

No.DGMS(Tech)(S&T) Circular No.13 of 2002 Dated, Dhanbad, the 31st December,2002.

To
The Owner Agent and Manager
of all mines.

Sub: Safety Management System – A guideline for implementation.

Sir,

You are aware the Ninth Conference on Safety in Mines recommended to adopt Risk Management as a tool for development of appropriate health & safety management systems in Indian mines. It was further suggested that the risk assessment exercise should follow an appropriate process.

The Science & Technology division of this Directorate conducted several workshops on 'Risk Management' in Indian mines with the assistance of experts from Australian International Mines Safety Training Co. Pvt. Ltd., under an Indo-Australian Aid Project. Drawing inputs from inferences drawn from the workshops and synthesizing the same with international recommended practices, a document on "Safety Management System – A guideline for implementation" has been prepared and enclosed as annexure – I Risk Management Plan, designed by the officials of a coal mine is given in the Annexure-II for understanding the actual process. **This is given as guide only and need to be tailored for specific requirements.**

You are requested to undertake a formal risk assessment process with the help of above guidelines. It should be followed by preparation of 'Risk Management Plans' and implementation thereof, aimed at reducing the likely hood and impact of mishaps of all kinds in Indian Mines.

Yours faithfully,

Chief Inspector of Mines

Encl: As above.

SAFETY MANAGEMENT SYSTEM – A GUIDELINE FOR IMPLEMENTATION

BACKGROUND

Indian Mining Industry makes a major contribution to the national economy and to the well being of the society as a whole. The country's mineral industry represents a unique mix of very small to medium to large mines. Currently there are 596 coalmines, 40 oil projects and a large number of non-coal mines with more than 6000 being in record under the Mines Act (however the figure is estimated to be much larger). Besides, there are innumerable small quarries restricted to shallow depth and employing a small number of persons that do not fall under the purview of the Mines Act. Total workforce of the mining industry in India consists of about one million. For the continuing viability and stability of the industry, it is important that full advantage be taken of developments in mining methods & procedures, modern machinery & equipments and advances in approaches to management of all mining activities, including health & safety.

While safety in any sphere of activities is important, it has special significance when the risk is greater. Unlike the major industries, mining has high potential risk of accidents. It has a dubious distinction of involving a very high actual hazard as the environment changes continually with the progress of work. It is, therefore, not possible for any external agency to ensure safety of any mine. The principal responsibility for the safety and good health of workers employed in mines rests with the management of that mine.

The present day environment demands to have a fresh look at *Safety Management* as a structured process composed of well defined systems that emphasises continuous improvement in work quality, health, welfare and productivity of workforce engaged in mineral industry through setting up of improved safety standards and their effective implementation and administration. Because the statutory provisions can never be fully comprehensive, appropriate and site specific and because the process of *Legislation Making* is often slow, these often trail behind the technological innovations. Trend, world over is, therefore, to make the statutory provisions 'Flexible' by switching over from the regime of '*Prescriptive Regulation*' to '*Self Regulatory or Goal Setting Legislation*'. It is now widely accepted world over that the concept of "*Risk management*" through "*Risk assessment*" contributes greatly

towards achieving these objectives. Considering the accident scenario in Indian Mining Industry, it has now become essential that risk assessment be undertaken of all hazardous operations, equipment and machinery, taking account of the procedures used, maintenance, supervision and management.

Introduction of risk management as a tool for development of good health and safety management system is a breakthrough in the traditional strategy as it differs from the existing one by involving the entire staff in the realization of safety improvement programme with responsibility and accountability sharing proportionate to the decisions making authority. The system is sure to be an effective tool for improvement of health and safety scenario in our mining industry. The Risk assessment process will identify all the existing and probable hazards in the work environment and in all operations, assess the risk levels of those hazards in order to prioritise which needs immediate attention for redressal, where maintenance of ongoing management will be sufficient and which are of very mild nature. Then for managing these risks, different *Mechanisms* (underlying causes) responsible for these hazards are identified and their control measures, set to timetable, are recorded pinpointing the responsibilities.

Further, the monitoring and auditing at regular interval recommended as a part of the system would ensure that safe operating procedure are followed, evaluated, corrected, standardised and documented training procedures for workers and executives are in place and are carried out regularly, and commitment to health and safety is demonstrated at all levels of organisation. On implementation of the system, an appropriate safety level in each stage of operation may be obtained by a systematic and documented management system with well-defined responsibility and accountability for safety among the mine employees.

