adjusting the selection on the basis of the following factors:

- The worker, including:
    - Any pre-existing medical conditions (for example, chronic lung diseases such as asthma) that could restrict or prevent the wearing of certain respirators.
    - Facial hair can be an issue for tight-fitting respirators (i.e. half and full-face RPE, both negative and positive pressure).

- The task and work environment, including:
    - physical demands and duration of the task (wearing unpowered RPE for more than an hour, or during hard physical work may become uncomfortable and result in a person removing the respirator)
    - how hot and humid the work environment is (powered respirators may be more appropriate where heat stress is a risk)
    - the use of other PPE (for example, safety glasses)
    - if the task requires the worker to have unrestricted vision or to speak clearly.

Fit testing
Fit testing should be used for all tight-fitting RPE provided by the PCBU. There are two accepted methods of fit testing:

1. **Qualitative fit testing** - is a pass/fail test that relies on the wearer's ability to taste or smell a test agent. This type of test is only suitable for half-face respirators.
2. **Quantitative fit testing** – uses specialised equipment to measure how much air leaks into the respirator. This type of test is suitable for half-face and is highly recommended for full-face respirators.

In addition to ensuring a tight-fitting respirator has been successfully fit-tested before it is first used, fit testing should also occur:

- at least once per year
- whenever there is a change in the wearer's facial characteristics or features which may affect the facial seal e.g. large weight loss or gain
- each time a new make or model of tight-fitting respirator is issued.

Fit testing can be carried out in-house by a competent person, manufacturer, supplier or service provider. The Australian Institute of Occupational Hygienists (AIOH) has introduced a scheme for fit testers (Resp-fit), which may provide evidence to help determine whether a fit tester is competent.

3.3 Consultation

WHS Act section 47(1): The PCBU must, so far as is reasonably practicable, consult with workers who carry out work for the business or undertaking who are, or are likely to be, directly affected by a matter relating to work health or safety.

If the workers are represented by a health and safety representative, the consultation must involve that representative.

WHS Act section 48(2): If the workers are represented by a health and safety representative, the consultation must involve that representative.

WHS Act section 46: If more than one person has a duty in relation to the same matter under this Act, each person with the duty must, so far as is reasonably practicable, consult, cooperate and coordinate activities with all other persons who have a duty in relation to the same matter.

Consultation involves sharing of information, including about hazards and associated health risks, giving workers a reasonable opportunity to express views and for PCBUS and officers to take those views into account before making decisions on health and safety matters.

Extensive guidance in relation to PCBUs' legal requirements to consult with workers and other duty holders is provided in the Work health and safety consultation, cooperation and coordination Code of Practice.

3.4 Workplace inspections

WHS Regulation section 34: A duty holder, in managing risks to health and safety, must identify reasonably foreseeable hazards that could give rise to risks to health and safety.

Regular workplace inspections can play a significant prevention role by identifying health and safety issues before they result in injury or damage at the workplace. Workplace inspections are also a key element in monitoring the health and safety standards of contractor activities.

A documented process should be used to control hazards identified during workplace inspections which is based on the risk management process. Inspections should be conducted in conjunction with a representative of the area which is being inspected to enable discussion and resolution of minor issues as they are identified. In shared workplaces, there may be multiple duty holders who should be involved in the inspection.

The PCBU should establish an inspection schedule allocating responsibility to appropriate persons for completion of the inspections. Whilst inspection programs should be undertaken at various times, the frequency of inspections will depend on the nature and circumstances of the area being inspected. Issues such as the level of risk and extent of control that the PCBU has over the workplace (e.g. remote locations) will influence the frequency of inspections.

If the PCBU appoints or has appointed a work health and safety officer, assessments and assessment reports are included in their responsibilities. Further information is provided in WHS Act 2011: Part 5A - Work health and safety officers.

Inspection reports

WHS Act section 70(1)(c): The PCBU must allow any health and safety representative for the work group to have access to information that the person has relating to:

1) hazards (including associated risks) at the workplace affecting workers in the work group; and
2) the health and safety of the workers in the work group.

WHS Act section 79(3): The PCBU must allow the health and safety committee for a workplace to have access to information that the person has relating to:

a) hazards (including associated risks) at the workplace; and
b) the health and safety of the workers in the workplace.

Inspection reports will provide important information on hazards (and associated risks) at the workplace, and so must be made available to any health and safety representative (HSRs) for the relevant work group or any health and safety committee (HSC).

Further information on HSRs and HSCs is provided in the Work health and safety consultation, cooperation and co-ordination Code of Practice.

3.5 Recording incidents at the workplace

WHS Act section 38(1): A PCBU must ensure that the regulator is notified immediately after becoming aware that a notifiable incident arising out of the conduct of the business or undertaking has occurred.

WHS Act section 38(7): A PCBU must keep a record of each notifiable incident for at least five years from the day that notice of the incident is given to the regulator under this section.

WHS Act section 39: The person with management or control of a workplace at which a notifiable incident has occurred must ensure so far as is reasonably practicable, that the site where the incident occurred is not disturbed until an inspector arrives at the site or any earlier time that an inspector directs.

A reference to a site includes any plant, substance, structure or thing associated with the notifiable incident.

This does not prevent any action:

a) to assist an injured person; or
b) to remove a deceased person; or
c) that is essential to make the site safe or to minimise the risk of a further notifiable incident; or
d) that is associated with a police investigation; or
e) for when an inspector or the regulator has given permission.

A notifiable incident has taken place if there is a death of a person, a serious injury or illness of a person, or a dangerous incident at the mill. As soon as the PCBU has become aware of the incident, they must ensure WHSQ is notified immediately.

The record of incident data or statistics should be used to assess the effectiveness of control measures for any given risk, and can also provide a mechanism for identifying other hazards in the workplace.

One of the roles of workplace health and safety committees is reviewing the circumstances surrounding work injuries, work-related illnesses or dangerous incidents referred to the committee for review.

Note: Further information on notifying Work Health and Safety Queensland of notifiable incidents is provided in WHS Act sections 35-39 (including definitions for 'serious injury or illness' and 'dangerous incident'.

3.6 Training

WHS Act section 19(3)(f): The PCBU must ensure, so far as is reasonably practicable, the provision of any information, training, instruction or supervision that is necessary to protect all persons from risks to their health and safety arising from work carried out as part of the conduct of the business or undertaking.

WHS Regulation section 39(2-3): The PCBU must ensure that information, training and instruction provided to a worker is suitable and adequate having regard to:

a) the nature of the work carried out by the worker; and

b) the nature of the risks associated with the work at the time the information, training or instruction is provided; and

c) control measures implemented.

The person must ensure, so far as is reasonably practicable, that the information, training and instruction is provided in a way that is readily understandable by any person to whom it is provided.

Adequate and appropriate training is a requirement for managing the risks associated with hazards in sugar mills and cane rail operations. The extent and nature of training should be determined by:

- the nature of the workplace hazard(s)
- the degree of risk associated with these hazards
- the complex aspects of work, such as operating procedures and equipment
- other controls being implemented
- the qualification and experience of the worker.

Training should cover the specific hazards, risks and controls associated with jobs or tasks that are carried out by the worker receiving the training. All people exposed to risk should be provided with information on:

- workplace health and safety legislation
- the organisation's workplace health and safety program
- workplace health and safety risk management processes
- control measures in place to minimize exposure to risks associated with workplace hazards
- the correct use of controls and how to ensure they are kept in working order
- any known residual risk(s)
- safe work procedures
- how to use and maintain equipment
- emergency procedures and what to do in the event of an emergency.

Training should be appropriate to the type of work to be performed. For tasks that involve a significant level of risk, such as the operation of plant, formal training is suitable. For tasks that involve a lower level of risk, on-the-job training may be adequate. The special needs of workers should be taken into account in deciding on the structure, content, and delivery of training. This should include literacy levels, work experience and specific skills required for the job.

Verification of Competency

A Verification of Competency (VOC) is a method of assessment that enables a PCBU to confirm the current and ongoing competency of a worker or contractor, and to assess any appropriate training, instruction or supervision needs for those operating plant.

A PCBU can use VOCs as evidence of how they have met their legislative duties and have confirmed the ability of a worker or contractor to use specific plant or perform specific tasks.

Further information on the role of VOCs, including recommendations on appropriate assessment content and timeframes, can be found in guidance materials published on the Workplace Health and Safety Queensland website.

3.7 Licensing

High risk work licence

WHS Regulation section 81: A person must not carry out a class of high risk work unless the person holds a high risk work licence for that class of high risk work.

WHS Regulation section 85(1): A PCBU at a workplace must not direct or allow a worker to carry out high risk work for which a high risk work licence is required unless the person sees written evidence provided by the worker that the worker has the relevant high risk work licence for that work.

As stated in the WHS Regulation, **no person is permitted to carry out high risk work unless they are a holder of a high risk work licence for that class of high risk work**.

Classes of high risk work include, but are not limited to:

- boiler and steam turbine operation
- crane and hoist operation
- forklift operation.

Schedule 3 of the WHS Regulation sets out the classes of high-risk work licences and the types of plant involved, and Schedule 4 sets out the competency requirements for a high-risk work licence.

A high risk work licence is not required if the work is carried out in the course of training towards a certification to be licensed and is undertaken under the supervision of a person who is licensed to carry out the high risk work.

Licensing - Electrical work

ES Act section 55: A person must not perform or supervise electrical work unless the person is a holder of an electrical work licence that authorizes the person to perform the work.

ES Act section 18(1): Electrical work means:

a) connecting electricity supply wiring to electrical equipment or disconnecting electricity supply wiring from electrical equipment; or

b) manufacturing, constructing, installing, removing, adding, testing, replacing, repairing, altering or maintaining electrical equipment or an electrical installation.

It is illegal to do electrical work in Queensland without a licence that authorises you to do that work. Work requiring an electrical licence includes, but is not limited to:

- electrical installation work
- electric line work
- electrical equipment work.

Section 18 and 55 of the ES Act outline the limited specific examples of unlicensed work that is permitted.

Part 4 of the ES Regulation outlines the full list of classes of electrical work licences in Queensland, and what each authorises. Schedule 1 of the ES Regulation outlines the electrical licence equivalents from other jurisdictions.

Further information on electrical work licenses and competency requirements can be found on the Workplace Health and Safety Queensland website.

3.8 Fitness-for-work assessments

Fitness-for-work assessments are a useful tool to help ensure that all workers are in a state of health compatible with their job requirements, so as not to endanger their own or others' health or safety.

Fitness-for-work assessments may be appropriate in the following circumstances:

- **Pre-placement**: to determine if the prospective worker is physically capable to do a specific task safely, or work in a particular work environment.
- **Prior to a worker taking on a new position/responsibility**: to determine if the worker is physically capable to do a specific task safely, in relation to a change in work location, work hours, physical demands or exposure.
- **Assessment related to a specific task or work environment**: to determine if a specific change to the worker or work environment affects the ability of the worker to safely perform a specific task or work in a specific environment.

A fitness-for-work assessment of an existing worker should only be carried out if the line manager, supervisor or team leader has a cause for concern for the person's health and their continued suitability for a specific task or work in a specific environment.

Details of any fitness-for-work assessment should be treated as confidential.

3.9 Housekeeping

Housekeeping is an important part of maintaining a system aimed to reduce or eliminate risk in the workplace.

For example, spilt cane billets and other detritus are dangerous underfoot, whether in a mill (at the tippler) or in cane rail operations (at sidings). Spillage cane destabilise a worker's footing, leading to accidents. Spillage can also lead to derailment of empty bins at the mill or in sidings adding further risk to workers.

All duty holders have roles to play in maintaining housekeeping standards in their work area and in all their activities. Training designed to encourage awareness of the importance of housekeeping, using systems set up at each site, should be included in induction programs. Additional training may be provided as appropriate.

Key methods for maintaining good housekeeping include:

- allocate responsibility for housekeeping for particular areas to teams or individuals (this may include reaching agreement where there is shared responsibility between multiple duty holders)
- regular housekeeping inspections and records
- process for corrective action for identified hazards based on risk management practices
- barricading areas where spills have created a health and safety hazard. The barricade should be of a standard which will contain the spill and restrict access to the area.
- restricted area management, particularly during maintenance season.

Further information on housekeeping to address specific hazards in sugar mills are provided in relevant sections of this code.

3.10 Safety signs

Safety signs are a recognised method of identifying hazards within a workplace and consist of signs, symbolic signs, markings and colour. Signs have a range of applications but should be considered an administrative control only. This section covers the issues associated with the identification of hazards by means of signage with an aim to ensure known hazards are identified by means of signs, markings or colour and that all personnel are familiar with the meaning of safety signs and markings.

The use of appropriate signage will be determined from the risk assessment process. This should include identifying the following hazards using the signage outlined below:

- physical hazards should be identified by means of colour
- confined spaces should be marked as required by Australian Standard (AS) 2865 Confined spaces
- underground services (pipes and cables) should be marked by means of the appropriate marking tape in accordance with AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)
- pipes, conduits and ducts should be identified in accordance with AS 1345 Identification of the contents of pipes, conduits and ducts.
- hazardous chemicals, including in containers and pipework (for further information, see Section 7.1 - Hazardous chemicals).

Safety signs in accordance with AS 1319 safety signs for the occupational environment should be installed where required.

Note: Signage should only be used in conjunction with other control measures.

The PCBU should be aware of the language capabilities of employees. Signage in other languages or symbols only may be required.

3.11 Emergency plans and procedures

WHS Regulation section 43(1): A PCBU at a workplace must ensure that an emergency plan is prepared for the workplace, that provides for the following:

a) emergency procedures, including:

   i. an effective response to an emergency; and

   ii. evacuation procedures; and

   iii. notifying emergency service organisations at the earliest opportunity; and

   iv. medical treatment and assistance; and

   v. effective communication between the person authorised by the person conducting the business or undertaking to coordinate the emergency response and all persons at the workplace

b) testing of the emergency procedures, including the frequency of testing

c) information, training and instruction to relevant workers in relation to implementing the emergency procedures.

A number of emergency situations may arise within sugar milling operations including but not limited to:

- fire and/or explosion
- rescue from heights
- rescue from confined spaces
- chemical spills
- natural disasters
- bomb threats.

A number of emergency situations may arise within cane rail operations including but not limited to:

- train contacts
- level crossing incidents
- natural events (floods, fires, cyclones)
- control system failure (radio network or individual failure)
- secondary contacts (contacts which occur in the vicinity of the track but do not involve rolling stock)
- power failures to control rooms
- chemical/fuel spills
- electrical incidents (including fallen powerlines).

PCBUs and officers must ensure that effective emergency response procedures are planned, distributed, understood and tested so that in the event of an accident or emergency, relevant workers are prepared.

In some instances, hazards which create emergency situations such as natural disasters cannot be controlled. However, the hazards associated with these events can be managed. PCBUs and officers must implement processes which enable:

- the notification of incidents to emergency services
- identification of the location of the incident site by emergency and other services and the provision of clear instructions and information (e.g. for cane rail operations, map reference or GPS location)
- the provision of medical treatment, such as basic first aid
- a first response system for dealing with emergency situations
- a method of instigating and controlling a site evacuation (or evacuation from an emergency location if it occurs offsite during cane rail operations).

These procedures must be implemented in a manner which allows the emergency system to successfully operate regardless of the status of the factory (e.g. when the mill is operational, non-operational, on continuous shift roster or on a five day roster) or cane rail operations. Consideration must also be given to other operational factors such as the general availability of personnel because of sick leave and annual leave.

Emergency procedures must be tested to ensure they are efficient and effective. Rehearsals should include relevant workers, and occur on a regular basis (for example, annually).

Further information on developing an emergency plan is provided in Queensland Fire and Rescue's Emergency Planning *Workplace Health and Safety Regulation 2011* guidance document.

Engagement with Queensland Fire and Emergency Services (QFES)

WHS Regulation section 361: This section applies if the quantity of a schedule 11 hazardous chemical used, handled, generated or stored at a workplace exceeds the manifest quantity for that hazardous chemical.

A person conducting a business or undertaking at the workplace must give a copy of the emergency plan prepared under part 3.2, division 4 for the workplace to the primary emergency service organisation.

If the primary emergency service organisation gives the person a written recommendation about the content or effectiveness of the emergency plan, the person must revise the plan in accordance with the recommendation.

Workplaces that exceed the manifest quantity listed in column 5 of Schedule 11 of the WHS Regulation are referred to as manifest quantity workplaces (MQWs) and must submit a copy of their emergency plan to QFES for review under section 361. Any recommendations about the content or effectiveness of the emergency plan will need to be incorporated into a revised plan.

Further information on emergency planning is available from WHSQ, including on how to submit emergency plans for MQWs to QFES. It is advised that you retain evidence of QFES receiving the emergency plan (e.g., email receipt) for your records.

More broadly, it is recommended that the PCBU engage early with local fire and emergency services when preparing emergency procedures. This helps ensure that rescue personnel are better prepared to provide assistance in the event of an emergency.

