



Government of **Western Australia**
Department of **Mines, Industry Regulation and Safety**
Resources Safety

Underground fire prevention audit – guide

Approved: 29 January 2016

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Introduction

This document was reformatted in November 2015. At this time no material changes were made to the content of the guide, which was originally published in February 2008 under the title *Guide to underground fire prevention HIF audit 2008*.

Note: The Safety Regulation System (SRS) has replaced the AXTAT system and all reporting is done online through SRS.

1 Fire prevention plan

Fire prevention plan

Point	Standard	Guideline
1.1	The mine has prepared an underground fire prevention and control plan.	<p>Intent: To ensure that an underground fire prevention and control plan has been prepared as part of the overall emergency plan requirements.</p> <p>Personnel: U/G manager.</p> <p>Method: Sight documentation. Refer to MSIR 4.30.</p>
1.2	The plan has been developed through a process of risk assessment.	<p>Intent: To ensure that a systematic risk assessment process has been applied in order to develop the plan.</p> <p>Personnel: U/G manager.</p> <p>Method: Examine the risk evaluation section of the documentation. Key areas such as diesel engine equipment usage, underground electrical sub-stations, explosives magazines and workshops must be included.</p>
1.3	The plan describes the fire risks present at the mine.	<p>Intent: To ensure that the details of the fire risk areas have been identified.</p> <p>Personnel: U/G manager.</p> <p>Method: Examine the documentation to ensure that the risks are detailed.</p>
1.4	The plan describes the methods by which the fire risks are managed.	<p>Intent: To ensure that the mechanisms to eliminate or control each fire risk have been identified.</p> <p>Personnel: U/G manager.</p> <p>Method: Examine the documentation for fire risk management strategies.</p>

1.5

There is a program for conducting fire emergency drills for underground employees.

Intent:

To ensure that a program has been developed whereby all underground employees are trained in fire emergency procedures.

Personnel:

U/G manager, underground employees.

Method:

Examine the program, records of previous drills and lists of participants. Interview personnel.

2 Resource requirements

Resource requirements

Point	Standard	Guideline
2.1	Current fire fighting infrastructure and equipment is marked on an underground plan.	<p>Intent: The location of fire fighting assets is available for reference.</p> <p>Personnel: U/G manager, safety officer.</p> <p>Method: View plan.</p>
2.2	Underground communications equipment is marked on an underground plan.	<p>Intent: The location of fire fighting assets is available for reference.</p> <p>Personnel: U/G manager, safety officer.</p> <p>Method: View plan.</p>
2.3	Fresh air bases, refuge chambers and escape ways are marked on an underground plan.	<p>Intent: The location of emergency assets is available for reference.</p> <p>Personnel: U/G manager, safety officer.</p> <p>Method: View plan.</p>
2.4	Current ventilation circuits are marked on an underground plan.	<p>Intent: The underground ventilation system information is available for reference.</p> <p>Personnel: U/G manager, ventilation officer.</p> <p>Method: View plan. Refer to MSIR 9.28(1).</p>

2.5	Air doors, stoppings, fans, regulators and ventilating devices are marked on an underground plan.	<p>Intent: The underground ventilation system information is available for reference.</p> <p>Personnel: U/G manager, ventilation officer.</p> <p>Method: View plan. It may be possible to limit the extent of fires by controlling or redirecting the flow of ventilating air. If this potential exists, circumstances should be predetermined and documented as part of the emergency fire control plan. Refer to MSIR 9.28(1).</p>
2.6	The potential for ventilating air flow modifications, by means of primary fan operational adjustments, has been predetermined and documented.	<p>Intent: To ensure that fire control strategies, utilising variations in the operation of the primary fans, have been considered.</p> <p>Personnel: U/G manager, ventilation officer.</p> <p>Method: Examine plans and procedures. It may be possible to limit the extent of fires by controlling, redirecting or reducing the flow of ventilating air by reversing, changing the speed or switching off of fans. If this potential exists the conditions under which such changes could be made should be predetermined and documented as part of the Fire Control Plan.</p>
2.7	There is an automated alarm system that can indicate the presence of an underground fire by monitoring the mine ventilating air exhaust.	<p>Intent: To ensure mine that a fire, smoke, carbon monoxide or similar alarm has been installed.</p> <p>Personnel: U/G manager, ventilation officer.</p> <p>Method: View documentation. Examine monitoring logs and settings. Refer to MSIR 4.36(2)(a).</p>
2.8	There is a system in place to enable all persons working underground to be promptly accounted for in the event of an emergency.	<p>Intent: To ensure that all employees underground can be accounted for.</p> <p>Personnel: U/G manager, safety officer.</p> <p>Method: Ensure the existence of a tag board, written register, swipe card system or similar method. Refer to MSIR 4.35.</p>

