STATUTORY REQUIREMENTS OF MINING PLAN & SCHEME OF MINING AND MINE CLOSURE PLAN

Mines & Minerals (D&R) Act,1957
Section 5 (2) b
No mining lease shall be granted by the State Government unless it is satisfied that-
[(a) there is evidence to show that the area for which the lease is applied for has been prospected earlier or the existence of mineral contents therein has been established otherwise than by means of prospecting such area; and
(b) there is a mining plan duly approved by the Central Government, or by the State Government, in respect of such category of mines as may be specified by the Central Government, for the development of mineral deposits in the area concerned.]

MINERAL CONSERVATION & DEVELOPMENT RULES, 1988

Mining Plan:
Rule 9 (1) : No person shall commence mining operations in any area except in accordance with a mining plan approved under clause (b) of sub-section (2) of section 5 of the Act.
Rule 9 (2) : The Controller General or the authorised officer [or the officer authorised in this behalf by the State Government, as the case may be,] may require the holder of a mining lease to make such modifications in the mining plan referred to in sub-rule (1) or impose such conditions as he may consider necessary by an order in writing if such modifications or imposition of conditions are considered necessary-
(a) in the light of the experience of operation of mining plan;
(b) in view of the change in the technological development.
Rule 10. **Modification of mining plan**:
(1) A holder of a mining lease desirous of seeking modifications in the approved mining plan as are considered expedient, in the interest of safe and scientific mining, conservation of minerals, or for the protection of environment, shall apply to the Controller General, [or the officer authorised in this behalf by the State Government, as the case may be,] setting forth the intended modifications and explaining the reasons for such modifications.
Rule 10 (2) : The Controller General or the authorised officer [or the officer authorised in this behalf by the State Government, as the case may be,] may approve the modifications under sub-rule (1) or approve with such alterations as he may consider expedient within a period of ninety days.
Rule 11. **Mining plan to be submitted by the existing lessee**:
(1) Where mining operations have been undertaken before the commencement of these rules without an approved mining plan, the holder of such mining lease shall submit a mining plan within a period of one year from the date of commencement of these rules, [to the Regional Controller or the authorised officer or the officer authorised in this behalf by the State Government, as the case may be, for approval].
Rule 11(4) : The Regional Controller [or the officer authorised in this behalf by the State Government, as the case may be,] may approve the plan as submitted by the lessee under sub-rule (1) or may require modifications to be carried out in the plan and the lessee shall carry out such modifications and resubmit the modified plan for [ ] approval.
Rule 11(5) : The Regional Controller or the officer authorised in this behalf by the State Government, as the case may be, shall, within a period of 90 days from the date of receipt of the mining plan or the modified mining plan, convey approval or disapproval to the applicant and in case of disapproval shall also convey the reasons for disapproving the said mining plan or the modified mining plan.

Rule 11(6) : If no decision is conveyed within the period stipulated under sub-rule (5), the mining plan or the modified mining plan, as the case may be, shall be deemed to have been provisionally approved and such approval shall be subject of the final decision whenever communicated.

Rule 11 (7) : The mining plan submitted under sub-rule (1) shall be prepared by a recognised person.
Rule 12. **Review of mining plan**:
(1) [Omitted]
(2) The owner, agent, mining engineer or manager of every mine shall review the mining plan as prescribed

under sub-rule(1) and submit a scheme of mining for the next five years of the lease to the Regional Controller [or the officer authorised in this behalf by the State Government, as the case may be,] for approval.
(3) The scheme of mining shall be submitted to the Regional Controller [or the officer authorised in this behalf by the State Government, as the case may be, at least one hundred twenty days before the expiry of the five years period, for which it was approved on the last occasion.
(4) The Regional Controller or the authorised officer [or the officer authorised in this behalf by the State Government, as the case may be,] shall convey his approval or refusal to the scheme of mining within ninety days of the date of its receipt.
(5) If approval or refusal of the scheme of mining is not conveyed to the holder of the mining lease within the stipulated period the scheme of mining shall be deemed to have been provisionally approved and such approval shall be subject to final decision whenever communicated.
(6) The provisions of rules 9, 10 and 13 shall apply to the scheme of mining in the same way as they are applicable to the mining plan.
(7) Every scheme of mining submitted under sub-rule (2) shall be prepared by a recognised person or a person employed under clause (b) of sub-rule (1) of rule 42.

RULE 42 of MCDR' 88

Employment of Geologist and Mining Engineer based on

- Machinery proposed which decides the category of mine
- Employment Potential (----------do---------)

Mineral Conservation Rules, 1960

Rule 22(4) of M.C.R, 1960

On receipt of the application for the grant of a mining lease the State Government shall take decision to grant precise area for the said purpose and communicate such decision to the applicant. On receipt of communication from the State Government of the **precise area** to be granted, the applicant shall submit a mining plan, within a period of six months of such other period as may be allowed by the State Government, to the Central Government for its approval. The applicant shall submit the mining plan, duly approved by the Central Government or by an officer duly authorised by the Central Government, to the State Government to grant mining lease over that area.

Rule 22(4), of M.C.R., 1960

The State Government shall competent to approve mining plan of open cast mines (mines other than the underground mines) in respect of the following non-metallic or industrial minerals in their respective territorial jurisdiction, namely:-

(i) Agate (ii) Ball Clay (iii) Barytes (iv) Calcareous Sand (v) Calcite (vi) Chalk (vii) Clay(Others) (viii) Corundum (ix) Diaspore (x)Dolomite (xi) Dunite/pyroxenite (xii) Felsite (xiii) Felspar (xiv) Fireclay (xv) Fusch.Quartzite (xvi) Gypsum (xvii) Jasper (xviii) Kaolin (xix) Laterite (xx) Limekankar (xxi) Ochre (xxii) Pyrophyllite (xxiii) Quartz (xxiv) Quartzite (xxv) Sand(Others) (xxvi) Shale(xxvii) SilicaSand (xxviii) Slate (xix) Steatite/Talc/Soapstone

Rule 22(6) of M.C.R., 1960

The mining plan once approved shall be valid for the entire duration of the lease:
Provided that any modification or modifications of the mining plan shall be approved by the competent authority and such approval of the modified mining plan shall remain valid for the balance duration of the mining lease.

Rule 22A of M.C.R., 1960

Mining operations to be in accordance with Mining Plans.
(1)Mining operations shall be undertaken in accordance with the duly approved mining plan.
(2) Modification of the approved mining plan during the operation of a mining lease also requires prior approval.

Rule 22B (1) of M.C.R., 1960

Mining plan to be prepared by recognized persons.
No mining plan shall be approved unless it is prepared by a qualified person recognized in this behalf by the Central Government, or duly authorised officer.

Rule 22BB (1) of M.C.R., 1960

Procedure for approval of mining plans.
Notwithstanding the provisions of rule 63 the mining plan shall be submitted for approval through authority notified by the Controller General of the Indian Bureau of Mines or by the State Government, as the case may be, in this behalf except for minerals specified in Part A and B of the First Schedule to the Act.
(1a) Every mining plan submitted for approval under sub-rule (1) shall be accompanied with a non-refundable fee of one thousand rupees for every square kilometer or part thereof of mining area covered under the mining lease.

Rule 22(7) of M.C.R., 1960
The powers under sub-rules (1) and (2) in regard to approval of mining plans shall be exercised by Director, Atomic Minerals Directorate for Exploration and Research, Hyderabad, and in regard to revision under sub-rules (3) to (5) shall be exercised by Secretary, Department of Atomic Energy, Mumbai, insofar as they relate to atomic minerals specified in Part B of the First Schedule to the Act.**There has been recent amendment in January, 2006 where Gemstones of Beryl origin exempted from Ist schedule.**

Rue 22(8) of M.C.R., 1960

The powers under sub-rules (1) to (5) in regard to approval of mining plan and revision shall be exercised by authorities designated in this behalf by notification by the Department of Coal insofar as they relate to coal and lignite specified in Part A of the First Schedule to the Act.

Rule 27(h) 0f M.C.R., 1960
The lessee shall not carry on, or allow to be carried on, any mining operations at any point within a distance of fifty metres from any railway line, except under and in accordance with the written permission of the railway administration concerned or under or beneath any ropeway or ropeway trestle or station, except under and in accordance with the written permission of the authority owning the ropeway or from any reservoir, canal or other public works, or buildings, except under and in accordance with the previous permission of the State Government ;

The Rule 29 of MCR, 1960 and Rule 23 of MCDR, 1988 were amended vide Gazette Notification dated 10-4-03 for ensuring scientific mine closure by way of submission, approval & implementation of Mine Closure Plan.
Consequent to amendments to Rule 29 of MCR, 1960 and Rule 23 of MCDR, 1988, sub-rule 29A was introduced in MCR, 1960 and sub-rules 23A, 23B, 23C, 23D, 23E and 23F were introduced in MCDR, 1988.

Rule29A of MCR,1960 : Determination of mining lease

The lessee shall not determine mining lease or part thereof unless a duly approved Final Mine Closure Plan (FMCP) is implemented.

Rule 23 of MCDR, 1988 : Abandonment of mine

A mine or a part of mine shall not be abandoned during the subsistence of the lease except with prior permission in writing of the Controller General or the authorized officer.

Further, the lessee shall not abandon a mine or part thereof unless a duly approved Final Mine Closure Plan (FMCP) is implemented.

Rule 23A of MCDR, 1988 : MINE CLOSURE PLAN

As per Rule 23A of MCDR, 1988, every mine shall have Mine Closure Plan which shall be of two types:-

- PROGRESSIVE MINE CLOSURE PLAN (PMCP)
- FINAL MINE CLOSURE PLAN (FMCP)

Rule 23B of MCDR, 1988 : Progressive Mine Closure Plan (PMCP)

The owner, agent, manager or mining engineer of every lease shall submit in case of fresh grant or renewal of mining lease, a Progressive Mine Closure Plan (PMCP) as a component of Mining Plan, to Regional Controller of Mines or officer authorized by the State Government, as the case may be, for approval within a period of 180 days from the date of commencement of this rule.

Rule 23C of MCDR, 1988 : Final Mine Closure Plan (FMCP)

The owner, agent, manager or mining engineer of every lease shall submit a Final Mine Closure Plan (FMCP) to the Regional Controller of Mines or the officer authorized by the State Government, as the case may be, for approval one year prior to the proposed closure of mine.

Rule 23D of MCDR, 1988 : Modification of Mine Closure Plan

The holder of mining lease desirous of seeking modification in the approved Mine Closure Plan shall submit to the Regional Controller of Mines or the officer authorized by the State Government, as the case may be, for approval setting forth the intended modification and explaining the reasons for such modification.

Rule 23E of MCDR, 1988 : Responsibility of the holder of mining lease

It is the responsibility of every lessee to ensure that the protective measures contained in the Mine Closure Plan including reclamation and rehabilitation works have been carried out in accordance with such approved Mine Closure Plan.

Rule 23F of MCDR, 1988 : Financial Assurance

- For the mining lease area put to use for mining and allied activities, Financial Assurance will be charged
- For 'A' category mine Rs. 25,000/- per hectare with minimum amount of Rs 2 Lakh
- For 'B' category mine Rs. 15,000/- per hectare with minimum amount of Rs 1 Lakh

Financial Assurance to be furnished in any of the following forms

(a) Letter of Credit from any Scheduled Bank
(b) Performance or Surety Bond
(c) Trust Fund or
(d) Any other form of security/ guarantee acceptable to the authority.

BROAD OUTLINE OF THE GUIDELINES FOR PMCP / FMCP IS AS UNDER:

1. Introduction
1.1 Brief introduction of the mine
1.2 Reasons for closure
1.3 Statutory obligations
1.4 Closure Plan Preparations

2. Mine description
2.1 Geology
2.2 Reserves
2.3 Mining Methods
2.4 Mineral Benefication

3. Review of Implementation of Mining Plan / Scheme of Mining including five years Progressive Closure Plan upto the final closure of mine

4. Closure Plan
4.1 Mined-out Land
4.2 Water Quality Management
4.3 Air Quality Management
4.4 Waste Management
4.5 Topsoil Management
4.6 Tailing Dam Management
4.7 Infrastructure
4.8 Disposal of Mining machinery
4.9 Safety & Security
4.10 Disaster Management & Risk Assessment
4.11 Care & Maintenance during temporary discontinuance

5. Economic Repercussions of Closure of mine and manpower Retrenchments
6. Time schedule for abandonment
7. Abandonment cost
8. Financial assurance
9. Certificates
10. Plans & Sections

COMMONLY OBSERVED DEFICIENCIES IN MINING PLAN & SCHEME OF MINING

Though Indian Bureau of Mines have approved a large number of Mining Plan (MP) & Scheme of Mining (MS), but it is observed that still a large number of deficiencies continue to occur in the Mining plans & Schemes of Mining submitted to IBM by RQPs. That is why most of the Mining Plans and Scheme of Mining are being referred back to the RQPs for modifications.

