

**REGIONAL MINERAL DEVELOPMENT STUDIES CARRIED OUT BY TMP
DIVISION OF IBM DURING THE ANNUAL PROGRAMME
YEAR 2013-14 & 2014-15**

Year 2013-14		
SN	Name of Mine	Owner
1.	Joda-East Iron Ore	M/s Tata Iron & Steel Co. (TISCO)
2.	Thakurani Iron Ore Mine	M/s Sardar Mines Pvt. Ltd.
3.	Jajang Iron and Manganese Ore mine	M/S Rungta Mines Limited
4.	Balda Iron Ore Mine	M/S Serajuddin & Company Ltd.
Year 2014-15		
5.	i) Gumgaon Manganese mine ii) Kirnapur Mn mine of	M/s MOIL Ltd. M/s Veet Rag Homes Pvt. Ltd.
6.	(i) Beldongri Manganese Mines (ii) Satuk Manganese Mines	M/s MOIL Ltd M/s MOIL Ltd
7.	i) Kandri Manganese Mine (ii) Munsar Manganese Mine. (iii) Bhandarbodi Manganese Mine	M/s MOIL Ltd. M/s MOIL Ltd. M/s D.P.Rai
8.	(i) Chikla Manganese Mine. (ii) Dongri Buzurg Manganese Mine.	M/s MOIL Ltd M/s MOIL Ltd

Regional Mineral Development Study (RMDS)
Joda-East Iron Ore Mine, M/s Tata Iron & Steel Co. (TISCO)
(For the year 2013-14)

- Joda East Iron Ore Mine (671.093 Hect.) located about 5 km from Joda-Bamebari Pakka road as well as from NH-215 connecting Joda to Bonaikela. The lease block is located in Barbil Taluka, Keonjhar District.
- The principal rocks met within the lease area are quartzitic sand stone, shales and cherty quartzites, both banded and un-banded. Sometimes colloidal quartzites contain bands of Hematite and are recognized as Banded Hematite Jasper (BHJ). The rocks show a general strike NNE-SSW direction with a westerly dip.
- The area has been thoroughly explored with 620 bore holes for total 25000m drilling keeping in view the Iron ore mining in totality and to meet the ever increasing demand of Iron ore both for domestic and export market.
- The present reserve under 111 category is 88.5 million tonnes. Based on the current reserve data and average rate of production, the life of the mine will be around 14 years.
- Joda East Iron Ore Mine is a captive mine. The mining operations are concentrated in two areas (North Quarry and South Quarry). Present method of mine working is by opencast mechanised considering the geological set-up of deposit, surface topography, continuation of ore deposit, quality variation, geo-technical aspects and required rate of production etc.
- The minimum bench width in the working bench in the ore and overburden waste is >25m and height is 9 m. Haul roads are having a gradient of 1:16. The designed ultimate pit depth of north pit is 96 m (579 mRL) and that of south pit is 137 m. (548 mRL). Overall stripping ratio is 1 : 0.25. Blasting is done by using mostly SME in loose form (Site Mixed Emulsion Explosives). Entire development of mine is being done as per the proposal in scheme of mining following the zero waste concept, ore / mineral recovery from pit comes to 85– 86 %.
- At present, mining is done with +58% Fe as feed to the plant to upgrade the same to +65% Fe products. ROM is treated either by wet processing or by dry processing. ROM with high alumina content is known as wet ROM and constitutes hard ore (20–30%), flakey ore (50 – 60%) and lateritic ore (10–20%). The cumulative sub-grade generated upto March 2013 was 18.06 million tones. The ratio of sub-grade generation with ROM is 10%. Precaution against loss of mineral is taken by making toe wall and providing garland drain all along the dumps toe with settling tank and check dams. The metal recovery is 37% while weight recovery is 34% which is on lower side.
- Waste rock generated is used as a land fill for filling up of low lying areas and for construction activities etc. Waste is being stacked separately in permanent dump. The rejects generation is there only in beneficiation stage. Wet processing of crushed ROM generates wet sized ore and classifier fines as products and slimes as rejects. This slime generated from wet beneficiation process is being stored separately in zero discharge

slime dam. Rejects contain average Fe 50-57% alumina >7% with size 0.15 mm. cumulative rejects generated till March 2012 is 7.81 million tonnes.