2.9	A means of transporting fire fighting equipment underground is provided.	<p>Intent: To ensure that a trailer or vehicle is available to transport fire fighting equipment underground.</p> <p>Personnel: U/G manager, safety officer.</p> <p>Method: View the method to be used to transport fire fighting equipment.</p>
2.10	Mutual aid agreements are in place with other mines.	<p>Intent: To ensure that assistance and / or backup is available for fire fighting.</p> <p>Personnel: U/G manager, safety officer.</p> <p>Method: View documentation.</p>

3 Personnel and training

Personnel and training

Point	Standard	Guideline
3.1	All underground personnel are instructed in how to use the emergency communications systems available.	<p>Intent: To ensure that all underground personnel know how to make contact with surface in the event of an emergency.</p> <p>Personnel: U/G manager, underground personnel.</p> <p>Method: View training records. Interview personnel. Refer to MSIR 4.36(2)(f).</p>
3.2	All underground personnel are trained in how to respond to an outbreak of fire.	<p>Intent: To ensure that all underground personnel know how to assess, and respond to, an outbreak of fire.</p> <p>Personnel: U/G manager, underground personnel.</p> <p>Method: View training records. Interview personnel. Refer to MSIR 4.36(2)(f).</p>
3.3	All underground personnel are trained in the evacuation procedures.	<p>Intent: To ensure that all underground personnel know what to do in the event that the mine has to be evacuated.</p> <p>Personnel: U/G manager, underground personnel.</p> <p>Method: View training records. Interview underground personnel. Refer to MSIR 4.36(2).</p>
3.4	Training for underground mobile equipment operators includes awareness of the types of fires likely on mobile equipment and the methods used to control and fight them.	<p>Intent: To ensure that the operators of underground mobile equipment are capable of assessing, and responding to, the specific types of fire that might break out on underground mobile equipment.</p> <p>Personnel: Training officer, underground mobile equipment operators.</p> <p>Method: View training records. Interview operators. Refer to MSIR 4.13.</p>

3.5	Training for underground fixed equipment operators includes awareness of the types of fires likely on fixed equipment and the methods used to control and fight them.	<p>Intent:</p> <p>To ensure that the operators of underground fixed equipment are capable of assessing, and responding to, the specific types of fire that might break out in crusher stations, pump rooms, hoist rooms, compressor stations, workshops, etc.</p> <p>Personnel:</p> <p>Training officer, fixed equipment operators.</p> <p>Method:</p> <p>View training records. Interview personnel. Refer to MSIR 4.13.</p>
3.6	Only competent persons may use hot work equipment underground.	<p>Intent:</p> <p>To ensure that hot work underground is only undertaken by trained, competent persons.</p> <p>Personnel:</p> <p>Training officer, underground personnel.</p> <p>Method:</p> <p>View training records. Interview personnel.</p>

4 Flammable / combustible liquids and materials underground

Flammable / combustible liquids and materials underground

Point	Standard	Guideline
4.1	The District Inspector of Mines has been notified in writing of the location and details of each diesel fuel service and storage facility constructed underground.	<p>Intent: To ensure that the Inspectorate has the details of all diesel fuel storage and service facilities located underground.</p> <p>Personnel: U/G manager.</p> <p>Method: View a copy of the notification letter. Refer to MSIR 10.58(1).</p>
4.2	Diesel fuel service and storage facilities are located underground such as to minimise the risk of hazards from that facility.	<p>Intent: xTo ensure that a risk assessment has been done in regard to the proposed location of such a facility.</p> <p>Personnel: U/G manager.</p> <p>Method: View design documentation. Refer to MSIR 10.58(2).</p>
4.3	Diesel fuel service and storage facilities are constructed underground such as to minimise the risk of hazards from that facility.	<p>Intent: To ensure that a risk assessment has been done in regard to the proposed construction method of such a facility.</p> <p>Personnel: U/G manager.</p> <p>Method: View design documentation. Refer to MSIR 10.58(2).</p>
4.4	Diesel fuel service and storage facilities located underground are ventilated such as to minimise the risk of hazards from that facility.	<p>Intent: To ensure that a risk assessment has been done in regard to the proposed means of ventilation of such a facility.</p> <p>Personnel: U/G manager.</p> <p>Method: View design documentation. Refer to MSIR 10.58(2).</p>

