

GUIDELINES FOR MANAGEMENT OF HAZARDS ASSOCIATED WITH CRUSHING AND SCREENING PLANT



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1.0 HAULAGE

- A. Traffic between extraction faces and the primary plant involves several hazards that require identification and management in accordance with relevant standards, codes of practice and guidelines. Haul roads must be designed and built to match the mobile plant used and with particular reference to carrying capacity, width, gradient and camber. Windrows should be constructed where vehicles could accidentally leave the roadway.
- B. Signs displaying speed limit, right of way, one-way systems and any other special information or warnings, should be posted up and maintained in good condition. Drivers should be authorised in writing to operate each machine type after they have been trained and demonstrated their competence, including a clear understanding of all safety features.
- C. Refer to “Guideline for Safe Operation of Mobile Plant in Surface Mines and Quarries.”

2.0 PRIMARY STOCKPILES

- A. Live stockpile accidents are all too common. The limits of safe tipping areas change as material is loaded out, and operating rules and procedures must fully account for this. Good visibility and clear communication between operators is vital and the whole process requires constant coordinated management. Light vehicles and pedestrians in the area will further increase accident risk and appropriate separation restrictions along with good visibility are essential.
- B. Refer to Guideline for the Safe Working of Stockpiles and Dumps in Surface Mines and Quarries.

3.0 PRIMARY HOPPERS

- A. Primary Hoppers must be robustly constructed and located on firm ground to ensure stability. Install an effective stop block to prevent the feed vehicles from accidentally entering the hopper - and maintain its effectiveness by regular removal of spillage.
- B. Ensure there is a clear signal operating system to prevent tipping when this could create a hazard. Spillage over the sides of hoppers should be eliminated by extensions to the hoppers and centralised walled vehicle approach ramps and guide systems. Vehicles should be well matched to the hopper capacity. If a hopper observation point is required install a suitable platform equipped with standard guardrails.

4.0 CRUSHING

- A. The hazards involved with blockages, dangerous moving parts, objects being ejected from crushers and maintenance tasks all need careful management.

4.1 *Crusher Blockage.*

- A. Clearing blocked jaw crushers can be very hazardous and many plant operators have been killed carrying out this task. Blockage incidents can be greatly reduced by supplying rock that is properly sized to match the primary jaw opening. Prevention of oversize in feed material starts at the face with good fragmentation. Removal of oversize material before delivery to the plant and vigilant control of the crusher feeder will make blockages unlikely.
- B. Remotely controlled methods are recommended for clearing blocked jaw crushers and if manual methods are to be used a comprehensive assessment of the risks is essential. Rules and safe operating procedures should be established for each task and the operators must be properly trained before being authorized to do this work.
- C. The practice of using of steel bars to lever rocks in blocked crushers has a high accident rate. Hand and back injuries are common but far more serious harm can occur, particularly if an attempt is made to bar material in a running crusher. Bars should never be used on or near a crusher while it is running. Before any barring begins, the plant should be shut down and locked out.
- D. Unstable material that could fall causing injury must be cleared away or made safe. The operator should select a bar that is a suitable length for the job and be positioned so as not lose balance. Appropriate personal protective equipment must be used, including fall protection if necessary. Use of steel wedges to free blocked jaw crushers also has a high potential for serious harm. Wedges can be ejected from a crushing chamber with considerable force and movement of the material in the chamber can also suddenly drag them down. If wedging is done by hand the tool must have a quick easy-release handle. Only mild steel wedges are suitable and while bucket teeth may be well shaped but they should never be used in crushers.
- E. Hooks should not be used in a running crusher unless remotely controlled. Before spalling to break up large rocks inspect the hammer and other equipment to be used and ensure it is in safe working order. Use eye, face and hand protection, and if necessary arm and leg protection as well. Clearing blockages in large jaw crushers by remote controlled hydraulic equipment is recommended but note that this may introduce other hazards such as flying rock chips from impact hammers.