Most of the deficiencies that occur in the Mining Plan are presentational deficiencies. Some of the common deficiencies are as given below:

1.The basic problem in preparation of mining plan starts because of non-availability of authentic exploration data. Generally the lessee contacts the RQP for preparation of mining plan only after he receives letter of intention to grant the lease from the state government as provided under rule 22(4) of MCR'1960. The lessee is not aware of the provisions under rule 4 to 8 of MCDR'1988 i.e. submission of scheme of prospecting, intimation about commencement of prospecting operations and report of prospecting operations etc. The prospecting report is required to be enclosed along with the application for lease. It is observed that the prospecting report is prepared based on hypothetical considerations and not based on actual litho logs, pits or trench exploratory data. There is tendency on the part of the lessee to do minimum of exploration. The exploratory data if at all contains information from well or nullah cuttings, or pits of nearby mines etc. The depth of some of the exploratory pits is as low as 0.25 or 0.50 mts. The boreholes etc., if proposed, should continue to be drilled till ore horizon is cut across. At least one of the boreholes should be drilled deeper in the area. The Prospecting report in case of an area already held under PL may be enclosed with the mining plan.
It is observed that surface geological plan is not prepared for the entire lease/ applied area.

Exploration work and appraisal of the deposit should be done well before end of five year period or mining plan so that modifications in the proposals of exploitation etc. can be incorporated in the mining scheme. Grade or the ore/mineral etc. should be described in detail. Chemical analysis of the ore/mineral should be furnished. Cut-off grade should be discussed. Difference between bulk density and specific gravity should be clearly understood. Losses due to various reasons should be described in detail. Losses in slope of the pit, handling and transportation should be mentioned with details.

2. Another important issue in preparation of a quality mining plan is lack of expertise and required facilities general1y available with the RQPs. It is desirable that the mining plan should be prepared by a team, consisting of a Geologist, Mining Engineer and Environmental Engineer so that the desired expertise is available.

3. Khasra numbers, survey numbers, type of land, etc., should be given. Break-up of different types of land should also be given. The khasra numbers described in the text should match with those shown on surface plan. Topography described in the surface plan should match with actual ground condition.

4.It is observed that the MP or MS is submitted to IBM without going through it: so much so that some sentences do not convey any meaning. There are blank spaces at a number of places, which probably were left for want of information but were not taken care of at the time of submission. The pages are missing or are not numbered properly.
In case lease is for more than one mineral, geological occurrence, exploration proposals and reserves estimation should be described for every mineral. In case only one mineral is proposed to be exploited the justifications for the same are to be given.
The key plan and other documents in the form of enclosures which are submitted as Xerox copies are not legible.
The cover page does not contain all the relevant information required to know at a glance. Area applied for, name of the lease, vi1lage, distt., etc. whether for fresh or for renewal or existing lease need be clearly mentioned. Name of the applicant lessee, name of the RQP, his registration number and validity of recognition must be mentioned.
The consent letter and certificates and declaration form by the applicant/ lessee are required to be submitted in original and not as Xerox copies. Moreover the certificates should also mention the name of the area and its details, for which the certificates are being submitted. The certificates should be as per format supplied by IBM and are not to be combined. In case the consent letter or declaration letter by the applicant is in regional/local language the same should also accompany with a Hindi/English translation.

9. The certificate of authorization to prepare the mining plan/ scheme of mining is not signed by authorized signatory and also not dated. The name of the signatory is also not given. In case of a limited company a certificate or resolution from Board of Directors that a particular person has been authorized for such purpose may be submitted. In case the certificates etc are signed by power of attorney registrar of court should duly authenticate the same. In case of a Proprietary firm or a Public or Private Limited company list of partners and all the directors should be given.
The words like "should be" or "may be" or "it is recommended", etc. need not be used instead it is required to be mentioned as to what actually is proposed to be done.
Years of implementation should be given as first year, second year etc., in case of fresh grant only. The year should be taken on financial year basis. In case scheme of mining is submitted after a gap of five years of mining plan period , the actual production, waste removal etc. should be given for the intervening period.
Justification for selection of the site for waste dumping is not submitted.

13. Requirement of technical persons as required under different rules is not given. No sincere efforts are made for employment of a qualified mining engineer even in a working mine, O.M.S., number of shifts per day, total working days in a year etc. should be considered for arriving at production and overburden removal proposals. If no mining engineer was employed by the lessee for a number of years the efforts made by him to employ a qualified mining engineer may be given.

14. There is inconsistency in the description/ text. For example while describing lithology it is mentioned that thickness of top soil is 0.5 mts but while describing proposal for stacking of top soil it is mentioned that there is no top soil. The contradictory statements in the mining plan at different places of the text must be reconciled.

Thickness or various litho units is not mentioned. Local geology relevant to the area/mine is necessary. Regional geology should be restricted to having relevance with the area for which mining plan is to be prepared.

Deviations observed with respect to the proposals along with justifications for deviations are not reflected properly in the MS. These should be given in tabulated form separately under the titles exploration, production, O.B. removal and ore to O.B. ratio proposed and actually achieved, plantation, monitoring of environmental parameters and mine effluents etc. The justification given at many a time is not at all convincing. For example exploration proposed could not be undertaken because it was felt there is no need for the same now. Overburden could not be removed due to paucity of funds etc.

In some cases it is observed that the sections are prepared based on one borehole only or other bore hole may be far apart. Also no dotted lines are shown in case the ore horizon is interpolated; rather this is shown by firm lines.

It is necessary to estimate the quantity of waste or overburden, which is likely to be generated each year, and during life of the mine. The site(s) selected for waste dumping should not be many. Slope of the dump should be taken into account for calculating the area required for waste dumping. The sides should be sloping and in case of more height it should be terraced. The total height of the waste dump should normally be not more than 10 mts.

The precautions which are required to be taken should be described in the chapter on dumping waste. The part of the waste dump need to be made inactive so that afforestation can be taken up early to make it stable. The side of the terraces should normally slope towards core of the dump. A contour drain or trench should be proposed all around the dump so that no wash off takes place from the dump, which could cause pollution to the nearby watercourse. To arrest any wash off and to provide stability to waste dump a retaining wall may be proposed all around the dump. Check dams along the slope of an area at suitable locations may be proposed to arrest wash-off in the interest of prevention of pollution to watercourse.

20.Similar to contour drain a trench could also be proposed all around the pit or only towards elevated part of the pit to prevent rainwater from entering the pit. The waste dumps should be proposed on a flat ground on a lower level which is non-mineralised so that wash off does not take place and also the dump is stable. In case section of borehole below the proposed ground or near the proposed site is available the same may be given. Barren ness of the area should be supported by surface geology of the area.

A number of pits are proposed in scattered manner. At times, a total number of pits proposed to be worked is six to seven or even more. The effort should be made to work minimum number of pits: preferably one or maximum of two to three pits for blending purpose. The proposal should be to work the pit up to maximum economical depth and not restricted to a shallow depth with a view to have maximum profit. This will take care of conservation of mineral and minimum land degradation.

Information such as imposition of section 22 of Mines Act, if any, on any part of the mine should be clearly brought out in the mining plan. The reason due to which the prohibitory orders have been issued and the efforts made to get the section 22 vacated may be mentioned in required detail.

It is also desirable to mention the accreditation of ISO 14001 or any other accreditation obtained by the mine.

The conceptual plan should be prepared for lease period/life of the mine as the case may be. The land use of the excavated area and abandoned pit is proposed without any scientific basis. In case the excavated pit is proposed to be utilized as water reservoir the same is required to be prepared by breaking the steep sides. Similarly in case the area is to be utilized for pisciculture the pit should not have excessive depth.

The number of plantation proposed is totally inadequate in comparison to the area. Normally one-third of the lease area should get afforested within the lease period and the tree density is taken as 1000 trees per hectare. In case of hilly topography the area to be afforested should be more i.e one-half because of high erosion potentia1.

PLANS & SECTIONS:

Some of the deficiencies are as given below :
Separate plans for each year of proposal are not submitted as a result it becomes difficult to make out clearly the progress of the face, waste dumping, afforestation, etc. In scheme of mining, a plan showing proposals as against actual work done is not furnished. This type of plan gives the deviations in the proposals at a glance. This is compulsory for mechanized mines.
The section lines alongwith their directions should be marked clearly on each section at both ends. Only that part of the section, which is seen as exposures or in litho log should be shown in firm lines. Remaining part should be shown as dotted lines. The contour vaIues should be shown at both the ends of a contour line
The north direction should be clearly shown. The whole area should be divided in co-ordinates for easy identification. Wind direction is generally not shown in the key plan. The contour interval in the key plan has now been revised to 20 mts from 15 mts earlier. The name of the area, name of the applicant/ lessee, area applied for and other details along with the name of the plan or section should be given on all the plans and sections. In sections vertical and horizontal scales are kept different. Instead of name of RQP, name of some company or proprietary firm is given. This should be avoided as only the name of RQP, which is registered with IBM, may be used. It is necessary to show ultimate pit limits on al1 the relevant plans & sections. The waste dump normally should be outside pit limit.
The plans and sections should match with the description given in the text.
The same colour should be used in the section to describe a litho unit, which has been used in the surface geological plan. The description of a litho unit by a serial number 1, 2, 3, etc. should be avoided.
Only standard symbols and colours should be used to describe the various features and litho units in various plans and sections.
The index shown is incomplete. A number of symbols and colours, which appear on the plans and sections are not explained in the index.
The plans should bear the signature of the RQP along with the date.
The plans and sections should be prepared on a durable paper or tracing cloth as required under rule 27(1) (e) of MCDR'1988. Preferably polyester film should be used which is durable. The folding and numbering of the plans and sections should be done properly so that the name of the plan and section and plate number are visible even without unfolding the plan and section.
It may be mentioned clearly that the Reduced Levels (R.Ls) are assumed R.L. or have been transferred from R.L of fixed reference point i.e. Bench Mark or Survey of India reference point as the case may be.
It is observed that the actual survey is not carried out and the contour lines etc. are drawn based on visual observations and this at times creates problem.

For the purpose of preparation of Mining Plan/Scheme of Mining, Mines have been classified mainly into three categories viz. 'A' Category Mines, ' B' Category Mines and Very Small 'B' Category Mines. Basically, mining plan in respect of 'A' & 'B' category mines has to address the following important technical requirements –

a) Geology & Exploration
b) Mining
c) Blasting
d) Mine Drainage
e) Stacking of Mineral Rejects & Disposal of Waste
f) Use of Mineral
g) Mineral Processing
h) Environmental Management Plan

Geology & Exploration

Topography and regional geology of the area alongwith local mine geology of the mineral deposits should be discussed. Local geology should be co-related with regional geological set up of the area. The physical and chemical characteristics of the litho units occurring in the subject area have to be described. Prominent Physiographic features, drainage pattern, natural water courses, vegetation, etc. need to be described under this head.

The details of exploration already carried out alongwith the adequacy of such exploration, need for future exploration has to be described. Rationale behind the proposed exploration should be discussed to its logical end keeping in mind that the exploration should be purpose-oriented. To the extent possible, the proposed exploration should be on a systematic pattern instead of random suggestion, just for the sake of mere suggestion. As far as possible, the reserves in respect of steeply dipping vein deposits should be estimated by cross-sectional method to have a higher degree of precision instead by surface area methods. Categorization of reserves should be as per UNFC classification. Geological and recoverable reserves should be duly supported by the grade.

Mining
Opencast Mines -

The existing/proposed method of mining should be clearly discussed. The geometry and bench parameters, sequence of development and exploitation should be discussed properly. The quantum of development and tonnage and grade of production expected should be furnished yearwise for the planned period. The details of machinery deployed/proposed to be deployed should be furnished duly discussing the adequacy of such machinery to achieve the planned development/production. The yearwise development plans and sections should be enclosed. The proposed rate of production when the mine is fully developed and the expected life of the mine should be indicated.

A conceptual mining plan for entire lease period in respect of 'B' category mines and upto the life of the mine in case of 'A' category mines has to be furnished basing on geological mining and environmental consideration.

The mode of working i.e. mechanized/semi-mechanized, manual, etc. has to be briefly described alongwith the locations for disposal of overburden/waste. Brief description about the layout of mine workings and sites for disposal of overburden/waste may be included.

Underground Mines –

In case of underground mines, mode of entry, system of winding/hoisting, underground layout, method and sequence of stoping, mine ventilation, etc. have to be described. Extent of mechanization alongwith the adequacy of the machinery should form a part of this description. Location of drives, winzes, cross-cuts, etc. should be shown on the plan and section. While estimating the reserves, a brief description about size, extent and spatial disposition of the ore body need to be furnished. Nature of wall rock, support system for strata control, geo-technical investigations, rock mechanic study carried out, if any, may also be discussed. Method of stoping, method of underground transport, adequacy of ventilation system, etc. need to be discussed in detail.

Blasting

Broad blasting parameters such as charge per hole, blasting pattern, charge per delay, manner and sequence of firing, type of explosives used/to be used, powder factor in ore and OB, whether secondary blasting is needed, if so, upto what extent, may be discussed in detail.

Mine Drainage

Anticipated depth of the workings, depth of ground water table in that area, quantity and quality of water likely to be encountered during mining, pumping arrangements, places where the mine water is finally proposed to be discharged, etc. have to be briefly described. In case dewatering is more than 100 M^3 per day or mine workings are proposed below ground water table; necessary Hydro-geological report need to be provided.

Stacking of Mineral Rejects & Disposal of Waste

Nature and quantity of top soil, OB/waste and mineral rejects likely to be generated in the plan period may be assessed. Land chosen for disposal of waste may be shown on the relevant plan with appropriate justification. A brief note should be attached indicating the manner of disposal, configuration, sequence of build up of dumps alongwith the proposals for stacking subgrade ore need to be furnished.

Use of Mineral

End use of the mineral should be briefly described indicating the physical and chemical specifications stipulated by the buyers/requirement of captive consumption.

Mineral Processing

The flow sheet or schematic diagram of the process procedure may be furnished if beneficiation of the mineral is planned. The quantity of water required for processing, its source of supply, disposal of waste water and possibility of recycling, etc. may also be discussed.