4.5	Diesel fuel service and storage facilities that are constructed underground conform to the relevant Australian Standards. Diesel fuel service and storage facilities that are constructed underground conform to the relevant Australian Standards.	<p>Intent: To ensure that underground diesel fuel service and storage facilities comply with AS 1940.</p> <p>Personnel: U/G manager.</p> <p>Method: View design documentation. Refer to MSIR 10.58(2).</p>
4.6	Where diesel fuel is reticulated from the surface to underground storage facilities, static electricity build up, due to fluid flow, is prevented.	<p>Intent: To ensure that static electricity build up, due to fuel transfer, does not present a hazard.</p> <p>Personnel: U/G manager.</p> <p>Method: Inspect the earthing system installed at fuel reticulation and storage facilities.</p>
4.7	Only purpose-built clearly labelled containers, which do not leak, are used to transport diesel fuel underground.	<p>Intent: To ensure that fuel transport in containers is carried out in such a way that hazards are minimised.</p> <p>Personnel: U/G manager.</p> <p>Method: View containers. Refer to MSIR 10.60(1).</p>
4.8	Diesel tank storage facilities located underground are bunded with a capacity of 150% of the largest tank present.	<p>Intent: To ensure that spillage due to tank rupture or leakage will be contained.</p> <p>Personnel: Engineering / design staff.</p> <p>Method: View design drawings. Compare bund capacity with largest tank capacity.</p>
4.9	The quantity of diesel fuel stored underground does not exceed that required for one week of work underground.	<p>Intent: To ensure that excessive quantities of diesel fuel cannot be stored underground.</p> <p>Personnel: U/G manager.</p> <p>Method: Compare storage capacity with weekly fuel usage records. Refer to MSIR 10.60(2).</p>

4.10	Flammable / combustible liquids and materials are stored and / or dispensed with 'no smoking', 'no naked flame' signs displayed.	<p>Intent: To ensure that fire hazards are clearly identified.</p> <p>Personnel: N/A.</p> <p>Method: Inspect storage locations. Refer to MSIR 4.10(1)(b).</p>
4.11	Spill containment equipment is available at those locations where flammable / combustible liquids are dispensed and any spillage is immediately cleaned up.	<p>Intent: To ensure that fire hazards are not allowed to develop.</p> <p>Personnel: N/A.</p> <p>Method: Inspect dispensing locations.</p>
4.12	Waste liquids and materials that are flammable / combustible are collected and removed to surface on a regular basis.	<p>Intent: To ensure that fire hazards are not allowed to develop.</p> <p>Personnel: N/A.</p> <p>Method: Inspect the facilities for the methods of collection, storage and removal of flammable wastes including waste oils, grease, cotton waste, rags, etc. Refer to MSIR 7.15(1).</p>
4.13	An automatic fixed fire suppression system is installed at each location where oils, fuels and lubricants are stored or dispensed underground.	<p>Intent: To ensure that any outbreak of fire can be automatically detected and suppressed.</p> <p>Personnel: U/G manager.</p> <p>Method: View design drawings. Inspect underground facilities. Refer to MSIR 10.59(3) and (5).</p>
4.14	Automatic fixed fire suppression systems can be manually operated from a safe location.	<p>Intent: To ensure that an automatic system can, if necessary, be manually operated from a safe location.</p> <p>Personnel: U/G manager.</p> <p>Method: View design drawings. Inspect underground facilities.</p>