4.2 *Crusher Maintenance*

- A. Hazards during maintenance are many including falls, being caught in moving equipment and being crushed by heavy components. Recently an overseas operator with more than 4 years experience was killed when a heavy jaw crusher liner plate dislodged as he was attempting to secure it. This type of accident calls attention to the need to have safe maintenance procedures for all tasks.
- B. Maintenance procedures must take account of manufacturers' instructions and safety warnings. When performing maintenance inside large jaw crushers a specially designed platform may be inserted into the jaws to prevent movement

and to provide a secure place to work from. Before lifting ensure the device is suitable for the job, and the load is securely attached with all personnel clear of the danger area. Following placement make sure the load will not accidentally fall or shift before detaching the lifting device.

4.3 Steel and Explosives in Crushers

- A. Precautions are needed to prevent explosives and steel from entering crushers with the feed material. Efficient blasting practice with good post-blast assessment and vigilant muck-pile observation are necessary. Magnets or metal detectors coupled to a warning or stop device will help keep steel out. In high-risk situations, the operator station may need a protection barrier.

5.0 SCREENING

- A. All accessible moving parts such as drive mechanisms, rotating flywheels, shafts and counterweights must be fully guarded to prevent accidental injury. Guard design should make it impossible for people to reach the hazard, including from the sides and rear. Identify hazards involved with screen repair and maintenance tasks and establish safe procedures. Where screens are elevated and lack secure platforms, a reliable access method must be provided.

6.0 CONVEYORS

- A. Belt conveyors are widely used for moving large tonnages of bulk material through various production processes. Often they are tremendously powerful and this high energy level means that accidental contact with moving parts can be disastrous. They are one of the most common single causes of serious injury accidents in New Zealand quarries. Operational safety falls into two main categories:
 - a. Physical guarding.
 - b. Safe operating rules and procedures - backed up by good training and supervision.

6.1 Conveyor Guards

- A. Conveyor Guards must be installed to effectively prevent contact with all moving parts that are accessible or, within reason could become accessible. Most of the serious injuries occur by entrapment in nip points – particularly on tail and head drums.
- B. Nip points on the head and tail pulleys of conveyor belts and at tensioning devices are well-recognised hazards, but serious harm can occur at idler rollers as well. With lightweight belts the risk of serious injury at the troughing rollers is normally low but where the belt is held down against the rollers by anti spillage skirts, guards should be fitted.
- C. With heavy-duty installations the belt weight alone may be sufficient to cause dangerous nip points on the idler rollers. Exposed rotating shafts that could entangle loose clothing or long hair must be guarded. Spillage is a fact of life with conveyors and many accidents occur while getting rid of it. Good plant design provides space for machine clearance and cleanup using high-pressure water. An

emergency stop mechanism (pull cord or emergency stop button) should be located along the accessible length of this conveyor.

- D. Nip points on drive-belt pulleys are notorious for amputating fingers and all accessible belt and chain drives should be completely enclosed, including from the back. Guards should be strong enough for their purpose and if placed where someone could stand on them this should be catered for. Consider the manual handling issues when designing removable guards.

6.2 Conveyor Training.

- A. A set of clear concise rules should be formulated and used in operator training around conveyor belts. It may be helpful to post up summarized rules at significant locations to remind people of key points and warning signs can be effective. No-entry areas must be well defined by barriers and warning signs.
- B. Standing on running conveyor belts is prohibited. Before working on a conveyor ensure it is locked out. Where the conveyor is inclined securely clamp it to the conveyor frame to prevent runback. Note that where runback prevention devices are installed in the drive mechanism, belts can still run back if a component fails.

6.3 Emergency Stopping

- A. Emergency Stopping of conveyors should be readily available. Where there is an adjoining walkway a pull wire system installed along the length is the best method. Conveniently located emergency stop switches can be provided for other accessible conveyors.

6.4 Start-up.

- A. The procedure should include a arrangement to ensure all persons are clear before start-up. If the operator is unable to see the whole area, devices that give clear recognizable warnings may be needed.

7.0 SURGE PILES AND BINS

- A. Access to these areas must be carefully controlled as burial in product bins, stockpiles and surge piles has resulted in many New Zealand fatalities – several of them involving children.
- B. Unauthorised entry onto surge piles (where the material is drawn out from below) must be prevented and the area marked with clear warning signs. Only trained competent people will be allowed to work in these areas.
- C. The entry procedures for surge piles and product bins include steps to ensure that feeders are locked and the draw zone is not hung-up. Persons entering the draw zone area should have a body harness attached to a rope that is secured to an anchor above. A second person will be stationed at the anchor point to direct the work, maintain rope tension and ensure attachment. Clear communication between the people involved is essential.

