GOVERNMENT OF INDIA
MINISTRY OF STEEL AND MINES
INDIAN BUREAU OF MINES

I.B.M.'S MANUAL FOR MINING GEOLOGISTS

PREPARED BY
MINES CONTROL AND CONSERVATION OF MINERAL DIVISION

NAGPUR
MAY, 1990

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C O N T E N T S.

PART-A

PART-B

CHAPTER 1

1.0 INTRODUCTION

1.1 The ancient Kautilya's Arthshastra records thus: "Mines are Nation's treasury". Evidently, the mining industry has been enjoying a recognised place in a country's economic management policy since aeons. In India in the pre-independence period the mining industry was mainly controlled by entrepreneurs, State and Provincial Administration, each having its own system of leasing of mineral properties. Immediately after Independence the Central Government resolved an act regarding mining industries, namely the Mines and Minerals (Regulation and Development) Act 1948. With this enactment, the Indian Bureau of Mins (IBM) was entrusted with a set of functions in August 1950. In accordance with this charter, the inspection of mines and mineral prospects became a regular activity of the IBM.

1.2 The Mineral Conservation and Development Rules (MCDR), first enacted and enforced in 1955 and later amended in 1958, assigned the Bureau the role of custodian of Indian mineral properties. Since then the IBM has been overseing the systematic development of mineral properties leased out to public and private lessees as per the provisions laid down in the MCDR 1958. Besides regular inspection of mines, a system of conducting periodical studies of the leaseholds was gradually introduced in different phases from time to time. The objectives of the different studies were also suitably modified from

time to time on the basis of the changed circumstances and the experiences gained through the studies carried out earlier. A time has now come, for codifying and standardising the various procedures involved in carrying out the different types of investigations keeping in view the provisions of the MCDR 1988. It has also become necessary to prepare a manual so that proper guidelines can be evolved for different studies being carried by the Department.

1.3 In the context of mining geological work the following types of studies/investigations have been recognised in the MCCM Division.

i) Mining geological study,
ii) Regional mineral development study,
iii) Mineral reject study,
iv) Colection of mineral/rock samples in connection with different investigations,
v) Examination of area under prospecting licence applications,
vi) Examination of prospecting licence area, which is virgin in nature,
vii) Examination of mines under stoping proposal,
viii) Preparation of geological reports of small leaseholds areas, and
ix) Preparation of mineral maps.

1.4 This manual for Mining Geological Studies marks the first attempt to bring together all relevant documents, which have been periodically issued for the purpose at various times. Since various groups of officers are involved in the

various activities described above, the place of co-ordinating and supervising authority has also been recognised and suitable guidelines for the supervisory officers are also incorporated in this manual.

1.5 The guidelines in respect of each study deal with aim and objective of study, methodology of field work and a format for report writing. Besides, difeerent important aspects dealing with preparation at headquarters before proceeding for field work has also been exhaustively discussed.

1.6 It is hoped that this manual will help the mining geological officers of MCCM Division to systematise and standardise their investigating and inspecting activities.

CHAPTER 2

2.0 AUTHORITY FOR INSPECTION/EXAMINATION OF MINES AND TECHNICAL CONTROL SYSTEM.

2.1 AUTHORITY FOR INSPECTION AND STUDY OF MINES AND LIMITATIONS :

2.1.1 The Section 24 of MMRD Act 1957 empowers any person authorised by the Central Government to enter and inspect any mine, survey and take measurements, examine any document or order the production thereof and examine any person concerned with the mine.

2.1.2 The Central Government Gazette notifications dated 27th January 1959, 29th March 1965 and 25th April 1972 authorise the powers of entry and inspecttion to the Regional Mining Geologists, Senior Miniing Geologist and Junior Mining Geologist under the above section besides other officers. At present, the powers to launch complaints in the Court of Law for violations of provisions of the MMRD Act 1957, Environment (Protection) Act, 1986 and approval of mining plan have not been delegated to officers of Mining Geology discipline of the Indian Bureau of Mines. The Chief Mining Geologist has been authorised to enforce rules 4(1)h, 6 and 63 under the MCDR 1988. These relate to prospecting operations and furnishing of information concerning particular mines.

2.2 ORGANIZATIONAL HIERARCHY FOR MINING GEOLOGICAL STUDIES AND REPORTING :

2.2.1 In the IBM the geological studies are carried out by the Mining Geologists at the Headquarters and those posted at 12 Regional Offices of MCCM Division located at Ajmer, Bangalore, Calcutta, Dehradun, Hyderabad, Jabalpur, Madras, Madgaon(Goa), Nagpur, Nellore, Ranchi and Udaipur and three Divisional offices situated at Nagpur, Bangalore and Ajmer.

2.2.2 At present the Chief Mining Geologist in the office of the Chief Controller of Mines, is the highest authority of the discipline who is vested with the followng functions :-

i) Planning and programming of mining geological activities of MCCM Division in relation to overall objectives,

ii) Periodic visits to the field to render guidance to the officers,

iii) Organising special studies, to be carried out in relation to specific reference received,

iv) Finalising the mining geological reports emanating from the zonal offices, and

v) Organising the preparation of mineral maps and geological mapping of small leases and co-ordination with the Mineral Economics and Mineral Statistics Divisions in the preparation of mineral inventories.

2.2.3 The Superintending Mining Geologists and Regional Mining Geologists posted in the zonal and regional offices respectively, draw technical instructions and guidance from the CMG/COM. The Supdtg. Mining Geologist is required to plan, guide and supervise the work of junior officers in the concerned regions besides undertaking special studies. The Regional Mining Geologist is similarly, requuired to look after the mining geological activities in one or more of the regions. The Senior Mining Geologists, Junior Mining Geologists and Assistant Mining Geologists (including STA Geology) form the core of the functional units. The planning and supervision of technical work of the mining geologists including field work and preparation of reports would basically rest with the officers of the Mining Geology discipline. But the overall administrative control of the region/zones rests with the RCOM/COM. However, as an exception both the technical, administrative and financial control of Geological Mapping and Mineral Map Cells have been delegated to the CMG.

2.3 ANNUAL PROGRAMME OF WORK :

2.3.1 The annual programme for the functional officers of mining geology dscipline, particularly those posted in the regional offices of IBM, are proposed on the basis of technical problems identified by the department or those referred to it by the industry/ministry. The annual programme is ultimately approved in consultation with the CMG. This approved annual programme of the regions is normally distributed over four quarters of the financial year with complementary action plan targets for completion and submission of study reports.

2.3.2 The norms of work for various geological studies have been fixed by the Government (vide F.23012/123/80 M.VI, dated 4/9/1980). However, certain changes in these are sometimes possible depending on the special requirements of the assignment. In such cases the changed norms will be communicated specifically.

CHAPTER 3

3.0 GENERAL PREPARATIONS FOR GEOLOGICAL STUDIES

3.1 PRE-TOUR PREPARATIONS :

3.1.1 Seeking Tour Approval : Every functional officer of the Mining Geology discipline shall apprise himself about the items of studies assigned to him and its scheduling as per the annual programme of the region/section well in advance. Accordingly, he should seek the approval for his proposed tour programme through a file noting, to be put up to his controlling officer at least one month before his scheduled departure. The proposal should include the names of team members, tour period, duration of tour, area/mining lease proposed to be studied during the period, the vehicle and other field equipment requiired for the purpose etc.

3.1.2 Literature Survey and Collection of Information on the Area: On approval of tour programme the touring officer shall make a thorough study of the technical literaure on the area of operation available in the concerned mines files like MCDR and detailed study reports, records, notices, returns and publicatons of Geological Survey of India and State Directorates of Geology and Mining. Thus, he should apprise himself thoroughly with the facts, figures, and problems of mines and also indentify areas of special attention before proceeding on tour. The area of operation should be located on the Survey of India toposheet and the infrastructural facilities

available in the area should be ascertained. A first hand discussion with the officers who have already visited the area or mine wil be quite useful.

3.1.3 Applying for Contingent Advance: At least 20 days before his departure the officer should submit a detailed estimate for non-recoupable contingent advance for the expenses (POL advance) which he expects to incur during the field work. This proposal should include the breakup of journeys involved, total requirements of diesel/petrol, oil and lubricants for the vehicle with respective costs, incidental and miscellaneous expenditure envisaged and the expenditure on the contingent labourers likely to be engaged for geological mapping, survey and sampling, etc. A consolidated proposal for the contingent advance should be submitted to the competent authority empowered to sanction the advance. Timely follow up should be made to ensure drawal of advance in time.

3.1.4 Seeking Travelling and Daily Allowance Advance: The inspecting officer should also submit a proposal for the grant of travelling and daily allowance in respect of himself and his team members for the period of tour. Normally, the daily allowance at hotel rate, for not more than 30 days, with travelling allowance for the entitled class is sanctioned by the competent authority.

3.1.5 Movement Order: The movement order in respect of the party incharge and his team members is normally issued by the controlling officer giving details and purpose of official journey at least one week before the departure of the field team. It is not merely an offiial notification, but has a wide

ranging and varied useful ramifications. It is often helpful to verify the official background of the team members, their status and purpose of tour. It is also handy during reservation of accommodation in Government Circuit House/Rest House, and in case of natural calamities, accident, etc. Therefore, the movement order should invariably be collected by the touring officer before his departure on field trips.

3.1.6 Maintenance and Upkeep of the Field Vehicle: The touring officer should ensure well in advance the road worthiness of the field vehicle allotted to him for field duty. All major and minors repairs and maintenance of the field vehicle should be attended to and completed at least one week before the departure on tour. The light vehicle driver should be apprised of the type of terrain that he has to negotiate on tour. He should also be advised to collect and keep ready the original documents pertaining to registration, maintenance and journey log books etc. complete in all respect.

3.1.7 Requisition of Stores, Equipment and Stationery:

The touring officer should requisition from the sectional/regional/divisional stores all field and camping equipment, general stores and stationery items required for his field work, well in advance. The stores should be received from the concerned stores section in time and carried to field for official use. A non-availability certificate in respect of items not available in the stores may be obtained from the stores section to facilitate purchase of necessary items in the field from the contingent advance. For any field work connected with geological studies the following items would be necessary.

i) Brunton compass,
ii) Steel tape (2m and 30m, one each),
iii) Set of pencils and erasers,
iv) Field diary,
v) Coloured pencils set,
vi) Diagonal and plotting scales,
vii) Protractor,
viii) Set squares,
ix) Pocket lens,
x) Horse shoe magnet, small size,
xi) Knife,
xii) Streak plate,
xiii) Canvas kit bag/Haversack,
xiv) Plotting, tracing and graph papers,
xv) Topographical base map of the area of operation,
xvi) Sampling kit,
xvii) Geological hammer,
xviii) Safety helmet,
xix) Field shoes,
xx) Raincoat (during Monsoon),
xxi) Water bottle,
xxii) Ball point pen,
xxiii) Calculator, and
xxiv) HCL acid bottle.

3.1.7.1 In addition to the above a good 35mm camera and binoculars are also useful in the field study.

3.1.8 Intimation and Correspondence with Lessee:

The lease/ area to be inspected/studied by the officer should be identified and the concerned lessee/owner should be intimated by registered A/D letter about the tour proramme, type of study and working facilities required to be provided by them

well in advance. The lessee should be requested to keep the mine record, available plans and sections updated and ready for inspection study. A formal request for the reservation of accommodation for the team in the local rest house/hotel can also be made to the local authorities or lessee.

3.2 PRECAUTIONS TO BE TAKEN DURING THE TOUR:

3.2.1 Use of Vehicle and Maintenance of Records:

The touring officer should ensure that onward and inward journeys are performed by the shortest route without loosing time enroute. He should also guard against the wasteful running of the vehicle. All the journey and maintenance details should be regularly entered in the concerned journey and maintenance log books of the Vehicle. After the completion of the calendar month, the monthly summary of the journeys should be prepared in the running log book to work out the average kilometerage of the vehicle.

3.2.2 Precautions During Vehicle Breakdown and Accident: In case of a vehicle break-down or accident, immediate action should be taken to inform the Headquarters, and local authorities or the police as the case may be. All legal and humanitarian responsibilities should be fulfilled in case of accidents without any loss of time.

3.2.3 Precautions Against Injury and Sickness:

The team incharge should take adequate precautions against sickness and injury to self and team members. A fully equipped first aid box should invariably be available with the touring officer which can be used during such unforeseen problems. Adequate preventive

measures should be taken under the advice of the local medical staff and social workers.

3.2.4 Contingent Purchase : The touring officer should exercise care and caution about the contingent purchase. He should ensure that only such inevitable expenditure be made which is necessary and incidential to the field study. The general norms and procedures for the repair and maintenance of vehicle should be followed. For all the purchases and expenditures duly certified original cash memos should be obtained from the parties on the prescribed forms and the items should be entered in the field stock register giving the receipt number, dealers name, item of expenditure and amount in each case.