5 Underground mobile equipment

Underground mobile equipment

Point	Standard	Guideline
5.1	Underground mobile equipment that is fuelled underground is fitted with “fast fill” type fuelling systems.	<p>Intent: To minimise the potential for fuel spillage during fuelling, and in the event of a rollover, on equipment such as loaders, trucks, graders, drill rigs, etc.</p> <p>Personnel: U/G manager.</p> <p>Method: Inspect underground fuelling facilities and examples of equipment.</p>
5.2	Each diesel engined unit that is used underground and is turbocharged or rated at 125 kW or more, and each loader or grader that is used underground, is equipped with an AFFF or FFFP fire suppression system with a minimum of 2 activators.	<p>Intent: To maximise the potential for a fire on large underground mobile equipment to be controlled.</p> <p>Personnel: U/G manager.</p> <p>Method: Inspect examples of applicable equipment. View copies of the certificates of installation. Refer to MSIR 10.59(1).</p>
5.3	Remotely controlled underground mobile equipment is fitted with remote activation of the on board fire suppression system from the operator’s remote control unit.	<p>Intent: To allow for a fire suppression system on remotely controlled underground mobile equipment to be activated under all circumstances.</p> <p>Personnel: U/G manager.</p> <p>Method: Inspect remote control units for the presence of an activator. View copies of the certificates of installation. Refer to MSIR 10.59(2).</p>
5.4	Underground loading and hauling equipment is fitted with brake temperature indicators.	<p>Intent: To minimise the potential for undetected overheated brakes becoming a source of fire.</p> <p>Personnel: Maintenance supervisors.</p> <p>Method: Inspect examples of applicable units for the presence of brake temperature indicators.</p>

5.5	The pre-start check of underground mobile equipment includes an inspection for potential fire hazards.	<p>Intent:</p> <p>To minimise the potential for unnoticed fire hazards. The procedure should include a check list, such as rags left in the engine compartment, loose battery terminals and leaks in fuel or oil lines. Details of observations and the name of the person doing the checks should be recorded.</p> <p>Personnel:</p> <p>Maintenance supervisors, equipment operators.</p> <p>Method:</p> <p>View documentation and examples of completed inspection records. Interview personnel.</p>
5.6	There is a system in place for the regular inspection of underground mobile equipment for potential fire risks, by a competent person.	<p>Intent:</p> <p>To ensure that underground mobile equipment is regularly inspected for fire risks by a competent person (other than operators). This could be part of each scheduled service.</p> <p>Personnel:</p> <p>Maintenance supervisors, the competent persons appointed for such inspections.</p> <p>Method:</p> <p>View system documentation, examples of completed inspection records.</p>
5.7	The scheduled service fire risk inspection includes a check of the integrity of fuel and hydraulic lines, the condition of electrical wiring, and the integrity of emergency shut down systems.	<p>Intent:</p> <p>To ensure that the greatest fire risks and the emergency control systems are inspected.</p> <p>Personnel:</p> <p>Maintenance supervisors, the competent persons appointed for such inspections.</p> <p>Method:</p> <p>View inspection documentation, examples of completed inspection records.</p>
5.8	The scheduled service fire risk inspection includes a check of the integrity of the shielding of the fuel and oil hoses in the vicinity of the exhaust and turbo charger.	<p>Intent:</p> <p>To ensure that fuel and oil hoses are adequately protected from heat and that the shielding has not been contaminated and hence flammable.</p> <p>Personnel:</p> <p>Maintenance supervisors, the competent persons appointed for such inspections.</p> <p>Method:</p> <p>View inspection documentation, examples of completed inspection records.</p>

5.9	The scheduled service fire risk inspection includes a check of the battery installation for rigidity, tight terminal clamps, cleanliness, etc.	<p>Intent: To ensure that any fire risks from unrestrained batteries, shorting out of terminals, etc. are minimised.</p> <p>Personnel: Maintenance supervisors, the competent persons appointed for such inspections.</p> <p>Method: View inspection documentation, examples of completed inspection records.</p>
5.10	The scheduled service fire risk inspection includes a check of the fire suppression systems and extinguishers fitted to the item of underground mobile equipment.	<p>Intent: To ensure that the fire suppression equipment, including portable fire extinguishers, is in a state of readiness for use.</p> <p>Personnel: Maintenance supervisors, the competent persons appointed for such inspections.</p> <p>Method: View inspection documentation, examples of completed inspection records. Refer to MSIR 10.59(1).</p>

