



Government of **Western Australia**
Department of **Mines and Petroleum**
Resources Safety

Guide to electronic reporting of seismic and fall of ground occurrences

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Introduction

The Department of Mines and Petroleum's online reporting system is known as the Safety Regulation System (SRS). Occurrence report forms for all reportable occurrences under the *Mines Safety and Inspection Act 1994* (ss. 76, 77 and 78) are now submitted via the SRS. This includes reports covering seismic events and falls of ground (FOGs), which are submitted using the SRS's Seismic/FOG Wizard.

The Seismic/FOG Wizard is based on a form developed by Resources Safety in collaboration with industry experts and geotechnical engineers working at seismically active mine sites. Use of the SRS Wizard will:

- ensure the uniformity and reliability of data collected for the Resources Safety database;
- reduce the need to follow up incomplete reports;
- and streamline the reporting process for mine sites.

Within SRS, all records are stored in a central location, with supporting documentation linked to the original occurrence report. The consistent reporting of seismic events and falls of ground within the Resources Safety database will assist trend analysis, evidence-based risk management and prioritisation of inspectorate activities. This will allow Resources Safety to work collaboratively with industry to efficiently and proactively address latent and emerging geotechnical risks in Western Australia's underground mines.

This guide will help those using the Seismic/FOG Wizard for the first time, or collating data for the occurrence report.

What to report

Section 78(3)(a) of the Act requires the reporting of "any extensive subsidence, settlement or fall of ground or any major collapse or any part of the operations of a mine, or any earth movement caused by a seismic event". In terms of the Seismic/FOG Wizard, these are Incident Types 1 (FOG) or 2 (seismic event).

Note: Please do not submit occurrence reports for seismic events or falls of ground as Incident Type 13 (potentially serious occurrence).

Report all seismic events and falls of ground that:

- result in damage to ground support;
- result in damage to rockmass, especially where there is no ground support (e.g. sidewalls and floor);
- had the potential to harm employees at the mine (i.e. occurred in an active access way); or
- actually harmed an employee in the mine.

The following information is required:

- event magnitude;
- event location;
- damage to support;
- damage to rockmass (including depth of damage);
- if fall of ground, tonnage;
- installed ground support
 - bolt type, length, pattern
 - order of installation and age

- technical specifications such as tonnes, energy, yield, if galvanised
- fibrecrete and/or mesh details;
- excavation history (size, age);
- blasting history (recent);
- seismic history;
- seismic sources or failure modes; and
- mine depth (deepest active stope).

The inclusion of seismic data relating to reportable occurrences improves the usefulness of the report. Where possible, provide:

- photographs of the damage site;
- seismic data (plotted on isometric projection of 3D mine plan);
- Omori Charts, if relevant; and
- internal investigation reports (these may be uploaded as they become available).

Reporting process

The initial occurrence report (OC) must be submitted within 24 hours of the event and may be reported by anyone at the site registered on SRS.

Whenever fall of ground (1) or seismic event (2) is selected for an underground mine's reportable occurrence, SRS automatically creates the Seismic/FOG occurrence report form (OS).

The sender of the initial occurrence report then automatically receives a "Request for information" message from SRS — this must be forwarded to the person on site responsible for geotechnical engineering.

Note: The geotechnical person must be registered as an SRS user by the company's SRS administrator before they can enter data in the Seismic/FOG Wizard.

The Seismic/FOG occurrence report form must be completed within ten working days of the initial occurrence report, and should only be completed by a qualified geotechnical or mining engineer.

Failure to complete the Seismic/FOG occurrence report form in time will result in an alert being sent to the SRS administrator stating the site is in breach of ss. 78 and 21(1)(o) of the Act. The system will also automatically alert the District Inspector, who may issue an improvement notice or prohibition notice for non-compliance.

If there is an injury associated with the initial occurrence report (OC), an injury occurrence form (IN) will be generated. The Seismic/FOG (OS) and injury (IN) occurrences are "children" to the "parent" initial reported occurrence (OC) and remain linked in SRS.

