SUB GROUP-IV

ON

MINERAL EXPLORATION AND DEVELOPMENT
(OTHER THAN COAL & LIGNITE)

FOR THE XII FIVE YEAR PLAN (2012-17)
## MEMBERS OF SUB-GROUP IV

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Chairman</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Joint Secretary (M), Ministry of Mines Shastri Bhavan, New Delhi</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Secretary, Mining &amp; Geology, Govt. of Andhra Pradesh</td>
<td>Members</td>
</tr>
<tr>
<td></td>
<td>Secretary, Mining &amp; Geology, Govt. of Jharkhand</td>
<td>Members</td>
</tr>
<tr>
<td>3</td>
<td>Director, Non-Ferrous Materials Technology Development Centre (NFTDC), Hyderabad.</td>
<td>Members</td>
</tr>
<tr>
<td></td>
<td>Director, National Geophysical Research Institute, Hyderabad.</td>
<td>Members</td>
</tr>
<tr>
<td></td>
<td>Director, Defence Metallurgical Research Laboratory, New Delhi.</td>
<td>Members</td>
</tr>
<tr>
<td>4</td>
<td>Director, Indian Lead-Zinc Information Centre, New Delhi</td>
<td>Members</td>
</tr>
<tr>
<td></td>
<td>Chief Technical Manager, India Copper Development Centre, Kolkata</td>
<td>Members</td>
</tr>
<tr>
<td></td>
<td>Secretary General, Aluminium Association of India, Bangalore</td>
<td>Members</td>
</tr>
<tr>
<td></td>
<td>Secretary General, Confederation of Indian Industries, New Delhi</td>
<td>Members</td>
</tr>
<tr>
<td>5</td>
<td>Director, Indian School of Mines University, Dhanbad</td>
<td>Members</td>
</tr>
<tr>
<td></td>
<td>Director (Research), Association of Indian Universities, New Delhi</td>
<td>Members</td>
</tr>
<tr>
<td>6</td>
<td>Department of Science &amp; Technology (DST)</td>
<td>Members</td>
</tr>
<tr>
<td></td>
<td>Representative of GSI</td>
<td>Members</td>
</tr>
<tr>
<td></td>
<td>Representative of Indian Bureau of Mines</td>
<td>Members</td>
</tr>
<tr>
<td>7</td>
<td>Prof. B. B. Dhar</td>
<td>Member</td>
</tr>
<tr>
<td>8</td>
<td>Dr. S. K. Haldar, Director (Tech) MECL</td>
<td>Spl</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Invitee</td>
</tr>
<tr>
<td>9</td>
<td>Director (SK), Ministry of Mines, Shastri Bhavan, New Delhi.</td>
<td>Member</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Secretary</td>
</tr>
</tbody>
</table>
TERMS OF REFERENCE (TOR)

1. To suggest ways of ensuring modernization, automation and computerization of mining sector in the interest of scientific mining, safety and productivity.

2. To review the present indigenous R&D set up in Mining Sector and to suggest strategy for exploiting and beneficiating low grade ores and to suggest measures for adoption of state of art technology in production and beneficiation to ensure zero waste mining in the country.

3. To review the outcome of R&D and training and suggest ways for capacity building for organizations concerned in the mineral sector to meet that emerging geo-scientific challenges.

4. To suggest ways of developing centers of excellence in R&D, for both fundamental and multidisciplinary research.

5. To review the role of regulatory agencies namely Indian Bureau of Mines and the State Directorates of Geology and Mining and suggest measures for strengthening them through capacity building measures, and use of modern technologies including informatics.

6. To suggest ways for making the governance system more effective in the mining sector, to review current mechanism of prevention and detection of illegal mining across States and suggest possible ways to develop capacities of concerned organizations for detecting, preventing illegal mining by using modern technologies and geo-referencing of mining leases in the country.

7. To create institutional mechanism for funding information, Education and Communications initiatives, including content development.

8. To develop global reporting standards and ranking systems for mining companies in mining practices.

9. To review the availability and requirement of human resource in mining sector during the XII Plan period and in perspective of 10 to 15 years and to suggest measures for capacity building by training and development of infrastructure for technical education and skill development. Also, to suggest strategy for modernization, updating of curriculum and technology to bring in the state of art.
10. To make such other recommendations as may be considered appropriate.
1.0.0 Chapter-I INTRODUCTION

2.0.0 Chapter-II AUTOMATION & MODERNISATION OF MINING SECTOR (TOR-1)
2.1.0 Scientific methods of Mining
2.2.0 Mining Technology
2.3.0 Automation and Modernisation in Mining
2.4.0 Mine Safety and Productivity

3.0.0 Chapter-III RESEARCH & DEVELOPMENT AND TRAINING (TOR-2,3 & 4)
3.1.0 Preamble
3.2.0 Review of present Indigenous R&D set up in Mining Sector
3.3.0 Research and Development in Mining Technology for achieving zero waste mining.
3.4.0 Strategy for State-of-art technology in mining and beneficiation of low grade ores.
3.5.0 Capacity building of mining organisations.
3.6.0 Developing centres of excellence in R&D for fundamental and multidisciplinary research.

4.0.0 Chapter-IV ROLE OF REGULATORY AGENCIES (TOR-5)
4.1.0 Review of role of Indian Bureau of Mines & State DGM
4.2.0 Strengthening of state regulatory agencies by use of modern technology and informatics

5.0.0 Chapter-V EFFECTIVE GOVERNANCE IN MINING SECTOR (TOR-6)
5.1.0 Good and Effective governance
5.2.0 Illegal Mining in India
5.3.0 How to identify Surface Illegal Mining?
5.4.0 How to identify Underground illegal Mining?
5.5.0 Steps taken to curb Illegal Mining.
5.6.0 Steps taken by the Ministry of Mines / IBM to curb the illegal mining
5.7.0 Use of Modern Technology to curb Illegal Mining.
6.0.0 Chapter-VI  GLOBAL REPORTINGS STANDARDS AND RANKING SYSTEM (TOR-8)

6.1.0 Preamble
6.2.0 Global Reporting Standards
6.3.0 Ranking System for Mining Companies

7.0.0 Chapter-VII  HUMAN RESOURCE DEVELOPMENT IN MINING SECTOR (TOR- 7 & 9)

7.1.0 Preamble
7.2.0 Availability and Requirement of Human Resources in Mining Sector in XII Plan (2012-17)
7.3.0 Measures for Capacity Building of Infrastructures
7.4.0 Modernisation and updating of Curriculum and Technology

8.0.0 Chapter-VIII  RECOMMENDATIONS (TOR- 10)
Chapter- I

1.0.0 INTRODUCTION

1.1.0 Minerals are finite and non-renewable valuable natural resources being the basic raw material for infrastructure, capital goods and various other industries. The history of the mineral extraction in India dates back to the Harappan Civilization. As India is endowed with very rich mineral resources and skilled manpower, it is important that scientific and detailed exploration is done for minerals using state of the art techniques in geologically conducive mineral bearing area which may lead to the growth and development of the mining sector in India.

1.1.1 The Country accounts for 67 major minerals and 23 minor minerals (besides a host of atomic minerals). However, the contribution of mineral production (mining & quarrying) to GDP was only 2.3% in 2009-10 as against 8.5% growth of Indian economy. Sustained efforts for mineral exploration over past few decades have enhanced resources and reserves of many minerals, however, despite some major discoveries and noteworthy additions to the National Mineral Inventory, India continues to lack in several critical minerals like diamond, nickel, copper, gold, platinum group of elements, tin, tungsten, molybdenum, fertilizer minerals etc. The situation therefore calls for immediate attention and efforts to augment their resources.

1.1.2 In pursuance of the reforms initiated by the Government of India in July’1991 in fiscal, industrial and trade regime, the National Mineral Policy was announced in March’1993. The National Mineral Policy recognized the need for encouraging private investment including foreign direct investment and attracting state-of-the-art technology in mineral sector. The basic Mining statute namely MMDR Act 1957 was amended from time to time to open up the sector to private investment and to make the mineral concession regime more investor friendly by delegating power to the State Governments and limiting the role of Government of India. Now 100% FDI is permitted in mineral exploration, mining and mineral processing, which has some what led to narrowing of technology gaps and exposed the Indian mineral industry to the foreign technology and practices.
The financial year wise FDI equity inflows from April-2007 to December 2010 in mining sector are given below:

<table>
<thead>
<tr>
<th>Financial Year</th>
<th>FDI in Crores of Rupees</th>
<th>FDI in in millions of US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007-08</td>
<td>1,761.66</td>
<td>444.26</td>
</tr>
<tr>
<td>2008-09</td>
<td>161.39</td>
<td>34.22</td>
</tr>
<tr>
<td>2009-2010</td>
<td>829.92</td>
<td>174.40</td>
</tr>
<tr>
<td>2010-11(up to Dec)</td>
<td>341.07</td>
<td>75.90</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>3,094.05</strong></td>
<td><strong>728.77</strong></td>
</tr>
</tbody>
</table>

Despite ushering in the various reforms, the mineral sector in India is far from achieving the growth potential in any significant manner. While developed countries have made rapid strides in the field of exploration and mining of concealed and deep-seated mineral resources, bio-leaching, mineral beneficiation and utilization of lean grade ores, India is yet to adopt State of the art technology on commercial scale in these areas of vital importance. In order to meet the needs of the changing global scenario and the needs of domestic industry it is therefore necessary to revisit the NMP 1993. Accordingly, NMP-2008 was formulated with a specific objective to deal with extraction of mineral resources delineated by regional and detailed exploration in a scientific and systematic manner over the entire geologically conducive mineral bearing areas of the country in a time bound manner. In addition to above, specific thrust is being given on scientific methods of mining, beneficiation and economic utilization with upgraded mining technology for utilization of entire run-of mines with renewed R&D efforts. The zero waste mining will be the national goal.

1.3 The National Mineral Policy, 2008 further enunciates measures to streamline and simplify the procedure for grant of mineral concessions, develop sustainable framework for optimum utilization of the country’s natural mineral resources for industrial growth in the country and at the same time endeavor to recast the policy initiatives for improving the life of people living in the mining areas located in the backward and tribal regions.

1.4 During the midterm appraisal of the XI Five Year Plan, following were the areas of concern:

- Illegal mining is rampant in many states. This amounts to stealing of public property; it is also an environmental hazard. Strong action is required by the states to check such illegal activities.

- There is shortage of geo-scientists in the mineral sector due to less intake in
the past in GSI and IBM and poor career progression. Steps need to be taken for enhancing the capabilities to ensure faster growth in the sector.

- In spite of step-up of investment in R&D since the Ninth Plan, no visible impact or outcome has been noticed in the sector so far. More attention is required to improve the performance.

- Accordingly there is a need to improve management capacity at Central and State Government levels. Further investment in Mineral Sector, as in an industry, are effected by the availability of land for projects and environmental concerns. Laws and policies and their administration, must be improved. Mineral sector enterprises must also overcome a large ‘trust deficit’ with the social sector, Therefore, they must voluntarily do much more to address social and environmental concerns.

1.1.5 Keeping in view the above policies of NMP-2008 the role of technology, therefore, appears crucial. A greater emphasis will have to be laid on research & development for exploration and exploitation of deep-seated mineral deposits adopting concept oriented programmes and application of cost effective and environment friendly mining technology. The growth in mining sector has not been commensurate with the growth of Indian economy. In order to sustain current momentum of 9% plus growth in XII Plan we need to introduce necessary reforms in the mineral/ mining sector to augment investment and production which would necessitate creating a strong base for research & development and to ensure employment of professionally qualified and trained manpower, besides world-class technology and laboratory facilities.

1.1.6 Qualified, experienced and skilled manpower and impressive network of R&D infrastructure are our productive assets in India. There is a large network of academic institutions providing basic education and training in geo-sciences, mining, mineral processing and metallurgy. These institutions ensure good availability of fresh graduates and post-graduates. However, investment and efforts in keeping the knowledge, expertise and skills of manpower updated has been inadequate which has been adversely affecting their capabilities. Thus, there is need to re-engineer the national human asset in order to enhance their level of performance. This calls for corrective action by way of creating capabilities for advanced research, training of manpower in key areas, institutional strengthening, encouraging students for research in hi-tech areas for their doctoral/ postdoctoral/ research projects, curriculum development, training of trainers, faculty development, introduction of new & advance courses, networking with national & international agencies thereby promoting collaborative approach, evolving a long time human resource planning for R&D, professionalizing management & support functions through appropriate training and induction of professionals and establishing coordination & linkages between R&D, academia and industry.

1.1.7 GSI, IBM, State Departments of Mines & Geology, State Mining Corporations, various other Central & State PSUs, research institutions, academic institutions,
private industry and joint venture exploration companies involving FDI (currently in various stages of implementation) are the key players who recruit competent and trained manpower in the mineral sector. Indian universities and R&D institutions are generally in a position to meet the requirements of education and training. Apart from demand-supply gap that is envisaged for human resource, which is seen generally in quantitative terms, there are significant gaps such as lack of (a) interdisciplinary R&D, (b) knowledge integration for technology development (c) inter-related R&D between mineral sector and construction and infrastructure sectors. Thus, there is a need to look at fundamental issues governing R&D and human resource development for the mineral sector ranging from revision of course curricula in line with modern developments, continuing education and training on one hand, interdisciplinary R&D in thrust areas, knowledge integration paradigms and national mission programmes on the other hand to meet the ambitious growth plans for the mineral industry.

1.1.8 The Indian mining sector has been facing severe criticism on several issues relating to its performance vis-a-vis sustainable development. Accordingly, the Ministry of Mines has moved forward to develop a Sustainable Development Framework for the country’s mining sector to ensure that mining operations are undertaken keeping in view the interest of stakeholders including the host population and the environment. The issue of illegal mining creates a negative impact on the mining industry. Hence a good and effective governance with effective steps with use of modern technology is the need for mining sector's all round growth.

1.1.9 In order to strengthen the growth of mineral sector and mining industry in particular, due emphasis needs to be given on the policy measures for ensuring modernization, automation, etc. for scientific mining, developments and renewed efforts in R&D, strengthening of regulatory agencies along with trained professionals for the industry while formulating the document for XII Plan.
SUB GROUP-IV MINERAL EXPLORATION AND DEVELOPMENT (OTHER THAN COAL & LIGNITE ) FOR XII PLAN (2012-17)

CHAPTER – II

2.0.0 AUTOMATION AND MODERNISATION OF MINING SECTOR (TOR-1)

2.1.0 SCIENTIFIC METHODS OF MINING

2.1.1 As per National Mineral Policy – 2008, the extraction of mineral resources located through exploration & prospecting has to be maximized through scientific methods of mining, beneficiation & economic utilization. Mining technology needs to be upgraded through modernization, automation, computerization to ensure extraction & utilization of the entire Run of Mine (ROM) taking care of all safety measures. A co-ordinated efforts between R & D institutions, the entrepreneurs, mining machinery manufactures and statutory bodies is need of the hour to achieve the zero waste mining - the national goal.

2.1.2 Enforcement of mining plans for adoption of proper mining methods and optimum utilization of minerals, safety & health of human resources and closure of mines will be ensured by the regulatory bodies. A framework of sustainable development to be designed which take care of bio-diversity issues and to ensure that mining activity take place along with suitable measures for restoration of the ecological balance.

2.1.3 Thus a financially viable, socially responsible, environmentally, technically and scientifically sound mining with long term view of development, uses mineral resources optimally and ensures sustainable post-closure land uses.

2.1.4 Mine development and mineral conservation as governed by the rules and regulations would be on sound scientific basis with regulatory agencies viz Indian Bureau of Mines and State Directorates, closely interacting with R & D organizations/institutions and scientific & professional bodies to ensure optimal mining plans. Conditions of Mining Leases regarding size, shape, disposition with reference to geological boundaries and other mining conditions should be such as to favorably predispose the leased areas to systematic and complete extraction of minerals. The regulatory agencies should be suitably strengthened through capacity building measures.

2.1.5 Mining methods determine the safety, economy, speed and percentage of extraction of ore reserves from a mine. Research and Development thrust would be directed specially in the area of rock mechanics, ground control, mine design engineering, equipment development & maintenance, energy conservation, environmental protection, safety operation and human engineering. This has to be done in a holistic way so that inter-linkage are established to the advantage of each segment.
2.2.0 MINING TECHNOLOGY

2.2.1 The mining technology adopted should be sustainable to meet the output levels commensurate with environmental protection, safety, health, conservation and economics. The ultimate goal should be to develop technology for cent per cent extraction and utilization of mineral deposits. There is an urgent necessity to develop innovative and cheaper mining methods and technology, efficient mining machinery, higher productivity and thereby make mining globally competitive.

2.2.2 To achieve the goal of Zero Waste Mining, the following points have been suggested.

- The low grade minerals and the less important minerals along with the main minerals which can not be extracted economically today should be stacked in a systematic manner so that it could be used for mineral extraction at later date when these become economically viable. For this intensive R & D efforts should be made.
- Efforts should be made to mine as far as possible only the desired ore. In case of waste bands in the ore body, the same may be sorted out after blasting and be disposed off in the stope itself.
- In order to reduce the waste disposal on the surface in tailing ponds, efforts should be made to dispose off waste/tailing into the worked out areas / voids in the mine which will enhance the stability of the mines.
- An extensive R&D effort is needed to use the slime part of waste/tailing for some industrial purposes.
- If there are number of thin parallel lenses which can not individually be mined economically could be merged to make a thick ore body which could then be mined economically by a suitable mechanised method. However, this will reduce the overall grade which can be compensated by increase in production due to mechanization.