6 Underground fixed mechanical installations

Underground fixed mechanical installations

Point	Standard	Guideline
6.1	Underground conveyor systems are monitored for abnormal operating conditions that could result in a fire.	<p>Intent:</p> <p>To ensure that any abnormal operating conditions that could result in a fire are monitored for. Conditions monitored could include belt alignment, belt slip, over / under speed, bearing overheating, chute or other blockages.</p> <p>Personnel:</p> <p>U/G manager.</p> <p>Method:</p> <p>Inspect installations for the presence of a condition monitoring system.</p>
6.2	Underground conveyor haulage ways have a fixed fire detection / suppression system installed that is designed for automatic operation and also has provision for manual operation.	<p>Intent:</p> <p>To ensure that any outbreak of fire can be automatically detected and suppressed.</p> <p>Personnel:</p> <p>U/G manager.</p> <p>Method:</p> <p>Inspect installations for the presence of an automatic fire suppression system that can also be manually operated.</p>
6.3	Underground fixed equipment condition monitoring and fire detection / suppression systems are maintained.	<p>Intent:</p> <p>To ensure that condition monitoring and fire detection / suppression systems are in an operating condition.</p> <p>Personnel:</p> <p>Maintenance supervisors.</p> <p>Method:</p> <p>View preventative maintenance schedule, records of inspections / tests / checks made.</p>
6.4	Underground conveyor belts are of a flame resistant type.	<p>Intent:</p> <p>To ensure that the risks of a conveyor belt fire are minimised.</p> <p>Personnel:</p> <p>U/G manager.</p> <p>Method:</p> <p>View the specification details for the conveyor belts installed underground. Refer to AS1332, 1334.</p>

6.5	Underground belt driven equipment e.g. pumps, is routinely checked for drive belt tightness.	<p>Intent: To ensure that the risk of fire on underground equipment driven via pulley belts is minimised.</p> <p>Personnel: Maintenance supervisors.</p> <p>Method: View inspection schedule and records of inspection.</p>
6.6	Underground areas with fixed mechanical equipment installed and operating have appropriate portable fire extinguishers located in the intake airway.	<p>Intent: To ensure that any outbreak of fire can be dealt with promptly.</p> <p>Personnel: U/G manager.</p> <p>Method: Inspect locations for the presence of appropriate fire extinguishers in the intake airway.</p>

7 Underground fixed electrical installations

Underground fixed electrical installations

Point	Standard	Guideline
7.1	There are documented standards for the installation of electrical equipment and cables, such that damage by mobile equipment or from other types of impact, is prevented or minimised.	<p>Intent: To ensure that the risk of fire due to impact damage on electrical equipment is minimised.</p> <p>Personnel: U/G manager, electrical supervisor.</p> <p>Method: View documented standards.</p>
7.2	Underground oil filled electrical equipment installations are constructed so as to contain any leaks.	<p>Intent: To ensure that any leak from oil filled electrical equipment is contained.</p> <p>Personnel: Electrical supervisor.</p> <p>Method: Inspect any such installation.</p>
7.3	Only non-flammable coolants are used in underground electrical equipment installations.	<p>Intent: To ensure that fire hazards are minimised.</p> <p>Personnel: Electrical supervisor.</p> <p>Method: Inspect any such installation.</p>
7.4	Where underground fixed electrical installations are within fenced enclosures, appropriate portable fire extinguishers are located outside of the fence, in the intake airway.	<p>Intent: To ensure that appropriate portable fire extinguishers are readily available in the event of a fire.</p> <p>Personnel: U/G manager.</p> <p>Method: Inspect any such installation.</p>
7.5	Only non-flammable sprays are used in the maintenance and cleaning of underground electrical equipment.	<p>Intent: To ensure that fire hazards are minimised.</p> <p>Personnel: Electrical supervisor, electrical workers.</p> <p>Method: Interview electrical workers.</p>