3.3 POST -TOUR PRECAUTIONS :

3.3.1 Adjustment Bill for Contingent Expenditure:

He should prepared an adjustment bill for the contingent advance taken by him and deposit the unspent amount with the cashier, within 15 days of his return from tour lesth invites penal rate of interest on the whole amount as per the existing Government Rules. The contingent adjustment bill should be prepared in triplicate giving details of purchases made during the tour and submit to the controlling officer for further necessary action. All original invoices and cash memos should be duly certified by the officer on the reverse with reference to concerned page numbers of the field stock register/vehicle log books.

3.3.2 Adjustment of DA/TA Advance: The touring officer should submit his adjustment bill for the TA

and DA advance taken for the tour. The unspent amount should be deposited with the cashier and a proper receipt obtained. While preparing his TA/DA adjustment bill he should keep in mind the relevant TA/DA rules in force and submit the final adjustment bill through proper channel within 15 days of his return from tour.

3.3.3 Synopsis of Field Study: The touring officer should submit a short report on field work and difficulties experienced if any, during the tour to his controlling officer within a week of his return from tour.

3.3.4 Return of Stores: All the stores, equipments etc., carried on the tour should be returned in time to the stores section. The survey equipments on use during the tour should be returned along with a report obtained from the surveyor on its condition. Any repair required in the instrument should immediately be informed to the office.

3.3.5 Despatch of Samples for Analysis:

3.3.5.1 The samples collected during the study, if any, should be processed preferably in the field itself and a duplicate should be preserved for further reference.

3.3.5.2 The original numbered samples should immediately be despatched to concerned chemical/mineralogical laboratory of IBM along with a covering letter duly authorised by the divisional/ regional head giving details of the samples with their numbers, type of investigation/analysis required to be done, radicals to be analysed and deadline for receipt of analytical report etc.

CHAPTER 4

4.0 MINING GEOLOGICAL STUDY

PART-A

4.1 OBJECTIVES :

4.1.1 Mining Geological study is kept confined to an individual leasehold or a large underground mine with the objectives of understanding the following aspects of the area/mine :-

i) Extent of mineralised zone,

ii) Mode of occurrence of mineral/ore,

iii) Occurrence of another mineral/ore of economic importance,

iv) Physical and structural details of ore body/ore zone, wall rock, which may have a bearing on mining of the mineral/ore,

v) Availability of prospecting/exploration data for proper understanding/assessment of details under(i) to (iv),

v) Availability of prospecting/exploration data for proper understanding/assessment of details under (i) to (iv),

vi) Availability of mineral/ore in terms of tonnage with categorisation and grade-wise distribution,

vii) Requirement of further prospecting/exploration, if considered necessary,

viii) Method of extraction of mineral/ore together with a view to examining generation of mineral rejects and its disposal,

ix) Marketing of ore with a view to ascertaining proper utilisation of mineral/ore as per grade/quality,

x) Cost analysis for fixing economic striping ratio, and

xi) Impact of mining on vegetation/forest, landuse of contiguous blocks, and contamination of different sources of water.

PART-B

4.2 METHODOLOGY OF FIELD WORK :

4.2.1 This type of study requires application of geological knowledge for the purpose of achieving the objectives set above. Since such investigations are to be conducted for different minerals-metallic and non-metallic, it may be difficult to list out details of method to be adopted in each case. However, broad guidelines are given below :

4.2.2 A reconnaissance survey of the lease area/mine is necessary to plan out survey of the leasehold for the purpose of preparing topographical map with details of geology and allied aspects or deciding a suitable approach for examining of a mine.

4.2.3 Services of a surveyor may be preferably utilised in respect of study related to a lease of opencast mines. In case of underground mines, underground plans/sections available with the lessee should be made use of. However , spot checking from survey stations in underground developments with Brunton compass may be done while preparing levelwise geological plan specially in respect of mica mines.

4.2.4 Control of Mineralisation: In the course ofpreparing geological plan of area/mine, critical examination of physiographic features, specially topography, may have to be done with a view to ascertaining its relaton, if any, with the zones of mineralisation. Similarly, examination of lithological units controlling occurrence of ores/ minerals have to be studied. Besides, change in mineralogical assemblage in mineral bearing zone and in barren zone may have to be noted in detail. Special stress on the structural aspects for delineating the role, if any, of specific structural factor in controlling economic mineralisation may be given. These details, when scanned may help in identifying the effect of topographical, lithological mineralogical, strucutral aspects controlling the mineralisation in a lease area or a mine.

4.2.5 The features noted above can be studied and established only when adequate openings are available through old or present workings and details of systematic prospecting/exploration are available with the lessee. Experience shows that most the areas/ mines may not provide with either of the above noted details. In such cases, the geologists may have to formulate some tentative idea with regard to different controls of mineralisaton based on available mine openings or exloration details. The basis of formulating tentative idea may have to be discussed, which will also propose limited prospecting/exploration for accepting or rejecting the tentative ideas about controls of mineralisation.

4.2.6 Reserve Estimation : Reliable estimation of mineral/ ore reserve in the absence of adequate details is no doubt a difficult task, but sincere attempts should be made for estimating in situ reserve position in terms of different categories,

i.e., proved, probable and possible. These three categories of ore reserve bear standard definition and therefore, calculation of ore reserves should be made on the basis of defined terms(Refer Annexure-I/IV).

4.2.6.1 Demonstrated (Proved and Probable) reserve out of insitu category should also be calculated after defining the basis of such calculation. The same formula could be extended to probable and possible categories, with a note that the formula is being utilised on the assumption that all geological aspects continue to remain the same in the explored area/porton of the mineralised zone.

4.2.6.2 For estimating gradewise reserve, the following two methods may have to be adopted :-

i) Collection of production details gradewise/ qualitywise from the record of mines, the figure of approximate recoveries; and

ii) Study of mine production during the period of study of the area/mine.

4.2.7 Mineral Rejects : The term mineral rejects encompasses portions or fractions of mineral/ore, which are being lost in course of mining due to size fraction, selective mining or sorting, defective ore handling and marginal or sub-grade mineral content. (These may be caused due to either ignorance of the management or with a deliberate intention of high profit making). Hence the study should aim to identify the stages of generation of rejects, type of rejects with approximate tonnage generated at one or various stages in the present working mines.

4.2.7.1 It would be desirable to examine old dumps with a view to finding out the availability of mineral rejects with debris. At places separate dumps of mineral rejects are kept. Hence, attempt may have to be made to assess availability of mineral rejects in old dumps.

4.2.7.2 A detailed method of conducting mineral reject studycan be found elsewhere in this manual. The same methods may be adopted.

4.2.8 Proper Utilisation of Mineral: On the basis of old reports/record, it may be said that mine owners have the tendency to sell high grade materials to those consumers, whose requirement is far medium or low grade material. This is against the principle of conservation. This aspect could be examined by collecting details from the management in respect of different consignments, address of consumers, sale price etc. These details could be compiled. Further, a reference may be made to ascertain the specification of raw materials of those consumers. This is a time consuming process. Hence the report will contain details collected from the managements and those details can be utilised by the office for ascertaining proper utilisation of ore/minerals from different mines/leaseholds.

4.2.9 Economic Striping Ratios: For an opencast mine, it is very essential to calculate economic striping ratio as it will help in proper mine planning and also restricting mining of ore from low burden zone only.

4.2.9.1 The break up of cost may have to be collected from the old reports/record of mines. These details alongwith sale price as provided under

4.2.8 above may help in finding out economic striping ratio.

4.2.10 Environmental Aspects : This study will restrict examination of environment aspects to following items :

i) Existence of vegetation of forest specially over mineral bearing zone and also on areas which are necessary to be utilised for mining activity.

ii) Disposal of mines rejects and its location with a view to finding out whether flow of mine rejects through different natural agencies would affect the fertility of nearby agricultural land or would contaminate nearby water sources or would obstruct stream or nalla courses or public road.

iii) Discharge of mine water may also have to be examined keeping in view its impact on nearby agricultural land or water sources.

iv) Steps, if any, being adopted by the lessee towards land reclamation and suggestion for further necessary steps to be taken by the lessee may be given in short.

PART-C

4.3 PREPARATION OF REPORT :

4.3.1 Reporting of information and data after proper analysis forms an equally important part of the study. The input of intelligence and labour of the worker, if systematically reflected in the report, helps the industry and brings reputation to his own

organisation. Hence it would be desirable to prepare a comprehensive but cohesive report within a reasonable time period after completion of field work. These reports should avoid copious references to other reports and publications, and should mainly deal with analysis and refereces drawn from observations made details collected during field work. References to other lieratures, however, need be made for supporting inferences drawn from the present field wok. The list of reports and literature referred may be mentioned in the report.

4.3.2 Time schedule for submission of reports for various studies is given in Annexure-I/XI under Chapter-XI.

4.3.2.1 It is a fact that report writing is an art which an individual will develop in his own way through guidance and practice but in order to bring an overall uniformity in reporting system broad guidelines for arranging the materials in the following chapters are given below :

4.4 FORMAT FOR REPORT

0.0 SUMMARY

1.0 INTRODUCTION

1.1 Objective, scope and limitations (may include date of tour days, assistance availed from lessee, and other agencies).

1.2 **Locations and Approach :** Reference to topo-sheet and major land marks preferably; clear idea about approach through rail and road desirable.

1.3 **Leasehold Details :** Status of lease and lease boundary.

1.4 **Previous Work :** Reference to previous work done by any other agency like GSI, MECL, State DGM or other private consultants and by our department.

2.0 GENERAL GEOLOGY :

Compliance position of Rule 28, 29 and 30 may be reported.

2.1 Physiography :

2.2 Stratigraphic Details : Regional stratigraphy as per standard work done by other in the area; lithological units observed within the area of study and their relation with regional stratigraphy, details of each lithological units with special treatment to the host rock units. Reference to source of reports and literature may be made.

2.3 Structure : Regional structure, if available, based on published/unpublished literature/report, structure as observed during field work based on examination of surface geology, underground level plans and cross-sections prepared by author; discussion on general structure and its relation with the zone of mineralisation, if any; structural features like details of fault, fold, joints, bedding plane foliation plane etc. country rock which may need consideration for mine planning.

2.4 Economic Ore/Minerals : Mode of occurrence; size and shape of mineralised zone as a whole with size and shape of individual lens, vein, pod, bed etc., associated minerals and impurities; grade distribution.

7.0 ENVIRONMENTAL ASPECTS :

7.1 Compliance of provisions of Rule 31, 32, 33, 34, 38 and 41 may be reported. Details of vegetation/forest in the entire lease hold with special reference to the mineral bearing ground and also the area necessary for conducting mining operation, dump site, with discussion about the possbility of flow of dump site, with discussion about the possibility of flow of dump materials through natural agencies to the neighbouring agricultural land, nala, stream, river, public roads and the likely impact, discharge of mine water and its impact over agriculural land and other water sources of the area; scheme of restoration of land over the old abandoned area, if any, scheme of plantation, if any.

8.0 CONCLUSIONS AND RECOMMENDATIONS :

8.1 **Conclusions :** It should contain important inferences or observations made with regard to controls of mineralisation, prospecting and exploration, shape, size and extent of ore body, gradewise distribution of ore, mining method, ore to overburden ratio, reserve estimation, production and marketing of ore, generation and handling of mineral rejects, beneficiation.

8.2 **Recommendations :** Recommendations should follow the same serial order which has been adopted under te heading, conclusion. The recommendations may be put in two parts :-

i) Violations/non compliance of relevant MCDR as mentioned in different

paragraphs of this guideline, and

ii) Suggestions for proper development of mine, conservation of minerals etc.

Every suggestion should be complete in the sense that the basis or background for suggestion may be given along with the suggestion and the expected result.

ANNEXURE-I/IV

STANDARD DEFINITIONS OF PROVED, PROBABLE AND POSSIBLE RESERVES.

PROVED RESERVE : This category will have to encompass conclusions on all main geological aspects of the deposit or part there of in matters such as tonnage, grade, physico-chemical and metallurgical parameters. Though strictly a geological ore reserve, the reserve included herein, must have total evaluation of the type of occurrence, shape and structure of the deposit including attitude and tenor etc., in different segments of the blocks under the purview of **"Proved Reserves".** The configurations of the mineral body should be defined by adequately spaced boreholes and/or exploratory openings. The information collected should be sufficient to take pre-investment decisions on production planning, mine development, capacity projections and preparation of feasibility reports with techno-economic options alternatively delinated after studies on anticipated recoverable mine produce, should the mining start. The error of estimaion of tonnage should be in the range of 10 to 20 percent.

PROBABLE RESERVE : This category implies a clearly lower status to the ore reserves in terms of degree of assurance, in spite of being still within the direction of economic consideration. Here the tonnage and grade are computed based partly on the data retrieved from **"Developed"** or **"Proved"** blocks on extensions and also partly from geological knowledge of analogous ore bodies within the metallogenetic province or epoch. This category thus must include the currently non-producible parts of

the deposits being exploited, developed or under feasibility study besides the deposits which too may become producible with marginal improvements in economic and/or technological fronts. Peripheral portions of large iron ore deposits could exemplify the former while medium to small base metal prospects of India could illustrate the latter kind of probable reserves, provided mineral exploration has been undertaken commensurate with desirable accuracy of vital conclusions thus enumerated. The error of estimate of tonnage sould be in the range of 20 to 30 percent.