GUIDELINES FOR IMPLEMENTATION

This guideline is structured in the following way:

- Objective,
- Structure (Strategic, Management, Operations)
- Processes for Hazard Identification & Risk Assessment
- Appendices.

1 OBJECTIVE OF THE GUIDELINE

This Guideline is to assist mines put a renewed focus on managing health and safety in their workplace.

The risk of various hazards arising in any mines ranges from almost zero to very high depending upon the deposit being worked, the complexity & size of mining operation as well as the conditions under which this is done and culture of the mines. Whilst many of these are mitigated by following Standards, the aim of this Guideline is to introduce new methods to assess and manage hazards in mines.

The Safety Management System established by a mine must ensure all risks are identified and critical risks are controlled to ensure long-term health and safety.

A Safety Management System should set the culture, framework and actions necessary to ensure that mining operations are carried out safely.

In order to turn these commonly agreed principals into an effective safety management system for the mine, the system may include the following elements: -

- Health & Safety Policy of the company and the mine
- Roles and Responsibilities of all levels in the organisation
- Specified competencies of staff
- Safety Committee, formation and role
- Method to identify and control high risk
- Forward Program to ensure actions to control hazards are carried out
- Emergency Preparedness to cope with a hazard if it should occur.
- Monitoring processes for all identified hazards with or without residual risks.
- Identification of trigger points and resultant actions if these are reached.
- Safety clearance for new equipment, work methods and materials used.
- Accident Statistics collection, analysis & actions
- Reporting and record keeping Requirements
- Auditing and review processes

2 STRUCTURE OF THE SAFETY MANAGEMENT SYSTEM

The basis for ensuring safe and healthy production depends primarily on: -

- Attitude of workforce at all levels
- Competent people
- Fit-for-purpose equipment
- Suitable work methods (or processes and procedures)
- Planned and controlled work environments

Good management will set standards to achieve these objectives and a suggested structure for the Safety Management System is summarised below and detailed in Sections 3 to 5.

2.1 Strategic Level

The following management strategies are required: -

- Development of organisation mission statement and policy, giving high regard to safety and production, strongly backed by management and owners.
- Have policies made by the organisation that ensures health and safety a critical element in all mining activities.
- Delegate organisational responsibility to appropriate levels.
- Institute formal structures and committees to discuss and implement safety improvements.
- Establishing and maintaining the Safety Management System

2.2 Management Level

Management is responsible to follow the strategic lead of the organisation by: -

- Implementing and managing site-specific Safety Management Plans.
- Identification of major hazards and assessment of risks
- Managing hazard reduction plans.
- Defining appropriate roles and responsibilities
- Having personnel with appropriate competencies for the work
- Having site-specific emergency processes in place and tested.
- Providing appropriate guidelines, directives and training.
- Operation of formal structures and committees

2.3 Operational Level

At operational level Managers/ Safety officers, workmen inspectors and workers should: -

- Assess risks associated with each step of all work
- Develop and maintain a Manual outlining worksafe standards and guidelines
- Ensure personnel are trained to a competent level for each work task
- Follow safe operational processes and procedures.
- Actively participate in safety committees and continuous improvement

3 STRATEGIC LEVEL

3.1 Health & Safety Policy

The Mine Health and Safety Policy is a statement by the organisation of its occupational health and safety philosophy and intentions. It provides a framework for action to achieve safety objectives and targets. The Policy should: -

- Provide a mission and vision of a healthy and safe work place
- Be inclusive and understood by everybody in the mine
- Provide management commitment for: -
 - A healthy and safe work place
 - Regular review of risks
 - Support for a Safety Management System (Safety Committee, Risk Assessment, Continuous Improvement etc)
- Carry the expectation that mine management, supervisory staff and work persons willingly comply with it.

3.2 Safety Management - Roles and Responsibilities

Ensuring the safety of a mining operation is a complex task requiring the continued commitment of all personnel associated with the mine, as well as compliance with all safety legislation, guidelines and circulars. The effective management of safety within a mine includes the following: -

- A sound Health & Safety Policy which is supported by all sectors of the mine
- Clear roles and responsibilities of all personnel for safety
- A safety management program and forward plan

- A safe work place design for jobs, equipment and materials
- Induction, training & continuous improvement of staff
- Hazard identification and control management
- Appropriate accident and emergency plans
- Effective accident / incident investigation and reporting
- Auditing of processes and outcomes against Policy
- Review of safety management plans

In the effective management of safety, all mine personnel have different roles to play but still have the same objective. They also share a duty of care to: -

- Provide a safe place of work
- Provide proper equipment and facilities
- Have and follow a safe system of work
- Have competent staff and employees
- Look after fellow workers
- Take appropriate precautions (eg. Use of Personal Protective Equipment)
- Raise safety issues and continuously improve
- Have appropriate emergency procedures

The roles of the following Key Staff in the Safety System should be clearly spelled out in the safety management system as well as in all the lower levels of the plan.