- The monitoring of air, water, soil and noise levels are carried out at regular intervals and water is mainly used at Joda east Iron mine for dust suppression, sanitation, plantation and beneficiation purpose. The requirement of water is met only from surface water drawn from Kundra nalla. The major use of surface water is for beneficiation of Iron ore. The decanted water from the slime pond is completely recycled back to the beneficiation plant within the mine ensuring zero outside discharge.
- It is anticipated that, out of 312.649 Ha. of mined out area of the quarry, about 250 Ha. area will be reclaimed concurrently by afforestation during the active mining operation. Up till now (i.e. April-2014) company has planted total 607066 numbers of saplings in the total 135.69 Ha. 1 lakh vetiver grass plantation has also been done over dump slope. The dumps have been stabilized through terracing, compaction and afforestation.
- It has been reported that on the basis of individual company level the social and community development work has been carried out time to time like medical camp, training , education, transportation etc.

Conclusion :

- i) The iron ore reserves available in Orissa have been estimated as 3083 million tones. The investigations carried out by the agencies indicate that the reserves would be higher even after taking into account the depletion during last 20 to 25 years. In the last decade, two important developments in the nature of demands of iron ore with far reaching importance on the exploration strategies in the ore mining industry took place in Odisha sector.
- ii) The total utilization of iron ores of appropriate quality irrespective of whether they are in the form of lump or fines. The development of agglomeration techniques of sintering led not only to the use of fines but to finally using increasing fines as raw material, feed for overall enhanced productivity in the steel plants. This has ultimately led to the utilization of old fines whose stocks are depleting fast in different mines if they are within the chemical specifications.
- iii) Iron ore mines in Odisha state have to go for adopting a system of total mining i.e. lump fines/friable and blue dust. The exploration of iron ore has been oriented not only to aim at establishing the overall reserves qualitative characteristics, distribution pattern of ore etc. but also to establish the quantitative proportions in the desired size range and their qualitative characteristics in such size range which would import in obtaining accurate knowledge of the ore body broken into small blocks showing the valuation patterns of physical & chemical characteristics of the ore deposit.
- iv) In the Odisha sector, the Hematite iron ores occupies the tops of several ridges trending NNE-SSW & forms the famous horse shoe also known as Bonai range of Dunn(1937) Spreading into southern Singhbhum distt. of Bihar & Keonjhar Sundergarh distt. of Odissa. They are considered tightly folded synclines, modified to

- varying extent & geometry of folding the eastern limb houses the Noamundi in the north followed southward by Thakurani, Joda, Baspani group, Malangtoli & Khandadhar deposits and are mostly hard and lumpy ore with varying proportions of laminated and powdery ores.
- v) The iron ore deposits of Odisha sector is not homogenous. It varies physically as well as chemically both vertically & horizontally on the same RL. Mining in the area is characterized by co-existence of small, medium and large mines, manual; semi mechanized and fully mechanized and fully opencast mines. Power shovels and dumper combination side by side shot hole blasting, breaking, sizing and harn sorting are applied.
 - vi) At present, the voids due to mining are not feasible to fill back with overburden (OB) which is mostly laterite waste rock which has been dumped with low height in a systematic manner on non-mineralized space.
 - vii) The iron ore produced in the Odisha sector are being presently utilized for:
 - A) Production of iron and steel in the integrated steel plants.
 - B) Iron ore is supplied to Sunflag Jindal, Hindusthan Electro Graphite plants export of iron ore through MMTC from Paradeep Port.
 - viii) Fines are used in Sintex plants steel mills for sweetening purpose.

Recommendations :

- The metal recovery is 37% while weight recovery is 34% which is on lower side. Further, the grade of tailing is very much near to the feed grade for which R&D study is required to improve the recovery.
- Direct reduction process (DR) Odisha iron ore have provided the best ground for such ventures and iron ore from Barbil Joda and Gandhamardhan areas of Keonjhar distt. can be used for making acceptable sponge iron .
- Majority of the quarries working on float ore have been permanently worked out and have been abandoned. Such quarries can be back filled and after proper re-contouring would be ideal sites for plantation.

Regional Mineral Development Study (RMDS) of Thakurani Iron Ore Mine of M/s Sarda Mines Pvt. Ltd. (for the year 2013-14)

The Thakurani Iron Ore Mine 947.046 Ha of M/s Sarda Mines Pvt. Ltd. is approachable by road from Barbil town & lies in Champua range of Keonjhar Forest Division (Reserve Forest).