4. General workplace hazards

Note: Section 4 of the Sugar mill safety Code of Practice provides information that is also suitable to cane rail operations in relation to:

- hazardous manual tasks
- whole-body and hand-arm vibration
- exposure to noise
- heat stress management.

The *Cane rail safety* supplement provides guidance specific to cane rail operations in relation to the following:

- fatigue management (see Section 3.4 Fitness for the Duty)
- electrical (see Sections 5.4 Downed power lines and 6.5 Overhead electric lines and exclusion zones).

4.1 Falling objects

WHS Regulation section 54: A PCBU at a workplace must manage risks to health and safety associated with an object falling on a person if the falling object is reasonably likely to injure the person.

WHS Regulation section 55(3): The PCBU provides adequate protection against the risk if the person provides and maintains a safe system of work, including:

a) preventing an object from falling freely, so far as is reasonably practicable; or

b) if it is not reasonably practicable to prevent an object from falling freely - providing, so far as is reasonably practicable, a system to arrest the fall of a falling object.

Sugar mills are multi-level installations and have some structures which can be higher than 60 metres like chimney stacks. This presents the risk that equipment, material, tools or debris could be dropped, dislodged or free fall and hit people in the workplace.

When assessing the risks arising from a potential falling object hazard, factors that the PCBU should consider include, but are not limited to:

- the design and layout of elevated work areas, including the distance of a potential fall and what the falling object might be
- the type of work being conducted at elevated work areas (and whether special provisions are required, such as for hot work)
- the number and movement of all people at the workplace
- how close people are to unsafe areas where loads are placed on elevated work areas, or where work is to be carried out at an elevated area and there is a risk of falling objects
- the consequences of being struck by a falling object.

4.1.1 Control measures—falling objects

Duty holders are required to work through the hierarchy of controls to determine which risk control measures to implement.

Lower order controls, such as administrative controls and personal protective equipment (PPE) should never be used as the primary control measure when other higher order controls are available and effective. Effective control measures are often made up of a combination of controls.

Risk control measures to prevent an object from falling from an elevated work area can include, but are not limited to:

- providing a secure physical barrier at the edge of the elevated work area, such as toe boards or infill panels, that form part of a guardrail system
- tethering or otherwise securing tools and materials to prevent them falling on people below
- using chutes if debris is being placed into a skip below a work area.

Risk control measures to arrest the fall, and manage high risk areas, can include, but are not limited to:

a. Engineering

- Establish an exclusion zone, with secure impassable barricades, to prevent unauthorised access persons or vehicles from accessing high risk areas. The exclusion zone should extend horizontally to a safe distance beyond the overhead work area
- Using catch nets or platforms to catch falling objects. The structures used should be strong enough to withstand the impact forces of the potential falling objects identified in the risk assessment
- Providing a falling object protective structure on mobile plant.

b. Administrative

Implementing a safe system of work to address falling objects that include:

- using exclusion zone signage
- providing supervision of exclusion zones so that no unauthorized person enters
- providing information, training and instruction to workers and others at the workplace advising them of the exclusion zones in place
- developing safe work procedures that describe the task, identify the hazards and document how to task is to be performed to minimise any risks associated with falling objects
- organising and sequencing of work tasks, to ensure work is not conducted above and below each other at the same time
- specifying pathways for workers and others.

c. Personal protective equipment (PPE)

- Using head protection (e.g. helmets, hard hats).

Note: Helmets and hard hats are personal protective control measures only. Guidance should be sought from the appropriate Australian Standard as to what level of protection they offer from falling objects.

Further information for reference is provided in the Safe Work Australia falling objects fact sheet, which is available on the Safe Work Australia website.

4.2 Slips trips and falls

WHS Regulation section 40(a): A PCBU at a workplace must ensure, so far as is reasonably practicable, that the layout of the workplace allows, and the workplace is maintained so as to allow, for persons to enter and exit and to move about without risk to health and safety, both under normal working conditions and in an emergency.

WHS Regulation section 40(c): A PCBU at a workplace must ensure, so far as is reasonably practicable, that floors and other surfaces are designed, installed and maintained to allow work to be carried out without risk to health and safety.

Slips trips and falls at level are a common cause of musculoskeletal injury in workplace. It is usually a combination of factors that can create the risk, such as:

- presence of contaminants on flooring
- poor stair design
- inadequate cleaning practices
- poor housekeeping
- unsuitable footwear.

Workers may not be able to move safely around the workplace if walkways are uneven or restricted. Inadequate lighting and loads being carried may also prevent good vision and increase the risk of injury.

Sugar manufacturing involves particular processes which may affect the risk of slips trips and falls. For example, reactions between concrete and sugar products (sugar dust, molasses, or massecuite) can, in the short term, cause surfaces to become slippery and over time damage floors and walkways.

Varying weather conditions can also introduce water and mud contaminants, creating slippery conditions for the workplace environment, both indoors and outdoors.

4.2.1 Control measures—slips trips and falls

Duty holders are required to work through the hierarchy of controls to determine which risk control measures to implement.

The following control measures should be considered to prevent or minimise the risk of trips and falls:

- the design of work areas; for example, shelter over walkways and entrances to production areas
- installation of appropriate flooring and then replacement or resurfacing of flooring to maintain slip resistance
- maintenance of equipment to minimise spills and floor contamination (e.g., repair of leaking pipes, joints, and vessels)
- adequate lighting
- ensuring the removal of potential trip hazards, or making them easier to spot (e.g., clearly marking fixed objects, edges of paths and steps)
- loss of sugar product reduction programs (e.g., example dust, molasses, liquor and juice leaks)
- ensure suitable cleaning products are used for the known contaminants
- review cleaning contractual arrangements to ensure cleaning of contaminants is performed as required
- regular housekeeping inspections
- establish a suitable footwear policy, which includes maintenance and replacement programs.

4.3 Working at height

WHS Regulation section 78(1): A PCBU at a workplace must manage risks to health and safety associated with a fall by a person from one level to another that is reasonably likely to cause injury to the person or any other person.

WHS Regulation section 79(3): The PCBU provides adequate protection against the risk if the person provides and maintains a safe system of work, including by:

a) providing a fall prevention device if it is reasonably practicable to do so; or

b) if it is not reasonably practicable to provide a fall prevention device, providing a work positioning system; or

c) if it not reasonably practicable to comply with either paragraph a) or b), providing a fall arrest system, so far as is reasonably practicable.

Sugar mills are multi-level installations and have some structures which can be higher than 60 metres like chimney stacks. Falling from a height is a serious risk when repairing, maintaining or gaining access to:

- silos
- towers
- sheds
- other plant and structures.

When assessing the risks arising from working at height, the PCBU should consider:

- the height of the work
- guard rails or other edge protection
- roof pitch and surface conditions
- weather conditions, including wind strength
- complexity of task
- the method of access to the work area.

Scaffolding

The erection, alteration, use and dismantling of scaffold exposes workers to the risk of a serious fall or being struck by falling objects, such as scaffold components, tools, or in the event of a collapse, the entire scaffold.

The WHS Regulation outlines specific requirements for PCBUs related to the use of scaffolds, including:

- preventing risk of fall in the erection and dismantling of scaffolding
- preventing unauthorised access to the scaffold while it is incomplete or unattended
- regular inspections of scaffolds by a competent person, including before use and following an incident or repairs.

Detailed guidance on managing the risks associated with scaffolding is provided in the Scaffolding Code of Practice.

4.3.1 Control measures – working at height

Duty holders are required to work through the hierarchy of controls to determine which risk control measures to implement. This includes prioritising elimination of the risk, so far as is reasonably practicable, by arranging for the work, or part of the work, to done on the ground.

If it is not reasonably practicable for the work to be done on the ground, the PCBU must minimise the risk so far as is reasonably practicable by implementing control measures.

WHS Regulation section 60(2): In determining what control measures to implement, the PCBU must have regard to all relevant matters that may contribute to a musculoskeletal disorder, including:

a) postures, movements, forces and vibration relating to the hazardous manual task; and

b) the duration and frequency of the hazardous manual task; and

c) workplace environmental conditions that may affect the hazardous manual task or the worker performing it; and

d) the design of the work area; and

e) the layout of the workplace; and

f) the systems of work used; and

g) the nature, size, weight or number of persons, animals or things involved in carrying out the hazardous manual task.

The PCBU should refer to the *Managing the risks of falls at workplaces Code of Practice* for information on their duties and requirements related to working at height, including for the use of effective controls including:

- fall prevention devices
- work positions systems
- fall arrest systems
- work positioning systems.

The Managing the risks of falls at workplaces Code of Practice also provides information on the PCBU's duties to establish emergency procedures for all arrest systems.

4.4 Hazardous manual tasks

WHS Regulation section 60(1): A PCBU must manage risks to health and safety relating to a musculoskeletal disorder associated with a hazardous manual task.

Manual tasks are a part of nearly all work performed by workers within sugar mill operations. However, not all manual tasks are hazardous. Hazardous manual tasks are defined as any activity where workers lift, lower, push, pull, carry or otherwise move, hold or restrain a load that has one or more of the following:

- repetitive or sustained force
- high or sudden force
- repetitive movement
- sustained or awkward posture
- exposure to vibration.

Examples of tasks that may have these hazards present include operating a control panel or a computer for long periods of time, pushing heavy loads, repairing machinery above shoulder height or in a twisted position, driving a bobcat all day, using sledgehammers, using vibrating tools or raking bagasse.

Hazardous manual tasks can contribute to musculoskeletal disorders (MSDs) such as sprain and strain injuries, as a result of a worker being exposed suddenly to a high or sudden force, for example, or develop over a longer period of time performing tasks with hazardous manual task risk factors present.

Performing a specific manual task risk assessment helps identify the risk factors. A useful tool for risk assessment of hazardous manual tasks is the Participative ergonomics for manual tasks (PErforM) program. This program can be used to help employers and workers work together to identify and manage manual task risks.

Further information and resources to support the use of the PErforM program can be found on the Workplace Health and Safety Queensland website.

4.4.1 Control measures - hazardous manual tasks

Duty holders are required to work through the hierarchy of control to choose the control that most effectively eliminates or minimises the risks. This may involve a single control measure or a combination of two or more different controls.

The Hazardous manual tasks Code of Practice provides detailed information about how to manage the risk of a musculoskeletal disorder arising from hazardous manual tasks in the workplace, including guidance on effective controls.

The PCBU is required to ensure information, training and instruction provided to workers is suitable and adequate given the nature of the work, risks associated with the work and what controls have been implemented to control the risks present.

The information, training and instruction should include:
- manual task risk management –what hazards are associated with hazardous manual tasks
- specific risks in the task or tasks and the measures in place to control them
- how to perform the task safely including how to use the mechanical aids, equipment, tools and safe work procedures provided
- how to report a problem or maintenance issue.

Note: Training workers how to lift, such as bending their knees and keeping their back straight is not considered adequate training.

4.5 Whole-body and hand-arm vibration

Many activities in sugar mills cause vibration which may r be introduced as part of a process or occurs as a by-product. Workers involved in the various processes may therefore be exposed to whole-body or hand-arm vibration. Both types of exposure are capable of causing ill health effects, disorders or disease. Studies have shown that simultaneous exposure to noise and vibration can cause greater hearing loss than exposure to either source alone.

Whole-body vibration
Whole body vibration may cause, or make worse:
- musculoskeletal disorders (MSDs), mainly involving the lower spine, back and shoulders, in particular, lower-back pain, herniated discs and early degeneration of the spine
- damage to nerves and circulation
- visual impairment
- problems with the balancing system in the ear, leading to symptoms like motion sickness and nausea.

There are no set limits for exposure to vibration. However, AS 2670.1 *Evaluation of human exposure to whole-body vibration - Part 1: General requirements* provides health guidance zones applicable to people in normal health and who are regularly exposed to vibration. It further provides guidance for the assessment of comfort and the incidence of motion sickness.

Further guidance is provided in the *Guide to measuring and assessing whole body vibration* and the information sheet on whole-body vibration. They are available on the Safe Work Australia website.

Hand-arm vibrations
Hand-arm vibration may result in:

- nerve and blood vessel degeneration leading to vibration white finger syndrome
- pain and cold sensation between attacks of vibration white finger
- loss of grip strength
- damage to joints and muscles in wrists and/or elbows
- carpal tunnel syndrome
- bone cysts in fingers and wrists.

AS ISO 5349.2 Mechanical vibration - Measurement and evaluation of human exposure to hand-transmitted vibration - Part 2: Practical guidance for measurement at the workplace provides guidelines for the assessment of hand-arm vibration.

Hand-arm vibration exposure is expressed as an average exposure over a four-hour period in a shift. Where exposure exceeds an acceleration value of 2.9m/s², the worker should be medically examined for the presence of vibration white finger or susceptibility for vibration white finger. People with, or susceptible to, vibration white finger should not perform work which causes hand-arm vibration.

See guide to measuring and assessing workplace exposure to hand-arm vibration and information sheet on hand-arm vibration for further information.

4.5.1 Control measures – whole-body and hand-arm vibration

Engineering control measures are the most effective form of controls because once in place they operate all of the time. The use of PPE is considered a less effective form of control as its effectiveness is heavily dependent on the wearer and should not be used as the primary control measure where design controls are available and effective.

Reduction of vibration in many instances also leads to reduction in noise emissions and the control of vibrations in work processes therefore serves an important dual purpose.

Ways to prevent or minimise the risk of vibration-related injury include:

- assessing the risks, including conducting vibration exposure surveys in accordance with *AS 2670.1 Evaluation of human exposure to whole-body vibration - General requirements* or *AS ISO 5349.1 Mechanical vibration - Measurement and evaluation of human exposure to hand-transmitted vibration - Part 1: General requirements as appropriate*, to identify risk processes and/or activities
- developing a vibration policy and vibration management program
- implementing a program for conducting vibration surveys on a regular basis and corrective actions
- implementing vibration control measures in consultation with workers and the engineering/maintenance section of sugar mills, in accordance with the hierarchy of controls

- providing management and workers with education, training and information on vibration exposure, its effects and the need for its control
- providing regular medical check-ups to exposed workers.

Control measures to minimise exposure to vibration that should be considered as part of a risk management process include:

- treating the vibration source (i.e., isolate vibrating plant from its foundation through dampers and springs, redesign or modify)
- treating the vibration transmission path (i.e., isolate ducts etc. from stationary plant)
- treating the receiver (i.e., isolate control rooms/enclosures etc. from vibrating plant and surfaces)
- using tools with anti-vibration handles
- maintaining properly sharpened cutting tools
- job rotation, to limit exposure to hand arm vibration exposure to no more than four hours per shift and of whole-body vibration to no more than eight hours per shift
- an adequate plant and equipment maintenance program
- personal protective equipment (e.g., anti-vibration gloves)
- using minimum hand grip on tools consistent with safe work practices
- avoiding smoking as this restricts the blood vessels.

If personal protective equipment (PPE) is to be used as a control measure, the PCBU who directs the relevant work must ensure that workers provided with PPE receive proper training and instruction on their correct use, care and maintenance. Selection of PPE must be on the basis of individual fit, comfort, work tasks and work environment with respect to the equipment being worn and in order to achieve a reduction in vibration exposure.

In each sugar milling operation, a program should be developed for the regular monitoring of vibration exposure levels and checking the effectiveness of vibration control measures. Maintenance schedules should be put in place to ensure vibration insulators on plant are maintained in good condition to achieve maximum vibration reduction.

Monitoring

A monitoring program should include:

- regular vibration exposure surveys of workers
- identification of sources of hazardous vibration
- assessment of vibration control measures
- suitability of any personal protective equipment provided
- regular medical checks at the discretion of the medical practitioner
- periodic review of the effectiveness of the vibration management program

Health monitoring

If health monitoring is required, it should be conducted by, or supervised by a registered medical practitioner with experience in health monitoring. Health monitoring for vibration exposure will include:

- pre-employment history, including the taking of medication for migraine, hypertension or heart disease
- examination within six months after commencing employment
- examination taken before a shift and after at least 12 hours away from exposure
- no smoking for four hours prior to test
- challenge tests
- provision of information for workers on vibration white finger and other symptoms of vibration exposure.

4.6 Exposure to noise

WHS Regulation section 57: A PCBU at a workplace must manage, under part 3.1, risks to health and safety relating to hearing loss associated with noise.

A PCBU at a workplace must ensure that the noise that a worker is exposed to at the workplace does not exceed the exposure standard for noise.

The use of plant and equipment in sugar mills can create significant noise, including:

- plant associated with steam and compressed air (e.g., vents, pressure reducing valves, silencers, pipes or turbines)
- power houses
- plant (e.g., shredders, fans, blowers or centrifuges)
- workshop activities (e.g., grinding, hammering, metal cutting operations).
- miscellaneous items (e.g., vacuum breakers, air operated valves, warning horns).

Exposure to high noise levels can cause permanent hearing loss and tinnitus (ringing in the ear). High noise levels can either cause gradual hearing loss over time or be so loud that it causes immediate hearing loss. Health risks also associated with exposure to noise include increased heart rate, higher blood pressure, stress and fatigue.