2.2.3 One of CPSUs in mining sector proposed to implement the following measures to achieve the goal of zero waste mining:

- It has planned to install 1.2 MTPA Pelletisation Plant along with slime beneficiation facility to ensure the beneficial use of slimes which are accumulated in tailing pond. About 6 Million tones of slimes are already impounded in tailing pond and about 0.7 MT slimes will be generated every year. In this way complete slimes will be transformed in usable saleable product within the life of mine.
- And also plan to install 1.8 MTPA BHQ/BHJ beneficiation plant to ensure the beneficial use of low grade BHJ wastes towards zero waste mining concept.
In both the above mentioned initiatives, the beneficiation technology has been developed in-house by CPSU, R&D. The use of latest technologies is being ensured by use of Global Open Tender for award of various packages for installation/commissioning of the plant(s)

2.2.4 Major thrust area:

a) Application of advanced technology tools like computerized management plan, MIS, total quality management, remote sensing, etc should be intensified to make mining more efficient and sustainable.

b) Environmental protection and land reclamation is major challenge for mines and allied industries not only due to stringent regulations, but also due to increased public awareness. Sustainable technology suitable for environmentally fragile areas needs also to be developed.

c) Safer mining practices are to be developed to eliminate accidents and disasters caused due to ground movement, mine fires, explosions, inundation and equipment usage.

d) Suitable steps are to be taken to guard the health of miners from occupational diseases and improve the comfort conditions of underground face workers.

e) Large-scale mechanization coupled with heavy equipment involves large capital requirements. To make mining more profitable, with high cost equipment, their availability and consequent utilization should be maximized to improve productivity, which calls for more emphasis on maintenance. The best maintenance philosophy would be condition monitoring, as random failures do not follow any time related pattern. Hence there is need for cheaper and efficient monitoring system.

f) Development of methodologies and techniques for processing low grade ores.

g) Infrastructure development to support mining and mining areas.
2.2.5 Underground Mining Imperatives

Due to continuous mining and depleting mineral resources, the shallow mineral deposits are getting exhausted. This is causing a shift of mining activities to deeper levels. Most of precious metals occur at deeper horizons and underground methods of mining are only viable route and in such cases the following real time problems are being faced by industry.

a) The high rock temperature is encountered at depth due to geothermic gradient.

b) The mines are mechanised in order to be cost effective. Several thousand kw of electric and diesel machines are run in closed space, generating heat, fumes and humidity.

c) In deeper horizons the ground control problems increase and water percolation also increases.

d) Ventilation problems increase and create difficult working conditions in deeper mines.

e) Deep underground mines also cause a serious safety problem.

f) Transferring of survey reference co-ordinates from surface to deeper levels and accuracy of Mine Survey.

2.2.6 Thrust Areas for Underground Mining

a) Mine Planning and Design.
b) Ground Control & Rock Mechanics.
c) Rock – Water interactions.
e) Mining Machinery optimization and Mechanised mining.
f) Studies for in-situ leaching in mines.
g) Studies for deep mine environment.
h) Development of sensors and Mine Safety.
i) Technology of deep mining.
j) Latest technology for deeper mine survey

The emphasis in all of these studies would be directed on removal of large tonnage and the lean ores.
2.2.7 Closure of Mine

- Once the process of economical extraction of a mine is complete, there is need for scientific mine closure which will not only restore ecology and generate biomass but also take into account the Socio-economic aspects of such closure. Where mining activities have spread over a few decades, mining communities get established and closure of the mine means not only loss of jobs but also disruption of community life. Whenever mine closure becomes necessary, it should be orderly and systematic and so planned as to help the workers and dependent community rehabilitate themselves without undue hardship.

- NMDC is going to implement the following measures for closure of mine as emphasised in National Mineral Policy-2008:

- NMDC fully supports the scientific mine closure after economical extraction of mineral wealth from a mine is complete. It is not only paramount but a responsibility of a miner to restore ecology and regenerate biomass while taking in to account the socio-economic aspects of such closure.

- Realising the socio-economic impact of the closure of a mine, NMDC in its Scheme of Mine closure in duly considering the rehabilitation aspect of the employees as well other local community connected directly/indirectly with the business of mining operation.

2.3.0 AUTOMATION AND MODERNISATION IN MINING

2.3.1 Mining Equipments and machinery

Indigenous industry for manufacture of mining equipment and machinery should be strengthened. Induction of foreign technology and participation for this purpose should be encouraged. Use of equipment and machinery which improve the efficiency, productivity and economics of mining operations and safety & health of persons working in mines and surrounding areas should be encouraged. Import of such equipment and machinery should be freely allowed.

In order to improve the competitive edge of the National Mining Industry, emphasis should be laid on mechanization, computerization and automation of existing and new mining units. Incentives should be given to the Mine Operators to promote adoption of mechanization, automation computerization and sustainable mining.
2.3.2 Automation in Mining

To meet the objective of safety and economic production attention should be given to the development of robotics, automated equipment and system for mining, especially for deep mining and transport to surface.

Development of Automation and implementing in mining will have a significant influence on all mining activities. Mining will be performed by means of intelligent, fully automated machine robots, equipped with sensors and control programme, making possible the autonomous work with full recognition of the internal state & external environment, analysis of the production process, automatic control, data processing, modeling & simulation, virtual reality, control of technological process safety control, etc.

Introduction of such machines would change the technology of excavation & transport, eliminating a man from the technological process and real time control. Research work to be done and results which are likely to be achieved in the fields of real time control, modeling & simulation and application of virtual reality methods.

Further, the automation and modernization of mining sector, mining of various minerals must be done most scientifically in order to extract the minerals using the state of art technology to ensure safety, economy, efficiency and conservation with due regard to environment. Safety and productivity are two sides of the same coin. Safe operations result in high production. Some of the modern equipment that can be used for mining, are:

- Shaft boring machines for deep shaft sinking
- Faster mine development raise borer
- Faster mine development tunnel borer
- Jumbo Drill Machine, Load Haul Dumper (LHD) & Low Profile Dump Truck (LPDT).
- A consortium of Private/Public Sector companies should be set up for buying and owning the high cost machines like shaft/raise borers and tunneling machines and hiring / leasing of these machines to all the mining companies for its optimum utilisation.

2.3.3 Computerization of Mining Industry

Computers can become an invaluable tool to mineral managers as they strive to make better and more knowledgeable decisions with regard to long range planning issues and short range operational problems by integrating data and information in a timely manner.

For efficient use of resources, it is all the more imperative to use computers for decision making wherever possible. Sophisticated Computer techniques such as expert system Fuzzy Logic (for blast design and production) and Advanced
Computer Design (CAD/CAM- for Mine mapping and spatial information system) should be used to get maximum advantage.

Other applications of computers may be in parallel processing for image processing, virtual mining, solid Modeling & Visualisation. Our endeavor should be to induct the latest technologies of Information Technology in Mining Industry and to tap the maximum potential of our employees in mineral industry by continuously upgrading their knowledge & skill.

Some of main thrust areas for using Information Technology in Mining Sector.

a) Computer applications in Mine Design & Planning.
b) Improving production and productivity.
c) Loading, Transport and Dispatch system.
d) Maintenance Management of equipments used in mines.
e) Updating of Open Cast Mine faces and resource Modeling using advanced Hardware & Software.
f) Digital Image Analysis Techniques for optimisation of Blast Design.
g) Development of programme for Deep Mine Hoisting System and automatic hoisting.
h) Reorganisation of Ventilation Network in underground mines through computer simulation.
j) Preparation of Mine Plans and Sections using Auto CAD/Map.
k) Mine Safety Management.
l) Management of HRD & Training.
m) Management of Statutory Requirements.

2.4.0 MINE SAFETY AND PRODUCTIVITY

2.4.1 Mining Operations are hazardous in nature. Accidents happen and often result in loss of life or limb of persons engaged in it. Geo-mining condition is likely to become more difficult as exploitation extends to deeper horizons. Problems of rockburst, ground control in high stress fields, problems of heat and humidity, hauling from long distances and winding from greater depth will need to be addressed.

2.4.2 Efforts must be directed towards the development and adoption of mining methods which would increase the safety of workers and reduce the accidents. Towards this end, participation and co-operation of mine workers should be secured. The steps should also be taken to minimise the adverse impact of mining on health of workers and surrounding population.

2.4.3 The in-house expertise available for solving these problems has to be forged to get the desired results. There will be ever increasing need of sharing and gaining experiences in these areas on a global basis.
2.4.4 The enforcement of Safety Rules & Regulations in mines, Regulatory Bodies i.e. Directorate General of Mines Safety and National Institute of Miner's Health should be strengthened.

2.4.5 Modern and efficient mining facilities utilize improved control methods and increased mechanisation & automation and computerization during mining process will increase safety and production efficiency.

2.4.6 The various available technologies and approaches to be adopted for safe mining. Various reasons for the disasters in mines, it may be observed that industry requires to have a holistic approach while planning for safety and productivity in mines. It is strongly believed that a higher level of hazard perception amongst employee, planning for a safe and productive mining, establishing a right attitude amongst one and all vis-a-vis safety and productivity, and due respect for safety legislations can go a long way in safe and productive mining. Safety and Productivity are not mutually exclusive but can go together hand in hand.
CHAPTER-III

3.0.0 RESEARCH & DEVELOPMENT AND TRAINING (TOR-2,3 & 4)

3.1.0 PREAMBLE

3.1.1 Minerals are valuable natural resources and closely linked with evolution of civilization since stone age to modern high tech era. Minerals are the vital raw materials for basic industries and infrastructure development. As a major resource for development and growth of the country, the exploration, extraction and management of minerals has to be integrated into overall strategy of the country’s economic development. The exploitation of minerals has to be guided by long term national goals and perspectives.

3.1.2 India is endowed with huge resources of many metallic and non metallic minerals. It has an obvious Geological potential area consisting of Achaean rocks covering 3,49,300 Sq.Km. and Proterozoic rocks covering 1,58,608 sq.km. India produces 86 minerals including 4 fuel, 10 metallic, 46 non-metallic, 3 atomic and 23 minor minerals. Total value of mineral production (excluding atomic minerals) during the year 2009-10 was about Rs.1,60,649 Crore.

3.1.3 Mining continues to be an important segment of Indian economy. The contribution of mineral production (mining and quarrying) to the GDP is very vital. The mining and quarrying sector has a share of about 11% in the overall index of industrial production(IIP). This sector registered an average growth rate of 2.5 to 3 % during the XI th plan. In the XII th plan a target of 9% growth in GDP is envisaged and in order to achieve this level of growth the mining sector is expected to grow @12% per annum during the XII th plan.

3.1.4 Development of mineral sector includes processes of exploration, mining, value addition, transportation, using, reusing, recycling and disposal of minerals & metal products in most efficient, competitive and environmentally responsible manner using best international practices. Therefore, in order to ensure sustainable development of mineral sector, it is necessary to strengthen infrastructure for Research & Development and training of human resources.

3.1.5 In the National Mineral Policy 2008 (NMP 2008), it is envisaged that, Research and Development in the mineral sector has to cover the entire gamut of activities from geological survey, exploration, mining, beneficiation, concentration of minerals to development of materials. Efforts will be directed towards the development of new technologies for conversion of existing mineral resources in to viable economic resources.

Appropriate technologies shall be developed to enable indigenous industries to utilize the mineral resources with which the country is abundantly endowed and as
substitutes for minerals whose reserves are poor. R & D efforts shall be directed to find new and alternative uses for minerals whose traditional demand is on the wane. Indigenous technology has to be upgraded through research and appropriate absorption and adoption of technological innovations abroad. R & D efforts shall be made to improve efficiency in process, operations and also the recovery of by-products and reduction in specifications and consumption norms. Efforts will be directed to evolve low capital and energy saving processing systems.

3.1.6 To achieve the above perspective, emphasis has been given to Research in Mining Methods, Mineral processing and Beneficiation, Development of Automated Equipment, Off Shore Mining, Production of Materials of High Purity and Coordination of Research organizations.

3.2.0 REVIEW OF PRESENT INDIGENOUS R & D SET UP IN MINING SECTOR

3.2.1 The Research & Development set up in India in the mineral and mining sector continues to be the same as it was during XIth plan period. It broadly consists of following institutions:

a) Laboratories under Council of Scientific and Industrial Research (CSIR) namely National Metallurgical Laboratory (Jamshedpur), Institute of Minerals and Materials Technology, Bhubaneswar, Advanced Materials and Processes Research Institute, Bhopal, North East Institute of Science & Technology, Jorhat, National Institute of Interdisciplinary Science and Technology, Trivendrum, Central Institute for Mining and Fuel Research, Dhanbad, Nagpur & Roorkee) and some of the defence laboratories

b) Laboratories under Indian Bureau of Mines (IBM)

c) Laboratories under the Bhabha Atomic Research Centre (BARC)

d) Laboratories under Hindustan Copper Ltd. (HCL) and National Aluminium Company Ltd. (NALCO)

e) Laboratories under Geological Survey of India (GSI) and Mineral Exploration Corporation Ltd. (MECL)

f) Laboratories under National Mineral Development Corporation Ltd. (NMDC) and Steel Authority of India Ltd. (SAIL)

g) Laboratories under private sector such as TATA R&D Centre, Pune and Central Research & Development Laboratory (CRDL) (Udaipur), Hindustan Zinc Ltd. (HZL)

h) Laboratories under Universities and National Technological Institutes including Indian Institute of Technology (IITs), Indian School of Mines (ISM), Indian
Institute of Science (IISc) (National facility for Semi Solid Forming at Bangalore), Institute of Technology, Banaras Hindu University etc.

i) Laboratories / centres of excellence under Ministry of Mines namely Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC), National Institute of Rock Mechanics (NIRM), National Institute of Miners’ Health (NIMH) and Nonferrous Materials Technology Development Centre (NFTDC)

j) R&D setups under State Directorates of Mining & Geology

3.2.2 Thus, there exists a large network of indigenous R&D setup in mineral / mining sector with strong technical capabilities and facilities. Various institutions have carried out research work on pilot plant scale / laboratory scale in the areas of bio-leaching beneficiation, by-product recovery, upgradation of low-grade ores, extractive metallurgy, development of alloys, waste utilisation, etc. As far as the R&D institutional mechanism is concerned, this is the growing area in the country’s R&D efforts. The R&D institutions in the country amongst themselves have a very broad spectrum of R&D expertise required for mineral / mining industry.

3.2.3 Areas of concern:
In spite of a large network of indigenous R & D set up in mineral/mining sector with strong technical capabilities and facilities in the country, the following are the main areas of concern which are to be addressed in result oriented manner.

- The success rate towards commercialization of the processes developed in the various institutions through R & D have been minimal. Most of the studies/research work have been confined to academic level.

- Lack of coordination between the industry, R & D institutions and the academia and absence of an umbrella agency for directing the efforts of the institutions towards commercialization.

- Lack of networking with national and international institutions.

- Inadequate utilization of facilities at R & D institutions, Industries and universities. Non utilization or under utilization of advanced equipments/installations.

- Lack of collaborative approach for marketing R & D operations as unified national programme.

- Lack of funding of the R & D projects by the Private sector/user industries.

- Lack of initiative, enthusiasm within the institutions/organizations/industries itself to build a strong R & D set up and impart training to human resources engaged in the mining industry.
• Under utilization of funds earmarked by Government for R & D activities and training under the previous five year plans.

3.3.0 Research and Development in Mining Technology for achieving zero waste mining:

3.3.1 Mining wastes covers all the wastes discarded at various stages of mining operations. Demand for more and more minerals leads to enrichment of low grade ores with concomitant generation of mineral wastes, which may become the principal raw material for future. The different types of mining wastes are solid wastes, liquid wastes and water wastes of toxic nature. Keeping in view the advances in equipment design and technology, there is a need for every mining enterprise/organization to prepare a mine waste management plan for reuse of mining wastes wherever possible and feasible to improve the economic viability and to mitigate various associated environmental issues/problems encountered in effective disposal of mining waste.

3.3.2 Minerals being a valuable resource, the extraction of mineral resources deciphered through exploration and prospecting has to be maximised through scientific methods of mining, beneficiation and economic utilisation. In the NMP 2008 it is emphasized that Zero waste mining will be the national goal and mining technology will be upgraded to ensure extraction and utilisation of the entire run-of-mines. To achieve both these goals of large scale prospecting and optimal mining large investments will be required together with the latest State-of-the-art technologies in prospecting and mining.

3.3.3 Conservation of minerals shall be construed not in the restrictive sense of abstinence from consumption or preservation for use in the distant future but as a positive concept leading to augmentation of reserve base through improvement in mining methods, beneficiation and utilisation of low grade ore and rejects and recovery of associated minerals. There shall be an adequate and effective legal and institutional framework mandating zero-waste mining as the ultimate goal and a commitment to prevent sub-optimal and unscientific mining. Non-adherence to the Mining Plan based on these parameters will carry repercussions. Mineral sectoral value addition through latest techniques of beneficiation, calibration, blending, sizing, concentration, pelletisation, purification and general customization of product will be encouraged. This is particularly important in iron ore mining as about 80% of the iron ore produced in the country is in the form of Fines and to promote such value addition fiscal and non fiscal incentives will be considered. A thrust will be given to exploitation of mineral resources in which the country is well endowed so that the needs of domestic industry are fully met keeping in mind both present and future needs, while at the same time exploiting the external markets for such minerals.

3.3.4 To enable the use of state of the art exploration techniques, scientific mining and optimal use of minerals through ore dressing and beneficiation technologies it is
necessary not only to promote research and development in minerals but to simultaneously establish appropriate educational and training facilities for human resources development to meet the manpower requirements of the mineral industry. These matters will receive prime importance and a comprehensive institutional framework for Research & Development, and Training will be developed. These aspects constitute the essentials of the new National Mineral Policy, 2008.