Using the SRS Seismic/FOG Wizard

Overview

The Seismic/FOG Wizard has the flexibility to enable reporting of any of the following combinations for an underground mine:

- seismic event with no fall of ground;
- seismic event with contemporaneous fall of ground;
- seismic event with rockmass or ground support damage or both, but no fall of ground;
- fall of ground only; and
- accessible and inaccessible hypocentre or damaged areas.

To assist in completion of the occurrence report using the SRS Seismic/FOG Wizard, the report form is also available online as a template (see Appendix 1) to record information while undertaking investigations. The data can then be entered using the SRS Seismic/FOG Wizard.

The legislative requirements mean that the Seismic/FOG occurrence report must be completed in SRS within ten days. However, using the report template as an adjunct allows for more data to be collected before it is entered into SRS to update existing information.

Supporting documentation such as internal investigation reports, photos, seismic plots and 3D graphics should be attached at Section 7 "Comments and actions" of the Seismic/FOG Wizard.

Section 1 Reporting details

Under s. 78(1) of the Act, the company is required to report immediately (within 24 hours) any incidents relating to seismic events and falls of ground. It is left to mine management's discretion as to which seismic events and falls of ground should be reported to Resources Safety (i.e. management does not have to report every detected seismic event and FOG if they are not relevant to overall safety at the mine, such as for micro-seismic monitoring data or falloffs in old stopes away from mine activity). The decision on what to report should be made with consideration for the level of risk to mine personnel (e.g. report when the occurrence results in ground support or rockmass damage in man accessways).

Sections 78 and 21(1)(o) require the mine to provide the particulars of the occurrence for the District Inspector's information. This is done through the Seismic/FOG occurrence report form, which is mandatory and must be completed within ten working days of lodgement of the initial occurrence report.

Seismic Occurrence | Area: Mining
Notifications - AXTAT Plus

REFERENCE ID: OS-341-111154 | Status: Incomplete
SRS TESTING PRODUCTION - EXPLN & MINING | MOD SMALL MINES / RSD | 02/05/2011

- 1. Reporting Details ✔
- 2. FOG/Damage- Time, Location, Extent & Excavation ⓘ
- 3. FOG/Damage - Description ⓘ
- 4. Seismicity & Blasting ⓘ
- 5. FOG/Damaged Area - Support Damage Rating ⓘ
- 6. FOG/Damaged Area - Installed Ground Support ⓘ
- 7. Comments & Actions ⓘ
- 8. Review ⓘ
- 9. Submit Notification ⊘

33% Complete

- Related Communication
- Related Notification
- Notification History

1. Reporting Details

Information

As required under ss. 76, 78 and 79 of the Mines Safety and Inspection Act 1994 and r. 6.36 of the Mines Safety and Inspection Regulations 1995.

Company Details

Company^a: SRS TESTING PRODUCTION - EXPLN & MINING
RSD Site Name: MOD SMALL MINES / RSD
Site Code: S0005552
Mine Site Name: test

Form Completed By:

Surname: GOH	Given Name(s): JENNIFER (EXTERNAL)	ex36472
Position: new tester		
Phone: 9358 8095	Mobile:	
Fax: 12345678	Email: jjjjj@yahoo.com	

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Section 2 FOG/Damage - Time, Location, Extent & Excavation

This section should be completed if there has been a fall of ground (FOG), regardless of whether or not there was an accompanying seismic event. If there has been no fall of ground, enter “n/a”.

Seismic Occurrence | Area: Mining | Notifications - AXTAT Plus

REFERENCE ID: OS-341-111154 | Status: Incomplete | SRS TESTING PRODUCTION - EXPLN & MINING | MOD-SMALL MINES / RSD | 02/05/2011

2. FOG/Damage- Time, Location, Extent & Excavation

Time & Extent*

Date Of FOG*: 02/05/2011 | Time Of FOG*: Known Unknown

FOG In Tonnes*:

Damaged Area*: m m m

Depth (m below surface)*

Mine (deepest active stopes)*: m

At FOG*: m

Location of Damage Site*

Lode/Block Name*:

Northing*:

Easting*:

Excavation Design (for Damages Development/Accessway)*

Date Mined*:

Development* : m m

Perimeter Blasting Used?

