Department of Natural Resources, Mines and Energy

Guidance Note QGN 02

Isolation of plant

Mining and Quarrying Safety and Health Act 1999

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Queensland Government

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

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1. Purpose and scope

This guidance note has been issued by the Mineral Mines and Quarry Inspectorate of the Department of Natural Resources, Mines and Energy (DNRME). It aims to provide guidance on how to prevent the uncontrolled release of hazardous energy by:

- ensuring effective isolation systems are developed and implemented that protect workers from the hazardous energy sources so the risk is at an acceptable level
- taking plant out of service.

This guidance note updates the 2005 version of QGN 02 Isolation Procedures, and also includes additional material from the withdrawn 2005 version of QGN 01 Out of Service Procedures.

A guidance note is neither a Guideline as defined in the *Mining and Quarrying Safety and Health Act 1999*, nor a Recognised Standard as defined in the *Coal Mining Safety and Health Act 1999*. In some circumstances, compliance with the guidance note may not be sufficient to ensure compliance with the requirements in the legislation.

Guidance notes may be updated from time to time. To ensure you have the latest version, either check the DNRME website or contact your local Inspector of Mines.

2. Introduction

Numerous incidents in the Queensland mining industry have been caused by ineffective isolation of plant, including:

- a fatal accident when an accumulator was taken apart while still pressurised
- a fatal accident when an underground worker unscrewed a pipe fitting containing pressurised air
- the wrong piece of plant was isolated in fixed plant with items of plant installed in parallel,
- entanglement in conveyors where a guard was removed before isolating.

This guidance note covers isolation of not only electrical energy but all other forms of hazardous energy found on mine sites.

Circumstances often dictate that systems required to effectively isolate plant are highly complex and may require other support processes. Those support processes (e.g. permits to work) are not covered in this guidance note.

Irrespective of the complexity, this guidance note aims to provide a basis for establishing the detail involved in developing systems to prevent:

- uncontrolled release of energy
- unexpected start-up
- impact of external forces.

Information is also provided on the use of Out of Service tags, which are **never to be used in the place of isolation locks and tags.**

3. Isolation systems and standard work instructions

Mines that are required to have a safety and health management system (SHMS), must have a system that provides for isolating, locking-out, tagging and re-energising plant.

Mines that are not required to have a SHMS must have a standard work instruction for isolating, locking-out, tagging and re-energising plant.

Determining the most effective isolation system or standard work instruction for a mine site will generally depend on the size, nature and complexity of the mine. A risk assessment of the types of plant and the hazardous energies present should be undertaken to determine the processes and resources needed to ensure effective isolation.

The risk assessment should involve worker(s) responsible for the isolation and re-energisation of plant and other workers involved in the task.

The following risk assessment steps should be considered:

1. Inspect and audit the mine to determine potential hazardous energy associated with plant on site.
2. Check Original Equipment Manufacturer (OEM) recommendations and warnings. Determine how each hazardous energy source is to be isolated and controlled.
3. Identify whether hazardous energy can build up or be introduced while isolated, for example:
   - air pressure leaking past a seal
   - chemical leaking past an isolation valve
   - alternative electrical supply and interlock situations
   - other plant and foreseeable activities in the area.
4. Check to ensure effective isolation facilities are available for plant.
5. Ensure suitable isolation resources are available for the type of hazardous energy, e.g.
   - locks/tags
   - valve handle covers (see fig.1)
   - electrical distribution board, circuit breaker isolation facilities.
6. Ensure suitable resources are available to mitigate risk if isolation fails, for example:
   - chocks/pins
   - drain valves
   - barricades/guards
   - exclusion areas
   - electrical earth straps
   - arc flash protection
   - additional personal protective equipment (PPE).
7. Check for multiple sources of energy.

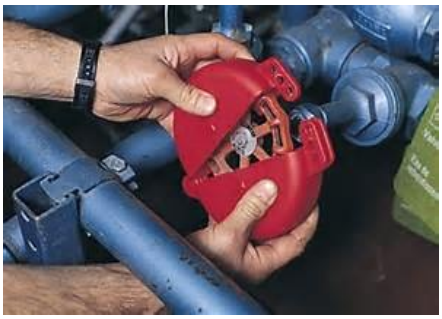

Figure 1 Valve isolator

The system and standard work instructions for isolation must cater for all foreseeable isolation requirements at the mine.

