Guidance Note QGN 30.1

Shaft construction metalliferous mines – Shaft construction management plan

Mining and Quarrying Safety and Health Act 1999

March 2018

Queensland Government

Reference is made to the following legislation as applicable to a Mine or Quarry in Queensland:

- *Mining and Quarrying Safety and Health Act 1999*
- Mining and Quarrying Safety and Health Regulation 2017

This Guidance Note has been issued by the Mines Inspectorate of the Department of Natural Resources, Mines and Energy (DNRME) to provide guidance and instruction to the SSE and those involved in shaft sinking operations in development and implementation of an effective Shaft Construction Management Plan (SCMP) that is integrated into the sites Safety Health Management System (SHMS). It sets out a risk management approach for developing an SCMP.

This Guidance Note is not a Guideline as defined in the *Mining and Quarrying Safety and Health Act 1999* (MQSHA) or a Recognised Standard as defined in the *Coal Mining Safety and Health Act 1999* (CMSHA). In some circumstances, compliance with this Guidance Note may not be sufficient to ensure compliance with the requirements in the legislation. Guidance Notes may be up-dated from time to time.

To ensure you have the latest version, check the DNRME website: https://www.business.qld.gov.au/industry/mining/safety-health/mining-safety-health/legislation-standards-guidelines or contact your local Inspector of Mines.

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This publication has been compiled by the Mines Inspectorate, Department of Natural Resources, Mines and Energy.

Contents

1 Foreword

Shaft construction is an integral part of underground mine development. It can provide efficient access to mine workings with minimal impact to the environment. These installations comprise many variations of shaft sinking winding systems and shaft construction design.

This document comprises three parts:

Part 1 provides guidance and instruction to the Site Senior Executive (SSE) and those involved in shaft sinking operations to be able to develop and implement an effective Shaft Construction Management Plan (SCMP) that is integrated into the sites Safety Health Management System (SHMS). It sets out a risk management approach for developing a SCMP.

Part 2 provides guidance and instruction to the SSE and those involved in the engineering design of shaft sinking and proposed winding equipment.

Part 3 is provided as a guide and prompt for the SSE and those involved with shaft construction activities for the identification of hazards, risk and their potential controls throughout the various stages and methods of shaft construction. For example, it could be used during:

- the formation of risk assessments
- the development of the SCMP
- when writing or reviewing standard work instructions and procedures
- when undertaking accident investigations and audits.

This SCMP applies to the construction of various types of mine shafts including, but not limited to:

- Haulage Shafts
- Men and Material
- Secondary Egress
- Ventilation
- Mine Services
- Exploration.

Shaft sinking is considered specialist and high risk work, with the potential for serious accidents or fatalities due to the inherent shaft conditions, processes involved to construct the shaft and various types of winding systems, plant and equipment utilised.

The purpose of this guidance note is to provide information to metalliferous mining operations on how to systematically manage shaft construction risks, so that obligation holders comply with the legislative framework.

Persons with an obligation under the *Mining and Quarrying Safety and Health Act 1999* (MQSHA) to manage risk at a mine should ensure that construction work at the mine is carried out in accordance with the applicable Australian Standards. In the event that there is no Australian Standard or material available, it should be sourced from other industry or regulatory sources. Note: If an Australian Standard subsequently becomes published, it should then be applied.

How to use this Guideline:

The words ***'shall,' 'must,' 'requires'*** or ***'mandatory'*** indicate that legal requirements exist and must be complied with. The word ***'should'*** indicates a recommended course of action, while ***'may'*** indicates an optional course of action.

This guidance note does not apply to opal and gemstone operations.

