Risk Assessment and Disaster Management Plan in Chasnala Coal Mine

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Abstract

From the time coal was first mined there have been difficulties. How to support the roof, getting fresh air to the face, mining economically, transporting the coal, seam gases dilution, fires prevention, coal dust problem, explosive outbursts, spontaneous combustion, collapse of overburden etc. Disaster in general is an event or series of event, which gives rise to casualties and damage or loss of life, properties, environment on such a scale which is beyond the normal capacity of the affected community to cope with. Disaster is also sometimes described as a “catastrophic situation in which the normal pattern of life or eco-system has been disrupted and extra –ordinary emergency interventions are required to save and preserve lives and environment”. A mining disaster is defined as “accident with 10 or more fatalities”. However, it may also be defined as “an unexpected, sudden occurrence, including in particular a major emission of gas, fire, explosion or inundation, resulting from abnormal developments in course of mining activity, leading to a serious dangers to workers, public or the environment, whether immediate or delayed, inside or outside the mine or involving one or more hazardous substances”. There may also be an emergency which may not cause loss of life, but may result in trapping of workers, or affecting persons requiring emergency actions as in case of a disaster. These incidents have potentials of a disaster in the mine. With these concepts in the background, the present study has been carried out in context with the Chasnalla Group of Mines, ISP, and SAIL.

Keywords: Disaster, catastrophic, inundation, hazardous, explosive, spontaneous combustion

I. INTRODUCTION

Mining and allied activities are associated with several potential hazards both to the employees and the public at large [1]. A worker in a mine should be able to work under conditions that are adequately safe and healthy. At the same time the environmental conditions should be such as not to impair his working efficiency. The various safeguards to be taken to ensure the safety of the mine and that of employees are provided in the Mines Act, 1952 [2].

Chasnalla Block lies in the South Eastern extremity of Jharia Coalfield (JCF) in the Dhanbad district of Jharkhand state. It covers an area of 4.5 Km². The area is roughly defined by north latitudes 23°38’25” and 23°40’00” and East longitudes 86°27’12” & 86°29’15”’. It is included in the survey of India Topo sheet no.73 I/6 and in Sheet No.8 of the geological map of JCF. Figure 1 shows the regional location of the area. This Block is located about 15 km from Jharia town and about 23 km from Dhanbad town. Dhanbad - Sindri Road passes through its northern boundary.

Mining and allied activities are associated with several potential hazards to both the employees and the public at large [3]. A worker in a mine should be able to work under conditions, which are adequately safe and healthy [4]. At the same time the environmental conditions should be such as not to impair his working efficiency [5]. This is possible only when there is adequate safety in opencast mines. Hence, mine safety is one of the most essential aspects of any working mine. Indeed, safety of the mine and the employees care of by the Mines Act. 1952. So, it is essential to carried out a detailed study covering identification and assessment of risk and recommendation of the measures to prevent damage to life and property against such risks [6]. There are various factors, which can create disaster in mine [7] & [8]. These hazards are as follows:

1) Blasting
2) Rock burst
3) Overburden failure/sliding
4) Heavy machinery
The mining activity has several disaster prone areas. A check list depicting likely disaster events due to the mining activity is presented in Table 1.

Table - 1
Check list for likely disaster in Open cast mine

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Activities</th>
<th>Human Risk</th>
<th>Ecological Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Severe</td>
<td>Non Severe</td>
</tr>
<tr>
<td>1.</td>
<td>Drilling and Blasting</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2.</td>
<td>Extraction of coal</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3.</td>
<td>Removal of Overburden and storage</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4.</td>
<td>Transportation of coal</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>5.</td>
<td>Use of Machinery</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>6.</td>
<td>Drilling and development work</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

A. Blasting:
Most of the accidents from blasting occur due to the projectiles, as they may sometimes go even beyond the danger zone, mainly due to overcharging of the shot-holes as a result of certain special features of the local ground. Fly rocks are encountered during initial and final blasting operations. Vibrations also lead to displacement of adjoining areas. Dust and noise problems are commonly encountered during blasting operations.

B. Rock burst:
A rock burst or bump in mine is a sudden and violent failure or collapse of the rock in situ under stresses greater than it can normally withstand and on a scale sufficient to cause material damage to endanger the safety of the workers.