8 Underground air compressors

Underground air compressors

Point	Standard	Guideline
8.1	Stationary and skid mounted air compressors installed underground comply with AS 4297.	<p>Intent: To ensure that underground air compressors meet a minimum standard.</p> <p>Personnel: U/G manager.</p> <p>Method: Inspect any such air compressor. Refer to AS 4297, Underground mining – Stationary air compressors.</p>
8.2	Air compressors used underground and driven by a diesel engine are liquid cooled.	<p>Intent: To ensure that the risk of fire on an unattended unit is minimised.</p> <p>Personnel: U/G manager.</p> <p>Method: Inspect any such air compressor. Refer to MSIR 9.24(e).</p>
8.3	Where an air compressor used underground is driven by a diesel engine, the engine is provided with an automatic fire suppression system.	<p>Intent: To ensure that the risk of an uncontrolled fire is minimised.</p> <p>Personnel: U/G manager.</p> <p>Method: Inspect any such air compressor.</p>
8.4	Air compressors used underground are fitted with a heat sensor in the discharge port which will initiate an alarm and then shut down at 150 degrees Celsius.	<p>Intent: To ensure that the risk of fire on an unattended unit is minimised.</p> <p>Personnel: U/G manager.</p> <p>Method: Inspect any such air compressor. Refer to MSIR 9.24(d).</p>
8.5	Where an air compressor used underground is unattended, it is located in a return ventilation airway behind an air control device.	<p>Intent: To ensure that any smoke from an outbreak of fire is immediately removed.</p> <p>Personnel: U/G manager.</p> <p>Method: Inspect any such air compressor.</p>

9 Underground workshops

Underground workshops

Point	Standard	Guideline
9.1	There are at least 2 clearly marked exits from each underground workshop.	<p>Intent: To ensure that a person is unlikely to be trapped by a fire in the workshop.</p> <p>Personnel: N/A.</p> <p>Method: Inspect workshop.</p>
9.2	Appropriate fire fighting appliances are provided in underground workshops.	<p>Intent: To ensure that any outbreaks of fire in the workshop can be immediately dealt with.</p> <p>Personnel: Workshop supervisor.</p> <p>Method: Inspect workshop.</p>
9.3	Class dedicated storage cabinets are used to store the hazardous substances used in the workshop.	<p>Intent: To ensure that there is a minimal risk of fire due to hazardous substances of incompatible classes not being segregated, e.g. Class 3 flammable liquids are stored separately from Class 8 corrosives.</p> <p>Personnel: Workshop supervisor.</p> <p>Method: Inspect the hazardous substances storage facilities.</p>
9.4	All compressed gas cylinders and associated equipment are checked for leaks.	<p>Intent: To ensure that there is a minimal risk of fire and / or exposure to a possible toxic gas.</p> <p>Personnel: Workshop supervisor.</p> <p>Method: Interview personnel.</p>

10 Maintenance and operating procedures underground

Maintenance and operating procedures underground

Point	Standard	Guideline
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10.1	A hot work permit system is in place for all such work underground work not carried out in a workshop.	<p>Intent: To ensure that the potential for a fire to start due to careless hot work is minimised.</p> <p>Personnel: Maintenance supervisors.</p> <p>Method: Review the hot work permit system documentation. Refer to MSIR 4.3.</p>
10.2	Maintenance procedures identify associated fire hazards.	<p>Intent: To ensure that the maintenance procedure documentation addresses potential fire hazards. Such hazards may include flammable waste, hot work, short circuits, etc.</p> <p>Personnel: Maintenance supervisors.</p> <p>Method: Review maintenance procedure documentation.</p>
10.3	Both mobile equipment and fixed fire suppression systems are tested and maintained in accordance with the manufacturer's specifications.	<p>Intent: To ensure that the fire suppression systems installed on mobile equipment and at fixed locations are correctly tested and maintained.</p> <p>Personnel: Maintenance supervisors.</p> <p>Method: View maintenance and test records.</p>
10.4	There is an inspection and maintenance procedure for fire hydrants, extinguishers and signs.	<p>Intent: To ensure that the fire fighting appliances provided are maintained.</p> <p>Personnel: Maintenance supervisors.</p> <p>Method: View inspection and maintenance records.</p>
10.5	Operating procedures require that a vehicle that experiences a flat tyre underground is then only driven a short distance to a location where a new tyre can be fitted.	<p>Intent: To ensure that the potential for a tyre fire, due to overheating from running flat, is minimised.</p> <p>Personnel: Mobile equipment operators.</p> <p>Method: Review procedures and interview personnel.</p>

10.6

Operating procedures require that trackless units are not left unattended unless the engine or power supply has been switched off.

Intent:

To ensure that the potential for an unobserved engine or electric motor fire is minimised.

Personnel:

Mobile equipment operators.

Method:

Review procedures and interview personnel. Refer to MSIR 10.41(1)(a).