2 Glossary

Attachments	Components used to connect the conveyance to the end of rope. The components includes rope sockets, capels, pins, couplers, chains bars, detaching hook, rope swivels and swivel hooks and similar. (Refer Australian Standard 3637 Series)3751 is for slope haulage
Arresting System	An assembly, incorporating one or more arrestors, for decelerating and stopping the main conveyance(s) within a winding system.
Arrestor	A device in an arresting system used for absorbing winding system energy.
Blind Shaft Sink	Shaft construction utilising the blind sink technique involves repetitive work cycles of drilling, blasting, extracting earth and material, installing ground support, formwork and concreting sequences to construct a shaft. The cycles are repeated until the shaft reaches the intended depth. Refer page 9.
Braceman	A person in charge of the immediate shaft area on the surface that slings and send equipment down a mine shaft.
Bunton	A horizontal steel member that supports the shaft guides
Cactus Grab	A cactus-grab mucker consists of a clamshell bucket used for the removal of waste material. The cactus grab is generally pneumatically or hydraulically operated and is suspended from a multi-deck shaft sinking platform. This unit can be either fixed or run on a mono-rail system under the stage bottom deck.
Catchplate / Detaching bell	An apparatus within the headframe which operates a detaching hook in the event of an over-wind, and from which the detached conveyance is suspended.
Competent person	A person who has, through a combination of training, education and experience, acquired knowledge and skills enabling that person to correctly perform a specified task.
Conveyance	Refers to any, carriage, cage, skip, kibble or stage in which persons, minerals or materials are wound through a shaft using a shaft winder.
Chairing	The operation of supporting a conveyance at some point in its normal vertical path by means other than the winding rope or gripper system.
Crosshead/monkey	A winding rope safety device utilised for guiding winding conveyances beyond 50m.
Commissioning	Means performing the necessary adjustments, tests and inspections to ensure that the plant is in full working order before the plant is used.
Dead load	The load due to the mass of the permanent components of a conveyance.
Detaching hook	A device located between the end of a winding rope and a conveyance so that, in the event of an over-wind, an ascending drum –wound conveyance is detached from the rope and held in the headframe.
Drum winder	A shaft winding system in which conveyances, kibbles, or stages are raised and lowered by means of a single rope attached directly and winding onto a cylindrical drum, or drums in the case of double drum winding system. A winder drum with a winding rope wound onto a drum for the purpose of raising men and material conveyances up or down a shaft.
E-Stop	Emergency Stop fitted to a device for the purpose of de energising plant or equipment.
Ferrules (nut box)	A blind nut set into the concrete walls of a shaft during the lining process, which later provides anchor points for fixtures and fittings in the shaft to be attached to.
Fleet angle	The angle formed between the line of the rope and the normal line at its point of incidence on the drum or sheave, measured in the plane of the rope.
Floormark	A position noted on the winder indicator dial to mark the working level or position of the floor in the shaft at that particular point in time
Headframe	The structure, including its footings, that supports the rope loads in a winding installation.
Head rope	A rope connected to the top of a conveyance and used to raise and lower the conveyance.
Horidiam Shaft Sink	A shaft constructed by widening the diameter of an existing shaft, commencing from the bottom of the existing shaft and working up from a purpose built stage. Blasted material falls freely to the bottom of the shaft.

Kerb Ring	The main supporting ring at the bottom of formwork that is installed to concrete line the shaft.
Winding system	All the infrastructure components relative for winding men and material up and down a shaft.
Knocker Line	A suspended cable down a shaft, for the purpose of providing shaft signals to the winder driver.
Leaky feeder	A cable that is run down the shaft that can emit and transmit radio signals
Live load	Is the load experienced by the winding system during the operating cycle
Mucking/Muck-out	To remove, dig out or extract waste material (muck) usually by use of a mechanical device
Obligation holder	A person with an obligation under the Mining and Quarrying Safety and Health Act
Overwind/Underwind	Unintentional travel of a conveyance beyond its normal operating limits.
Safety Catch System	A system of devices mounted in the headframe and on the conveyance to prevent the conveyance from falling an excessive distance after the conveyance has been brought to rest.
Overhang mark	A designated point within the shaft for the winder driver to stop the main hoist conveyance and to hold at that point, until signalled to move.
Overshot mucker	Is an air operated track mounted loading machine that mucks via a front-mounted bucket and discharges it to the rear of the machine by passing the bucket over the machine without rotating the bucket. The operator stands to one side of the machine during operation.
On site activities	All activities relevant to site setup inclusive of civil works and shaft construction.
Pentice	A structure in a shaft constructed to protect workers working below in the shaft
Pig –Tail fitting	A device attached to the shaft wall approximately every 30m, allowing cables to run through it, ensuring that the cables are kept close to the shaft wall and not entangle with shaft infrastructure, winding ropes etc.
Rated load	The maximum load a conveyance is designed to carry during normal use.
Shaft	A vertical or steeply inclined opening for access underground or for the purpose of ventilation.
Shaft signals	A bell communication system utilised between the shaft miners, braceman and the winder driver.
Shaft sinking system	The equipment used in the process of mining to develop a mine shaft.
Sky shaft	A structure, including its footings, that is primarily designed to support conveyance guides above a shaft collar and to with stand impact loads resulting from an overwind.
Sliding Shutters	Type of segmented circular formwork installed to provide a formwork for concrete lining of the shaft. This is generally known as ‘slip’ formwork that is lowered from the top down as the shaft progresses.
Stage Upper Limit	The position in the shaft that indicates the maximum allowable upper limit that the Sinking Stage can be hoisted to without contact being made with any structure or equipment at the shaft collar
Strip and Line Shaft Sink	The process of shaft construction by way of drilling a pilot borehole from the surface or upper level to existing underground workings below; reaming the hole to a large diameter; then drilling, blasting and mucking the spoil down through the centre borehole. The waste material falls freely to the bottom of the shaft and is then mucked out via conventional methods. The shaft can be lined as excavation proceeds.
Working load limit	The maximum load that is permitted to be applied.

3 Purpose and scope

3.1 Purpose

The purpose of this guidance note is to provide information to metalliferous mining operations on how to systematically manage shaft construction risks so that obligation holders comply with the legislative framework. This guidance note is to protect persons against harm to their health, safety and welfare through the elimination or minimisation of lifecycle risks associated with shaft sinking winders, winding systems and associated shaft sink processes and practices.

3.2 Scope

This document sets out a risk management approach for the development of a SCMP and for inclusion in the overall SHMS for a mine. This guidance note sets out recommended minimum safety standards for the design, installation, maintenance for shaft sink winding systems and shaft sink construction processes, using **"Blind Sink"** and **"Strip and Line"** techniques.

