

# **SAFETY RISK ANALYSIS AND MANAGEMENT TECHNIQUES IN COAL MINES**

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## **Introduction**

Risk assessment and risk management is inherently about the management of unplanned events. Unplanned events which occur on a mine site have the potential to impact on the viability of a mine. The process of assessing and managing these risks is aimed at reducing the likelihood that these negative events will occur and increasing the likelihood that positive outcomes will be realized. In the 11<sup>th</sup> Safety Conference held on 4<sup>th</sup> & 5<sup>th</sup> July, 2013 at New Delhi, DGMS recommended that every mine should employ a sound risk analysis process, should conduct risk assessment, and should develop a safety management plan to address the significant hazards identified by the analysis/assessment.

Risk analysis and assessment techniques are classified into three main categories: (a) the qualitative, (b) the quantitative, and (c) the hybrid techniques (qualitative-quantitative, semi-quantitative).

## **Qualitative and Quantitative Risk Analysis Techniques**

The different qualitative techniques used for risk assessment are: Checklists, What-if-analysis, Safety Audits, Task Analysis (TA), The Sequentially Timed Event Plotting (STEP) technique and The HAZOP method (Hazard and Operability study) etc. , The different Quantitative Techniques include: The proportional risk-assessment (PRAT) technique, The decision matrix risk-assessment (DMRA) technique and The QRA (Quantitative Risk-Assessment)..

## **Hybrid Risk Analysis Techniques**

These are: Fault-tree analysis (FTA) and the ETA method (Event Tree Analysis). FTA is an analysis technique that visually models how logical relationships between equipment failures, human errors, and external events can combine to cause specific accidents. Fault trees are constructed from events and gates.

**Table 1. The decision matrix risk-assessment technique: The risk matrix**

Severity of consequences ratings (S)	Hazard probability ratings (P)					
6	36	30	24	18	12	6
5	30	25	20	15	10	5
4	24	20	16	12	8	4
3	18	15	12	9	6	3
2	12	10	8	6	4	2
1	6	5	4	3	2	1

### HAZOP

The HAZOP analysis technique uses a systematic process to identify possible deviations from normal operations and Ensure that appropriate safeguards are in place to help prevent accidents (Table 2).

**Table 2. HAZOP Worksheet for Conveyor belt**

Conveyor Belt		Team Members:			Date:
Parameter	Guide Word	Consequence	Cause	Risk	Recommendation
Flow	Zero Flow/ Empty	Clean-up. Damage to adjacent equipment	Spillage from conveyors	Occasionally Critical	Provide a cover around the conveyor to prevent any spilt Coal damaging other equipment
Temperature	Zero Flow/ Empty	Conveyor belt fire with toxic products of combustion potentially smoke logging the building	Friction, e.g. from coal stuck on belt	Catastrophic	Include in the fire safety study assessment of belts fires and the risk to emergency responders
Electricity	No	Loss of power to operate system components	Power grid loss; circuit breaker trip	Remotely Critical	Provide source of emergency backup power
Electricity	More	Trips circuit breakers	Power Surge	Remotely Critical	Provide for fault detection and isolation
Electricity	Less	Insufficient power to adequately operate system components	Power grid fault	Occasionally critical	Provide source of emergency backup power

## SAFETY RISK MANAGEMENT

A Safety Management System (SMS) consists of comprehensive sets of policies, procedures and practices designed to ensure that barriers to unwanted incidents are in place, in use and are effective. An integrated SMS focuses on both the traditional OHS area and on management of engineering safety. The SMS tends to integrate all aspects of safety into the ongoing activities of everyone involved in the operations—from the operator to the chief executive officer. The responsibility for safety is both individual and collective. The process of risk management is shown in Fig. 1.

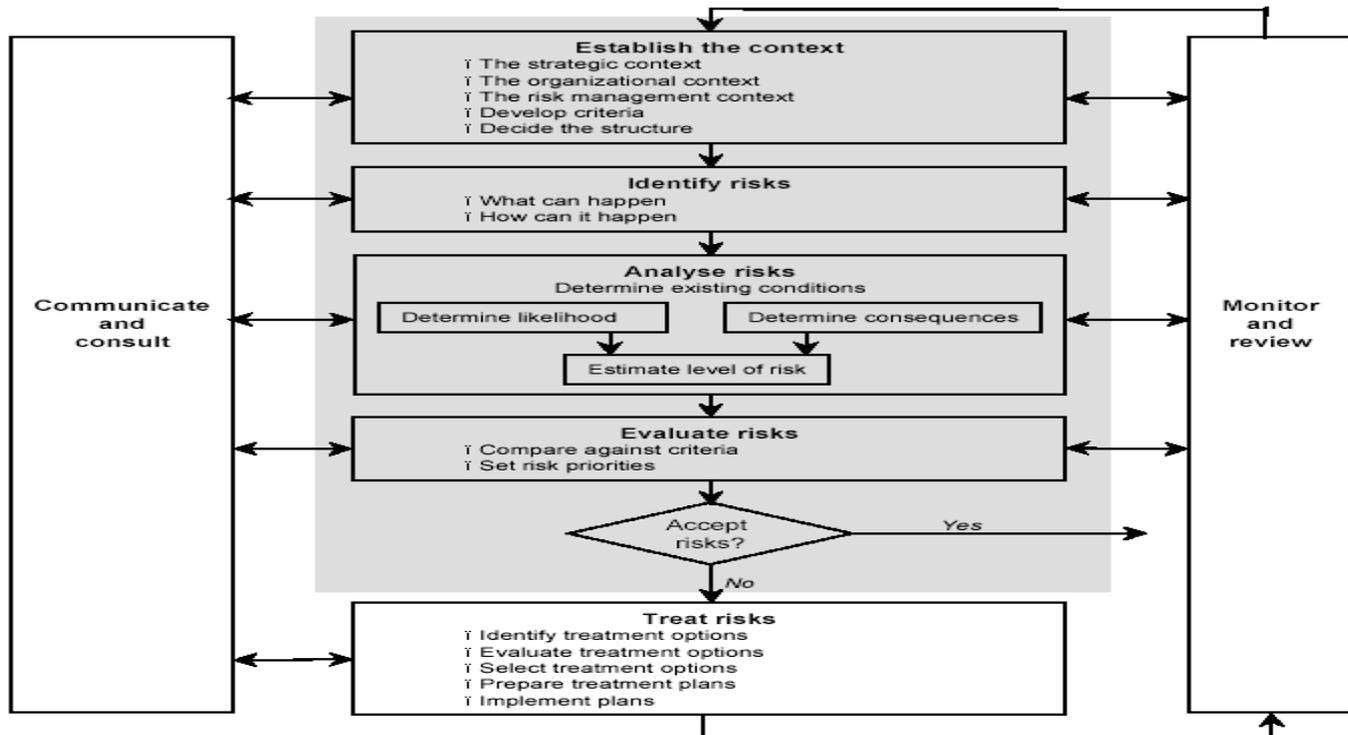


Fig.1.Safety Management System

### Conclusion

Safety and environmental risk assessment is sine quo non for ensuring mine and miners safe .It is necessary to assess the risk from different mining operations and take cost effective suitable measures to prevent, eliminate and minimize risk. Both qualitative and quantitative risk approaches can be followed to assess the risk level. Risk analysis techniques like FTA, ETA and HAZOP etc can be used as tools as study and understanding the risk levels more effectively and can aid in risk prevention and control.