The Thakurani-pahar constituting the northern part of the eastern limb of the horse shoe-synclorium and is situated between Noamundi and Joda.

As the exploration proposed in the mining scheme could not be achieved due to requirement of forest clearance and DRP proposal which is under process, production of ore also cannot be achieved as proposed in the scheme of mining, the utilization of machineries is 67% with its maximum mechanical efficiency of 86% .

Conclusions:

- The iron ore reserves available in Odisha have been estimated as 3083 MT. The investigations carried out in the recent years by GSI, State Directorate of Mining & Geology OMC, SAIL, TISCO & other agencies indicate that the reserves would be higher even after taking into account the depletion during last 20 to 25 years. In the last decade, two important developments in the nature of demands of iron ore, with far reaching importance on the exploration strategies in the ore mining industry look place in Odisha sector.
- The total utilization of iron ores of appropriate quality irrespective of whether, they are in the form of lump or fines. The development of agglomeration techniques of sintering led not only to the use of fines but led to finally using, increasing fines as raw material feed for overall enhanced productivity in the steel plants. This has ultimately led to the utilization of old fines, whose stocks are depleting fast in different mines if they are within the chemical specifications.
- With the increasing usage of fines, the other important demand from the steel mills is for calibrated ores with fixed and uniform chemical composition.
- Iron ore mines in Odisha state have to go for adopting a system of total mining i.e. lump fines/friable and blue dust. The exploration of iron ore has been oriented not only to aim at establishing the overall reserves qualitative characteristics, distributions pattern of ore etc. but also to establish the quantitative proportions in the desired size range and their qualitative characteristics in such size range which would import in obtaining accurate knowledge of the ore body broken into small blocks, showing the valuation patterns of physical & chemical characteristics of the ore deposit.
- In the Bihar Odisha sector, the Hematite iron ores occupies the tops of several ridges trending NNE-SSW & forms the famous horse shoe also known as Bonai range of Dunn(1937) Spreading into southern Singhbhum distt. of Bihar & Keonjhar Sundergarh distt.of Odisha. They are considered tightly folded synclines, modified to varying extent

& geometry of folding the eastern limb houses the Noamundi in the north followed southward by Thakurani, Joda, Baspani group, Malangtoli & Khandadhar deposits and are mostly hard and lumpy ore with varying proportions of laminated and powdery ores.

- The iron ore deposits of Odisha sector are not homogenous. It varies physically as well as chemically both vertically & horizontally on the same RL. The quality fluctuations caused by nature can be controlled by forming ore blocks.
- Mining in the area is characterized by co-existence of small, medium and large mines, manual; semi mechanized and fully mechanized and fully opencast mines. Power shovels and dumper combination side by side shot hole blasting, breaking, sizing and harn sorting are applied.
- Due to strict enforcement of forest laws, it is not possible to progress the mining faces further by way of developmental work and this may affect the availability of iron ore. The ecological availability of the iron ore resources would be much less if restriction on mining in the forest land continues. However, with prudent investment in exploration judicious mining can be ease the situation.
- The estimated proved and probable resources as on 01.04.2013 as per UNFC is 215.861 million tones (111 & 122 Category) in the lease hold area.
- At Present block 5 & Block 8 is active block and are working. However working of block 8 could not be advanced due to non clearance from forest department
- At present the mine is fully developed and has produced maximum of about 7.593 million tones of ROM ore during 2012-13
- Mining waste is generated from the mining is about 3.5-4% of total ROM produced & 11% in beneficiation process. Out of these, part of waste are used for back filling & road making and rest is staked separately in OB dump which will be stabilized and rehabilitated by plantation.
- The iron ore produced in this mine sector are being presently utilized for:
 - (i) Production of iron and steel in the integrated steel plants.
 - (ii) Iron ore is supplied to Jindal, steel
- For transportation of iron ore to the various concerning industries and for export from mining areas, both rail and road and ropeway transportation are being practiced.
- Air, water, noise & soil samples monitoring is being done through NABL accredited lab, for the dust suppression in and around the mines 5.1 km stretch of haul road has been facilitated with fixed water sprinklers. The frequency of sprinkling is once in 40 minutes.
- Extensive afforestation have been carried out both within and outside the mine lease area and about 2 lakh trees planted outside the leasehold area since the inception of the project. A specialized technique called “Miyawaki Plantation” has been adopted named after Prof. Akira Miyawaki, a Japanese Botanist & Expert in Plant Ecology and pioneered for plantation over dump and other degraded areas.