In this guidance note, shaft construction covers workers within the shaft during the construction process for a pre-sink up to 50m or shaft sink beyond 50m using the following techniques:

1. **Blind Sink**

   A Blind Sink is where the shaft is constructed from the surface down by means of conventional drill and blast methods with the waste removed to the surface via a winder and kibble. If the shaft is to be lined it is normally installed as the excavation proceeds.

2. **Strip and Line**

   The Strip and Line sink involves a drilling a pilot borehole from surface to existing underground workings, then reaming it to a larger diameter and then mining it to final diameter by conventional drill and blast method. The waste material is dropped down through the centre hole. The waste material is then mucked out via conventional methods. The shaft can be lined as the excavation proceeds.

3. **Horidiam**

   Horidiam shaft sink is a method used to increase the diameter of an existing shaft. It commences from the bottom of the shaft and works up, and is undertaken from a purpose built Horidiam stage. Blasted material falls freely to the bottom of the shaft and is then mucked out in the same way used for the Strip and Line method. As this method results in a rough wall finish, the final shaft is normally used as an unlined ventilation shaft.

This guidance note applies to all mine shaft developers using shaft sink winding equipment for the construction of mine shafts such as:

- Haulage Shafts
- Men and Material
- Secondary Egress
- Ventilation
- Mine Services
- Exploration

This guidance note should be referenced by designers, manufacturers, owners and users when:

- designing new mine shafts, sinking winders and winding systems
- independently verifying mine shaft designs and winding systems
- notifying the DNRME of mine powered winding systems
- carrying out audits on mine winders and winding systems
- reviewing winder designs, winding systems and shaft sink processes, following an incident
- altering, maintaining or repairing mine shaft sinking winders and winding systems.

4 Overview

While not specifically covered in this guidance note, during the shaft construction project feasibility and design stages, a number of factors should be taken into account which influence the type of shaft to be constructed and the methodology to be employed.

These need to be considered to ensure that an effective SCMP can be developed and implemented. Factors that should be considered include:

1. Geology of the ground to be excavated
2. Strike, dip, plunge and depth of the ore body
3. Hydrogeology of the strata to be penetrated
4. The basic shaft design parameters, including the size of the opening, configuration and depth of shaft.
5. Interaction and influence on and with existing infrastructure and resources
6. Local environmental conditions that could impact on the project/shaft:
    a. Flooding
    b. Prevailing winds
    c. Seasonal changes

In Part 1, references are made to the MQSHA, the Mining and Quarrying Safety and Health Regulation 2017 (MQSHR), Guidance Notes (GN) and Safety Bulletins.

References:

- MQSHR 2017 Part 6 Facilities and processes
    - s.43 Excavations
    - s.44 Ground control
    - s.45 Mine layout, design and construction
    - s.46 Mine roads
    - s.48 Ventilation
    - s.49 Working at heights
- MQSHR 2017 Part 8 Mine plans
    - s.82 Plans of mine workings
- MQSHR 2017 Part 10 Plant generally
    - s.100 Selection and design
    - s.102 Plant controls and control systems
    - s.104 Manufacture, construction, storage, transport and installation
    - s.112 Specifications, instructions and other information about plant
- MQSHR 2017 Part 13 Winding operations
    - s.121 s.130

5 Notification

Shaft construction is considered to be a significant change to operations therefore, at least two months before any shaft construction commences, the mine operator must provide a facility description to the Mines Inspectorate.

The facility description must include enough information to describe the risk management measures that will ensure the development and implementation of an effective SHMS. For further information visit www.dnrme.qld.gov.au.

For a shaft construction project, the development and implementation of a SCMP by the site senior executive (SSE) will form part of the SHMS.

The facility description should include, but is not limited to:

- mine details
- overarching project safety and health risk assessment
- project schedule
- final purpose of the shaft
- proposed shaft specifications
- where the shaft collar (surface or underground) is situated
- proposed method of construction
- shaft construction and fit out sequencing / methodology
- principal contractor(s) and their specific responsibilities / tasks
- proposed management structure including responsibilities and necessary competencies of those persons
- personnel numbers, rosters and hours of work
- what type of winding system proposed for the shaft sinking and at what stages of that sink will the method be used (e.g. crane, slewing head frame, fixed head frame)
- description of geotechnical and hydrological conditions
- proximity to other underground infrastructure and voids
- power demand and supply sources.

References:

- Guidance Note QGN 23 Facility descriptions for metalliferous mines and quarries
- MQSHA 1999 Part 4 Provisions about the operation of mines
    - s.50 Management structure for safe operations at mines
- MQSHR 2017 Part 3 Accidents, incidents and injuries
    - s.14 Reporting accidents and high potential incidents
    - s.16 Giving inspectors details of accidents and high potential incidents
- MQSHR 2017 Part 4 Electrical
    - s.19 Proposed introduction or disconnection of electricity
- MQSHR 2017 Part 6 Facilities and processes
- MQSHR 2017 Part 7 Hazardous substances and dangerous goods
- MQSHR 2017 Part 8 Mine Plans
- MQSHR 2017 Part 9 Persons on site
- MQSHR 2017 Part 10 Plant generally
- MQSHR 2017 Part 13 Winding operations

6 Shaft construction management plan

To ensure that the risk is adequately managed, the SSE should ensure a SCMP is developed and implemented prior to the commencement of any onsite activities in relation to the shaft construction. The SCMP should cover the lifecycle of the shaft construction project. The SCMP should be:

- project specific
- align with the goals and objectives of the mine's SHMS
- be established using risk management practices and procedures
- address all relevant activities and processes associated with shaft construction at the mine.
- be integrated into the mine's SHMS
- controlled, documented and auditable.
- include change management process procedure.