POSSIBLE RESERVE : This category includes reserves estimated after exploration which may suffix for a rapid evaluation of tonnage, grade and physico-chemical characters of deposits, based on assumed continuity of ore from geological evidence and/or widely spaced exploration openings, corroborating geophysical/geochemical survey data, large-scale geological maps and/or rather disconnected surface information from pits, cliff sections, mine faces and similar suggestive interpretations, if available. The **"Possible Reserves"** may have an error level of 30 to 50 percent.

CHAPTER 5

5.0 REGIONAL MINERAL DEVELOPMENT STUDY

PART-A

5.1 OBJECTIVES :

5.1.1 The Regional Mineral Development Study aims at bringing out a comprehensive account of all the basic data required for systematic planning, development, and utilisation of a mineral or closely related groups of minerals within leaseholds in a compact mining district or a mineral belt.

5.1.2 The primary objectives of these studies may be enumerated as follows :-

i) appraisal of the resource potential of mineral (or group of minerals) in a mining district and classification and categorisation of the resources, leading to the preparation of Mineral Inventory and Mineral Maps.

ii) review the status of exploration and mine development within the district,

iii) locating gaps and problems of exploration, reserve assessment, extraction, conservation, waste disposal etc.

iv) defining more promising and potential blocks within the district, requiring further detailed studies fo systematic development,

v) assessment of production potentials within the leaseholds in a district,

vi) review of the status of infrastructure facilities such as, transport and communication, power, water, space, labour, auxiliary and subsidiary support industries and facilities, etc.,

vii) assessing the possibility of setting up of new mineral based industry within the region,

viii) impact of mining activity on environment and remedial measures for minimising the adverse impact. These studies are multi-disciplinary in nature though mining geologists have to play a major role. In fact, the RMDS does not end in itself but serves as the feeding ground for many other studies. Because of its basic and comprehensive character, this study helps to bring out diverse problems facing the mining and mineral industries of the region and then of the country as a whole.

PART-B

5.2 METHODOLOGY FOR FIELD WORK

5.2.1 The R.M.D. studies are to be carried out by a team comprising one Mining Engineer and a Mining Geologist. The Mining Geologist will be looking after the items (i) to (v) as mentioned above.

5.2.2 The methodology for conducting field work will be almost similar to that discussedin the guidelines for Mining Geological Study. In fact, the type of study for each leaseold will be almost the same. The only difference will be that all the leaseholds in a particular mining district or mineral belt are studied in continuity for an overall assessment of

the mineral potentiality, its development and utilisation of minerals. However, in this study, some additional investigations on the following two aspects are envisaged :-

i) Mining aspects, and
ii) Techno-Economic aspects.

5.2.3 The details and data on mining aspects will be examined and collected by the officers of Mining Engineering discipline, in the course of techno-economic survey. Services of Ore Dressing Engineers may have to be utilised when large scale beneficiation problems are envisaged or a proposal for setting up mineral based industry is to be decided.

5.2.4 For the above two aspects the details to be collected could be on the lines indicated below :-

5.2.5 Mining Aspects : These aspects may be examined under the following sub-heads :

i) Mining method,
ii) Machinery in use,
iii) Drilling and blasting,
iv) Cost of production,
v) Winning and Processing of ROM,
vi) Loading and transport, and
vii) Employment potential.

5.2.6 Techno-Economic Aspects : For the techno-economic aspects, the details may have to be collected are as follows :-

i) Transport and communication,
ii) Availability of power and its envisaged requirement,
iii) Water,
iv) Labour,
v) Space, and

vi) Marketability vis-a-vis demand and specification of trade.

5.2.6.1 The field work shall be completed within the specified period as determined in the annual programme of work for the year.

PART-C

5.3 PREPARATION OF REPORT

5.3.1 General guidelines have been given in para 4.2.1. A format for the report is given below :-

5.4 FORMAT FOR REPORT

0.00 SUMMARY

1.00 INTRODUCTION

1.01 Purpose : Short background note indicating the need/justification of this study.

1.02 Scope and Limitations : Brief outline of approach to the study, its scope and constraints as imposed by the field conditions, available data, time and personnel devoted or deployed.

1.03 Location and Approach : Reference to toposheet and major land marks preferable, clear idea about approach through rail and road desirable. All the leases may be shown on a single map or on continuous sheets of a map.

1.04 Description of the Leases : List of leases with same reference number as shown on location map may be given in tabular form with details of period of lease and any other information of specific interest.

1.05 **Previous Work :** Reference to previous work done by any other agency like GSI, MECL, State DGM, Private Consultants or by our department.

2.00 **GENERAL GEOLOGY :**

Compliance position of Rule 28, 29 and 30 may be reported. Description of the following aspects may be done for mining district or mineral belt as a whole but specific references may have to be made for the different leaseholds where observations have been made on different aspects.

2.01 **Physiography :**

2.02 **Stratigraphic Details :** As detailed in para 2.2 of M.G.S. report format.

2.03 **Structure :** As detailed in the para 2.3 of MGS report format.

3.00 **EXPLORATION AND DEVELOPMENT :**

As detailed in para 3.00 of MGS report format.

4.00 **RESERVES :**

As detailed in para 4.00 of MGS report format.

5.00 **MINING METHOD, ORE PRODUCTION :**

5.01 **Mining Method :** The mining method should be described in brief - opencast/underground, semi-mechanised; mechanised. It may indicate whether mining practice is suitable for maximum recovery of ore/mineral; proper quality control; proper system of blending as per rule 15(3). Comments on possible economic ore to overburden ratio and the ratio being maintained in the mine.

5.1.1 This sub-chapter can be discussed under folloing heads :-

i) Mining method,
ii) Machinery in use,
iii) Drilling and blasting,
iv) Winning and processing of ROM
v) Loading and transport, and
vi) Cost of production.

5.1.2 Detailed description of the above items for each leasehold/mine/quarry may not be necessary unless there is a marked difference in any mine or some specific aspect or topic is intended to be highlighted in tabular statement as far as possible may be made for each item followed by discussion on each item.

5.1.3 Production of Ore : As detailed in para 5.2 of MGS report.

5.1.4 Mineral Rejects : As detailed in para 5.3 of MGS report. Compliance position of Rule 16 and 18 may be reported.

6.00 BENEFICIATION :

As detailed in para 7.00 of MGS report format.

7.00 ENVIRONMENTAL ASPECTS :

As detailed in Para 7.00 of MGS report format.

8.00 TECHNO-ECONOMIC APPRAISAL :

8.01 Review of the resource position,

8.02 Review of the status of development,

8.03 Review of the production potentialities, vis-a-vis the regional allocation, if any, of the production targets and problems thereof.

8.04 Review of the infrastructure facilities available or required. It may be necessary to subdivide again into the following :

i) Transport and communication,
ii) Power,
iii) Water,
iv) Space, and
v) Labour.

8.05 Review of marketability vis-a-vis the demand and specification of trade, characteristics of the deposits, problems and need for beneficiation, R and D needs, etc.

8.06 Review of the economic parameters.

8.07 Feasibility for setting up of mineral based industry (including beneficiation plants) in the region. Based on the data presented under the different chapters and sections enumerated above, it sould be possible to identify the need and possibility of setting up of beneficiation plant or mineral based industries within the region, on the basis of mineral resources available in the region or, if feasible, supplemented in part, by mineral resources from outside the region. Each of these possible industries should be described here separately. It should be desirable to discuss each of these under the following topics :-

i) Name of the industry and end products,
ii) Likely present or future demand of the product within the region or within the country, or possible export potential.
iii) Raw material required and availability of the raw material within the region or from outside the region,
iv) Short description of the process involved,

v) Brief information or comments on whether same or similar industry or technology is available within the country or is practised outside the country, and wherever possible their scales of operations and relevant technical data,

vi) In case same or similar technology is available within the country the scale of operation envisaged or sustainable with the available resources within the region,

vii) If possible an idea about the approximate investment required for setting up of such mineral based industry unit,cost of operation; average unit, price of the product, etc.

viii) Requirement of fuel, power and ancillary infrastructure facilities, etc. and extent of availability of these within the region,

ix) An approximate idea about the employment potential, and

x) Choice of locatiion for such industry.

9.00 CONCLUSION AND RECOMMENDATION :

9.01 Conclusion : This should not be a mere summarisation of different chapters and sub-chapters but should endeavour to bring out the major and significant inferences drawn and problems identified.

9.02 Recommendation : Recommendations should follow the same serial order, which has been adopted under the heading, 'Conclusion'.

Each recommendation should be complete in itself i.e., basis or background for recommendation may be given alongwith the specific and brief recommendation.

10.00 ACKNOWLEDGEMENT :

11.00 BIBLIOGRAPHY :

CHAPTER 6

6.0 MINERAL REJECT STUDY

PART-A

6.1 OBJECTIVES :

6.1.1 The two terminologies, "Mineral Rejects" and "Mining Waste" are commonly used in mining field. It would be helpful to define these two terminologies.

6.1.2 "MINERAL REJECTS" are those which come from mineralised areas of a mine during mining practices but do not confirm to the prevalent specifications of marketable grade, at a particular point of time. The Government has taken a specific measure under rules 16(1) and 33 of MCDR, 1988 which envisage mine owners to stack and preserve mineral rejects, fines, etc. separately without mixing them with waste material. It only insists that it should be stacked and stored separately. The threshold value defining the wastes from rejectsshould be such that it is well below the limiting mineral value up to which beneficiation has been possible, even if the process is not necessarily economically viable. Materials below these values may also not have any recoverable by-products and also co-products. Mineowners may throw away only those material which qualify these criteria.

6.1.3 "MINING WASTE" generally constitues dead over-burden or separately mineable bands of non-mineralised rocks or unitsof inert material (completely devoid of mineralisation) occurring within ore zones.

6.1.4 The mineral rejects may include all materials which are either (i) chemically subgrade materials,

below the acceptable limits of current commercial specifications, or (ii) of different physical characters or of different ore types than acceptable in the market, or (iii) of sizes lower than the acceptable miniimum size, or (iv) contain certain deleterious constituents to make it unacceptable grade materials.

6.1.5 The rejects may arise out of inherent characteristics of the deposit or due to particular technique employed in mining and ore handling or due to a combination of both. Therefore, a proper study of the generation of mineral rejects would involve careful examination of the mine faces and mining techniques employed. The objective of study of the mineral rejects is :-

i) to ascertain nature and type of rejects being generated from the mines or quarry faces,

ii) to assess quantum and proportion of such generation in the current workings at every stage of mining and dressing,

iii) to assess the volume/tonnage of mineral rejects available in old dumps,

iv) to determine grade and major physical/ chemical characteristics of such rejects by actual sampling,

v) to study method of disposal including conservation of such rejects,

vi) to study and suggest possibility of suitable stacking, preservation and/or conservation, etc.,

vii) to explore possibility of beneficiation and/or recovery of co-products and by-products,

viii) to correlate current generation of rejects with the exposed and likely ore type distribution with mining and ore handling process,

ix) to project generation of rejects in future mining and production programmes, keeping in view the nature, rate, quantum and grade characteristics of the future reject generation on a long term basis, and

x) to examine need for change in the pattern of mining, beneficiation, or chemical technology, if possible.

PART-B

6.2 METHODOLOGY OF FIELD WORK :

6.2.1 The following methodology of work may be followed in conducting field study :

6.2.2 Identification of Ore Distribution Pattern and other Geological Data of Mine Face : The faces of the quarry or mine under study should be examined carefully for ore distribution pattern in the exposed ore body. A rough sketch plan of the faces may also be prepared showing distribution of the different ore types or grade zones, pockets of lateritisation, weathering and alteration, etc. as may be exposed. A rapid an overall picture, on the basis of a few field measurements and rough sketches should be available.

6.2.3 Collection of Mining Details : Method of mining including brief particulars of the faces and bench layout with respect to different ore types, overburden and weathering zones may be given. Method of overburden and ore removal, drilling and blasting pattern, ore collection an ore handling which have

bearing on rate of generation of rejects may be examined.

6.2.4 Determining Points of Rejects Generation : The points of rejects generation both at mine faces and during dressing may be noted and their relative significance in reject generation may be indicated.

6.2.5 Study of the Rate of Generation :

6.2.5.1 For estimating rate and quantum of reject generation previous one or more years of recorded data of production of graded material, their analysis, quantity of rejects generated and disposed and their analysis, etc. are desirable. However, in most of the cases such complete and systematic data are not being maintained either by way of actual measurement or through differential payments for different types of material. Even in some cases, records are not complete particularly in respect of the rejects disposal. In many cases 'rejects' are mixed with 'wastes' and it is not possible to work out their relative quantum. Attempts should be made to collect and process the relevant information as far as possible for conducting the study.