7.1 Reclaim tunnels

- A. Reclaim tunnels have particular confined space hazards that may include poor air quality, low light, fire hazards and entrapment by a rush of material due to water

saturation or feeder/chute malfunction. Guards on dangerous moving part must be designed to allow for the restricted space and reliable emergency stop systems installed.

- B. Bin and tunnel entry permit procedures should be developed with reference to relevant confined space standards and an effective unauthorised entry control maintained. Refer also to Guidelines for the Safe working of Stockpiles and Dumps in Surface Mines and Quarries.

8.0 WASHING PLANTS AND PONDS

- A. In washing plants moving machine parts on trommels, screw classifiers, pumps etc. need guarding. Walkways may require skid resistant surfaces and warnings of possible slippery surfaces. Where deep ponds create a potential drowning hazard they should be fenced off and warning signs posted. Barriers such as windrows are required where vehicle traffic moves adjacent to deep ponds. Regular inspections may be necessary to assess stability in areas where erosion could undercut and weaken embankments.

9.0 ELECTRICITY

- A. Electrical work can only be done by qualified electricians but operators should make regular visual checks to ensure that equipment is in a safe condition and that cables remain properly supported and well protected. Overhead and underground cables should be marked on a plan and precautions taken to avoid contact with machines e.g. visible markings. New Zealand Electrical Code of Practice (NZECP 34:2001) refers to electrical safe distances and requires the distance between any live overhead electric line and any part of a mobile plant (or load carried) to be “at least 4 metres”, unless the operator has received written consent from the line owner. If mobile plant is to be used in the proximity of overhead electric lines a warning notice should be conspicuously posted in the cab in view of the operator.
- B. Fires are often caused by faulty electrical equipment and suitable fire extinguishing capability should be readily available. Electrical installation rooms must be kept dry and clear of combustible materials and must not be used for general storage. Isolating transformers or earth leakage protection should be used for work with electrical hand tools.

10.0 PLANT MAINTENANCE

- A. Clear effective isolation and lockout procedures are essential. Premature or unplanned start up has caused many accidents in crushing and screening plants. Refer to “Guideline for the Preparation of Isolation and Lockout Procedures in Mines, Quarries and Tunnels”. Carry out periodic maintenance in accordance with manufacturers’ recommended procedures. Tools and machinery must be suitable for the job and inspected regularly to ensure they are maintained in good working order.
- B. Welding and gas cutting require training and use of special protective equipment. Always ensure that gas bottles are restrained, combustible materials removed and appropriate fire precautions are in place. Persons in the vicinity may need protection by barriers and warnings. Hot work permits should be a requirement in

high-risk situations. Refer to “Guidelines for use of Gas Cutting and Welding equipment in Surface Mines and Quarries.”

- C. Manual handling can result in serious harm and the hazard is often overlooked. Employees should be taught how to lift and carry correctly and instructed not to attempt to lift heavy or bulky loads on their own. Storage areas must be designed and maintained to minimize the need for people to bend awkwardly when lifting heavy items. Refer to “Approved Code of Practice for Code for Manual Handling”
- D. Lifting with Machinery. Cranes must have a current certificate of inspection and be operated by authorized operators who have been trained in procedures that include manufacturer’s instructions and site-specific factors. Ensure lifting tackle is certified and tagged with the safe working load and that loads are always within the rated lifting capacity. The tackle and other attachments should be inspected regularly for wear and damage. When signalling is required, one person should be designated should carry it out and to ensure no person is ever under, or at risk of harm from a suspended load.
- E. Refer to “Approved Code of Practice for Cranes” and “Approved Code of Practice for Load-lifting rigging”

11.0 GENERAL HAZARDS

11.1 Loud noise

- A. A noise survey should be carried out to identify areas and equipment where noise levels exceed 85 dB(A) over an 8-hour period and 140 dB peak. Regulations require all practicable steps to be taken to prevent exposure to noise above these levels and in areas where it is not practicable to reduce it, warnings should be posted up and suitable hearing protection provided. Supervision to ensure the protection equipment in used and maintained should be in place. Plant operators are most at risk and soundproofed operator cabins may be necessary to maintain safe exposure levels.
- B. Refer to “Guidelines for Noise Control in Mines, Quarries and Tunnels” for more information.