C. Land Sliding in Overburden Dump and Mine Pit
The high overburden dumps may cause land slides. High overburden dumps created at the quarry edge may cause sliding of the overburden dump or may cause failure of the pit slope due to excessive loading, thereby causing loss of life and property. Siltation of surface water may also cause runoff from overburden dumps.

D. Heavy Machinery
Most of the accidents during transport of dumpers, trucks and other heavy vehicles are often attributable to mechanical failures, in which the factor of human errors cannot be ruled out.
II. MEASURES ADOPTED FOR DISASTER MANAGEMENT

A. Measures to Avoid Accidents Due to Blasting:
1) Shots shall not be fired except during the hours of day light or until adequate provision is made of artificial light; then the holes charged on any particular day shall be fired on the same day.
2) Shots, if fired after hours of day light should be muffled so that the flying fragments from the blasting material do not project beyond a distance of 10 meters from the place of blasting.
3) Adequate blasting shelters or other protection shall be provided at all times.
4) The shot fired shall give sufficient warning by effective signals over the entire area falling within a radius of danger zone.
5) If a single shot exploder is used or if blasting is done with ordinary detonator the shot-firer shall not fire more than sixty shots in one shift, but if multishot exploder is used the number can be one hundred and twenty.
6) During the approach and progress of electrical storm, adequate precautions shall be taken.
7) No shot hole shall be drilled in the overburden above the underground galleries.

Blasting shall be carried out as per the provisions contained in the Circulars issued by the Directorate General of Mines Safety (DGMS). When the quarry face reaches near surface features (roads, etc.) controlled blasting shall be adopted after due trial and with the approval of the Directorate General of Mines Safety to avoid danger of fly rock and vibration.

B. Measures to Prevent the Danger of Overburden:
1) A sturdy stone wall should be built around the toe of each active dump at a distance of about 50 m from the toe.
2) To prevent the failure of overburden slopes, especially during rainy season, following precautions need to be taken against this hazard:
   1) Proper terracing of the dump slopes, with maximum bench height of 30 meters,
   2) In flat areas where the dumping operations have come to an end, the slope angle should be flattened by about 50 lower than the angle of repose which varies from site to site but it is generally expected to be around 25°.
   3) Planting vegetation as early as possible over the overburden dump slopes.
   4) The drainage channels along the overburden dump toe provide additional protection.
   5) While doing this, a distance of over 15 m should be left between the overburden dump and the bench, and
   6) If the mine is abandoned, the bench and overburden dump should be separated from each other by digging a trench of 6 to 10 m width.

C. Measures to Prevent Accidents due to Trucks and Dumpers:
1) All transportation within the main working should be carried out directly under the supervision and control of the management.
2) The vehicles must be maintained in good repairs and checked thoroughly at least once a week by the competent person authorized for the purpose by the Management,
3) Road signs should be provided at each and every turning point specially for the guidance of the drivers at the night,
4) To avoid danger while reversing the trackless vehicles especially at the embankment and tipping points, all areas for reversing of lorries should as far as possible be made man free, and
5) A statutory provision of the fences, constant education, training etc. will go a long way in reducing the incidents of such accidents.
6) Haul tracks should be oriented essentially perpendicular to the bream, while unloading.
7) Generally, oversize rocks should be dealt with in the pit by secondary blasting. Load consisting of large rocks must not be carried to the edge. This is unsafe and may damage equipment. Such load must be dump in side and pushed over the edge by dozers (Figure 2).
8) Dumping of overburden or waste material by dumpers and dozers should follow certain general precautions. A typical dump platform is illustrated in Figure 3.
D. Measures for Dump Management and Stabilisation:

The dump slopes being constituted of loose soil and rock are prone to serious erosion during heavy rains and suffer from weathering if left exposed which may lead to skin type failure. The protection of slope surface reduces the gully formation, the surface erosion and chances of skin failure, thereby increasing the stability of dumps. If necessary, the following or any other measures determined by the Civil Engineer may be implemented.

1) In the construction of dump, care must be taken to ensure that there is no impoundment of water on the dump top surface after the rains. Such impoundment of water is highly detrimental to the dump stability as the water will slowly enter the dump and when dried may lead to formation of tension, cracks and sometimes adversely affecting the frictional parameters of the dump material resulting in decrease in the dump stability. To avoid such situation, a proper drainage of the dump top surface in necessary. The system requires that the dump top is uniformly graded and sloped for easy flow of water and number of drains at suitable intervals is maintained to collect and take away the water from dump top surface.

