



VULCAN MINE

Standard Operating Procedure

Dealing with and recording of Misfires



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1. PURPOSE

To detail the procedure to be followed when misfires occur at Vulcan Mine, so that they are found, recovered, and detonated in such a way as to meet all legislative requirements and protect the health and safety of people working at Vulcan Mine.

2. SCOPE

This SOP applies to all Coal Mine Workers (CMWs) who are involved in the finding, recovering, detonating, and recording of misfired explosives at Vulcan Mine. This procedure was developed from VUL-RSK-116 WRAC Explosives Management and later reviewed and updated from VUL-RSK-116(h,i)-Review_Update-0323.

3. DEFINITIONS

Authorised Person	A person who has the required competencies and who has been appointed by the Site Senior Executive, or their appointed representative to carry out a designated scope of duties.
CMSHA	Coal Mining Safety and Health Act.
CMSHR	Coal Mining Safety and Health Regulation.
CMW	Coal Mine Worker.
Competent Person	Competence for a task at a coal mine is the demonstrated skill and knowledge required to carry out the task to a standard necessary for the safety and health of persons. The CMW must be assessed as competent and authorised by the SSE or SSE delegate to perform the task.
DNRME	Department of Natural Resources, Mines and Energy.
IMS	Integrated Management System.
JHA	Job Hazard Analysis.
SHMS	Safety and Health Management System.
SOP	Standard Operating Procedure.
Take 5	Personal Risk assessment.

4. PROCEDURE

4.1. Hazards

Unplanned detonation of explosives whilst dealing with a misfire (excavation or handling)	Handling and disposing of out of date or damaged explosives
Geological issues/instability	Environmental / Biological
Failure of explosives/accessories	Snap, Slap and Shoot
Theft and/or misuse of explosive product	Hot Holes/Reactive Ground



4.2. Requirements

For all operations, check that operators have site authorisation to operate appropriate equipment and to perform agreed tasks.

Any person who is required to transport explosives and explosive ingredients shall:

- Be competent and site authorised to operate the particular type of equipment
- Be competent and site appointed to handle explosives
- Have a familiarity and understanding of this procedure and the relevant aspects of the Australian Explosive Code (AEC)

A Shot Firer's vehicle with correct signage displayed is required for transport.

All vehicles carrying explosives onsite shall comply with the Australian Code for the Transport of Explosives by Road and Rail.

Access to explosives is restricted and controls outlined in VUL-PLN-014 SSAN Explosives Security Plan.

4.3. General Rules

- Only an appointed Shotfirer, or an Assistant Shotfirer under the direct supervision of a shotfirer, are permitted to manage a misfire.
- If a misfire is found, whilst digging, all operations in the vicinity must cease immediately, report situation to OCE or Shotfirer, and follow their direction. The misfire must be reported to the Shotfirer, OCE/Supervisor and Operations Manager.
- Shotfirer must complete – VUL-FRM-16-03 Misfire Report Form.
- Shotfirer must create and maintain a job pack to capture all misfire data.

The Misfire Job Pack must include:

- I. Shot name*
 - II. VUL-FRM16-29-IE/HE Failure report*
 - III. Survey location RL*
 - IV. Loading information*
 - V. Copy of a JHA*
 - VI. VUL-FRM16-16 Daily on bench toolbox talk*
 - VII. Current Dig plan*
 - VIII. Copy of misfire exclusion zone*
- The location of the misfire is to be surveyed immediately to identify the hole ID, depth, column charge, stemming height etc. Location of misfires to be included into the mine plans.
 - If a misfire cannot be dealt with immediately, it must be barricaded at a minimum of 10m, and clearly demarcated. – Misfire Report must be completed, and the timeline for dealing with the misfire must be indicated.
 - Where a misfire has occurred in hot or reactive ground, all activities must be stopped and all persons removed to no less than 600m from the misfired explosives, until a risk assessment has been completed to manage and control the event. The procedures outlined in the AEISG Elevated Temperature and Reactive Ground; Section 11 shall be followed as a guideline.
 - Where a misfire is uncovered during excavation operations, the OCE and Shotfirer must be contacted and appropriate controls put in place:
 - Where the Shotfirer is contacted and available to attend, the misfire shall be managed immediately.
 - When digging within the 10mt exclusion zone the shotfirer will update the job pack and notify the OCE and D&B Coordinator of any changes and clearance RL prior to the end of each shift.