Owner, Agent, Manager, Supervisor, Safety Officer, Workman Inspector, Trade Union Representative, mechanic, operator, Worker, Contractor and Contractor Management, etc.

3.3 Safety Committee

The Safety Committee can have a significant role in effective Mine Safety Management. It contains representatives from all aspects of the mine, with a focus on ensuring and improving health and safety in the workplace. Whilst the committee's function is well defined in the Mines Rules, the Safety Plan needs to outline the operation of the Safety Committee to ensure committee members and the mines workforce are quite clear on its role, its responsibilities and objectives.

The types of areas to clarify are: -

- The members of the Committee & their roles
- Key Responsibilities of the Committee to: -

- Improving health and safety in the workplace
- Reviewing accident / incident reports & statistics
- Identify hazards & the review of action plans
- Meeting arrangements for sub-committees, if formed
- Implementing & managing the Plan (schedule of activities)
- Reporting responsibilities and notice boards

3.4 Overall Safety Management System and Plans.

Activity	Frequency	Role – Action
Management	Annually	Set and review Mine Health & Safety (H&S) policy
	Annually	Lay basis for Safety and Hazard Management Plans
	Annually	Arrange for internal/external audits
Regular Health and Safety meetings involving representation across the mine.	Annually	Review H & S policy set by Management
	Annually	Implement/manage Safety/Hazard Management Plans
	Annually	Create and manage the Safety Manual
	Annually	Establish high risk areas/issues in mine for review
	Annually	Set program & responsibility for the forthcoming year for hazard review and other issues (eg. training, job analysis, equipment assessment, etc.).
	Quarterly	Review/Participate in new Hazard examinations
	Monthly	Review actions completed against Action Plans; training achievements, work procedures etc
	Monthly	Review accident statistics and accident investigation, adverse incident analysis and make appropriate decisions
	Monthly	Conduct site inspections
	Monthly	Raise matters of H & S concern
	Monthly	Report against Safety and Hazard Management Plan
Special	Arrange special meetings as required	

4 MANAGEMENT LEVEL

4.1 Hazard Identification & Risk Management

The management of the mine should conduct a risk assessment process to identify any hazard that could influence the safety and health of workers of the mine.

For all hazards that pose a potential chance of multiple fatalities at one time and are not fully controlled, a *Hazard Management Plan* must be drawn up.

To operate mines safely all hazards must be quickly identified and controlled. Using a risk ranking process can assist mine staff to identify the highest risk hazards for attention. This process is summarised below and detailed in Section 7.

- Identify hazards
- Assess the risks posed by these hazards (risk ranking)
- Control or treat hazards to reduce unsafe or unhealthy situations

This technique should be used to assist effective management of safety in the workplace within the Safety Management Plan.

It should be noted that Hazard Identification and Risk Assessment should not be considered to be a once off occurrence but should be done at regular intervals to ensure that the plans to cope with the identified hazards are pertinent and up to date.

4.2 Safety Management Plans.

The Safety Management Plan is a working document, which outlines all of the actions to be carried out to ensure the safety and health at the work place. This document is fundamental to the management of safety by the Health and Safety Committee and Management. The sort of issues which should be addressed in the Safety Management Plan include: -

- Important committee or safety related meeting dates
- Dates to review policies, manual or work procedures
- Dates required for major hazard analyses to be completed
- Outcomes or actions following review of hazards, accidents or statistics
- Actions, dates and responsibilities to complete agreed actions
- Achievement of actions

4.3 Safety Manual

Accompanying the Safety Management Plan should be a Safety Manual. This manual would outline the operational procedures to comply with the overall and specific hazard management plans.