Recommendations

- Direct reduction process (DR) in Odisha iron ore have provided the best ground for such ventures and iron ore from Barbil Joda and Gandhamardhan areas of Keonjhar distt can be used for making acceptable sponge iron.
- The rejects from beneficiation plant are likely to contain Fe > 45 % hence a beneficiation study is required to be carried out to arrive at optimum recovery of mineral.

Regional Mineral Development Study (RMDS) of Jajang Iron and Manganese Ore mine of M/S Rungta Mines Limited (For the year 2013-14)

Jajang Iron and Manganese Ore Mine is located about 25 kms from Barbil, the nearest tehsil place and 12 Km. from Joda. Barbil is 289 kms. north of Bhubaneswar and is well connected by state highway. The lease block is located in Barbil Taluka, Keonjhar District. Jajang Iron and Manganese Ore Mine is having a lease area 666.150 Hect. The principal rocks met within the lease area are quartzitic sand stone, shales and cherty quartzites, both banded and un-banded. Sometimes colloidal quartzites contain bands of Hematite and are recognized as Banded Hematite Jasper (BHJ). The area comprises of mostly hilly terrain having general strike NNE-SSW and dip 30-40⁰ due East.

The lease area has been explored by 408 boreholes, covering a total of 14,218 meterage. Based on the Geological mapping most part of the area has been delineated to be mineralized zone. The present reserve under 111& 122 category is 91.751 million tones. Based on the current reserve data and average rate of production, the life of the mine will be around 17 years.

Jajang Iron and Manganese Ore Mine is a non captive mine. The mining operations are concentrated in two blocks i.e Block-B and Block-C. Present method of mine working is by opencast mechanised considering the geological set-up of deposit, surface topography, continuation of ore deposit, quality variation, geo-technical aspects and required rate of production etc.

Conclusion and Recommendation:

- In the mine about 27.83 million tonnes of in-situ BHQ material are present in the lease area which is the potential of future resources that requires details geological, feasible and economic study.
- The up-gradation of the low grade iron ore lying in huge quantity in the form of old dumps is core issue. While to processing the ROM only dry crushing and screening system has been adopted. To further improve the recovery of sub grade ore, it has been suggested that the wet beneficiation system of crushing, grinding and screening must be adopted at the earliest as proposed in the approved Scheme of Mining.
- It has been observed that the socio-economic condition of the local people is very poor. It is reported that on the basis of individual company level the social and community development work has been carried out from time to time like medical camp, training, education, transportation etc. As the tehsil- Barbil, Dist.- Keonjhar, Odisha state falls under the tribal belt, the ground reality does not highlight the work of sustainable development to fulfill the need of the local people. Therefore, it is suggested that a joint venture fund including the entire lease holder may be formed and supervised by district level committee towards strengthening the sustainable development of the region.
- The Barbil tehsil of Keonjhar district is the core area of iron ore mines, and there are 20-25 mechanized mines in the surrounding in close proximity. It has been observed that the road serving the transportation of ore is heavily affecting from traffic density, jamming with dumper and loaders and is accident prone. The air pollution and concentration of dust is high along the road side. Therefore it is advised that railway siding to transport the ore by railway must be compulsory for the mine producing more than 5 MT ore annually to avoid

such situation. The meter gauge line passing to the close proximity of region which will be beneficial to the mine owners as well as society and environmental point of view.

Regional Mineral Development Study (RMDS) of Balda Iron Ore Mine M/S Serajuddin & Company Ltd. (for the year 2013-14)

The Balda Iron Ore Mine (335.594Ha) of M/s Serajuddin & Company Ltd is located about 32 kms from Barbil, the nearest tehsil is about 12 Km. from Joda. Barbil is 289 kms. north of Bhubaneswar and is well connected by state highway. The lease block is located in Barbil Taluka, Keonjhar District. The main Iron and Manganese ore deposits of the State are found along the classic Bonai-Keonjhar horse-shoe shaped Iron Ore Synclorium.

