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श्रम एवं रोजगार मंत्रालय

Ministry of Labour and Employment

खान सुरक्षा महानिदेशालय

Directorate General of Mines Safety



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DGMS (Tech.) (S&T) Circular No. 08 of 2016 Dhanbad, dated 03/05/2016

To

All Owners, Agents and Managers of Coal Mines

**Subject: Emergency Management Plan for Indian coal and metal mines**

Sir,

*Abbreviations - DGMS: Directorate General of Mines Safety; CIL: Coal India Limited; SCCL: Singareni Collieries Company Limited; CIMFR: Central Institute of Mining and Fuel Research; ISM: Indian School of Mines; MOIL: Manganese Ore India Limited; UCIL: Uranium Corporation of India Limited; HCL: Hindustan Copper Limited; HZL: Hindustan Zinc Limited; HINDALCO: Hindalco Industries Limited; SAIL: Steel Authority of India Limited.*

Regulation 199A of the Coal Mines Regulations'1957 & Regulation 190A of the Metalliferous Mines Regulations'1961 stipulates preparation of an emergency plan for every mine having workings belowground for use in time of emergency. The emergency plan shall incorporate provision for mock rehearsals at regular intervals.


Recently, a DGMS (Tech.) (S&T) Circular no.05 dated 2<sup>nd</sup> April 2016 was issued, detailing an integrated approach for development of Safety Management Plan for coal and metalliferous mines and also underlining the concept of emergency exercise.

On 22<sup>nd</sup> April 2016, a workshop on "Emergency Preparedness and Response System" was organized at DGMS, Dhanbad, for facilitating discussion and deliberations on recent developments in emergency management in mines and suggests inputs for drawing up a roadmap to effect a qualitative improvement in

the system in vogue. Eighty five mine safety & rescue experts from different stakeholders like CIL, SCCL, HCL, MOIL, HINDALCO, Tata Steel, SAIL, UCIL, ISM, CIMFR and DGMS participated in the workshop.

Based on the simulated emergency exercises conducted by DGMS and inputs gathered from the workshop, a guideline for developing emergency management plan for Indian coal and metal mines is enclosed as Appendix.

All Owners, Agents and Managers of coal & metalliferous mines are advised to ensure compliance with this circular.

  
(Rahul Guha)

Director General of Mines Safety

## **1. Introduction**

Scenario planning & Hypothesis testing exercise may be conducted to consider different hypothetical (but likely) scenario of mine emergencies vis-à-vis barriers to prevent, in the backdrop of risk assessment and initiated hazard control measures. Mine officials of neighboring mines with decent exposure to risk assessment process may be engaged to conduct the exercise with facilitation by experts.

During interaction sessions efforts would be made to search for solutions/controls of possible hazards and risks that may not have been previously identified.

One of the critical decisions to be made following an emergency is the classification of that event to initiate appropriate level of response. Often it has been observed that several events, some resulting in multi fatalities, could not be designated as emergencies promptly enough, thus critically delaying the initiation of appropriate responses. The management and control of any event, whether involving one or several persons, is always best controlled through an effective and automatic response plan initiated at the earliest possible time.

## **2. Trigger action response plan and emergency initiation protocol**

Regular inspections are to be made as per the established protocol to identify the possible sources of hazards and initiate remedial measures by activating mechanism of control/elimination. Taking due account of situations prevailing at mine site, 'Trigger Action Response Plans' (TARP's) and 'Emergency Initiation Protocols' (EIP's) need to be devised, for each level in the order of their seriousness and gravity.

## **3. Self rescue and aided rescue**

Objective evidence gathered during the course of conducting emergency exercises worldwide demonstrated that adoption of self-escape philosophy offers the best chance of survival to the underground personnel, when ably supported by an aided rescue strategy, which provides for external assistance to those persons unable to

reach a place of safety, unaided. Ingraining the philosophy, an action plan for formulation of an emergency management plan (EMP) has been illustrated in Figure -1 for Indian mines.