Environmental Management Plan

This aspect includes three subheads viz. Baseline Information, Environmental Impact Assessment and Environmental Management Plan.

Under Baseline information, existing land use pattern, water regime, flora and fauna, quality of air, ambient noise level and water, climatic conditions, human settlement, public building and monuments, etc. should be described briefly.

Under Environmental Impact Assessment, the impact of mining and beneficiation on environment should be assessed with respect to land area, air quality, water quality, noise levels, vibration levels, water regime, socio-economics, historical monuments, etc.

The Environmental Management Plan defining the time bound action proposed to be taken with respect to the following items should be attached:

a) Temporary storage and utilization of top soil
b) Yearwise proposal for reclamation
c) Programme of Afforestation
d) Stabilisation of dumps
e) Measures to control erosion/sedimentation of water courses,
f) Treatment and disposal of mine water
g) Protection measures for ground vibrations
h) Socio-economic benefits arising out of the mining, etc.

Mining Plan in respect of very small 'B' category mines comprises the following technical aspects:

a) Geology & Exploration, b) Reserves, c) Development & Production Programme, d) Waste Disposal, e) Reclamation Plan & f) Strategy for protection of river courses, nallas, water tanks, villages, important monuments if any

a) Geology & Exploration: General topography of the area along with a brief account of local geology of the mineral deposit has to be furnished. A brief description about the exploration already done confirming to the evidence of existence of the mineral deposit as well as proposed exploration to be carried out during the plan period has to be furnished.

b) Reserves: Reserves should be estimated following standard method of estimation and the results should be categorized in accordance with UNFC classification. The reserves estimation should be duly supported by analytical reports.

c) Development & Production Programme: A brief outline about year wise development and production programme for the plan period has to be furnished including precautions to be observed to prevent haphazard excavation of pits, scattering of waste and sub-grade mineral and avoidable loss of mineral in ground, etc. The information should be supplemented with manpower deployment utilization of mineral with specific reference to the type of industry to whom the mineral will be sold.

d) Waste Disposal arrangements: Arrangements made for stacking of top soil, mineral rejects and disposal of waste along with the respective quantity likely to be generated during the plan period have to be briefly described.

e) Reclamation Plan: Year wise reclamation plan giving proposed plantation programme, scope of back-filling of work out areas need to be described.

f) Strategy for protection of river courses, nallas, water tanks, villages, important monuments if any:
Proposed strategy for protection of river courses, nalas, water tanks, villages/houses/hutments/agricultural land, important monuments, etc. should be briefly discussed.

Scheme of mining in respect of category A and category B mines

Important technical requirements of the scheme of mining related to Category A and Category B mines are:

1: Reserves
2: Mining
3: Handling of Waste and Sub-Grade material
4: Use of Mineral
5: Mineral Beneficiation and
6: Environmental Management Plan
7: Conceptual Mining Plan

1: Reserves

Under this head reserves estimated in the earlier mining plan along with grades, depletion of reserves during the previous plan period, additional reserves established and category wise updated reserves with grade indicating end use grade with analysis have to be furnished. Updated surface geological plan and sections in respect of opencast mines and updated assay plans in case of under ground mines are to be provided.

2: Mining

This should cover salient description of present method of mining, year wise development plans for the plan period including the design and lay out of the mine workings in case of opencast mines and development/stoping for under ground workings for the plan period should be submitted. The information should be supplemented with year wise production plan proposed for the plan period, any change in proposed method of mining, a list of mining machinery under use/proposed vis-a-vis its adequacy.

3: Handling of Waste and Sub-Grade material

A brief description about the rate of yearly generation of waste and proposals for waste disposal for the plan period; configuration of the dumps, precautions envisaged for stabilisation of dumps; rate of yearly generation of sub-grade mineral along with proposals for stacking of such material seperately should be furnished under this head.

4: Use of Mineral

Changes proposed in the use of mineral if any,changes in the specifications imposed by the user industries and efforts made for utilisation of sub-grade mineral should be highlighted.

5: Mineral Beneficiation

Results of any beneficiation investigations conducted, changes made in existing mineral beneficiation plant and tailing disposals, if any may be briefly discussed. If any, beneficiation test has been conducted on sub-grade mineral, such details along with any proposals for installation of new/additional beneficiation facility may also be incorporated.

6: Environmental Management Plan

Proposals made in the previous mining plan vis-a-vis the compliance position at the end of that plan period along with the current proposals for the ensuing plan period in respect of the following items may be furnished.

7: Conceptual Mining Plan

Conceptual mining plan covering the period of anticipated life of the mines supported by the text covering exploration, mine development, optimum exploitation and utilisation of the mineral, waste and sub-grade mineral, management and environmental aspects shall be included under this head.

i) Top Soil storage preservation and utilisation.
ii) Land reclamation and rehabilitation
iii) Waste dump management
iv) Afforestation programme
v) Quality of air
vi) Quality of make up of water, treatment of mine water.
vii) Noise level/vibration
viii) Recirculation of treated water

Scheme of Mining to be submitted in respect of very small 'B' Category Mines:

The document comprises the following technical requirements:
1) Exploration & Reserves, 2) Mining, 3) Disposal of Mine Waste & separate stacking of sub-grade minerals, 4) Use of minerals, 5) Environmental Management Plan, 6) Conceptual Mining Plan.

1) Exploration & Reserves: This chapter should cover a) Reserve estimated in the approved mining plan with grades, b) Depletion of reserves during mining plan period, c) Additional reserves established, d) Updated reserves with grade & e) Year wise exploration proposed to be carried out during the plan period.

2) Mining: This chapter dwells upon a) Year wise Development for the plan period, b) Year wise production for the plan period, c) Any change in proposed method of mining, drilling & blasting & deployment of machinery, d) Precautions to be observed during drilling and blasting.

3) Disposal of Mine Waste & separate stacking of sub-grade minerals: This chapter encompasses a) Nature of waste & its rate of yearly generation, b) Selection of dumping site, c) Method of dumping, d) Precautions for confinement of dumps, e) Arrangement for separate stacking of sub grade minerals.

4) Use of minerals: A brief account of the changes proposed if any in the specifications of minerals being sold and the efforts made for utilization of sub grade mineral may be furnished.

5) Environmental Management Plan: Under this head various proposals made in the approved mining plan, their respective compliance position and the proposals for the next plan period should be discussed.

6) Conceptual Mining Plan: Conceptual Mining Plan should be discussed comprising exploration programme, ultimate pit limit, identification of sites for disposal of waste and unsaleble ores, post mining land use, etc.

TECHNICAL REQUIREMENT OF MINE CLOSURE PLAN

Important technical requirement of Mine Closure Plan are as follows:

1) Mine Description
2) Review of Implementation of Mining Plan/Scheme of Mining
3) Closure Plan
4) Economic Repercussions of Closure of Mine and Man Power Retrenchment
5) Time Scheduling for Abandonment
6) Abandonment Cost

Mine Description:

Under this head, brief description of geology comprising topography and general geology of the area; category wise mineral reserves as estimated in the last Mining Plan/Scheme of Mining alongwith grade particulars; brief description about the method of mining followed, extent of mechanization, mining machinery deployed, production level, etc.; brief description of the mineral beneficiation practice, if any being adopted have to be furnished.

Review of Implementation of Mining Plan/Scheme of Mining:

A detailed account of various proposals committed in the earlier Mining Plan/Scheme of Mining with special emphasis on the proposals for protection of environment vis-à-vis their status of implementation need to be furnished. The reasons for deviation from the proposals, if any should be given with corrective measures taken.

Closure Plan:

(a) Mined out Land –
Proposals to be implemented for reclamation and rehabilitation of mined out land duly supported with all relevant plans and sections have to be furnished.

(b) Water Quality Management –
A detailed description about the existing surface and ground water bodies and measures to be taken for protection of the same, measures for protection of contamination of ground water from leaching etc. should be given. A report on hydrological study carried out in the area may also be submitted.

(c) Air Quality Management –
The status of existing air quality vis-à-vis corrective measures to be taken for prevention of pollution of air should be described.

(d) Waste Management –
Type, quality and quantity of ore burden, mineral rejects, etc. available and their disposal practice should be discussed. If utilisation of waste material is not proposed, stabilization measures of such material should be described.

(e) Top Soil Management –
Top soil available and its utilisation should be discussed.

(f) Tailing Dam Management –
Steps to be taken for protection and stability of tailing dam, stabilization of tailing material and its utilisation, periodic de-silting measures to prevent water pollution from tailings, etc., arrangement for surplus water overflow, ground contaminants, if any should be discussed.

(g) Infrastructure –
Existing infrastructure facilities and their future utilisation should be evaluated. If retained, measures to be taken for their physical stability and maintenance should be described. If de-commissioning is proposed, dismantling and disposal of building structures, support facilities and other infrastructure should be described in connection with restoration of land for further use.

(h) Disposal of Mining Machinery –
De-commissioning of mining machinery and their possible post mining utilisation, if any should be discussed.

(i) Safety & Security –
Safety measures implemented to prevent access to surface openings, excavations, etc. and arrangements proposed during mine abandonment plan and upto the site being opened for general public should be discussed.

(j) Disaster Management & Risk Assessment –
A action plan for high risk accidents and emergency plan proposed for quick evacuation, ameliorating measures to be taken as well as the capability of the lessee to meet such eventualities and the assistance to be required from the local authority should be furnished.

(k) Care and Maintenance during temporary discontinuance –
A emergency plan for the situation of temporary discontinuance or incomplete programme due to court orders or due to statutory requirements or any other unforeseen circumstances including a plan indicating measures of care, maintenance and monitoring of status of unplanned discontinued mining operations expected to reopen in near future should be discussed.

Economic Repercussions of Closure of Mine and Man Power Retrenchment:

Under this heading, man power retrenchment, compensation to be given, socio-economic repercussions and remedial measures consequence to the closure of mines should be described.

Time Scheduling for Abandonment:

The details of time schedule of all abandonment operations as proposed under the head " Closure Plan" should be described here. The schedule of such operations should also be supplemented by PERT, Bar chart, etc.

Abandonment Cost:

Abandonment cost should be estimated based on the activities required for implementing the protective and rehabilitative measures including their maintenance and monitoring programme.

CRITICAL ISSUES OF MINE CLOSURE PLAN INCLUDING ECONOMIC REPERCUSSION

INTRODUCTION

The mine closure and decommissioning involves various issues like reclamation & rehabilitation of degraded areas due to various mining activities, environmental protection issues and social and economic impact on the people working in the mines and living around the mines. Out of all these issues, physical & biological reclamation of the degraded land due to various mining activities and rehabilitation of the workers are the most important issues for the sustainable development of the mining sector. In this lecture we will discuss these issues and the mitigation measures to be taken. We will mainly confine to opencast mines as there are only a few underground mines and their problems are also different.

LAND

Land is the most important aspect of mine closure. The reclamation and rehabilitation of the degraded land due to mining is the major issue in the opencast mines. It is the responsibility of the lessee to bring back the degraded land to its original use and hand it over to the concerned authority /authorities when the mineral gets exhausted or it becomes uneconomical to further mien the area. However, it may not be always possible to bring it back to its original use, therefore, efforts have to be made to bring it back to the next best possible use like water reservoir.

Therefore, it is responsibility of the lessee to plan the mining operations in such a manner that simultaneous back filling of the worked out areas is started at the earliest. The planning of reclamation should be planned and started at the initial mine planning stage. To achieve the above objectives it is essential to know the complete configuration of the mineral deposit with grade and its economic limits. Some of the important steps to be taken in this regard are:

- Carry out adequate exploration of the deposit
- Find out the economic depth and limits (These can be reviewed at suitable intervals).
- Plan excavation from one end of the deposit progressing to the other end in plain areas and working from top downwards in hill areas.
- Disturbing only minimum surface area for envisaged production.
- Plan simultaneous reclamation of mined out areas and dead dumps.
- Take desired help of technology like sloping stability, grinding water survey etc.

If mining operations are carried out in a scientific manner there will be only a small area left un-restored or not reclaimed at the end of life of the mine. Most of the degraded land will be reclaimed while the mining operations are continuing. This will considerably reduce the burden of restoration/reclamation of the residual mining excavation with the ore is exhausted. The progressive mine closure plan should give the details about the area likely to be reclaimed & rehabilitated during the five-year period. The final mine closure plan should indicate details of such residual restoration/reclamation including manpower, machinery, time frame and financial involvement.

Reclamation and rehabilitation of worked out areas, while the active mining continues on other part of the lease area , can be seen in some of the mines of iron ore , china clay, limestone etc .

In case the waste material is insufficient and not possible to bring back the worked out area to its original shape, the following steps should be adopted:

- Efforts should be made to re- contour the degraded area so that it merges with the general topography of the area.
- In case some benches have to be left, then they should be made safe. For long-term stability, they should have a slope angle of not more than 30- 35 degrees and properly vegetated.
- Converted the worked out pits into water reservoirs by taking adequate safety measures.

In case of underground workings possible subsidence of the surface due to underground mining should be marked on the plans and be fenced and other protective measures taken for avoiding accidental entry in to the dangerous areas. Whenever necessary void fill should be carried out as being practiced in some of the opencast mines.

Stabilization and rehabilitation of dumps

Waste and low grade dumps are common features of opencast mines. Efforts have to be made to have minimum external dumps and as far as possible back fill the worked areas by waste material. The back filling of the worked out areas should be started as early as possible. If required, the external dumps should be re handled and back filled into the worked out pits and rehabilitated. In some of the mines, where the

entire lease area is mineralized, dump have made on the mineralized area and then re-handled to work that area.