2) In addition, it is necessary to have a full drainage system to prevent water standing on or uphill of the dump and to transmit that water away from the dump. It may include cut off drains at the top of the slope to reduce erosion and possibly some monitoring system on high dumps.

3) Ring dumping to provide intermediate benches and to reduce length of slopes

4) Regarding to reduce slope angle

5) Benching either formed during dumping or subsequently

6) Installation of pack walls or other hand terracing
All new dumps should be designed by competent Civil Engineers experienced in the type of work involved. A uniform slope of 28 degrees is not appropriate for conditions in India and should not therefore be rigidly applied to all the mines. All slopes should be individually designed to suit site conditions in accordance with good engineering practices and the need for biological restoration. It is, therefore, suggested that at the proposed project before formation of dumps, all the above stated recommendations should be taken into account and necessary actions to be taken accordingly.

### III. SAFETY MEASURES

All prevailing statutory provisions applicable to the opencast mines are to be strictly adhering. To prevent danger due to inrush of water during rainy season to open pit, garland drain to should be made all around each quarry so as to divert storm water into seasonal nalla. Moreover, adequate pumping capacity shall be provided to deal with peak rainfall. Fire fighting organization along with emergency organization, etc. as per the DGMS’s Circular shall be maintained at the mine during its operation. The Standing Orders shall be framed and regular mock rehearsal shall be carried out to keep the mine personnel up-to-date for dealing with any eventuality. During day to day operation, model traffic rules shall be followed to avoid any road accident due to movement of HEMM. An efficient communication system shall be maintained within the mine premises so that immediate action can be taken in case of emergency.

### IV. MAINTENANCE FACILITIES

A well-equipped workshop shall be maintained to carry out day to day maintenance job so as to avoid the failures of HEMM.

### V. MEDICAL AID

Well-equipped First Aid Centre with trained personnel shall have to be maintained to deal with medical emergency arising due to accident. No occupational health hazard is anticipated during opencast operations. However, an ambulance has been provided in
the Project Report for providing emergency medical services. Periodical Medical Examination for the workmen exposed to dusty environment in the mines shall be carried out at fixed intervals by rotation so as to identify the effected person.

VI. OTHER MEASURES

Emergency organization in respect of dangers from inundation (for surface and underground mines), coal dust explosion in underground mine, fire (in surface and underground mien) shall be maintained in the mine. Standing order specifying the duties and responsibilities of key personnel in each case shall be maintained and displayed at strategic locations for awareness among mine personnel. Mock rehearsal etc. shall be carried out. Adequate number of persons shall be trained in rescue and recovery work and they should be given accommodation near the mine with communication facilities so that they can be contacted immediately in case of emergency.

Some of the unavoidable measures listed below are more practicable and should be ensured to get fulfilled:

A plan has to be drawn in advance to tackle the situation.
1) A number of employees and executives have to be trained in the Risk Management
2) One Officer should be entrusted with the job for each shift.
3) HEMM, viz Dozer should be ready available at the site. It should be kept at a high level that the sudden flooding does not cause any obstruction to its movement/operation.
4) In case of heavy rains, machinery deployed inside the mine should be shifted from low-lying areas to avoid drowning. All electrical connections should be cut off in case it is observed that the flood is likely to be unmanageable.
5) The store should be instructed to keep extra pump set tools, tackles, lights, rain coats, etc. in the store in sufficient numbers to avoid any problem at the last moments during such occasion. Similar instruction has to be given to the Medical Section.

VII. CONCLUSIONS

Efficient management of disaster, rather than mere response to their occurrence has, in recent times, received increased attention both in India and abroad. Thus, in the event of a disaster, experience and expertise of highly trained mine emergency response specialist assistance may be utilized to build a safer and disaster resilient Indian Mines. The following conclusions may be drawn from the above discussion:

1) Coal mining is associated with a number of hazardous.
2) These hazardous can be identified and assessed which has been done for this project.
3) Preventive measures against identified risks have been provided in this report.
4) With adoption of such protective measures, the operation of the mine would be safe.

REFERENCES

[8] Aftab Ahmad, A K Sinha, & R M Bhattacharjee Disaster Management: “Managing the Risk of Mining Disaster”