33% Complete

Previous Next

Time and extent

Provide the time, tonnes, length, width and depth of the damaged area where the FOG is located.

Depth

Provide the depth, in metres below surface, of the deepest stope at the mine, as well as the site of the FOG. This is background contextual information for the Resources Safety database.

Location of damage site

Provide the name of the orebody where the FOG occurred, and the mine grid co-ordinates for the FOG's location.

Excavation design (for damaged development/accessway)

Provide information on the history of the FOG's location, such as mining age, size (especially span or width) and blast practices to prevent rockmass damage during excavation.

Section 3 FOG/Damage - Description

Completion of this section is mandatory whether reporting a seismic event, fall of ground or both, as long as the damage site is safe to access to collect the necessary data.

Seismic Occurrence | Area: Mining Notifications - AXTAT Plus

REFERENCE ID: OS-341-111154 | Status: Incomplete SRS TESTING PRODUCTION - EXPLN & MINING | MOD SMALL MINES / RSD | 02/03/2011

3. FOG/Damage - Description

1. Reporting Details

2. FOG/Damage- Time, Location, Extent & Excavation

3. FOG/Damage - Description

4. Seismicity & Blasting

5. FOG/Damaged Area - Support Damage Rating

6. FOG/Damaged Area - Installed Ground Support

7. Comments & Actions

8. Review

9. Submit Notification

33% Complete

Related Communication

Related Notification

Notification History

Damage Site Description*

Site Geology, Structure, Stress Conditions, Presence of Water (Us)*

Kaiser Rock Damage Scale*

R0	R1	R2	R3	R4	R5
No Rockmass Damage	Minor New Fractures	Minor damage << 1t displaced	< 1t displaced	1 - 10t displaced	> 10t displaced
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Failure Mode*

Static	Seismic (Ref: ACG Generic SRMP)				
Wedge Sliding Block Topping Unravelling	Strain Burst (incl Bulking)	Buckling	Face Crush / Pillar Burst	Shear Rupture / Fault Slip	Shakedown
<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Previous Next

Damage site description

Describe the damage site of the seismic event hypocentre or FOG. If reporting a seismic event with no FOG, it is still possible to have rockmass damage. Provide a concise description of the damage, including photos, which should be attached at Section 7.

Site geology, structure, stress conditions, presence of water (litres/second)

Whether reporting a seismic event or FOG, describe the geology, stress and other geotechnical considerations for the site that may assist understanding of the causal factors.

Kaiser rock damage scale

The Kaiser rock damage scale has been adopted by the Australian Centre for Geomechanics (ACG) in its generic seismic risk management plan for underground hardrock mines (SRMP) and, as such, has been adopted by Resources Safety for use in occurrence reporting.

If there is no visible damage, click on the “R0” button. Otherwise, refer to the rock damage scale (see Table 1 in Appendix 1) to determine whether the event is R1, 2, 3, 4 or 5.

Failure mode

When reporting an FOG, click on the “Static” button (wedge, block etc). To report a seismic event only, click on the “Seismic” button that best describes the event. The categories are extracted from the ACG’s generic SRMP. If reporting both an FOG and seismic event in the one occurrence, click on both the “Static” button and the applicable “Seismic” button (e.g. shakedown or buckling).

Section 4 Seismicity & Blasting

Seismic details are not applicable when reporting an FOG only. The provision of blasting details is mandatory for all occurrence types.

The screenshot displays the '4. Seismicity & Blasting' section of the AXTAT Plus software. The interface includes a navigation menu on the left with 9 steps, a progress bar at 33% complete, and a main form area. The form is divided into several sections: 'Source Mechanism' (a text input field), 'Seismic Event Hypocentre' (with fields for Date Of Event, Time Of Event (Known/Unknown), Level/RL/meters below surface, Northing, Easting, and Distance from damage site(s)), 'Magnitude' (with radio buttons for Seismic System: ISS, ESG, Other, and a field for S:P Energy Ratio), and 'Most Recent Blast Details' (with fields for Date Of Blast, Time Of Blast, Blast Tonnes, Blast Type (Production, Development, Other), Exclusion Zone Details, and Re-entry Period). The interface also features a 'Previous' and 'Next' button at the bottom right.