In scientific mining practice with proper planning the waste dumps are developed in steps with overall slope angle of about 25 –28 degrees for long-term stability. This slope of the dumps will help in faster vegetation and minimum wash offs. The height of the dumps should be determined by scientific means. The dumps should be adequately compacted and vegetated to prevent wash offs and stability.

It has to be kept in mind that the physical and chemical characteristics of a waste dump may lessen the ability to support any vegetation cover. The acid generation potential, leachability of the constituents, toxicity, radioactive nature and combustible substances are to be neutralized or removed. The final stability of the dumps should aim at preventing erosion by wind or by water and developing aesthetically balanced appearance.

A proper record of the low grade dumps, both quality and quantity, should be maintained and furnished in the mine closure plans so that , if required , they can be re-worked at some later date .

Top Soil Management

As you all know the top soil is very precious item, therefore, it should be managed properly. The quality and quantity of top soil available in the lease area should be assessed before the start of the mining operations. Removal and stacking of the topsoil should be planned properly. Efforts should be made for simultaneous utilization of the top soil for reclamation with production. The topsoil should be utilized at the earliest possible as the top soil has got only a shelf life of about six months. The final mine closure should utilize the of top soil which has not been utilized during the progressive closure.

Generation of vegetation cover

Immediately after the top soil is removed, it should be stacked properly and suitably spread in a systematic manner over the waste dumps / backfilled areas for rehabilitation. If required, adequate quantity of suitable fertilizers may also be added. The afforestation should preferably be done in consultation with the local forest department. Only local species suitable to the climatic conditions, water resource availability and the fast growing varieties should be preferred .

For the sustainable development of the mining it is expected that all the pits, dumps, tailing ponds etc. are properly reclaimed and vegetated. Areas required to be rehabilitated should be identified and workload assessed, programme for rehabilitation to be planned. Manpower, equipment, time scheduling and financial implication should be detailed in the mine closure plan. It must be kept in the mind that rehabilitation does not mean only the back filling and providing suitable vegetative cover but also includes use of the land surface in the form of water, reservoir, pisiculture or water storage facilities, picnic spot and similar uses for the surrounding population of the area. Therefore, the important aspects of reclamation are: safety, health and social use.

People

The start of large scale mining operations in an area have great impact on the lives of the local residents. The first impact is the loss of land during acquisition, the second impact is change of life style and the third impact is loss of job or opportunities when the mine is closed. Therefore, care has to be taken to plan the level of production and other activities in such a manner that minimum land is degraded and only a limited are retrenched at the time of closure of the mines. Before the final closure of the mines, all the persons likely to loose the job are trained in some other trade so that they can continue to live a happy life even after the closure of the mines.

The people directly or indirectly associated with the mining projects will have emotional link with the area infrastructures, landscaping, recreational facilities etc. The mine closure operations should have a fine-

tuning with the balancing of the expectations and future involvement of the people. The roads, buildings, other super structures, drainage system, electrical distribution, water supply lines, educational facilities, health programmes, community development resources should be planned to amalgamate with the expanding resources of the local administration and continued use of such facilities under the local authorities for the people would be most healthy proposition provided the local administration takes part in the final rehabilitation of the area and self sustained management procedures are evolved while the physical handing over of the area takes place. It may be necessary to dismantle/decommission some of the super structures, cap up sub surface opening, dismantle sub-stations and electrical supply lines, regenerate appropriate facilities and formal handing over to the authority in the notice of the public will be essential and planned to detailed in final mine closure plan. This will be presided by disposing off or transporting away of the plants and equipments, scraps, stores, hazardous waste, reagents, chemicals or any other such items not required by the users of the area beyond decommissioning.

Safety and Security of the Area

After the stoppage of the production from the mines it is essential to make the entire area safe for the people living around the area on long term basis. Therefore, all the pit slopes and external dumps have to be made safe and vegetated. Further all the buildings and other structures made for the purpose of mining and other allied activities have to be demolished or removed from the lease area. However, if the buildings etc are required by the neighbouring villages, they can be handed over to them with the permission of concerned authority. Therefore, till this work is completed essential guards etc should be provided till the management of the area is handed over to the concerned authorities.

Documentation

An important requirement of a mine closure plan is to have complete systematic documentation of the mining carried out in the area. The essential requirements in this regard are:

- Surface plan of the area at the end of the life of the mine, showing the back filled areas, dumps, water logged areas with depth etc.
- Surface geological plan and sections.
- Complete bore hole data with grade & chemical analysis of ore & overburden, mined out reserves, and the ore reserves left in-situ un mined.
- Quantity and quality of sub grade dumps.

INFRASTRUCTURE:

Developed infrastructure in the mining lease area like roads, aerial ropeways, conveyor belts, rail lines, power lines, building and other civil structures, water treatment plant, water supply sources and its distribution lines, sewer lines, telephone cables, underground tanks, bridges culverts, transformers etc. If these facilities are not required by the society they have to be dismantled / removed. Therefore, a time bound schedule has to be made for dismantling / removal of these facilities. If they are to be amended or converted to make them suitable for future use, it has to be planned and executed as part of de-commissioning. In case they are to be continued, it will be essential that each of these items are to be handed over to appropriate authority who will be responsible for its upkeep and maintenance for continued use for a particular purpose in post mining period. Necessary fencing and security arrangements have to be made during the period of dismantling. Many of the items may be useful to any other project where the same may be dispatched. Safety and security to surface or any other excavation, the property, stores and other infrastructure should be provided especially during decommissioning period when mining activity has ceased.

Risk Analysis

Risk assessment is a common factor applicable at all stages of a mine life cycle. The management is to ensure the risk to business is minimized or eliminated. Such risks can be divided into the following major categories:

- Environmental risk
- Safety and health risk
- Community and social risk
- Legal and financial risk
- Technical risk.

The above risk factors are to be judged properly and suitable action plan to be prepared to meet them with minimum financial and legal implications.

The risks may cover surface water sedimentation, ground water contamination, lowering of ground water table, acid mine drainage, increase in levels of heavy minerals, salinity near the sea, damage to agricultural lands, affect on drinking water system, gas emission, affect on flora & fauna, huge voids created by mining, subsidence, possible damage due to earth quakes, floods, inundation, health of the workers and people living around the mines etc . Appropriate risk analysis to be discussed in the mine closure plan, health of the workers.

DISASTER MANAGEMENT

Disaster management has to be planned for high-risk accidents like massive slope failures, subsidence in case of underground mines, landslides in hilly areas, inundation, fire, earthquake, failure of tailing dam etc. This should also include action plan in case of unplanned discontinuance of mining operations for maintaining status of mine to be reopened in future days. Such precautionary measures to be taken at that point and to remain in surveillance so that failure of slopes or any incident as indicated to be high risk incident to be reported for initiating action on disaster management action plan.

Disaster management plan should include different activities to be taken up immediately either simultaneously or in series of actions, responsibilities to be earmarked and resources to be mobilized for meeting emergency situation. Assistance from local civic bodies are to be recognized to be initiated during that period so that disaster can be managed in a successful manner.

ECONOMIC REPERCUSSION AND MANPOWER RETRENCHMENT

Mine closure is an important activity for the surrounding community in general and for mining site in particular. Mining ceases as a result of exhaustion or reserves or the operations become uneconomical or due to any other reason. Unlike in the past, mine closure is now required to be considered at the outset of mine development. Therefore mine closure planning forms an integral part of the planning, feasibility studies and environmental impact assessment for new mines. For an operating mine, it is an increasingly important aspect in the management of existing operations. The primary aim of mine closure planning is to ensure that decommissioning and rehabilitation of the mine is successfully achieved. In India, mine closure has been given importance vide Notification Nos. GSR 329(E) and GSR 330(E). dt.10th April, 2003 by which Mineral Concession Rules, 1960 and Mineral Conservation & Development Rules. 1988. have been amended. The central idea of these amendments is that every lessee has to submit two types of closure plans viz.. Progressive Mine Closure Plan (PMCP) and Final Mine Closure Plan (FMCP) and the lease cannot be surrendered unless the measures as envisaged in these closure plans are implemented.

Preparation of Mine Closure Plan:

As per Rule-2 (JJ) and 3 (OO), the 'Final Mine Closure Plan' and 'Progressive Mine Closure Plan' respectively, are required to be prepared in the manner specified in the standard format and guidelines issued by Indian Bureau of Mines. Accordingly, the guidelines and format have been devised by IBM and issued vide Circular No. 14/2003, dt. 08/08/2003. by the Chief Controller of Mines. Chapter-05 of the said circular and format deals with 'Economic Repercussions of Closure of Mines and Manpower Retrenchment'. The present paper is restricted to preparation of this particular chapter only and the following points are required to be described.

- Manpower Retrenchment.
- Compensation to be paid
- Socio-economic Repercussion and Remedial Measures

It can be observed that these aspects are generally relevant only at the time of final or permanent closure of mine. Thus, these aspects are 'to be described only in case of preparation of 'Final Mine Closure Plan'. However, in case of mine where it is proposed to reduce the manpower in a phased manner then it is essential to describe these aspects under 'Progressive Mine Closure Plans' as well.

Manpower retrenchment:

As per the Industrial Disputes (Amendment) Act, 1976, and also based on the further amendment in the year 1984, the following issues are to be considered while closure of any establishment.

- The provisions of this act are applicable to all industrial establishments employing 100 or more workmen. Therefore, the same will be applicable to the mine where more than 100 persons are employed.
- An employer who intends to close down an establishment shall have to apply to the appropriate Govt. authority for prior permission at least 90-days before the date on which the intended closure is to become effective. Closing down of an establishment when the permission has not been granted by the appropriate Govt. authority is illegal and the workmen affected by such illegal closure are entitled to all the benefitS under the law as if no notice has been given to them.
- Where the establishment is permitted to close down every workmen is entitled to compensation equivalent to 15-days average pay for every completed year of continuous service.

However, the above indicates only the minimum compensation that has to be provided but does not prevent any higher compensation *if* the establishment wants to offer to its employees.

Ideally, the following policy should be adopted while considering economic compensation and support for closure of a mine:

- Ensure that any compensation scheme is comprehensive, long term and sustainable.
- Make arrangements for infrastructure, such as health center, school etc., to remain viable even after closure.
- Work with local people to determine what industries or economic activities will be most important to the area once the mine closes.
- Adopt a policy of hiring local people and providing training if they lack the right skills.
- Support local business and use local products wherever feasible.
- Assist local people in getting loans to start their own business or alternate employment.
- To have clarity and transparency, complete and formal written agreements between the companies and the local community.

Compensation to be paid:

Manpower retrenchment invariably involves compensation, thus it is required to describe the number of local persons as well as outsiders employed in the mine. It will be worthwhile to indicate their family occupation before employment in the mine. It is also essential to indicate here what whether their family occupation is still continuing or otherwise. For example, some employees work in the mine and at the same time also continue their family occupation such as agriculture farming, fishery, etc. After closure of mining operations whether there is scope for continuing family occupation back or alternate job potential is required has to be indicated.

Socio-economic repercussion:

Mine closure plan can have a negative impact on the socio economic structure of the region. Socio-economic rehabilitation of the community assumes role of great importance ensuring that the benefits of the projects are sustainable. The physical and social rehabilitation programme should be integral part of the life-cycle of the mine.

In many countries, local communities and to a lesser extent, Govts., will have little information about the development of mining project. The introduction of cash economy, contributed by employment, compensation, royalties and spin-off businesses can upset the local balance and ultimately the culture of the region. Often the mine is a source of direct employment in the area and also supports the local economy and indirect employment. Closure of a mining project, if not carefully planned, is likely to have a severe negative impact on the socio-economic status of the community by the sudden removal of this major financial provider with nothing to take its place. The socio-economic aspects of closing a mine should take into consideration the workforce, the community that has become established because of the mine and the local community who were in the area before the advent of the mine. The mining company needs to work with the local community and the Government to establish strategies for supporting these communities from the concept or the project. Consultation should be aimed at establishing of development plan for the region that takes into account the continuation of essential services such as medical care, schools, etc, and the identification of self-sufficient industry, which need to survive after the mining company has left.

Requirement in Mine Closure Plan :

The mine closure plan should describe the following items in details:

Number of local residents employed in the mine, status of continuation of family occupation and scope of joining the occupation back:

It is required to be described here the number of local persons employed in the mine. It would be worthwhile to indicate their family occupation before employment in the mine. It is also essential to furnish here that whether their family occupation is still continuing or otherwise e.g. some employees work in the mine and at the same time also continue their family occupation such as agriculture, fishery, etc. After closure of mining operation, whether there is scope for continuing their family occupation back or alternate job potential is required, has to be indicated. It would be desirable to give abstract in the following manner:

No. of local persons Employed in the mine	Their original/ family Occupation	Likely occupation after Closure of mine

Compensation paid or to be paid to the employees connecting with sustenance of himself and their family members. Under this item, it is essential to describe the compensation given or to be given consequent to the closure of mine. It is also necessary to indicate here that the compensation which is required to be given as per the relevant law/rules as applicable to the mines vis-a-vis compensation given or proposed to be given for retrenchment of the workers.