3.3.5 Inputs from the mining organizations from both Public sector and Private sector are required to prepare a detailed approach towards adoption of State-of-art technology in production and beneficiation to ensure zero waste mining in the country during the XII Plan.

3.4.0 Strategy for State-of-the-art technology in mining and beneficiation of low grade ores:

3.4.1 The strategy for mining and beneficiation of low grade ores as envisaged in XI plan document and recommendations made there-in, are to be reviewed for extent of implementation during the XI plan period so far, and to be reconsidered for XII plan for further implementation.

3.4.2 In the NMP 2008, it is envisaged that attention will be given to beneficiation and agglomeration techniques to bring lower grades and finer size material into use. Research organisations, including the National Mineral Processing Laboratories of the Indian Bureau of Mines will be strengthened for development of processes for beneficiation and mineral & elemental analysis of ores and ore dressing products. There shall be cooperation between and coordination among all organisations in public and private sector engaged in this task. Research and development shall be oriented to ensure maximum economic recovery of the associated minerals and valuable metals.

3.4.3 In order to enable the use of state of the art exploration techniques, scientific mining and optimal use of minerals through ore dressing and beneficiation technologies it is necessary not only to promote research and development in minerals but to simultaneously establish appropriate educational and training facilities for human resources development to meet the skilled/expert manpower requirements of the mineral industry. These matters should receive prime importance during the XII Plan period and a comprehensive institutional framework for Research & Development, and Training will have to be developed.

3.5.0 Capacity building of mining organizations:

3.5.1 In the Mid Term appraisal of XI Plan, the Government has made a serious observation that, in spite of step-up of investment in R & D since Ninth plan, no visible impact or outcome has been noticed in the mineral sector so far. It is expressed that more attention is required to improve performance.
3.5.2 The role of mining organizations in building in-house facilities for R & D work and imparting training to its human resources in advanced, state-of-art technology in their respective field of mining operations is of prime importance to contribute to the national perspectives envisaged in this aspect. Apart from their own capacity building in R & D work and training, they have to look out for outsourcing some of the related works to specialized reputed national/international institutions/organizations to enhance their overall capacity in the mineral/ mining sector to meet the emerging geo-scientific challenges.

3.5.3 Mining methods determine the safety, economy, speed and the percentage of extraction of the ore reserves from a mine. Therefore, in the NMP 2008 it is indicated that Research & Development thrust shall be directed specially in the areas of rock mechanics & ground control, mine ventilation & underground environment, mine design engineering, equipment deployment and maintenance, energy conservation, environmental protection, safety of operations and human engineering.

3.5.4 Considering the shift of mining activities to deeper levels, due to depletion/exhaustion of shallow mineral deposits on account of continuous mining, the thrust in R & D is also essential for tackling problems related to deep mining such as high rock temperature encountered at depth due to geothermal gradient; problems arising due to continuous running of electric and diesel machinery generating heat, fumes and humidity; ground control; controlling water percolation; mine drainage; ventilation problem etc. Hence adoption of modern technology with proper R & D input is essential for deeper mining with due consideration to economic viability.

3.5.5 The mining organizations should make appropriate funding provisions in their growth plan and future investment plan exclusively for R & D and training of human resources.

3.5.6 Inputs are required from Mining organizations for preparing detailed approach on the subject.

3.6.0 Developing centres of excellence in R & D for fundamental and multidisciplinary research.

3.6.1 Considering need to have trained manpower in the field of exploration, geology, geophysics, drilling, mining, mineral processing and metallurgy, there is an immediate need to reorganize and strengthen the infrastructure for training in multidisciplinary fields, and upgradation of the present training infrastructures to an international standard. Therefore, a fully residential world-class infrastructure needs to be created for education and training in the entire field of geosciences, mining, mineral processing and metallurgy. The institute should be linked to UGC and AICTE system for providing degree / diploma. Strengthening of institutions like ISM should also be considered.
3.6.2 Creation of centres of excellence is to be first initiated which will require human resource at high level of expertise in R & D in specialized fields and at the same time, knowledge workers in the respective knowledge domains. The thrust areas are chosen such that knowledge integration takes place and the centres of excellence have to perform the role of both specialized knowledge creation as well as knowledge integration to solve practical problems.

3.6.3 Thrust areas identified are to be treated like national mission projects such as the space or nuclear programme. For each of the four major areas, namely exploration, mining, mineral processing and metals and products development, a nucleus is already available with R&D organizations under Ministry of Mines (NIRM, JNARDDC, NIMH), GSI, IBM, ISM, NFTDC, ITBHU, etc. For each area, R & D thrust areas have also been identified. It is now required to put together multiple projects under each mission within the centre of excellence concept and concurrently develop the human resource. Mission mode projects would create leadership level HR as well as large number of knowledge workers. Since the issue of Miner’s health falls under the domain of Mines Act, 1952 which is implemented by the Ministry of Labour, the NIMH may be transferred to Ministry of Labour.

3.6.4 In the NMP 2008, under the head ‘Coordination of Research Organizations” the following perspective is spelt out:

Research and development activities in the mineral sector are carried out in the national laboratories, educational institutions and R&D units of public and private sector enterprises. Pooling of resources and expertise available in the various R&D Organisations is imperative to meet the challenges and to fulfil the tasks ahead in the mineral sector. Linkages and interaction between the various institutions engaged in R&D in the mineral sector shall be strengthened to derive the maximum benefit. Interchange of scientists among institutions shall be encouraged to accelerate the pace of interaction. It shall also be ensured that the research findings are made available to users expeditiously. There shall be cooperation between and coordination among all organisations in the public and private sectors engaged in this task.

3.6.5 Mining methods determine the safety, economy, speed and the percentage of extraction of the ore reserves from a mine. Research and development thrust needs to be directed in areas of such as rock mechanics, ground control, mine ventilation & underground environment, mine design engineering, equipment deployment and maintenance, energy conservation, environmental protection, safety of operations and human engineering. This has to be done in a holistic way so that inter-linkages are established to the advantage of each segment. To this end the diverse research, development and training initiatives within the public domain shall be reorganised into a single and cohesive R & D and Training institution of excellence to be known as the National Institute of Mineral Development. Organizations such as the National Mineral Processing Laboratories of the Indian Bureau of Mines, the National Institute of Rock
mechanics, the Jawaharlal National Institute of Aluminium Research and Development, the R & D initiatives of the Geological Survey of India will be combined to provide a collective thrust.

3.6.6 In order to provide the thrust for Research & Development under the proposed Institute 'National Institute of Mineral Development', the following key areas are identified where the collective thrust needs to be given for R&D in the activities from geological survey, exploration, mining, beneficiation, concentration of minerals to development of materials as per NMP-2008. Accordingly, the following broad areas may be considered which may take care of the problems faced by the Industry.

- Exploration and exploitation of concealed and deep-seated deposits including concealed deposits in the continental shelf.
- Development of newer technologies for up-gradation of the low grade ores.
- Introduction of new technology and mechanisation for production of large tonnages of low grade ores to effect conservation and mineral development.
- Enhanced efforts on the exploration and exploitation of high value & low volume minerals, like minerals of platinum group to lessen our dependence on imports.

Keeping the above in view, the R&D focus is required to be directed by following the underline methodology:

- Strengthening the coordination & interaction mechanism between the various Science & Technology institutions, Research & Development Centres, and Entrepreneurs/organisations in the mineral sector to derive the maximum benefit for the mineral industry.
- Interchange of scientists among institutions to accelerate the pace of interaction.
- To ensure that the research findings are made available to users expeditiously.
- Cooperation and coordination among all organizations/institutions in the public and private sectors engaged in the R & D task of mining/mineral sector.
- Basic R & D facilities/supports to be provided/developed in the laboratories under the State Government to benefit the Small & Medium Enterprises.
- Private sector developing R & D facilities should be given benefits in terms of tax relief, etc.
- To undertake the R & D works/projects related to various problems/issues related to Mining including deep mining activity.

A) Exploration:

- Numerical modeling of the crustal processes leading to formation of minerals.
- Study of metallogenesis and distribution of mineral deposits in space and time using computer-simulation/numerical-modeling.
- Study of the metallogenic processes for exploration of the deep-seated and concealed deposits by integrating geophysical geochemical and geological/petro-logical tools.
- Study of the greenstone belts and their associated minerals specially gold and platinum group elements mineralization.
- Study of the Precambrian granites and porphyries and related hypogene mineralization of tin, tungsten and copper.
- Study of the geochemistry of Paleo-weathering sites and such other locales of mineralization for gold, uranium and nickel.
- Study of beach sand and placer deposits, polymetallic nodules and the concealed mineral deposits in the EEZ.
- PGE mineralization in layered igneous complexes and other bodies.

B) Mining:

With gradual depletion of the shallow depth deposits, the mining activity has to shift to lower horizons, beyond 1000 m from ground surface. The problems of high rock pressure, excessive temperature coupled with humidity, have resulted into increase in the cost of mining due to increased ground support and mine environmental costs. Application of low cost methods of extraction with mechanisation and application of newer technologies, is the only way-out for extraction of deep-seated deposits. The thrust areas for R & D in deep mining would include:

- Mine planning and design including use of modern technology for excavation of deep shafts for approaching the deep-seated deposits.
- Applied rock mechanics and ground control.
- Underground environment.
- Hoisting from deep horizons.
- Alternative methods of extraction such as in-situ leaching/ bio-leaching/solution-mining.
- Application of modern electronics communication system for improving safety of operations in deep mining.
- Application of modern technology with high degree of mechanisation for large production would enable mining of even little lower grade minerals without jeopardizing the economics.
The closed / abandoned mines for the metallic minerals viz, Gold, Silver, Copper, Lead & Zinc, etc, due to non-viability for exploitation to be revived with implementation by adopting new mining technology and benificiation techniques.

C) Mineral Processing and Value Addition:

With the exhaustion of higher grade minerals, we will be left with no option but to mine the lower grade minerals, even those which are below the cut-off grade. Therefore, it is essential that we develop newer technologies for up-gradation of the low grade minerals. Also the concept of zero waste mining has to the brought in, and this will need extensive R & D work not only for up-gradation but also for use of the so called waste material to effect zero waste mining.

The major thrust areas for R & D in mineral processing would include the following:

- Development of newer cost effective technologies for up-gradation of low grade ores.
- Extraction of by-products and research into the use of remaining products, that is, the so called waste today, to effect zero waste mining. This will also include effective waste management and extraction of the valuable contents from slag, tailings, old waste dumps, anode mud and other slimes.
- Extensive application of mathematical modeling and computer simulation in mineral processing.
- Development of value added products for all minerals with value addition at all levels of minerals processing.
- Development of multi-material extraction process and technology for beach sands.
- Application of advanced research for production of material of high purity with emphasis on technology metals for development of multimetal extraction strategy.

D) Value Addition for Strategically Important Minerals and Technology Metals.

The technology metals/minerals combined with energy critical minerals & rare earths, constitute less than 0.1% of earth crust. But these minerals do not occur as primary minerals, however, are won as byproducts while processing of ore of various metals. In view of above a multi material extraction strategy is necessary to obtain the overall solution both from technical as well as techno-economical perspective.
Minerals and metals can be grouped into following five categories depending on a combination of factors such as process technology, present abundance in terms of extraction, co-occurrence, applications and their critical/strategic impact. Other than the primary metals, the other groups are strategically important and details are given below.

**Technology Metals :**

1) **Minor metals produced as by-products of base metals**

(Mo, Re, Te, Se, Ge, Cd, In, Ga, V, Sc)

There are nearly 10 important minor metals used in many applications which have impacted our lives in a big way. Their availability is critically linked to production of primary base metals like Cu, Al, Pb/Zn and their extraction in the primary circuit itself. They are used in very small quantities but when multiplied by large volumes of ultimate products, they become strategically important. The applications range from aircraft engines, motors and domestic appliances, automobiles, cell phones and computers, ubiquitous energy devices thus serving a large consumer base. There are twin qualities in the application of these minor metals. Their production is technology intensive and the dispersion (large entropy production in its life cycle) in the final products over makes their retrieval and recycling difficult though possible with strong regulations, till date it is very minimal.

The picture becomes serious, when we consider Ge, Cd and In which come from the Zn primary circuit. These metals (along with Se and Te coming from Copper circuit) form the backbone of thin film electronics industry with applications in computers, TV displays to cell phones, energy devices and innumerable PCBs.

Bayer liquor in aluminium extraction process is the only source for gallium metal which together with arsenic (Gallium arsenide) is an important semiconductor which occupies the second place immediately next only to silicon in terms of depth and breadth of applications. Vanadium occurs both as primary and as secondary source, it is found in significant quantities in Bayer liquor. Presently it is taken out as sludge and disposed off to scrap traders. India being one of the largest producers of alumina and aluminium, it is but logical that a multi metal extraction strategy would have made India the largest producer of Ga and V as well.

Scandium is one of the costliest metals that have important applications as alloying
element and as additive to other rare earth oxides used in energy devices and electronic goods. Scandium generally occurs along with tin deposits and till date efforts to identify Sc in Sn sources and presence of Sc in Sn slag that is disposed off at low prices are to be intensified.

2) **Metals produced from their generic minerals.**

a) **Important Transition Metals:** Ti, Zr, Ni, Co, V, Cr

Beach sands are an important source for rare earths and group IVA metals (Ti, Zr, Hf). Titanium, Zirconium and Hafnium are produced by metallothermic reduction of their chlorides by magnesium metal.

Zirconium is entirely in atomic sector and it is augmented primarily for use in fuel clad assemblies. Zirconium oxide and zircon are important ceramic materials finding extensive use in advanced engineering ceramics. It is important that availability of pure and ultra fine zirconium oxide and zircon will become important value addition exercises.

b) **Refractory Metals:** Nb, Ta, W, Mo, V

It is worth noting that both Ta and Nb are being extracted in small quantities for its internal use by DAE. Nb and Ta co-occur with tungsten and many deposits have been found by GSI. The tungsten bearing deposits should be studied for metal/intermediate compound extraction as these metals are part of important technology metals. In case of primary molybdenum & vanadiferous deposits flow sheets have to be developed urgently by the R & D centres in the country.

c) **Minerals and Metals Enabling Energy Technologies**

*(Solar grade Si, Li compounds, chalcogenides, Cassiterites)*

While the predominant position of Silicon as an important metal that ushered in the solar energy conversion devices is well known, what is emerging in the past decade and which is going to make big inroads is LITHIUM based compounds. Lithium compounds are important materials that go into making of high energy density batteries and other energy conversion/storage devices. With the advent of electric and hybrid vehicles, the utilization of Li batteries is going to see phenomenal increase thus fuelling a large scale exploitation of Li based minerals. It is here that
a national mission on Lithium is required to be launched covering exploration to products based on lithium.

3) Rare Earths
With regard to rare earth metals India is similarly blessed with large deposits of easily mineable monazite beach sands. IREL is the only company extracting a few metals for its use. Important rare earth metals such as samarium(Sm), neodymium(Nd), cerium(Ce), lanthanum(La), Gadolinium(Gd), Dysprosium(Dy) are required to be extracted.

4) Primary Metallurgical Reductant Metals:
(Magnesium, Calcium and Lanthanum)
In addition to carbon and hydrogen which are the workhorse reductants available to a metallurgist, metals such as Na, Al, Si, Mg, Ca and La serve as important metals that reduce oxides, chlorides and fluorides of other important technology metals.

R&D thrust for Technology Metals.
An end to end technology development with systems approach and deployment paradigm in a consortium mode with dedicated mission projects is necessary as a strategy for these important "TECHNOLOGY METALS". This calls for concerted effort in exploration where it is not done so far (eg Li, V, Nb, Ta etc), developing multi metal extraction strategies in the present primary metal circuits for the ten metals identified above and R & D thrust to develop beneficiation and extraction/synthesis flow sheets, purification process technologies and finally alloy/compound and precursor/input product developments for specific sectors such as aerospace, automotive, energy, manufacturing, consumer electronics etc.

Secondly, it is important to note that as we are starting very late in the entry into the process technologies for many of these metals we can take advantage of developing energy efficient and environment friendly routes. India has to be varying of other countries of their older versions of technologies.
Thirdly, process equipment development is an important area that is affecting the development of plants many of which are required only in the pilot scale. Many of these equipments are in technology denial regime as they fall under dual use (hence the term technology metals). A robust equipment design and development specific to these technology metals is urgently needed.

Though based on natural wealth, it is the paradigm that eminently kicks in the development in the area of non-ferrous metal sector. Thus, even dull disbursed scrap such as used batteries and cells containing nickel and cadmium or used PCBs have to be brought under regulated regime (e-waste) for recovery and reclamation of both heavy metals as well as valuables. This would not only serve the environment cause but we as are devoid of natural resources of many non-ferrous metals, it will serve as mandatory policy of 3Rs, namely reuse, reclaim and recycle. India should have a policy for brining in technologies as well as development plans for recovery of metal value from all wastes.

3.6.8 In order to meet the above requirement for R & D development in thrust areas identified for the XIIth Plan, a National R&D Fund in the form of Grant-in-Aid under the domain of Ministry of Mines is proposed to be created for catering to requirement of above mentioned specific areas.

a. National Institute for Mineral Development – Rs. 500 crores

b. Grant-in-Aid for Mineral Exploration – Rs. 50 crores

c. Grant-in-Aid for Mining – Rs. 50 crores

d. Grant-in-Aid for Mineral Processing – Rs. 50 crores

e. PPP Models for private organisations to develop the above kind of centres in their respective domains. This may be 50:50 Model (50% by Government and 50% by Private company)- Rs. 50 crores.

f. R & D thrust programme for technology metals with a significant outlay (say Rs 250 crores) is required to attend to the entire spectrum of activities, ranging from exploration to mining to beneficiation to extraction to purification together with process equipment developments.
CHAPTER – IV

4.0.0 ROLE OF REGULATORY AGENCIES (TOR-5)

4.1.0 Review the role of Indian Bureau of Mines and State Directorates of Geology and Mining

The regulation of minerals & mining Industry is mainly done by Indian Bureau of mines and the different State Directorate of Geology & Mining. The Role of different regulatory authorities is given below.