6.2.5.2 In the absence of reliable relevant data, it becomes necessary to carry out certain test studies for estimating rate and quantum of generation of rejects. This is done by recording production from the mineralised zone of a mine for a continuous period of 7 to 17 days against approximate quantum of rejects. All the day to day rejects obtained at various points should be stacked separately and complete record at each point of recovery of graded material and quantum of rejects by actual measurement should be prepared.

6.2.5.3 Collecting Production History : Annual production from the particular pit/quarry/mines should be noted on the basis of last five years 'production'.

6.2.5.4 Disposal of Rejects : The manner of reject disposal at each pit is to be critically examined and recorded. The specific aspect may be such as whether the mineral rejects are being utilised fully or partially by carefully blending with other high grade products, or are stacked separately and sampled, or are being mixed with waste and thrown in dumps. The nature of stacking or dumping ground may also be studied and comments on its suitability or otherwise may also be made. If, the study reveals that a sizeable proportion of rejects is being thrown away with the waste, then specific recommendations, regarding the manner and method of conserving and stacking the rejects should be made. An attempt should also be made, on the basis of present study, for selecting suitable stacking ground beyond potential mineral bearing area.

6.2.5.5 Assessment of the Chemical/Physical Characteristics of Rejects : Choice of screen size for different minerals, rejects material so collected at each point is subjected to screen tests. The commercial specification for the sizes for particular mineral commodity may act as guide for selection of screen sizes. However, guidelines for few important minerals are given in Annexure-I/VII. The results of screen tests are to be recorded.

PART-C

6.3 PREPARATION OF REPORT

6.3.1 Report writing for each type of field work has to be oriented in order to focus the achievements as per objectives of the study. A general format for preparation of report after completing field work of mineral reject study is being provided below : It is, however, suggested that each report should be prepared keeping in view the objectives of each study. At the same time it may be ensured that details should be at least to the extent of completing the format suggestd herewith.

6.4 FORMAT FOR REPORT

0.00 SUMMARY : Only salient features are to be included here.

1.00 INTRODUCTION :

1.1 Purpose : Objective with number of tour days, materials/information collected, etc. may be dealt with here.

1.2 Scope and Limitations of Work: As detailed in paras 1.1 and 1.22 of MGS report format.

1.3 Location and Approach : As detailed in para 1.2 of MGS report format.

1.4 Description of the Leasehold : As detailed in para 1.3 of MGS Report format.

1.5 Previous Work : A short resume of work done by earlier workers citing references of work which have bearing on the present study may be given here.

2.00 GENERAL GEOLOGY :

2.1 **Physiography :** A detailed geo-morphological description may be given here.

2.2 **Geological Setting :** Regional stratigraphy with local stratigraphy, occurrence, distribution and broad description of lithounits, etc. are to be given here.

2.3 **Structure :** Major and minor structural elements their plotting on surface and underground maps, interpretation with the help of geological sections control of mineralisation, etc.

2.4 **Mineralisation :** Detailed morphological description of the ore body/mineralised zone keeping in mind the genetic aspects may be given here. Associated minerals alongwith wall rocks may be described here.

3.00 ORE TYPES AND THEIR DISTRIBUTION :

3.1 A comprehensive account of the distribution of different grades and types of the mineral deposit, degree of alteration and such other geological, physical and chemical features which have a bearing on rejects generation is to be detailed here.

4.00 MINING :

4.1 It should include the method of mining, mineral winning and handling processes, waste and rejects disposal and details of bench and face layouts in the different ore types and overburden, etc. Order of production, present and projected is given in details.

5.00 REJECTS GENERATION :

5.1 Points of Generation :

5.2 Rate of Generation : Details of the method adopted for estimation of the rate of generation at different points and data so generated are to be given in details.

5.3 Quantum and rejects generation at different points and average rate of generation for the leasehold.

5.4 Assessment of Rejects Characteristics : Method of sampling, data there from and review of data for all ore types and for the leasehold are required.

6.00 DISPOSAL OF REJECTS AND WASTES :

6.1 Present practice, desirable practice, availability of stacking yard, etc. are to be given in details.

7.00 ENVIRONMENTAL ASPECTS :

7.1 Short description following the available guidelines on RMDS/MGS may be given.

8.00 CONCLUSIONS AND RECOMMENDATIONS :

8.1 Conclusions :

8.2 Recommendations :

CHAPTER 7

7.0 SAMPLING

7.1 DEFINITION :

7.1.1 "Sampling is the process of taking a small portion of an article such that the consistency of the portion shall be represetaive of the whole" - Baxter and Parks.

7.2 OBJECTIVES :

7.2.1 The different types of mining geological studies expected to be carried out would not be complete unless mineral assemblages in rocks and ores in a mine are fully identified.

7.3 GENERAL PRINCIPLES :

7.3.1 In all cases of sampling, it has to be ensured that a sample drawn for the pupse of laboratory study is truely representative of the entire body. In order to attain this, it is necessary to choose proper places for sampling. Any sample representing a very rich ore portion or a lean portion of an ore body loses its representative character. Theoritically, different samples collected from various parts of the ore body can be combined into a single composite sample to give a representative picture of the whole orebody, but this is not proper as it is also necessary to know average grade of rich and lean portions of the ore body separately. Hence it would always be advisable to mark the site for samples and width of the sampling area on a plan of the area/mine before actual field work relating to sampling.

7.4 ESTIMATION OF SAMPLE SIZE :

7.4.1 Geological samples have often to be collected from heterogenous masses. Materials particularly when loose, tend to be mixed, the individual particles showing great diversity in sizes. A representative sample should have proportionate amount from each fraction. In order to achieve this it is advisable to follow the Richards-Chechette procedure which generalizes the amount of starting sample to be collected to achieve this proportionate representation. The procedure is as given below :

Richards Chechette formula reads, $Q = KD^2$

Where Q=Reliable weight of the sample in kg.

D=Diameter of the largest particle in the sample in millimeters.

K=Factor of homogeneity which will have values as shown in Table 7.4

TABLE 7.4

HOMOGENEITY OF ORE

Sl.No.	Ore Type	Factor of Homogeneity(K)
1.	Homogeneous	0.05
2.	Non-homogeneous	0.10
3.	Very non-homogeneous	0.20 to 0.30
4.	Extremely non-homogeneous	0.40 to 0.50

7.4.1 The constant K is determined on the basis of the irregularity of distribution of the ore constituents of the concerned material. Table 7.4.1 gives certain worked out examples of sample sizes which can be followed.

TABLE 7.4.1

THE QUANTITY OF SAMPLE REQUIRED AT DIFFERENT SIZES OF THE LARGEST PARTICLES IN THE SAMPLE (BASED ON FORMULA $Q = KD^2$)

If the size of the largest piece(D) is		Then the quantity of sample in Kg to be collected for material of various homogeneity will be					
(D)in mm	$(D)^2$ in mm	Homogeneous (K = 0.05)	Non-Homogeneous (K = 0.10)	Very non-Homogeneous (K = 0.20 to 0.30)			Extremely Non-Homogeneous (K=0.40 to 0.50)
200	40,000	2,000.00	4,000.0	8,000.0	12,000.0	16,000.0	20,000.0
150	22,500	1,125.00	2,250.0	4,500.0	6,750.0	9,000.0	11,250.0
125	15,625	781.25	1,562.5	3,125.0	4,687.5	6,250.0	7,812.5
100	10,000	500.00	1,000.0	2,000.0	3,000.0	4,000.0	5,000.0
75	5,625	281.25	562.5	1,125.0	1,687.5	2,250.0	2,812.5
50	2,500	125.00	250.0	500.0	750.0	1,000.0	1,250.0
25	625	31.25	62.5	125.0	187.5	250.0	312.5
12	144	7.20	14.4	28.8	43.2	57.6	72.0
6	36	1.80	3.6	7.2	10.8	14.4	18.0
3	9	0.45	0.9	1.8	2.7	3.6	4.5

NOTE : If the final quantity of sample is as shown in the above table (i.e., two opposite quarters from the final core) remember that the last core will be double the above quantity and that much material should get broken to the required size.

7.4.2 However, it is not necessary that in any given circumstances the size of the starting sample will be according its size distribution. In such cases the sample should be sized down to a smaller size and the weight to size ratio as per formula should be established at the first stage of sizing.

7.4.3 On the basis of the Richards-Chechette formula the starting size of samples can always be worked out. This is the minimum sample that should be collected to make it truely representative of the mass. Sometimes it becomes necessary to increase this sample size because the basic requirements of the pilot plant may be a few hundred tonnes but the representative sample may be only a few tonnes. This needs to be carefully examined and it should be ensured that the starting sample gets a chance to be mixed, coned and quartered atleast twice to arrive at the desired sample which is to be sent for beneficiation studies.

7.5 EQUIPMENT FOR SAMPLING :

7.5.1 A set of proper equipment is needed for sampling. A list of the basic items as given in Annexure-I/7. However, it may be noted that for collection of large samples prticularly from ROM and dumps, additional equipmnt, will be necessary which should be improvised by the mining geologist in the field itself.

7.6 TYPES OF SAMPLING :

7.6.1 Many types of sampling can be recognised. In the work of the IBM the following types of sampling are usually considered. (i) Grab sampling, (ii) Channel sampling, (iii) Chip sampling (iv) Bulk sampling, and (v) Borehole sampling.

7.6.2 Grab Sampling : This is done from different blasts at the faces or small stacks of ore or dumps at random for information of a very general nature. Care should be taken to see that material of varying sizes is collected according to its proportion by weight in the blasted material or the stacks or dumps as the case may be. Several such grabs are mixed together to form a sample.

7.6.2 Channel Sampling : In this sampling, a channel is cut across the face of the exposed ore, and resultant cuttings and chips are collected as a sample. The surface to be sampled is first cleaned to remove the dust, soluble particle, etc. A thin layer of the exposed ore may be removed to avoid cuttings the weathered ore. Then a channel outline 5 - 10 cm in width and extending from the footwall to the hanging wall of the ore body is drawn by chalk or paint. Then the channel is cut by a moil and hammer to a depth which should be equal to the width. The resultant pieces are collected carefully on a clean sheet of canvas or any other convenient receptacle. The sides and the floor of the channel should be smooth and uniform so that overcutting (and over representation) is effectively minimised. The channel may be divided into 1 to 2 m section or their multiples in the case of massive and more homogeneous ore bodies or section of 30 to 50 cm in the case of more heterogeneous distribution and may be separated as per the physical characteristics of the ore.

7.6.4 Chip Sampling : When values are regularly distributed as in an iron ore outcrop, chip sampling can be very useful. In chip sampling, first the outcrop or face to be sampled is cleaned properly and a regular, rectangular or square pattern is made by drawing lines and along and across the outcrop at

fixed intervals. Then, small pieces of ore are broken loose either from the centre of the grid or rectangle or at the intersection points of the lines. The ore pieces should have approximately the same shape, size and weight. After collecting the pieces are mixed together to form a sample. In case of highly unpredictable values, the practice of shifting the grid by half the width or length of the grid is adopted to get another set of samples which may be treated independently and compared with the first set of chip samples.

7.6.5 Bulk Sampling : Bulk sampling is done in two specific cases, one situation is when a pilot plant test is to be done on an ore. The other is when an irregularly distributed constituent of the ore has to be determined accurately. Bulk samples may be made by collecting a portion from every blast continuously, or from shovels or cars in the case of mines. Bulk samples may be collected from a series of pits or a number of trenches, adits or underground drives in the case of prospects. For technological studies covering laboratory scale beneficiation tests, a bulk sample may be 100 to 250 kg in weight. In some complex ores samples upto 1000 kg may be necessary whereas for pilot plant tests samples of 50 tonnes of material would be usually required. Bulk samples may be collected from dumps also. In all these cases the heterogeneity of the material should be studied and starting sample sizes worked out. The total volume of the starting sample should then be distributed to various separate openings, mines, dumps, etc. on the basis of desired proportions.

7.6 .5.1 Sampling of Rejects : The sampling and screening play, a very crucial role as these tests generate valuable information on grade and size rejects. The methodology for drawal of samples and screen testing is a complicated process. Details of a few important minerals are given in Annexure-II/7 as examples. Principles of sampling have already been discussed. In addition the following points may be kept in view :

i) Each pile of rejects should be thoroughly mixed for preparation and drawal of sample,

ii) Stacks of a square base area on a fairly level ground and with maximum height of about 0.6 m may be made. The top surface of stacks should be levelled, as far as possible,

iii) In case of stacks of 3m x 3m x 0.5m or less, five point for sectional sampling should be selected, one at the centre and four near the four corners but well inside the stack. Sample should be collected from each point by taking the whole section of the stack from top to bottom within area of a circle of 25 cm diam. In addition, one scoop of about 25 cm width and 20 cm depth should be made from top to bottom from the mid points of all the four sides. Entire material from the scoops is to be collected

iv) In case of stacks of area larger than 3m x 3m size sampling and scoop points should be suitably increased,

v) Entire material drawn from sectional and scoops points may be mixed together to make one sample of the stackk. This sample is then subjected to screen analysis followed by preparation of samples from each of the screen fractions, adopting standard method of sample reduction. Weight of each fraction may also be recorded etc. Sampling of rejects of a few typical minerals is given in Annexure-II/4.