Satellite occupation connected to the mining industry – Number of persons engaged therein – continuance of such business after mine closes:

Under this head, the number and type of satellite occupations established after commissioning of mine should be described. For example, the number of automobile workshops opened up, business houses dealing with trading of minerals etc., which have direct connectivity with the mining operations are required to be described. Similarly, the numbers of persons engaged on such satellite occupations are also to be indicated. The possibility of continuation of such satellite occupations or otherwise after the closure of mine should be described. Norma1ly, in a cluster of mines. if anyone mine terminate its operations, no significant impact is visualised on the satellite occupations.

Continued engagement of employees in rehabilitated status of mining area and any other remnant activities:

The continuation of engagement of employees even after rehabilitation of mined out areas, if any, should be described here. The type of activity for which employee may continue to work may also be described, viz., few security guards for safety and security purpose, pump operators alongwith crew of mechanical engineers for pumping operations in case of an underground mine may be required. All such occupations alongwith their numbers may be indicated here.

Envisaged repercussion on the expectation of the society around due to closure of mine:

This is an important issue and shall have wider social implications and therefore, requires to be described in an apt manner. The expectations of the society around the mine due to closure should be described here. It is unreasonable for any mining company to retain commercial interest once the mining has ceased. However, since the closure can be planned in advance, cooperation between the mining company and Govt. agency can help attract alternate industry. Mine site possesses facilities and infrastructure (i.e. power. water supply - buildings etc.) that may be valuable to other industries. Mining company will have to leave infrastructure behind, as this often makes closure easier to implement. Opportunities for reuse the site or its facilities, may be described. Mines in the remote areas are frequently centres for community facilities, especially medical and local transport facilities. They also playa role in assisting emergency services (e.g. fire fighting transport to specialist medical centers). Society outlay expects to continue these facilities. It may be difficult to replace these facilities without the introduction of other industry to the area or increased government investment.

EXPLORATION ASPECTS OF A MINING PLAN AND SCHEME OF MINING

Mineral exploration is the process undertaken in the endeavour of finding ore (commercially viable concentrations of minerals) to mine. Mineral exploration is a much more intensive, organized and professional form of mineral prospecting. Mineral exploration is backbone of any mining projects. Success of any mining project is depended on reliability of exploration data.

Stages of mineral exploration

- Area selection
- Target definition
- Resource evaluation
- Reserve definition
- Extraction

First two stages of exploration are applicable for unknown areas. Mining Plan and Scheme of Mining are prepared for targeted areas, which is proved for occurrence of extractable quantum of mineral deposit. Therefore, exploration aspects of targeted area shall be discussed in detail and remaining aspects shall be dealt in brief.

Area Selection:

- Area selection is a crucial step in professional mineral exploration.
- Selection of the best, most prospective, area in a mineral field, referring regional geological maps and literatures.
- Geological region or terrain will assist in making it not only possible for finding ore deposits, but also in find them easily and quickly.

- Area selection is based on applying the theories behind ore genesis.
- The knowledge of known ore occurrences and the method of their formation.

This process applies the disciplines of basin modeling, structural geology, geochronology, petrology and a host of geophysical and geochemical disciplines to make predictions and draw parallels between the known ore deposits and their physical form and the unknown potential of finding a 'lookalike' within the area selected.

The ultimate result of an area selection process is the pegging or targeting potential area for exploration.

Target generation:

The target generation phase involves investigations of the

- Geology of the area via mapping.
- Remote sensing
- Conducting geophysical and geochemical surveys (for the surface and subsurface geology).

Resource/Reserves evaluation:

Applying general exploration methods of geological mapping of larger area on smaller scale, applying remote sensing, geophysical and geochemical techniques will help only to identify/target potential area.

Next stage of resource/reserves evolution is by detailed exploration investigation of targeted area. In the recent development of adopting United Nations Framework Classification (UNFC) for resource/reserves estimation has identified four levels of exploration i.e.

- G-4 - Reconnaissance stage
- G-3 – Prospecting stage
- G-2 - General Exploration and
- G-1 – Detailed Exploration.

Detailed Exploration

Preparation of detailed geological map:

- Preparation of detailed geological map on scale of 1:1000 or

1 : 2000 depend upon extend of lease area and type of deposit.

Features should include in the geological map are

- All surface geological features including strike and dip of bedding/foliation/schistasity, joints, axis of minor folds with plunge using appropriate symbol.
- Delineation of mineralized zone/ore body with distinguishable lines of exposed and inferred contacts including other rock types occur in the lease area and define mode of occurrence and extent of mineralisation.

- Geological plan should also include all features indicated under Rule 28 (1)(b) of MCDR 1988.

Identifying areas required to be prospected to know subsurface geology and generation of exploration data:

Detailed geological map provides all features exposed on the surface of lease area, often, which are not sufficient for resource/reserves evaluation. Therefore, it is essential to identify the gaps and generate additional information.

Additional information/data shall be generated by exploration pits, trenches or by drill holes. The type of exploration and intensity of exploration required is solely depending upon nature of deposit.

The nature/type of deposits broadly classified as follows :

- Stratiform, Stratabound and Tabular Deposits of Regular Habit.
- Stratiform, Stratabound and Tabular Deposits of Irregular Habit.
- Lenticular Bodies of All Dimensions including Bodies Occuring enchelon, Silicified Linear Zones of Composit Veins.
- Lenses, Veins and Pockets; Stock-works, Irregular Shaped Modest to Small size Bodies.
- Gem-stones and Rare Metal Pegmatites, Reefs and Veins.
- Placer and Residual Mineral Deposits of Hill and Valley Wash.

Type of exploration method and its intensity should be carefully selected depend up on simple or complex nature of deposit.

EXPLORATION PRACTICE IN DIFFERENT TYPES OF DEPOSITS

SI. No.	Types of Deposit	Characteristics of Deposit	Principal kinds of Mineral	Exploration Practice
1.	Stratiform, stratabound and tabular deposits.	Of regular habit with predictable change in trend with sharp to moderate physical contrast with bounding surfaces, low dipping to moderately steep, simply folded and faulted. Also as blanket cappings and surficial tabular bodies.	Coal seams, lignite beds, iron-ore formations and cappings, manganese horizons in sedimentary and metasedimentary sequences, thick bauxite cappings, regional chromite lodes in large ultrafamics; limestone, dolomite barites, gypsum, potash and salt beds; chalk and fireclay; fuller's earth.	Wide-spaced drilling generally good enough upto probable reserve category with attendant alternate exploratory pit/trench openings for bulk sampling, as necessary Spacing for : Coal, gypsum potash and salt beds 1,000 m Iron and manganese ore 400-200m Limestone and dolomite 500-300m Bauxite of thick capping 400-200 m Chromite as regional lodes 300-100m Barytes formations 400-300m Progressive grid reduction for higher category. Adit in suitable topography Dry drilling in bauxite and in formations vulnerable to wash.

2.	Stratiform, stratabound and tabular deposits.	Of irregular habit and/or with faults of large measure folds solution cavities, irregular erosion and weathering (oxidation) feature, partings and bifurcations, igneous intrusives, facies changes, etc.	Coal seams, lignite beds, iron ore formations and cappings, manganese horizons in sedimentary and meta-sedimentary sequences, thick bauxite cappings, regional chromite lodes in large ultramafics, limestone, dolomite barites, gypsum, potash and salt beds, chalk and fireclay; fuller's earth.	Closed-spaced, probing, choice of location and number of sites dependent on variability. Borehole Geophysics in complicated fault or folded structures; regular grid pattern may be replaced by selection of sites best suited to unravel the structural complexity. Example may be cited of a faulted coal basin where the area may be sub-divided into polygonal homogeneous blocks bounded by structural planes (here faults). Assessibility in complicated folded body is poor.

3.	Lenticular bodies of all dimensions including bodies occurring in echelon; silicified linear zones of composite veins.	Gradual and abrupt charge in thickness and grade along strike and dip direction bounding surfaces of mineralized bodies often sharp, but in sulphides mostly defined by assay contacts; (a) Massive bodies with irregular shape and grade-homogenous distribution of metal values as in replacement and disseminated type bodies - shapes interpretative; (b) Steeply dipping narrow bodies with or without pitch; pinch and swell type, with or without bifurcations, partings etc.	Base metal sulphides, supergene iron and manganese bodies in laterited country pockety bauxite and nickel-cobalt laterites, auriferous quartz reefs, graphite lenses porphyry deposits of copper, molybdenum and tin; pyrites and pyrrhotite bodies.	Moderate to close-spaced drilling and pitting upto probable reserves, adits/shafts and two level development and underground boreholes for steeply dipping bodies with deviation check; sampling interval commensurate with complexity (0.5 m to 1.0m) check sampling. Spacing of probe points along strike generally not to exceed 200m to be decided on the length of individual lenses in series drilling in dipping mineralized zones, fewer probe points in deeper intersections. Drilling preferably with application of borehole geophysics. Exploration planning to be guided by the results of ground geo-chemical and geophysical surveys.

4.	Lenses, veins and pockets; stockworks, irregular shaped, modest to small size bodies.	Bodies distributed space lacking estimable regular patterns; structural control less than lithologic, if any; small cluster of multi-shaped bodies of volcanic origin pipes and chimneys, of magmatic origin plugs and pods, clots and segregations of	Bodies distributed in space lacking estimable regular patterns; structural control less than lithologic, if any; small cluster of multi-shaped bodies of volcanic origin pipes and chimneys, of magmatic origin plugs and pods, clots	Irregularity in shape and distribution of grade demand larger input of exploratory mining, deep pittings, trenching/ benching, level development in underground mines with supporting underground boreholes. Close drilling (50 m to 25 m) assess gradewise estimates of reserves. Well-documented surveys-surface and sub-surface. Proved category difficult to achieve. Exploration planning to be guided

		hydrothermal origin-vein and replacement, Bodies in stock-work Metamorphic and meta-somatic in skarn and tektites, in greisens in thermal aureole around intrusives.	and segregations of hydrothermal origin-vein and replacement. Bodies in stock-work Metamorphic and metasomatic in skarn and tektites, in greisens in thermal aureole around intrusives.	by the results of careful ground geochemical and geo-physical surveys. Exploation preferably with attendant exploitation scheme.

5.	Gemstone and rare metal pegmatites, reefs and veins.	Highly erratic distribution of minerals and metals. No trend in grade and thickness, no assured continuity, cluster of high values haloed by barren zones, structural and litholigic controls indeterminable.	Tin-Tungsten-tantalum-niobium-molybdenum veins and pegmatite; beryl, topaz, emerald deposits, mineralisation associated with alkaline rock complexes and veins in carbonatites.	High input of exploratory mine openings-open pit or underground with bulk determination of grade. Role of drilling secondary to delineate likely outline of host rock. Category of reserve unattainable beyond possible reserves. Exploration of regional and preliminary resource evaluation scale followed by direct exploration.
6.	Placers and residual refractory mineral deposits of hill and valley wash.	Eluvial, colluvial and alluvial placer concentration of heavy metals and minerals; pebble and cobble, boulder beds, gravel beds in alluvium and colluvium; conglomerates, foothills fan deposits, grain-size from extremely fine striated material to rough to polished boulders.	Placer tin and gold deposits, monazite, garnet, limonite, rutile; diamoniferous conglomerate; floats and gravel beds of corundum, kyanite, sillimanite floats and talus deposits of magnetite.	Pitting in grids; trenching hydraulicking, sluicing and pannings for bulk sample, concentration and concentrate analysis, large diameter drilling; boulder exposure tracing in alluvial and colluvial terrains; geomorphic analyses of terrain and slope formation.

Economic aspect of Exploration:

- Economic aspect of Exploration should be given utmost important and the proposals should be economically viable.
- First stage of detailed exploration is to know the configuration of ore body.
- Subsequent stage of exploration is to assess quantum and quality of ore, which may be planned in phased manner.
- Determining ore body bottom is very essential to prepare realistic project proposals.

Sampling, Determination of Bulk density and Chemical Analysis :

- Sample should represent the ore body at particular position.
- Samples collected from surface exposures, exploration pits and trenches should representative of entire width of the ore body.
- Proper conning and quartering should be done to take final sample.
- Core samples should be prepared splitting core into equal halves and remaining portion should be preserved.
- Analyses of samples should also be done for associated minerals.
- End-use grade classification and threshold value fixed by IBM should be taken as guidelines to classify ore and waste.
- Bulk density test should be conducted for different types of ores. Small variation in bulk density makes huge difference in reserves estimation.

Preparation Geological Cross Sections Based on Exploration Data:

- Geological cross-sections should be prepared across the strike direction incorporating all exploration data generated.
- Position of exploration trenches and pits should be marked over cross sections.
- Boreholes should be projected over cross sections marking borehole logs.
- It is essential to mark collar levels of the bore holes.
- Projection of cross-sections should be according to dip of the formation.
- Cross-section intervals should be decided based on nature of the ore body.

Reserve definition

- Reserve definition is undertaken to convert a mineral resource into an ore reserve, which is an economic asset. The process is similar to resource evaluation, except more intensive and technical, aimed at statistically quantifying the grade continuity and mass of ore.
- Reserve definition also takes into account the milling and extractability characteristics of the ore, and generates bulk samples for metallurgical testwork, involving crushability, floatability and other ore recovery parameters.
- At the end of the exploration process, a feasibility report is prepared, and the ore deposit may be either deemed uneconomic or economic.

Presentation of Exploration Data in Mining Plans and Scheme of Mining:

- Detailed description of exploration already carried out in the mining lease area should be given along with logs and chemical analysis.
- The future exploration programme should be given year wise in a tabular form.

Year	No. of boreholes	Total meterage	No. of pits & dimensions	No. of trenches and dimensions
First				
Second				
Third				
Fourth				
Fifth				

Note: In case of existing mines, the year should be given in financial years.