The PCBU is required to identify all reasonably foreseeable hazards in the workplace, including noise hazards. This can be done using the noise hazard identification checklist provided in the *Managing noise and preventing hearing loss at work Code of Practice*. This checklist should be used to assess workstations in the sugar mill.

Once a noise hazard has been identified, the PCBU should assess the risks by carrying out a noise assessment, unless the noise exposures can be reduced to below the standard immediately.

Further information on noise hazards and conducting a noise assessment is provided in the *Managing noise and preventing hearing loss at work Code of Practice.*

4.3.1 Control measures – exposure to noise

Duty holders are required to work through the hierarchy of controls to determine which risk control measures to implement, with the most effective control measure being removing the source of noise completely.

The PCBU should refer to the *Managing noise and preventing hearing loss at work Code of Practice* for information on selecting, maintaining and review controls related to exposure to noise, including:

- designing, purchasing or constructing plant at the workplace to minimise noise levels
- engineering controls to minimise or isolate noise
- maintenance of plant, to avoid deteriorating plant getting noisier
- job rotation
- provision and maintenance of hearing protectors.

Hearing protectors
Hearing protectors must be worn in work areas where noise cannot be practically reduced below the exposure standard (noises greater than 85 dB(A)) by higher order controls or, as an interim, until such controls can be put in place. Signage indicating the requirement to wear hearing protection in these areas should be erected and visible to workers.

Note: A policy of personal hearing protection for all persons entering factory processing areas is recommended. If personal hearing protection is used in a work area, the PCBU should review the use of communication devices or alarms as control measures.

Monitoring
A program for the regular monitoring of noise exposure levels and checking of the effectiveness of noise control measures is an appropriate way to structure the regular assessments and review of controls outlined in the Managing noise and preventing hearing loss at work Code of Practice, including:

- regular noise assessments
- identification of sources of hazardous noise
- assessment of noise control measures
- suitability of personal hearing protectors provided
- regular audiometric testing
- periodic review of the effectiveness of the noise management program based on the results of the noise surveys, audiometric tests, use of hearing protectors and other control measures.

4.7 Heat stress management

WHS Regulation section 40(f): A PCBU at a workplace must ensure, so far as is reasonably practicable, that workers carrying out work in extremes of heat or cold are able to carry out work without risk to health and safety.

- Summer temperatures and humidity in Queensland are often high, especially where many sugar mills are located. Exposure to heat stress-related injury and illness must be managed in the sugar industry. Heat stress comes from the combined contributions of job factors, such as work of a strenuous nature (e.g., clearing chokes)
- work that is sustained for extended periods
- work in confined spaces
- work in close proximity to heat sources (e.g., boilers)
- work that involves generating heat (e.g., welding)
- inadequate cooling off or rest periods.

Environmental and seasonal factors, such as:

- high air temperatures
- radiant heat from hot objects such as machinery (e.g., hot boiler drums, effet and pan vessels)
- radiant heat from working outdoors in the sun.

Worker-related factors, such as:

- excessive or inappropriate clothing, protective or otherwise
- dehydration from poor diet, vomiting, diarrhoea, alcohol and caffeine (diuretics) consumption and insufficient drinking
- medical condition (i.e., heart problems, diabetes, hypertension or fever caused by infections).

The most common health problems associated with heat stress are fainting, transient heat fatigue and heat rash. However, with excessive exposure to heat stress, especially for those who are overweight, elderly or those on specific medications, more serious heat illnesses such as heat cramps, heat exhaustion and heat stroke may occur.

4.7.1 Control measures – heat stress management

Duty holders are required to work through the hierarchy of controls to determine which risk control measures to implement. If it is not reasonably practicable to eliminate exposure to heat, risks must be minimised. The following control measures should be considered:

Altering work environment:

- Reducing the body's metabolic heat production using automation and mechanisation of tasks.
- Reducing radiant heat emissions from hot surfaces and plant, with insulation and shielding.
- Using ventilation and air-conditioning.
- Reducing humidity; for example, by installing a dehumidifier.
- Installing shade structures for outdoor work.

Hydration:

- PCBUs must ensure the provision of drinking water for workers.
- Workers should drink 150-200 ml of cool fluids every 15-20 minutes, rather than drinking a litre at less frequent intervals.
- Full re-hydration should be achieved before recommencing work on subsequent days

Medication and fitness:

- Workers should seek a doctor's advice if working in hot environments and using medications like sedatives, tranquillisers, antidepressants, amphetamines, antispasmodics, diuretics or those affecting blood pressure, as they may interfere with heat tolerance.
- Avoid alcohol and caffeinated drinks as they are diuretics

Administrative, work schedule and clothing:

- Task rotation to limit duration of exposure to hot work.
- Scheduling regular rest breaks in cool, shady areas with protective clothing removed.
- Organising outdoor work so workers carry out alternative tasks, or work in shade, during hot periods of the day.
- Isolating hot work practices to times/locations distant from other workers
- Providing outdoor workers with personal protective equipment and clothing, such as a wide brim hat, long sleeved and collared shirt, long pants, sunglasses and sunscreen

PBCUs should ensure supervisors and workers are trained to identify and report early symptoms of any heat-related illness.

Note: Consulting with the relevant workers to determine an appropriate break schedule for tasks involving heat stress should form part of the risk assessment for these tasks. See section 3.3. for more information on consultation with workers.

4.8 Fatigue and working hours

Fatigue is an issue which should be considered as part of an overall safety system for sugar milling operations. Fatigue affects a person's health, reduces performance and productivity within the workplace and also increases the chance of a workplace incident occurring.

The following factors are associated with fatigue:

- spending long periods of time awake
- insufficient amount of sleep over an extended period
- poor quality of sleep over an extended period.

Fatigue is also caused by prolonged periods of physical and/or mental exertion without enough time to rest and recover. The level of fatigue can depend on:

- workload
- length of shift
- previous hours and days worked
- time of day or night worked.

4.5.1 Control measures – fatigue and working hours

Duty holders should consider the following factors when managing fatigue and working hours:

- roster design (e.g. number of consecutive night shifts worked, starting and finishing times of shifts and length of shifts)
- commuting hours (e.g. excessive hours spent travelling to and from work can extend the effective length of a shift, and reduce the time available for sleep and recovery between shifts)
- shift rotation (e.g. if the starting times of shifts vary throughout the cycle of shifts, the cycle should begin with an early start and move progressively later)
- breaks (e.g. time spent away from the work environment has the potential to allow workers to recover from fatigue and improve work performance, vigilance, safety and efficiency)
- occupational exposure levels (e.g. extended working hours may result in exposure to hazards such as noise, heat and chemicals increasing and should be carefully monitored)
- manual tasks (e.g. the prolonged performance of repetitive tasks without the adequate chance of rest and recovery may result in an occupational overuse injury).

Further guidance is provided in the *Workplace Health and Safety Queensland Preventing and managing fatigue-related risk in the workplace* guide, and the Safe Work Australia Guide for *Managing the risk of fatigue at work and Fatigue management - a guide for workers.* These guides are available on the Workplace Health and Safety Queensland website.

4.9 Electrical

ES Act section 30: A PCBU must ensure the person's business or undertaking is conducted in a way that is electrically safe.

The duty includes:

a) ensuring that all electrical equipment used in the conduct of the person's business or undertaking is electrically safe; and

b) if the person's business or undertaking includes the performance of electrical work, ensuring the electrical safety of all persons and property likely to be affected by the electrical work; and

c) if the person's business or undertaking includes the performance of work, whether or not electrical work, involving contact with, or being near to, exposed parts, ensuring persons performing the work are electrically safe.

The *Electrical Safety Act 2002* (ES Act) and *Electrical Safety Regulation 2013* (ES Regulation) prescribe ways to control the risks associated with electricity for duty holders. The ES Act outlines general electrical safety duties. The ES Regulation states the allowable distance for working near a live electrical part.

The following Electrical Safety Codes of Practice give practical advice on safe systems of work and exclusion zones.

- Managing electrical risks in the workplace
- Working near overhead and underground electric lines
- Works

Common tasks in a sugar milling environment that may have electrical risks are:

- operation of plant around electrical lines and parts
- electrical work
- use of electrical equipment including equipment failure
- working on electrical switchboards or electrical machines subject to high fault currents and arc flash.

Note: Only licensed electrical workers can do electrical work, including on electrical installations, electric lines and electrical equipment. See Section 3.6 - Licensing, for more information.

Hazards associated with electrical equipment or installations may arise from the design, construction, installation, maintenance and testing of electrical equipment or electrical installations.

The milling process operating environment can be the subject of wet areas or dust conditions which can affect the electrical safety of electrical equipment or the electrical installation. Measures are required that ensure the electrical installation and electrical equipment are electrically safe and are operated in a way that is electrically safe.

For further guidance refer the *Managing electrical risks in the workplace Code of Practice.*

4.9.1 Powerlines – overhead and underground

ES Regulation section 68: A PCBU at a workplace must ensure, so far as is reasonably practicable, that no person, plant or thing at the workplace comes within an unsafe distance of an overhead or underground electric line.

If it is not reasonably practicable to ensure the safe distance of a person, plant or thing from an overhead or underground electric line, the person conducting the business or undertaking at the workplace must ensure that:

a) a risk assessment is conducted for the proposed work; and

b) control measures implemented are consistent with:

i. the risk assessment; and

ii. if an electricity entity is responsible for the electric line—any requirements of the entity.

Contact with overhead or underground powerlines can be fatal, whether the lines are carrying a voltage as high as 330,000 volts or as low as 230 volts. Contact with an overhead electric line is not necessary for an electric shock to occur. A close approach to the line conductors may allow a 'flashover' or arc to take place. The risk of flashover increases as the line voltage increases.

As part of a risk assessment before work commences, an inspection of the work area should be conducted to identify energised overhead powerlines or associated electrical equipment, and the whereabouts of any underground electric lines. A risk assessment should involve more than one of the following:

- talking to workers and observing where overhead electric lines are located
- using Look up and Live to locate any overhead electric lines (e.g., by checking online or using the app)
- getting advice regarding the location of any underground electric lines (e.g., by contacting "Before You Dig")
- talking to electricity entities regarding electric lines the entity is responsible for
- reviewing incident reports
- reviewing drawings or schematics
- identifying markers on the ground
- using cable locators.

Working near powerlines is therefore a very dangerous activity unless the appropriate precautions are taken, which includes:

- developing a safe system of work, before undertaking work near powerlines
- keeping workers/contractors informed and trained in safe work procedures, emergency procedures and exclusion zones
- ensure powerlines and poles are visible with clear signage (such as signs that point to any overhead and underground powerlines)
- establish exclusion zones, in line with Schedule 2 of the ES Regulation.

Note: If you expect that your work may cause a person and/or equipment part to come closer than the exclusion zone of a power line, you must ensure a risk assessment is conducted and control measures are consistent with the risk assessment and any requirements of the electrical entity who is responsible for the line.

You are not allowed to start work near the powerline without meeting this requirement.

Further guidance on electrical risks and control measures for powerlines and electrical cables, including exclusion zones, is provided in the *Working near overhead and underground electric lines Electrical Safety Code of Practice*, and the Workplace Health and Safety Queensland Working safely near powerlines industry guides.

4.9.2 Electricity generation

ES Act section 29: An electricity entity has a duty to ensure that its works:

a) are electrically safe; and

b) are operated in a way that is electrically safe.

The duty includes the requirement that the electricity entity inspect, test and maintain the works.

ES Regulation section 195: A person, including an electricity entity, who designs, builds, maintains or operates works of an electricity entity must ensure that the requirements of this part for the works of an electricity entity are complied with.

Electricity can be generated in a sugar mill from steam turbines, which are powered by boilers fueled by the burning of bagasse. The electricity generated is used to power factory operations in the mill, with some mills exporting additional electricity to the National Electricity Market or grid.

The ES Act and ES Regulation outline specific legal requirements for electrical entities, which includes businesses that generate electricity (a generation entity). These concern the design, installation and maintenance of electrical equipment, and electric line associated equipment, used by the entity to generate or supply electricity.

For sugar mills this includes electrical asset management:

- electrical maintenance
- work undertaken by licenced electrical workers with training appropriate to the work, including workers trained in high voltage (HV) switching where appropriate
- engaging services of a licenced electrical contractor
- engaging an accredited auditor for high voltage and hazards areas (ES Regulation s.221).

Further guidance on meeting the requirements of an electrical entity is provided in the *Works electrical safety Code of Practice* and the *Prescribed electricity entities safety management system, audit and governance guide*. Both are available on the Workplace Health and Safety Queensland website.

4.9.3 Control measures–electrical safety

The PCBU should consider the following factors should be considered when assessing risks:

- type of work carried out and tools or equipment used
- proximity of the work to energised parts
- the types of tools and equipment used in the work (e.g., the conductive properties of tools)
- environmental conditions such as confined spaces, wet surfaces or unfavourable weather
- assessing the need to repair equipment while it remains energised (e.g., cleaning a low voltage switch room)
- work that may impose additional risks (e.g., welding or grinding that could damage adjacent electrical lines or equipment).

Duty holders are required to work through the hierarchy of controls to determine which risk control measures to implement to eliminate or manage electrical risk.

Further guidance on risk assessment and control measures for electrical safety is provided in the *Managing electrical risks in the workplace Code of Practice.*

5. Plant

WHS Regulation section 203: A person with management or control of plant at a workplace must manage risks to health and safety associated with the plant.

WHS Regulation section 213: The person with management or control of plant at a workplace must ensure that the maintenance, inspection and, if necessary, testing of the plant is carried out by a competent person.

Note: The *Cane rail safety* supplement provides extensive guidance on requirements and controls in relation to items of plant that are specific to cane rail operations (e.g. locomotives and control of cane bins outside the mill premises

There is a large range of plant within sugar milling operations, including plant that has been designed, manufactured, commissioned, or altered on site. PCBUs and officers must manage the associated risks to health and safety.

Chapter five of the WHS Regulation outlines a range of requirements on PCBUs and other duty holders relating to plant, including but not limited to:

- ensuring plant is only used for the purpose for which it was designed, unless the proposed use does not increase the risk to health and safety
- ensuring health and safety features (including guarding, operational controls, emergency stops ad warning devices) are used in accordance with instructions
- ensuring plant not in use is left in a state that does not create a risk to the health or safety of any person
- ensuring the maintenance, inspection and, if necessary, testing of the plant.

The *Managing risks of plant in the workplace Code of Practice* provides further information on the legislative duties in relation to plant, including for:

- installation and commissioning of plant
- designing, making or commissioning alterations to plant
- regularly inspecting plant
- maintenance, repair and cleaning of plant
- storing plant
- decommissioning, dismantling and disposing of plant
- plant registration.

Duty holders, including PCBUs who design, manufacture, import or supply plant, are strongly advised to read the *Managing risks of plant in the workplace Code of* Practice for practical guidance on how to manage risks related to plant to a standard that meets these requirements in the legislation.

Note: A PCBU, person with management or control of plant, or worker using plant, could be a contractor. Contractors must also comply with the relevant requirements in Chapter five of the WHS Regulation and should also meet or exceed the standards of safety outlined in this code.

The below sections provide specific guidance on key hazards and safety measures that are particularly relevant to sugar mills.

5.1 Emergency shutdowns and stoppages

Routine shutdowns and start-ups should usually be scheduled and planned so that the appropriate preparations can be made, and precautions taken to minimise risk of injury to workers and damage to mill equipment. Examples of routine shutdowns include, but are not restricted to:

- routine planned maintenance
- wet weather shutdown
- maintenance day activities
- weekend shutdown if five/six day cycle
- routine testing of emergency stop procedures.

Unscheduled shutdowns, as the name implies, usually require an emergency stop for immediate repair. They occur at any time while the factory is in normal production. There are two types of unscheduled shutdowns within sugar milling operations:

- type 1 – those that can occur from time to time as a consequence of, for example, choked feed chutes and motors tripped on overload
- type 2 – those that are not expected to occur and are the result of a failure, for example, conveyor belt breakage or mechanical failure in an item of plant.

Other types of unscheduled shutdown due to failure that can occur at sugar mills include:

- water tubes failing in a boiler
- ruptured steam/hot juice pipes
- steam driven plant failure
- loss of external electricity supply
- motors or pumps failing
- hydraulic driven plant failures
- electrically driven plant failures.

Routine shut-downs and subsequent start-ups processes should be documented in standard work procedures. These procedures can be made available in a number of ways such as paper based, as in a folder system or, on-line and printable from a maintenance management system.

Where modifications are planned as part of a scheduled shut-down, safe work procedures should be provided to ensure the appropriate person is fully aware of the modifications to be undertaken and the safe work practices to be used. This is particularly important while energy supply systems in the plant are live, for example, boilers, generators and air compressors. Operators should be instructed in any new procedures needed to operate and/or maintain modified equipment. Each safe work procedure should be signed off by a supervisor or the person in control of the work.