Source mechanism

Type "n/a" if only an FOG. For a seismic event, describe the possible causal factor for the event in terms of features such as nearby faults, structures, rock types, voids and stress redistributions (e.g. a high S:P ratio would normally indicate a fault slip event). Note any observed displacement on structures or heave.

Seismic event hypocentre

Type "n/a" if only an FOG. For a seismic event, the site's seismic monitoring system should provide the location of the hypocentre. Provide co-ordinates and distance from the location of the damage (if there is damaged) as well as the time of the event recorded by the site's monitoring system.

Magnitude

Type "n/a" if only an FOG. For a seismic event, the site's seismic monitoring system should provide the magnitude of the event. Click on the applicable "Seismic System" type and provide the local magnitude and S:P ratio.

Blasting

This section is mandatory whether reporting a seismic event, FOG or both, as there is often a close relationship between these and blasting. Provide details on the last blast fired before the event, such as time, blast type and tonnes (e.g. stope production or development). Briefly describe the exclusion zones and re-entry periods used for blasting (preferably based on site-specific Omori Chart analyses).

Section 5 FOG/Damaged Area - Support Damage Rating

Completion of this section is compulsory.

The Kaiser support damage scale has been adopted by the ACG in its generic SRMP and Resources Safety has done likewise for its use in occurrence reporting.

If there is no damage, click on the “S0” or “SC0” button. Otherwise, refer to the support and shotcrete damage scales (see Table 2 in Appendix 1) to determine whether the event is S or SC01, 2, 3, 4 or 5 (see Appendix 1 – Table 2).

Seismic Occurrence | Area: Mining
Notifications - AXTAT Plus

REFERENCE ID: OS-341-111154 | Status: Incomplete
SRS TESTING PRODUCTION - EXPLN & MINING | MOD SMALL MINES / RSD | 02/05/2011

- 1. Reporting Details
- 2. FOG/Damage- Time, Location, Extent & Excavation
- 3. FOG/Damage - Description
- 4. Seismicity & Blasting
- 5. FOG/Damaged Area - Support Damage Rating
- 6. FOG/Damaged Area - Installed Ground Support
- 7. Comments & Actions
- 8. Review
- 9. Submit Notification

33% Complete

- Related Communication
- Related Notification
- Notification History

5. FOG/Damaged Area - Support Damage Rating

Kaiser Support Damage*

S0 (No Damage)	S1 (1st signs of distress)	S2 (loaded, plates deformed, mesh bagged but OK)	S3 (heavy loaded, few broken, mesh bagged, some torn/open)	S4 (major damage, many broken bolts, mesh failed or bagged to capacity, rock ejected between bolts)	S5 (complete failure of support components)
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Shotcrete Damage Rating Level

SC0 (No Damage)	SC1 (1st cracks in Shotcrete)	SC2 (Shotcrete cracked & loaded)	SC3 (Shotcrete fractured, debonding, some fragments)	SC4 (Shotcrete heavily fractured, large pieces fallen)	SC5 (Shotcrete non-functional)
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Previous
Next

Section 6 FOG/Damaged Area - Installed Ground Support

Completion of this section is mandatory whether reporting a seismic event, fall of ground or both, as long as the damage site is safe to access to collect the necessary data.

If the seismic event hypocentre is located in an inaccessible area, such as an open stope, type “n/a”, otherwise perform a stocktake of all support installed in the area and list it in order of installation (i.e. chronological order).

Select the order (hint: start at 1 as the first support installed at this location) and enter bolt type (e.g. split set), black/galvanised, bolt length (m), bolt pattern (burden x spacing, m), bolt static capacity (tonnes/bolt), bolt dynamic capacity (kJ/bolt), displacement (for dynamic bolts, mm), bolt age (months), and condition or corrosion.

This list should include mesh and shotcrete or fibrecrete, and they must be entered in the order installed (e.g. before or after bolts) with details on their specification.

The list may include up to eight stages of ground support installation.