4.1.1 INDIAN BUREAU OF MINES (IBM)

Indian Bureau of Mines was set up on 1st March, 1948. Initially IBM functioned purely as an advisory body. It helped government in framing various rules like Mines & Minerals (Regulation & Development ) Act, 1948, Mineral Concession Rules, 1949 and Petroleum Concession Rules, 1949. IBM was given a set of functions in 1950 and in accordance with it, the inspection of mines and mineral prospects became a regular activity. By 1953 IBM was given an additional function of undertaking detailed exploration of mineral deposits. Among the minerals explored by IBM were Iron Ore, Limestone, Dolomite, Coal, Copper, Tungsten. Later Mineral Conservation & Development Rules, 1955 and Mining Leases (Modification of Terms), 1956 were framed.

With the passage of time the activities of IBM grew in depth and extent like Technical Consultancy and preparation of mineral maps leading to complete inventory of mineral resources. With its pool of mining engineers, geologists and ore dressing engineers it covered a wide variety of needs of the mining industry. Various publications related to mining and mineral industries were brought out.

Offices were set up in the different parts of the country close to major mining centers. In the last decade, with the change in the policy of Government, two very important activities were undertaken by IBM. The first being the processing and approval of mining plans and schemes of mining for all the mines in the country and second one being the implementation of rules for the protection of environment. IBM accepted this challenge and has been successful in promoting the awareness about protection of environment in the mines through the "Mines Environment & Conservation Week".

IBM also started imparting training to the industry personnel in the preparation of mining plans and also in the other fields. Modern Mineral Processing Laboratory, Analytical Laboratory and Pilot Plants were set up at Nagpur, Ajmer and Bangalore.

IBM lost no time in realising the potential of information technology and entered into the agreement with BRGM of France in setting up "Mineral Resources Intelligence System" and "Technical Management Information System" in HQ and its 3 zonal & 12 regional offices.
In a nutshell, the IBM has been able to promote awareness amongst all sections of the mining industry, necessity and advantages of systematic mining and conservation of minerals and protection of environment. The results of its ore dressing investigations have formed the basis of new commercial beneficiation plants and thus enlarged the mineral resource base. The IBM's clientele seeking technical consultancy covers a wide spectrum of small and large mines and many public sector organisations. IBM has been able to provide useful information to the industry through its publications and has been recognised as the Mines and Minerals Data Bank of the country.

4.1.2 The New Charter of Functions of Indian Bureau of Mines is as follows:

To promote systematic and scientific development of mineral resources of the country (both onshore and offshore)

To approve mining plans, schemes and mine closure plans having regard to conservation of minerals and protection of environment.

To collect, collate and maintain database on exploration, prospecting, mines and minerals and to bring out publications/bulletins highlighting the problems and prospects of mining industry.

To play a pro-active role in minimising adverse impact of mining on environment by undertaking environmental assessment studies on regional basis.

To conduct suo moto techno-economic field studies in mining, geology, mineral processing and environmental aspects including analysis of ore and minerals and to promote R & D activities in these areas.

To provide technical consultancy services on promotional basis within the country and abroad in the field of mining, geology, mineral processing and environment.

To provide training to the scientific, technical and other cadres of the department and persons from the mining industry and other agencies for human resource development.

To advise the Government on matters in regard to the mineral industry, relating to environment protection and pollution control, export and import policies, trade, mineral legislation, fiscal incentives and related matters.

To promote awareness about conservation, systematic and scientific development of mineral deposits and protection of environment including restoration and rehabilitation of mined out areas through exhibitions and audiovisual media.

To promote and monitor community development activities in the mining areas.

To undertake any such other activity as may become necessary in the light of the developments in the field of geology, mining, mineral beneficiation and environment.
4.1.3 Organizational Structure

The Indian Bureau of Mines is a subordinate office of the Ministry of Mines, Government of India. The Controller General (CG) as the head of the IBM has overall responsibility of planning and execution of programmes of the organization.

The CG, IBM is supported by the six Divisional Heads at the Central Headquarters as in-charge of Mines Control & Conservation of Minerals (MCCM) Division, Ore Dressing (OD) Division, Planning & Co-ordination (P&C) Division, Technical Consultancy, Mining Research & Publications (TMP) Division, Mineral Economics (ME) Division and Mining & Mineral Statistics (MMS) Division. The headquarters of IBM are at Nagpur. All six Divisional Heads of functional Divisions of IBM are also stationed at Nagpur. Except for MCCM & OD Divisions, other Divisions are based at Nagpur. The MCCM Division has three zonal offices located at Ajmer, Bangalore and Nagpur with 12 regional and 2 subregional offices under these zonal offices spread all over the country. Regional offices are located at Ajmer, Bangalore, Bhubaneswar, Chennai, Kolkata, Dehradun, Goa, Jabalpur, Hyderabad, Nagpur, Ranchi and Udaipur and subregional offices located at Guwahati and Nellore. The Ore Dressing Division has a Modern Mineral Processing Laboratory and Pilot Plant constructed with the UNDP assistance at Nagpur and two Regional Ore Dressing Laboratories and Pilot Plants operational at Ajmer and Bangalore.

IBM is a multidisciplinary organisation comprising of personnel from various disciplines such as Mining Engineering, Mining Geology, Ore Dressing, Mineral Economics, Chemical, Statistics, Publications and Administration. Functions and Activities of various Divisions of IBM: The present Divisional set up of the Bureau is in accordance with Re-organization of functions of Divisions of IBM as per Ministry's Letter No. 31(69)/92-MIII dated 17.1.1994.

4.1.3.1 Mines Control & Conservation of Minerals (MCCM) Division

MCCM Division led by the Chief Controller of Mines is responsible for systematic development of mineral deposits, conservation of mineral resources and protection of mining environment through inspection of mines, conservation studies, and approval of mining plans and mine closure plans. Mineral maps and inventory of minerals of private leasehold area are also prepared under the guidance of a Chief Mining Geologist of the Division.

Important activities carried out by the MCCM Division are:

- Processing of Mining Plans, Schemes of Mining and Mine Closure Plans.
- Preparation of Mineral Maps with forest overlays.
- Collection of low grade ore samples for beneficiation.
- Spot guidance to mine owners.
- Launching of prosecution in case of defaulters.
- Grant of recognitions to prepare Mining Plans
- Examination of ‘stoping’ permissions in underground mines
- Advising Central Government on fresh grant of mineral concessions.
- Advising State Governments on second and subsequent renewal of mining leases.
- Promoting and monitoring community development activities in mining areas.
- Maintenance of record on reconnaissance permits.
- Computerised on-line Register of Mining Tenement system.

### 4.1.3.2 Ore Dressing (OD) Division

The Director (OD) heads the OD Division. Since its inception in 1960 OD Division carries out R&D studies in the field of mineral beneficiation. Its Modern Mineral Processing Laboratory and Pilot Plant comprising of Ore Dressing Laboratory, Mineral Beneficiation Pilot Plant, and Analytical Laboratory Complex established with the assistance of UNDP is well equipped with state-of-the-art facilities to carry out R&D studies in the field of mineral beneficiation and mineral characterisation, and analysis of environmental samples. The Bureau has region-wise facilities in mineral testing and beneficiation with regional ore dressing laboratory and pilot plants at Ajmer and Bangalore which are also well equipped with sophisticated equipment. A ‘Clay Laboratory’ has also been established to cater to the needs of the north-eastern region exclusively.

Important activities carried out by the OD Division are:

- R&D Studies for Development and Evolving Process know-how for Beneficiation of Minerals.
- Chemical Analysis of ores and minerals/ mine rejects/wastes, beneficiation plant effluents/ tailings.
- Mineralogical identification studies on ores, minerals, beneficiation products, etc.
- Technical auditing of beneficiation plants.
- Environmental analysis of air and water samples.
- Techno-economic feasibility reports/sizing and selection of equipment.
- Training in mineral processing, chemical analysis and mineralogy to Scientist from India & Abroad.
- Suggestions on new methodology for chemical analysis of different ores, minerals, metals, etc. under BIS.

### 4.1.3.3 Planning and Coordination (P&C) Division

The Controller of Mines heads the Division and located at headquarters. It is responsible for administration, planning and Technical Cooperation. Two wings namely Technical Secretary’s Section providing vital technical support to the Controller General and Administration & Establishment Wing headed by the Head of Office function under this Division. The Training Centre is also looked after by this Division. IBM’s Training Centre conducts training programmes for its employees as well as for the industry personnel including foreign nationals, on various topics related to minerals and mining industry. A
number of IBM Officers have been trained in advanced countries like USA, Germany, Australia, Canada, France, UK and USSR. Under the IBM-BRGM technical programme, a number of IBM Officers have been trained at BRGM, France.

Important activities of the P&C Division are:

- Planning of Work Programme and Budget Estimation
- Co-ordination between different divisions of IBM & with the Ministry.
- Technical Assistance to the Controller General
- Human resource development Programmes for: Departmental personnel, industry Personnel, and Foreign National Personnel Administration, Establishment, Accounts & Store

**4.1.3.4 Technical Consultancy, Mining Research & Publications (TMP) Division**

The TMP Division led by the Controller of Mines is located at the headquarters. It offers technical consultancy services to mining industry in surveying, exploration, geology, mining feasibility studies and environment related issues. The sole objective is development of mineral industry and so very nominal fees are charged for consultancy assignments with special concession to small entrepreneurs. TMP division is well equipped with trained personnel and latest computer facilities (SURPAC-2000 and Acr-Info) for deposit evaluation, project costing, and financial analysis etc. The division has two cells namely Mining Research (MR) Cell and Publication Cell (PC).

The MR Cell undertakes research investigations on geotechnical projects and environment related issues, both on promotional and consultancy basis. The Cell has a mobile environmental monitoring lab with state-of-the-art equipment for air quality measurements.

Publication Cell of IBM brings out Monographs and Bulletins of topical interest. So far, it has published monographs on various minerals like Iron ore, Manganese, Asbestos, Chromite, Copper, Bauxite, China clay, Limestone and Dolomite, etc.

Important activities carried out by the TMP Division are:

- Preparation of mining feasibility reports and detailed project reports.
- Geo-technical investigations for slope stability and pit slope design.
- Preparation of REIA, EIA and EMP for mining projects as well as risk analysis and preparation of disaster management plan.
- Blast Vibrations studies
- Quantification survey of ore and waste material
- Publications on topical interest.

**4.1.3.5 Mineral Economics (ME) Division**

The Chief Mineral Economist heads the ME Division. The division provides information support and advisory services to the Government and mineral industry especially on issues of marketing, specifications and uses of minerals, mineral legislation, inventory of mineral
resources, mining leases, and taxation, etc. The division disseminates latest information on mineral industry, collected through statutory as well as non-statutory sources, through its flagship publication ‘Indian Minerals Year Book’ and also through number of other Publications.

Important activities carried out by the ME Division are:

- Collection of information on exploration activities, carried out in the country by various exploration agencies.
- Preparation, maintenance and quinquennial updation of National Mineral Inventory as UNFC
- Collection of information on mining laws of various countries including tax laws, development agreements, developments in legislation for exploration and mining of minerals from the seabed.
- Formulation of mineral legislations for adoption in Indian conditions.
- Survey of demand supply of minerals and metals over short and long terms both internal and international markets.
- Processing, analysis and dissemination of data through publications.
- Advisory role to Government on matters of Policies, Royalty fixation/taxation, Inventory of Minerals etc. matters.
- World Mineral Intelligence Study in respect of important countries
- Systematic collection of mineral intelligence and preparation of Indian Minerals Yearbook

4.1.3.6 Mining and Mineral Statistics (MMS) Division

The MMS Division is led by the Deputy Director General (Statistics) is located at the headquarters. IBM functions as the Nation's Data Bank on Mines and Minerals. It has been recognized as one of the sub-systems of the National Information Systems of Science & Technology (NISSAT). The division is manned by the officers of Indian Statistical Service (ISS) and Sub-ordinate Statistical Service (SSS) cadre. The Division is responsible for collection, processing, and storage of statistical data on mines and minerals collected through various statutory returns. It disseminates the latest statistical data on mineral industry through its publications including publication of ‘Monthly Statistics of Mineral Production’ (MSMP) though which the value of minerals for calculation of royalty is being published. It also caters to the needs of the Central and State Governments, Planning Commission Central Statistical Organization, Research & Educational Institutions, United Nations and other foreign organizations and private agencies.

The important activities being carried out by the MMS Division are:

- Collection of data on Mining Leases, mineral production, costs, dispatches, employment, inputs in mining and mining machinery etc. through statutory returns.
- Compilation of Mineral Data and its Dissemination through Standard Periodicals and Publications
- Collection of ancillary statistics on production of fuels, minor minerals,
metals production, mineral trade and market prices of minerals through correspondence with various agencies.

- Publication of Monthly Statistics on value of mineral production for calculation of royalty by State Govt.
- Construction of index numbers of mineral production & mineral prices and Computation of national income accrued from mining sector
- Preparation of cabinet summary for monitoring overall activities of mining and quarrying sector

4.1.4 Ministry of Mines has entrusted additional responsibility of administering the grant of Mineral concession and regulating the Offshore Areas Minerals (Development and Regulation) Act 2002 on IBM by Notification, dated 11th February 2010. Sixty two mineral bearing off shore blocks have been allotted based on the recommendation of the Controller General Indian Bureau of Mines, Nagpur for grant of exploration licenses in the off shore waters of the Bay of Bengal and Arabian Sea consequent to notification dated 7.6.2010. Out of these 26 blocks are in the Bay of Bengal and 36 in the Arabian Sea. Considering the role and responsibility of IBM in the scenario, a committee has been setup in the Ministry for restructuring of IBM. The report of the committee is under finalisation.

In order to ensure better mineral administration, more transparent accounting of Mineral production, trade, consumption and exports, Rule 45 of the Mineral Conservation and Development Rules were amended on 9th February, 2011 to provide for registration of procedures, traders for reporting all transactions to IBM and State Governments.

**Thrust Areas.**

The main thrust areas of Indian Bureau of Mines are

k) Conservation of Minerals
l) Systematic & Scientific Methods of Mining
m) Sustainable Development of Mineral resources
n) Environmental Protection in Mining Areas.

4.1.5 **Strengthening of Indian Bureau of Mines (IBM).**

2 A committee has been constituted in the Ministry of Mines for revising and restructuring of functions and role of IBM in terms of the Policy directions given in the National Mineral Policy (NMP), 2008. The committee has prepared a draft report which has been put up on the website of the Ministry for inviting comments of the stakeholders.

3 Government have approved the revival of 86 scientific and technical posts in IBM, which was abolished earlier.
4.2.0 STRENGTHENING OF STATE REGULATORY AGENCIES BY USE OF MODERN TECHNOLOGY AND INFORMATICS

The strengthening of state regulatory agencies is very much important in the present scenario of National Mineral Policy (NMP) -2008. The different ways by which the agencies can be strengthen is given below :-

4.2.1 Implementation of Uniform Mineral Policy:- Uniform Mineral policy should be introduced for all the states and union territories.

4.2.2 Geoinformatics: The State Government recognizes that the key to attracting investment in the mining sector is making available relevant information in a way most useful for investment decision making. The State Directorate shall create and constantly update a Website in order to ensure information regarding: -

- State policies, legislation and executive instructions to prospective investors and the mining community.
- Availability of areas for prospecting and mining through creation of a Mining Tenement Registry in collaboration with the State Department of Land Records.
- Geological and geophysical data in spatial as well as non-spatial formats including data gathered during reconnaissance and prospecting after lock in period is over.
- A concession management system to provide for end-to-end management from application to mine closure.

The State Directorate will liaise with the GSI and IBM in order to ensure uniformity and standardization of applications and the best possible synergy from the databases.

4.2.3 HR Development and Training:-

1. Vocational education system should be reviewed to ensure for skills required in the mining sector are adequately addressed.

2. College education system should also be reviewed in order to enable the adequate supply of Geologists, Geophysicists, Chemists and engineers not only to meet the State’s own needs but also those of other States and of Central institutions and the private sector and thus increase employment opportunities for the educated youth of the State.

3. A training institute will be developed under the Directorate to impart in service training on regulatory and development aspects of mining to the State Government officers of the Geology & Mining, Environment, Forrest, Police, Prosecution and other relevant departments.

4. Training facilities should also be made available for RQPs and private mining industry on payment basis in order to improve sectoral capacity.
4.2.4 Cluster Deposit Mining:- In many areas of the State mineral deposits occur in small clusters not amenable to scientific mining in the natural way. They include quarry and construction material, beach sand minerals and float ore deposits. Unscientific exploration of such local deposits can cause serious environmental problems.

In the interest of proper management of such deposits and to generate local employment, the State shall encourage the revival or creation of cooperatives for the extraction and processing of cluster deposits. Where cooperatives are not feasible such deposits shall put to auction in a cluster to consortia of miners under Panchayat supervision.

4.2.5 e-governance

All queries should be sorted out at once.

The state government departments should prepare a Citizen's Charter, displaying the time limit / schedule for disposal of applications. Such as: Under section 23 (A) (1) of Mines and Mineral (Development and Regulation) Act, District officer will be empowered to compound offences related to illegal excavation, transportation or storage of minerals.

Implementation of Citizen's Charter of Department should be a part of Policy. Lease applications at all levels should be connected on-line, including the applicants. Transparency should be ensured through a computerized file tracking system. The department should also upload an interactive website.