It is the document that would be available to all workers on site and should enable them to be aware of not only the framework within which they have to do their work but also what is expected from them to ensure a safe and healthy work environment. It could contain: -

- Relevant Acts, Regulations and Circulars
- Emergency Procedures
- Standing Orders
- Individual Job Procedures
- Process for introducing new methods, equipment or materials etc.
- Training Requirements
- Hazard Identification and Risk Management Process
- Safety Management Forms (accident investigation, hazard analysis, reporting etc.)
- Medical examinations
- Entitlements for employees injured or suffering health impacts at the mine

5 OPERATIONAL LEVEL

Operational processes and safe operating procedures need to be made to suit the site-specific conditions of the mine. These need to be simple and clear whilst meeting the requirements of legislation, regulations, Mine Standing Orders and recognise Hazards associated with that work. These operating procedures must form the basis for training and competency assessment of mine operators.

Typically, safe-operating procedures would be required for the following areas: -

- Work associated with each step of the mine production and maintenance
- Roof Support methods and rules
- Explosives transport, storage, handling and usage
- Ore handling, storage and transport
- Traffic rules and safety on haul roads
- Rules for operating equipment

- Usage of Personal Protective Equipment and critical spots in the mine for dust, noise, heat, vibration, Illumination etc.
- Inspections, supervisions and daily reporting requirements.
- Emergencies.
- Housekeeping rules.

The safety management system should at all time be such that it promotes a process of **continuous improvement**.

Because of their status and immediacy to the job, Managers and Supervisors have a key safety role in the mine to ensure: -

- The work environment is safe for workers
- Planned work methods are safe & followed
- All accidents & near misses are investigated
- Workers are competent & know their duties
- Adequate reporting on shift change-over occur

6 HAZARD IDENTIFICATION & RISK ASSESSMENT

6.1 Definitions

Hazard: Source of potential harm, injury or loss.

Risk: combination of the likelihood of a specific unwanted event and the potential consequences if it should occur.

Risk Assessment: Is a process that involves measurement of risk to determine priorities and to enable identification of appropriate level of risk treatment (used also to describe the overall process of risk management).

Risk Control: Implementation of strategies to prevent or control hazards.

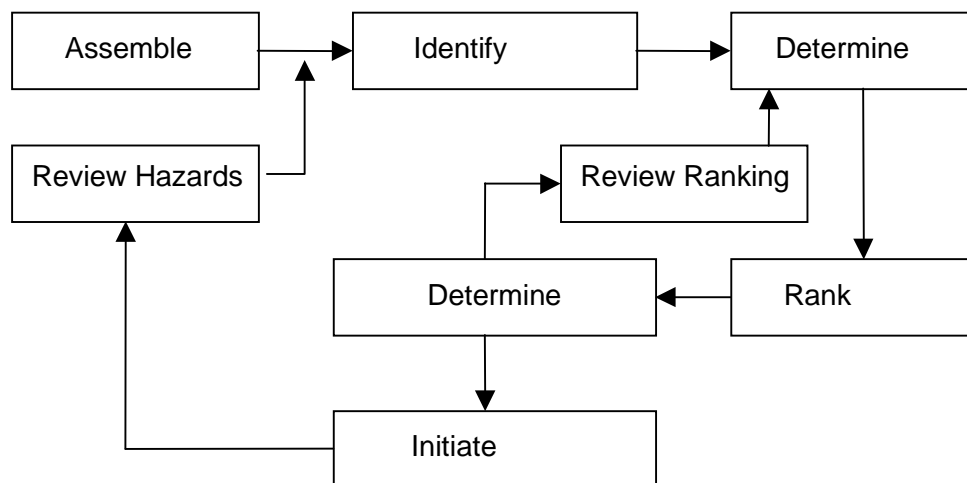
Risk Rating: The category or level of risk assigned following risk assessment (eg. High, Medium, Low etc.)

Risk Management: Overall description of the steps taken to manage risk, by identifying hazards and implementing controls in the workplace

6.2 Risk Assessment Process

Risk assessment is to be performed on a regular basis. The goal for each risk assessment session is to identify hazards, determine risk ratings and controls, and to review the implementation of risk controls from previous risk assessment sessions.

The following workflow diagram illustrates the areas involved in performing a risk assessment session.



6.2.1 Assemble the Team

A team approach is recommended to establish hazards in the workplace. It is best to use a vertical wedge of employees (eg. manager, engineer, safety officer, supervisor, worker) as well as workers from different aspects of the operation to provide different perspectives on views, likelihood, consequence and controls that are both practical feasible and cost effective. The members of the team should be varied from session to session to gain a broad perspective of the hazards across a site.

6.2.2 Identifying the Hazards

The process of identifying hazards is possibly the most important part of the whole risk assessment process. This can be done in many ways but the objective is to ensure that all of the possible hazards are identified.