The lease area has been explored by 150 boreholes, covering a total 10,633 meterage drilling. The minimum depth is 12m and maximum 152 m. Based on the Geological mapping most part of the area has been delineated to be mineralized zone. It is envisaged to concentrate the additional exploration activities in the mine by drilling proposed 41 nos. of boreholes to be drilled during year 2012-13. However, the proposed drilling programme could not be achieved because it falls under DLC forest area and non-clearance from Forest department.

Balda Iron Ore Mine is a non-captive mine and fully mechanized. The mining operations are concentrated in three blocks i.e Block-1, Block-2 and Block-4. Present method of mine working is by opencast mechanised means.

Conclusions

- The iron ore reserves available in Odisha have been estimated as 3083 million tonnes. The investigations carried out in the recent years by GSI, State Directorate of Mining & Geology OMC, SAIL, TISCO & other agencies indicate that the reserves would be higher even after taking into account the depletion during last 20 to 25 years. In the last decade, two important developments in the nature of demands of iron ore with far reaching importance on the exploration strategies in the ore mining industry took place in Odisha sector.
- The total utilization of iron ores of appropriate quality irrespective of whether they are in the form of lump or fines. The development of agglomeration techniques of sintering led not only to the use of fines but led to finally using increasing fines as raw material feed for overall enhanced productivity in the steel plants. This has ultimately led to the utilization of old fines whose stocks are depleting fast in different mines if they are within the chemical specifications.
- The lease area is 335.59 hec. of which 73% area is explored by drilling and having 7-8 big pits. The remaining 27% (92 hec.) area is unexplored.
- There was a proposal to explore area further by drilling 41 boreholes during 2012-2013, However the proposed exploration programme could not be carried out because of non-clearance from the forest department.
- Iron ore mines in Odisha state have to go for adopting a system of total mining i.e. lump fines/friable and blue dust. The exploration of iron ore has been oriented not only to aim at establishing the overall reserves qualitative characteristics, distributions pattern of ore etc. but also to establish the quantitative proportions in the desired size range and their qualitative characteristics in such size range which would import in obtaining accurate knowledge of the ore

body broken into small blocks showing the valuation patterns of physical & chemical characteristics of the ore deposit.

- At present, the voids due to mining are not feasible to fill back with overburden (OB) which is mostly laterite waste rock which has been dumped with low height in a systematic manner on non-mineralized space.
- The iron ore produced in the odisha sector are being presently utilized for:
 - A) Production of iron and steel in the integrated steel plants.
 - B) Iron ore is supplied to Sunflag Jindal, Hindusthan Electro Graphite plants export iron ore through MMTC from Paradeep Port.
- Fines are used in Sintex plants steel mills for sweetening purpose.
- For transportation of iron ore to the various concerning industries and for export from mining areas of Odisha sector, both rail and road transportation are being practiced

Recommendations

- The upgradation of the low grade iron ore lying in huge quantity in the form of old dumps is core issue. While to processing the ROM only dry crushing and screening system has been adopted. To further improve the recovery of sub grade ore, it has been suggested that the wet beneficiation system of crushing, grinding and screening must be adopted.
- The Barbil tehsil of Keonjhar district is the core area of iron ore mines, and there are 20-25 mechanized mines in the surrounding in close proximity. It has been observed that the road serving the transportation of ore is heavily affecting from traffic density, jamming with dumper and loaders and is accident prone. The air pollution and concentration of dust is high along the road side. Therefore it is advised that railway siding to transport the ore by railway must be compulsory for the mine producing more than 5 million tonnes ore annually to avoid the situation. The meter gauge line passing to the close proximity of region which will be beneficial to the mine owners as well as society and environmental point of view.
- It has been observed that the socio-economic condition of the local people is very poor. It is reported that the on the basis of individual company level the social and community development work has been carried out time to time like medical camp, training , education, transportation etc. As the tehsil- Barbil, Dist.- Keonjhar, Odisha state falls under the tribal belt, the ground reality does not highlight the work of sustainable development to fulfill the need of the local people. Therefore it is suggested that a joint venture fund including the entire lease holder may be formed and supervised by district level committee towards strengthening the sustainable development of the region.