- Under the chapter of conceptual plan, the exploration proposals should be given to cover entire lease area in phased manner at five yearly intervals.

Greenfields vs. Brownfields

- Exploration is termed either Greenfields or Brownfields depending on the extent to which previous exploration has been conducted on the tenements in question.
- Greenfields alludes to unspoilt grass, and brownfields to that which has been trodden on repeatedly. While loosely defined, the general meaning of brownfields exploration is that which is conducted within geological terranes within close proximity to known ore deposits.
- Greenfields are the remainder.
- Greenfields exploration is highly conceptual, relying on the predictive power of ore genesis models to search for mineralisation in unexplored virgin ground.
- Greenfields exploration has a lower strike rate, because the geology is poorly understood at the conception of an exploration program but the rewards are greater because it is possible to find deposit in an area.
- Brownfields exploration is less risky, as the geology is better understood and exploration methodology is well known, but since most large deposits are already found the rewards are incrementally less.

Aspects of Mineral Beneficiation in Mining plan & Scheme of Mining

Minerals are required by many industries, viz. metallurgical, chemical, cement, refractory, fertilizer, etc. All these industries lay down certain specifications (chemical, physical and mineralogical) for ores/minerals to be used as raw materials

Ores and minerals are seldom found in nature in the form and purity as required by the consuming industries and are always associated with deleterious impurities and worthless diluents (gangue minerals).

Mineral resources being non-renewable & non-replenishable natural assets, their optimum utilization in the prevailing technology is of paramount importance & consideration for their conservation.

Mineral beneficiation/processing plays an important role in exploitation and conservation of mineral resources by producing saleable products from low grade ores, waste dumps, mine rejects etc. They also ensure production of suitable mineral based raw materials for direct use in industry or for subsequent metallurgical treatment.

Mineral beneficiation may be defined as processing of ores and minerals by physical methods to yield marketable products termed as concentrates keeping the chemical identity of the mineral intact. It yields product of fairly uniform quality. Since ore dressing process involve mainly physical separation techniques, they are simple and cheaper as compared to hydrometallurgical and pyrometallurgical treatment.

Mineral beneficiation encounters its position in between mining & metallurgical treatment in case of metallic minerals and for industrial minerals its position is after mining for desired market.

The various stages involved in mineral processing are:

1.Characterisation studies which involves identification and quantification of useful as well as worthless(gangue) minerals using Microscopes,X-Ray Diffractometer (XRD) and Electron Probe Micro Analyser (EPMA) .

2 Comminution for size reduction by crushing and grinding to liberate valuable minerals from the gangue minerals and also to prepare feed suitable for separation.

3.Separation of of the liberated gangue minerals from the valuable ones by taking advantage of the difference in physical properties like colour, specific gravity, magnetic susceptibility, electrical conductivity, surface characteristics, etc.

4.Quality evaluations of various separated products by Chemical Analysis using wet classical methods and various instruments.

Physical properties of minerals used in separation and the techniques deployed.

Physical properties	Techniques employed
Colour & Lusture	Hand sorting, optical sorting, Radiometric sorting, X-Ray sorting
Specific Gravity	Heavy media, jigs, shaking table, spirals, water only cyclone and floatex density separator.
Magnetic Susceptibility	Low and High, Dry and Wet Magnetic Separation.
Conductivity	High Tension Separators
Shape & Texture	Size reduction and screening.
Surface Properties	Froth flotation for selective separation of minerals

The mining plan, a mandatory requirement under MCDR, 1988 encompasses a whole gamut of various discipline viz., geology, mining, mineral beneficiation, mineral conservation, utilization, environmental aspects etc. This paper deals exclusively with chapter of “Mineral Beneficiation” and discusses various aspects on which information is required to be furnished in the mining plan & scheme of mining.

Mineral beneficiation aspects in mining plan/ scheme of mining:

Invariably, most of the mines/ lessees engaged in value addition of their mine produce have a consultant for beneficiation or its own in house R&D facility. The findings of such R&D endeavor resulted in erecting mineral beneficiation plants/facilities and the same is to be reflected in mining plan & scheme of mining. The various aspects of mineral beneficiation need to be covered for development of a process flow sheet are discussed hereunder:

1.Specification of the marketable/end product:

The details of the finished product specification in respect of chemical, mineralogical & physical (size) are to be incorporated. These specifications may be in the form of grade of valuable constituents (+65% Fe for iron ore) and or tolerance/limits of impurities (%P, %S, %Al_2O_3 & % SiO_2 in iron ore), concentration of valuable minerals (Kyanite, Sillimanite, Wollastonite etc.) and size specification (-30+10mm for BF grade iron ore, -10+1mm for sinter fines etc).

2.Characterization of ore/ feed to the beneficiation plant:

This is the most important aspect for any flow sheet development. These studies are made in three distinct heads of mineralogy, chemical composition & physical properties. Characterization of feed to beneficiation plants are to be made under following heads:

(i)Mineralogical characterization: Complete qualitative & quantitative identification of various minerals present in the sample, their nature of mineralization & mode of occurrence. Textural disposition and liberation mesh.

(ii)Chemical characterization: Complete qualitative & quantitative chemical analysis of the plant feed sample. This will include valuable & valueless constituents besides other detrimental constituents in trace amounts.

(iii)Physical characterization: Size analysis of feed to the beneficiation plant particularly the feed to concentration unit operation.

3.Process flow sheet:

The process flow sheet may be given in three distinct phases of fed preparation, concentration and product handling like dewatering & filtration..

(i)Feed preparation circuit: Incorporating whole range of machineries right from ore bin where ROM ore is unloaded to crushing, screening, grinding, sizing/classification etc. Tentative details of machine specifications etc., its feed & product size analysis etc., are to be given in brief.

(ii)Concentration circuit: The ground material from feed preparation section is feed to concentration section. This circuit incorporates whole lot of the various concentration unit operations involving classification, concentration, cleaning & scavenging operation etc.

This section provides the most vital metallurgical details such as %Wt. material, its grade & % distribution of valuable constituents in each & every unit operations. This data will not only will helpful in understanding efficacy of a unit operation but also help in eliminating redundant unit operation.

Tentative details of machine specifications, its operating parameters etc., its feed & product size analysis etc., are to be given in brief.

(iii) Product Handling System: The concentrates & tails disposal to be given in it. Water recovery system deployed may also be given.

A typical flowsheet is appended with this paper showing the feed preparation system followed by concentration. Material balance at every stage is also given which gives a very clear picture of the recovery of the valuable mineral at various stages and the overall tailing losses, at a glance.

Preparation of EMP & various notifications issued by MoEF

1.00 INTRODUCTION

As per National Environment Policy 2006 the `Environment' comprises all entities natural or manmade, external to oneself and their inter-relationship which provide value now or perhaps in future, to mankind. Environmental concerns relate to their degradation through action of human.

According to Environment Protection Act 1986 `Environment' includes water, air and land & the inter-relationship which exists among and between water, air and land and human beings, other living creatures, plants, micro-organism & property.

It is well known that the mining activities affect air, land and water and call for implementation of Environment Management Plan. Environment Management is a process of natural resource optimization for short and long term human welfare. The strategy is very simple-mineral resource need to be extracted and converted into goods and services to be of use to human but other resources like bio-diversity and genetic material contribute to human welfare through conservation. There is, thus, a delicate balance which has to be maintained to ensure that benefits are available on a sustained basis for a long time.

Environmental concerns have become as integral part of any developmental activity and mining industry is not an exception to it. These concerns are required to be addressed right from the conception stage itself and similar attention is required to be given to evaluate the project from environmental angle besides economic viability under the above backdrop Environment Management Plan is required to be prepared with due care and attention.

Environment(Protection) Act 1986 empowers the Central Govt. to take such measures as it deems fit to protect and improve environment in support of the measures prescribed under any other law for the time being in force relatable to the subjects of this Act. Some of the important notifications issued by the MoEF related to mining industry are as follows :

i) EIA Notification September, 2006
ii) Aravalli Notification 1992
iii) CRZ Notification 1991
iv) Doon Valley Notification 1989

2.00 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

Environmental Management Plan (EMP), which forms an integral part of the Mining Plan, is required to be prepared and submitted to IBM or the State Govt. (for few major minerals) for approval under Rule 22 of the Mineral Concession Rules, 1960 in case of fresh grants of Mining Leases (ML) as well as for renewal of ML. For working mines, initial mining plans are to be submitted under Rule 11 of the MCDR 1988. After 5 years of the Mining Plan period, the implementation of the mining plan as well as the EMP is to be reviewed to bring out the major deviations together with the justification for the same. Under this it is also necessary to spell out year wise programme of mining operations and the environmental mitigation measures for the subsequent 5 years. This is covered in the Mining Scheme, submitted to IBM or to the State Authority as the case may be for approval under Rule 12 of MCDR 1988. Similarly, EMPs are also required to be submitted to the Ministry of Environment & Forest for the Environmental Clearance with respect to the mining lease areas.

An Environment Management Plan involves three parts :

- Base Line Information
- Environmental Impact Assessment
- Environmental Management Plan

2.1 BASELINE INFORMATION

Baseline study involves measurement/collection of details on various environmental parameters existing in the area.

EXISTING LAND USE PATTERN : In case of fresh lease, the present land use in terms of forest, waste land & agricultural land etc. and in case of active lease, land use due to mining activities are to be worked out. Reconnaissance survey, topography map preparation, satellite imagery interpretation are methods to know the land use. It should be supported with an Environment Plan of the area on 1 : 5000 scale with contours showing details of the surrounding villages, rivers, streams, water courses, roads, forest land, wild life sanctuaries, agricultural land, grazing land, etc. as prescribed in rule 28 (5) (b) of MCDR 1988 within and 500 m distance from the lease area.

WATER REGIME : Information on natural surface water courses including river, streams, nallas (seasonal or perennial) and surface runoff, watersheds & catchment areas, lakes, tanks, reservoirs etc and or natural groundwater resources like springs, wells etc. should be furnished. Information on anthropogenic sources including Mine discharge, artificial reservoirs/tanks made for storage, imposed drainage to divert surface flow should be detailed.

FLORA AND FAUNA : The details of existing plant & animal species, endangered species if any, tree density, area of forest population of animals & their migration pattern, area required for compensatory aforestation etc. should be elaborated. The distance of nearest National park, sanctuary, biosphere reserve, reserve forest etc. should be furnished.

CLIMATIC CONDITIONS : Both macro and micro meteorological data like information on wind speed & direction, surface air temperature, relative humidity, atmospheric pressure, rain fall etc should be furnished.

HUMAN SETTLEMENTS: The study on demographic profile, occupation, working population, literacy rate and infrastructure facilities, covering the socio-economic & endemic health problem health care system, recreational facilities should be furnished. The availability of power, power requirement for mine, their supply and demand position, schools, colleges, post offices, telephone and telegraph services of the villages should be elaborated.

PUBLIC BUILDINGS, PLACES AND MONUMENTS : The details of surrounding public buildings, places and monuments, their distances etc. should be furnished.

QUALITY OF AIR, NOISE LEVEL, WATER AND GROUND VIBRATION :CCOM Circular No.3/92 and 2/93 should be followed for collection of data on quality of air , noise levels, water etc.

Whether the area falls under Notified area under Water Act, 1974 - It applies in the first instance to the whole of the States of Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Rajasthan, Tripura and West Bengal and the Union territories; and it shall apply to such other State which adopts this Act by resolution passed in that behalf under clause (1) of article 252 of the constitution.

AIR QUALITY MEASUREMENT : Air pollutants are of reactive type and mostly present in low concentrations. Air pollution due to mining are divided into following two categories.

i) Mobile sources-like automobiles, transport trucks etc.
ii) Stationary Source-like loading and unloading points, blasting sites, crushing and grinding units of ore beneficiation plants & power generation units.

A general EIA guidelines on minimum number of stations in core zone is as follows -

Leasehold area	Green Field Site	Working Mine
< 200ha	2	2
> 200 < 650 ha	3	3
> 650 ha	3	5

Further minimum of one station is to be located in the buffer zone. Locations of stations are to be

based on the distribution of the emitters, pathway & receptors and on physiography and climatic conditions of the area.

SAMPLING METHODS AND FREQUENCY : High volume Samplers or Respirable Dust Samplers are used for monitoring the air quality. Normally RDS are used in Work Zones to assess the RPM. The Parameters measured by these equipments' are RPM, SPM, SO2 and NOx. The monitoring frequency is 8 hours, twice a week, two samples per day, for 8 samples per season for 3 seasons (Summer, Post monsoon & winter) excluding the monsoon. Further, in some mines estimation of heavy metals like Lead etc. are required to be analyzed from the dust collected over the filter papers. If metallic pollution is found to be in excess analysis have to be continued for the remaining two seasons.Dust Gauges are used for estimating the dust fall rate. Dust fall is particulate matter collected from air borne particles settled by sedimentation into dust fall gauges.

NOISE QUALITY MEASUREMENT : Noise measurement is required to assess its detrimental effects on human beings & wild life. In the work zone, the exposure level to workers of intensities greater than 90 dB (A), for 8 hours duration are extremely dangerous.