Hazards are only discounted when they have been assessed not to pose a risk. Until that is done all possible hazards should be identified and noted down.

Normally the best process is to proceed step by step through a task. A number of other processes can also be utilised: -

- Previous experience of accidents or occurrences on the mine.
- Work process evaluation

- Consultation with employees who may have experience in the job
- Off-site specialists with experience at other mine sites (consultants).
- Fault tree analysis to determine underlying issues and hazards that might not be evident at first glance.
- Safety statistics for this or other mines.
- Significant incident, near miss or accident reports
- Inspections in the mine

Another method is to consider the hazards that could occur from an unwanted release of energy (eg. Mechanical, Electrical, Gravity, Fluids or air, Chemical, Nuclear, Heat, Light, Noise)

Decide how to divide up the workplace, e.g.: -

- By activities (or processes) e.g.drilling & blasting, load and haul, crushing;
- By equipment, machinery e.g. mobile plant, trucks, conveyors, crushers;
- By geographical areas e.g. pit, compound, workshop;
- By specific job activity;

Look at specific issues and jobs. Break processes up into nodes. Examine each node independently and look at failure modes or things that can go wrong for each node. Examine accident-prone jobs or situations. Carry out a brainstorming exercise and visit the site. Identify all hazards. Hazards will be identified that are likely or less likely, have major and minor impact and importance. At this stage collect do not exclude ideas, be defensive or squash potential hazards that are raised. Record findings.

Notwithstanding whichever method is used for the identification of the hazards, they should all be noted down so that a record of their existence is kept. This can be used to save time and effort when further rounds of risk assessment are being done. Simple forms are provided in the Appendix for use.

There should also be a mechanism for reporting of hazards by staff as they are found which is separate from the formal risk assessment process. Hazards to be recorded before staff forgets about potential hazards, or are not selected for the risk assessment team.

6.2.3 Assessment of the Risk & Ranking

Objectives of risk ranking are to: -

- Identify which risks are most in need of attention, and the options for achieving that risk reduction

- Identify which risks need careful ongoing management, the nature of the ongoing management as well as the indicators that show that the risk is being managed.
- Identify triggers which might be used to monitor that hazard and initiate remedial action if elimination is not feasible

The process of Risk Ranking is carried out by considering both the Likelihood of the occurrence of each Hazard and the potential Consequence should the Hazard occur. Each can be estimated or calculated by engineering principles. This will enable the risk ranking to be carried out. Risks are ranked according to the level of risk i.e. the highest risk to the lowest risk. It is important that the risks are ranked to identify those requiring immediate attention and maximise benefits from the efforts.

The risk of any hazard is dependent upon the chance that it will occur (likelihood) and the impact of an occurrence (consequence): -

Risk Score = Likelihood x Consequence

Consequence is the size of the loss or damage. In terms of health and safety, it is the degree of harm that could be caused to people exposed to the hazard, the potential severity of injuries or ill health and / or the number of people who could be potentially affected. It should be remembered that consequence of a hazard need not only be in terms of safety criteria but could also be in terms of a money loss, incurred costs, loss of production, environmental impacts as well as public outrage.

Likelihood is the chance that the hazard might occur.

In some cases personnel are only exposed to the hazard for part of the time. A more detailed analysis can be carried out of the Risk Ranking by taking this into consideration. Replacing Likelihood by Exposure (% time personnel are present) and Probability (chance that they will be harmed).

Risk score = Probability x Exposure x Consequence

The values used for Likelihood, Consequence, Exposure or Probability need to be agreed by the risk assessment team.

Risk ranking can be determined by qualitative and quantitative means. It should however be remembered that none of these methods are best. The best choice of method will depend on the circumstances and preferences at the mine at the time the exercise is done. However regardless of the method establishing Risk Ranking will set priorities for Hazard control. The most important purpose in Hazard Identification, Risk Assessment and Ranking is to draw up and implement plans to control these hazards. However, Keeping the acceptance of the participants during workshops conducted at different mines, a criteria table for Quantitative Risk ranking is given in Section 7.

These plans are then included in the Safety Management Plan.

6.2.4 Treatment Controls and Action Plans

Examine the high priority risks. Consider the potential to reduce or eliminate the risk by using the hierarchy of controls. This assists establishing methods to reduce the risk. From experience, the effectiveness of each method is given as a percentage after each of the control descriptions.