The SCMP is not a document that is developed by the shaft construction contractor and provided to the SSE, it should be developed in consultation between all parties associated with the shaft construction project and approved by the SSE. The SCMP must be available on request to all workers. It is to be made available upon request from an Inspector of Mines. All procedures and standard work instructions (SWIs) must be current and controlled. Any changes should be subjected to the SCMP change management process.

The contents of the SCMP should include but not limited to the sections shown below:

- how the SCMP fits within the SHMS
- management structure and workers generally
- risk management processes and procedures to be used for shaft works
- procedures and standard work instructions
- maintenance
- winding plant
- emergency preparedness
- auditing.

6.1 How the SCMP fits within the SHMS

The SSE must ensure there is a single SHMS for the mine. The SCMP should be site specific for the project and be integrated into the site SHMS. To achieve this, the SCMP should be assessed and approved by the SSE to ensure that it is compatible with the site SHMS.

Critical processes to be checked, but not limited to, include:

- the SCMP risk management processes
- procedures and Safe Work Instructions
- workers competencies
- emergency preparedness and response
- communication processes
- contractor management
- management structure roles and responsibilities
- change management
- compatibility and suitability of componentry that will make-up the Winding / Shaft Sink equipment
- inspection and maintenance regime / processes to be adopted for the projected.

The SSE must ensure the SCMP is implemented and effective at all times through regular inspections and audits.

6.2 Management Structure and Workers Generally

6.2.1 Management Structure and Supervision

The SSE needs to ensure the site management structure as part of the SHMS provides for adequate supervision during all stages of shaft construction activities. The management structure specific to the shaft construction project must be documented in the SCMP.

Prior to authorising a person to perform the duties of supervisor the SSE should ensure:

- the person's roles and responsibilities are clearly defined, documented and understood
- the person holds the necessary statutory competencies and
- the person has the appropriate experience relevant to the shaft construction activities being supervised

Adequate supervision is achieved by ensuring workers:

- are not likely to be exposed to conditions beyond the worker's capabilities
- are suitably trained to undertake the assigned tasks
- have the resources to carry out tasks without exposure to an unacceptable level of risk
- are working within the limits of the worker's fitness and competence and
- comply with the worker's safety and health obligations

The role of the supervisor should include:

- understanding the competencies to undertake the tasks and knowing their workers' competencies
- communicating effectively with workers regarding hazards, risk controls and work instructions
- inspecting and monitoring workplace conditions
- monitoring worker performance and correcting unsafe acts by ensuring that processes and procedures within the SHMS and SCMP are followed and applied
- providing systems to communicate with and check on lone workers
- reporting and investigating incidents and accidents
- respond to emergency situations in accordance with the emergency response plan
- supervise the activities of contractors to ensure the processes and procedures within the single SHMS and SCMP are followed and applied
- monitor and control the work cycle of workers to prevent fatigue.

References:

- MQSHA 1999
  - s.13 Meaning of competence
  - s.21 Meaning of operator
  - s.22 Meaning of site senior executive
  - s.23 Meaning of supervisor
  - s.25 Meaning of site safety and health representative
  - s. 50 Management structure for safe operations at mines
  - s. 51. Competencies of supervisors
- MQSHR 2017 Part 4 Electrical
  - s.17 Appointment of persons to control electrical work
  - s.18 Acknowledgement of appointment
- MQSHR 2017 Part 9 Persons on site – *Division 3 – Carrying out tasks*
  - s.96 Supervising workers
  - s.122 Appointment of persons to control winding operations
  - s.123 Acknowledgement of appointment

6.2.2 Training and Assessment of Workers

The SSE must ensure workers are competent to carry out their allocated tasks including the operation and maintenance of plant and equipment. Competence means workers have the knowledge and skills necessary to perform tasks safely to a standard. Competency is gained through training, assessment and experience while being supervised or mentored.

The SSE needs to identify and document:

- tasks to be carried out
- skills and knowledge necessary for the tasks (via assessment i.e. a training needs analysis)
- training required to provide the identified skills and knowledge (recorded via skills matrix)
- assessments required to demonstrate competence
- frequency for refresher training.

Workers include both the SSE's employees and any contractor's or sub-contractor's employees.

Contractors should also have a training matrix or similar in place to be able to demonstrate to the SSE that contracted personnel have the required training and competencies before undertaking activities associated with shaft construction. The SSE must ensure that where statutory competencies are required that the individuals possess these as necessary.