4. Hazardous energy

Sources of hazardous energy may include but not be limited to:

Electrical - electrical power supply, static charges, batteries, capacitors

Mechanical - drives, moving and rotating machinery, noise, vibration

Pressure - compressed air, vacuum, hydraulics, wind

Gravity - counterweights, vehicle runaways, hung-up material, truck trays

Stored energy - springs, wire ropes

Thermal - hot or cold surfaces and substances

Radiation - heat, lasers, welding, electro-magnetic fields, X-rays, radioactive sources

Chemical - reactive, explosive, flammable, corrosive

4.1 Stored hazardous energy

Stored energy can exist in springs and wire ropes, as well as within other energy categories such as gravity, pressure, electrical and chemical. Stored energy is difficult energies to identify as it is often not visually obvious. Risk based processes should be used to identify stored energy, carried out by workers with a comprehensive knowledge of the plant.

5 Isolating and re-energising process steps

The isolation process should be kept as simple as possible. There are three key stages to any isolation process: isolation, validation that isolation is effective and re-energisation.

Note: While the nature of some hazardous energies and complexity of operations can require procedures to be more detailed, they should still follow the same principals of isolation and re-energisation.

5.1 Isolating

As a minimum the isolation process should include:

- identifying all hazards in the immediate working area and putting in place appropriate controls prior to work commencing
- identifying all sources of hazardous energy with the potential to impact on workers carrying out the tasks, including those in the circuit before and after the plant to be worked on
- ensuring that the isolation points belong to the plant to be isolated
- locking and tagging all isolating devices to ensure all stored energy is either contained or released to prevent build-up
- verifying that the isolation is effective
- ensuring the method of releasing or containing the energy is maintained
- monitoring to ensure there is no re-accumulation of energy.

If an additional source of hazardous energy is identified during the course of carrying out the task, all the above steps should be repeated.

5.2 Re-energising

After the tasks have been completed the re-energisation process should include the following:

- check and confirm that all personnel are clear of the machine prior to starting
- checking that the plant is fit for restoration of energy sources
- removing isolation devices and advising the person in control of the plant that it is fit for use, or
- attaching an Out of Service tag to the isolation point if work has not been completed or plant is not fit to return to service.

6 Methods of isolation

Methods of isolation depend on the complexity of work to be undertaken and hazardous energy present.

6.1 Single point isolation and single worker

A single worker isolation can be carried out by a worker who has been:

- trained and assessed as competent in the plant isolation requirements
- issued with a personal lock and tag, (fig.2).

Figure 2 Lock and tag

6.2 Single point isolation and several workers

Figure 3 Use of scissor clasp for single point and several workers

This process is suitable for most standalone fixed and mobile plant where a single isolation point will de-energise the entire plant. On a mobile plant this is generally the full current battery isolation point. On a fixed plant it is generally the main full current isolator for the entire plant. This process is only suitable if the power required to carry out the task, for instance using a welder, is supplied from another independent source.

To enable several workers to lock out and tag at a single isolation point, a scissor lock (fig.3) or similarly effective device should be used.

One worker should be appointed to control the isolation process.

6.3 Several isolation points and a limited number of workers

The complexity of introducing multiple locks and tags for each worker means that this isolation method should be restricted to a limited number of defined workers. It is only suitable for use in fixed plants.

However, a risk assessment should be conducted to determine if using a group isolation process, as described in the next section, would lower the level of risk.

6.4 Group isolation

Figure 4 in situ lock box

Group isolation is a method used when a number of workers access plant with multiple isolation points - generally where single point isolation is ineffective.