Elimination: Remove step to eliminate the hazard completely (100%)

Substitution: Replace with less hazardous material, substance or process (75%)

Separation: Isolate hazard from person by guarding, space or time separation (50%)

Administration: Adjusting the time or conditions of risk exposures (30%)

Training: Improving skills making tasks less hazardous to persons involved (20%)

Personal protective equipment: Used as the last resort, appropriately designed and properly fitted equipment where other controls are not practicable (5%).

Control measures can reduce either the Likelihood or Consequence of the event or both. Depending on the level of reduction of the hazard there could still be a residual risk that needs to be monitored so that a secondary prevention process can be initiated when trigger points are reached.

The team should develop an action plan recommending actions, responsibilities and when it should be completed. Put forward to decision-making authority and review if necessary. Make a decision to proceed.

Allocate tasks, monitor progress. Review implementation effectiveness and determine if other hazards have been created. Pursue continuous improvement.

A number of forms are included for carrying out this activity. Alternatively, the use of software tools will enable the recording of controls and allocation of responsibility for controls. Whichever method is used it should be formalised and controlled periodically.

6.3 Induction, Training & Continuous Improvement

Each mine will have training programs for employees, which need to be reviewed against safety criteria. The updating of training requirements should include re-training of existing personnel to the new skill level. This can be performed on-the-job. When the new skill, procedure, etc. has been taught to an individual and they have been assessed to have achieved that Competency, this should be recorded. This allows the mine to track staffs that are qualified to perform particular tasks. In some instances, staff should be prevented performing tasks until they have been correctly trained in new procedures and are considered competent to perform a task safely.

6.4 Accident / Incident Reporting & Investigation

This would be a Standing Order to ensure compliance with Regulations and to inform mine personnel of responsibilities and reporting requirements. It should cover: -

- Responsibility of those on the site
- Immediate response and Emergency backup
- Notifying key staff of accident
- Securing the site
- Treatment of any injuries
- Investigation and Reporting
- Review of any recommendations and determining actions

6.5 Auditing & Review/Revise

Reviewing the effectiveness of programs within the Safety Management Plan. This should be an on-going process. This should show whether policies, Regulations and expectations are being met or where systems can be made more effective. Both internal and external audits should be considered. Auditors need training to be objective and independent. Management Team or the Health and Safety Committee would have to decide how often would audits be done, what systems or areas would be audited and reporting arrangements.

7 PROCESS

Using the equations in Section 6.2.3 the following values can be used to calculate Risk Score for a Hazard.

Risk score = Consequence x Likelihood

Risk score = Consequence x Probability x Exposure

Scale for consequence.

- | | |
|--|--------|
| • Several dead | 5 |
| • One dead | 1 |
| • Significant chance of fatality | 0.3 |
| • One permanent disability/
less chance of fatality | 0.1 |
| • Many lost time injuries | 0.01 |
| • One lost time injury | 0.001 |
| • Small injury | 0.0001 |

Scale for exposure

- | | |
|--------------|----|
| • Continuous | 10 |
|--------------|----|

- Frequent (daily) 5
- Seldom (Weekly) 3
- Unusual (Monthly) 2.5
- Occasional (Yearly) 2
- Once in 5 years 1.5
- Once in 10 years 0.5
- Once in 100 years 0.02

Scale for probability

- May well be expected 10
- Quite possible 7
- Unusual but possible 3
- Only remotely possible 2
- Conceivable but unlikely 1
- Practically impossible 0.5
- Virtually impossible 0.1

8. CONCLUSION

Management of safety issues based on assessment of risks not only integrates safety with productivity but also can be used as a very good tool for reduction of costs. The systems stand on the premise that all risks need not be eliminated and different control measures can be adopted for different levels of risks. The key here is to aim for ALARA (as low as reasonably achievable), which eventually depends on cost considerations. The system allows prioritisation of allocation of scarce resources thereby cutting costs and reducing wastages. This assumes great importance in the current Indian scenario.

The other merits of the system are that it is created by the mine operators themselves through considerable brainstorming. This approach let the mine operators/users feel ownership of the system, something that is not cast upon them by experts, Govt. agencies or outsiders, and hence chances of successful implementation is much more. In this system, grey areas are minimized; responsibilities for action are pinpointed and scopes for auditing and improvements are always present.

For conveniences of the mine operators different forms for risk assessment, its control and audit is enclosed in Annexure-I. A Risk Management Plan, designed by the officials of a coal mine is given in the Annexure-II for understanding the actual process. **This is given as guide only and need to be tailored for specific requirements.**