7.6.6 Bore Holes Sampling : Bore holes are drilled for collecting samples from various cancealed parts of an ore body. Basically two types of materials come out of drill holes (i) solid core, and (ii) cuttings of various types dry or sludge.

7.6.6.1 Sampling of Solid Core : Affter recovery of drill cores and their placement in a proper core box lithological logging is done to identify various formations broadly and also to identify various parts of the ore zone in detail. The selection of core for analysis has to be done with meticulous care. For this purpose the first and foremost necessity would be to recognise hanging wall and foot wall of an ore body. In most of the caes samples may be drawn between hanging wall and foot wall ofany ore body to study the ore zone in detail. If the ore zone is uniform in character, i.e., it shows almost simila lithologgy it will be better to adopt a samplin technique which will give randomness to the su samples. The whole core is sedom analyseed together With increasing emphasis on statistical processi of drill core analysis it has become standard practi to take one metre length core (or a convenient equ sample length) for one sub sample. It has been fou

that this technique is robust enough and ensures randomness. In most cases, first and foremost the core from the ore zone is divided into one metre segments. This will normally leave some extra core length either in the footwall or in the hanging wall, which have a length less than one metre. This may be allowed to remain as such. After marking the one metre segments the core is cut into one metre length pieces and then split into two pieces longitudinally. In case the core is required for chemical analysis, geotechnical studies and ore dressing investigations (as are increasingly becoming the case) then it will be required to split the core into four equal segments, longitudinally. This is done by using a core splitter. First the core is split into halves, and then one split half is again split into two halves. Thus there are three split samples, one half split and two quarter splits. One quarter split sample is sent for analysis while the half core and the remaining quarter core are preserved for future use. The quarter split sample for chemical analysis is sized down in a pestle and mortar to 0.10 to 0.15mm size and a sample of 220 gms is taken by coning and quartering. The remaining is kept as aduplicate for future use. The aim is to preserve as much of the core material as possible so that further verification and testing can be carried out in case of necessity without having to drill further bore holes in nearby sites.

7.6.6.2 Sampling of Sludge : Sludge is the cutting brought out by return water from the drill hole during drilling. Sampling of sludge is necessary when frequent core losses are experienced during drilling. There are various arrangements for sludge collection which are available with the core drill. In the process of collection of sludge and its sampling the following points may be kept in view :-

i) The sludge (in each case) should correspond to the exact core length from where core loss has occurred. This required a certain amount of precise collection which can be done by proper supervision at the drill site. Care should be taken to see that the sludge is not lost which often happens when drilling is in loose formation. However, it may be noted that sludge collection may be done only in very exceptional cases when due to factors beyond the control of the drilling engineer core losses are formidable. It is necessary to note that core and sludge cannot be averaged by weight. There is a separate procedure for combining core values with sludge values which is generally done by the following formula.

$$A = \frac{C}{L} \times \frac{D^2}{D_1^2}(A_1 - A_2) + A_2$$

Where A = Average assay

C = Recovered core

L = Length of the hole(relevant to the calculated portion)

D = Diameter of the hole

D_1 = Diameter of the core

A_1 = Core assay and

A_2 = Sludge assay

7.6.6.3 Sampling of Drill Cuttings : Drill cuttings may be of two types.

i) cutting produced by normal small diameter drills and

ii) cuttings produced by blast holes. In the later process large volumes of sample material will be available. In sampling of ordinary cuttings, procedure followed for making segments, etc. my be done as prevalent in the case of core (or a convenient equal sampling lengths) for every one metre, there may be one sample. The normal difficulty experienced in sampling of cutting is that it gets mixed up with those of hanging and footwall materials. Further, sample materials of contiguous segments get mixed up. Therefore, such sampling should be done by the geologists at the site itself ensuring that materials taken out of the drilled bore hole or cutting receptacle is representative of the segment through which the drill bit had passed through. Cuttings may be analysed totally after sizing, coning and quartering down to the laboratory size of the whole material in a pestle and mortar as was mentioned in the case of core sampling. Sampling of cuttings from blast holes is a specialised job. This may be done by allowing the cuttings to accumulate around the collar of the borehole. The material accumulates in the form of a heap around the collar. This methodology is used only in active opencast mines and should be used only for augmenting already existing core results. In the normal case it is difficult to segmentise the sample. The whole sample also cannot be treated

because there will be hundred of kilograms or in some cases a few tonnes of materials. Therefore, it is necessary to collect samples from cuts which can be formed on the wall of the heap after removing some portions by shovels. The materials in such cases being loose, cuttingg a channel or a groove is often difficult. However, with a little care uniform grooves can be cut and uniform amount of material can be removed. Usually, one or two samples from each heap may be collected separately. They may be combined for processing and chemical analysis.

7.7 PROCESSING OF SAMPLES :

7.7.1 It is necessary to bring the size of the sample down to the requirement of the laboratory or test facility as the case may be. The material can be sized and reduced by coning and quartering. A flow chart for this is given in Annexure-III/7. Although the chart is for a relatively small sample, on a similar basis other charts can be worked out for smaller samples as well as for larger samples giving due weightage to the ratio of the size to total sample volume at every stage.

7.7.2 In the case of bulk samples from ROM, rejects and dumps it will be advisable for the sample to be stored in a prepared even surface preferably with a concrete base and covered by fresh clean tarpaulin. The various sub-samples will be examined and first and foremost the larger fragments will be broken down to a uniform size. After this sizing the material can be mixed. A central heap can first be made of

all the material. The first heap may be spread out and flattened and a central depression may be made by working the sample to all the four directions uniformly, then the material can be reheaped. This can now be repeated by pushing the material diagonally and then again reheaped. This may be done repeatedly 2 to 3 times to ensure proper mixing ofall the materiale Mechanical device like front end loader, etc. if available can be made ue of in this operation. If coning, and quartering is possible then this may be resorted to. Size reduction may also be achieved by a process of random shovelling. This can be done by handling the material by shovels and collecting material for the final sample by saving one shovel out of every so many. This can be mathematically worked out depending upon the total weight or volume of the starting sample and the total weight required to be sent for studies. Here again mechanical devices can be made use of in order to save time and labour.

7.8 ERRORS AND PRECAUTIONS :

7.8.1 It has been observed earlier that sampling is subject to various types of erros, the most important sampling error relates to salting of samples. This error can easily be avoided. It is observed that such errors are generally made inadvertently. By observing precautionary practices the inadvertent type of errors could be avoided. The important points are discussed below :

7.8.2 Mixing up of extraneous material with a sample is a common source of salting. Extraneous material may be from any source, the most common source being from other samples. Take for example a channel is being sampled in sections. If the canvas is not properly cleaned after collection of one sample then the remnants of previous sample on the canvas

may get mixed up with subsequent samples. This can happen during the processng of samples at various stages, such as sizing, coning, quartering and even bagging. For avoiding this error it may be ensured that after each sample is handled the recepticle should be properly cleaned so that all remnants from earlier samples are fully removed.

7.8.3 Errors which are common to sampling may also come from unsystematic sampling practices. The usual problem will be about the size of the sample groove or the size of the idividual chip. It is therefore, necessary that size of sample groove and also size of chips will have to be standardised and properly maintained for all samples at all times.

7.8.4 Collection of samples should be done with adequate care in all cases the collected sample should be kept on canvass or metal sheets prior to processing. Collection of samples from a dump is a relatively difficult task, sometimes calling for extensive excavations. The best method of collecting samples is by sinking pits from the top to the bottom and digging out all the material. The pit may sometimes yield samples which are larger than required in which case the material should be reduced to the appropriate size by coning and quartering. pitting of very big dumps particularly on hill slopes should be done with adequate safety precautions to protect the life of sampler and also to maintain the integrity of the sample. Since the material is loose there will be always a tendency for it to slip down the excavation. This can be prevented by driving boards. Methodology for this is described in IBM's Publication, Bulletin No.9, Elements of Mineral Exploration on pages 120 to 123.

7.8.5 It need to be mentioned that systematic marking and maintenance of proper ledgers, and accounts about movement of samplsfrom site to sampling shed and to different analytical agencies will ensure reliability of the analytical and other results. Labelling of the sample bags should be carefully done in such a way that the sample label never gets mutilated or crumbled during the process of long storage. Good durable material should be used for the purpose of labelling. Sample bags should have double lining. The inner lining may be of polythene material and the outer covering may be of cloth or another packaging material such as hessian or pplastic or PVC material which are available in the market.

7.8.6 Sampling is subject to certain limitations due to sampling errors. Sampling errors may be of two types (i) radom, and (ii) systematic. Of these, the random errors have lesser danger as it tends to cancel out each other whereas systematic errors accumulate to create gross errors. The errors accumulate due to four factors. :

i) When check samples are taken from the same spot, there will be a natural divergence between the value of the principal sample and the control sample. This cannot be overcome.

ii) Errors accumulated due to measurement errors, poor facilities and equipment which can happen in remote areas and poor eye judgement of the sampler,

iii) Errors due to mistake of calculations, misprints and poor numbering, and

iv) Limitations of the assaying technique itself.

7.8.7 Of the four types of errors indicated above, the first two are random errors and the other two are systematic errors. In addition, errors may crop up because of intentional or unintentional salting of the sample iteself. All these errors have to be avoided to the extent possible to get a reliable estimate of the orebody. Check sampling and repeated sampling help in avoiding some of the mistakes whereas great care at every stage of sampling alone can offset the other mistakes like salting.

ANNEXURE-I/7

LIST OF EQUIPMENT FOR SAMPLING

1.	Spring balance 100 kg or 50 kg capacity	1 No.
2.	Spring balance 10 kg (100 gm div.)	1 No.
3.	Screen 25 mm, 12 mm, 10mm, 6 mm, sizes of 1.5 x 1.0m dimension for screening tests.	1 No. (of the required size).
4.	Sieves 3mm (18mm or 2.0 cm) for preparation of samples.	1 No.
5.	Measurement boxes (wooden) 40cm x 40cm x 25cm for determination of bulk weights.	1 No.
6.	Sampling plate (steel) 22cm x 22cm x 12mm for preparation of samples.	1 No.
7.	Steel mortar and pestle, for fine crushing and preparation of samples.	3 Nos.
8.	Steel stripe 1.2m x 15mm x 5mm for sampling operation.	3 Nos.
9.	Tarpauline 4mm x 3m for drawal and processing of samples.	3 Nos.
10.	Sledge hammer 2 kg	3 Nos.
	" 1 Kg	6 Nos.
11.	Spades	3 Nos.
12.	Baskets/Iron pans	7 Nos.
13.	Shovels	3 Nos.
14.	Thick paper tags	
15.	Sample bags 30cm x 25cm	
16.	Steel tape.	

(While these are some of the basic equipments necessary for any sampling, additional equipments may be required in many different types of specific cases. In all such cases the concerned mining geologist should improvise additional equipments to suit specific occasion).

ANNEXURE-II/7

METHODOLOGY FOR SAMPLING AND SCREEN TESTS FOR MINERAL REJECTS OF A FEW IMPORTANT MINERALS.