Group isolation requires a lock box (figs.4 & 5) into which the keys to the isolation locks are placed. The lock box itself is then locked by an isolation lock and tag. The sequence of using the lock box is as follows:

1. The worker in charge isolates all the hazardous energies using their dedicated locks and tags, and places the keys inside the lock box.
2. The worker in charge then secures the lock box by attaching their own lock and tag.
3. All other workers then attach their **personal locks and tags** onto the lock box.
4. As the workers complete their work, they remove their **personal locks and tags** from the lock box until all are removed.
5. The worker in charge inspects the plant to ensure it's ready for re-energisation.
6. The worker in charge removes their lock and tag from the lock box and then removes all the dedicated locks and tags using the keys from inside the lock box.

Figure 5 Portable lock box

7 Identifying effective methods of isolation

The method of isolation should be determined by a risk management process that accounts for the complexity of the operation, the energy sources and number of workers.

Whatever method used must include checking that all hazardous energies able to impact on workers are effectively isolated and participating workers must have been trained and assessed in that method.

To ensure the selected method is effective some of the following processes may be applied:

- documented procedure developed
- job safety analysis
- standard work instructions

- permits to work
- checklists.

8 Testing for effectiveness of isolation

The testing method should be identified and included in the risk assessment process. Assume that all plant is live until the isolation is proved to be effective. Some examples of test for effectiveness are:

- attempting to start the plant under controlled conditions
- ensuring valves used for releasing energy are not blocked
- installing phase indicator lamps
- use of pressure gauges.

Testing and indicator equipment must be checked for accuracy as part of the isolation process.

9 Mitigating controls

Consider what mitigating controls are needed should isolation be ineffective or a hazardous energy not be identified. Some examples include:

- appropriate routine personal protective equipment and task specific personal protective equipment for chemical splashes, arc flashes (e.g. fig.6)
- exclusion zones that are defined with authorised access
- resuscitation notices and provision of first aid
- emergency response and resources.

Figure 6 Arc flash PPE

10 Other ways of controlling the energy

As it is impossible to apply isolation devices to control some forms of energy, consider eliminating such energy sources or separating workers from any potential uncontrolled release.

On mobile plant the energy due to gravity can be controlled by using chocks and lowering implements onto the ground. On fixed plant, pins can be used at the base of hoppers or chutes. Any means used must be fit for their intended purpose.

Exclusion zones (e.g. fig.7) can prevent workers not associated with the task from being in an area that could result in their injury if there is an unexpected release of energy.

Figure 7 Confined space entry isolation

11 Working on energised plant

Working on energised plant should not occur when work could be performed with the plant de-energised and isolated.

Energised plant includes plant unable to be moved due to it being seized up or jammed by material.

If work must be carried out on an energised plant, a risk assessment must be conducted to determine appropriate processes to be followed and approved by a competent person. Consider escalating the approval process above supervisor level to verify the work has to be done when the plant is energised.

12 Working on plant removed from a power supply

Maintenance work on power tools or other plant that has been unplugged or disconnected from its power source may not need to be locked out if a risk assessment has determined that this is the case. Otherwise the plant should be tagged out of service or isolated by fitting a lock-out plug (fig.8) and tag.

Figure 8 Lockout plug

13 Isolation facilities

Electrical equipment must have a full current isolation facility (e.g. fig.9) in a location that is easily accessible. The isolation facility must be capable of being locked-out and tagged or otherwise secured.

In summary the plant must have provision for:

- the attachment of a lock and tag
- full current electrical isolation
- a reliable mechanical means of achieving the isolation
- unambiguous labelling that matches and is correct at all locations.

The following examples are not to be used for isolation:

- emergency stops
- conveyor emergency pull wires
- switches in control circuits (including software controls)
- ignition keys.

Figure 9 Circuit-breaker isolation

14 Isolating, locking out and tagging

Isolating, locking out and tagging protects workers from hazardous energies. Locks, tags, scissor locks, and lock boxes should be durable and in good condition for their intended use and environment. They should be standardised throughout the site.

A personal lock issued to a worker should have only one unique key that is issued with the lock (fig.10). This key should always remain in the possession of the worker.

Isolation tags may be single or multiple use. As a minimum the tag should display the name of the worker and the date that it was attached

Figure 10 Personal lock and tag

Personal locks should be removed when that worker has completed their task or at the end of their shift. If the work is not completed, an Out of Service tag should be placed in a prominent position on the plant (generally at the isolation point or where the main controls are located).