In relation to a shaft construction project the SSE should ensure critical work is carried out by a person with particular technical competencies (i.e. winder/winding system specific knowledge and skills). These positions include:

- Underground Mine Manager
- Person to control winding operations (PTCWO)
- Person to control electrical work (PTCEW)
- Winder System Maintainer
- Winder Driver.

The SSE must ensure that before workers commence work on site they are inducted and made aware of the relevant hazards, associated controls and procedures. The induction must as a minimum include:

- the nature and layout of the site's operations
- the site organisational structure and communication procedures
- the site procedures and practices
- the site risk management process
- emergency procedures and basic first aid
- relevant legislation (including obligations).

The SSE should ensure that where workers speak a language other than English the SHMS and associated documentation, information, training and assessment is provided to those workers in their language. Where this occurs, the Operator and SSE should ensure that the risk of injury to workers is not compromised or made ineffective by the translation of the SHMS and associated documentation, information, training and assessment into a language other than English.

Provision within the induction must also be made for management and control of visitors' safety and health while on site.

References:

- MQSHA 1999
  - s. 13 Meaning of competence
- MQSHR 2017 Part 9 Persons on site
  - s.91 Induction training and assessment
  - s.92 Persons who have not completed induction training

- s.93 Training
- s.94 Records of training

6.2.3 Health and Fitness

Due to the nature of the work and risks involved in shaft construction activities the SSE must ensure that workers health and fitness is adequately managed.

To achieve this, the SSE must:

- identify the health and fitness requirements for workers involved in the project
- ensure that where necessary employees have undertaken appropriate medical assessments
- implement a drug and alcohol policy and program
- establish approved hours of work and shift rosters that ensure personnel are not subject to fatigue.

When establishing the controls the SSE should as far as practicable be consistent with the broader site standards. Where this is not possible the SSE must ensure that risk assessments are conducted and controls implemented. Once the controls have been decided they should be included in the SCMP.

References:

- MQSHR 2017 Part 9 Persons on site
  - s.84 Alcohol and drugs
  - s.85 Fitness of workers
  - s.86 Worker's self-assessment of fitness level
  - s.87 Assessing workers to decide fitness level
  - s.88 Fitness of visitors
  - s.89 Work hours and rest breaks
  - s.90 Amenities for workers' fitness and health

6.2.4 Contractor Management

The majority of shaft construction work is normally undertaken by specialist contractors who bring with them their own equipment, work methods, procedures and practices. Where these items are to be used as part of the shaft construction project the SSE must ensure they are reviewed, authorised and incorporated into the SCMP.

Contractors are workers and the SSE must ensure that they are supervised and comply with the SCMP. The SSE must ensure that there is an effective management structure which is capable of adequately achieving this.

The management structure must identify the positions within the mine management and contractor management group who have responsibility and accountability for the implementing the SCMP. Once identified, the responsibilities and competencies required for each position must be clearly defined and documented. Only persons that hold the appropriate competencies should be appointed to those positions.

References:

- MQSHA 1999 Part 3 Safety and health obligations
  - s.30 Obligations for safety and health
- MQSHA 1999 Part 3 Safety and health obligations
  - s. 36 Obligations of persons generally
- MQSHA 1999 Part 3 Safety and health obligations
  - s.37 Obligations of holders

- s.38 Obligations of operators
- s.39 Obligations of site senior executive
- s.40 Obligations of contractors
- s.41 Obligations of designers, manufacturers, importers and suppliers of plant etc. for use at mines
- s.42 Obligations of erectors and installers of plant
- s.42A Obligations of designers, constructors and erectors of earthworks
- s.43 Obligations of manufacturers, importers and suppliers of substances for use at mines
- s.44 Obligation of provider of services at mines
- s. 50 Management structure for safe operations at mines
- s. 51. Competencies of supervisors

6.2.5 Communication

The methods of communication between the shaft construction personnel (including contractors) and mine management should be formalised to ensure that the SSE has sufficient information to be satisfied that the SCMP is implemented, effective and the risk is adequately managed.

Methods of achieving this can include:

- regular project meetings
- daily prestart/handover meetings
- safety meetings
- project personnel are included in the relevant site safety /committee meetings
- project personnel are included in the distribution list for site safety information
- procedures for reporting accidents, incidents and hazards.

The methods chosen to support communication during the project should be documented in the SCMP.

The SSE should ensure that records are kept.

References:

- MQSHA 1999 Part 3 Safety and health obligations
  - s. 36 Obligations of persons generally
- MQSHR 2017 Part 9 Persons on site
  - s.97 Communicating with workers working alone underground
- QGN16 Fatigue risk management

6.3 Risk Management Processes and Procedures to be used for Shaft Works

Risk management processes must be identified and implemented to ensure risk to workers from shaft construction activities is as low as reasonably achievable. The SSE should approve the risk management processes that will be used for the shaft construction activities.

The personnel involved in these risk assessments should have sufficient knowledge and skills in risk assessment processes, shaft construction stages, and the plant and equipment to be used. This should allow them to effectively identify the hazards and associated risks, and recommend controls. The risk assessments and the controls identified should then be incorporated in the SCMP.