5.1.1 Control measures – emergency shutdowns and stoppages

For unscheduled and emergency shutdowns and start-ups, the supervisor and/or operator should conduct a risk assessment and take appropriate actions to minimise risks of injury to workers. Where appropriate, a safe work procedure (if not already available) and safe work permit should be issued for the repair of the particular plant including all the necessary precautions and hazard control measures arising from the risk assessment.

Following an emergency shutdown, if standard work procedures exist for the plant requiring repair, then these should apply. Where no standard work procedures exist for the repair of the plant and significant risks are identified, then safe work procedures should be developed and implemented prior to commencement of the task (e.g., via a safe work permit).

The process should include an appropriate safety inspection prior to start-up, to ensure that any incomplete work or hazards, resulting from the shut-down, are identified and risks eliminated, or emergency shutdown minimised. Each safe work procedure should be signed off by a supervisor or the person in control of the work on completion of the job.

Management should ensure that all persons involved in shut-down and start-up activities are trained and competent to perform their respective duties.

5.2 Isolation and lockout

People performing tasks involving the maintenance, repair, installation, service and cleaning of plant at a sugar mill have a higher risk of being killed or injured through the unintended operation of machinery and equipment they are working in, on or around.

The hazards associated with the unintended operation of plant include, but are not limited to:

- release of hazardous chemicals (e.g. caustic soda or milk of lime)
- release of hot materials (e.g. steam, hot juice, massecuites and other process streams)
- contact with energy sources (e.g. electrical, mechanical, heat, pneumatic or hydraulic);
- injury from accidental movement of a machine mechanism, including collision with moving parts.

An assessment of the risks should be conducted before any work involving removal or repair of plant, breaking into lines and systems or any other task that may involve exposure of workers to hazards from the unintended operation of plant, is commenced.

5.2.1 Control measures – isolation and lockout

When the risk of unintended operation of plant during a task has been identified, a safe system of work should be provided. A key part of the safe system of work should be an isolation procedure - a set of predetermined steps that should be followed when workers are required to perform tasks such as maintenance, repair, installation, service and cleaning of plant.
Isolation procedures involve isolating potentially hazardous energy, so the plant does not move or start up accidentally. Isolating plant also ensures entry to a restricted area is controlled while the specific task is being carried out.

Isolation procedures will vary in detail because of the differences in machinery and equipment, power sources, hazards and processes. Isolation procedures can be item specific or generic, such as procedures to replace or repair valves, pumps or pipe sections, replace fugal screens or shredder hammer replacement.

However, all isolation procedures should include specific details for:

- identified hazards and energy sources (including gravity, moving loads or steam)
- identification of lockout points and zones of isolation systems
- type of lockout and isolation devices to be used, including but not limited to:
    - locks - keys
    - multi-lock or code lock
    - mechanical devices - bars, clamps, chains
    - removal of component
    - valve bleeding
- application and removal of lockout and isolation devices
- use of tags, including safety tags and out-of-service tags
- drive systems that incorporate multiple motors.

Stored energy should not be used to effect isolation (e.g. pneumatic valves which fail safe without a mechanical isolator). The use of manual isolation valves is recommended where possible.

In mills, it is recommended to maintain and provide written isolation procedures, particularly:

- when plant is suspected of being in a hazardous condition (e.g. malfunctioning, broken or damaged) and inspection and repair/replacement is required
- following an incident when it is necessary to isolate plant
- for routine inspection
- for any entry into plant by workers
- when it is desirable to prevent the use, including unlawful use of plant.

Training in relation to isolation procedures should be conducted to ensure competency of workers who are required to comply with those procedures. Isolation procedures and lockout systems should be periodically audited and tested. When plant is modified or replaced, or new plant is introduced to the system, the isolation procedure should be reviewed. Records of training, audits and procedure/system reviews should be kept.

Further guidance on isolation and lockout procedures is provided in the *Managing risks of plant in the workplace Code of Practice* and Workplace Health and Safety Queensland's *Guide to machinery and equipment safety*, both of which can be found on the Workplace Health and Safety Queensland website.

The safe work procedure for the task being undertaken should also include specific details for:

- all isolations and lock outs to be tested by competent persons before commencing work on the plant
- nomination of trained and authorised personnel for isolation procedures for each work area (e.g. an isolation coordinator).
- process and authority for over-riding any interlocks already in place
- regular testing of isolation and lockout systems
- electrical items to be isolated from all sources of electrical power prior to the commencement of any work on the equipment
- testing procedures which may require systems to be energised prior to the final completion of work.

Where equipment is isolated regularly (i.e. during routine replacement or maintenance, isolation procedures) standard work procedures should be developed and used as required.

If it is not possible to isolate the electricity supply, the item of plant should be fully de-energised before workers perform maintenance, repair, installation, service and cleaning of plant. A safe work permit system should then be used to make sure these tasks are only performed when the plant is de-energised.

See Section 8.3 - Safe work permit systems, for more information.

5.3 Mobile plant

Sugar mills utilise a wide range of mobile plant including powered mobile plant (e.g. forklifts, bob cats, end loaders, mobile cranes and general heavy vehicles) and non-powered mobile plant (e.g. cane bins).

Mobile plant operation is related to a range of hazards, including:

- contact with persons
- contact with other plant
- contact with electrical parts
- roll over
- operator error.

The PCBU must ensure that the risks to health and safety from powered mobile plant and non-powered mobile plant are prevented or minimised, so far as is reasonably practicable.

To manage this risk, the PCBU should ensure that a traffic management plan (TMP) is prepared. The plan should detail how the risks associated with mobile plant will be managed at the mill. Plans should be regularly monitored and reviewed to ensure they are effective and account for changes in the workplace.

Workplace Health and Safety Queensland (WHSQ) has provided an onsite traffic management self-assessment tool, to assist with the development of a TMP. The tool is available on the WHSQ website. Further guidance is also provided by the Safe Work Australia general guide for workplace traffic management, which is available online.

In the event that multiple business operators are sharing the same workplace, PCBUs must consult, cooperate and coordinate activities so far as is reasonably practicable. For example, the PCBU must consult, cooperate and coordinate with any contractors using mobile plant to deliver or receive mill-related products (such as cane billets, mill mud, molasses, raw and refined sugar etc.) in order to minimise risks to health and safety.

5.3.1 Control measures – work with powered mobile plant

WHS Regulation section 214: The person with management or control of powered mobile plant at a workplace must under part 3.1, manage risks to health and safety associated with the following:

a) the plant overturning

b) things falling on the operator of the plant

c) the operator being ejected from the plant

d) the plant colliding with any person or thing

e) mechanical failure of pressurised elements of plant that may release fluids that pose a risk to health and safety.

WHS Regulation section 215: This section applies to a person with management or control of powered mobile plant at a workplace.1) The person must ensure, so far as is reasonably practicable, that a suitable combination of operator protective devices for the plant is provided, maintained and used.

2) The person must ensure, so far as is reasonably practicable, that no person other than the operator rides on the plant unless the person is provided with a level of protection that is equivalent to that provided to the operator.

3) The person must ensure that the plant does not collide with pedestrians or other powered mobile plant.

4) Without limiting subsection 4), if there is a possibility of the plant colliding with pedestrians or other powered mobile plant, the person must ensure that the plant has a warning device that will warn persons who may be at risk from the movement of the plant.

In addition to the duties on the PCBU to manage risks associated with plant in the workplace, there are specific duties related to powered mobile plant.

The PCBU must prioritise higher order control measures that eliminate or isolate risks, so far as is reasonably practicable, in relation to traffic management at the workplace. Appropriate control measures include:

- physically separating pedestrian routes or work areas from areas where powered mobile plant is in use, using:
    - overhead walkways
    - underpasses
    - physically separated walkways on a level with mobile plant
    - physical barriers or fencing (e.g., guarding) that prevents access to exclusion zones
    - interlocking gates, to prevent access during traffic movement
- segregating discharge and delivery points from mill working areas
- substituting mobile plant e.g., using a conveyor system to transport materials, such as excess bagasse

- designing mobile plant to minimise risk, using:
    - warning devices, such as reversing lights and beepers[1], fitted to vehicles
    - presence sensing devices
    - speed limiters
    - operator protective devices, such as a rollover protective system for heavy plant, or a roll bar for ATVs
- designing mobile plant routes to minimise risk, using:
    - warning lights at intersections to control traffic
    - mirrors at intersections to enhance visibility
    - speed bumps.

If a risk remains, these control measures should be supported by lower order control measures such as:

- permit systems to manage access to work areas
- two way radios, to enable communication
- warning signs to support exclusion areas and/or permit systems
- providing high visibility garments to operators and workers
- regular maintenance
- good housekeeping standards.

Note: Administrative controls and PPE must not be used as the primary control measure when other higher order controls are reasonably practicable. See Section 1.3 for more information what is 'reasonably practicable'.

A combination of controls is often most effective for managing risk. For example, the risk of a pedestrian collision with semi-trailers in the mill yard could be minimised by ensuring a physically separate access route is used by workers to access work areas without entering the mill yard. This could be used in combination with physical barriers to prevent unauthorised access to the mill yards, and a permit system to manage authorised access.

If guarding or barriers are used to prevent access to plant, the WHS Regulation has specific requirements on the appropriate guarding to be used. See Section 5.4 - Guarding plant and machinery, for more information.

5.3.2 Control measures—movement of cane bins

The movement and storage of cane bins at the sugar mill can present significant risks to workers on the site. When empty, a cane bin can weigh up to 4 tons. When full, a cane bin can weigh significantly more. Even when moving at low speeds, a collision with a full or empty cane bin can cause serious injury or death.

The risk of collision will depend on the following factors:

- presence of pedestrians e.g., workers at the coupling or decoupling stations
- presence of other mobile plant e.g., semi-trailers at a transloader, tractors used to shunt cane bins
- proximity to plant or machinery with dangerous moving parts e.g., the tippler, winch systems or bin brakes/retarders.

[1] Beepers may not be effective in a loud working environment, such as a sugar mill during the crushing period, or when earplugs are in use. Any warning device fitted should be suitable to the working environment and compatible with existing controls.

Where there is a risk of cane bin collision with workers or other mobile plant, the PCBU must use higher order control measures that eliminate or minimise that risk, so far as is reasonably practicable.

In these areas where the risk of collision is present, control measures should include:

- physically separating pedestrian routes or work areas from areas where mobile plant is in use, using:
    - overhead walkways
    - underpasses
    - physical barriers or fencing (e.g., guarding) that prevents access to exclusion zones[2]
    - interlocking gates, to prevent access when cane bins are moving
- isolation systems to prevent bin movement in relevant section e.g., tippler area
- rail attachment devices to stop vehicle movement (chains, choke blocks and derailment devices).

Installing automatic de-couplers, where reasonably practicable, can help to minimise the risk of collision by ensuring workers do not need to be near the cane bin delivery and collection system when in operation. However, guarding or barriers should still be used to prevent access to the cane bin track.

Note: In the delivery and collection yard, a perimeter fence should be used to prevent workers and other persons from unauthorised access. This should be supported by a permit system to manage access when required.

If a risk remains, these control measures should be supported by lower order control measures such as:

- permit systems to manage access to work areas
- warning signs to support exclusion areas and/or permit systems
- providing high visibility garments to operators and workers
- regular maintenance
- good housekeeping standards.

Note: Administrative controls and PPE must not be used as the primary control measure when higher order controls are reasonably practicable. See Section 1.3 for more information what is ‘reasonably practicable’.

Where guarding or barriers are used to prevent access to plant, the WHS Regulation has specific requirements on the appropriate guarding to be used. See Section 5.4 - Guarding plant and machinery, for more information.

Use of powered mobile plant to move cane bins

Locomotives, tractors, and other powered mobile plant are commonly used at the delivery and collection point of the mill. Winch systems, pushers and other automated processes can then be used to propel the cane bins through the mill premises. At some stages of the track, cane bins can be propelled by gravity.

The below diagram provides an example of cane bin movement in which the bins are propelled by powered mobile plant, automated processes and gravity at different stages.

[2] Physical barriers must be of solid construction and securely mounted to resist impact or shock loads that could be applied to the guard e.g., impact of collision with mobile plant.

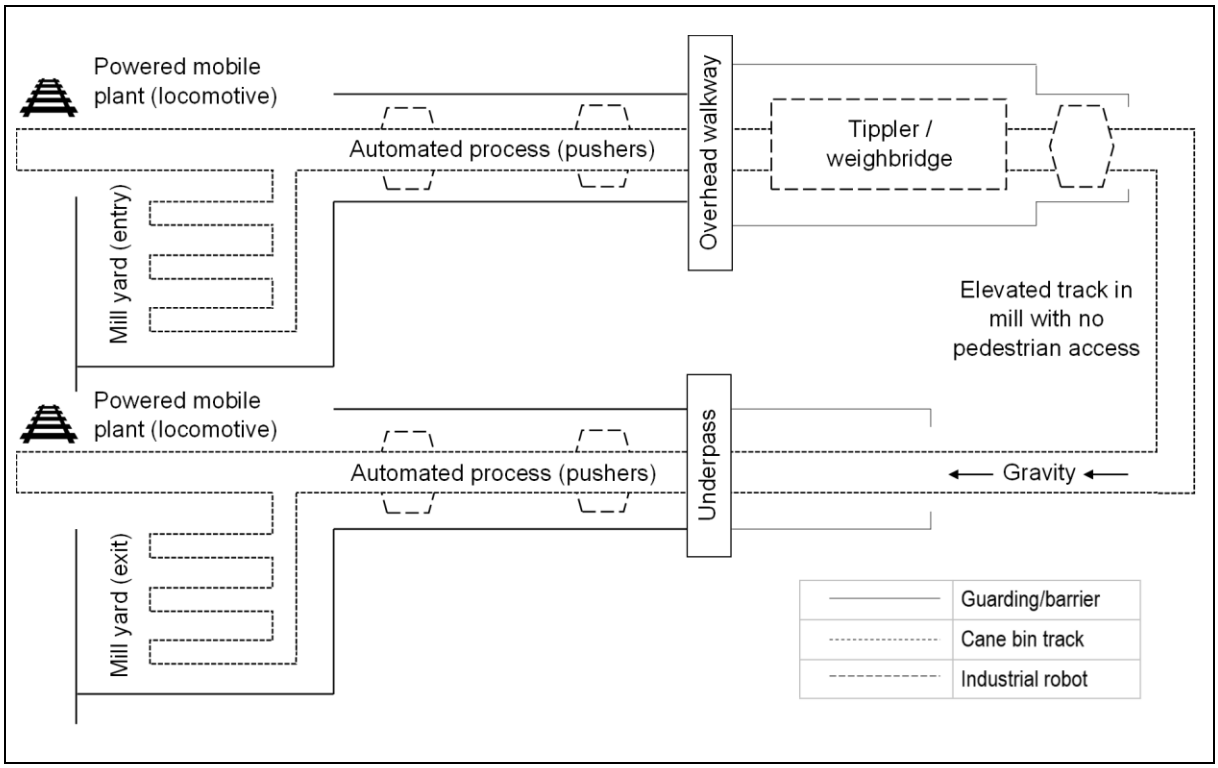

Figure 3: Example of c*ane bin movement*

At all stages of the track where powered mobile plant is used to move the cane bins, the PCBU should refer to Section 5.3.1 Control measures–work with powered mobile plant, when determining how to manage risk of collision, in accordance with section 215 of the WHS Regulation.

At all stages of the track where automated processes are used to move the cane bins, or when cane bins are uncontrolled (e.g., gravity), the PCBU should refer to Section 5.3.2 Control measures–movement of cane bins, when determining how to manage risk of collision. The PCBU should refer to Section 5.4.2 Control measures–guarding–remote and automatically energised plant, when determining how to prevent unauthorised access to the immediate vicinity of the plant (such as the tippler or pushers).

Note: Risks associated with cane rail operations outside the mill premises must be managed in accordance with the guidance provided in the *Cane rail safety* supplement to the Sugar mill safety Code of Practice.

5.4 Guarding plant and machinery

WHS Regulation section 208: The person with management or control of the plant must ensure that:

a) If access to the area of the plant requiring guarding is not necessary during operation, maintenance or cleaning of the plant, the guarding is a permanent fixed physical barrier; or

b) Access to the area of the plant requiring guarding is necessary during operation, maintenance or cleaning of the plant, the guarding is an interlocked physical barrier that allows access to the area being guarded at times when that area does not present a risk and prevents access to that area at any other time; or

c) If it is not reasonably practicable to use guarding mentioned in a) or b),the guarding used is a physical barrier that can only be altered or removed by the use of tools; or

d) If it is not reasonably practicable to use guarding mentioned in a), b) or c), the design includes a presence-sensing safeguarding system that eliminates any risk arising from the area of plant requiring guarding while a person or any part of a person is in the area being guarded.

Guarding is commonly used with plant and machinery to prevent access to dangerous moving parts, to screen harmful emissions, and to prevent ejected parts or off-cuts from striking people.