- Where the OCE is contacted and shotfirer cannot attend immediately, a stand-off zone of ten (10) m must be delineated and equipment must be relocated to an alternate dig area. The activities in the area immediate to the delineated zone shall be subject to a risk assessment. At a minimum, the risk assessment must consider:
 - Access to the misfire
 - The risk of rock fall if the misfire is on a dig face.
 - The type of misfire, including the class of explosive.
 - The means used to make the misfired explosive safe, such as excavation, flushing with water, or refiring. In the case of refiring, the main hazard is fly rock.
 - Operations and ongoing excavation in the area.

5. TREATMENT OF MISFIRES

VUL-SOP-049 Risk and Hazard Management is to be followed in the event of a misfire.

In the first instance it is critical that for any misfire:

- Notify relevant Supervisor/Shotfirer/OCE/Blast Controller of the misfire
- Personnel on the bench are to be minimised to only those directly involved with the management of the misfire.
- An exclusion zone shall be put in place around the misfire area for activities not directly associated with the recovery of the misfire.
- If a misfire is found in hot or reactive ground, an Emergency Evacuation Plan shall be developed, and communicated to all personnel involved in managing the misfire, covering what shall be done if a reaction is to be observed prior to or during the recovery of the misfire.
- The charging of associated patterns, which are hot/reactive and whose firing could negatively impact on misfire recovery procedures, immediately cease. In this situation, a separate risk assessment shall be conducted to access the next course of action.
- The D&B Coordinator shall contact the explosives provider to inform them of the situation if it is a product/accessories related issue/failure. Details of the product used in the area shall be provided and a reassessment of the recommended product range may be required.
- In addition to standard misfire procedures, water may be used to wash out elevated temperature holes, though it must be noted that water may become hot with exposure to hot ground conditions.

For further information, refer to AEISG Code of Practice – Elevated Temperature & Reactive Ground, Section 11

5.1. Dealing with Loss or Failure of Product Prior to Firing a Shot

This can be a hole that has slumped after loading with no downlines present or cut downlines. The following process is to be followed:

- Shotfirer to investigate.
- Supervisor/OCE notified.
- Survey to pick up hole location and include in the mine plan.
- Complete VUL-FRM16-29-IE/HE Failure Report

A JHA is to be carried out to determine what action to take to recover the lost or failed product.

Possible options may be:

- Suck stemming out of the hole with a Vac truck to locate downlines.
- Excavate beside the hole location to locate downlines.
- Excavate stemming by hand to recover downlines. Do not use ferrous metal implements (hand shovel)



If shot is to be fired with the lost or failed product present a survey of the hole is required. Once the shot has been fired, Survey is to mark original hole location and in discussion with the Drill & Blast Engineer and Shotfirer, determine the possible location of the hole taking into consideration direction of dirt movement due to the angle of initiation design of blast.

Once the location has been determined the area is to be demarcated with blasting cones and red flashing lights / blast flagging with a 10-metre radius around misfire location with the above considerations. This location is to be communicated to technical services department for the location to be put into the mine plans to make operators aware of misfires in this location.

OCE is to be also notified of misfire location so they can enter it into the OCE Report.

6. DEALING WITH A MISFIRE OF THE ENTIRE SHOT

If the entire shot fails to initiate during firing, the Shot Firer is to follow the below procedure:

- Immediately attempt to refire the shot.
- If the shot fails to fire again, notify Blast Controller, and wait at least a minimum of 5 minutes before re-entering the exclusion zone and investigating the issue
- After investigating the cause discuss with Blast Controller/ Shot Firer the appropriate actions to re-fire
- Attempt to refire the shot

7. DEALING WITH A MISFIRE OR PARTIALLY FIRED SHOT

If part of the shot fails to initiate during firing, and is discovered during the post-blast inspection, then the following procedure shall be followed.