When all details have been entered, a table will display showing the details in chronological order of every stage of ground support installed.

Seismic Occurrence | Area: Mining
Notifications - AXTAT Plus

REFERENCE ID: OS-341-111154 | Status: Incomplete
SRS TESTING PRODUCTION - EXPLN & MINING | MOD SMALL MINES / RSD | 02/05/2011

- 1. Reporting Details
- 2. FOG/Damage- Time, Location, Extent & Excavation
- 3. FOG/Damage - Description
- 4. Seismicity & Blasting
- 5. FOG/Damaged Area - Support Damage Rating
- 6. FOG/Damaged Area - Installed Ground Support
- 7. Comments & Actions
- 8. Review
- 9. Submit Notification

33% Complete

- Related Communication
- Related Notification
- Notification History

6. FOG/Damaged Area - Installed Ground Support

Support Description

Order Of Installation*: <input type="text"/>	Bolt Load Capacity*: <input type="text"/> t
Support Type (bolt/reinforcement name)*: <input type="text"/>	Bolt Energy Capacity*: <input type="text"/> KJ/bolt
Black/Galvanised?: <input type="text"/>	Displacement Limit: <input type="text"/> mm
Bolt Length*: <input type="text"/> m	Age of Support*: <input type="text"/> mths
Pattern (Burden x Spacing)*: <input type="text"/> m x <input type="text"/> m	Condition/corrosion?: <input type="text"/>
Mesh?: <input type="checkbox"/> SC/FC?: <input type="checkbox"/>	

Clear
Add

Installed Ground Support											
Order	Support Type	Black / Galv?	Length	Pattern	Load Capacity	Energy Capacity	Disp Limit	Age	Condition	Mesh	SC / FC

Previous
Next

Section 7 Comments & Actions

Resources Safety requires formally documented investigation reports for seismic and fall of ground occurrences. The seriousness of the occurrence will dictate whether this requires an ICAM, TapRoot or equivalent investigation.

Action plans arising from the investigation should be included with the investigation report.

As appropriate, also attach level plans, seismic system 3D hypocentre plots, photos, rock noise reports and any other relevant information.

Seismic Occurrence | Area: Mining Notifications - AXTAT Plus

REFERENCE ID: OS-341-111154 | Status: Incomplete SRS TESTING PRODUCTION - EXPLN & MINING | MOD SMALL MINES / RSD | 02/05/2011

7. Comments & Actions

- 1. Reporting Details ✓
- 2. FOG/Damage- Time, Location, Extent & Excavation ⓘ
- 3. FOG/Damage - Description ⓘ
- 4. Seismicity & Blasting ⓘ
- 5. FOG/Damaged Area - Support Damage Rating ⓘ
- 6. FOG/Damaged Area - Installed Ground Support ⓘ
- 7. Comments & Actions ⓘ**
- 8. Review ⓘ
- 9. Submit Notification ⓧ

33% Complete

Related Communication

Related Notification

Notification History

General Comment*:

Remedial Actions*:

Please attach relevant photos, investigation memos, seismic history and data analysis:

Attach file...
Add

Attached Files		
File Name	Size	Attached

Previous Next

Technical reference list and suggested reading

Durrheim, R., Goldbach, O., Linzer, L., Spottiswoode, S., Cichowicz, A., Ebrahim-Trollope, R., Essrich, F., and Stankiewicz, T., 2007, Guidelines, standards and best practice for seismic hazard assessment and rockburst risk management in South African mines: in 4th International Seminar on Deep and High Stress Mining, November 7-9 2007, Perth, pp. 249-261.

Heal, D., Potvin, Y., and Hudyma, M., 2006, Evaluating rockburst damage potential in underground mining: in ARMA/USRMS 2006 Conference, June 19-21 2006, Golden Colorado.

Hudyma, M., 2004, Mining induced seismicity in underground, mechanised, hardrock mines – results of a worldwide survey: Australian Centre for Geomechanics, Perth.

Hudyma, M., and Brummer, R., 2007, Seismic monitoring in mines – design, operation, tricks and traps: in 1st Canada-US Rock Mechanics Symposium, Vancouver, May 2007.