Location of Sampling Stations:

1. Noise source monitoring
2. Work zone noise level monitoring
3. Ambient noise level monitoring

SAMPLING METHODS AND FREQUENCY : Monitoring schedule should be minimum for 1 season preferable dry season, for day & night, near Quarry equipment, fixed plant installation or mobile plants. Noises emitted by the mobile equipment are measured at the rate of about 10 to 15 min within the cabin. Multiple of complete cycle of operations, outside the equipment at a distance of 5 m measured for 20 to 30 min. Work zone monitoring to be done in a representative portion of shift say for 2 hours in the morning & in the evening when temperature inversions are likely to occur. For measuring the ambient noise level, stations are to be located in the surrounding residential villages, colonies and sensitive places and in silence zones. It is normally done for 24 hours duration. Further from these 24 hourly readings, night time readings between 2100 to 06 hours to be separated out to show their loudest and quietest periods. For the measurement of noise level, the Integrating Sound Level Meter is to be used which provides a complete acoustical measurement system with a data logger. This is suitable for long term environmental and industrial acoustic applications.

GROUND VIBRATIONS : Ground vibrations should be monitored in dry and rainy seasons. Three measurements of 3 heavy blasts with varying degree of charges on 3 different days in nearest human settlement, archeological monuments, public roads, sanctuary etc. in terms of Peak particle velocity, frequency & air over pressure.

STREAM WATER : Stations to be located on all water courses/nallahs (both perennial & seasonal) at discharge point of mine water course, workshop effluents, tailing dam, beneficiation effluents, township/sewerage, office complex etc. into natural water course. All perennial water sources such as rivers, streams, ponds, springs, water tanks etc. are to be monitored and should be tested based on IS : 2490 (Part-I) 1081.

Pit-water : Water quality monitoring at each quarry will include

- Water level measurement in the abandoned pits with reference to MSL.
- For water pumped out of the pit measurement of discharge rate.
- Water samples taken from outlet of the pipes where water is discharged out of the pit.
- From pit it self where there is no pumping.

Process water: From tailing ponds existing for effluent quality and monitoring to include

- Measurement of discharge rate if the water is discharged outside the pond.

Groundwater: Water quality monitoring to include:

- The depth of water from the ground level.
- Continuous recording of the ground water level every month for one year duration.

- Selection of two monitoring wells one to record natural variations is ground water level in upstream side & second one in the down-stream affected by mining.

Monitoring frequency:

- 3 samples/season, one sample on 3 different days/for 4 season
- For rivers sampling twice at high tide & at low tide,

WATER -QUALITY MONITOIRNG TO INCLUDE:

- Field analysis include measurement of pit, temperature, electrical conductivity, DO, BOD & coli form.
- Chemical analysis in the laboratory for major ions & metallic elements.

WATER QUANTITY : The water quantity should be measured in terms of rate of discharge per minute (liter/second) during summer, winter and monsoon seasons from discharge point from mine quarry, springs, waterways, rivers within 5 km buffer zone, from mining & processing operations.

SOIL QUALITY ANALYSIS: Normal soil and sub-soil samples are to be collected at depths 0-30 cm, 31-60 cm and 61-90 cm from different places based upon their use (e.g. forest area, Agricultural land, Afforestation area, avenue plantation, Green belts etc.) the parameters to be analyzed are metals, particle size, pH, conductivity, moisture retention capacity, permeability, bulk density, exchangeable K, available organic carbon, ammonia, nitrogen and Phosphorus.

2.2 ENVIRONMENTAL IMPACT ASSESSMENT

Environmental impact is any alteration of environmental condition or creation of new set of environmental conditions, adverse or beneficial, caused or induced by the action or set of action under consideration. Environmental Impact Assessment (EIA) is a policy and management tool for both planning and decision making and it contain an analysis of the proposed actions, alternative actions and associated impact on the environment. EIA is based on the field studies conducted during the baseline data generation and is a valuable project planning tool. In it's assessment of environmental consequences, the major impact areas on physical, biological and human environments should be considered. Mining in general affects the land, water and air systems existing Noise pollution is another serious problem. The EIA should include the following topics:

1. NECESSITY OF THE MINING COMPLEX : In terms of requirement of the mineral and for the socio-economic up-liftment of the entire area.

II. IMPACT ON LAND : Description of the anticipated changes in the land to include alternation in relief, Estimation of soil erosion and quantities of soils to be removed and stacked, details of deforestation, Existing land use & likely changes due to quarrying, pitting, dumping, roads, processing plants, workshop, township etc., affect on landscape beauty, Estimation of Scree & Fly-rocks, Affect on Sensitive Areas and Important structures to be protected/relocated from Land slides and Subsidence.

III. IMPACT ON WATER RESOURCES : Surface Water : Alteration in stream flow and its flow rate. Qualitative affect due to effluent discharge and acid mine drainage. **Ground water :** Aquifer parameters. Seasonal fluctuations in ground water table, yield and recharge rates, inventory of water withdrawals and discharge rates. Depletion of water table and estimation of total development of ground water due to mining and it's radius of influence. Qualitative affect due to percolation of mine discharge water, tailing dam etc. **Effect on water balance:** Requirement of water from different sources for different uses, compared with the ground water yields and surface water flow rates, water demand for the mining area. Lean season flow, Plant and mine discharge rates, assessment of further demand of water in the downstream areas. **Receiving body characteristics :** Quantum of waste water discharge and details of their receptors i.e. land, Lake/reservoir/River/Stream, Water quality before and after disposal of effluents. Quantum of effluent discharge and sources and effluent treatment measures in vogue, if any.

IV. IMPACT OF AIR QUALITY : Dust Erosion : Estimation of total emissions due to different sources both mobile and stationary and stack emissions and their affect on nearby human settlements, agricultural crops in forest areas. **Noxicious Gases:** Estimation total emissions due to different sources and stack emissions

and their affect on nearby human settlements agricultural crops and forest areas.

V. IMPACT DUE TO SOLID WASTES : Nature and quality of solid wastes generated. Hazardous wastes, Radio active wastes, Heavy metals, Inflammability, Periodic quantities of waste generated, their toxicity, disposal in terms of back filling of worked out portions and external dumping and their anticipated pollution on land and water.

VI. IMPACT DUE TO NOISE AND VIBRATIONS : Noise Level: Identification and characterization of existing noise sources and measurements of noise levels at different sources in mines/plants, noise due to blasting, present noise exposures of general population and of miners. **Prediction on Air-blast:** Affect on nearby surface features and human beings. **Ground Vibrations:** Affect on nearby surface feature, human beings and wild life.

VII. IMPACT ON HUMAN ENVIRONMENT: Economy : Beneficial effect due to creation of employment potentials and the adverse affect on the oustees. Infrastructure Facilities: Improvements and adverse affects due to rehabilitation. Medical & Health Facilities: Improvement in facilities and hazards due to pollution and occupational diseases. **Population Density:** Migration of oustees and immigration of skilled labour.

VIII. IMPACT ON ECO-SYSTEM : Information on rare threatened and endangered plant and animal species, if any, in the impact area and anticipated changes on them, Evaluation of implications of the project related to species diversity, Evaluation of implications of project on species of economic importance, Affect on food chain.

IX. LEGISLATIVE CONTROL : State and central Government pollution control board's standards & Bureau of Indian Standards for pollution control and analytical procedures.

X. ENVIRONMENTAL IMPACT MATRIX : Before the implementation of the protective measures and quantification through numerical values.

2.3 ENVIRONMENT MANAGEMENT PLAN

Once the impact of the proposed mining activities are known, an EMP should be prepared incorporating adequate safeguards or abatement measures for preventing/mitigating the likely damage to the Environment. The key factors for success of an EMP are :

- It should setout clear achievable targets and if possible quantitative indicators of the level of environmental management required.
- It should specify realistic institutional responsibilities for implementation, taking account of the local conditions.
- An EMP should be able to modify and shape the project in the light of monitoring results.
- Where appropriate, it should address the responsibilities and requirement of contractors and ensure that these are incorporated into contract documents.
- An EMP must address the costs of implementation and resolve the issues of how those costs are to be met with.
- It should create effective accountability for implementation and for monitoring its success.

(I) GENERAL CONSIDERAIONS : Anticipated pollution specific to mine site, ore dressing plant and waste dumps.

(II) TEMPORARY STORAGE AND UTILIZATION OF TOP SOIL : Manner of removal and storage, proper design of stacks, collecting & storage for improvement in Quality & Reuse.

(III) LAND RESTORATION/RECLAMATION : Minimum area should be opened for mining so that it can be worked to the ultimate depth and reclaimed conveniently. Year-wise proposal for reclamation of land affected by abandoned quarries & other mining activities indicating extent of backfilling, recontouring, alternative use of unfilled/partially filled excavations/road side/slopes & mine should be furnished.

(IV) WASTE DUMP MANAGEMENT :. Proper terrace height with drainage facilities, provision of garland drain & retaining wall around the waste dump and settling tanks minimizes generation of wash offs and prevents to escape to the natural surrounds.

1. Design of solid waste dumps : Selection of suitable area, heights and slopes of the dumps and provision of intermittent berms

2. Design of retaining walls : Their shape, width, height, and size of foundation and material for construction.

3. Back filling - Old & worked out Quarries.

4. Design of tailing dams : Tailing is the residue of ore processing and represent a significant component of mineral waste, Tailing are commonly deposited as slurry containing from 45-80% water, depending upon the de-watering measures taken at the mill. Tailings include a variety of heavy metals, radioisotopes, cyanide, hydrocarbons, salts etc. Such constituents can leach from the tailings and enter surface and ground water. They can be disseminated through wind and water erosions. They can even migrate upward via capillary action and diffusion to contaminate the soil placed over the tailing surface to support vegetation; they can be absorbed by plants and introduced into food chain. The major environmental problem associated with mining is the tailing disposal, which includes Site selection, erection of dams, method of disposal, settling of slimes, decantation, reuse of water etc. The primary requirement of a tailing pond is to prevent the discharge of substantial amount of solids into the receiving watercourses.

(V) AFFORESTATION PROGRAMME :

1. Compensatory afforestation for forest lands: Compensatory afforestation is one of the most important conditions stipulated by the Central Government while approving proposals for the reservation or diversion of forestland for non-forest uses. Compensatory afforestation shall be done over equivalent area of non-forest land. In the event that non-forest land of compensatory afforestation is not available in the same district, non-forest land for compensatory afforestation may be identified anywhere else in the State/Union territory, as near as possible to the site of diversion, so as to minimize adverse impact on the micro-ecology of the area. No compensatory afforestation shall be insisted upon in respect of proposals involving diversion of forestland up to one hectare and for underground mining, in forestland below 3m.
2. Mulching and artificial soil formation on the waste dumps and reclaimed surface.
3. Initial reclamation crop-to improve soil quality.
4. Economic utilization of the area through commercial crops and through plantation of trees.
5. Provision of infrastructure facilities required for the afforestation work.
6. Provision of Green barriers Estimation of their widths and species selection for dust and noise control.

(VI) DRAINAGE CONTROL AND HYDROLOGIC BALANCE : It should include -

1. Protection of surface drainage system.
2. Design of garland drain.
3. Design of check dams.
4. Hydrological balance and recharge of ground water.
5. Water harvesting systems

(VII) LIQUID EFFLUENT TREATMENT : It should include -

1. Treatment of mine and plant drainage water.
2. Design of settling tanks and water treatment plants.
3. Design of sewage treatment plants and grease traps.

(VIII) TREATMENT OF DRINKING WATER: Filtration and chlorination of drinking water.

(IX) CONTROL OF SOIL EROSIONS: Design of drainage structures, spread of mulches and growth of vegetation.

(X) CONTROL ON FALL OF SCREE & FLY ROCKS : Modification of the blasting parameters if required to control the spread of fly-rocks.

(XI) CONTROL ON AIR QUALITY: It should include -

1. Noxious Gases : Measures to control emissions at source in the plants and with in the mines through scrubbers traps and stacks.
2. Dust control: Measures to control emissions at plants, mines and mine roadways, through filters, scrubbers, water sprays and green barriers.

(XII) CONTROL ON NOISE AND VIBRATIONS:

1. Noise level : Design of noise abutments structures and green barriers.

2. Ground vibrations: Controlled blasting technique/Alterations to conventional blasting systems to protect surface features and migration of wild life.

(XIII) WILD LIFE PROTECTION: Promotion of congenial environment for immigration of wild life

(XIV) HUMAN ENVIRONMENT: Preparation of practicable rehabilitation plants.

(XV) MANAGEMENT ON SOCIO-ECONOMIC FABRIC:

Provision of new avenues for jobs, adoption of surrounds villages, rural development programme, health care systems and preparation of cost-benefit analysis.

(XVI) POST-PLANTATION CARE: Permanent irrigation facilities and other post plantation care for the re-vegetated areas.

(XVII) MONITORING SYTEM : A feedback mechanism that the mitigation measures function efficiently. Locations of monitoring sections and analytical procedures to be adopted are to be specified.

(XVIII) EQUIPMENT FOR RESTORATION THE PLAN: Machinery and equipment required for soil preparation, afforestation, chemical analysis, meteorological data and erection of pollution control structures.

(XIX) MANPOWER ORGANISATION : Export facility required and the requirement of other staff, technical persons and workers.

(XX) MANAGEMENT COSTS : For monitoring better environment in mining area, fiscal estimates of expenditure (both capital and recurring) year-wise in the next 5 years should be made and provided for in the annual budget every year..

(XXI) LIST OF PLATES TO BE PREPARED

1. environment plan of the area showing base line information.
2. Drawings on the design of the waste dumps, tailing dams, check dams, garland drains, water treatment plans, etc.
3. Environment Management Plan showing year wise proposals during first five years of planned period & up to Conceptual Plan period for A category mines.