Shot Firer	Notify the Blast Controller of the misfire In conjunction with Blast Controller, assess the cause of the misfire, collect all relevant data (pictures, hole numbers etc.) and develop a plan to re-fire the holes. A new JHA shall be required as part of this step. Shotfirer, Blast Controller are to determine the cause of action to be taken - whether to re-fire the shot or resume mining activities to allow time to determine the cause of the misfire and next course of action Prior to refiring, check the integrity of surface leads and replace any that may be damaged (from fly rock, ground movement etc.) Retie the misfired holes if required and attempt to re-fire the shot following SOP –, VUL-SOP-116g Charging and Firing Explosives of All Blast Holes, or at the Blast Controller's discretion of where to start the radio protocol. Depending on firing time window, it may be necessary to postpone refiring of shot until the following day. Where the shot cannot be fired a sentry will be required to guard the shot until such time that it can be fired. If the holes still do not fire, clearly mark them with blast demarcation, so they can be identified by production personnel (refer to section 5.1 of this document). If misfire is not cleared and remains in the area until excavated, a VUL-FRM-16-03 Misfire Report Form shall be completed. The shotfirer is to complete incident report as per VUL-MOP-015-Incident Reporting & Investigating, involving the OCE.
Blast Controller	Immediately notify OCE and SSE. Announce to Blast Guards. Assist Shotfirer in determining the cause and what action to take.
OCE	Participate in the Incident investigation Advise production personnel about the location of the misfired shot. Check blast demarcation is erected around the misfire area. Notify Surveyor of the misfired shot for the misfire plan.



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8. DEALING WITH UNKNOWN MISFIRE DURING DIGGING OPERATIONS

If part of the shot fails to initiate during firing and is discovered later during digging operations, the following procedure shall be followed:

- Machine operator is to cease mining operations immediately
- Immediately notify OCE and Shot Firer and follow their direction

The Shot Firer shall:

- Safely demarcate a minimum of ten (10) metre radius around misfire
- Assess the area
- Complete a JHA before proceeding any further, collect all relevant data (Refer to section 9)
- Arrange for survey pick up of misfire location and to be added to the mine plan
- Refer to blast pack relating to hole location (blast previously fired in this location). All load information for the hole/s is to be examined by Shot Firer to determine amount and type of explosive still left in hole to help in decision on best way to deal with hole

Consult with the Drill and Blast Engineer and determine the next action consider the following issues:

- Recovering primed misfires is hazardous and this should be relayed to all involved. The focus of the recovery is to concentrate on the primers and their safe extraction or re-detonation;
- Any excavation is to be done only under the Shot Firer's direction and must be done around the hole and not into it;
- If downlines are present, check to see if they are live or not;
- Excavation to the product level may expose product. If the product is ample and still of a quality that will fire, this may be reprimed and fired;
- If you expose the original downlines, attempts to refire using only these downlines may not be successful. Do not rely on these downlines for initiation. Excavation may need to be continued to find either product or the original cut-off point of the downline;
- Excavation to the point of the primers is very hazardous with large equipment. Digging beside the hole and letting the original hole subside slowly will allow you to view the area in a safer manner and this may also expose the product in a column instead of spreading it;
- Reaching exposed products in a hole may require another flitch or bench to pass through before it is safe to reach;
- If there is product-only in a column this can be reprimed and refired or washed out depending on product type and depth;

If possible, one (1) of the following may be considered:

- Wash out the blast hole to flush out and desensitise the product
- Expose boosters for safe retrieval



8.1. DEALING WITH A KNOWN MISFIRE DURING DIGGING OPERATIONS

Where a misfire, or loss of explosive components (including boosters, primers, or initiation systems) is identified or reasonably suspected at the time of loading or firing, the following procedure shall apply.

8.1.1. Immediate control and notification

- Shot firer to cease all loading activities
- The Shotfirer shall immediately notify the OCE and Drill and Blast coordinator
- As the location is within an established blast loading exclusion area, no additional access controls are required at this stage beyond reporting and instruction.
- Following firing of the shot, the misfire location and RL shall be surveyed, physically demarcated and entered into the Mine Plan.
- Drill and blast engineer to send out the misfire notification

Demarcation shall include, as a minimum:

- flagging, red triangles, and red flashing lights; and
- a ten (10) metre stand-off from the misfire column location.

8.1.2. Planned recovery and verification strategy

A planned recovery and verification strategy shall be developed prior to any excavation or disturbance, including:

- completion of a task-specific JHA for the proposed activity.
- review of blast design, loading records, tie-in data, and firing information; and
- confirmation of the misfire location relative to current and final RL.

Controlled excavation under the direction of the Shotfirer may be undertaken to:

- verify the presence or absence of explosive product or initiating components; and
- determine whether explosive material can be safely recovered, re-primed and re-fired, or whether it must remain in situ due to depth, confinement, or unacceptable recovery risk.

Where no explosive components are identified, the location shall continue to be treated as a misfire unless conclusively demonstrated otherwise.