4.2.6 Revision of Royalty Rates : Keeping in view the increase in royalty revenues to the State Governments due to revision of royalty rates in August 2009, the State Governments have been requested to prepare Action Plan for strengthening of the State Directorate of Mining & Geology in line with the recommendation of the National Mineral Policy.

4.2.7 Scientific and systematic mining:- There is need to enforce scientific and systematic mining practices so that, the precious natural resources are not left unutilized. The State Department of Mines and Geology through their Directorates and the Indian Bureau of Mines (IBM) and Directorate General of Mines Safety are the main authorities to ensure systematic and scientific mining. Concerted efforts will be made to achieve better coordination between these departments for fulfilling the objectives of scientific and zero waste mining. For this purpose, the State Directorate shall endeavour to develop expertise in Mining Plans and Mine Closure Management Plan. As far as possible, the State Directorate shall ensure that mining activities adhere to the approved plans. The State Directorate will also develop expertise in ore beneficiation techniques and preparation of techno-economic feasibility Reports.

4.2.8 Land use planning and Sustainable Development:- To facilitate and ensure sustainable development of mineral resources in harmony with the environment, a comprehensive view on land use will be taken keeping in view the needs of development as well as needs of protecting the forest, environment and ecology. Compliance of Environmental laws by miners will be enforced through the Department of Forest and Environment.
Attempts will be made to utilize mine wastes and also promote the concept of zero waste mining to minimize the impact on the environment.

Mining Plans and Mine Closure Plans will be dovetailed and harmonized for sustainable development. Local communities including Panchayats, NGOs, etc. will be closely associated with the process of preparation of Mine Closure Plans and it will be ensured that such Plans include adequate provision for long-term sustainability of host populations and for the best possible use of the mined out areas based on the needs of the local communities.

4.2.9 Ore-linkage and value addition: The State policy on ore-linkage (including captive linkage) and value addition shall be based on the following:

- The basic effort will be to ensure that all mineral based industries have a reasonably assured supply of inputs including ore. For this purpose, in respect of minerals such as iron ore which are openly traded, the first priority will be to create a system of long-term ore-linkages by designating large-scale professional and technologically advanced mining companies including Public Sector Units for providing the ore linkage, and regulating their arrangements in a transparent manner in keeping with market conditions. Beneficiation, calibration, blending, sizing, concentration, pelletisation and customization, etc. at ore stage will be incentivised and encouraged and overriding preference in allocation of prospects will be given to such companies who provide long term ore linkage to the sector, with further preference to the extent of value addition.

- In respect of ores such as limestone which are not substantially traded, or where long-term linkages are not possible because of the nature of the mineral, or the market, or in respect of pioneer industries in new mining areas, captive mines shall be allocated where possible through an auction process. For this purpose, the State Government will proactively carry out prospecting at public expense to delineate ore bodies.

- Where mines are given on captive basis (through either the prospecting route or the auction route) the intention will be to ensure that the entire run-of-the-mine is gainfully utilized to the maximum possible by beneficiation or other value addition processes. Ore not possible to be utilized by the captive unit shall be encouraged to be beneficiated to industry standard and traded under specified conditionalities, including ore linkages with other end-use industries.

- New mineral-based industries will be encouraged for setting up units in or near mineralized areas through appropriate tax and other incentives. While ore linkages shall be offered subject to availability, captive mines shall be allocated only through an auction process, or on the accepted principle of first-in-time at prospecting stage in non-notified areas or in accordance with the policy in notified areas.
• Application from new or intending mineral based industries for areas notified for prospecting or mining shall be considered in an equitable manner with weightage for all or any of the following criteria to the extent specified in the notification:-

- Non-availability of adequate ore linkage.
- Pioneering nature of the industry in a location.
- Induction of high end and sophisticated technology.
- Use of advanced equipment and successfully proved novel mining technologies.
- Beneficiation or value addition at ore stage and better utilization of the run-of-the-mine.

• Application from new or intending mineral based industries for areas not notified for prospecting or mining shall be considered along with all other applications in accordance with the provisions of the Mines and Minerals (Development and Regulation) Act, 1957 and Rules framed there under.

Any applicant claiming preference for special reasons shall make a specific claim to this effect supported by documents and all such claims shall be considered together and disposed off in a transparent manner with reasons in support. Special reasons must be closely related to zero waste scientific mining, strategic mineral development and use of new and advanced technologies likely to qualitatively improve sectoral best practices.

4.2.10 Joint Venture with Public Sector:– Joint ventures with public sector units for exploiting mineral resources or setting up mineral based industries shall be undertaken in a transparent matter by publically/globally inviting Expressions of Interest and selecting a suitable applicant based on notified criteria that may include all or any of the following

- Special expertise or knowledge.
- Long experience.
- Financial resources.

4.2.11 Environmental and Forest related issues:– The State Government shall ensure expeditious processing of cases involving forest land. It shall proactively identify areas where mining-related activities are likely to lead to unacceptable damage to the ecology and the environment and declare ‘no-go’ areas. It shall also identify suitable areas for compensatory afforestation, including mined out areas.

In all cases of ore bodies prospected at public expense the State Government shall ensure that before putting such ore bodies to auction first stage forest clearance is obtained wherever required.

The State Government shall ensure adequate coordination between the State Directorate and the State Pollution Control Board for the conduct of the Environmental Impact Assessment in a quick, transparent and professional manner and ensure facilitation of preparation, approval and monitoring of the Environmental Management Plan.

4.2.12 Mining Tribal Areas:– The State shall as far as possible ensure that mining in tribal areas if unavoidable, is done through State agencies in collaboration with local tribal communities, or by tribal organizations such as Tribal Cooperatives, Forest Labour
Cooperatives, etc. The State shall facilitate the setting up of such institutions and shall ensure arrangements for the technical support and financial credit, and for marketing of the ore.

4.2.13 Development of Infrastructure:- For extraction and utilization of minerals and promotion of mineral-based industries, infrastructure development is a basic necessity. Existing infrastructure in the mineral-bearing regions is not adequate. Hence, development of roads within the mining areas and connecting roads to railway stations/ports would be given topmost priority.

Large potential mineral bearing areas will be notified and applications invited from large capacity mining companies who can take up integrated development of the area and develop transportation network along with large scale mining operation. In public funding of infrastructure, royalty funds will be transparently applied in mining affected areas for development of health and educational institution and for their confirmed management. Facilities like drinking water, power and village development will also be systematically funded.

Transportation of ore from mining area to railway siding/stockyard through conveyor belts, rope ways and other similar methods will be encouraged. This will avoid pollution in neighboring villages, congestion and damage of roads and prevention of accidents. The State will identify and develop by-pass roads on PPP basis across towns and villages through which the minerals are transported.

National Mineral Policy, 2008, categorically states that Government of India will support States in developing infrastructure in and around mining areas. Government of India will be requested to come out with a plan programme for infrastructure and other developments in mining area on the lines of JNNURM.

Transportation costs from pit mouth port is the highest in India due to poor rail and port infrastructure. Coordination with Rail and Ports department of the State and Central Government to upgrade, expand and develop rail lines and improve existing and new seaports in the State to export minerals and value added products will be a priority.

4.2.14 Reclamation & Restoration involving minor minerals:- Mining activity will need to be done in a manner that does not permanently degrade the land. The State shall ensure that the mines in their Mining Closure Plans make adequate provision for reclamation and/or restoration of the land to the best possible potential in collaboration with local communities, and for their use. Land after closure shall be returned to the local Panchayat for management preferably as a Common Property Resource, particularly for the benefit of the rural poor.

Reclamation/restoration efforts shall specifically address issues of

- Bringing land into productive use;
- Reducing soil erosion through vegetative means;
- Dealing with chemical pollutants of soil and water;
- Improving the water regime and recharge potential; and
- Mitigating the adverse visual impact.
Mine closure including progressive mine closure processes will be closely monitored and it will be ensured that stakeholders are taken into confidence at all stages through a transparent process facilitated by the State Government.

Old and disused mines dating to prior to regulated Mine Closure shall be restored or rehabilitated using funds generated from royalties so as to enable local communities to regain the use of such lands.

4.2.15 Prevention and Control of Illegal Mining

Illegal mining besides being a loss of State revenue has widespread negative impact including:

- Environmental damage.
- Alienation of local population.
- Corruption, crime and lawlessness, etc.

Though there are many reasons for illegal mining taking place, the main causes are:

- Tax regulation and corruption.
- Delays and complex procedures in getting legal concessions, including forest clearance.
- Keeping known deposits without notifying to invite applications.
- Refusal to grant renewal for a mine that is not exhausted.
- Arbitrary reduction in lease area, particularly during renewal.
- Non-obtaining of surface rights in the case of large areas, particularly with PSUs.
- The State Government shall take steps to improve the regulatory supervision of areas of potential mineralization and shall involve the local population in the process. A part of auction proceeds and royalties of local mining activities shall be credited to the Panchayats to create a stake and improve compliance.
- Forest clearance and other regulatory approvals shall be fast tracked and monitored through the State Empowered Committee.
- Transport of minerals through e-permits with security features incorporated, will be introduced in a time bound manner.
- Village Panchayats will be incentivized to keep vigil on the mining of sand and boulders from streams in their jurisdiction and awareness generation programmes shall be organized for the purpose.
- Indian Bureau of Mines will be requested to assist the State Directorate to identify mining irregularities in the leased areas.

4.3.0 SCHEME FOR CAPACITY DEVELOPMENT OF STATE DGMs

4.3.1 Introduction:- The National Mineral Policy, 2008 has laid out the broad contours of the future evolutionary direction of the mineral sector. While the GSI will be the principal agency for regional mapping and survey and IBM will be instrumentality to ensure that the regulatory environment is conducive to investment and technology flows. The Policy gives a clear indication of the need for the Central and State Government to play a facilitating and regulatory role while encouraging more and more private sector participation in exploration and mining, so as to make it the main source of investment in the sector. The policy,
therefore, requires that GSI, IBM and the State Directorate of Geology & Mining (DGM) be strengthened with manpower, equipment and skill sets for the purpose.

4.3.2 The recent spurt in the illegal mining has resulted due to lack of capacity of the State DGMs to monitor the mining tenements and plan effectively. The States should have an online link with the Indian Bureau of Mines (regulatory authority of Central Governments) for effective remedial measures.

4.3.3 Presently the mining plans are prepared by a Registered Qualified Person (RQP). The UN Framework Classification requires that the task of reserves / resources estimations is carried by a competent person who should be professionally qualified and is a member of good standing of an appropriate professional association, institution or a body. The mining plan and other document are to be prepared by him. He should have the necessary professional experience in so far as it relates to the contents of the mining plan and other documents prepared by him. This remains a most effective way to ensure competence and to protect the interests of public.

4.3.4 Most of the State DGMs lack adequate competence and laboratory backup for ore testing and beneficiation studies, in approval of mining plans, checking of illegal / unscientific mining, awareness about sustainable mining practices and GIS based mining tenements and mineral concession database etc.

4.3.5 GSI and IBM are already funded out of Central budgetary allocations which need to be appropriately fine tuned for the purpose. However, there is a large gap in respect of the quality of resources in the State Directorates, which need to be addressed through a management and technology oriented intervention. Hence this scheme.

- **Scheme:**- The Scheme shall be called the ‘Scheme for Capacity Development of State DGMs’.

- **Nature of Scheme:**- The Scheme shall be 100 % Centrally Sponsored Scheme. It shall be applicable initially to the mineral rich States of Jharkhand, Chattisgarh, Orissa, Madhya Pradesh, Andhra Pradesh, Rajasthan, Maharashtra and Goa and North Eastern States.

- **Implementing Agency:**- The Scheme shall be implemented by the Indian Bureau of Mines through the State Governments or any agency designated by Ministry of Mines and the State Government.

- **Scheme Components:**- The funding will be project based as follows:-

  ♦ A project shall be prepared and got approved from the Ministry of Mines in a prescribed manner. Project period may extend upto three years.

  ♦ The project may include components of all or any of the following items:-

    o Setting up of laboratories for testing and, ore beneficiation studies.
- Creation of facilities for large scale (more than 1:50 K) geological, geophysical, geochemical mapping.

- Creation for competence for the studies of natural hazards and multidisciplinary geosciences including climate change related studies.

- Setting up of Portals and Websites for geospatial data, mineral resource inventories, tenement data and mineral concession related data and online linking with IBM.

- Creation of mechanisms to prevent and detect illegal mining. Setting up facility for the study of remotely sensed data for detection of illegal mining and training of the DGM’s officials.

- Setting up of facilities for EIA and sustainable development studies.

- Creation of facilities for scrutiny and approval of prospecting and mining plans and mine closure plans.

- Management of mine closure events.

- Awareness creation regarding sustainable mining.

- Training and human resource development for sector.

- Reclamation of the abandoned mines causing environmental degradation.

- Support for geo-technical and other geo-scientific investigations such as landslide risk assessment, disaster management, natural hazard zonation maps, geo-environmental studies, geo-hydrological studies, remote sensing studies, seismic studies including seismic micro zonation (NER specific).

- Support for organizing promotional events such as conferences / investors meeting Setting of Geological Museums for awareness and Promoting Geo-tourism (NER specific).

- Capital construction costs will be permitted to be included in the project. However, in such cases Central contribution will be limited to 25%.

- There will be a pre-project period during which manpower and financial budget benchmarks for the DGM shall be agreed for the project period. These benchmarks must be maintained. Benchmarks shall include S&T staffing availability, adequate budgeting for running of field and office establishments and for maintenance, particularly of expensive geoscientific equipments.

- **Project Approval:** Project proposals shall be considered and approved by an Empowered Committee chaired by Secretary (Mines) and including representatives of IBM, GSI, Planning Commission, Department of Science & Technology, etc. The
Project Completion Report and Annual Evaluation Report will also be reviewed by the Committee.

- **Monitoring & Evaluation**: Monitoring shall be through the SGPB of the State, and periodical reports of the Ministry of Mines, who shall carry out an annual concurrent evaluation through GSI, IBM or third parties. At the end of the project, the State Government shall submit a Completion Report showing the outcomes and the capacity building achieved.

- **Fund Requirement**: It is expected that the fund requirement for the Central share during the XIIth Plan will be as follows:

  Year I : Rs.25 crores  
  Year II : Rs.25 crores  
  Year III : Rs.50 crores  
  Year IV : Rs.50 crores  
  Year V: Rs.50 crores

- **Outcomes**: The Scheme when implemented is expected to significantly improve State DGM capability to:

  - Capacity building in the scientific regulation of the mining and mineral sector of the State.
  - Manage geospatial data sets and produce map services for geoscientific and societal purposes.
  - Help reduce incidence of illegal mining and increase State royalty and other revenues.
  - Improve environmental standards through systematic implementation of EMPs, SDFs and Mine Closure management plans.
  - Create an aware and empowered local community adequately informed.
  - Do large scale mapping (1:25 K to 1:10 K).
  - Do Natural hazard studies.
CHAPTER-V

5.0.0 EFFECTIVE GOVERNANCE IN MINING SECTOR (TOR-6)

5.1.0 Good and Effective governance

5.1.1 A good and effective governance in mining sector may be defined as the capacity to effectively develop, implement and monitor policies and strategies to manage the economic, social and environmental costs and benefits related to mining. This good and effective governance is essential to effect the transformation of the natural capital into other forms of transferable capital for sustainable development.

5.1.2 Mining is a most demanding and location specific industrial sector to manage:

- Unique characteristics of mineral wealth
- Complex Socio-economic & environmental issues
- Mining goes where the ore body is, not where capacity for governance exists.
- Localised activity.
- Lack of government capacity
- Recent community awareness

5.1.3 In the Mining sector governance, Government plays primary role to set the legislative, legal, and regulatory framework for all players to effect transformation. The role of Industry is to create wealth and be supportive when needed.

5.1.4 Illegal Mining

5.1.5 The absence of land rights, license, mineral transportation permit may be considered as prima facie evidence of illegal mining. It can be operated in the surface or underground mining.

As in the case of most of the countries in the world, in India also, the mineral resources belong either to state or centre. Hence these resource can only be operated by a licensed operator who can legally mine following various norms set by the - state government and rules and regulations framed by Government of India.

In most of the cases the illegal mining is characterized by the small size of operations. Large-scale illegal mining operation is very unusual phenomenon and is more likely linked to a non authorized or non documented extension of the granted land rights.

Most of the illegal mining takes place in not easily accessible mineralised areas or abandoned mining sites. Therefore the main characteristic of illegal mining are the
low productivity and limited production. However, for the size of a country like India and the frequency of the illegal mining, these micro production can be termed into a visible portion of the national production.

5.2.0 Illegal Mining in India:

5.2.1 In India, illegal mining is reported frequently in various ore rich states like Karnataka, Andhra Pradesh, Orissa, Jharkhand, etc.

5.2.2 Illegal mining can be operated in the surface or underground. Identifying surface or underground illegal mining represents two very different challenges and as such involves two different methodologies.

5.3.0 How to Identify Surface Illegal Mining?

5.3.1 In most mining countries, enforcement officers are in charge of spotting any signs of mining activities. Blasting operations which produce noise, vibration and fumes are a good way to identify illegal mining activities. Nevertheless in many case, illegal mining takes place in remote location and blasting is not always necessary to extract the targeted resources. More traditional methods such as scrapping, digging or screening are most likely in use especially when high value minerals like gold, diamond, precious stones etc. are concerned.

5.3.2 Installation of check points and patrols in rural areas or port facilities are also part of some countries’ strategy to search for shipments of illegal minerals. Satellites imagery and photography taken from unmanned aircraft are now in use to monitor illegal mining in developed countries. Plant cover disruption, unmapped access roads, coloured acid drainage water are amongst the main information that can come from imagery and brings evidence of illegal mining activities.