The SSE must ensure risk management is carried out throughout the life cycle of the project. This should include but not be limited to the following:

- overarching project risk assessment
- planning and design
- construction cycles:

    - site preparation
    - mobilisation
    - civil and shaft collar
    - winding system installation
    - pre-sink
    - main sink
    - breakthrough
    - fit out
    - de-mobilisation
- each stage of construction:
    - daily work activities
    - development of procedures and SWIs
    - change management
- foreseeable Emergencies
- shaft sinking within hazardous atmosphere.

Risk management must be carried out as per MQSHR Part 2 and be:

- consistent with SHMS requirements
- documented
- kept onsite
- involve a cross section of the workers
- inclusive of project and site specific considerations
- inclusive of information contained within this Guidance Note
- where practicable conducted in the workplace.

The primary purpose of undertaking these risk assessments is to ensure that the SSE has sufficient information on how each step of the shaft construction is to be carried out to be satisfied that the risk is being adequately managed.

References:

- MQSHA 1999 Part 2 Basic concepts
    - s. 26 What is an acceptable level of risk
    - s. 27 Risk management
    - s. 28 What happens if the level of risk is unacceptable
- MQSHR 2017 Part 2 Safety and health risk management
    - s.5 Risk management practices and procedures
- MQSHR 2017 Part 2 Safety and health risk Management
    - s.6 Hazard identification
    - s.7 Risk analysis
    - s.8 Risk reduction
    - s.9 Risk monitoring
- MQSHR 2017 Part 2 Safety and health risk management
    - s.10 Risk management record
    - s.11 Risk monitoring record

6.4 Procedures and Standard Work Instructions

The nature of shaft construction activities are such that to ensure the risk is being adequately managed and controlled, procedures and standard work instructions are required. Contractors involved in the shaft construction will have, or want to use, their own procedures and SWIs.

The SSE should ensure that all site procedures and SWI'S relevant to shaft construction and those intended to be used by the contractors are:

- identified
- reviewed by a competent person and updated as necessary to ensure they are specific to the site and the shaft construction methods to be used
- that the procedures are supported by risk assessments
- where necessary are compatible with and do not conflict with wider site procedures
- be subject to an approval and document control process that ensures that they are not implemented, changed or modified without SSE approval
- are clearly identified and listed in the SCMP
- communicated to workers and form part of the induction and training.

Examples of site specific procedures could include:

- accounting for persons working underground
- shaft signals
- drill & blast
- shaft re-entry
- muck out
- ground support
- concrete lining
- shaft services installation
- isolation and lockout
- first aid and emergency response.

References:

- MQSHR 2017 Part 11 Procedures and standard work instructions
  - s.114 Procedures and standard work instructions for particular operations
  - s.115 Accessing current procedures and standard work instructions
  - s.116 Written procedures
  - s.117 Standard work instructions

6.5 Maintenance

To ensure that the risk from plant and equipment is as low as reasonably achievable the SSE must establish a program of scheduled inspections and maintenance for all plant and equipment. This must include written procedures for monitoring and maintaining winding equipment.

This program should include:

- list or register of all plant and equipment to be used as part of the project
- a process to ensure that all plant is fit for purpose and safe prior to use or operation (i.e. site inspection and pre start inspections)
- routine scheduled testing and maintenance
- system to manage modifications and change.

As the majority of plant and equipment to be used as part of the shaft construction project is owned, operated and maintained by contractors, the SSE should ensure that the contractor equipment meets the site standards

To achieve this, the SSE should consider the following when assessing the contractor systems:

- does the contractor have a register of equipment?
- is there a maintenance and service history for the plant and equipment?
- commissioning records?

- is there a preventative inspection and maintenance program in place and does this meet the original equipment manufacturer (OEM) instructions and/or Australian Standards as applicable?
- can the contractor provide current inspection and certification for items such as:
  - winding ropes
  - attachments
  - winder drums
  - brake components
  - items requiring design certification, calculations and testing
  - conveyances and stages
  - lifting equipment
- does the contractor have the relevant maintenance and operation manuals and associated procedures?
- What are the competencies and qualifications of the personnel who undertake the maintenance and testing?
- what critical spares are carried by the contractor and how are these maintained?
- what onsite resources are needed by the contractor to effectively maintain the equipment?
- what pre start and inspection systems does the contractor have in place?
- what process does the contractor use to review, record and authorise modifications or changes to plant and equipment:
  - mechanical
  - electrical
  - operating parameters.

The SSE must ensure that plant or equipment is taken out of operation, if it cannot be demonstrated that it can be operated, serviced or maintained within its design limits or if it is unsafe to operate.