Hudyma, M., and Heal, D., 2007, Proactive versus reactive seismic monitoring in mines – results of a seismic monitoring survey: in 4th International Seminar on Deep and High Stress Mining, November 7-9 2007, Perth, pp. 207-220.

Hudyma, M., Heal, D., and Mikula, P., 2003, Seismic monitoring in mines – old technology – new applications: Australian Centre for Geomechanics, Perth.

Mercier-Langevin, F., and Hudyma, M., 2007, The development and implementation of a comprehensive seismic risk management plan at Agnico-Eagle's LaRonde Mine: in 4th International Seminar on Deep and High Stress Mining, November 7-9 2007, Perth, pp. 221-232.

Mikula, P., Heal, D., Hudyma, M., and Potvin, Y., 2008, Generic seismic risk management plan for underground hardrock mines: in Australian Centre for Geomechanics Phase Three Mine Seismicity and Rockburst Risk Management (MSRRM) Project, 2006-2008 Technical Report.

Misich, I., and Lang, A., 2001, Examples of rockburst damage in Western Australia: in Rockbursts and Seismicity in Mines – RaSiM5, South African Institute of Mining & Metallurgy, pp. 59-68.

Australian Centre for Geomechanics

<http://www.ms-rap.com/ACG_Mine_Seismicity_Downloads> (viewed June 2011)

Presenters' notes to "Working safely in active ground conditions" (dated January 2006).

Seismic Hazard Mapping with MS_RAP Version 3, September 2005, by ACG (Mine Seismicity and Rockburst Risk Management Project, Phase II – 2003-2005 Technical Report)

"Mine Seismicity & Rockburst Risk Management 1999-2009" ACG Presentation on MSRRM 10 year Project

Appendix 1

Significant seismic event and/or fall of ground occurrence report form

Template available at www.dmp.wa.gov.au/6713.aspx#7008

TIME, LOCATION AND EXTENT OF FOG / DAMAGED ROCKMASS / DAMAGED SUPPORT							
Time and extent	Time of FOG?	FOG tonnes (t)		Damaged area – depth (m)	Damaged area – width (m)	Damaged area - length (m)	
	<i>DD/MM/YY HH:MM AM/PM</i>	<numeric>		<numeric>	< numeric>	< numeric>	
Depth (m below surface)	Mine (deepest active stopes)			At fall of ground (FOG)			
	<text description>			<text description>			
Location of damage site <Attach screen dump from mine software showing development, stopes and major structures>	Lode/block name		Northing	Easting			
	<text description>		<text description>	<text description>			
EXCAVATION DESIGN (For damaged development / accessway)							
Excavation details – in area of FOG / damage	Date mined	Development width/span (m)		Development height (m)		Perimeter blasting used?	
	<i>DD/MM/YY</i>	<numeric>		<numeric>		<input type="checkbox"/> Yes <input type="checkbox"/> No	
SUMMARY DESCRIPTION OF FOG/ DAMAGED ROCKMASS							
Damage site description	<text description> E.g. stope brow						
Site geology, structures, stress conditions, presence of water (l/s) <describe>	<text description> E.g. porphyry dyke contact with ultramafics, high stress at brow, dry.						
Kaiser Rock Damage Scale (see Table 1) (tick one only)	R0 (no rockmass damage)	R1 (minor new fractures)	R2 (minor damage <<1t displaced)	R3 (<1 t displaced)	R4 (1-10 t displaced)	R5 (>10 t displaced)	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Failure mode (tick correct box)	Static		Seismic (Ref: ACG Generic SRMP)				
	Wedge Sliding block Toppling Unravelling		Strain burst (including bulking)	Buckling	Face crush/ pillar burst	Shear rupture/ fault slip	Shakedown
	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SEISMICITY (fill in this section only if a seismic event has occurred)							
Source mechanism (e.g. high S:P = fault slip)	<text description> E.g. 'Jog Fault' slip, observed displacement / heave of 300 mm						
Seismic event hypocentre	Time of event	Level / RL/ mBS	Northing	Easting		Distance from damage site(s)?	
	<i>DD/MM/YY HH:MM AM/PM</i>	<numeric>	<numeric>	<numeric>		<numeric>	