Examples in sugar mills include, but are not limited to:

- the tippler
- crushing mill drives and rollers
- rotating end drums of belt conveyors
- rotating shafts
- moving parts that do not require regular adjustment
- machine transmissions, such as pulley and belt drives, chain drives, exposed drive gears
- juice screens
- chemical treatment areas.

The PCBU is required to identify reasonably foreseeable hazards that could give rise to risks to health and safety. All plant that has dangerous moving parts, could have harmful emissions, or could eject parts, or entrapment, should be subject to a risk assessment process. This process will help to determine the appropriate control measures to eliminate or minimise risk as much as is reasonably practicable.

The risk assessment should prioritise risks so that effort can be directed to eliminating or controlling risks that have a high potential to cause harm. More than one type of guarding system may be required to ensure the safe operation of machinery or plant.

In addition to this code, further guidance on guarding plant and machinery is provided in the *Managing risks of plant in the workplace Code of Practice* and Workplace Health and Safety Queensland's 'Guide to machinery and equipment safety'. Both documents are available on the Workplace Health and Safety Queensland website.

Additional guidance material can be found in AS 4024 Safety of machinery (series). These standards are referenced in the table in the appendix of the *Managing the risks of plant in the workplace Code of Practice.*

5.4.1 Control measures – guarding – access to plant

Where a risk assessment indicates a significant risk to workers required to work in close proximity to or interact with plant, the PCBU must ensure that the requirements outlined in Section 208 of the WHS Regulation are followed to determine the appropriate guarding:

- If access to the area of the plant requiring guarding is not necessary during operation, maintenance or cleaning, the guarding is a **permanently fixed barrier**.
    - Permanently fixed barriers have no moving parts.
    - Examples include fibre-reinforced plastic barriers and metal systems.
    - The PCBU should consider whether routine maintenance can be done from outside the barrier, via remote adjustment or lubrication systems, allowing a permanently fixed barrier to be used.

- If access to the area of the plant requiring guarding is necessary during operation, maintenance or cleaning of the plant, the guarding is an **interlocked physical barrier** that allowed access to the area being guarded at times when that area does not present a risk and prevents access to that area at any other time.
    - Interlocked guarding prevents the plant from operating unless the guard is closed, as the act of moving the guard to allow access stops the action of the hazardous mechanism).
    - Interlocked guarding is generally achieved via mechanical or electrical means but may also include hydraulic or pneumatic control systems.
    - Examples include a trapped key interlocking system.

- If it is not reasonably practicable to use either a permanently fixed barrier or an interlocked physical barrier, the guarding used must be a **fitted guard** - a physical barrier than can only be altered or removed using a tool.
    - The tool or tools to remove the barrier or guard should not be normally available to the operator.
    - During the period when a fitted guard is removed to enable access, appropriate lockout procedures should be used to ensure the plant cannot be restarted unless the guarding is replaced - see Section 5.2 - Isolation and Lockout.

- If it is not reasonably practicable to use a permanently fixed barrier, an interlocked physical barrier, or a fitted guard, the guarding must include a **presence-sensing system**.
    - Presence sensing systems detect when a person is in the identified danger area, and stops or reduces the power or speed of the mechanism at the time of entry to provide for safe access.
    - The most appropriate type of sensing device will depend on the operating environment and access requirements. They can utilise foot pressure pads, infra-red sensing, light beams or laser scanning.
    - Guidance on the design of presence-sensing systems, including reaction times to ensure hazardous mechanisms are not operating when the person reaches the area of the plant being guarded, is provided in AS4024.
    - The person with management or control of the plant with a presence-sensing system must keep a record of safety integrity tests, inspections, maintenance, commissioning, decommissioning, dismantling and alterations of the plant.
    - This record must be kept for five years, for the life of the plant, or until the person relinquishes control of the plant if it is registered plant or has been altered (the person must then make the record available to the person to whom they have relinquished control of the plant).
    - The record must be kept available for inspection.

A person with management or control of the plant must ensure that the guarding:

- is of solid construction and securely mounted so as to resist impact or shock loads that could be applied to the guard
- makes by-passing or disabling the guarding, whether deliberate or accidental, as difficult as is reasonably practicable
- does not create a risk in itself
    - For example, guarding should not obstruct operator visibility, weaken the plant, cause discomfort to operators or introduce new hazards, such as pinch points, rough or sharp edges
- is properly maintained.

If guarding can be removed to allow for maintenance and cleaning, the person with management or control of the plant must ensure that, so far as is reasonably practicable, the plant cannot be restarted unless the guard is replaced.

All guarding installed should meet be in accordance with *AS 4024.1201 - Safety of machinery - General principles for design - risk assessment and reduction*.

Additional controls

Safe work procedures should also be prepared, issued and signed off when access to hazardous parts of plant is required. The safe work procedures should identify the circumstances where access to guarded parts is safe.

Any worker assigned to a task that involves access to guarded plant, or is in close proximity to guarded plant, must be provided with information and training regarding:

- the nature of the task
- the nature of the risk associated with the guarded plant or machinery
- how to use the control measures implemented.

Additional control measures to highlight where a machine is remotely started and/or operation may include:

- signposting
- flashing lights timed to operate prior to the plant activation
- audible alarms
- local isolation switches.

Where guarding is malfunctioning, or where a risk assessment has determined the guarding is an insufficient control measure, the erection of additional barriers or fences and warning signs should be considered as a short-term interim measure.

Machine guarding and interlocks should be inspected and maintained at regular intervals.

5.4.2 Control measures – guarding, remote and automatically energised plant

WHS Regulation section 222: This section applies to a person with management or control of an industrial robot or other remotely or automatically energised plant at a workplace.

The person must not allow or direct a worker to work in the immediate vicinity of the plant if it could start without warning and cause a hazard, unless suitable control measures are in place to control the risks to health and safety.

If the remote or automatic energising of the plant could lead to risks to health and safety, the person must ensure that access to the area in the immediate vicinity of the plant is controlled at all times:

a) by isolating the area; or

b) by:

i. providing interlocked guards; or

ii. if a risk remains, providing presence-sensing devices; or

iii. if a risk then remains, providing permit to work systems.

Sugar mill processes typically involve plant that is remote or automatically energised. This means that the power source for the plant is either controlled automatically, or from a location that is separate to the immediate vicinity of the plant.

Examples of remote or automatically energised plant in sugar mills include, but may not be limited to:

- tippler
- cane bin propulsion systems
- bagasse systems (loading to boiler, exporting excess bagasse).

Sugar mills may also use industrial robots. See Section 9.1 - Dictionary for a definition of industrial robot.

The PCBU is required to identify reasonably foreseeable hazards that could give rise to risks to health and safety. Remote or automatically energised plant should be subject to a risk assessment process. This process will help to identify the hazards and assess the risk of the plant automatically energising whilst a worker is in the immediate vicinity of the plant.

The person must not allow or direct a worker to work in the immediate vicinity of the plant, unless suitable control measures are in place. WHS Regulation section 222 outlines the suitable control measures that must be used to eliminate or minimise this risk as much as is reasonably practicable:

- isolating the area e.g., separating the plant from work areas using permanently fixed barriers
- providing interlocked guards - see Section 5.4.1
- providing presence-sensing devices - see Section 5.4.1
- providing permit to work systems.

A sequential isolation process for the plant can be used to support a permit to work system.

5.4.3 Control measures – guarding, hazardous emissions and ejected objects

Hazardous emissions and ejected objects can present a significant risk to workers. When identifying reasonably foreseeable hazards related to plant, the PCBU should consider:

- what flying objects could be generated and/or ejected. Such as:
    - splinters
    - metal fragments or components, such as from a failure of the equipment
    - dust
    - sparks
    - bagasse
- what hazardous emissions could be released by the plant or machinery, where the emissions collect and the way they may cause harm. Such as:
    - heat
    - fumes
    - light or radiation
    - leaked substances, such as fluids, steam or fuel
    - noise - see Section 4.3 - Exposure to noise - for further details.
    - chemicals
    - contaminated water - see Section 6.1 - Legionella - for further details.

In choosing the control measures to manage these risks, the PCBU should prioritise higher order control measures that eliminate or isolate the risk, so far as is reasonably practicable.

Appropriate control measures include:

- hoods, lids, covers or impervious guards (solid barriers that prevent the escape of the emission)
- ventilation and extraction systems, such as local exhaust ventilation (LEV) or vacuum systems
- application of sound absorbing materials
- application of screens to mitigate light emissions
- spill prevention and containment strategies and procedures
- plant maintenance, to prevent generation of ejected parts or off-cuts.

If higher order controls are not reasonably practicable, or if a risk remains despite the use of higher order controls, the PCBU must minimise the remaining risk, so far as is reasonably practicable, by implementing administrative controls. If a risk still remains, the PCBU must minimise the risk further, so far as is reasonably practicable, with the provision and use of personal protective equipment (PPE) (e.g., safety glasses to protect eyes from slivers of wood, metal, concrete or sparks).

Note: Administrative controls and PPE must not be used as the primary control measure when higher order controls are reasonably practicable. See Section 1.3 for more information what is ‘reasonably practicable’.

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5.5 Pressure equipment

WHS Regulation section 224: The person with management or control of pressure equipment at a workplace must ensure that:

a) the equipment is inspected on a regular basis by a competent person; and

b) any gas cylinder that is inspected is marked with a current inspection mark showing the date of the most recent inspection.

Boilers, associated vessels and pressure piping are used in sugar mills to generate steam to power factory machinery and generate electricity, as well as to support the extraction, evaporation and pan stages of the milling process. Steam turbines are also used to provide motion to equipment, including the electricity generation, within the sugar mill.

Risks that can arise from the poor management of boilers and turbines include burns from hot surfaces, hot water or steam, and boiler explosions.

5.5.1 Control measures–pressure plant and equipment

In order to minimise the risks associated with pressure plant and equipment management, the PCBU should ensure that the following measures are undertaken:

Specific to boilers:

- Documented boiler operator work procedures, which clearly outline:
    - boiler prestart checks
    - boiler start up procedures, including purging requirements
    - boiler operation and monitoring, including indicators with specific operating limits
    - boiler operation log
    - routine testing program, to be followed by boiler operator and/or maintenance staff
    - shift handover procedure
    - boiler shutdown procedure
- Safety relief valves have identification tags and a suitable seal, with the tag stating the date of the last inspection/overhaul and test
- Good housekeeping to prevent build up of flammable materials near boilers or other heat-generating plant and equipment.

Applicable to boilers and other pressure plant and equipment:

- Maintenance and inspection criteria and procedures, including keeping of records of all inspections and testing
- Water treatment and monitoring program
- Safe storage and handling systems for hazardous chemicals (See Section 7.1 - Hazardous Chemicals)
- Labelling of all valves, pumps, piping and gauges/indicators with identification of function and operation
- Emergency plans developed, maintained and implemented for the site
- Firefighting equipment suitable for the type of fuel and fire
- Training, instruction and supervision of pressure plant operators
- Adequate workspace or exclusion zones provided around boilers.

Guidance material can be found in *AS 3873 Pressure equipment – Operation and maintenance, AS 2593 Boiler safety management systems*, and AS 3788 Pressure equipment – In-service inspection. These standards are referenced in the table in appendix D of the *Managing the risks of plant in the workplace Code of Practice.*

Licence requirements

A high risk work licence is required to operate pressure equipment, such as boilers and steam turbines. The relevant licence classes are:

- standard boiler (BS) - a standard boiler has a single fuel source and does not have a pre-heater, superheater or economiser attached
- advanced boiler (BA) - a boiler fitted with any of the following:
    a. multiple fuel sources
    b. super heater
    c. economiser
    d. pre- heater
- turbine operation (TO) - a turbine that has an output of 500kW or more and includes one of the following:
    a. multi-wheeled
    b. capable of a speed greater than 3600 revolutions per minute
    c. has attached condensers
    d. has a multi-staged heat exchange extraction process.

Schedule 4 of the WHS Regulation sets out the competency requirements for a high-risk work licence.

Registration of plant designs and items of plant

Schedule five of the WHS Regulation requires certain items of plant to be registered (registrable plant). This includes the following pressure equipment:

- boilers categorised as hazard level A, B or C according to criteria in section 2.1 of the *AS 4343-2005: Pressure equipment - hazard levels*
- pressure vessels categorised as hazard level A, B or C according to criteria in section 2.1 of the *AS 4343-2005: Pressure equipment - hazard levels*
    - Note: design registration is also required for boilers and pressure vessels including those categorised as Hazard Level D in addition to the items listed above.

The purpose of registering items of plant is to ensure the plant is inspected by a competent person and is safe to operate.

The following items of pressure equipment do not require registration:

- any pressure equipment (other than a gas cylinder) excluded from the scope of *AS/NZS 1200: Pressure equipment*. See section A1 of Appendix A to *AS/NZS 1200.*
- gas cylinders
- LP gas fuel vessels for automotive use
- serially produced vessels.

A PCBU must not direct or allow a worker to use a registrable item of plant in the workplace if it has not been registered. A person must not use a registrable item of plant in the workplace if it has not been registered.

Further information on the requirements for plant registration, including how to register an item, registration documents and registration renewal, is provided in the *Managing the risks of plant in the workplace Code of Practice.*

6. Biological substances

Note: Section six of the Sugar mill safety Code of Practice provides information that is also suitable to cane rail operations in relation to leptospirosis.

6.1 Legionella

Cooling towers are used extensively in the sugar milling industry and the presence of legionella bacteria can cause serious infection in humans, called legionellosis, which can take two forms: legionnaires' disease and Pontiac fever.

Legionella can contaminate and multiply in cooling towers if a combination of conditions occurs for example:

- the water temperature ranges from 25 to 45 degrees
- nutrient levels are high
- there is an accumulation of organic materials, sediments and other micro-organisms.

Legionella is one form of microbial contamination, and it should be noted that other microbes can contaminate air-conditioning units and cooling towers. Other microbes can result in other health problems such as respiratory sensitisation and building related illness.

6.1.1 Control measures – legionella

Duty holders are required to work through the hierarchy of controls to determine which risk control measures to implement.

The following control measures should be considered to reduce contamination of cooling towers:

- develop a risk management plan to assess critical risk factors and to document appropriate procedures that address the operation and maintenance of the colling water system
- follow manufacturer's recommendations for cleaning and disinfection:
    - prior to commissioning
    - before startup
    - when idle
    - after shutdown
- keep water temperatures between 20-45 degrees Celsius
- automated anti-corrosion, anti-scale, and disinfectant closing
- monitor and treat microbial levels
- circulating water through all areas of the cooling system, including all standby chiller pumps, balance lines and dead legs
- filtering water to reduce suspended solids
- regular inspection, testing, maintenance, cleaning and disinfection.

AS/NZS 3666 (SET) Air-handling and water systems of buildings (set), and its supporting document *AS SAA.HB32 Control of microbial growth in air-handling and water systems of buildings*, specify minimum requirements for design, installation, commissioning, operation and maintenance of air-handling and water systems in buildings to assist in the control of micro-organisms, including legionella bacteria.

The following control measures should be considered as effective methods to minimise the risk of infection by aerosol transmission:

- install and maintain drift eliminators to restrict water droplets from leaving the cooling tower
- provide workers with tight-fitting P2-filtered respiratory protective equipment (RPE) when entering or working in the immediate vicinity of a cooling tower
- restrict access and prevent people congregating around cooling towers.

For more control measures refer to the guide to legionella control in cooling water systems, including cooling towers, which provides guidance on controlling the growth of legionella in cooling water systems associated specifically with evaporative condensers and cooling towers in both industrial and air-conditioning situations.

6.2 Leptospirosis

Leptospirosis is a zoonotic disease (transmittable from animals to humans) caused by bacteria known as leptospira. The bacteria survive in water, wet conditions, mud and some clay soils.

The most common way people become sick with leptospirosis is from:

- contact with urine or tissues of infected animals (rats, mice, cattle, or marsupials)
- contact with water, agricultural vegetation, soil, or mud contaminated with infected urine.

People can be infected via the skin, eyes, mouth or broken skin. Symptoms include high fever, severe headaches, chills, muscle aches and vomiting. Other symptoms include jaundice, red eyes, abdominal pain, diarrhoea and rash.

Outbreaks are associated with rodent plagues, and weather events such as tropical cyclones, heavy rainfall, or flood events. The leptospira bacteria can survive in soil and freshwater for weeks to months.

6.2.1 Control measures–leptospirosis

The PCBU is required to identify reasonably foreseeable hazards that could give rise to risks to health and safety. The following factors should be considered to determine whether there is a risk of workers coming into contact with leptospira:

- information on the number of cases of leptospirosis in the area
- the type of work to be performed
- the environmental conditions in the work area (e.g., tropical, subtropical or dry/wet)
- the likely exposure paths (presence of rats or mice)
- the likely exposure frequency.