References:

- MQSHR 2017 Part 10 Plant generally
  - s.100 Selection and design, part (a)
  - s.102 Plant controls and control systems, part (b)
- MQSHR 2017 Part 10 Plant generally
  - s.104 Manufacture, construction, storage, transport and installation, part (b)
  - s.105 Commissioning
  - s.108 Monitoring
  - s.109 Service and maintenance

6.6 Winder Plant

The SSE must ensure all plant to be used during the shaft construction is fit for purpose. All information required to ensure that the winding system is designed, constructed, installed, operated and maintained within its design envelope should be contained in the SCMP. Information to determine if the winder system plant is fit for purpose may include:

- compliance to relevant legislative requirements
- compliance to site SHMS standards of design and installation
- compliance with Australian Standards where applicable
- OEM design and specifications:
  - engineering calculations
  - duty cycles
  - NDT results

    - proof loading
    - software certification and verification
    - test certificates
    - OEM operating and maintenance parameters
    - maintenance and testing requirements
- verification of certifier competency
- where and when manufactured
- engineering assessment and design review undertaken carried out for all winding components to ensure they are compatible and fit for the intended project.
- all safety critical functions and devices required to monitor and control the winder as identified and documented by the designer (refer Queensland Guidance note for Shaft Construction Part 2-3 – Engineering and Design)
- operational history
- ensuring effective safety features as per relevant legislation
- a record of the commissioning.

The SSE must maintain information on all major plant utilised during each stage of the construction project. This information should be retained for the life of the plant while on site. The SSE must ensure that there are processes and procedures in place so that winding plant and equipment is operated and maintained as part of shaft construction activities such that:

- it is fit for use in its intended environment and operating within the OEM design envelope
- it is inspected and maintained at regular intervals in accordance with OEM specifications (pre-start, breakdown and routine scheduled maintenance)
- records of maintenance and repairs are kept on site and available for inspection
- it is only operated if safety critical components are functioning and are not defective
- personnel who undertake repairs and maintenance are competent to undertake the work and have the necessary OEM manuals, tools, equipment and procedures to undertake the repairs
- where scheduled maintenance and breakdown work is to be undertaken in a way that differs from the OEM recommended methods or where environmental conditions are unfavourable the site's risk management processes are applied
- not modified or adapted without consulting the OEM and conducting appropriate risk assessments.

The OEM operating manuals are to be taken into account when developing training material and operating procedures and are available to the operators.

References:

- MQSHR 2017 Part 10 Plant Generally
    - s.100 Selection and design
    - s.101 Instrumentation and warning devices
    - s.102 Plant controls and control systems
    - s.103 Isolation facility
- MQSHR 2017 Part 13 Winding Operations
    - s.104 Manufacture, construction, storage, transport and installation, part (b)
    - s.108 Monitoring
    - s. 112 Specifications, instructions and other information about plant
    - s.128 Monitoring and maintaining winding equipment
- Safety Bulletin 136 – The mine and quarry electrical installation design

6.7 Emergency Preparedness and Response

The SSE must ensure that a suitable emergency response plan and emergency response capability (including trained personnel and resources) are developed, maintained and matched to the shaft construction activities being carried out at the time. To achieve this, the SSE must identify the foreseeable emergency situations, conduct a risk assessment and establish effective mitigation controls. Scenarios to consider could include:

- falls from height
- loss of power
- failure of critical winding equipment
- rock falls or ground failure
- sinking stages becoming stuck or jammed in the shaft
- serious injury to persons in the shaft or on the stage
- flooding
- irrespirable atmospheres
- fire
- illness or injury to the winder driver
- loss of means of egress from the shaft.

Mitigation controls to be considered include:

- identification of trained personnel to control and manage the emergency response
- trained personnel to respond to the emergency
- shaft specific emergency response equipment
- suitable and sufficient first aid and emergency response equipment
- secondary means of egress
- ventilation Safety controls and winding interlocks
- shaft communication and monitoring systems
- backup power supply for winders
- water management – assessment.

The emergency response plan developed for the shaft construction activities must be mapped to and form part of the overall site emergency response plan and procedures. The SSE must ensure that all first aid and emergency response equipment is inspected and maintained periodically.

The SSE must ensure that the emergency response plan and procedures are tested periodically. Ideally this should be matched with the various stages of the project. A record of the tests and improvement opportunities as a result of the tests should be kept.

References:

- MQSHR 2017 Part 5 Emergencies
  - s.32 Risk management for emergencies
  - s.33 Emergency preparedness – general
  - s.35 Emergency response plan
  - s.36 Evacuation
  - s.36A Escape ways from underground
  - s.37 Refuges
  - s.38 Rescue
  - s.39 Resources for first aid and medical treatment
  - s.40 Maintaining and improving emergency response capability
  - s.41 Mine rescue plan

6.8 Auditing

Once the SCMP is established and implemented the SSE must establish a program of inspections and audits. This is to ensure the SCMP is effective at all stages of the shaft construction activities in managing and controlling the risk.

The program of audits and inspections can include:

- workplace inspections – pre-start, daily and weekly
- task observations
- routine scheduled plant inspection and maintenance
- review of accidents and incidents
- third party inspections and technical audits
- training needs analysis
- review of risk assessments undertaken and controls identified
- periodic review of procedures and assessment of worker understanding and compliance
- formal auditing of the SCMP.

A record of the non-compliances identified and corrective actions taken as a result of these inspections and audits should be kept as part of the SCMP. The timing of these inspections and audits should coincide with the timing of the major activities associated with the shaft construction project. For example these could include:

- when the project commences and site setup is underway
- when variations to the project occur
- during the shaft pre-sink
- during the shaft main sink
- following significant changes to management, contractors or personnel.