Regional Mineral Development Study (RMDS) of Gumgaon Manganese Mine of M/s MOIL Ltd. & Kirnapur Mn mine of M/s Veet Rag Homes Pvt. Ltd. (for the year 2014-15)

The study area under this RMDS includes mining leases of Gumgaon Manganese Ore Mine of M/s Manganese Ore India Ltd. & Kiranapur Manganese Ore Mine of M/s Veet Rag Homes Pvt. Ltd located 35-45 kms NW of Nagpur near Khapa, taluka Saoner, district Nagpur, in Maharashtra.

The Gumgaon manganese mines comprise three contiguous mining leases over an area of 48.60 ha, 1.33Ha. & 35.97Ha. working through common underground mine. The Kirnapur manganese mine is opencast mine spread over an area of 23.67 hectares,

Total world reserve of manganese ore is approx. 630 million tonnes of metal content. Reserves of manganese are located in South Africa (24%), Ukrain (22%), Brazil (17%) Australia (15%) & India (9%).

The total resources of manganese ore in the country as on 1.4.2010 are placed as 430 million tones as per UNFC system. Out of these, 142 million tones are categorized as reserves and balance 288 million tones are in resource category. State wise Odisha tops the total resources with 44 % share followed by Karnataka 22%, Madhya Pradesh 13% Maharashtra 8%, Andhra Pradesh 4% & Jharkhand & Goa 3%. In Maharashtra manganese is produced mostly from the districts Nagpur & Bhandara.

Conclusions :

- The manganese ore is associated with mica schist in hang wall side and feldspathic/pink quartzite at the footwall side. The strike of the formation is almost east-west with southerly dips varying from 45° to 55° in Gumgaon mine with thickness variation of 6 to 40 m. In Kirnapur mine, country rock is mica schist of Mansar formation and Quartzites of Chourbaoli stage. The ore body having thickness 2-4m, and the host rock have similar strike N 75° E and S 75° W, dip varies from 45° to 60° towards South and plunge towards west.
- About 40m thick manganese ore band intersected during core drilling in P.L. area of M/S Manganese Ore India Ltd. (MOIL Ltd) beyond 300m depth from the surface, indicates the existence of deep seated ore body in the area. The area in the up dip side is highly promising for opencast mining and it is assumed that huge quantity of resources after exploration may be added to nation's inventory.
- Structurally the area has passed through various phases of deformation resulting into displacement of ore body along dip and strike direction in both the mines. Ongoing exploration in Gumgaon mine in deeper section will confirm the geometry of ore body.
- In Gumgaon mine exploration has established the presence of mineralization up to 320m depth from the surface and in Kirnapur mine 90m depth from the surface. The mineralization further continues at depth in both mines and its continuity needs to be established.

- Total resources in Gumgaon Mine, as per UNFC has been estimated as 4219464 T includes proved, probable and inferred mineral reserve whereas mineable reserves estimated as 2626474T & in case of Kirnapur mine, proved and probable reserves have been estimated as 95170T & 68270T respectively with the intersection of mineralization at deeper level during recent exploration the total resources will increase considerably.
- Gumgaon Manganese mine, mining by underground method is being practiced by using over hand flat back, cut & fill method with sand stowing. About 20% production is reported from dump mining from BD1 & BD2. In Kirnapur mine mining is worked by opencast mechanized method.
- The cost of production for Gumgaon underground mine for the year 2013-14 is Rs.3956.12/- per tonne & for Kirnapur opencast mine it was Rs 1850/tonne .
- In Gungaoon mine ROM produce from the underground mine hoisted to surface by shaft which is sent to crushing & screening plant for up gradation of R.O.M. Only sizing separation is being done on crusher where as quality sorting done by manually. +25% Mn is saleable and +10% Mn to 25% Mn is reject which is non saleable and is stacked separately for future use. In Kirnapur mine sorting and sizing is done manually and mechanically.
- As Gumgaon mine is being worked by underground method, the air pollution is restricted to bare minimum. Plantation of 44.98 hect. of land has been done in Gumgao mine & 2500sqm area has been covered by plantation in Kirnapur Mn mine to provide eco friendly environment. All protective measures are being taken to control the air pollution, water pollution, dust pollution in both the mines. There is no adverse impact on environment due to mining in both the mines. The benches developed in the Kirnapur mine are unsystematic which needs to be systematized for scientific development of mine.
- Huge quantity of resources is already established in Gumgaon mine and ongoing exploration has also proved the mineralization at deeper level. Hence at present, there is no possibility of closure plan and issue of retrenchment of employees, rather with present status locals will be benefited through fresh employment. In immediate future the closure of Kirnapur mine is not anticipated.
- Exploration on west side of mine intersected at depth good ore body of 30m to 40m width, having good quality ore. The existing underground mine may be continued further in the west for winning of ore. After completion of exploration huge reserves of manganese will be established and this mine will be lead in production among the other mines of MOIL. The Kirnapur mine is concerned, though there is sufficient area available for stacking the waste and other infrastructure purpose, systematic development of mine is required to be taken up to sustain the future development of the mine.