While discussing the methodology in a generalised manner, it was felt necessary to deal specifically wit a few important minerals so as to bring out the crux of the problem together with a reasonable solution of the same. Moreover, the detailed methodology of important minerals would help to plan out the methodology for other minerals.

i) Iron Ore :

a) In case of mechanised mines, it is expected that full details and records of rejects generated during mining and subsequent ore handliing, stacking and utilisation or disposal of rejects (fines, and blue dust, if any) will be available, and no field tests would normally be called for. Here the attempts will be to collect all these data (if not already collected) and possibly drawal of some samples from the rejects from their screening plants for chemical and size analysis. The methodology to be drawn may be determined after discussions with the plant authorities and depending upon the facilities available.

b) In case of semi-mechanised or manually operated mines the sampling should, as far as possible, be done separately in respect of (i) low grade rejects (ii) undersized rejects and (iii) blue dust if any. Each of these rejects should be subjected to screening at 12mm (or 10mm) and 6mm and representative samples from each screen fractions should be drawn. In addition a representative sample for the entire material of the particular reject may also be drawn.

ii) Manganese Ore :

a) Wherever the ROM ore is successfully screened and sorted for separation of block-rock, sized ore for jigging, and bed waste (as in MOIL mines in M.P and Maharashtra), no screen test may be necessary. Sampling operations should be conducted on the different size fractions of the rejects e.g. (i) block rock (ii) bed rejects (iii) jig rejects at different jig size and (iv) raw ore (in case any particular fraction of the raw ore is not jigged at the moment).

b) In other areas where such practice is not followed, the rejects are to be subjected to screening tests on 25mm, 12mm and 6mm screens, and representative samples are to be drawn from each screen fraction.

c) Wherever the manganiferous laterite overburden shows appreciable proportion of maganese ore as nodule, patches or streaks, or wherever the existance of bimetal ore (total Mn + Fe over 56 percent and Mn 5 - 20 percent) is suspected, such overburden material may also be subjected to screening and sampling as suggested at (b) above. A quantitative estimate of this material may also be made.

d) In case of North Kanara soft, siliceous manganese ore horizon, the concretionary manganese ore is won from the lower part of the siliceous horizon by successive screening upto 3mm size. The top lean zones and the -3mm fractions containing soft and fine ores are rejected. Separate representative samples may also be drawn from the rejects of the top leaner part of the zone (or if necessary by channelling at the face exposures) and also from the -3mm rejects from the economically workable zones.

iii) Limestone and Dolomite :

a) The choice of screen size depend upon the lowest size of the saleable or acceptable product. Wherever the minimum size adopted is 40mm, the rejects may be subjected to screen tests at 25mm and 12mm sizes. In other cases only 12mm sscreen may be used. Representative samples of the different screen fractions are to be drawn.

b) In cases where wobblers or such other contrivances are used at the mine site to eliminate clayey constituents, the generation of rejects at such spots may also be studied and samples of the rejects may be drawn. In such cases no further screen tests may be necessary for such reject fractions.

iv) Clay (China Clay), Soapstone, Pyrophyllite, Asbestos etc. :

Since the rejects generated are mostly on the basis of such physical properties like colour, plasticity, grit co[illegible]nt, ceramic and refractory properties, len[illegible]s, distribution and grade of fibres, tensile [illegible]rength, etc. and

since these may not be determinable by the suggested conventional macro-size screening and chemical analysis screen tests and sampling for chemical analyses of the rejects from such minerals may not be of much relevance. Besides, our laboratory is not equipped to carry out the requisite physical or industrial tests for such minerals. Hence, these tests may be normally avoided, unless there is any specific reason to suspect possible improvement in grade or utilisation (with or without beneficiation) at a particular screen size. In such cases, however, screen testing at the requisite size may be carried out. But in all cases, the quantum of generation of such reject their types and specific properties or reasons for being rejected may be noted. In cases where the need for any chemical analysis, beneficiation or tests for industrial utilisation is felt, specific recommendation to this effect may be made and depending upon the nature and magnitude of the problems, appropriate action may then be initiated with suitable agencies like C.G.C.R.I. etc. for conducting such tests.

v) **Other minerals like Bauxite, Magnesite, Kyanite, Barytes etc. :**

The rejects may be subjected to screen tests on 12 mm (and also on 6 mm screen, if felt necessary) and representative samples be drawn from each of the screened fractions for chemical analyses.

CHAPTER 8

8.0 EXAMINATION OF P.L.AREAS

PART-A

8.1 OBJECTIVE AND METHODOLOGY OF FIELD STUDY:

The objective of examination of P.L. area would be :

i) to examine whether the management is following the scheme of exploration submitted to the department;

ii) to examine whether results of exploration pits, trenches, bore holes, samples are being properly maintained;

iii) to examine whether the scheme of exploration needs modification;

iv) to assess the prognostic resource position on the basis of data so far generated from the exploration work; and

v) to examine whether sufficient care is being exercised to maintain the environmental condition in a balanced way.

8.1.1 The field study may comprise reconnaissance survey of the entire PL area for checking details about physiography, morphology and environment as submitted by the lessee as per Rule 4 of MCDR 1988. Further critical examination of the exploration done so far may be done and results noted. The results as observed and noted during field examination may have to be compared with the records being maintained at the site in order to assess whether proper recording with proper interpretation of the geological exposures is being done. This may also

help in finding out whether scheme of exploration submitted is being followed during its actual execution. Field study should be conducted in such a way which may help in determining the effectiveness of scheme of exploration preparation by the lessee and also to suggest whethrany modification is warranted for proper appraisal of the area.

8.1.2 All relevant details/data may have to be collected which may help in preparing a report as per the suggested format In case additional data/details are available, which are considered relevant for the purpose, then those may also be collected.

PART-B

8.2 FORMAT FOR REPORT

1.0 INTRODUCTION :

1.1 Preamble with data of Inspection/ Examination.

1.2 Location, geographical, co-ordinates and a reference to Survey of India toposheet/village/forest map, etc.

1.3 Approach

1.4 Description of P.L.area.

i) Total area,

ii) Period of license with date; first grant/Renewal/re-grant,

iii) Area covered by prospecting,

iv) Area considered potential out of (iii),

v) Area unexplored,

vi) Area requiring further prospecting

out of (v) and

vii) Name, qualification and experience of Geologist/Mining Engineer in charge of operation.

1.5 Compliance of Rules 4 to 8 of MCDR, 1958.

2.00 GENERAL GEOLOGY :

2.1 Previous work : Pertaining to the area under question or area surrounding or nearabout.

2.2 Physiography :

2.3 Regional Geology : A brief account is desired to obtain a broad geological, structural frame work and pattern of mineralisation.

CHAPTER 9

9.0 EXAMINATION OF VIRGIN AREA UNDER PL APPLICATION/ ML APPLICATION.

PART-A

9.1 OBJECTIVES AND FIELD WORK :

9.1.1 Examination of a virgin area for the purpose of preparing comments to be sent to the granting authority amounts to almost a critical examination of an area for purpose of preparing a scheme of exploration. In such a situation the area may have to be examined with the objective of ascertaining whether the mineral, for which prospecting is to be done, is likely to occur in the area under investigation. This could be possibly done by examining the outcrops of rock types. The occurrance of rock types in the area would indicate possibility of occurrence of the particular mineral. Besides, natural cuttings, streams, nala, ravines, well diggings - may help in observing exposure of the particular ore/mineral. Protection and maintenance of environment as far as possible near to the pre-mining condition is an important consideration. Hence it is essential that relevant details about the fauna, flora, water courses, land use, habitats, public utility spots, etc. may be collected.

9.1.2 Besides, the technical aspects detailed above, a few administratv aspects may have to be looked into viz.

i) shape and size of applied area, continuity of areas under consideration in case it is more than one block to check up relevant provisions of MMRD and MCR.

ii) details of nearby mines/leaseholds discussing the status of other neighbouring leaseholds (within a radial distance of 500m) whether it is a public sector mine or captive mine in a private or public sector etc.

9.1.3 A format for preparation of report has been suggested and, therefore, all relevant data, which are required for preparation of report as per the format, must be collected. In addition to these, if there are other available details/data relevant to the purpose then they may also be collected.

PART-B

9.2 FORMAT FOR REPORT

1. Name of the area,
2. Name of the Applicant,
3. Location :
   - i) Latitude and longitude with toposheet number,
   - ii) Village - District,
   - iii) Nearest Railway station and Approach road.
4. **Geological Set up of the Area :** Broad physiographic details with lithological units and structural features as could be observed from the surface examination,
5. Outcrop of the minerals or its exposures in any opening/cutting,
6. Relevant details from any other literature or previous reports published or unpublished;

7. Prognostic reserve appraisal based on available details and data,

8. Details of nearby mines/leaseholds discussing the status of other neighbouring leaseholds (within 500m radial distance) whether it is public sector mine/captive mines in private or public sector etc.

9. Shape and size of lease area, continuity of lease blocks in case it is more than one block in order to check up the relevant provision of MMRD and MCR.

10. Environmental details - Vegetation, land use, location of nearby habitats/river/stream/nala/ public roads, any other permanent structure of public utility.

11. Recommendations :

i) The recommendations should be specific with justification based on observations made in report.

ii) In case of ML application, the available details need be analysed to recommend whether the area be considered for ML or PL.

iii) Details may also need examination with a view to recommending part or whole of the area applied for PL or ML.

CHAPTER 10

INSPECTION OF MINES IN CONNECTION WITH STOPING NOTICE.

PART-A

10.1 DEFINITION :

10.1.1 Mining operations in an underground mine is generally done in two phases - 'Development' and 'Stoping'

i) Development means the driving of an opening to, or in an ore-body or seam or removing overburden or unproductive or waste materials as preparatory to mining or stoping, and

ii) Stoping means making any underground excavation other than development working made for the pupose of winning ores or minerals and includes extraction or splitting or reduction of pillars or blocks of minerals.

10.1.2 Stoping operations may be partial or full. In partial stoping one or more pillars (but not all pillars) developed in a mine may be extracted simultaneous with development in other sections of a mine. Whereas in full stoping, all the pillars developed in a mine are proposed to be stoped with a programme of final abandonment of the particular mine.

10.2 OBJECTIVE :

10.2.1 In the course of development of a mine, the management is expected to develcp the mine systematically as per the approved mining plan. At

the same time, modification in development scheme may be suggested byIBM through suggestion/direction.

10.2.2 For stoping operations, the mine management has to seek permissionfrom the department for partial stoping or full stoping as per provisions of Rule 26 of MCDR'88. Permission for stoping is given by the Controller of Mines of the Zonal Office.

10.2.3 The main objective of inspection of a mine, where stoping operation has been proposed, is to examine in case of partial stoping :

i) Whether the blocks proposed to be stoped have been fully developed or blocked

ii) whether stoping of the proposed block would hamper further development of the mineral body along strike direction or along dip direction, and

iii) whether all the pay shoots (specially lean ore shoots/veins) have been included in the proposed stope block.

10.2.3 In case of inspecting a mine, where stoping of all blocks has been proposed, with the ultimate idea of abandoning the mine, examination of mine should be conducted with a view to ascertaining :

i) whetherr the ore body/bodies exposed in the mine have been fully developed atleast up to economic pay limits,

ii) whether sufficient exploration has been conducted in order to ascertain occurrence of any other ore bodies or pay zones within a reasonable distance from the opened sections of the mine, and

iii) whether there is any possibility of developing the mine in future due to change in mining technology, cost structure, etc.

PART-B

10.3 PREPARATION OF FIELD WORK :

10.3.1 The Rule 26 of MCDR 1988 directs a mine owner to submit an application for permission to stope blocks/pillars in a mine in Form 'H', accompanied by plans and sections on a desired scale.

10.3.2 The details provided in the application should be carefully examinedwith a view to finding out that

i) the details provided appear to be reliable and cogent,

ii) the details provided are sufficient to ascertain the economic value of blocks/pillars under proposal of stoping. This aspect may need recalculation in office in order to see thatallpossible lean zones in the contiguous sections have been included, while maintaining the minimum cut-off grade,

iii) the details provided clearly spell out the proposed method of stoping and also collection of ore from the stop area, and

iv) the details provided are sufficient to understand the provisions made for further development of sections of the mine contiguous to the proposed stope.

10.3.3 The plans and sections submitted need be thoroughly checked in order to gain reliable knowledge about :

i) ore distribution pattern and morphology,

ii) scope of further development of any or all ore bodies in the mine;

iii) proper blocking of the proposed stope sections, and

iv) provisions of ingress and egress after stoping of proposed block.

10.3.4 In case of partial stoping, it may be examined whether stoping of small sections in the form of one or two blocks at a time creates locking of sufficient ore in crown or sill pillars of small sections. If rich pay zones are likely to be left out in crown or sill pillars then it may have to be examined whether partial stoping is desirable.

10.3.5 Thus, before going to field all these technical details may have to be examined so that the mine may be examined with the set objective.

10.3.6 The legal aspects of the rule may also be scrutinised. In case of finding non-compliance of the provisions of the rule, the same may be pointed out immediately to the mine management.

10.3.7 The past performance of the lessee specially in relation to compliance of suggestions/directives issued if any, from the department and status of stope, if any, permited earlier, should be checked in from the office record.

PART-C

10.4 METHODOLOGY OF FIELD WORK :

10.4.1 The provision of Rule 26 indicates that a lessee should submit a notice 60 days prior to the date of commencement of stoping operations Hence, it provides a binding that the department should accord

permission or indicate reasons for not according permission within the stipulated period of 60 days. It would, therefore be desirable that inspection of mine should be planned in such a way that the field officer is able to submit his report to the officer authorised to grant permitting or rejecting the application at least in about 45 days from the date of receipt of applicton. This will provide 15 days time to the granting authority to examine the report and convey the decision well within the stipulated period of 60 days.

10.4.2 The points of discrepanceis or lacunae, if any, observed after thorough scrutiny in the office, may have to be first discussed with the mine management. This will provide an opportunity to understand the points of proposal, which might have remained silent or unexplained in the application.

10.4.3 In conducting the mine examination, the geological plans, ore distribuion plan, assay plan submited by management may be varified by ground checking the critical/important sections of a mine. Differences if any, observed may have to be projected on cross-sections also in order to find out the actual limits of ore bodies/veins.

10.4.4 The relevant data with respect to preparation of assay plans, cost structure, etc. may be verified from office records in order to assess their degree of reliability.

10.4.5 In addition to the above aspects, special attempt may have to be made to understand clearly the morphology of the ore body,its disposition, its structural behaviour and also aspects relating to

controls of mineralisation. This knowledge is very much necessary to decide whether the ore body has been properly and fully developed or being developed and whether exploration done so far as sufficient or further exploration is required. These aspects are highly essential to consider the proposal for stoping whether it be for a few blocks or all blocks.