In India the information on illegal mining is gathered from local people by the state Government officials in freehold areas. Working by lessees outside the leasehold areas also amounts to illegal mining. These can be ascertained during the inspection by the statutory authorities. Further in leasehold areas when the production is not commensurate with the excavation then also the extra production is met from illegal mining which can be detected during inspection by statutory authorities.

5.4.0 How to Identify Underground Illegal Mining?

In the case of illegal underground mining the techniques in use for identifying surface illegal mining are inadequate.
5.4.1 The first obvious characteristic is the—subsidence due to—large scale illegal underground excavation. Excavation of minerals reduces the support of the ground surface above the mine area. Being able to map subsidence zones helps a lot in spotting underground illegal mining. Comparable techniques, including aerial imaging, have a long positive track record in archaeology field in uncovering tombs or building foundations, from vegetation difference in colour or density. Today, ‘landscape archaeology’ combines satellite imagery with Global Positioning System data to lease out a landscape's hidden details, such as long-buried roads and canal systems.

As far as mining is concerned, the greatest subsidence mostly occurs in the surface centre of underground mining activities, and the subsidence magnitude decreases from centre to edge, finally forming a spatial funnel in the area. Differential Radar Interferometry (DInSAR) appears to be the most adequate technology for underground for mining-induced subsidence detection. The Coverage is for a large area. Colour gradients reveal surface deformations due to underground subsidence. Mining status and legal mine site documented locations over the whole region can be easily extracted from DInSAR results, unveiling illegal mining activities.

In India the illegal underground mining is mostly in small scale. The information is gathered from local people.

5.5.0 Steps taken to curb Illegal Mining

5.5.1 Mining leases are granted by the State Government and the boundaries of the executed leases are marked on the ground by State Authorities. They also control issue of transport permits and collection of royalty. Section 23(C) of Mines and Minerals (Development and Regulation) Act, 1957 empowers the State Governments to frame rules to prevent illegal mining and the State Government may, by notification in the Official Gazette, make such rules for preventing illegal mining, transportation and storage of minerals and for the purposes connected therewith in the State. While the issue of prevention of illegal mining is not covered within the functioning of IBM, it has been associated with the illegal prevention efforts of the State Government and its law enforcement agencies.

5.5.2. In pursuance of the provisions of the said Section under MM(D&R) Act 1957, the Ministry of Mines have formulated a three-pronged strategy for prevention of illegal mining viz. constitution of Task Force by the State Government at state and district level having a representative of IBM, framing of rules under Section 23 C of the MMDR Act, 1957 by the state Governments for prevention of illegal mining and furnishing of quarterly returns on illegal mining for review by the Central Government.

5.5.3 Under the direction and guidance of the Central Government various State Government(s), all together, 20 State Governments have constituted Task Force namely, Andhra Pradesh, Assam, Chhattisgarh, Goa, Gujarat, Haryana, Himachal
Pradesh, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttarakhand and West Bengal and 17 states have framed the rules under section 23 C of MMDR Act 1957 namely Andhra Pradesh, Bihar, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Nagaland, Orissa, Rajasthan, Uttar Pradesh, Uttarakhand and West Bengal so far. The function of the Task force is to review the action taken by member department for checking illegal mining activities in their respective jurisdiction. Further, whenever IBM detects illegal mining during the course of routine MCDR inspection, the same is reported to the State Govt. concerned for taking suitable action.

5. 5.4 Ministry of Mines has directed the State Governments to conduct special drive to increase awareness on the issue of illegal mining by organizing “Pakhwara’ (Fortnight Programme) in liaison with the office of IBM in the State. Accordingly, IBM has initiated the action on the matter and nominated one officer each from the Regional Offices of IBM for the event. So far pakhwaras in 2 states (Himachal Pradesh and Madhya Pradesh) during 2008-09, in 7 states (Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Madhya Pradesh, Rajasthan Tamilnadu) during 2009-10 and in 2 States during 2010-11 were organized.

5. 5.5 Besides, IBM has nominated Nodal Officers for every regional offices to look after all the work of prevention of illegal mining activities in the respective regions/States. They will co-ordinate with the State Government for timely submission of quarterly returns on illegal mining; liaisoning with state government for framing rules under section 23 C MMDR Act 1957 and constitution of task force; participation in the regular task force meetings and coordination in organizing Pakhwara for prevention of illegal mining; attending all the references pertaining to illegal mining as and when received and submission of report/comments thereof, referring the cases of illegal mining noticed during MCDR inspections to the State Governments and action taken by the State Government and other related issues.

5. 5.6 In compliance of the direction of the Ministry, Task Force-I of IBM was constituted during 2009-10 to check illegal mining in the states of Andhra Pradesh, Jharkhand, Karnataka and Orissa for Iron and Manganese Ore and Gujarat for Bauxite, which are the major states where illegal mining is rampant. Similarly Task Force-II of IBM was constituted during 2010-11, which has been assigned a target of 425 mining inspections in identified endemic areas in phased manner.

5.6.0. Steps taken by the Ministry of Mines & IBM to curb the Illegal Mining

5.6.1 The Central Government has been alive to the menace of illegal mining, and the following are some of the important action taken by the Ministry of Mines:

- State Governments were asked to frame rules to control illegal mining as per Section 23 C of MMDR Act.
State Governments were requested to set up Task Forces at State and District level to control illegal mining since the year 2005.

To reinforce mechanism to control illegal mining, the State Governments were advised to:

- Set up State Coordination-cum-Empowered Committee (SCEC) to coordinate efforts to control illegal mining by including representatives of Railways, Customs and Port authorities.

- Frame State Mineral Policy on the basis of model Mineral Policy drafted by the Ministry of Mines and to adopt transparent concession grant policies to reduce scope for illegal mining.

- To adopt an Action Plan with specific measures to detect and control illegal mining including, use of remote sensing, control on traffic, gather market intelligence, registration of end-users and setting up of special cells etc.

5.6.2 Outcome of the meeting of Ministry of Mines with the State Government

Ministry of Mines has so far held four meetings with the State Governments to specifically review the action taken by the State Governments on illegal mining on 3.8.2009, 27.11.2009, 22.2.2010 and 16.4.2010. Latest review meeting has been held on 21.9.2010.

In a meeting of all State Mining Secretaries convened on 21.9.2010, action taken by State Governments to curb illegal mining were reviewed and the following important decision were taken to tighten regulation of mining activities.

State Governments to immediately start the process of strengthening their Directorate of Mining and Geology, which has been made a part of the action plan to be monitored by Central Government.

- Coordination and information sharing with Railways, Customs and Port Authorities to be activated immediately through State Coordination-cum-Empowered Committees at the highest level.

- Yearly targets for inspection of endemic areas of illegal mining by Special Task Force constituted in coordination with IBM.

- Best practices followed by a State Government to curb illegal mining to be adopted by all State Governments.
• Standardization of maps for the purpose of grant of mineral concessions, use of GPS based technologies and speeding up digitization of cadastral maps.

• To ensure compulsory registration and reporting by miners, Traders/stockiest for better accounting of minerals.

5.6.3 Achievement of the proactive stance taken by the Central Government

Mainly because of the proactive stance taken by the Central Government on the issue, the following developments have been reported:

• Eighteen States (Andhra Pradesh, Bihar, Chattisgarh, Gujarat, Goa Haryana, Himachal Pradesh, Jharkhand, Jammu and Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Nagaland, Odisha, Rajasthan, Uttrakhand, Uttar Pradesh and West Bengal) have framed Rules under Section 23C of the MMDR Act, 1957.

• Twenty one States (Andhra Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Goa, Haryana, Himachal Pradesh, Jharkhand, Karnataka, Madhya Pradesh, Manipur, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Tamilnadu, Uttrakhand, Uttar Pradesh and West Bengal) have set up Task Force at State and/or District Level.

• The State Governments (Andhra Pradesh, Assam, Chhattisgarh, Gujarat, Goa, Haryana, Karnataka, Maharashtra, Orissa, Rajasthan and West Bengal) have set up Coordination-cum-Empowered Committee.

• States like Andhra Pradesh, Gujarat, Maharashtra, Rajasthan, Karnataka, Jharkhand and Tamilnadu have undertaken digitization of the mining area to varying extent.

• States Governments of Rajasthan and Orissa have reported to commenced using Satellite imagery.

• State Governments of Gujarat, Jharkhand, Karnataka and Odisha have reported to have started use of holograms/bar codes in the transport permits.

• During the first half of year 2010, the State Governments detected 35136 cases of illegal mining of minor and major minerals as compared to 41578 cases detected in the full year 2009.
5.6.4 Some Other Measures

Special Task Force

Central Government through the Indian Bureau Mines had constituted Special Task Forces for inspection of mines in endemic areas. Special Task Force conducted inspections in a total of 268 mines in the States of Karnataka, Andhra Pradesh, Odisha, Jharkhand, and Gujarat, and suspended 107 mines under the rule 13(2) of Mineral Conservation and Development Rules, 1988 due to serious violations. Further, the Indian Bureau of Mines have recommended for termination of three leases.

Amending the Mineral Conservation and Development Rules, 1988

The Ministry of Mines have recently notified (on 19th February 2011) amended Rule 45 in Mineral Conservation and Development Rules, 1988, which stipulates mandatory registration of miners, stockists, traders, exporters, and end-users of minerals, and stringent reporting norms for ensuring end-to-end accounting of the mineral produced.

Setting up of Commission of Inquiry

The Government has set up a Commission of Inquiry under the Justice M.B. Shah (retired Supreme Court Judge) to inquire into instances of illegal mining of iron ore and manganese in several states in the country. The Commission has commenced its inquiry from its office in Ahmedabad.

5.7.0 Use of Modern Technology to curb Illegal Mining

5.7.1 Geo-referencing of Mining Leases

Geo-referencing of Mining leases allotted to various agencies would help in curbing the illegal Mining activities. If the leases are geo-referenced, any mining activity can be detected on images or by using other detection methods and can be compared for whether they are legal or illegal.

5.7.2 DGPS survey

There are a number of cases of disputes on boundary and position of the area. To avoid this DGPS survey which has sub-centimetre accuracy is a possible solution. Under the direction of the Central Government, IBM has already issued a circular to get the areas surveyed by DGPS through an agency recognized by the respective State Government. Some state Governments have already done the survey for area using DGPS.
5.7.3 Satellite Imagery to curb Illegal Mining

Satellite Imagery can be useful in detecting illegal mining. It can be used in detecting the mining activity and its extent (particularly in case of surface mining) in the area and then be compared with the co-ordinates of actual mining lease coordinates for assessing whether the lease holder is illegally mining beyond the lease boundary. This can also be used for altogether isolated illegal mining activity.

5.7.4 ISRO Imagery to curb Illegal Mining

The Indian Space Research Organisation (ISRO) is the Ministry of Mines’ latest ally in cracking the whip on illegal miners.

The ministry is tapping ISRO and other remote sensing agencies to obtain satellite imagery of mining areas in states like Orissa, Chhattisgarh, Karnataka, among others. This imagery is being used to correlate with the mining lease coordinates for assessing the extent of violations by lease holders.

5.7.4 GPS devices to check Illegal Mining

GPS (Geographical Positioning System) can be very useful tool in detecting and curbing illegal mining. Its usefulness increases many fold when used with other like Satellite Imagery. In can be used by the Enforcement Officers at mining site to check whether mining activity being carried out is well within the coordinates of the mining lease. It can also be used in the in the vehicles being used by mine owners for transporting the mining material to track their movement.
CHAPTER-VI

6.0.0 GLOBAL REPORTING STANDARDS AND RANKING SYSTEMS FOR MINING COMPANIES (TOR – 8)

6.1.0 Preamble

6.1.1 Mining activities have a significant environmental impact which needs to be tackled through effective environmental management system, effective mine closure planning, restoration of ecological balance, and observance of best mining practices to ensure maintenance of critical natural capital. Loss of biodiversity is loss of natural capital and the process is irreversible. Environmental Impact Assessments as part of environmental management system should integrate environmental responsibilities into everyday management practices through changes in organizational structure, procedures and processes.

6.2.0 Goal of Global Reporting Initiative

6.2.1 By 2015, all large and medium sized companies in the world, especially in the emerging economies should report publicly on their economic and environmental, social and governance performance. GRI is committed to mainstreaming sustainability reporting. One way to achieve this goal is to drive a report or explain approach to reporting. GRI works in a number is ways to support organizations that want to report.

6.2.2 The Global Reporting Initiative –

- Encourages organizations of all sizes, from all sectors and all regions to produce sustainability reports
- Ensures every company in the world has access to GRI’s Sustainability Reporting Framework by making it available as a free public good in multiple languages
- Offers support to reportees by producing publications and providing training
- Continually improves the Sustainability Reporting Framework by creating a more robust version of the GRI Reporting Guidelines and by developing sector supplements, using a collaborative, multi-stakeholder working process
- Harmonizes reporting guidance with other existing framework and initiative.

6.2.3 Organizations can improve their sustainability performance by measuring, monitoring and reporting it, helping them have a positive impact on society, the economy, and our sustainable future.
6.2.4 GRI’s goal is a sustainable global economy, where companies’ disclosure of their environmental, social and governance performance is a mainstream activity. It is a goal shared by private sector leaders, civil society organizations, trade unions, trade associations, governments and committed individuals around the world. It is in everyone’s interest that such performance information is made public – that companies reveal their impacts, or the reasons why if they don’t.

6.2.5 Governments, regulators, stock exchanges, investors and associations can help information reach a critical mass in the market by asking: “Why don’t you report?” There are many ways to do this, for example through regulation. Sustainability reporting does not necessarily need to be mandatory: If regulators were to adopt a report or explain policy, companies could still be free to choose what information to disclose. Such an approach could persuade more companies to report rather than to explain why they don’t, and provide markets and society with information to judge their choices.

6.3.0 Objectives of Global Reporting Initiative

6.3.1 Climate change and demographics are changing the fundamentals of our economy – we need to look forward and use different information to inform our decisions. Markets will be threatened by new factors and success measured against tomorrow’s needs. Pioneers of sustainability reporting had to present the business case for disclosing their performance data. To drive change, we need to shift the question from “Why do you report?” to “Why don’t you report?”

6.3.2 Establishing basic sustainability disclosure requirements brings clear benefits - for business, investors and society at large:

- Measuring sustainability performance enables organizations to identify opportunities to improve operations, and avoid risks to the long-term value of your organization.
- The ability to manage sustainability impacts helps organizations preserve and increase their value.
- Investors and analysts gain vital insight into organizational performance, and optimal investment potential.
- Transparency increases trust - stakeholders and civil society can respond to comparable and standardized information.
- Organizations can mitigate negative impact.

6.3.3 The Report or Explain Campaign Forum is a convening space for everyone who wants to drive sustainability disclosure as a mainstream management and accountability tool. The Forum is open to all who believe that sustainability reporting is necessary and beneficial – that companies should reveal their performance or the reasons why they don’t.
6.4.0 GRI Reporting Framework

6.4.1 GRI's Reporting Framework is developed through a consensus-seeking, multi-stakeholder process. Participants are drawn from global business, civil society, labour, academic and professional institutions.

6.4.2 The Reporting Framework sets out the principles and Performance Indicators that organizations can use to measure and report their economic, environmental, and social performance.

6.4.3 The cornerstone of the Framework is the Sustainability Reporting Guidelines. The third version of the Guidelines – known as the G3 Guidelines - was published in 2006, and is a free public good. Details are available on the net.

6.4.4 Other components of the Framework include Sector Supplements (unique Indicators for industry sectors) and National Annexes (unique country-level information). These are all available on the net.

6.5.0 Benefits of GRI Reporting

6.5.1 Sustainability reports based on the GRI Framework can be used to demonstrate organizational commitment to sustainable development, to compare organizational performance over time, and to measure organizational performance with respect to laws, norms, standards and voluntary initiatives.

6.5.2 GRI promotes a standardized approach to reporting to stimulate demand for sustainability information – benefiting both reporting organizations and report users.

6.6.0 Global Reporting Standards

6.6.1 There is no international organization capable of passing and implementing performance standards for the mining industry as a whole. However, there is a great need for such standards and this may be done by consensus. There are very few ways on the international level that anyone can force the observance of standards.

6.6.2 It is also clear that there has never been a consensus seeking process on a global scale that has included everyone who has an interest in the subject. Everyone in the world is a consumer of minerals, and most of us are also impacted by the processes of finding, mining, refining, fabricating, disposing of or recycling minerals. Nor has any process been perfectly balanced among different interests – the rich countries of the global North, for example, are generally much better represented in such processes than the poor countries of the “South.” And the traditional overseas minerals investors from places like Europe or North America have been consulted much more than the so-called “emerging investors” in countries such as Brazil, China, India or Russia.

6.6.3 Since there is no official body that promulgates or recognizes standards, there is difference of opinion over which sets of standards should be included in such a list.
6.6.4 Following are some of the reporting standards, each having a particular focus, some distinct and others overlapping. No single standard exists to cover the needs of all the users. This in part stems from the processes used to develop the standards, participants in the standards development process, and the particular focus of each standard.