Hierarchy of Controls	
Level	Application
Elimination	Attempted first (recovery of misfire)
Isolation	Exclusion zone, vertical separation(>4m), RL controls
Engineering	Defined dig limits, mine plans, survey height control, barricading
Administrative	SOP alignment, JHA, Permits, Handover controls, MSDS Data Sheets
PPE	Not relied on for a misfire risk



8.1.3. Excavation of Misfire – Isolation by Vertical Separation

Where a known misfire is identified during digging operations and recovery, removal, or re-firing of explosive product or initiating components is assessed as not reasonably practicable, the misfire may be managed by isolation through vertical separation, subject to the following controls.

Preconditions

- A task-specific JHA shall be completed for the proposed activity.

Prior to adopting isolation by vertical separation as a control measure:

- The Shotfirer shall assess the misfire and confirm that recovery or re-firing presents an unacceptable risk due to depth, confinement, ground conditions, or exposure of personnel and equipment.
- The misfire location shall be surveyed, confirmed, and recorded relative to current and final RL.
- The OCE and Drill and Blast coordinator shall be consulted and endorse the proposed control strategy.

8.1.4. Establishment of Vertical Separation

Isolation shall be achieved by:

- controlled excavation under the direction of the Shotfirer to an agreed RL, being a minimum of **four (4) metres** below the intended working or running surface and a 10-meter radius from the surveyed hole; and
- confirmation that no excavation, ripping, drilling, or other ground-penetrating activities will occur at or below the misfire horizon.
- This control relies on physical separation to eliminate the risk of mechanical interaction (cutting, crushing, or striking) with explosive product or initiating components.
- Low-frequency vibration from mobile equipment is not considered the primary hazard where adequate vertical separation is maintained.
- Where required to maintain surface stability or trafficability, a survey scan is required to confirm the new vertical separation.

Controls Following Isolation

Once the minimum vertical separation has been established:

- the misfire location shall remain physically demarcated and identified as a controlled residual hazard zone;
- In the event that physical demarcation around the surveyed misfire location cannot be established then sighter pegs may be used.
- the location shall be surveyed and recorded on mine plans;
- all reasonable efforts shall be made to avoid trafficking over the area;
- movement of mobile equipment over the area is not a preferred control and shall only occur where avoidance is not reasonably practicable;
- no ground-penetrating activities below the defined isolation RL or within the 10m misfire standoff zone are permitted.



**Note - Each situation requires a task-specific JHA, because risk varies with:*

- a) Traffic volume and queuing*
- b) Equipment type (truck, dozer, grader)*
- c) Intersections and loading zones*
- d) Ground conditions and wall stability*
- e) Work sequencing and dig direction*
- f) Visibility, night shift, weather*

8.1.5. Weather, Ground Condition and Stability Inspections

Where a misfire remains in-situ and is managed by isolation through vertical separation, the area shall be subject to ongoing inspection to verify the continued effectiveness of controls.

Inspections shall be undertaken:

- following **significant rainfall events**;
- following **extended wet weather** or saturation of the area;
- following **prolonged inactivity** in the area;
- where **ground conditions, stability, or surface integrity** may have changed; or
- prior to **resumption of work** in the vicinity of the isolated misfire.

Inspections shall confirm, as a minimum:

- a) integrity of the working surface and cover above the isolated misfire;
- b) absence of subsidence, erosion, slumping, or exposure of explosive product or initiating components.
- c) visibility and condition of physical demarcation and signage; and
- d) that no unauthorised excavation or ground-penetrating activities have occurred below the defined isolation RL or within the 10m misfire standoff zone.

Where inspection identifies any degradation of controls or a change in conditions that may increase risk:

- a) all work in the area shall cease; and
- b) the misfire shall be reassessed by the Shotfirer in consultation with the OCE and Drill and Blast Coordinator.

8.1.6. Ongoing verification and re-assessment

Re-survey, re-delineation, and review of controls shall be undertaken where:

- the area has been inactive for a defined period (managed by OCE and Shotfirer)



- ground conditions, work sequencing, or traffic patterns change; or
- additional excavation or work is proposed in the vicinity of the isolated misfire.

8.1.7. Recording and escalation

- The misfire location and isolation RL shall be surveyed, recorded on mine plans, Misfire register and communicated to relevant personnel.
- If explosive products or initiating components are exposed or suspected at any stage, **all work shall cease immediately, and Section 8 of this SOP shall be enacted.**

9. REPORTING

For any misfire, a site incident report must be written up by the Shotfirer and made available for the duration of operations in the area of the misfire or until the misfire has been cleared.