10.4.6 The proposed method of extracting ore is to be studied thoroughly during inspection with special reference to the stoping method the position of ore chutes, man ways, fill passes, draw points, haulage road, the preparatory drives, if any, prior to actual commencement of stoping, the sequence of attacking each stope block/blocks, the position of stope faces as well as mode of supporting the stope back/wall rocks at various stages, crown/sill/rib pillars proposed to be left, envisaged percentage of extraction during stoping operations etc. All these aspects are to be critically examined and commented upon. Present state of development and development contemplated butnot completed at the time of inspection should be clearly brought out. Inspecting officer should ensure during field visit that development of the mine in lateral directions or in depth would not get jeopardised if permission for stoping of the block/blocks in question is given. In case such a possibility is contemplated, the same along with preventive measures in the form of suggestions for development, should be incorporated in the inspection report. It is to be ensured that adequate 'development LEAD' is being maintained in comparison to the blocked out areas for stoping purposes. The future plan of the lessee in extracting different types of pillars with expected recovery percentage may also be commented upon.

10.4.7 The above mentioned aspects are necessary to study in order to protect the interest of conservation of mineral resources.

PART-D

10.5 PREPARATION OF REPORT :

10.5.1 It is very important to bring out all the information collected during checking of stoping notice at the headquarters and information generated at the time of actual field inspection. Stoping cases are time bound and hence extra effort would be required for preparation and submission of the inspection report within a very short period of time, say within 10 to 15 days from the date of inspection of the mine. All attempts are to be made to be precise in bringing out the prepared aspects very clearly. The report may be prepared in the following pattern.

10.6 FORMAT FOR REPORT :

1.0 INTRODUCTION :

1.1 The object of inspection, date of receipt of stoping notice, date of taking up inspection tour, etc. may be included here. Scrutiny of information, plans and sections submited at the headquarters and deficiencies, if any, pointed out to the lessee and subsequently obtained, modified information from the lessee may be included here with date.

2.0 LOCATION AND APPROACH :

2.1 Coordinates, toposheet number, approach by road, nearest railway station, etc. are to be given here.

3.0 LEASE PARTICULARS :

3.1 Total lease area, date of granting of lease, date of expiry, date of renewal if any, and similar other information may be given here. A brief account of earlier stoping notices received and permission granted or not granted for block/blocks of the mine may be given here.

4.0 COMPLIANCE OF EARLIER NOTICES :

4.1 Compliance of stipulations/suggestions in respect of stope blocks permitted earlier.

5.0 GEOLOGY, STRUCTURE AND CONTROL OF MINERALISATION :

5.1 Physiography and stratigraphy may be given in brief.

5.2 Distribution, lithological units on the surface as well as underground, clearly bringing out the positon of ore body in the geological set up, is to be given. Geological disposition of orebody and wall rocks for each individual level is to be given with special stress in the geological aspects of the concerned block/blocks and block/blocks lying one level below and above the concerned block/blocks.

5.3 Structural interpretation based on available data and data generated during inspection is to be attempted and control of mineralisation, if any, should be brought out. The possibility of occurrence of parallel/satellite ore bodies may be commented upon.

5.4 Exploration done and gaps in exploration may be commented upon.

5.5 Delineation of the ore body with the help of development already made and further development, if any, required for complete delineation of the ore body may be commented upon. In case of base metals, recasting of ore zones taking different cut off grades, may be necessary.

6.0 MINING AND DEVELOPMENT :

6.1 Proposed stoping method is to be studied. Development practice with the formation and disposition of ore chutes, man ways, fill pass, drawn points, drivages, haulage roads, thickness of sill/barrier/crown pillar, development of sill levels, sublevels, etc. for each level are to be described and the status of development may be commented upon. The status of block/blocks for which permission is sought may be specially commented upon. Extraction of lean zone/zones parallel/satellite ore bodies, mining of parallel ore bodies by forming composite stope block by amalgamating the barren parting as envisaged by the lessee or as considered necessary by the inspecting officer may be incorporated in the report.

7.0 CONCLUSION AND RECOMMENDATIONS :

7.1 Geological, structural and mining aspects as covered in earlier chapters, are to be critically reviewed in arriving at conclusions. While suggestions for further development are formed, comments on compliance of earlier suggestions may also be given.

CHAPTER 11

11.0 GUIDELINES FOR SUPERVISORY OFFICERS :

11.1 Reports pertaining to MGS, RMDS, MRS, etc. can be considered of real value if the suggestions/ recommendations of the reports are found to be useful by enterpreneurs and the department. Proper suggestions/recommendations can emerge only after thorough analysis of details and data put in the report. It has been experienced that the quality and comprehension of details of geological aspects vary from person to person on the basis of their experience of field work. In case the geological details collected from the field are either inadequate or improper they will not help in drawing proper inferences for formulaton of valuable/effective suggestions/recommendations. Hence guidance and supervison of field level by senior officers are considered not only highly essential, rather a necessity for these types of scientific study of natural resources of the country.

11.1.1 Field guidance may have to be provided in three stages viz.,

i) When the officer is working in the field for executing his programme of work;

ii) during the process of analysing the data after field work, and

iii) when the officer has submitted his report after completion of the work.

11.2 PREPARATION AT HEADQUARTERS :

11.2.1 The supervisory officer may have to study the relevant literature, reports(published or

unpublished) of the area, specially for the purpose of acquainting himself with the regional geological set up, control of mineralisation, physical and chemical characteristics of mineral/ore, etc. The supervisory officers, placed in zonal offices and Head Office shall have easy access to literature and reports. They may collect the relevant details for the purpose or supplying those details to field officers who maynot have opportunity to refer to the reports/literature at their regional offices.

11.2.2 In case, the supervisory officer is proposing to examine the mine/area, on the basis of a submitted report then he shall examine the report in detail before going to field. The report shall be examined keeping two aspects in view;

i) collection of field details and their depiction/presentation of plan/section, and

ii) analysis of field observations and other relevant data collected from the lessee for drawing inferences.

11.2.3 While examining field details, special stress may have to be paid on the cross-checking of the following aspects :

i) depiction of all litho-units in chronological/systematic manner,

ii) possible shape and extent of ore bodies/ mineralised zones,

iii) methods adopted for drawal of samples, the points from samples were drawn and its relevance to the purpose of drawing samples, and

iv) method adopted for calculating specific gravity, recovery factor, percentage of reject generation at various points, etc.

11.2.4 Presentation of field data and their analysis may have to be thoroughly scrutinised in order to see that the inferences drawn tally with the details.

11.2.5 The supervisory officer may have to decide his programme of field work well in advance and intimate the same to the RCOM of concerned regional office and also the field officer. This will help in conducting joint field work smoothly.

11.3 GUIDELINES FOR FIELD WORK :

11.3.1 The supervisory officer should keep the objective of imparting his experience and expertise to the field officers rather than adopting an attitude of pin-pointing defects/deficiencies only. For this purpose, it would be ideal if check reconnaissance and check field mappings are done in the field with thefield officer so that it will be suitable demonstration of what has been discussed in different guidelines.

11.3.2 In the second circumstance, i.e., providing guidance in an area for which report has been submitted the supervisory officer may have to examine all the critical points, which are necessary for determining the different controls of mineralisation, shape and size of ore body/mineralised zone, and conservation of mineral. This may be done by random checks with the field officer. This will enable the field officer to find out whether he had made correct observations during his field work and whether he had overlooked/missed certain important observations.

11.3.3 The different sections prepared and projections made about extent of ore bodies may be cross-checked in field with background of natural topography/exposures observed in the field.

11.4 SUPERVISION FOR TIMELY EXECUTION OF JOB :

11.4.1 A format for maintaining time schedule in connection with preparation and submission of report by the officer under his charge is being suggested herewith (Ref. Annexure-I/11). This may be utilised when an investigation has limitation of time or for which payment is expected from a lessee for purchase of the report.

ANNEXURE-I/11.

FORMAT FOR TIME SCHEDULING FOR SUBMISSION OF REPORTS

1. Name of the Project :
2. Name and Designation of Officer. :
3. Number of field days :

Field work started on.	Field work completed on.	Total field days.

4. Total area covered :
5. Headquarters work :
6. Expected date of submission of survey plan if any :

A. Completion of topographical and geological plan (percentage of work) : (Anticipated date)

B. Finalisation of topographical and geological plan(percentage of work) : -do-

C. Preparation of cross-sections(Percentage of work) : -do-

D. Finalisation of cross-sections(Percentage of work) : -do-

E. Proposal of Exploration Scheme (Percentage of work) : -do-

F. Finalisation of Exploration Scheme (percentage of work) : -do-

G. Estimation of Reserves (Percentage of work) : -do-

H. Report format discussion and finalisation (Percentage of work) : -do-

I. Preparation and submission of report(percentage of work) : -do-

CHAPTER 12

12.0 PREPARATION OF GEOLOGICAL MAPS OF SMALL LEASEHOLDS.

PART-A

12.1 OBJECTIVES :

12.1.1 Proper geological maps and sections of leaseholds are considered as minimum basic necessity to enable the Mining Engineers or Geologists of the IBM to make a meaningful recommendation about systematic development of the mineral deposits, within the leasehold. In this connection, the Indian Bureau of Mines made an assessmentaout the availability of proper geological maps and sections in respect of leasehold areas. It was observed that geological maps and section of leasehold areas in respect of large mines and mines belonging to organised sectors were available but they are not available in respect of leasehold areas of small mines. The small mines constitute about 68 percent of the total mining lease areas in the country. It was also observed that the small mine owners do not have the capacity to maintain or procure service of proper technical personnel for this job. The Government, therefore, added a new function to the IBM in 1980. This function was in connection with preparation of geological maps and sections pertaining to small leaseholds.

PART-D

12.2 METHODOLOGY OF FIELD WORK :

12.2.1 The methodology adopted for field work in connection with preparation of geological maps and section of small leaseholds are similar to the one

which have been discussed in connection with Mining Geological Study of mine/leasehold. This aspect has been discussed in Chapter-4, Part-B, Pages 12 to 15.

PART-C

12.3 REPORT WRITING :

12.3.1 Reporting of information and data after proper analysis forms an equally important part of the study. A format for preparation of report on the subject is provided here with It is expected that an investigating officer will collect field information and data at least to the extent which may supply all the details as required in the columns of the format. It does not, however, restrict efforts of an investigating officer to collect further additional relevant information and data in respect of leaseholds.

12.3.2 The title of the report will be **REPORT ON THE GEOLOGICAL APPRAISAL OF .....LEASE/MINE.**

12.3.3 The Geological Mapping report will consist of seven chapters (1) Introduction, (2)Geology, (3) Mining, (4) Estimation of Reserves, (5) Scheme of Exploration, (6) Environmental Aspects, and (7) Conclusions and Recommendations.

12.4 FORMAT FOR REPORT

1.0 INTRODUCTION :

1.01 This Section may have 8 to 9 paragraphs. The paragraphs will not be subtitled, but will only have paragraph numbers. In this sub-section, the background of the investigation may be clearly brought out.

1.2 **Lease Details :** The lease details will show the following items. Name and address of the lessee, state, extent of lease area, period of lease and whether the lease area is a first lease or a renewed lease. Problems of the lease such as closure, temporary discontinuity, legal disputes etc. should be metioned here.

1.3 **Period of Study and Persons Associated :** In this para, the actual period with dates spent by the field party in the executional work in the field will be mentioned. The number of technical persons involved in the work will also be mentioned.

1.4 **Location and Accessibility :** This may be as given in Para 4.3 (1.2).

1.5 **Methodology and Approach :** The methodology is divided in two parts (1) Survey and (2) Geology. The methodology adopted for survey should deal with the type of survey done and the statistical account of the numberof stations, traverse points, etc. Mention should also be made of the permanent reference point that was made use of and its relationship with standard Survey of India markings. In the case of the geology, the method adpted for geological field work should be mentioned here in fair detail.

1.6 **Acknowledgement :** This will contain acknowledgements to various individuals and organisations who have contributed and helped in the study.

2.0 GEOLOGY

2.0.1 This chapter will be divided into two major sections (1) Regional Geology and (2) Geology of the leasehold.

2.1 Regional Geology : This section may be done in two sub-sections.

2.1.1 A short review of earlier work: This may be as given in para 4.3(1.4).

2.1.2 Stratigraphic Sequence : This will refer to a standard reference work showing the stratigraphy of the region as a whole. Due acknowledgement to the source of reference is necessary. This should also mention generally the stratigraphic sequence in which mineralisation is found in the lease area.

2.2 Geology of the Leasehold : In this section, there may be six sub-sections as given below

2.2.1 Physiography and Drainage : The general topography of the area, the highest and lowest points, general slope, erosional features, drainage, rainfall data if available etc. Important aspects of climatic features may also be mentioned here.

2.2.2 Sequence of Litho Units : The succession of the rock formation seen in the opening within the lease may be shown in a succession chart. This may be followed by description of each litho-units which may be described with sub-para numbers such as 2.2.2.1.....etc.