6.6.5 A set of underlying objectives that these reporting standards encourage have been given in the following table:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Nations Global Compact (UNGC)</td>
<td>The UN Global Compact is a US sponsored organization that provides a framework for CSR reporting. The Global Compact has ten principles on which companies provide a &quot;Report on Progress&quot;.</td>
</tr>
<tr>
<td>CDP (Carbon Disclosure Project)</td>
<td>The Carbon Disclosure Project approaches large organizations and invites them to provide a report on their carbon impact and plans to reduce carbon production. Its focus is on the Analyst / Investor community.</td>
</tr>
<tr>
<td>CERES ((Coalition for Environmentally Responsible Economies)</td>
<td>CERES has developed a set of reporting requirements for Environmental Reporting. This reporting framework provides a high-level framework only, and is more closely aligned to environmental reporting than the GRI's framework that includes Social and Economic as well as environmental reporting.</td>
</tr>
<tr>
<td>FRP (Facility Reporting Project)</td>
<td>Where GRI is used and viewed as a corporate level reporting standard, FRP takes such reporting to the facility level. The FRP is a CERES project with the objective of improving sustainability reporting at individual facilities. This is a US based initiative.</td>
</tr>
<tr>
<td>GBS (Global Business Standards) Codex</td>
<td>The GBS Codex is a framework resulting from the analysis of a number of standards to arrive at a suggested standard that brings together the common aspects of all, and providing an interesting overlap between the standards. The GSB Codex started from the premise that there is a growing consensus that all Codes of Conduct form a foundation for the performance of all businesses.</td>
</tr>
<tr>
<td>GRI (Global Reporting Initiative)</td>
<td>The GRI is one of the leading CSR/Sustainability reporting standards in use today, with more than 1000 companies and entities creating GRI reports. In October 2006, the GRI released its third iteration of the standard, the G3 standard. The GRI G3 provides a library of elements that can and should be reported. The G3 also expects reporting entities to identify performance</td>
</tr>
</tbody>
</table>
objectives, and to report on achievement (or otherwise) of those objectives. A key strength of the GRI standard is that it provides a set of reporting indicators, but does not mandate how an organization reports. To be GRI compliant a reporting organization need only index their reports to the GRI set of indicators.

<table>
<thead>
<tr>
<th>The GHG (Green House Gas) Protocol for Project Accounting</th>
<th>In December 2005 the World Resources Institute (WRI) and the World Business Council on Sustainable Development (WBCSD) released their Green House Gas Protocol for Project Accounting.</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBA's Forge (British Banking Association's Forge)</td>
<td>Developed by the BBA (British Banking Association) and the ABI (Association of British Insurers), the Forge standard provides guidance on the creation and provision of CSR and Sustainability reporting the financial services industry.</td>
</tr>
<tr>
<td>ISO 9000</td>
<td>The ISO 9000 family of standards relate to quality management systems and are designed to help organizations ensure they meet the needs of customers and other stakeholders. The standards are published by ISO, the International Organization for Standardization and available through National standards bodies. ISO 9000 deals with the fundamentals of quality management systems. ISO 9001 deals with the requirements that organizations wishing to meet the standard, have to meet. ISO 9001 is one of the most widely used management tools in the world today.</td>
</tr>
<tr>
<td>ISO 14000</td>
<td>ISO 14000 is primarily operationally focused, as opposed to the external marketing of some other reporting standards.ISO 14000 covers environmental management systems.</td>
</tr>
<tr>
<td>SA 8000</td>
<td>This standard focuses on employee rights and fair working environment. Compliance demonstrates the employers commitment to ethical employment principles.</td>
</tr>
<tr>
<td>ISO 26000</td>
<td>ISO 26000:2010 is intended to assist organizations in contributing to sustainable development. It is intended to encourage them to go beyond legal compliance, recognizing that compliance with law is a fundamental duty of any organization and an essential part of their social responsibility. It is intended to promote common understanding in the field of social responsibility, and to complement other instruments and initiatives for social responsibility, not to replace them.</td>
</tr>
</tbody>
</table>
**WICI** (World Intellectual Capital Initiative)

WICI, the world’s business reporting network, is a private/public sector collaboration aimed at improving capital allocation through better corporate reporting information.

**“DVFA’s ESG/KPI indicators”**

A guideline for the integration of ESG (Environmental, Social and Governance issues)/ KPI (Key performance Indicators) into financial analysis and corporate valuation.

**OHSAS 18001**

The OHSAS 18001 standards are an occupational health and safety (OH&S) standard. These are used to establish the *occupational health and safety management system (OHSMS)*.

*DVFA: Society of Investment Professionals in Germany.*

- **GLOBAL REPORTING INITIATIVE – GRI** is a network-based organization that has developed the world’s most widely used sustainability reporting framework. ([http://www.globalreporting.org/Home](http://www.globalreporting.org/Home))

- The G3 Guidelines are the cornerstone of the GRI Sustainability Reporting Framework which serves as a good basis for an organization’s sustainability report. ([http://www.globalreporting.org/ReportingFramework/G3Online/](http://www.globalreporting.org/ReportingFramework/G3Online/))

- See also the most recent Mining and Metals Sector Supplement: ([http://www.globalreporting.org/ReportingFramework/SectorSupplements/](http://www.globalreporting.org/ReportingFramework/SectorSupplements/))

  As such the GRI Guidelines have become the global standard for CSR reporting.

6.6.6 There are some other reporting standards also, like International Financial Reporting Standards of the International Accounting Standards Board; International Mineral Valuation Standards; CMMI based standards and Standards for Reporting Mineral Reserves, Resources and Exploration Information which are also used by mining enterprises.

6.7.0 **Ranking System for Mining Companies**

6.7.1 *The Sustainable Performance Ranking System*: Ranking system of mining companies should be done based on their performance in various aspects of mining sustainability. The key issues are:

- Biodiversity/Ecosystem services and general environment
- Financial (KPIs): Fundamentals, Profit Margins, Growth Rates, Financial Strength, Analyst Estimates
- Labour, Social Performance Indicators (SPIs): Product Responsibility, Community development, Human Rights, Diversity & Opportunity, Employment Quality, Living conditions, Welfare amenities provided by the company
- Health and Safety Management at work; Occupational diseases; disabilities due to occupational diseases or work related accidents
- Artisanal and small-scale mining
- Rehabilitation and Resettlement
- Closure planning / mine closure plan
- Governance Performance Indicators (GPIs): Board Functions, Board Structure, Compensation, Vision & Strategy, Shareholder Rights
- Productivity and production with safety, efficiency, economy with due regard to the conservation and the environment.

6.7.2 Each of the items mentioned above, should be allocated maximum marks, say, 10 marks each out of total marks of 100. The total marks scored by a company out of 100 should decide the rank of that mining company. The grading/ranking system as suggested here, is as follows:

<table>
<thead>
<tr>
<th>Marks</th>
<th>Grade</th>
<th>Diamond Ranking</th>
<th>Star Ranking</th>
<th>Colour Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>91-100</td>
<td>Excellent</td>
<td>Diamond</td>
<td>****</td>
<td>Gold</td>
</tr>
<tr>
<td>81-90</td>
<td>Very good</td>
<td>Platinum</td>
<td>****</td>
<td>Green</td>
</tr>
<tr>
<td>71-80</td>
<td>Good</td>
<td>Gold</td>
<td>***</td>
<td>Blue</td>
</tr>
<tr>
<td>61-70</td>
<td>Fair</td>
<td>Silver</td>
<td>**</td>
<td>Orange</td>
</tr>
<tr>
<td>51-60</td>
<td>Satisfactory</td>
<td>Bronze</td>
<td>*</td>
<td>Yellow</td>
</tr>
<tr>
<td>41-50</td>
<td>Poor</td>
<td>No Rank</td>
<td>No Rank</td>
<td>No Rank</td>
</tr>
<tr>
<td>00-40</td>
<td>Very poor</td>
<td>No Rank</td>
<td>No Rank</td>
<td>No Rank</td>
</tr>
</tbody>
</table>

Depending upon the marks and grade, any of the ranking systems given in columns 3, 4 or 5 may be used.

In the event of a tie, the company with the higher total average environmental, social, governance (ESG) score receives the higher rank.

The above system is only suggestive, however, an alternative system of ranking may, if required, be adopted.
7.0.0 HUMAN RESOURCE DEVELOPMENT IN MINING SECTOR (TOR – 7 & 9)

7.1.0 PREAMBLE

7.1.1 The Mining Industry has contributed approximately 2.5%-3% to the GDP over the last few years and the same is expected to increase to about 5% to the GDP over the next few years. Also, the Mining Industry in India is the largest employer and the sector is poised for rapid expansion, thus, it is essential that the knowledge and skills in the workforce be attuned towards growth opportunities.

7.1.2 The most important asset of the mining sector is its Human Resource base. The shortage of Mining Engineers, Mines Managers, Mine Surveyors, Mine Foremen, Mining Mates, Blasters, Operators, Skilled Workmen and other professional skills is pressing concern for the growing mining sector. The National Mineral Policy -2008 aims at attracting private investment both domestic and foreign direct investment along with the state-of-the-art technology for exploration and mining. The policy also envisages level playing field for public and private sector. The increasing investment will also need more skilled manpower in this sector.

7.1.3 Despite availability of professionally qualified and skilled manpower and a well established network of R&D institutions in India, desired investment and efforts in keeping the knowledge and skills of our technical manpower update has not been adequate and this has adversely affected their creative abilities and realisation of the gains for the system. Thus, there is a need to re-engineer our human assets to enhance the level of performance and productivity.

7.1.4 However, investment and efforts in keeping the knowledge, expertise and skills of manpower has been inadequate, which has been adversely affecting their capabilities. Thus, there is need to re-engineer the current human resources to enable to meet the requirements of the industry. This calls for corrective action by training of manpower in key areas, institutional strengthening, curriculum development, training of trainers, faculty development, introduction of new & advance courses, networking with national & international agencies thereby promoting collaborative approach, evolving a long time human resource planning for the mining sector, & establishing linkages between academia and industry.

7.1.5 The increasing investment in mining sector will also need more skilled human resource. In order to ensure the modernization process successful and sustainable development of mining sector, it is necessary to strengthen the infrastructure for Human Resource Development and Training.
7.2.0 Availability and requirement of Human Resources in Mining Sector in XII Plan (2012-17)

7.2.1 The Mining Industry in India is the largest employer and the sector is poised for rapid expansion. More than Nine lakh people are employed in the mining & exploration of Coal, Metallic and Non Metallic, Minor & Other minerals. Coal accounts for about 75% of the total mining employment in India. Contractual / outsourced human resource constitute around 40% in mining operations. Women constitutes only about 7% of total employment in the Mining industry.

7.2.2 Major proportion of the workforce is employed in Mining Operations, Maintenance and safety. Other supporting activities include Information Technology (IT), Finance, Marketing/Sales, Purchase, Legal / Liaison etc.

7.2.3 Engineers include Mining engineers (employed in mine operations, mine planning, etc.) as well as Mechanical, Electrical, Instrumentation and Civil engineers (employed in the maintenance department) and Statutory manpower viz. first & second class Mine managers, Mine Surveyors, Mine Foremen, Mining Mates, Blasters, etc. are required for safe mining.

7.2.4 As per the report prepared jointly by Ministry of Mines & Confederation of Indian Industry the projected figure of employment in mining sector by the year 2017 will be more than 10.60 lakhs. Similarly by the year 2025 the figure will be more than 12.10 lakhs. The sector wise projected figures are as follows

<table>
<thead>
<tr>
<th>Sector</th>
<th>Current</th>
<th>2017</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploration &amp; Regulatory</td>
<td>20,565</td>
<td>24,854</td>
<td>25,828</td>
</tr>
<tr>
<td>Fuel (Coal &amp; Lignite)</td>
<td>767,761</td>
<td>783,997</td>
<td>891,240</td>
</tr>
<tr>
<td>Metallic &amp; Non Metallic</td>
<td>116,029</td>
<td>258,322*</td>
<td>294,098</td>
</tr>
<tr>
<td>Minor Minerals</td>
<td>87,762</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>992,117</td>
<td>1,067,173</td>
<td>1,211,166</td>
</tr>
</tbody>
</table>

7.2.5 Coal & Lignite is expected to continue to be maximum employment segment till 2025. Exploratory and Regulatory will experiences increase in employment in the near future but is expected to remain stable after 2017

7.2.6 In the study made by CII about the skill gaps in Planning, Operation, Maintenance and Safety in Mining Industry deficiencies in the following are observed:
Planning:
- Knowledge of latest trends in modern mining methods.
- Knowledge of Mining specific software.
- Knowledge of Mine closure management.

Operation:
- Education/ training for rock excavation.
- Trained machine operators.
- Knowledge of operations of modern machinery.
- Awareness of preventive maintenance.
- Safety awareness.
- Shortage of certified shot firers/blasters, mining mates, mine foremen.
- Ability to identify the right kind of explosives to suit the mining requirements
- Ability to minimise the usage of explosives
- Knowledge of advanced surveying technologies and instruments
- Shortage of trained professionals
- Education and training in areas like Rock Excavation Technology

Safety:
- Knowledge of safety techniques and mine disaster management
- Awareness of safety requirements and regulations of DGMS
- Knowledge of health related issues and provisions

Maintenance:
- Knowledge of maintenance requirements of modern machinery
- Ability to schedule preventive maintenance and condition monitoring
- Cost analysis of maintenance management strategies

7.3.0 Measures for Capacity Building of Infrastructures

7.3.1 To bridge the gap between demand and supply of the human resource and also to update the knowledge in tune with the advancement in technology, the following initiatives are required for capacity building of infrastructure:

7.3.2 Education Related Measures:

(a) Mining engineering: Mining engineering category is expected to experience a demand supply gap of about 3,000 in the short term (2009-2017) and about 8,500 over the longer term (2009-2025). The course curriculum also needs to be updated with focus on mine safety, environment related issues and rock mechanics to better address the requirement of the industry.

(b) Diploma engineering – There are lack of diploma courses catering to the mining sector. The current course in surveying needs to be updated with focus on imparting computer knowledge for capturing the survey data in digital form and usage of advanced survey machines. Also given the increase in the level of automation in the mining industry there is requirement of diploma in mining machinery course. The
existing important educational institution providing mining related courses and R & D institutes are given in Annexure - I

(c ) To support the growth of the mining sector there is immediate requirement to start courses for mining lawyers, mineral financial analyst/economist. Also new courses such as Diploma in mining machinery, M.Tech in spatial technologies, etc. needs to be introduced.

(d) There is a large network of academic institutions providing basic education and training in geosciences and mining related courses. These institutions ensure good availability of fresh graduates and post-graduates. However, investment and efforts in keeping the knowledge, expertise and skills of manpower has been inadequate which has been adversely affecting their capabilities. Thus, there is need to re-engineer the current human resources to enable to meet the requirements of the industry. This calls for corrective action by training of manpower in key areas, institutional strengthening, curriculum development, training of trainers, faculty development, introduction of new & advance courses, networking with national & international agencies thereby promoting collaborative approach, evolving a long time human resource planning for the mining sector & establishing linkages between academia and industry. There is a need to increase the number of seats on the mining engineering and geosciences field.

(e) There is a need to align mining related courses in order to make them more relevant to the growing demand of the industry. Curriculum of courses such as Geo-informatics, Climatic change studies, Remote sensing, Mining engineering, Diploma in surveying, etc. needs to be updated to make them relevant to the current trend and demand.

(f) To improve the attractiveness of mining programme, scholarship schemes may be initiated in the educational institutes dealing with Mining industries.

7.3.3 Skill Development Measures:

(a) Mining industry in India is currently facing huge shortage of trained operators such as blaster, shot firer, drillers, heavy machine operators, surveyor, etc. There is a complete lack of infrastructure to train people at this level. One way to address this issue is through introducing relevant courses in the existing ITI/ITC located close to mining centres.

(b) Given the change in technology and growing environmental concerns there is a need to enhance the skill of personnel already employed in the industry in areas such as safety, environment, health and surveying etc., through short term refresher courses.

(c) Given the structure of the Indian Mining Sector, where people move up the ranks from lower level to managerial positions, it is important to optimize the existing talent pool within the organization through training and various career development programs.
(d) Since mining involves significant field work, there is a requirement of exposures to field environment to improve the curriculum delivery process.

(e) Regulatory process need to be developed through DGMS / IBM etc. to ensure that the accreditation process of skill imparting institutions are of requisite quality and only person with requisite diploma are employed with them.

(f) Institute should also formalize the train-the-trainer initiatives to ensure that the current practices and technological advancement in the industry percolate into the education system. There are already many ‘not-for-profit’ institutions who provide skill training at ITI like institutions. The Ministry of Mines needs to facilitate a dialogue between such institutions and industry and promote skill development as part of CSR actively of the industry.

7.4.0 Modernisation and updating of curriculum and technology

7.4.1 It may be necessary to review mining course curriculum in the B Tech programme so as to sensitize the graduates to a more multidisciplinary future. The curriculum has to prepare the professionals for both research & development and mining technology. The need for professionals is more in R&D as the thrust in the next decade will be to augment research capabilities in the country. It will be more appropriate, if academic institutions become strong partners in mission oriented national programme related to mining. Manufacturing will be dictated more by economics and automation, which in turn will demand more generalist engineers with mining as an extra specialization. In this regard, mining engineering courses for non-mining engineers is also relevant, as this sector will employ a very large number of mechanical and electrical engineers. The academic institutions and the mining industry can come together to institute undergraduate and post graduate mining engineering courses that would serve as (a) orienting non-mining engineers for the mining industry and (b) to encourage mining engineering diploma holders employed in industry to pursue higher education.

7.4.2 There is a need to build networked institutions of excellence for building synergies of strengths and focuses of different academic and research institutions, be private, public or non-profit sectors.

7.4.3 In order to strengthen academic institutes like IITs, ISM and other educational institutions, new courses and scholarships need to be introduced.