Recommendations:-

- Considering the regional setup of the area, established existence of mineralization by drilling in the study area, and structure of the area, the area between Gumgaon mine in the east up to Kirnapur mine is recommended for detailed exploration by Government

Agencies like Geological Survey of India, Mineral Exploration Corporation Ltd. or State Government of Maharashtra as per the provisions of MMDR-Bill 2015. The area may also be granted under prospecting license cum mining lease.

- Ore body in the P.L area has been established beyond 300m depth i.e. deeper level. The present exploration is confined to deeper level only. In view of confirmation of outcrop/ incrop of the ore body at shallow level, it is recommended that suitable strategy may be chalked out for proving the ore body at upper level by exploration on priority by M/S MOIL Ltd.
- The ore body in Kirnapur mine needs to establish beyond 90m depth for systematic development and scientific mining. It is recommended that depth continuity may be established by exploration on priority by M/S Veet Rag Homes Pvt.Ltd.

Regional Mineral Development Study (RMDS) of Beldongri & Satuk Manganese Mine of M/s MOIL Ltd. (for the year 2014-15)

The study area under this RMDS includes mining leases of Beldongri & Satuk Manganese Ore Mine of M/s MOIL Ltd., located 38kms NNE of Nagpur, taluka Parseoni, district Nagpur, in Maharashtra.

The Beldongri Manganese mines comprises of two leases namely Beldongri-I & Beldongri-II over an area of 26.6604Ha & 12.99Ha respectively. Presently the Beldongri mines is being worked by underground method, whereas, the Satuk manganese mine is opencast mine spread over an area of 8.684Ha. (Old Satuk) & 16.84 Ha.(New Satuk) respectively,

Total world reserve of manganese ore is approx. 630 million tonnes of metal content. Reserves of manganese are located in South Africa (24%), Ukrain (22%), Brazil (17%) Australia (15%) & India (9%).

The total resources of manganese ore in the country as on 1.4.2010 are placed as 430 million tones as per UNFC system. Out of these, 142 million tones are categorized as reserves and balance 288 million tones are in resource category. State wise Odisha tops the total resources with 44 % share followed by Karnataka 22%, Madhya Pradesh 13% Maharashtra 8%, Andhra Pradesh 4% & Jharkhand & Goa 3%. In Maharashtra manganese is produced mostly from the districts Nagpur & Bhandara.

Conclusion:

The present RMDS covered three manganese mines namely Beldongri, Satuk (old) and Satuk(New) all belonging to M/S MOIL Ltd.

The Manganese ore deposits are associated within the rocks of Sausar Series of Pre-Cambrian age. The mineralization is restricted within Mica Schists on hang wall side of Mansar Stage and Quartzite on foot wall side of Chorbaoli stage. The area has passed through various phases of deformation resulting into folding and faulting of strata. Due to thick mantle of soil cover in the area the regional structure largely remains vague. The regional strike of the litho-units in the area varies between EW to WNW-ESE with general dips towards south. The Manganese ore deposits in the area consists of both syngentially formed primary Braunitic and Gonditic ores and Supergens oxidized ores.

The mineralization is restricted to shallow synclinal basins. The ore zone is lenticular in shape, thick at the centre and pinches out at both the ends. Braunite is the principle ore mineral associated alongwith haussmanite, jacobsite psilomelane, rhodonite etc. Gondite is present at the contact zone. Spessartite occurs within the Gondite.

Beldongri mines have been explored by drilling 15 bore holes, Old Satuk by 2 boreholes and New Satuk has been explored by drilling 9 boreholes. The exploration carryout so far is inadequate for delineation of obeboddy at depth.