#### 4. Simulated emergency exercise

The structure of the simulated emergency exercise may be envisaged encompassing following features in view:

- Systematic and consistent with the concept of mutual assistance from other mines;
- Directly addresses the risks prevailing at the mine;
- Inclusive of external agencies such as mines rescue station, DGMS, senior company officials, district administration, medical services and media representatives;
- Incorporates an assessment and evaluation process;
- In tune with risk assessment principles to ensure that the exercises do not introduce new safety risks to persons at a mine

The main function of aided rescue is to provide external assistance to those work persons unable to reach a place of safety, on their own. The main features of an aided rescue protocol are furnished below:

- Incident management teams; formation thereof, placement of a code detailing roles, responsibilities and authorities of persons engaged in the exercise and inclusion of such details in duty cards, which are essential tools that act as critical memory prompts and provide a valuable recording and reporting function. It is also imperative to set up verifiable communication channels for accurate and timely flow of information, both on and off side.
- Control room set up; may include among others, the following:

Requisite facilities for recording and analysis of data; ready availability of external expert assistance of academic and research institutions; and, an

efficient electronic communication system for in-mine as well as external communication.

- Mine rescue organizations; essential features are:

Efficient management, manned by a team of dedicated and competent personnel. Comprehensive mine rescue protocols and guidelines need to be in place. A well coordinated and structured system of training and retraining of rescue personnel is a necessary component of any mine rescue management system.

### **5. Barriers to re-entry**

Initiation of a process of hazard analysis and risk assessment is an essential prerequisite to the event of re-entry. Thereafter, barriers to re-entry may be critically examined and evaluated and recovery be effected as per devised rescue protocols and guidelines.

### **6. Simulated emergency exercise at Coal Mine- A & Coal Mine- B**

Two emergency exercises were conducted at Coal Mine-A and Coal Mine-B to assess the emergency preparedness and response systems in Indian coal mines.

#### **6.1 Observations**

In general, all coal mine personnel were committed to the exercise and the underground workers participated fully and in good spirit under difficult circumstances. All workers reached places of safety in good time in Coal Mine - A, whereas 12 persons at Coal Mine - B could not. Samples of (a) exercise event log and (b) assessment data sheets are enclosed for reference.

The outcome of the exercise, summarized below, also very clearly underlined the fact that there are ample opportunities for inducing a qualitative and quantitative improvement in the existing scenario:

- ❖ Majority of work persons were not able to don their self rescuer's correctly;


- ❖ Little efforts were made by workmen to communicate their circumstances to surface;
- ❖ There were little deliberations/planning among the team members before commencing their evacuation, which resulted in non-adoption of defined order of travel, agreed route of travel, means to ensure they stayed together;
- ❖ Some teams had no gas monitoring equipment and others who possessed them, left the instruments in hurry while evacuating;
- ❖ The teams did not make any efforts to ascertain the atmospheric conditions and was not in a position to evaluate the degree of danger to which they are exposed even after donning the self rescuer's which was of 30 minutes duration;
- ❖ There was little, if any discernable ventilation flow to assist the teams in directional orientation;
- ❖ Escape ways were not maintained properly and contained numerous trip hazards & obstructions;
- ❖ In poor visibility, signs posted in primary escape ways were of little or no use;
- ❖ Alternative escape routes were not sign posted;
- ❖ Not all team leaders ( overman/mining sirdar ) were carrying hand plans;
- ❖ There was an urgent need for:
  - developing awareness among work persons about the hazards and implications of the underground mine fires;
  - training the work persons in the prevention and combat of underground mine fires;
- ❖ There was considerable under estimation of expected evacuation/travel times at Coal Mine - A;
- ❖ Fire fighting capabilities and resources available at Coal Mine - B needs urgent review; and
- ❖ The main rescue van was under repair and the backup rescue van was not in full standby mode at Coal Mine - A.

## 7. Recommendations

Based on the inferences drawn from the review of existing practices and conducted simulated emergency exercises, it is suggested that the following issues may be kept in perspective while formulating an emergency response management scheme:

- a) Consequent upon Risk assessment exercise, control measures may be formulated detailing responsibility of concerned mine officials with a protocol of implementation, to obviate the possibilities of dangerous occurrence in a coal mine.
- b) Scenario planning & hypothesis testing sessions may be conducted to search for possible solutions/controls of hazards and risks which may have not been previously identified:
- c) Details of ventilation net works with airflows and quantity may be incorporated in ventilation plan.
- d) A schedule of training and re-training need to be drawn up for all persons on the correct donning and wearing procedures for self rescuers.
- e) Use of gas chromatography equipment need to be considered for mine gas analysis purposes.
- f) Current standing orders be reviewed with a view to incorporate concepts like developing trigger action response plans to establish specific trigger points.
- g) Release of stink gas as a mode of emergency initiation protocol need to be considered to advise all work persons in the mine, particularly those without easy access to telecommunication system of an order of evacuation.
- h) Establishment of procedures detailing standard methods for deciding plans/options with work persons prior to evacuation, including routes of travel, modes of travel, order of travel, use of link lines, communications, signaling, etc.