11.2 Dust

- A. Dust is another widespread significant hazard in crushing and screening plants. Airborne rock dust can cause serious lung disease, as well as giving rise to visibility and environmental problems. Lung diseases are caused by very fine particles known as respirable dust that penetrate deep into the lung.
- B. Elimination and isolation of harmful dust by engineering and administrative controls should be the first priority and only where there is no practicable solution should respiratory protection masks become the method of minimizing harm.
- C. Refer to “Guidelines for Dust Control in Mines, Quarries and Tunnels” for more information.

11.3 Vibration

- A. Vibration may cause dangerous situations to develop in the form of broken welds and loose bolts but the vibration itself can also be a serious health hazard. Noise

and vibration are usually connected so where there is loud noise there is likely to be a vibration hazard as well. Unexpected or excessive vibration may be an indication of an instability problem, particularly on a portable plant. Long-term contact with hand held vibrating machines such as percussion rock-drills can cause circulation damage, usually to the fingers. With continued exposure some permanent loss of feeling in the fingers may develop.

- B. Plant operators exposed to intense long-term vibration are at risk of developing chronic back pain and other complaints due to whole-body vibration. Vibration is generally transmitted to the body from crushing and screening plant surfaces through the feet or through seats. The structure of operating areas should be designed to minimize vibration.

11.4 Falling Objects

- A. Falling Objects, overflow from plant items such as hoppers, crushers and conveyors is a potential hazard and so are rocks (and other objects) that may fall from elevated platforms, mobile plant and stockpiles. Plant and stockpiles should be designed and constructed to eliminate the problem as far as practicable.
- B. Operators require training in methods that will avoid creating potential rockfall situations. In hazardous areas fencing or barriers may be required to protect people from falling objects and warnings signs should be posted prohibiting entry. Housekeeping should include regular removal of rock spillage – particularly from walkways and platforms. Where there is a risk of falling objects hard hats should be worn.

11.5 Flying rock chips

- A. Flying rock chips are a potential hazard in many parts of the crushing and screening plant and should also be eliminated or isolated by engineering design where possible.
- B. Precautions may include:
 - a. Selecting plant designed to minimise this hazard.
 - b. Providing operator protection by enclosed cabins and/or other barriers.
 - c. Ensuring appropriate personal protective equipment is used – in particular eye protection.
 - d. Post up and maintain clear warnings at all hazardous areas.

11.6 Fall hazards - Walkways, Landings and Ladders.

- A. Elevated fixed platforms, walkways and access stairways should be provided with protection rails and toe-boards. Useful information on construction arrangements can be found in Standard NZS/AS 1657:1992. Inspections should take place with sufficient frequency to ensure that the floors, railings are sound and safe from moving machinery.
- B. Where plant must be accessed that cannot be safely reached from designated walkways proper arrangements must be made. Climbing up or walking on places and equipment that were not designed for the purpose should be prohibited. Portable ladders should be of industrial type and any work off them limited to short duration jobs that don't need use of both hands, or require reaching out. Provision of remote lubrication points can reduce the need for temporary access.

- C. Elevating work platforms such as cherry-pickers and scissor-hoists may be used by operators who have been trained in set-up and operation procedures. Scaffolding must be properly constructed using material that has the strength to cater for all loading that it may be subjected to.
- D. Refer to Department of Labour publication “Approved Code of Practice for the Safe Erection and Use of Scaffolding”
- E. Suitable barriers or exclusion zones should be in place to prevent falls into crushers and other dangerous machinery. Note that the use of a harness and fall arrest device is a specialised area and should only be undertaken by people who have been suitably trained. Emergency procedures must be in place to enable a rescue within a few minutes of any fall occurring. Refer to Department of Labour publication “*Guideline for the Prevention of Falls*”