Magnitude	Seismic system	Local (M _L) (ESG)	Richter equivalent (MR) (ISS)	S:P energy ratio
	ISS / ESG / other	<numeric>	<numeric>	<numeric>

BLASTING (provide details of last blast before the FOG/seismic event)

Most recent blast details	Time of blast	Blast tonnes	Blast type (stope production/development/other?)	Exclusion zone details (part of mine closed)	Re-entry period – hours after blast (based on Omori Chart analyses)
	DD/MM/YY HH:MM AM/PM	<numeric>	Prod / Dev / Other	<text description>	<Hours>

SUPPORT DAMAGE RATING IN FOG/ DAMAGED AREA

Kaiser Support Damage Rating (see Table 2) (tick one only)	S0 (no damage)	S1 (1st signs of distress)	S2 (loaded, plates deformed, mesh bagged but OK)	S3 (heavy loaded, few broken, mesh bagged, some torn/open)	S4 (major damage, many broken bolts, mesh failed or bagged to capacity, rock ejected between bolts)	S5 (complete failure of support components)
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	SC0 (no damage)	SC1 (1st cracks in shotcrete)	SC2 (shotcrete cracked and loaded)	SC3 (shotcrete fractured, debonding, some fragments)	SC4 (shotcrete heavily fractured, large pieces fallen)	SC5 (shotcrete non-functional)
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

INSTALLED GROUND SUPPORT IN FOG/DAMAGED AREA

Order of installation	1	2	3	4	5	6	7	8
Support type <bolt / reinforcement name>								
Black / galvanised?								
Bolt length (m)								
Pattern (burden x spacing, m)								
Bolt load capacity (t)								
Bolt energy capacity (kJ/bolt)								
Displacement limit (mm)								
Age of support (months)								

Condition / corrosion?								
Mesh	Sheet size (W x L, m)	Aperture (mm)	Gauge (mm)	Energy (kJ/m²)	Overlap pinned?	Coverage		
	<W x L>	<numeric>	<numeric>	<numeric>	<input type="checkbox"/> Yes <input type="checkbox"/> No	Backs / Shoulder / Grade line		
Shotcrete / fibrecrete	Design thickness (mm)	Actual thickness (mm)	Energy (kJ/m²)	Fibre dosage (kg/m³)	UCS (MPa)	Coverage		
	<numeric>	<numeric>	<numeric>	<numeric>	<numeric>	Backs / Shoulder / Grade line		
GENERAL COMMENTS AND REMEDIAL ACTIONS								
<i>Provide further relevant information. Describe immediate rectifications and actions as a result of this event. Please attach relevant photos, investigation memos, seismic history and data analyses.</i>								

Table 1 Rock Damage Scale

Reference: Kaiser, P.K., Tannant, D.D., McCreath, D.R., and Jesenak, P., 1992, Rockburst damage assessment procedure: in Rock Support in Underground Mining and Construction, Kaiser and McCreath (eds), Balkema, Rotterdam, pp. 639-647.

Source: *Generic Seismic Risk Management Plan, ACG, 2008.*

Damage level	General description	Rockmass / excavation damage
R0	Conditions unchanged	No new damage due to rockburst
R1	Excavations undamaged but first signs of distress detectable	Rock shows fresh but minor, small fractures and cracks (possibly behind 'loose') Small shards of rock may have been displaced
R2	Slight damage to excavations Only 'loose' displaced	Slight sloughing from back and walls of unsupported excavations (only 'loose' rock displaced, little freshly broken rock) Small shards and a few chunks of rock displaced in supported excavations (possibly retained by mesh) Rockmass shows only minor new fracturing
R3	Minor damage to excavations 'Loose' displaced and new rock failure	Unsupported drifts sustain damage with <200 kg of rock displaced from either a fall of ground or due to newly generated fracturing of rock (spalling) In drifts supported with only rockbolts and mesh, small to large pieces and occasional blocks (totalling < 1000 kg) of rock dislodged Moderate new bagging of mesh by fractured and displaced rock Clear evidence of newly fractured rock, possibly displaced violently
R4	Moderate to considerable damage to excavations Violent displacement of 'loose' and freshly broken rock	Unsupported drifts sustain damage at multiple locations Drifts supported with only rockbolts and mesh are damaged with substantial rock displaced (<10000 kg) but are still passable Rock is heavily fractured and displaced violently
R5	Serious or severe damage to excavations Opening collapsed	Unsupported drifts completely closed Drifts supported with only rockbolts and mesh heavily damaged and unpassable Substantial amounts of rock displaced (> 10000 kg) Rock is highly broken and fractured