- i) Primary and secondary escape routes be established and maintained. The escape ways may be fitted with guide ropes, clearly sign posted and facilities like fluorescent droppers, embossed printing be used to make them identifiable in poor visibility.
- j) In each working district, places need to be identified where workmen can gather in the event of an emergency. Such places are to be equipped with telephones, mine plans, link lines and blind -man walking sticks.
- k) Development of duty cards that individually detail the expected roles, responsibilities and authorities of all persons in charge of coordinating and/or controlling an emergency response, which may be kept at a number of designated places around the mine site.
- l) The construction of 'refuse chamber' need to be given a serious consideration to mitigate the hazards associated with extensive workings and steep gradient in coal mines like Coal Mine-B.
- m) A comprehensive re-training program may be put in place to raise the awareness of work persons on the circumstances to be expected in the vicinity of an underground fire. Additional training should be conducted on the options available to combat underground fires and the risks and hazards associated with each.

  
(Rahul Guha) 25.16

Director General of Mines Safety



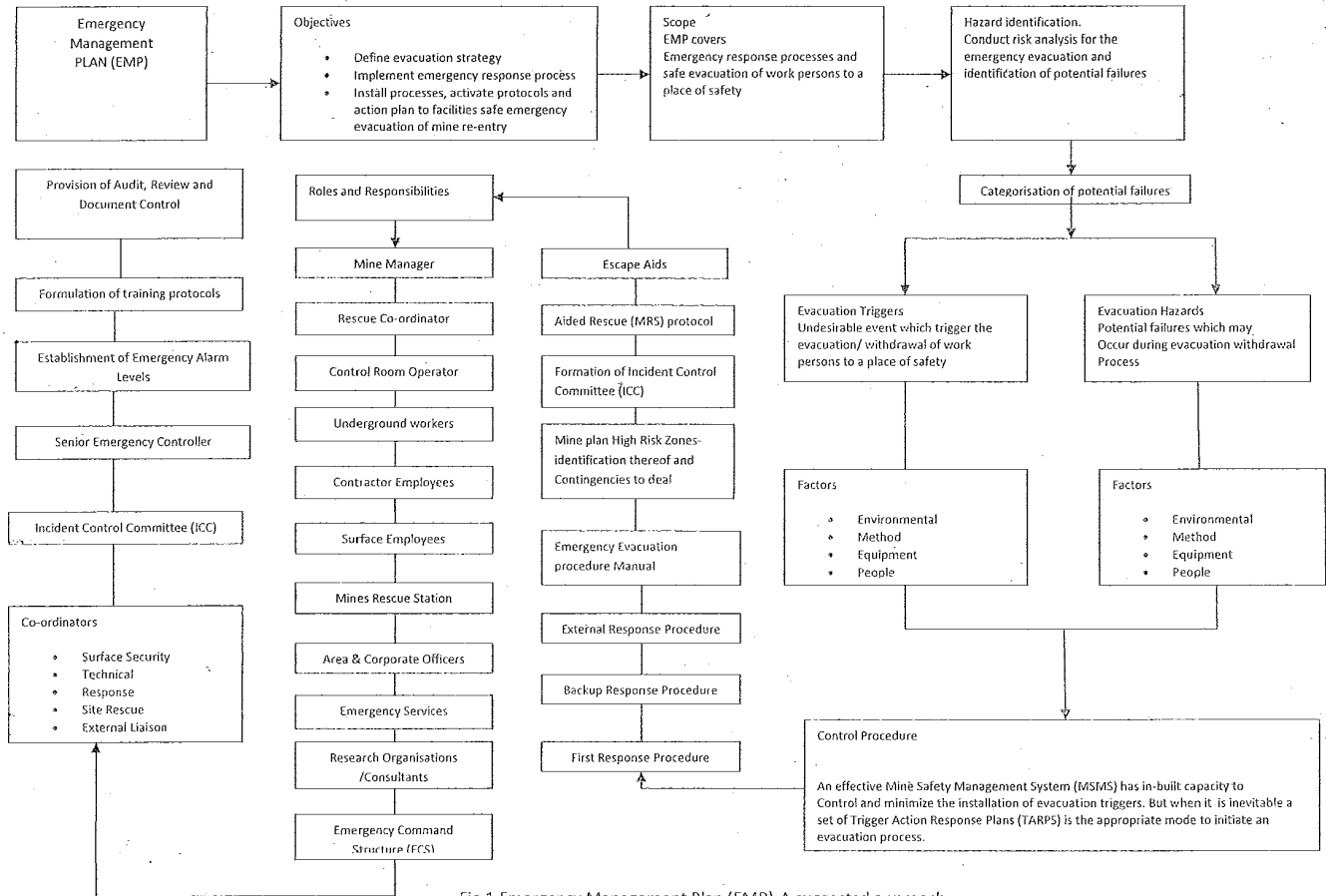


Fig.1 Emergency Management Plan (EMP)-A suggested approach