It may thus be observed that Environment Management in mining areas involves the study of certain changes that would be brought about in the natural environment existing before the commencement of mining as a result of mining operations. Thus environmental dimensions should be integrated into the planning, design, development, operation and working practice of mining on scientific and rational line. This can be achieved by regular monitoring of various environmental parameters, identifying the causes for such adverse impacts and suggesting ways and means to contain the likely environmental damage so that these parameters remain within permissible limits.

3.00 VARIOUS NOTIFICATIONS ISSUED BY MOEF :

Some of the important notifications issued by the MoEF related to mining industry are as follows :

1. EIA Notification September, 2006
2. Aravalli Notification 1992
3. CRZ Notification 1991
4. Doon Valley Notification 1989

ENVIRONMENT IMPACT ASSESSMENT (EIA) NOTIFICATION SEPTEMBER, 2006

- The National Environmental Policy, 2006 is intended to mainstream environmental concern in all developmental activities. As a sequel to the National Environmental Policy, 2006, the Government of India issued a new notification on 14th September, 2006 in supression of the 27th January 1994 notification specifying the mandatory requirement of prior Environmental Clearance to specified projects or activities.

- The EIA notification has been considered to be principal methodology for appraisal of new project and reviewing existing project. The important characteristics of the EIA 2006 is to formulate transparent, decentralized and efficient regulatory mechanism to incorporate necessary

environmental safeguards at planning stage of specified investment projects and to involve stake holdings in the public consultation process.

- All new projects or activities and also expansion and modernisation of existing projects or activities as listed in the schedule to the September,2006 notification shall require the prior environmental clearance from the concerned regulatory authority

- As per September 2006 notification, EIA is now mandatory for mining of 'minor minerals' as well which was hitherto not applicable. Further the allied activities to the mining industry such as Mineral Benefeciation, Aerial Ropeways, Common Effluent Treatment Plants would also require the prior environmental clearances.

- In September,2006 notification the projects and activities are classified into A & B categories and in respect of category B projects or activities State Level Regulatory Authority is competent to issue/reject clearance. This decentralisation of process is expected to help in speedy disposal of the cases.

- As per September,2006 notification Public Hearing is compulsory for mining projects having lease areas equal or above 5.00 Ha.

- It is mandatory for the project mangement to submit half-yearly compliance report to the regulatory authority.

COASTAL REGULATION ZONE (CRZ) NOTIFICATION, 1991

- Notification under Section 3(1) & Section 3(2)(v) of the EP Act 1986 and Rule 5(3)(d) of EP Rules 1986.

- The objective of the CRZ notification was to prevent widespread degradation of our precious beaches and check the imbalance to coastal ecology.

- The coastal regulation zone has been declared as " coastal stretches of seas, bays, estuaries, creeks, rivers and backwaters which are influenced by tidal action (in the landward side) up to 500 meters from High Tide Line (HTL) and the land between the Low Tide Line (LTL) and the HTL as coastal regulation zone." The CRZ has been classified into four categories.

- All activities of disposal of hazardous substances, untreated wastes from cities or towns, dumping of ash from thermal power stations, any constructions, setting up new industries including mining of minerals are prohibited.

- Clause (2) of the Coastal Regulation Zone Notification No. S.O. 114 (E) dated 19th February'1991 declares several activities as prohibited within the coastal regulation zone. Sub clause ix of this clause 2 prohibits-
  " Mining of sands, rocks, and other substrata materials, except those rare minerals not available outside the CRZ areas".

- CRZ notification provided that Committee Constituted by Lieutenant Governor of the Andaman & Nicobar Islands may permit mining of sands based on mining plan from such sites and in such quantity which shall not have adverse impacts on environment.

ARAVALLI NOTIFICATION 1992

- The Aravalli Range covering the northern states of Rajasthan and Haryana is ecologically sensitive area. as per Notification no. S.O.319(E) dated 7th May 1992, issued by MOEF, all mining operations (including renewals of mining leases) have been prohibited.

CONCLUSION :

Minerals play a decisive role in the growing economy. With the dawn of the 21st century, Indian Economy has transformed from stagnant to vibrant phase. The debate 'Mining or Environment' is now over and India is heading toward sustainable development with carefully drafted and strictly implemented environmental legislation. New National Environmental Policy 2006 and EIA Notification 2006 featuring greater transparency, decentralisation of powers, procedural simplification, post clearance monitoring will definitely mark a new milestone in the evolutionary process of Indian Mining.

ABANDONMENT COST. FINANCIAL ASSURANCE AND PRESENTATION OF THE DOCUMENT

Abandonment cost :

Determining the cost associated with closure and accruing these cost during the life of the mining operation is the fundamental part of closure planning so as to ensure that there are sufficient funds to close the operation and that closure cost do not become a burden at later parts of mine life. The closure plan should provide cost estimate for progressive rehabilitation on five yearly basis and for final closure activities including post closure maintenance and monitoring exercise. The cost of estimation for final closure should be initiated sufficiently in advance (at least 2-5 years) before the final closure activities start as by that time there is sufficient site specific information and data available. The closure cost can be estimated reasonably based on the present market value.

The closure cost though be indicative only but can be based on broad industry experience.

The closure cost should be reviewed regularly to reflect changing circumstances. While estimating the cost of abandonment different activities required for reclamation and rehabilitation, maintenance and monitoring including post closure monitoring and another administrative expenditures related to the closure operations should be accounted for as the objective of providing financial provision is to ensure that the adequate funds are available at the time of closure. While determining the closure cost of the following items and activities should be part of estimation of closure cost

1. Decommissioning / demolition.
2. Removal of infrastructure
3. Removal of equipment and heavy machineries
4. Site safety
5. Remediation / mitigation measures
6. Reclamation & rehabilitation of workings.
7. Maintenance / monitoring during and after closure operation.
8. Retrenchment and re-location cost.
9. Research & Development.
10. Administration / management

1. **Decommissioning / demolition:**

This may include the cost of dismantling, demolition and disposal of buildings i.e. structures and foundation of administrative, residential and service buildings, shaft structure including shaft service building, mineral processing plants, etc. and their support facilities i.e. electrical transmission lines, water and gas pipes, water work and sewer systems, telephone cables. etc.

2. **Removal of infrastructure :**

All the infrastructure created in the mining areas which are not required to be Dismantled and removed. The expenditure to be incurred on the following items should be accounted for.

i) Transportation infrastructure: This may include, rails, ropeways, belt conveyors, bridges, culverts etc.

ii) Electrical infrastructure: This may include electrical equipments, cables, transformers, electrical transmission lines, etc.

3. **Removal of equipments and heavy machineries :**

The expenditures to be incurred on removal of mining equipments i.e. pumps, hoists, fans, motor vehicles, drills, shovels, compressors, mineral processing equipments (crusher, grinding mills, flotation cells, etc.) and other equipments, if any are to be taken into account.

4. **Site safety :**

The expenditure to be incurred may include the following activities.

i) Sealing of underground openings (Shafts, adits, inclines)

ii) Providing stability to pillars, stopes and other underground structures and subsidence areas.

iii) Safety measures required to prevent access to open pits voids and underground openings i.e. providing fencing, safety walls, buds etc.

5. **Remediation / mitigation measures :**

Under this head the cost to be incurred for control and abandonment of pollution and providing physical and chemical stability to the accumulation areas is to be considered. These may include the following activities:

i) Providing construction bunds, check dams, garland drains, retaining walls, diversion channels, sedimentation tanks, etc.

ii) Providing physical and chemical structural stability to the tailing dams, dump etc.

iii) Reclamation and rehabilitation of dumps and tailing ponds etc. through vegetation, plantation, covers and water proof ness mechanism (for acid mining drainage control) etc.

6. **Reclamation and rehabilitation of workings :**

Under this head the following activities should be taken into account for cost estimation.

i) Rehandling of waste material, back filling, leveling and rehabilitation by way of vegetation, plantation, agriculture or any other post mining land use.

ii) Where back filling is not possible, the expenditure for developing pits / voids into water reservoirs for use of domestic irrigational, pisciculture recreational lakes etc. to be taken into account including modification of pit slopes, land scaping and development of final land form which should be stable, productive and self sustaining.

7. **Maintenance / monitoring during and after closure operation :**

Maintenance and monitoring of physical and chemical stability and of Environment Protection measures taken during and after closure operation is to be carried out to ascertain that remedial measures taken are effective and the site is safe and stable. The duration of maintenance and monitoring after closure may vary from 2 –5 years as per the situation. The maintenance and monitoring cost may include the following:

i) Providing equipment and instrument to be used for the purpose.

ii) Collection of samples and testing / analysis of pollutants, tailings and waste material (Physical, Chemical & biological).

iii) Data collection and evaluation of information gathered.

iv) Salary and wages on manpower deployment for the purpose.

8. **Retrenchment and relocation cost :**

Under this head the compensation and any other benefit to be paid for the manpower to be retrenched, expenditure to be incurred for providing training suited to any alternative job, facilities to be extended to the communities affected with the mine closure including health and safety measures etc. are to be considered for the purpose.

9. **Research & Development (R & D)** :

Expenditure to be incurred for R & D work related to restoration and rehabilitation i.e. revegetation studies, stability studies, studies on control and treatment of waste generating acid mine effluents etc. are to be considered.

10. **Adminstrative / management:**

The cost may include fees to be paid for preparation of closure plan, procurement of information and data from various institutions / organizations. Salary and wages of supervisory and managerial personnel for maintenance and monitoring activities and any other related administrative expenditures.

Financial Assurance : Financial assurance is the financial surety to be furnished by the lessee to be Regional Controller of Mines or to the officer authorized by the State Govt. as the case may be so as to indemnify the authority in the form guarantee by bank or any other financial institutions. The amount of surety to be deposited should be computed based on the area put to use for mining and allied activities. It should be estimated 5 years progressively basis on the basis of conceptual plan submitted with an addition of areas to be excavated during five years period minus the area already rehabilitated. The financial gurantee given should be irrevocable and encashable when needed.

Area put to use for mining and allied activities may be as follows.\

Areas to be excavated, storage for top soil, overburden dump, mineral storage, infrastructure (road, railway, workshop etc.) green belt, tailing pond, effluent treatement plant, mineral processing plant, township, others (to specify) The estimation should be carried out as follows:

(i) A Category mines. - Rs.25000 per hectare to the minimum of Rs.2 Lakhs.
(ii) B Category mines - Rs.15000 per hectare to the minimum of Rs. 1 Lakh.

The financial assurance guarantee as per rule should be submitted in any of the following forms or in combination of them.

a. Letter of credit from any schedule bank.
b. Performance or surety bond
c. Trust fund.
d. Any other form of security / guarantees acceptable to the authorities.

a) **Letter of credit :** It is issued by banks (acceptable from any scheduled bank). Letter of credit is an agreement between financial institutions and a company authorizing the bank to pay funds to a third party (to RCOM or authorized officer of State Govt.). The letter of credit is normally valid for one year or more. The agreement must provide for the automatic renewal of the letter of credit until the certificate of release is issued by the competent authority. In case bank has no provision for automatic renewal then it should be renewed when due by the party and the same should be submitted to be authority with whom it was earlier submitted.

b) **Performance or Surety bond :** Performance or surety bond is guarantee issued by bank, insurance company or another financial institution which agrees to hold itself liable for the performance (acts and failures) of third party (mining company). This is issue in the form of Fidelity bonds/surety bonds/performance bonds, etc.

c) **Trust fund :** Such type of trust fund probably has not yet been established. However, if any guarantee given from such trusts so established for the purpose, that may be acceptable.

d) **Any other form of security / guarantee :** The performance has to be given for financial assurance of the type mentioned in the form of letter of credit or surety bond. However other form of surety may be in the form of mortgage of the property by the applicant or by a third party who may stands gurantee on behalf of the application by hypothecation of immovable property or in any other form as acceptable by the competent authority. i.e. N.S.C, fixed deposit infrastructure bonds etc.

Closure of agreement : The agreement between the financial institutions amongst others should also include the following :

a) That no person may make withdrawal and make reimbursement without prior authorization from the RCOM authorized officer of State Govt. as the case may be. The purpose of the guarantee is to ensure completion of the work provided for in the mine closure plan.

b) In case the authority to whom financial security / gurantee was deposited and authority need to use the amount for carrying out protection, reclamation and rehabilitation work, the guarantee becomes payable on request.

Therefore the clause of agreement should be such that gurantee given should be irrevocable and encashable when needed.

Certificate :

A certificate as mentioned below has to be enclosed with the mine closure plan duly signed by the lessee.

"The mine closure plan complies all statutory rules, regulations, orders made by the central or state govt. statutory organizations, court etc. has been taken into consideration and wherever specific permission is required the concerned authorities will be approached. I also give an undertaking to the effect that all measures proposed in this closure plan will be implemented in a time bound manner."

Documentation :

The report should be concise and may be written in clear and simple language. It must be informative and contains all relevant information with tables to present results. Calculation details, analysis reports, and other data should be attached as appendices / annexures. However, only results and summarized statistics are to be presented in the body of the text. The report should be bound preferably with spiral or ring binder. The final closure plan should be first submitted in draft form (two copies) to the Regional Controller of Mines and finally it has to be submitted in five copies for approval.

Plans, Sections etc. :

The closure plan should be supplemented with all the plans, sections, sketches, drawings required for implementation of rehabilitation work as envisaged under various chapters of the guidelines of Mine Closure Plan already circulated. In addition to the requisite plans and sections where possible photographs of the sites, satellite images etc., may also be provided.