To meet statutory reporting requirements a technical report shall be completed and managed by the Shotfirer and as a minimum contain the following:

- Surveyed location of misfired holes
- Photographs of misfire site
- Hole number(s)
- Hole depth(s)
- Original collar RL
- Load information (column height of explosive)
- Hole diameter
- Suspected cause of misfire
- Remedial actions used
- Preventative actions being considered

This misfire report must be completed and sent to the Licence Holder.

The SSE is responsible for investigating and then reporting the misfire to the Explosives Inspector (Explosives Act, Section 55) and Mines Inspector (Queensland Coal Mining Act and Regulations, Section 214).

This may be delegated to the Operations Manager or appointed SSE delegate. Form 1A – Record Notification of Event is to be completed and communicated to the Explosives and Mine Inspector.

A copy of this form and report shall be kept on the Intranet in the Mine Record.

In order to re-fire a misfire, the following is needed:

- Exposed quality product and the original downlines (if live)
- New primers buried deep in good product
- Carry out a risk assessment, taking into consideration the following;
 - Ground movement
 - Possible location of primers in explosives column
 - Burden around product
 - Explosives column to be fired
 - Direction of overpressure
 - Serious consideration being given to extension of exclusion zones



- If explosives are recovered, inspect them, remove detonator from booster only if they are loose. DO NOT force detonators.
- If detonator cannot be removed from the booster, they must be left intact. DO NOT transport primers.
- A risk assessment is to be carried out prior to firing. The primer is to be treated as a misfire and refired by taping to a new primer.
- Complete a misfire report.

10. DEALING WITH OBSOLETE EXPLOSIVES

If obsolete explosives are identified, then the Shot Firer is to follow the procedure below:

- Inform the D&B Coordinator that out-of-date explosives have been identified
- Fill out the Explosives Inspectorate form in Appendix A - Life Extension of Out-of-Date Explosives – Disposal/Use/Transport/Storage and email to the email address on the form
- Complete a JHA to determine how to dispose of obsolete explosive (e.g., lay surface connectors in an open area initiate and inspect that all surface connectors have initiated)
- Record disposal of explosives on the Shot Firer's Shift Report

11. RESPONDING TO AN ELECTRICAL STORM

In the event of an electrical storm, the VUL-TAR-005 Lightning TARP and the below points shall be followed.

OCE/Shotfirer	All Blast Crew personnel are to follow the instructions of the Shot Firer or OCE Evacuate the blast area Remove all people from the blast clearance zone: • Contact all personnel by site two-way notifying that the area is being cleared • Confirm checks are in place to be certain everyone has been evacuated The decision to evacuate the excavation and adjacent areas shall be the responsibility of the OCE and Shot Firer If there is a need to re-enter the pit during an electrical storm a JHA needs to be completed with consultation with the OCE and Shot Firer
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12. ROLES & RESPONSIBILITIES

SSE	Shall review and approve this procedure.
HST Manager	Shall ensure that all provisions of this procedure are implemented, and that compliance is achieved.
Managers/Superintendents	Shall be responsible for their area of operations and the implementation and application of this procedure; Provide adequate training, information, structure, and supervision to ensure that this procedure is implemented; Carry-out a periodic review of activities to ensure the appropriate application and understanding of this procedure; and Ensure immediate and appropriate steps are taken to investigate and rectify any risks to health and safety arising from these activities.
Supervisors	Ensure all CMWs are familiar with, have access to and comply with the requirements set out in this procedure.
All CMWs (including visitors and contactor)	Shall comply with the requirements of this procedure.

13. REFERENCES

- Coal Mining Safety and Health Act 1999 (Qld)
- Coal Mining Safety and Health Regulation 2017 (Qld)
- Explosives Act 1999
- Explosives Regulation 2017
- AS 2187.2-2006 Explosives – Storage and use of explosives
- AEISG Elevated Temperature and Reactive Ground.

14. REVIEW

This document shall be reviewed bi-annually, or as follows:

- when there is a change of method and/or technology and/or legal or other requirement that may affect the accuracy of this document.
- when operational changes occur that effect the currency of the document.
- when there has been a significant event to which this document was relevant; and
- as a result of relevant audit findings.

15. DOCUMENT CONTROL

Version	Date	Description	Document Controller
01		Development	Rachael Decker
02	31/03/2021	WRAC & review	Nicole Davey
03	20/03/2023	Review and update	Allira Spencer
04	08/12/2025	Review and formatting	Chris Payne
05	05/01/2026	Addition of section 8.1	Chris Payne