## SAMPLE EMERGENCY EXERCISE EVENT LOG

### Coal Mine – A

<b>START TIME</b>	<b>EVENTS</b>	<b>ELAPSED TIME</b>
11:40	Assessment team in lower Seam advise workers of thick choking smoke entering their workplace.	0:00
11:45	Assessment team in upper Seam advise workers of thick choking smoke entering their workplace.	0:05
11:50	Mine workers donned Self Rescuers and commenced evacuation.	0:10
11:54	Sirdar from Escaping team 1 advised surface of circumstances.	0:14
11:58	Acting Manager telephones Mines Rescue Brigade.	0:18
12:03	Escaping team 3 arrive at pit-bottom (shaft).	0:23
12:05	One worker each from Escaping teams 1 and 2 simulate collapse (unconscious) from carbon monoxide poisoning.	0:25
12:05	Escaping team 4 arrive at pit-bottom (shaft).	0:25
12:08	Mines Rescue Brigade ready to leave station – six persons, fully equipped.	0:28
12:09	Escaping teams 1 and 2 arrive at pit-bottom (shaft) and contact the Onsetter and the surface Banksman.  Escaping teams 1 & 2 demanded cage to complete evacuation to surface.	0:29
12:11	Escaping team 3 & 4 demanded cage to complete evacuation to surface.	
12:13	Ambulance arrives on surface.	0:33
12:15	Escaping team 1 & 2 arrived at surface Attendance Cabin.	0:35
12:30	Escaping team 3 & 4 arrived at surface Attendance Cabin.	
12:38	Exercise Terminated.	0:58

Coal Mine – A

Sample assessment sheet (Emergency evacuation): Team 4 at 35 Stopping, lower Seam

Assessors: Three officials (Coal company – one; International Expert-one; DGMS -one)