If a risk of exposure is identified, the PCBU must following the hierarchy of controls to eliminate or minimise the risk, so far as is reasonably practicable. The following control measures should be considered, so far as is reasonably practicable, based on the likelihood of exposure:

- an eradication program for vermin, such as rats and mice
- maintain clean workplaces and amenities, with:
    - facilities for secure storage of food and drinking water
    - regular disposal of wastes and scraps
    - regular wipe down of benches and eating areas with a chlorine-based product
- provide waterproof boots and waterproof gloves for work in wet conditions, and when handling materials that may be contaminated by urine

- make sure workers wash hands thoroughly with soap and water on a regular basis (this is particularly important before eating, drinking and smoking)
- make sure any cuts, grazes and/or abrasions are covered with waterproof dressings.

7. Hazardous substances

Many substances may present hazards at sugar mills. But if the hazards are known and understood, appropriate precautions can be taken so that they can be used safely.

Note: The *Cane rail safety* supplement provides guidance specific to cane rail operations in relation to fire risk management (see Section 7.4 Fire events)

7.1 Hazardous chemicals

WHS Regulation section 351: A PCBU must manage, under part 3.1, risks to health and safety associated with using, handling, generating or storing a hazardous chemical at a workplace.

In managing risks the person must have regard to the following:

a) the hazardous properties of the hazardous chemical

b) any potential hazardous chemical or physical reaction between the hazardous chemical and another substance or mixture, including a substance that may be generated by the reaction

c) the nature of the work to be carried out with the hazardous chemical

d) any structure, plant or system of work:

i. that is used in the use, handling, generation or storage of the hazardous chemical; or

ii. that could interact with the hazardous chemical at the workplace.

Hazardous chemicals found within a sugar milling environment can include:
- petroleum products
- caustic soda (sodium hydroxide)
- hydrochloric, phosphoric, sulphuric and sulphamic acids
- formaldehyde
- lime (calcium hydroxide).

Sugar mill operators should identify activities that could give rise to risks involving these chemicals and implement control measures to eliminate or minimise the risk so far as is reasonably practicable.

For example, sugar mills operators should consider activities or issues such as:
- unloading and bulk transfer
- process or plant failure
- operator error.

7.1.1 Control measures – hazardous chemicals

The WHS Regulation includes specific duties for a PCBU to manage the risks of hazardous chemicals, which must be followed in sugar milling operations.

These duties include:

- obtaining the current safety data sheet (SDS) for any hazardous chemical used, handled or stored at the workplace, subject to any exclusions or exemptions under WHS laws
- ensuring the SDS is readily available for anyone likely to be exposed to the hazardous chemical
- maintaining a register and manifest (where relevant) of hazardous chemicals and providing notification to the regulator of manifest quantities where applicable
- correct labelling of containers and pipework, using warning placards and outer warning placards and displaying of safety signs (see *Labelling of workplace hazardous chemicals Code of Practice*)
- identifying risk of physical or chemical reaction of hazardous chemicals and ensuring the stability of hazardous chemicals
- ensuring that exposure standards are not exceeded, and conducting air monitoring when the PCBU is not certain on reasonable grounds if the exposure standard is exceeded
- controlling ignition sources around flammable substances, with flammable and combustible substances kept at the lowest practical quantity
- provision and availability of fire protection, firefighting equipment, and emergency and safety equipment
- preparing an emergency plan and, if the quantity of a class of hazardous chemical at a workplace exceeds the manifest quantity for that hazardous chemical, providing a copy of the emergency plan to Queensland Fire and Emergency Services
- stability and support of containers for bulk hazardous chemicals including pipework and attachments
- provision of health monitoring to workers (refer to next section for further information)
- provision of information, training, instruction, and supervision to workers
- provision of spill containment system for hazardous chemicals if necessary.

PCBUs are required to work through the hierarchy of controls to determine which risk control measures to implement.

Further information, including on appropriate higher and lower control measures, is provided in the *Managing the risks of hazardous chemicals in the workplace Code of Practice.*

Health monitoring

WHS Regulation section 368: A PCBU must ensure that health monitoring is provided to a worker carrying out work for the business or undertaking if:

a) the worker is carrying out ongoing work at a workplace using, handling, generating or storing hazardous chemicals and there is a significant risk to the worker's health because of exposure to a hazardous chemical mentioned in schedule 14, table 14.1, column 2

b) the person identifies that because of ongoing work carried out by a worker using, handling, generating or storing hazardous chemicals there is a significant risk that the worker will be exposed to a hazardous chemical (other than a hazardous chemical mentioned in schedule 14, table 14.1) and either:

   i. valid techniques are available to detect the effect on the worker's health; or

ii. a valid way of determining biological exposure to the hazardous chemical is available and it is uncertain, on reasonable grounds, whether the exposure to the hazardous chemical has resulted in the biological exposure standard being exceeded.

Health monitoring means monitoring of a person's health to identify changes in their health status, particularly in relation to exposure to certain hazardous chemicals or substances.

Further information on requirements related to health monitoring is provided the *Managing the risks of hazardous chemicals in the workplace Code of Practice*, and in Safe Work Australia's *Health monitoring for exposure to hazardous chemicals - guide for persons conducting a business or undertaking.*

7.1.2 Storage of hazardous chemicals

WHS Regulation section 363: A PCBU at a workplace must ensure, so far as is reasonably practicable, that a system used at a workplace for the use, handling or storage of hazardous chemicals:

a) is used only for a purpose for which it was designed, manufactured, modified, supplied or installed; and

b) is operated, tested, maintained, installed, repaired and decommissioned having regard to the health and safety of workers and other persons at the workplace.

The person must ensure that sufficient information, training and instruction is given to a person who operates, tests, maintains or decommissions a system used at a workplace for the use, handling or storage of hazardous chemicals for the activity to be carried out safely.

A storage and handling system covers all container types and associated pipes, fittings and fixtures that for the use, handling and storage of hazardous chemicals.

Examples include packages, cylinders, drums, tanks, pressure vessels, processing equipment, associated spill containment systems and safety devices that is expected to be in contact with the hazardous chemical.

Stopping use and disposing of storage and handling systems

WHS Regulation section 365: This section applies to a system used at a workplace for the use, handling or storage of hazardous chemicals if a PCBU at the workplace intends that the system no longer be used for the use, handling or storage of the hazardous chemicals or be disposed of.

The person must ensure, so far as is reasonably practicable, that the system is free of the hazardous chemicals when the system stops being used for the use, handling or storage of the hazardous chemicals or is disposed of.

If it is not reasonably practicable to remove the hazardous chemicals from the system, the person must correctly label the system.

WHS Regulation section 366: This section applies to a system used at a workplace for the use, handling or storage of hazardous chemicals underground if a PCBU at the

workplace intends that the system no longer be used for the use, handling or storage of the hazardous chemicals or be disposed of.

The person must ensure, so far as is reasonably practicable, that the system is removed.

If it is not reasonably practicable to remove the system, the person must ensure, so far as is reasonably practicable, that the system is without risks to health and safety.

WHS Regulation section 367(2-3): The tank is taken to be abandoned if:

a) the tank has not been used to store flammable gases or flammable liquids for 2 years; or

b) the person does not intend to use the tank to store flammable gases or flammable liquids again.

The person must notify the regulator of the abandonment of the tank as soon as practicable after the tank is abandoned.

Abandoned underground fuel tanks present an explosion and fire risk due to the presence of flammable gas or vapours being trapped and unable to escape. Tar-like deposits and sludge may have accumulated in the tank and pipe work. These can remain in place for decades and be at risk of ignition via future excavation activities (e.g. excavator impact on the tank shell and resulting metal-on-metal sparking) or maintenance activities (e.g. cutting off connected pipework).

If untreated, abandoned underground tanks can also provide an underground void risk as the tank shell condition becomes compromised over time. For example, steel tanks will be significantly affected by presence of acid-sulphate soils.

Further information on the above duties, as well as the notification process for abandoned underground fuel tanks and associated assurance documentation requirements, is provided in the *Managing the risks of hazardous chemicals in the workplace Code of Practice* and on the WHSQ website.

7.1.3 Manifest quantity workplace (MQW)

WHS Regulation section 348: A PCBU at a workplace must ensure that the regulator is given written notice if a quantity of a schedule 11 hazardous chemical or a group of schedule 11 hazardous chemicals that exceeds the manifest quantity is used, handled or stored, or is to be used, handled or stored, at the workplace.

Sugar mills in Queensland will meet the definition of a manifest quantity workplace (MQW) if they are storing, handling or using hazardous chemicals in quantities that exceed the prescribed manifest quantities - as outlined in Schedule 11 of the WHS Regulation, table 11.1, column 5 for that hazardous chemical (reproduced in Appendix D of the *Managing the risks of hazardous chemicals in the workplace Code of Practice*).

PCBU must prepare a manifest of Schedule 11 hazardous chemicals at the workplace when a prescribed Schedule 11 manifest quantity is exceeded.

A manifest is a written summary of specific types of hazardous chemicals with physical hazards, acute toxicity or skin corrosion that are used, handled or stored at a workplace. It

contains more detailed information than a register of hazardous chemicals as its primary purpose is to provide the emergency services organisations with information on the quantity, classification and location of hazardous chemicals at the workplace. It also contains information such as site plans and emergency contact details.

The manifest must comply with the requirements of Schedule 12 of the WHS Regulation, and it must be updated as soon as practicable after any significant change in the risk of using, handling of storing Schedule 11 hazardous chemicals. A significant change resulting in an update to the manifest should also lead to a review and/or amendment to the mill's emergency plan.

An example of a significant change is an increase in quantity of a hazardous chemical, such as installing an additional hazardous chemical product tank.

Further information on the requirements for manifest quantity workplaces, including the need to notify WHSQ and to share emergency plans with QFES, is provided in the Manifest requirements for hazardous chemicals under the *Work Health and Safety Act 2011* guidance document published by Work Health and Safety Queensland.

Emergency plans
If the sugar mill meets the definition of an MQW, the PCBU has additional specific obligations related to the workplace's emergency plan. Further information is provided in Section 3.11 - Emergency plans and procedures.

7.2 Laboratory chemicals

Laboratory staff may have a more frequent exposure to a larger range of hazardous chemicals in smaller quantities. It is important to minimise the risk of exposure so as to reduce the possibility of acute and chronic health effects over the long term.

Handling, mixing and transferring hazardous chemicals such as corrosives (hydrochloric acid, sulphuric acid, caustic soda), toxics (lead, mercury and silver salts), oxidisers (nitrates and nitrites) and flammable liquids including ethanol are some of the activities which are undertaken in sugar mill laboratories.

Users of chemicals should also be aware of any byproducts or chemical reactions which may take place during their use, handling or storage which could create additional hazards during laboratory processes, including any waste streams that could be generated, and interactions with any equipment present.

7.2.1 Control measures – laboratory chemicals

Specific control measures should be implemented for each separate activity involving a hazardous chemical in mill laboratories. The most appropriate control measures will depend on the particular circumstances of use and the hazardous chemical.

Typical control measures should include:
- detailed analytical procedures, including disposal considerations
- training in the standard procedures to be followed
- emergency response training and access to specialty first aid treatment
- provision of, and training with, the recommended personal protective equipment for each activity
- provision of eye wash and safety shower facilities adjacent to the site but isolated from

likely engulfment
- easy access to safety data sheet, information and emergency procedures in the laboratory
- adequate labelling of all containers of hazardous chemicals, including generated hazardous wastes (see *Labelling of workplace hazardous chemicals Code of Practice*).
- use of automatic pipettes
- adequate ventilation
- a high standard of personal hygiene (e.g. handwashing after handling chemicals)
- disposal systems for used personal protective equipment
- separate laundering of laboratory coats, hand towels etc.
- use of fume cupboards that comply with *AS/NZS 2243.8 Safety in laboratories - Fume cupboards*
- fit-for-purpose chemical storage systems e.g. flammable goods cabinets or cabinets for corrosive substances
- eliminating or minimising interacting hazards e.g. benchtop storage and use of flammables near heated equipment e.g. ovens
- proper glassware handling techniques, including regular inspection and removal / disposal / repair to broken items
- ensuring toxic or irritant powders are handled in ventilated environments such as fume cupboards, and if not possible that other suitable controls are put in place in accordance with the hierarchy of controls.

7.3 Lead

All sugar factory laboratories use lead in the form of dry lead acetate and a lead acetate solution to remove impurities during sugar juice analysis. Mill workers can also be exposed to lead dust, fume or mist and by ingesting lead that has contaminated hands, food or cigarettes. Maintenance workers may be exposed to lead fume and dust while machining brass bearing components which contain lead.

Work conducted in the sugar mill laboratories is considered a lead process and such work must be undertaken in compliance with the WHS Regulation 2011, Part 7.2 – Lead, which outlines duties and requirements for PCBUs in workplaces where lead is used, including:
- obtaining safety data sheets
- labelling containers
- keeping registers
- keeping records
- conducting risk assessments
- notifying of lead risk work
- controlling exposure
- conducting health monitoring
- providing information and training.

Assessing the risk must include a PCBU assessing each lead process in the workplace and determining if lead risk work is carried out in the process. If a PCBU is unable to determine whether lead risk work is carried out in a lead process at the workplace, the process is taken to include lead risk work until the person determines that lead risk work is not carried out in the process.

7.3.1 Control measures – lead

Duty holders must follow the hierarchy of control when managing lead risks and consult with workers and their representatives. Their experience will help determine the appropriate control measures and their involvement will increase the level of acceptance of any changes that may be needed to the way they do their job.

Appropriate control measures in the laboratory include:

- labelling all containers in which any lead compound is stored
- avoiding generating dust when handling dry lead acetate
- providing automatic dispensers for wet lead
- when transferring to smaller containers:
    - use personal protective equipment (face shield, P2-filtered respiratory protective equipment and gloves)
    - transfer in a well-ventilated area free of strong air currents
- maintaining high standards of personal hygiene
- regularly cleaning surfaces when lead acetate is used
- not allowing drinking from laboratory taps
- training and supervision to ensure that the correct procedures are followed.

Appropriate control measures when machining, grinding, sanding and polishing metal components which contain lead include:

- eliminating or substituting high lead containing alloys with lead free or low lead alloys
- using wet methods (cutting fluid, lubricants or coolant) or low exhaust ventilation when sanding, grinding, buffing or polishing metal components.
- handling and disposing waste which may contain lead safely
- maintaining high standards of personal hygiene
- not allowing eating, drinking or smoking in work areas
- preventing a build-up of dust by regularly cleaning surfaces in the work area (brooms and compressed air should not be used to clean workers or work areas)
- wearing respiratory protective equipment when higher order controls cannot adequately protect workers from exposure.

Further information on requirements related to RPE is provided in Section 3.2 - Hierarchy of Control Measures.

7.4 Bagasse

Bagasse, a by-product of the milling process, is a natural, fibrous material which occurs in respirable and inspirable sizes. It is normally used as fuel in suspension boilers in sugar mills which in turn produces the steam necessary to operate factory processes.

Bagasse is a nuisance dust which is difficult to control, particularly in the form of bagacillo, a dry dust separated from the larger fibres by cyclones and screens, used to mix with material subsided from juice to create mill mud. Bagasse fibres and sugar dust are classed as irritants, and the build-up of bagasse at the mill can present a fire risk if not properly controlled.

This section provides guidance for managing the following risks:

- Section 7.4.1 - bagasse and sugar dust
- Section 7.4.2 - bagasse and fire risk

7.4.1 Control measures – bagasse and sugar dust

Duty holders are required to work through the hierarchy of controls to determine which risk control measures to implement.

In general, operations which involve handling, production or storage of bagasse should utilise equipment which is designed, operated and maintained so that releases of dust are minimised, including:

- designing and maintaining plant to minimise leakage of bagasse so far as is reasonably practicable (e.g., covered conveyors and transfer points)
- designing and maintaining mobile plant used to transport bagasse to minimise leakage of bagasse so far as is reasonably practicable.

A review of the risks associated with stored bagasse may require additional control measures such as:

- identification of sources of dusts
- assessment of measures to minimise the generation of dusts
- site inspections to assess housekeeping standards
- suitability and use of personal protective equipment provided.

The following control measures will help to minimise the growth of mould in bagasse storage areas:

- monitoring factors that influence microbiological activity in stockpiles, such as temperate, low bound nitrogen and water availability
- covering stockpiles with tarpaulins to minimise dust emission or the entry of water.

Reclamation or de-baling of stored bagasse can generate significant levels of airborne dust. Control measures that should be implemented for these types of operations include:

- provision of positive pressure HEPA-filtered cabins on machinery used for these activities
- conducting the activities only when weather conditions are suitable
- providing and using suitable personal protective equipment, including:
    - respiratory protective equipment (RPE) with particulate filters (further information on RPE is provided in Section 3.2.1)
    - eye protection
    - gloves.

In general, safe systems of work should be developed and implemented for workers accessing bagasse storage areas (see Section 8.3).

Inhalable sugar dust

> **WHS Regulation section 49:** A PCBU at a workplace must ensure that no person at the workplace is exposed to a substance or mixture in an airborne concentration that exceeds the exposure standard for the substance or mixture.