Notes:

- 1) *The damage indicators listed in this table describe damage that is new and was caused by the rockburst. If the observer cannot ascertain that the damage was inflicted by the rockburst then the damage should be ignored for the purposes of damage classification.*
- 2) *The mass of displaced rock serves only as a rough guide and should not be used alone to establish the degree of rockburst damage. Other qualitative descriptions are equally important when deciding on the degree of damage.*
- 3) *One or more damage scales may be observed in the same area and should be recorded separately.*
- 4) *'Loose' is rock that could be scaled down by hand without much effort.*

Table 2 Support Damage Scale

Reference: Kaiser, P.K., Tannant, D.D., McCreath, D.R., and Jesenak, P., 1992, Rockburst damage assessment procedure: in Rock Support in Underground Mining and Construction, Kaiser and McCreath (eds), Balkema, Rotterdam, pp. 639-647.

Source: *Generic Seismic Risk Management Plan, ACG, 2008.*

Damage level	General description	Support damage	Shotcrete damage
S0	Conditions unchanged	No new damage or loading	No new damage or loading
S1	Support undamaged but first signs of distress detectable	No damage to any support component	Shotcrete shows new cracks, very fine or widely distributed
S2	Slight damage to support Loading clearly evident but full functionality maintained	Plates and wooden washers on some rockbolts are deformed, showing loading Individual strands in mesh broken Mesh bagged but retains material well	Shotcrete cracked, minor flakes dislodged Shotcrete is clearly taking load from broken rock mass (mostly drummy)
S3	Moderate damage to support Support shows significant loading and local loss of functionality ; retaining function primarily lost (except in laced or shotcreted areas)	Plates, wooden washers, and wood blocking on rockbolts are heavily deformed, showing significant loading; bolt heads may be "sucked" into rock Mesh torn near bolt heads with some strands broken and mesh torn or opened at overlapping edges Moderate bagging of mesh and isolated failures of rockbolts Cable lacing performs well	Shotcrete fractured, often debonded from rock and/or reinforcement Major flakes possibly dislodged Holding elements mostly intact
S4	Substantial damage to support More extensive loss of retaining and holding functions (except for lacing systems)	Mesh is often torn and pulled over rockbolt plates; if it did not fail, it is substantially bagged (at capacity) Many rockbolts failed Rock ejected between support components Cable lacing is heavily loaded with bagged mesh	Shotcrete heavily fractured and broken, often separated from the rock mass with pieces lying on the ground or hanging from reinforcement (Connections to holding elements often failed or holding elements failed locally)
S5	Severe damage to support Support retaining, holding, and reinforcing functions failed	Most ground support components broken or damaged Most rockbolts fail and rock peels off cable bolts Shotcrete non-functional Mesh without cable lacing heavily torn and damaged Cable lacing systems heavily stressed and often failed	For damage level S5, shotcrete fails to be functional and the left-hand column applies

Notes:

- 1) *The damage indicators listed in this table describe damage that is new and was caused by the rockburst. If the observer cannot ascertain that the damage was inflicted by the rockburst then the damage should be ignored for the purposes of damage classification.*
- 2) *One or more damage scales may be observed in same section and should be recorded separately.*

- 3) *Rock and support damage levels need not correspond.*
- 4) *Because the function of shotcrete support is somewhat different and more complex than for other support systems, a separate column of indicators is provided over the range of S0 to S4. It is important to record where shotcrete is present and when it has been used to determine the support damage level.*
- 5) *Failure of rockbolt applies to failure of nut, plate, anchor or shank.*