Personal locks and tags should only be removed by the worker who placed them on the plant. However if the worker fails to remove their lock and tag after they have completed their work, there should be an appropriate system that is followed to remove their lock and tag.

15 Using Out of Service tags

Out of Service tags should be placed on plant and equipment to:

- advise that it should not be started or operated
- protect the plant from damage
- warn workers that starting the plant could cause an injury.

Out of Service tags must not be used to protect workers whilst they are working on the plant. Out of Service tags should, as a minimum, detail the reason for placing the tag on the plant.

Figure 11 Out of service tag

16 Training

Training and assessment in isolating, locking out and tagging of plant must be part of induction training. Further training and assessment, including identifying sources of hazardous energy, should be given to workers who, for example:

- operate mobile plant
- maintain mobile plant
- operate fixed plant
- maintain fixed plant
- install, maintain and remove underground services
- work on high voltage installations
- commission or decommission plant.

Workers must be trained and assessed as competent to ensure they understand the operation of the plant to be isolated and are aware of the isolation points. Workers who have not been trained and assessed must be directly supervised by a worker competent in the operation of the plant to be isolated.

All training programs should place particular emphasis on how to determine that the correct item of plant has been isolated.

Records of the training and assessment must be maintained.

17 Monitoring of isolation systems

The effectiveness of the isolation should be monitored at regular intervals using systems such as supervisor checks, job observation and auditing. A system should be in place to take appropriate action if non-conformances are found.

18 Appendices

Applicable legislation

The Mining and Quarrying Safety and Health Regulation 2017 has the following specific requirements relevant to isolation of plant:

PART 4 ELECTRICAL

26A Basic safety principle

(1) A person carrying out or preparing to carry out work on or near electrical equipment must treat each exposed electrical conductor as live until it is—
(a) Isolated and proved to be de-energised: and
(b) If it is a high voltage conductor—earthed.

(2) In this section—
electrical equipment means an item used for generating, converting, transmitting, distributing or using electrical energy.
high voltage means a voltage of more than 1200V.

27 Isolation facilities

(1) The operator and site senior executive must ensure each item of electrical equipment used at the mine has a full current isolation facility in a location that is easily accessible by a person required to carry out the isolation.

(2) The operator and site senior executive must also ensure the isolator is –
(a) clearly marked or labelled as the isolator for the plant: and
(b) compatible with the mine's isolation and lock-out procedures.

PART 10 PLANT GENERALLY

103 Isolation facility

(1) If, having regard to the nature and level of risk from plant used at a mine, it is necessary for managing the risk, the site senior executive must ensure the plant has a facility for –
(a) preventing its operation;
(b) preventing or controlling the release of its stored energy; or
(c) isolating its energy supply.

(2) The site senior executive must ensure the facility is capable of being locked-out and tagged or otherwise secured.

106 Operating plant

A person who has an obligation under the Act to manage risk at a mine in relation to the operation of plant must ensure the plant is not operated –
(a) in a way that creates an unacceptable level of risk; or
(b) if inspections, tests or monitoring show the plant is unfit for use; or
(c) if the plant is locked-out and tagged.

107 Isolating, locking-out and tagging plant

(1) A mine's safety and health management system must provide for the following–

(a) isolating plant, including effectively isolating plant to control the risk from a release of energy;

(b) taking plant out of service;

(c) testing plant or its energy source for zero potential;

(d) returning plant to service.

(2) The site senior executive for a mine that is not required to have a safety and health management system must ensure the mine has a standard work instruction for the activities mentioned in subsection (1)(a) to (d).

(3) If the safety or health of a person is directly affected by the operation or non-operation of plant, the system or standard work instruction must also provide for locking-out and tagging the plant.

References

- AS 4024. 1603 Safety of machinery. Part 1603 Design of controls, interlocks and guards—Prevention of unexpected start-up
- AS/NZS 3007:2013 Electrical equipment in mines and quarries - Surface installations and associated processing plant (sections 2.9 & 4.3)
- DNRME Safety bulletin 49 Isolation of plant containing stored energy