Additionally the mine operator has an obligation to audit the effectiveness of the SSE's SHMS, including the SCMP, to ensure risk to persons from operations is at an acceptable level.

References:

- MQSHA 1999 Part 3 Safety and health obligations
  - s.38.1(e) Obligations of operators
  - s. 39 1(f) Obligations of site senior executive for mine
- MQSHR 2017 Part 2 Safety and health risk management
  - s.9 Risk monitoring
- MQSHR 2017 Part 9 Persons on site
  - s.96 Supervising workers
  - s.98 Checking work quality
  - s.108 Monitoring
  - s.109 Service and maintenance

7 References

The guidance note and design parameters for shaft sink winding systems and shaft sink construction methods make reference to the following Acts, Regulations, Australian Standards, and Guidance notes for the construction of vertical shafts.

Applicable Queensland legislation:

- *Mining and Quarrying Safety and Health Act 1999*
- Mining and Quarrying Safety and Health Regulation 2017
- *Explosives Act 1999*

- Explosives Regulations 2003

Guidance notes

QGN11 Handling Explosives in Underground Mines

QGN16 Fatigue risk management

QGN23 Facility descriptions for metalliferous mines and quarries

Safety bulletins

Safety bulletin no 136 mine and quarry electrical installation design expectations

Australian Standards (AS) and Australian and New Zealand Standards (AS/NZS) Underground mining – Shaft equipment	
AS 3785.1	Underground mining – Shaft equipment Part 1: Shaft overwind safety catch system
AS 3785.2	Underground mining – Shaft equipment Part 2: Shaft winding arresting systems.
AS 3785.3	Underground mining – Shaft equipment Part 3: Drum winding gripper systems
AS/NZS 3785.4	Underground mining – Shaft equipment Part 4: Conveyances for vertical shafts
AS 3785.5	Underground mining – Shaft equipment Part 5: Headframes
AS/NZS 3785.6	Underground mining – Shaft equipment Part 6: Guides and rubbing ropes for conveyances
AS 3785.7	Underground mining – Shaft equipment Part 7: Sheaves
Underground mining – Winding suspension equipment	
AS 3637.1	Underground mining – Winding suspension equipment Part 1: General requirements
AS 3637.2	Underground mining – Winding suspension equipment Part 2: Detaching Hooks
AS 3637.3	Underground mining – Winding suspension equipment Part 3: Rope Cappings
AS 3637.4	Underground mining – Winding suspension equipment Part 4: Drawbars and connecting links
AS 3637.5	Underground mining – Winding suspension equipment Part 5: Rope swivels and swivel hooks
AS 3637.6	Underground mining – Winding suspension equipment Part 6: Shackles and chains
Ropes	
AS 1394	Round steel wire for ropes
AS 3569	Steel wire ropes – Product specification
AS 2759	Steel wire rope—Use, operation and maintenance
AS/NZS 4812	Non-destructive examination and discard criteria for wire ropes in mine winding systems
AS 2759	Steel wire rope—Use, operation and maintenance
Electrical	
AS/NZS 1020	The control of undesirable static electricity
AS/NZS 3000	Electrical installations (Known as the Australian/New Zealand Wiring Rules)
AS/NZS 3017	Electrical installation – Verification guidelines
AS/NZS 3019	Electrical installations – Periodic verification
AS 61508	Functional safety of electrical/electronic/programmable electronic safety-related systems

AS 62061	Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems
AS/NZS 3007	Electrical equipment in mines and quarries - Surface installations and associated processing plant
AS/NZS 3190	Approval and test specification – Residual current devices (current operated earth-leakage devices)
AS/NZS 3760	In-service safety inspection and testing of electrical equipment
AS/NZS 1768	Lightning protection
Cranes	
AS 1418.1	Cranes, hoists and winches Part 1: General requirements
AS 1418.2	Cranes (including hoists and winches) Part 2:Serial hoists and winches
AS 1418.5	Cranes, hoists and winches Part 5: Mobile cranes
AS 2550.1	Cranes, hoists and winches-- Safe use Part 1: General requirements
AS 2550.5	Cranes, hoists and winches—Safe use Part 5: Mobile cranes
Fixed Platforms	
AS 1657	Fixed platforms, walkways, stairs and ladders – Design, construction and installation.
Fall-Arrest	
AS/NZS 1891 Series	Industrial fall–arrest systems and devices
General	
AS/NZS ISO 31000	Risk management – Principles and guidelines
AS/NZS 4024 Series	Safety of machinery
AS/NZS 3679 Series	Structural steel
AS/NZS 1554 Series	Structural steel welding
AS 3990	Mechanical equipment - steelwork
AS 4100	Steel structures
AS 1403	Design of rotating steel shafts
Foundations and lining	
AS/NZS 1170 Series	Structural design actions
AS 2187 Series	Explosives
AS 3600	Concrete structures
AS 3610	Formwork for concrete
Inspection and Testing	
AS 1012 Series	Methods of testing concrete
AS 1710	Non-destructive testing – Ultrasonic testing of carbon and low alloy steel plate and universal sections – Test methods and quality classification