Inhalable sugar dust is subject to a workplace exposure standard, to ensure that workers are not exposed to the risk of breathing in sugar dust at a level that can cause adverse health effects.

The exposure standard for inhalable sugar dust which must be observed provides for an allowable time-weighted average (TWA) airborne concentration for sugar dust of 10 mg/m^3.

This value is a standard value for all inhalable dusts containing no asbestos and less than one percent crystalline silica.

Duty holders are required to work through the hierarchy of controls to determine which risk control measures to implement. In general, operations which involve handling, production or storage of sugar which create sugar dust should utilise equipment which is designed, operated and maintained so that releases of dust are minimised.

Note: The production of raw sugar in sugar mills is typically not associated with generating inhalable sugar dust, which is a result of refinery processes.

7.4.2 Control measures – bagasse and fire risk

WHS Regulation section 355: A PCBU at a workplace must, if there is a possibility of fire or explosion in a hazardous area being caused by an ignition source being introduced into the area, ensure that the ignition source is not introduced into the area (from outside or within the space).

As a flammable substance, the uncontrolled build-up of bagasse fibres and bagacillo at the sugar mill can present a fire risk.
Minimising the fire risk should be achieved by:

- minimising the release of bagasse dust, as outlined in Section 7.4.2
- preventing contact with sources of ignition.

Plant such as boiler infrastructure should be designed and maintained to minimise leakage/blowout of sparks and flame, in order to minimise the risk of ignition.

Additional appropriate control measures include:

- elimination of other sources of ignition such as hot work, smoking and naked flames
- high standards of housekeeping, in particular around potential sources of ignition (such as the boiler station), to ensure bagacillo is not allowed to build up over time
- fire management systems connected to conveyor belt systems, maintained in good working order (in accordance with AS 1851-2012: Routine service of fire protection systems and equipment) with staff are trained in the operation of alarm and sprinkler systems
- other associated control conditions (e.g., automatic disconnection of power supply and alarm initiations).

7.5 Welding and cutting fumes

The fumes and gases arising from welding and cutting processes may contain a number of hazardous chemicals. The welding/cutting arc can cause reactions which produce oxides of nitrogen, carbon monoxide and other gaseous contaminants. The intense ultraviolet radiation emitted from some arcs may also give rise to significant quantities of ozone.

The health effects of exposure to welding and cutting fumes and gases can vary. Effects can include irritation of the upper respiratory tract (nose and throat), tightness in the chest, asphyxiation, asthma, wheezing, metal fume fever, lung damage, bronchitis, cancer, pneumonia or emphysema.

The composition of the fume depends upon:

- consumables - electrodes or filler metals, heating or shielding gases and fluxes
- material - chemical composition of material being cut or welded and of any protective coating (e.g. galvanising) or primer paint (e.g. lead-based paints)
- operating conditions (e.g. temperature and rod current).

The amount of fume generated depends on:

- process and thermal conditions - amperage, voltage, gas and arc temperatures and heat input which may also vary with the welding position and degree of enclosure and the degree of skill of the welder
- consumables
- materials
- duration of welding or cutting.

When assessing the risks associated with a particular welding or cutting process, total fume concentrations as well as individual fume components should be considered. In addition to complying with workplace exposure standards for specific contaminants, such as chromium and nickel, the total fume concentration in the breathing zone (which is inside a welder's helmet when a helmet is worn) must not exceed 5 mg/m^3 TWA (time weighted average).

7.5.1 Control measures – welding and cutting fumes

Note: The *Welding processes Code of Practice* and the *Technical Note 7 - Health and safety in welding* produced by the Welding Technology Institute of Australia should be consulted for detailed information on fume generation and control, as well as guidance on choosing the most appropriate controls.

Duty holders are required to work through the hierarchy of controls to determine which risk control measures to implement. When selecting control measures, routine tasks should be identified so that generic procedures can be developed and documented for future use.

Within sugar milling operations these tasks can include:

- roller arcing
- welding and cutting in dedicated workshop areas
- railway maintenance.

Special consideration is also required for specific tasks such as:

- hot work in confined space
- welding in open spaces
- tasks involving stainless steel, galvanised steel mor metal coated with lead-based paint.

An example of a safe work procedure for roller arching is provided in Appendix 9.3.

If it is not reasonably practicable to eliminate the risk, the risk must be minimised so far as is reasonably practicable must be used. The following control measures should be considered:

- substituting a welding or cutting process to one that produces less airborne contaminants
- removing surface coatings or contaminants before carrying out welding
- isolating the welding process, for example welding in isolation booths away from others
- using engineering control measures, for example installing a fixed local exhaust or on-torch extraction ventilation system to capture or remove airborne contaminants

- implement administrative control measures, for example training workers, implementing procedures for welding or erecting signs warning of possible welding risks.
- provide P2-filtered respiratory protective equipment; for example, a welding helmet fitted with a Powered Air Purifying Respirator (PAPR) - see Section 3.2.1 for further information.

Further information on hazards related to welding (such as radiation, electrical risk and burns), as well as when RPE, air monitoring and health monitoring is required, is provided in the *Welding processes Code of Practice.*

7.6 Methane gas

Methane gas (CH4) is a colourless, odourless gas that forms when organic matter decomposes under oxygen-poor conditions.

Within a sugar milling environment, methane or ‘fermentation’ gas can be produced as a result of fermentation of certain materials within the factory (e.g. mixed juice, liquor, molasses and mesquite). Methane can also result from fermentation of fibre products such as cush material (fibre separated from mixed juice prior to processing) or bagasse deposits mixed with water such as in mill boots, juice pits and within the cush-cush system.

Exposure to low concentrations of methane may cause dizziness, headaches or fatigue. High concentrations of methane are considered an asphyxiant and can lead to a lack of oxygen in the air.

High concentrations of methane gas in the air can be flammable, and if methane gas occurs in a confined space it can be explosive; the explosive range is between five percent and 15 percent methane in air.

Workers should be aware of possible methane gas deposits after extended close downs in areas such as:
- molasses pipes
- hollow mill rollers
- between wear plates on pressure feeder chutes
- juice pipes
- pans
- effets
- mill boots
- juice pits/drains
- rotary filter boots
- heaters
- a range of tanks such as subsiders, mixed juice, incubators and flash tanks.

7.6.1 Control measures–methane gas

PCBUs should seek to prevent the generation of methane by ensuring that areas where these materials may remain following a shut down or mill closure are cleaned out before there is a risk of fermentation, thus avoiding methane build up.

PCBUs must consider the hierarchy of controls in dealing with potential risks from methane gas explosion, including:

- training of personnel (awareness and inclusion on risk management forms as “prompter”
- engineering controls (e.g., ventilation or flame proof equipment)
- sign posting and marking of areas where flammable atmospheres may exist to exclude ignition sources by a safe distance
- work procedures
- safe work permit systems for identified high risk processes (e.g., hot work permit systems including monitoring for flammable atmospheres in areas identified to be at risk).

7.6.2 Monitoring for methane gas before permitting entry to potentially flammable atmospheres

Monitoring for methane gas is required prior to an entry permit being issued for hot work or any other work that could possibly introduce an ignition source into an area where methane gas may be present.

A PCBU must ensure, so far as is reasonably practicable, that while work is being carried out in a confined space, the concentration of methane gas in the atmosphere of the space is less than five percent of its Lower Explosive Limit (LEL).

If it is not reasonably practicable to limit the atmospheric concentration of methane gas in a confined space to less than five percent of its LEL and the atmospheric concentration of the methane gas in the space is equal to or greater than five percent, but less than 10 percent of its LEL, the PCBU must ensure that any worker is immediately removed from the space unless a suitably calibrated, continuous-monitoring flammable gas detector is used in the space.

However, if the concentration of methane gas in the space is equal to or greater than 10 percent of its LEL, the PCBU must ensure that any worker is immediately removed from the space.

Further information on work in confined spaces is provided in section 8.1 of this code, and in the *Confined Spaces Code of Practice.*

7.7 Asbestos

WHS Regulation section 420(1-2): A PCBU at a workplace must ensure that:

a) exposure of a person at the workplace to airborne asbestos is eliminated so far as is reasonably practicable; and

b) if it not reasonably practicable to eliminate exposure to airborne asbestos - exposure is minimised so far as is reasonably practicable.

A PCBU at a workplace must ensure that the exposure standard for asbestos is not exceeded at the workplace.

Asbestos is a carcinogen, which poses a risk to people's health when asbestos fibres become airborne and are inhaled. Inhaling asbestos fibres puts people at risk of asbestos-related illness such as mesothelioma, cancer of the lung, larynx, and ovary. These illnesses can occur decades after exposure to asbestos.

Historically, asbestos insulation was installed in sugar mill plant, such as boilers, steam and hot water pipes, tanks, burners, pumps, valves, gaskets and filter systems. Asbestos materials were also used extensively in the construction of structures housing the fixed plant. If cement sheet is present and was installed up until 1990, it is likely to contain asbestos bonded to the cement particles.

Asbestos containing materials and asbestos membranes or tanking were often used in bunds and areas of buildings that were prone to wet conditions. Walls and flooring in these areas may contain asbestos due to its strength and water-resistance qualities. Likewise, pipes throughout the building that carry water and sewage may also contain asbestos.

As a result, asbestos therefore is most likely to be a risk in sugar mills when undertaking maintenance on old plant/ equipment manufactured or installed prior to 2004, or undertaking demolition/ renovation of a building or sections of building constructed/renovated prior to 1990.

The WHS Regulation, Chapter 8 - Asbestos, outlines the requirements on duty holders to prevent or minimise the risks from exposure to asbestos fibres.

7.7.1 Control measures – asbestos

A person with management or control of the workplace must ensure that:

- all asbestos or asbestos containing material (ACM) at the workplace is identified by a competent person
- assume a material is asbestos or ACM if you are unsure if the material contains asbestos
- assume asbestos is present if part of the workplace is inaccessible and it is likely to contain asbestos or ACM.

In the event that asbestos or ACM is identified or assumed to be present in the workplace, a person with management or control of the workplace must take steps to manage the risk, including ensuring that:

- an asbestos register is prepared, maintained, reviewed and kept at the workplace. It must be readily available to workers, their health and safety representatives and other persons
- a written asbestos management plan is prepared, maintained and reviewed. It must be accessible to workers, their health and safety representatives and other persons.

Note: An asbestos register is not required if the building was constructed after 31 December 1989 and no asbestos has been identified at the workplace and asbestos is not likely to be present.

WHS Regulation section 424: A person with management or control of the workplace must ensure that:

a) the presence and location of asbestos or ACM identified at the workplace under section 422 is clearly indicated; and

b) if it is reasonably practicable to do so, indicate the presence and location of the asbestos or ACM by a label.

If using labels to indicate the presence of asbestos or ACM, the labels should:

- be placed as near to the source of asbestos as it is safe to do so
- be clearly visible to any persons in the immediate vicinity
- provide clear safety guidance for workers.

For example, a sticker label could be attached to a flange to warn that gaskets may contain asbestos.
However, if a risk assessment determines that it is not safe to use a label (for example, if using a label may disturb the asbestos), a prominent warning sign should be posted in its immediate vicinity. Technology may also be utilised to assist in alerting people about the content of the register and the management plan, for example by installing QR codes throughout the mill on asbestos materials to allow workers and contractors to scan the QR code to consult or update the register and management plan in real-time as maintenance or removal work is planned or carried out on asbestos materials

Further information on all of the above duties, and requirements related to asbestos-related work, signage, training and health monitoring, is provided in the *How to manage and control asbestos in the workplace Code of Practice* and the *How to safely remove asbestos Code of Practice.*

Prohibition of certain work involving asbestos

WHS Regulation section 419: A PCBU must not carry out or direct or allow a worker to carry out work involving asbestos if that work involves manufacturing, supplying, transporting, storing, removing, using, installing, handling, treating, disposing of or disturbing asbestos or ACM, except in prescribed circumstances.

Note: The prohibition on the supply of asbestos also prohibits the sale of asbestos or ACM.

Work involving asbestos or asbestos containing material (ACM) is prohibited except in very limited circumstances. Information on the prescribed circumstances is provided in the *How to manage and control asbestos in the workplace Code of Practice.*

7.8 Fire and explosion

WHS Regulation section 359(1): A PCBU at a workplace must ensure the following:

a) the workplace is provided with fire protection and firefighting equipment that is designed and built for the types of hazardous chemicals at the workplace in the quantities in which they are used, handled, generated or stored at the workplace, and the conditions under which they are used, handled, generated or stored, having regard to:

   i. the fire load of the hazardous chemicals; and

   ii. the fire load from other sources; and

   iii. the compatibility of the hazardous chemicals with other substances and mixtures at the workplace

b) the fire protection and firefighting equipment is compatible with firefighting equipment used by the primary emergency services organisation

c) the fire protection and firefighting equipment is properly installed, tested and maintained

d) a dated record is kept of the latest testing results and maintenance until the next test is conducted.

Fire and explosion can result in catastrophic consequences, causing serious injuries or death of workers and others, as well as significant damage to property. A PCBU must prevent the possibility of fire or explosion from an ignition of flammable substances associated with a hazardous area or a hazardous atmosphere.

Guidance on requirements related to fire risk management can be found in:

- Section 3.11 Emergency Plans and Procedures
- Section 7.1 Hazardous chemicals
- Section 7.4.1 Bagasse and fire risk
- Section 7.6 Methane gas.

Further information on managing the risks of fire and explosion is provided in the *Managing the risks of hazardous chemicals in the workplace Code of Practice.*

7.8.1 Control measures—hazardous area classification

WHS Regulation section 52: A PCBU at a workplace must manage risks to health and safety associated with an ignition source in a hazardous atmosphere at the workplace.

WHS Regulation section 355: A PCBU at a workplace must, if there is a possibility of fire or explosion in a hazardous area being caused by an ignition source being introduced into the area, ensure that the ignition source is not introduced into the area (from outside or within the space).

There are a number of flammable liquids, vapours and gases that may be present in a sugar mill as by-products, including:

- methane (see Section 7.6)
- sugar dust (combustible dust)
- ethanol.

Wherever these substances are generated, used, stored or handled, a hazardous area classification must be conducted to determine the extent of applicable exclusion zones for potential ignition sources and the selection of suitably rated electrical equipment. Exclusion zones are divided into zone 0, 1, or 2 based on the probability of a flammable atmosphere being present as follows:

- **zone 0** – hazardous area is an area where a flammable atmosphere is present continuously or for long periods or frequently
- **zone 1** – hazardous area is an area where a flammable atmosphere is likely to occur in normal operation occasionally
- **zone 2** – hazardous area is an area where a flammable atmosphere is not likely to occur in normal operation but, if it does occur, it will exist for a short period only.

The purpose of the hazardous area classification is to identify where flammable atmospheres (e.g. methane gas) may exist, and to be able to either eliminate or control potential ignition sources in those identified zones.

The classification should be carried out by a competent person in accordance with the following Australian Standards:

- *AS/NZS 60079.10.1: Explosive atmospheres—Classification of areas—Explosive gas atmospheres (IEC 60079-10-1, Ed.1.0 MOD)*
- *AS/NZS 60079.10.2: Explosive atmospheres—Classification of areas—Combustible dust atmospheres.*

Where electrical equipment is located within a hazardous area classification zone, specific requirements are mandated in *AS/NZS 60079.14 Design selection, erection and initial inspection* for the selection and installation of the electrical equipment.

Under no circumstances should battery chargers or low-pressure sodium vapour discharge lamps be installed in hazardous locations.

8. Work environment

WHS Regulation section 40: A PCBU at a workplace must ensure, so far as is reasonably practicable, the following:

a) the layout of the workplace allows, and the workplace is maintained so as to allow, for persons to enter and exit and to move about without risk to health and safety, both under normal working conditions and in an emergency

b) work areas have space for work to be carried out without risk to health and safety

c) floors and other surfaces are designed, installed and maintained to allow work to be carried out without risk to health and safety

d) lighting enables:

i. each worker to carry out work without risk to health and safety; and

ii. persons to move within the workplace without risk to health and safety; and

iii. safe evacuation in an emergency

e) ventilation enables workers to carry out work without risk to health and safety

f) workers carrying out work in extremes of heat or cold are able to carry out work without risk to health and safety

g) work in relation to or near essential services does not give rise to a risk to the health and safety of persons at the workplace.

The PCBU has a range of duties related to making sure that workers can carry out work without risks to their health and safety from the work environment.

Duty holders, including PCBUs, are strongly encouraged to read the *Managing the work environment and facilities Code of Practice* for practical guidance on how to meet these duties and address common risks.

The following sections provide additional guidance on specific hazards identified in sugar mills.

Note: The *Cane rail safety* supplement provides guidance specific to cane rail operations in relation to the following:

- access to work environment (see Section 4.3 Contact between train and other things and 6.3.2 Work environment).

8.1 Safe working in confined spaces

WHS Regulation section 66: A PCBU must, under part 3.1, manage risks to health and safety associated with a confined space at a workplace including risks associated with entering, working in, on or in the vicinity of the confined space (including a risk of a person inadvertently entering the confined space).