2.2.3 Structural Features : This may mention the strike and dip of the major formations, fault, fold, unconformities, joints, foliation, lineation, etc. of the major litho-units. Broad structural features of the lease etc. may be included in this.

2.2.4 Mineralisation : In this sub-section, field observation of mineralisation may be given attitude of the ore bodies, types of mineralisation present, (whether vein type, lense type, bedded type, etc.) or any other observations that may be made in the field. This may also show the number of mineral deposits, veins, etc. Mention may be made in a sub-para about the nomenclature of the deposit. If more than one deposit is there each deposit should be described showing their dimensions and their general strike, dip, etc., after establishing the nomenclature.

2.2.5 Ore Genesis : This is a conceptualisation of the origin of the deposit on the basis of observations made and recorded in the above paragraphs. Reference to standard sources of literature earlier workers opinions, contradictions alongwith the authors own view of the deposit and its genesis should be reflected in this sub-paragraph. A conceptual genetic model of the deposit is necessary before making assumptions regarding depth extensions, strike extensions, quality variations etc. of the deposit which are critical in the estimation of reserves.

2.2.6 Guides for Prospecting and Exploration : This may deal with local guides, used by prospectors and mine owners for loating new deposits. Other standard guides relevant to the mineral also maybe briefly mentioned.

3.0 MINING :

In this chapter there may be **eleven paragraphs** namely methodology, sequence, **winning of ore,** description of workings, **generation of** unutilisable ore, generation of **wastes, list** of machinery, specification of **ore and** utilisation and plant and equipments, etc.

3.1 Methodology : In this the broad type of mining whether opencast, underground, mechanised, semi-mechanised, or fully mechanised, etc. should be discussed.

3.2 Sequence : The sequence of drilling, blasting, mucking, sorting, stacking, etc. should be discussed here.

3.3 Winning of Ore : This will reflect the specific methodology used for mining of the ore, recovery of ore and removal of overburden.

3.4 Description of Workings : This may consist of a description of each mine opening. Measurements of pit, bench heights, details of ore exposures, etc. should be included in this section. Prospecting openings such as pits and trenches may also be included in this. When too many openings are there, these may be put in suitable tables.

3.5 Specification of Ore : Here the specification of the ore that can be used in the plant or export or whatever other ways of utilisation of the ore prevalent should be reflected upon. This may be on the basis of information made available by the mine owers themselves and on the author's own observations.

3.6 **Generation of Unutilisable Ore :** On the basis of the above specifications the unutilisable ore should be recognised an the rate of generation of this should be mentioned. It is also necessary to mention as to what is being done with this unutilisable ore.

3.7 **Generation of Wastes :** Wastes as distinguished from unutilisable ore should be recognised and efforts should be made to mention what exactly is being done with this. Specifically whether the mine owner is mixing the unutilisable ore and pure wastes should be found out during field work and mentioned in the report.

3.8 **Ore to Overburden Ratio :** The economics of opencast mining is largely dependent upon the ore to overburden ratio. Therefore, the geological reports should contain ore to overburden ratio computations on the basis of the geological cross - sections prepared during the field work.

3.9 **Production and Utilisation :** The present utilisation of the ore and past production for five previous years from the mine on the basis of available information may be included in this paragraphs.

4.0 ESTIMATION OF RESERVES :

4.0.1 This chapter may have eight sub-paras as described below. There should be a section on e exploration, prospecting and sampling and this should be linked to the reserves.

4.1 Prospecting and Exploration :This should describe the amount of prospecting and exploration done along with all available details of such activity.

4.2 Sampling : Describe the sampling done by the author, location of sampling points, and if possible with analytical details.

4.3 Review of All Existing Sampling and Exploration Data : This should be done to give a foundation to the reserves estimtion that is done. All available data shoulu be obtained from the mine owners and analysed and studied and the results of this analysis should be given in this paragraph.

4.4. Shape and Size of the Ore Body : The various ore bodies their shapes, sizes, etc. as reflected in the geological map should be summarised here.

4.5 Parameters of Estimation : The parameters which have been adopted and assumed for the reserves estimation should be summarised in this paragraph.

4.6 Method of Estimation : The specific method used for estimation of reserves should be described in details in this para.

4.7 Categorisation of Reserves : The categorisation of reserves of the leasehold along with a reference to the definitions on which the categorisation is based should be given.

4.8 Reserves in the Leasehold and Grade : This section should briefly detail the reserve position of the leasehold and should end with a summary table showing the categorywise reserves both insitu and recoverable of the lease.

5.0 SCHEME OF EXPLORATION :

5.0.1 This will consist of three sub-paras as shown below :

5.1 General Considerations : Exploration data available have been reviewed earlier. This para should mention the gaps which exist in the exploration and the possible ways for filling in the gaps.

5.2 Quantum and Extent of Exploration Suggested : This para should deal with the amount of exploration suggested. The location of various exploration points and a summarised table showing the details of exploration suggested along with map reference.

5.3 Cost of Exploration : This will be computed on the basis of the quantum of drilling, trenching, pitting or other operations as may be suggested and mentioned here. A discussion on the total reserves that are likely to be established by this effort also should be included.

6.0 ENVIRONMENTAL ASPECTS :

6.0.1 This will consist of four paras as shown below :

CHAPTER 13

13.0 PREPARATION OF MINERAL MAP

PART-A

13.1 OBJECTIVES :

13.1.1 The Indian Bureau of Mines is considered as the custodian of mineral wealth of the country. For this purpose, the IBM maintains mineral inventory of all the mineral occurrences. However, in order to understand the extent of economic mineral deposits, gaps in exploration, available infrastructural facility, and to assess future requirements for development of the known deposits and also the reported occurrences of deposits, a map showing location and extent of mineral deposits, their present status in respect of exploration, development etc. is considered highly essential. This type of map being prepared by the department is known as 'Mineral Map'. The mineral maps are thus prepared to serve the purpose of data base maps, which may aid in planning for development of areas on regional scale.

13.2 TYPES OF MINERAL MAPS :

Two types of maps are prepared namely Index Map and Block Plan.

13.2.1 Index Map : Scale and size of the Index Maps are determined on the basis of avaiabiity of Survey of India toposheet of the area. These toposheets are generally available on the following scales.

i) 1 : 63,360(1" = 1 mile)

ii) 1 : 50,000(New sheets on metric scale)

13.2.1.1 The size of each sheet is kept as 45 x 50cm. The Index Map includes the following details:

i) Physiographic features,
ii) Regional Geology,
iii) Infrastructural details like road, rail and water ways.
iv) Power line,
v) Villages and townships,
vi) Important buildings of monumental type and,
vii) Temples, mosques, synagauge, etc.

13.2.1.2 A separate topographic-cum-forest map is prepared on similar scale and size. But these maps are prepared on transparent sheets, which are utilised as overlays on the original Index Map. These maps help in assessing the impact of mining on local vegetation/forest, and other aspects. Further these overlays may be referred for land use planning and preparation of feasibility/project reports.

13.2.2 Block Plans : The size of Block Plan is also kept as 45 x 50 cm. The scale of block plans is kept as 1:16,000 if the Index Map is prepared on scale of 1:63,360. In case Index Map is available on a scale of 1:50,000 then Block Plan is prepared on a scale of 1:10,000. It may, however, be noted that scales of Block Plans are suitably changed for select areas on the basis on requirements of the details to be shown. The Block Plans include the following details.

i) Physiographic features,
ii) Lithologic units with structural details,
iii) Distribution and disposition of mineral deposits,
iv) Location of old and working pits/mine openings,

v) Exploration details, and
vi) Infrastructural details.

On these Blocks Plans, information with regard to each leaseholds area is povided in the side column. The types of informations are:

i) Name of Owner,
ii) Area of lease,
iii) Period of lease,
iv) Categorywise and gradewise estimated reserve, and
v) Status of leasehold whether working or abandoned.

In case, similar details about freehold areas are available then those details are also provided in this plan.

13.2.2.1 Besides Index Map and Block Plan, there is a provision to prepare regional maps. These maps are generally prepared on a scale of 1:2,53,450 (1"= 4 miles) for important mining belt/districts. The purpose of this map is to present an overall view of a mining district/mineral belt on a single sheeet. The regional maps include :

i) Lithologic units,
ii) Mineral occurrences with extent,
iii) Leasehold areas,
iv) Exploration details, and
v) Important features of infrastructure developed in the area.

13.3 STEPS IN PREPARATION OF MINERAL MAPS:

13.3.1 For preparation of mineral maps the following basic data and maps are required.

i) Survey of India Toposheets,

ii) Lease area map with geological details with relevant information like period of lease exploration details, estimated reserves, etc. These can be had from MCCM Division/ State Departments or mine owners.

iii) Relevant data of mining district/mineral belt in respect of infrastructure, mineral based industries, marketability of ore, environment and ecology, etc. and

iv) Survey of India toposheets : The survey of India toposheetsare generally available in the Mineral Economics Division of the Department. These maps can be obtained from the M.E.Division on a requisition issued by a competent authority. For M.M.Cell, the competent authority is the Supdtg. Mining Geologist.

13.3.2 The reports and records of the MCCM Division should be first consulted for this purpose. If lease map showing geological details are not available in the department then the same has to be procured from the mine owners. The mine owners generally require 2 to 3 months for supplying the required details. Hence, correspondence with mine owners may be initiated well in advane for procuring the materials. Sometimes co-operation from the regional office of the concerned area is sought for procurement of the details from the lessees. If the map and details supplied by the lessee are found inadequate then a

field visit would be necessary to collect relevant details.

13.3.3 Sources for relevant details about leasehold areas/mining districts are :

i) reports and records of MCCM Division,
ii) Mine owners, and
iii) Published reports and articles.

13.3.4 For procuring details from the MCCM Division and mine owners effort may have to be made as discussed above. Besides, these sources, relevant details may also have to be obtained from books, memoirs, bulletins, journals, periodicals, etc. available in the Library.

13.3.5 It would be advisable to initiate action for collection of maps, plans and all other details at-least three months in advance.

13.3.6 In the office, preparation of mineral map may be done in the sequence discussed below:-

13.3.6.1 At the initial stage, Index Map may be prepared. For this purpose, tracing of the relevant toposheet will be required. On the traced toposheet map, location of leasehold is shown. In doing this job, the difficulties, experienced in general are:

i) lease maps are generally available on cadestral maps on scale 1" : 330' or larger scale. In such a situations, there is difficulty in plotting the lease areas on toposheets with accuracy. The lease maps on cadestral map are reduced to the scale of relevant toposheets and then with the help of important locations like towns/villages rivers, roads, etc. the locations as far as possible near to the

exact locations are shown,

ii) the lease maps do not show correct boundaries with corner pillars. In such situation, the matter may have to be referred back to the lessee for necessary clarification/correction.

13.3.6.2 On these Index Maps location of deposits in freehold areas may have to be shown. The Index Map thus prepared would show location of mineral bearing area and leasehold area. Hence relevant portion of the toposheet may have to be enlarged on suitable scales for preparation of block plans. The block plan should contain details as discussed earlier. Maps showing contour lines, important physiographic features and ecological details may be prepared on suitable scales on transparent paper to serve as overlay on idex maps.

PART-B

PREPARATION OF TECHNICAL RESUME.

13.4.1 Each mineral map is appended with a Technical Resume. The Technical Resume should contain a brief note on general geology and extent of mineral belt, characteristics features about mode of occurrence of ore and nature of mineralisation relevant details about leaseholds like ownership, period of lease, present status of mining activity, ore distribution pattern, status of exploration, mining practices, details about environment and ecology etc. For this purpose a proforma has been provided. Attempt may have to be made to collect and provide details as shown in various columns in the proforma but serious effort may be made to collect, collate, analyse and then add relevant useful information other than those provided in the proforma also.

13.5 FORMAT FOR TECHNICAL RESUME

1. **Introduction :** Brief account of the area/district of the mineral selected. Method adopted in the presentation of various plates, viz., regional, index and block plans. Total coverage and limitations.

2. **Physiography :** The rivers, hillocks and forest tracks should be broadly discussed.

3. **General Geology :**In addition to the sequence presented on the maps, any additional significant features on the regional structure, genesis, mineralisation, etc. may be discussed.

4. **Lease Particulars :**Percentage of the coverage, grouping of small/large lease holding, ownership etc. may be analysed.

5. **Reserves :**Summary to the details already given in the individual plates needs to be given. A mention may be made on the potentialities of the adjoining freehold areas.

6. **Exploration :** The exploration work carried out by various agencies should be reviewed. Future requiremnt of exploration, if possible, may be discussed.

7. **Environment:** The impact has to be discussed as a result of mining activities in the area.

8. **Mining :** A brief account may be given on the method of mining and mining practices followed.

9. **Production** : The overall contribution from this area/region, its grade marketing etc. may be discussed.

10. **Conclusions** : For the mining district as a whole considering the various aspects mentioned above, broad conclusions, highlighting the findings and their solutions should be attempted.

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