ELEMENT	PERFORMANCE CRITERIA	OBJECTIVE EVIDENCE SOUGHT	OBSERVATION
Information about the emergency circumstance to the Sirdar present at 35 stopping of lower seam.  [Information given by the Assessor at 11.45am.]	Thick Choking Smoke coming down intakes.	Recognition of changed circumstances.	# Mining Sirdar immediately stopped working and started evacuating. # Counted number of workmen present in the workplace. # Sirdar did not cross-check the information.
Mine workers to be notified by Sirdar about the incident.	<ul style="list-style-type: none"> <li>✦ All mine workers were notified and accounted for; and</li> <li>✦ Mine workers marshaled together.</li> </ul>	<ul style="list-style-type: none"> <li>✦ Location of outbye workers considered; and</li> <li>✦ Log times.</li> </ul>	<ul style="list-style-type: none"> <li># All Mine workers were located &amp; accounted for. They were marshaled together within 8 minutes.</li> <li># Efforts were not made to inform mine workers located in the outbye area.</li> </ul>
Mine atmosphere and evacuation strategy. [Assessor informed that: ✦ Canary birds were found unconscious; ✦ Nil methane observed, and ✦ Flame safety lamp still burning]	Understanding the situation and recognition of the risks while evacuation.	<ul style="list-style-type: none"> <li>✦ Ability to identify risks and chalk out evacuation plan accordingly;</li> <li>✦ Team discussion initiated by the leader to consider options for evacuation and decide route of travel; and</li> <li>✦ Use of devices and methods to assess the atmospheric condition while evacuation.</li> </ul>	<ul style="list-style-type: none"> <li># Lack of understanding displayed by Sirdar.</li> <li># No time logged while evacuating.</li> <li># Sirdar did not discuss about the options for safe evacuation and decided the route of evacuation.</li> <li># No briefing provided to crew by the Sirdar about expected route of travel, method of travel or method to ensure no-one is left behind.</li> <li># While evacuating, checking of atmospheric conditions by methanometer and flame safety lamp was not carried out by the Sirdar.</li> </ul>
Donning of Self Rescuers and its applicability under present circumstances.	<ul style="list-style-type: none"> <li>✦ Self rescuers fitted correctly; and</li> <li>✦ Fitted in sufficient time.</li> </ul>	Recognition of expected duration of evacuation vis-à-vis working life of self rescuers.	<ul style="list-style-type: none"> <li># Self rescuers donned in two minutes time. Three crew members put self rescuers on satisfactorily, and two crew members put head straps on over helmets.</li> <li># Life of self rescuer vis-à-vis travel time was not assessed by Sirdar before commencing evacuation.</li> </ul>
Incident Equipment.  [May be carried by workmen & Sirdar.]	What extra equipment is taken [Put smoke glasses on all crew members and one assessor.] [Supply blind man canes]	Record equipment taken	Sirdar carried methanometer and flame safety lamp.

Sirdar to contact Surface control on phone.	<ul style="list-style-type: none"> <li>✦ Describe circumstances;</li> <li>✦ Inform about number of workmen accounted for; and</li> <li>✦ Expected route of travel.</li> </ul>	<ul style="list-style-type: none"> <li>✦ Provide complete and correct information; and</li> <li>✦ Log times.</li> </ul>	Sirdar could not contact surface as no phone was available for the purpose.
Route of travel.  [To be decided by the Sirdar after studying the mine plan and deliberation with team members.]	<ul style="list-style-type: none"> <li>✦ Appropriate means decided;</li> <li>✦ All workmen traveled together;</li> <li>✦ Pace of travel appropriate;</li> <li>✦ Correct escape route was followed;</li> <li>✦ Use of blind-man canes; and</li> <li>✦ Use of link-lines</li> </ul>	<ul style="list-style-type: none"> <li>✦ Monitor and record significant incidents; and</li> <li>✦ Log times.</li> </ul>	<p># The team led by Sirdar commenced evacuation at 11.47 am.</p> <p># No discussion was held about method or route of travel.</p> <p># No discussion was held on order of travel i.e. who should lead – who to follow last, how to stick together.</p> <p># Lead person changed four times as team members walked past each other.</p> <p># Workers were acquainted with escape route.</p> <p># Speed of travel was satisfactory.</p> <p># Body contact between some workers was excellent – others walked on their own.</p> <p># Obstructions along escape route were navigated well.</p> <p># Contact with team members was maintained by "humming" through mouthpieces.</p>
Action at Pit bottom (shaft).	<ul style="list-style-type: none"> <li>✦ Contact made with On-setter; and</li> <li>✦ Contact made with Banksman/Surface officials.</li> </ul>	<ul style="list-style-type: none"> <li>✦ Correct Information passed on; and</li> <li>✦ Log times.</li> </ul>	The team established contact with onsetter at 12.34 pm, and thereafter made contact with Banksman /Officials present at the surface.
Actions on surface.	<ul style="list-style-type: none"> <li>✦ Contact made with attendance clerk; and</li> <li>✦ De-briefing.</li> </ul>	<ul style="list-style-type: none"> <li>✦ Accounting of workmen who exited the mine after emergency; and</li> <li>✦ Debriefing – record information sought and passed on.</li> </ul>	<p># Workmen led by Sirdar marked out and accounted for by the attendance clerk in the attendance register.</p> <p># Debriefing of Sirdar and team members were done by a team of assessors. While some team members exhibited a fair understanding, yet in general, there exist critical gaps in the implementation module of emergency preparedness and response system of the mine.</p>