Within sugar milling operations a range of plant is installed which meets the definition of a confined space in WHS Regulation, Schedule 19 - Dictionary. Types of equipment that may be a confined space can include:

- air conditioning ducts
- bagasse bins
- boilers
- clarifiers
- pans and evaporators
- filter drums
- pipes
- pits
- sugar bins
- trenches
- sugar dryers
- tanks.

A confined space can also be created during the manufacture of plant, equipment and or machinery such as building a tank.

There are a number of hazards associated with confined spaces, including:

- flammable or toxic atmosphere
- displacement of air (i.e., oxygen) which can occur from steam ingress or long term microbial action
- external hazards that may affect those in the confined space
- residual hazardous chemicals
- hot surfaces (which can result from contamination)
- engulfment
- electric shock
- temperature extremes
- access and egress
- visibility
- noise
- psychological factors
- mechanical equipment.

Further information on identifying hazards and assessing risks related to work in confined spaces is provided in the *Confined spaces Code of Practice.*

8.1.1 Control measures – safe work in confined spaces

The *Confined spaces Code of Practice* provides practical guidance on how to manage health and safety risks associated with work carried out in a confined space, with reference to the specific legal requirements for safe working in confined spaces. This includes, but is not limited to:

- entry permit systems
- communication and safety monitoring;
- isolation
- atmosphere
- entry and exit procedures
- maintaining and reviewing control measures.

Emergency procedures

The *Confined spaces Code of Practice* provides guidance on the key considerations that should be taken into account when establishing emergency procedures for confined spaces, including:

- location of the confined space
- communications (between workers inside and outside of the confined space)
- rescue and resuscitation equipment
- capabilities of rescuers
- first aid
- local emergency services.

Sugar mills are commonly located in remote and rural areas. If a risk assessment identifies that local fire and emergency services are unlikely to be able to provide assistance in time to prevent a serious injury or loss of life, the PCBU should make sure there are workers trained to safely perform first aid and rescue procedures.

It is recommended that the PCBU engage with local fire and emergency rescue services or a competent contractor to assist in preparing emergency procedures. This can help make sure that rescue personnel are better prepared to provide assistance in the event of an emergency.

Further information on emergency procedures is provided in Section 3.11 of this Code.

8.2 Hot work

Before commencing hot work (welding, thermal or oxygen cutting, heating, and other fire-producing or spark-producing operations that may increase the risk of fire or explosion) the PCBU must ensure any risks associated with the hot work are properly assessed. This is so work may be carried out safely and not produce sources of ignition in areas where flammable gases, flammable dusts or combustible substances (such as oils, bagasse etc.) may be present.

Consideration should also be given to hot work in areas which contain flammable liquids or buildup of flammable solids such as cane trash (around the tippler) or in other areas where there is a risk of fire or explosion (sugar dust or bagacillo risk).

8.2.1 Control measures – hot work

A safe work permit should be issued prior to the commencement of any hot work which outlines the process to be followed, including any isolation and other controls. Persons authorised to issue safe work permits must be trained in the identification of specific hot work hazards, risk assessment and the selection of appropriate control measures to minimise or eliminate the risks.

Consideration should be given to:
- the removal of flammable or explosive materials before work commences
- the reduction in the flammability of materials (wetting down)
- isolating plant
- residues of flammable materials
- testing for flammable and fermentation gases (e.g. methane)
- special precautions (e.g. using a lookout)
- personal protective equipment
- suitable tools, equipment and materials to be used for the work
- emergency procedures
- the location of the firefighting equipment.

If flammable materials are present, a suitably trained and qualified observer should be in attendance for the duration of the hot work.

Persons carrying out hot work must be qualified and trained for the task (e.g., welding or fire extinguisher use). This training should be documented.

Where flammable gases may be present, testing of the atmosphere prior to the work and at regular intervals must be carried out.

8.3 Safe work permit systems

Safe working permit systems enable mill operators to enhance safety procedures and this section provides information on the requirements associated with safe work permit systems including:
- the authority to issue safe work permits
- the situations where a permit is required
- things to be considered prior to the issue of a permit
- the conduct of the work in accordance with the permit
- the closure of the permit.

There are many advantages to using a permit to work system as it:
- ensures appropriate people are authorised to carry out designated work. This designated work may be for specific work or any work in a specific area
- makes it clear to people carrying out the work the exact identity, nature and extent of the job and the hazards involved. It also outlines any limitations on the extent of the work and the time during which the job may be carried out
- specifies the precautions which need to be taken, including safe isolation from potential risks such as electricity and hazardous chemicals
- ensures the person in direct charge of the plant or in charge of the area where the plant is located, is aware of all the work being done under the permit to work system
- provides a system of continuous control and also a record showing the nature of the work and the precautions needed which is checked by a competent person or people

- provides for the suitable display of permits
- provides a procedure for times when work has to be suspended
- provides for cross referencing of permits for work activities that may interact or affect one another
- provides a formal handover procedure for use when the permit is issued for a period longer than one shift
- provides a formal hand back procedure to ensure that part of the plant affected by the work is in a safe condition and ready for reinstatement.

Before a safe work permit is issued, a risk assessment must be conducted and documented with the permit. Each mill must develop a register of tasks requiring a safe work permit within its operations.

Any task on the register or other tasks considered at the time to pose a significant risk, should not be performed without a safe work permit being issued and adequate controls implemented.

The issuer of the work permit should be properly trained in hazard identification, risk assessment and risk control techniques. Their responsibilities and authority must be clearly defined, training reviewed and documented periodically.

Before issuing a safe work permit, the issuer and recipient should consider all potential hazards such as material hazards, pressure, temperature, fumes, electrical power, mechanical energy, hazardous areas, height, radioactive sources, explosive materials, restricted space or field vision, and others.

The work permit should clearly specify the precautions and risk control measures which need to be employed, such as:

- isolation
- decontamination
- working in confined spaces
- hot work
- working at heights
- excavation and building work
- work on high voltage equipment
- personal protective equipment
- provision to notify relevant persons when work commences and when work is completed any other special precautions.

The issuer of a safe work permit should ensure that the recipient(s) are competent to perform the task. Once a work permit has been issued, the work should be carried out as specified in the safe work permit. At completion, the permit should be returned to the issuer and closed.

8.4 Access to work environment

WHS Act section 19(2): A PCBU must 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.

WHS Act section 20: The person with management or control of a workplace must ensure, so far as is reasonably practicable, that the workplace, the means of entering and exiting the workplace and anything arising from the workplace are without risks to the health and safety of any person.

The PCBU with management or control of the sugar mill, and all other PCBUs associated with the sugar milling operations, have a duty to prevent harm to members of the public arising from the work undertaken in the sugar mill.

Non-mill personnel may be exposed to risk if they enter the site, including by the full yards, the rail system or other unsecured access points. Unauthorised access to sugar mill premises, and to the plant onsite, carries a significant risk of injury or death. Risks associated with unauthorised access to a sugar mill include:

- a person deliberately or accidentally entering the area of a machine or moving plant while it is being operated, for example, a member of the public being struck by cane bins
- a person attempting to climb or access plant or structures on site
- a person tampering with the plant or structure.

8.4.1 Control measures – access to work environment

The PCBU must conduct a risk assessment to determine the hazards, risks and suitable control measures to manage access to their workplace from members of the public or non-mill personnel.

Key areas of risk that should be considered as part of the risk assessment include:

- cane bins delivery and collection points at the mill
- presence of mobile cranes, forklifts and other mobile plant.

In determining the appropriate control measures, consideration must be given to the particular hazards that are present and the level of risk that may arise from these hazards such as mobile and automated plant, hazardous chemicals and heat sources.

Consideration should also be given to the proximity of the mill to residential areas, schools and pedestrian traffic.

Control measures may include perimeter fencing, gates, barriers, locks, and security personnel. Any perimeter fencing, gates, barriers and locks should be checked regularly and maintained in good condition to prevent unauthorised access to the device.
If fencing is used, the following factors should be considered as part of a risk assessment to determine the appropriate fencing:

- difficulty of access – preventing access under the fence or by scaling the fence
- strength of fencing – withstanding anticipated loads to which it may be subjected, such as wind forces, persons attempting to scale and vehicle impact loads
- security and weak points – all panels, joints, or gates to provide the same level of security.

In circumstances where it is not reasonably practicable to install fencing, gates, barriers or locks to prevent unauthorised access, the PCBU should ensure security arrangements for the site to minimise the risk of unauthorised access.

Preventing or minimising unauthorised access to the sugar mill premises should not limit emergency access or the ability of to evacuate persons if necessary.

8.4.2 Construction work – access to work environment

WHS Regulation section 298: A person with management or control of a workplace at which construction work is carried out must ensure, so far as is reasonably practicable, that the workplace is secured from unauthorised access.

If construction work is carried out on the mill site, the person with management or control of the mill must make sure the work area is secured to prevent unauthorised access.

Key factors that should be considered include:

- risks to health and safety arising from unauthorised access to the workplace
- the likelihood of unauthorised access, including proximity to schools, parks, shopping precincts and other public spaces often frequented by children
- if unauthorised access can not be prevented –how to isolate hazards within the workplace.

If the construction work involves demolition, additional requirements apply as outlined in the *Demolition work Code of Practice*. Further information on duties and requirements related to construction work is provided in in codes of practice and guidance materials is available from www.worksafe.qld.gov.au.

9. Appendices

9.1 Dictionary

***Cane rail safety* supplement** means the document titled '*Cane rail safety—A supplement to the Sugar mill safety Code of Practice 2024.*'

Confined space means an enclosed or partially enclosed space that:

- is not designed or intended primarily to be occupied by a person; and
- is, or is designed or intended to be, at normal atmospheric pressure while any person is in the space; and
- is or is likely to be a risk to health and safety from:
    - an atmosphere that does not have a safe oxygen level; or o contaminants, including airborne gases, vapours and dusts, that may cause injury from fire or explosion; or
    - harmful concentrations of any airborne contaminants; or
- engulfment,
- but does not include a mine shaft or the workings of a mine.

Consequence: the most probable results of an incident due to the hazard under consideration.

Demolition work: work to demolish or dismantle a structure, or part of a structure that is loadbearing or otherwise related to the physical integrity of the structure, but does not include:

- the dismantling of formwork, falsework, or other structures designed or used to provide support, access or containment during construction work; or
- the removal of power, light or telecommunication poles.

Exposure: the frequency of occurrences of the hazard.

Hazard: means a situation or thing that has the potential to harm a person.

Hot work: welding, thermal or oxygen cutting, heating, and other fire-producing or spark producing operations that may increase the risk of fire or explosion.

Interlocking guard: a guard which has a moveable part that is interconnected with the power or control system of the plant item so that, until the guard is in place, the interlock prevents the machine from operating. Interconnections can be electrical, mechanical, hydraulic or pneumatic.

LAeq,8h: the eight-hour equivalent continuous A-weighted sound pressure level in decibels (dB(A)) referenced to 20 micropascals, determined in accordance with AS/NZS 1269.1:2005 (Occupational noise management—Measurement and assessment of noise immission and exposure).

LC,peak: the C-weighted peak sound pressure level in decibels (dB(C)) referenced to 20 micropascals, determined in accordance with AS/NZS 1269.1:2005 (Occupational noise management—Measurement and assessment of noise immission and exposure).

Probability: the likelihood that once the hazard - event occurs, the complete incident-sequence of events will follow with the timing and coincidence to result in the incident and consequences

Risk: the possibility that harm (death, injury or illness) might occur when exposed to a hazard.
Risk management: the identification of hazards, the assessment of the risks associated with those hazards and the implementation of methods to eliminate or control the risks.

Safe work permit: a procedure to ensure the risks associated with specific high risk tasks are documented, addressed, controlled or minimised.

Safe work procedure: a document to communicate to employees and contractors, the safest way of controlling identified hazards associated with a particular task.

9.2 Further information

9.2.1 Workplace Health and Safety Queensland and the Electrical Safety Office

Further information is available from www.worksafe.qld.gov.au or by contacting 1300 362 128.

Legislation
- *Work Health and Safety Act 2011*
- *Work Health and Safety Regulation 2011*
- *Electrical Safety Act 2002*
- *Electrical Safety Regulation 2013*

Codes of Practice
- *Confined spaces Code of Practice*
- *Electrical safety Code of Practice - Electrical equipment rural industry*
- *Electrical safety Code of Practice – Working near overhead and underground electric*
- *lines*
- *Electrical safety Code of Practice - Works*
- *Electrical safety Code of Practice - Managing electrical risks in the workplace*
- *First aid in the workplace Code of Practice*
- *Hazardous manual tasks Code of Practice*
- *How to manage and control asbestos in the workplace Code of Practice*
- *How to manage work health and safety risks Code of Practice*
- *How to safely remove asbestos Code of Practice*
- *Labelling of workplace hazardous chemicals Code of Practice*
- *Managing noise and preventing hearing loss at work Code of Practice*
- *Managing risks of hazardous chemicals in the workplace Code of Practice*
- *Managing risks of plant in the workplace Code of Practice*
- *Managing the risks of falls at workplaces Code of Practice*
- *Managing the work environment and facilities Code of Practice*
- *Mobile crane Code of Practice*
- *Rural plant Code of Practice*
- *Safe design and operation of tractors Code of Practice*
- *Safe design of structures Code of Practice*
- *Scaffolding Code of Practice*
- *Spray painting and powder coating Code of Practice*
- *Welding processes Code of Practice*
- *Work health and safety consultation, co-operation and co-ordination Code of Practice*

Other Publications

- *"Guide to machinery and equipment safety" (2015)*
- *"Guide to Legionella control in cooling water systems, including cooling towers" (2018)*

9.2.2 Standards Australia

www.standards.com.au

- *AS 1210 Pressure Vessels*
- *AS/NZS 1269 Occupational Noise Management - Overview and general requirements*
- *AS 1319 Safety signs for the occupational environment*
- *AS 1345 Identification of the contents of pipes, conduits and ducts*
- *AS/NZS 1596 The storage and handling of LP gas*
- *AS 1657 Fixed platforms, walkways, stairways and ladders - Design, construction and installation*
- *AS/NZS 1668 (SET) The use of ventilation and air-conditioning in buildings set*
- *AS/NZS 1680.0 Interior lighting - safe movement*
- *AS/NZS 1715 Selection, use and maintenance of respiratory protective devices*
- *AS 1940 The storage and handling of flammable and combustible liquids*
- *AS 2030.2 The verification, filling, inspection, testing and maintenance of cylinders for the storage and transport of compressed gases - Part 2: Cylinders for compressed dissolved acetylene*
- *AS/NZS 2243.8 Safety in laboratories - Part 8: Fume cupboards*
- *AS/NZS 2293.1 Emergency escape lighting and exit signs for buildings - Part 1: System design, installation and operation*
- *AS/NZS 2381.2 Electrical equipment for explosive atmospheres - Selection, installation and maintenance - Part 2: Flameproof enclosure 'D'*
- *AS 2670.1 Evaluation of human exposure to whole body vibration - Part 1: General requirements*
- *AS 2865 Confined spaces*
- *AS/NZS 3000 Electrical installations (known as the Australian/New Zealand wiring rules)*
- *AS/NZS 3666 (SET) Air handling and water systems of buildings set*
- *AS 3853.1 Health and safety in welding and allied processes - Sampling of airborne particles and gases in the operator's breathing zone - Part 1: Sampling of airborne particles*
- *AS3780 The storage and handling of corrosive substances*
- *AS3745 Planning for emergencies in facilities*
- *AS/NZS 4024 Safety of Machinery*
- *AS 4332 The storage and handling of gases in cylinders*
- *AS/NZS ISO 31000 Risk Management - Principles and guidelines*
- *AS/NZS 4804 Occupational health and safety management systems - General guidelines on principles, systems and supporting techniques*
- *AS/NZS ISO 60079.10.2 Explosive atmospheres - Part 10.2: Classification of areas - Explosive dust and atmospheres*
- *AS 1851 Routine service of fire protection systems and equipment*
- *AS 61508 Functional safety of electrical/electronic/programmable electronic safety-related systems*
- *ASIEC 61672.1 Electroacoustics - Sound level meters - Part 1: Specifications*
- *ASIEC 61672.2 Electroacoustics - Sound level meters - Part 2: Patternevaluation*

tests

9.2.3 Safe Work Australia

https://www.safeworkaustralia.gov.au/

- *Hazardous Chemicals Information System (HCIS)*
- *National Standard for Licensing Persons Performing High Risk Work*
- *Guide to measuring and assessing whole body vibration*
- *"Guidance note for the protection of workers from the ultraviolet radiation in sunlight"ASSC (2008)*
- *Workplace Exposure Standards for Airborne Contaminants*
- *"Guidance on the Interpretation of Workplace Exposure Standards for Airborne Contaminants" (2013)*

9.2.4 Other

- *Welding Technology Institute of Australia, Technical Note No 7, Health and Safety in Welding, NSW, 2020. Available on Weld Australia.*