7.4.4 Seeing the emerging needs of the country’s mineral sector, the number of students in mining engineering discipline has been increased in almost all the institutions. Many of these talented students are going for non-mining jobs because of more attractive emoluments and perks. Some of the students go for management study and hardly few for higher studies in mining. In order to attract the talented students to the mineral sector, it is essential to enhance the emoluments and perks to make the jobs more attractive.
ANNEXURE-I

ACADEMIC INSTITUTIONS PROVIDING MINING COURSES AT VARIOUS LEVELS
AND R & D INSTITUTIONS

(A) THE PRINCIPAL ACADEMIC INSTITUTIONS PROVIDING MINING RELATED COURSES

- Indian School of Mines, Dhanbad
- Indian Institute of Technology, Kharagpur
- Jadavpur University, Kolkata
- Institute of Technology, Banaras Hindu University, Varanasi

(B) OTHER INSTITUTIONS AWARDING MINING ENGINEERING DEGREES

- Bengal Engineering College, P.O. Botanical Garden-711103, Howrah, (W.B.)
- Birsa Institute of Technology (Formerly known as Bihar Institute of Technology), P.O. Sindri Institute, Dhanbad -828123 (Jharkhand)
- College of Engineering, Anna University, Guindy, Chennai– 600 025 (T.N.)
- Government Engineering College, Bilaspur – 495009 (M.P.)
- Government Engineering College, GE Road, Raipur – 492002 (M.P.)
- MBM Engineering College, Rathoda, Jodhpur – 402117 (Rajasthan)
- Rajiv Gandhi College of Engineering, Research and Technology (Formerly known as Chandrapur Engineering College, Ballarpur Road, Babupeth, Chandrapur – 442403 (Maharashtra)
- Golden Valley College of Engineering, Kolar, Karnataka
- Mining Engg. Department, MP University of Agri & Tech, Udaipur
- Mining Engg. Department, National Institute of Technology, Rourkela
- Mining Engg. Department, National Institute of Technology, Nagpur
- Mining Engg. Department, National Institute of Technology, Suratkal
- Mining Engg. Department, Sarang, Orissa
(C) INSTITUTIONS / POLYTECHNICS AWARDING DIPLOMA IN MINING

- Asansol Polytechnic, P.O. Dakshin Dhadka, Dist. Burdwan, Asansol-713 302, (W.B.)
- Govt. Engineering College, Bhuj, Dist. Kutch, Gujarat
- Govt. Polytechnic, Bellampalli, Adilabad Distt., (Andhra Pradesh)
- Govt. Polytechnic, Ambikapur, Distt. Surguja-497 001 (M.P.)
- Govt. Polytechnic, Khirsadah Post Office-Parasia, Dist. Chhindwara-480 441 (M.P.)
- Govt. Polytechnic, Gudur, Nellore Dist (Andhra Pradesh)
- Govt. Polytechnic, Rudrampur (Post), Kothagudem, Khamman District, 507 119 (Andhra Pradesh)
- Govt. Polytechnic, Mayem, Bicholim, Goa-403 504
- Govt. Polytechnic, Narisipatnam-531 116 (Andhra Pradesh)
- Govt. Polytechnic, Ratnagiri-415 612 (Maharashtra)
- Govt. Polytechnic, Pandav Nagar Road, Shahdol-484 001 (M.P.)
- Institute Of Mining, Girjapara, Ranigunj, Dist. Burdwan-713 347(W.B)
- Orissa School Of Mining Engg., Keonjhar-758 001 (Orissa)
- Sri Y.S.R. Reddy Polytechnic, Pulivendula, Cuddapah District, 516 390 (Andhra Pradesh)
- Vivekanand Edu. Soc's Vivekanand Poly, Sitasaonji, Tumsar, Dist. Bhandra-441 929 (Maharashtra)

(D) R & D INSTITUTES RELATED TO MINING ACTIVITIES

- Centre for Mining Research, Design and Development (CMRDD) (Presently Mining Research and Technical Consultancy Cells of IBM)
- Centre for Rock Mechanics and Geo-technical Engineering (CRGE) (Presently National Institute of Rock Mechanics )
- Centre for Advanced Training in Geo-scientific Management (CATGM) (Presently Training Setup of GSI, IBM and the Research Institutions)
- Centre for Research in Miners' Health and Hygiene (CRMHH) (Presently National Institute of Miner's Health)
- Central Institute for Mining and Fuel Research (CIMFR) (Presently under CSIR)
8.0.0 RECOMMENDATIONS (TOR-10)

8.1.0 India is endowed with vast mineral resources. Therefore, mining continues to be an important segment of Indian economy. The contribution of mineral production (mining and quarrying) to the GDP was estimated at 2.3% in 2009-10. The mining and quarrying sector has a share of about 11% in the overall index of the industrial production (IIP). Therefore, in order to ensure growth of mineral sector [except coal, lignite, petroleum (crude) and atomic minerals], we would need to ensure enhancing production of metallic & non metallic minerals, which contribute presently about 12% of the total value of mineral production. Development of mineral sector includes processes of exploration, mining, value addition, transportation, using, reusing, recycling and disposal of mineral & metal products in most efficient, competitive and environmentally responsible manner using best international practices. Therefore, to ensure sustainable development, it is necessary to strengthen infrastructure for automation & modernisation, research & development, human resource development, review and strengthening of regulatory authorities, effective governance and induction of global reporting system in mineral sector.

In order to undertake the task of building the infrastructure in mining sector and for significant growth of Indian mineral industry, it would be necessary to carve out a way forward not only in attaining self sufficiency but also in establishing share in the global mining & metals map, the following recommendations are put forward:

8.2.0 Mineral Development Fund:

8.2.1 Mineral Development Fund should be set up in each State having stake in major mining activity by earmarking 15% of the annual royalty collections for the fund as recommended in the XI plan.

8.2.2 As suggested in National Mineral Policy-2008:

i) steps to be taken to facilitate financing of mine development and also of exploration integral to the mining project.

ii) Prospecting being a high risk venture, access to “risk funds” from capital markets and venture funds to be facilitated. Early stage Exploration and Mining companies to be encouraged and differential listing requirements through segmented exchanges may be explored. Induction of foreign technology and foreign participation in exploration and mining for high value and scarce minerals to be
pursued. Foreign equity investment in joint ventures for exploration and mining promoted by Indian Companies to be encouraged.

8.3.0 Infrastructure Development:

8.3.1 For planning and promoting the development of mine, special emphasis need to be given on linking Infrastructure in the mineral bearing area such as rail, road, power and other basic facilities such as education, health, drinking water, etc.

8.3.2 Infrastructure to be built in the area, by the government with available financial resources to the maximum extent possible through recourse to user charge on the basis of Public-Private-Partnership (PPP) arrangement.

8.3.3 Motivate the large capacity mining companies to undertake construction of transportation net works (road and rail) on their own.

8.4.0 Single Window Clearance:

8.4.1 Single window clearance for grant of permission from RP/PL/ML to mine operation/closure and process simplification on time bound grant of environment clearances through single empowered panel and single nodal agency for monitoring the compliance of environmental parameters/issues as against a number of State & Central Departments. Clearances should be deemed to be granted after the expiry of the allotted time.

8.4.2 To operationalize and simplify the application of provisions regarding land acquisition & compensation, etc, for fast track large projects to deal with mining lease related issues in reserve forests/bio-forests and private land owners.

8.5.0 Exploration:

8.5.1 To generate focus on mineral exploration, being fundamental for future development of metals industry, there is a need to evolve a framework of commitment to accelerate exploration by GSI, MECL and joint venture in association with overseas organisations.

8.5.2 To attract large investments in metals sector by introducing tax concessions on “Exploration” in line with R&D activities, allowing duty free imports of capital goods for setting up projects.

8.5.3 Part of the royalty be allocated towards infrastructure/community development and also for funding fresh exploration.

8.6.0 Automation and modernisation of mining sector:

8.6.1 The extraction of mineral resources deciphered through exploration & prospecting has to be maximized through scientific methods of mining, beneficiation & economic utilization. A framework of sustainable development to be designed
which take care of bio-diversity issues and to ensure that mining activity take place along with suitable measures for restoration of the ecological balance.

8.6.2 Use of modern mining equipment & machinery and latest available technology which improve the efficiency, productivity and economics of mining operations, safety & health of persons working in the mines and surrounding areas to be encouraged. Import of such equipment & machinery and technology to be freely allowed.

8.6.3 Mining technology needs to be upgraded through modernization, automation, computerization to ensure extraction & utilization of the entire Run of Mine (ROM) taking care of all safety measures. A co-ordinated effort among R & D institutions, the entrepreneurs, mining machinery manufactures and statutory bodies is need of the hour to achieve the zero waste mining - the national goal.

8.6.4 To achieve the goal of Zero Waste Mining, the following points have been recommended.

- The low grade minerals and the less important minerals along with the main minerals which can not be extracted economically today should be stacked in a systematic manner so that it could be used for mineral extraction at a later date when these become economically viable. For this intensive R & D efforts should be made.
- Efforts should be made to mine as far as possible only the desired ore. In case of waste bands in the ore body, the same may be sorted out after blasting and be disposed off in the stope itself.
- In order to reduce the waste disposal on the surface in tailing ponds, efforts should be made to dispose off waste/tailing into the worked out areas / voids in the mine which will enhance the overall stability of the mines.
- An extensive R&D effort is needed to use the slime part of waste/tailing for some industrial purposes.
- If there are number of thin parallel lenses which can not individually be mined economically could be merged to make a thick ore body which could then be mined economically by a suitable mechanised method. However, this will reduce the overall grade which can be compensated by increase in production due to mechanization.

8.6.5 In the present high mineral price scenario, there is a need to explore the possibilities of re-opening of the closed mines in joint venture with overseas organisations adopting a suitable mining technology.

8.6.6 Steps to be taken to encourage exploitation of Beach Sand Minerals through a judicious mix of public private sector participation including foreign investment.

8.6.7 Deep open cast mines may be converted in to underground mines for exploitation of deep seated deposits.
8.6.8 For exploitation of small deposits of minerals scattered all over the country, efforts to be made to promote small scale mining in a scientific and efficient manner while safeguarding vital environmental and ecological imperatives.

8.6.9 The Ministry of Earth Sciences (MoES) and its agencies are entrusted with the task of sea-bed exploration and mining. MoES with the coordination of GSI, should expedite for development/acquisition of necessary technology to achieve this objective within a time bound framework.

8.6.10 Rehabilitation & Reclamation plan to be implemented by the owner of abandoned or closed mines to give eco-friendly image to mining industry.

8.7.0 Research and Development

8.7.1 At present the R&D setup in the industry is largely working as an internal department with emphasis on problem solving and applied research. In order to update technology, strengthen the R&D department/organization, adequate budgetary support is necessary. National R & D Fund for Mineral Sector to be established and re-structured.

8.7.2 Focus to be given on R & D efforts for recovery of minor/trace metals and development of cost effective applications.

8.7.3 New improved mining methods to be developed for narrow vein mining for their economic exploitation.

8.7.4 Specific R&D projects may be formulated for exploration and mining (other than metallurgical projects).

8.7.5 Considering thrust areas recommended, it is necessary to create projects involving (a) streamlining of the execution by the existing institutional mechanisms and (b) to create centres of excellence on a mission mode to undertake interdisciplinary research.

8.7.6 Considering strong need for active interface, networking and coordination among Science & Technology Department, R&D Institutions/Centres, Academia and Entrepreneurs/Organisations in the mineral sector to be strengthened to derive the maximum benefit from mineral industry.

8.7.7 Interchange of scientists between institutions to accelerate the pace of interaction.

8.7.8 To ensure that the research findings are made available to users expeditiously.

8.7.9 Cooperation and coordination among all organizations/institutions in the public and private sector engaged in the R & D tasks of mining/mineral sector.
8.7.10 Basic R & D facilities/supports to be provided/developed in the laboratories under the State Government to benefit the Small & Medium Enterprises. NIMH may be transferred to Ministry of Labour.

8.7.11 Private sector developing R & D facilities should be given benefits in terms of tax relief, etc.

8.7.12 To undertake the R & D works/projects on various problems/issues related to Mining including deep mining activity and study of beach sand and placer deposits, poly-metallic nodules and the concealed mineral deposits in the EEZ.

8.7.13 In order to meet the above requirement for R & D development in thrust areas identified for the XIIth plan, a National R & D Fund in the form of Grant-in-Aid under the domain of Ministry of Mines is proposed to be created for catering to requirement of above mentioned specific areas.

8.8.0 Role of regulatory agencies

8.8.1 Since Indian Bureau of Mines and State Directorates of Mining & Geology are responsible for regulations at each step, a comprehensive framework has to be formulated for the most sustainable use of the country’s mineral resources for national development, taking due notice of the conflicts of interests of various agencies.

8.8.2 Therefore Indian Bureau of Mines and State Directorates of Mining & Geology to be strengthened with manpower, equipment, and skill sets upgraded to the level of state of the art.

8.8.3 Strengthening of Indian Bureau of Mines (IBM): A committee has been constituted in the Ministry of Mines for revising and restructuring of functions and role of IBM in terms of the Policy directions given in the National Mineral Policy (NMP), 2008. The committee has prepared a draft report and recommendations of committee may be implemented.

8.8.4 Most of the State Directorates of Mining & Geology lack adequate competence and laboratory backup for ore testing and beneficiation studies, for granting approval of Mining plans, checking of illegal / unscientific mining, awareness about sustainable mining practices and GIS based mining tenements and mineral concession database etc. The State Directorates of Mining & Geology need to be strengthened through a management and technology oriented intervention of IBM and GSI.

8.9.0 Effective Governance in Mining Sector

8.9.1 Mining activities, including exploration, development, production, and disposal of minerals generally affect the environment and ecology of the mined areas. Therefore, environmental and social concerns must be addressed sensitively, for
which effective governance systems are required to ensure mining in a sustainable manner.

8.9.2 Illegal mining is rampant in many states. This amounts to stealing of public property; it is also an environmental hazard. Strong action is required to be taken by State Governments to prevent and detect such illegal activities.

8.9.3 The following ways are suggested to detect the Illegal Mining

- Regular inspection and survey of mining lease areas by Regulating Authorities and by the Special Task Force set up for the purpose.
- Regular co-ordination between the State Governments having common borders.
- Twenty four hours vigilance on transit of minerals by establishing check posts in the mining areas and especially in the suspected areas.
- Use of satellite imageries for tracking of mining activities.
- Computerisation of Weigh Bridges at mine sites.
- Proper maintenance of Reports should be compulsory for the mining companies which should be open to inspection.

8.9.4 The following ways are suggested to curb the Illegal Mining

- Survey of the lease boundaries using DGPS and establishing permanent boundary pillars on the ground.
- Digitisation of land records as well as sketches of mineral concessions granted
- The State Government should develop capacities for using satellite imageries for curbing illegal mining which can be used to identify illegal mining activities
- In order to curb illegal mining, close co-ordination and interaction among State Land Revenue Department, Mines and Geology Department, State Forest Department, Regional Remote Sensing Centres and IBM is essential.
- Registration of all end users with State DMG as well IBM.

8.10.0 Global Reporting Standards and Ranking System

8.10.1 Global Reporting Standards
The mining companies should be encouraged to use the World's most widely used Global Reporting Initiative (GRI) and GRI Mining and Metals Sector Supplement for sustainability reporting.

8.10.2 Ranking System for Mining Companies

Ranking system of mining companies should be done based on their performance in various aspects of mining sustainability. The key issues are:

- Biodiversity/Ecosystem services and general environment
- Financial (KPIs): Fundamentals, Profit Margins, Growth Rates, Financial Strength, Analyst Estimates
- Health and Safety Management at work; Occupational diseases; disabilities due to occupational diseases or work related accidents
- Community
- Artisanal and small-scale mining
- Rehabilitation and Resettlement
- Closure planning / mine closure plan
- Governance Performance Indicators (GPIs): Board Functions, Board Structure, Compensation, Vision & Strategy, Shareholder Rights
- Productivity and production with safety, efficiency, economy with due regard to the conservation and the environment.

8.11.0 Human Resource Development in Mining Sector

8.11.1 Mining Industry in India is the largest employer. The rapid expansion with increasing investment in mining sector and to ensure the modernization process successful and sustainable development, it is necessary to strengthen the infrastructure of Human Resource Development and Training.

8.11.2 In the study made by CII about the skill gaps in Planning, Operation , Maintenance and Safety in Mining Industry are observed. To bridge the gap between demand and supply of the human resource and also to update the knowledge in tune with the advancement in technology, the following initiatives are required for capacity building of infrastructure:

- Education related measures:
  a) There is a demand supply gap in Mining Engineering graduates and Diploma in
Mining Engineering category in the sector. In Institutes like IITs, ISM, BHU and other educational institutions, the nos of seats for mining courses to be increased and new courses and scholarships need to be introduced.

b) To support the growth of the mining sector there is immediate requirement to start courses for mining lawyers, mineral financial analyst/economist. Also new courses such as Diploma in mining machinery, M.Tech in spatial technologies, etc. needs to be introduced.

• Skill Development Measures:

Mining industry is currently facing huge shortage of trained manpower such as blaster, shot firer, drillers, heavy machine operators, surveyor, etc. To address this issue is through introduction of relevant courses in the existing ITI/ITC and imparting refresher courses at places located close to the mining centres.

• Modernisation and updating of curriculum and technology:

a) The academic institutions and the mining industry can come together to institute undergraduate and post graduate mining engineering courses that would serve as (i) orienting non-mining engineers for the mining industry and (ii) to encourage mining engineering diploma holders employed in industry to pursue higher education.

b) There is a need to build networked institutions of excellence for building synergies of strengths and focuses of different academic and research institutions, be private, public or non-profit sectors.

c) Many of the talented students in mining engineering discipline are going for non-mining jobs because of more attractive emoluments and perks. Some of the students go for management study and hardly few for higher studies in mining. In order to attract the talented students to the mineral sector, it is essential to enhance the emoluments and perks to make the jobs more attractive.