Mining in Beldongri is being done by U/G method where as in Satuk, mining is by opencast. The Manganese Ore produced from the mines is used after blending with different grades of ores. The Ore is mainly consumed in Steel Making & Ferro Alloy Plants.

No mechanical process of beneficiation is involved at mine site. Manual hand sorting and grading is done. High grade Mn ore blended with low grade.

Considering the scale of production, land degradation in Satak mines is minimal and in Beldondri mine, mining is by underground method , hence no land degradation , but being underground mine the only cause for concern is underground water.

Recommendations:

The ore body is structurally complex and not established fully, hence it is recommended that exploration strategy may be evolved by M/S MOIL Ltd. on priority for deciphering the exact geometry of mineralization below 148 mRL.

In Old Satuk mines, additional exploration may be proposed in the hang wall side and based upon the out come of this exploration land acquisition may be taken up.

In New Satuk mine, in the interest of conservation of mineral, extensive dewatering may be taken up and ore may be mined up to ultimate depth by advancing of the necessary benches.

Based on the available subsurface data, complexity of structure, the continuity of orebody outside the lease area can not be ruled out. Hence it is recommended that the area outside the lease may be granted under auction under P.L.cum M.L. route as per the provisions of MMDR Bill-2015.

Regional Mineral Development Study (RMDS) for the year 2014-15 of three Manganese mines namely:-

- (i) Kandri Manganese Mine of M/s MOIL Ltd.
- (ii) Munsar Manganese Mine. of M/s MOIL Ltd.
- (iii) Bhandarbodi Manganese Mine of M/s D.P.Rai.

Kandri Manganese Mine (83.065 Hect. of M/s MOIL Ltd.), Munsar Manganese Mines (108.630 Hect.) of M/s MOIL Ltd. and, Bhandarbodi Manganese Mine (7.380 hect.) of M/s D.P.Rai. are located about 42 to 65 kms NE of Nagpur, near Ramtek Tehsil of Maharashtra. The study area lies in Sausar belt of Pre-cambrian era. The manganese ore is associated with metamorphosed manganeseiferous sediments of Sausar Series. In hangawall side of ore body, in general there is quartz–mica schist and in footwall side there is muscovite sillimanite schist.

In Munsar mine, the strike of the formation is almost NW-SE with NE dips varying from 70° to 85° . In Munsar mine the deposit has been explored with 104 boreholes for establishing strike and dip direction. The thickness of ore varies from of 2 to 20 m. During the scheme period 2012-13 & 2013-14, 18 numbers of bore holes have been drilled.

In Kandri mine, because of tectonic activities, the ore zone has become S shaped (north and south limb). The ore zone plunges SE with angle of $25-45^{\circ}$. All the limbs dip with almost 65 to 70 degree. The existence of mineralization along the strike and dip direction has been established by drilling 73 numbers of bore holes within the lease area. The thickness of ore body varies from 10-35m. During the scheme period 2012-13 and 2013-14, 13 number of boreholes have been drilled. Structurally the area has passed through various phases of deformation resulting into displacement of ore body along dip and strike direction in both the mines. About 35m thick manganese ore band intersected during core drilling in Kandri area of M/s MOIL Ltd. beyond 420m from the surface, indicates the existence of deep seated ore body in the area.

In Bhandarbodi mine, strike of ore body is NE-SW with dip $42-44$ degree towards SE. The thickness of ore body is about 2.5m a total 05 numbers bore holes were suggested for the year 2013-14 in the scheme of mining. But the proposed exploration programme could not be achieved by the lessee.

The total Mineral Resources estimated are 5226325 tonnes in Kandari, 4266981 tonnes in Munsar and in Bhandarbodi 34826 tonnes.

Conclusion

- In Kandri and Munsar mines exploration has established the presence of mineralization up to 420m and 365m depth respectively from the surface and in Bhandarbodi mine, about 17m depth (as per the scheme of mining in case of Bhandarbodi mine) from the surface. The mineralization further continues at depth in all the mines and its continuity needs to be established.
- In Kandri and Munsar Mn mines, mining by underground method are being practiced by using over hand flat back, cut & fill method with sand stowing, whereas in Bhandarbodi mine, mining is by opencast manual method.
- In Kandri and Munsar mines, ROM produced from the underground mine hoisted to surface by shaft which is sent to crushing & screening plant for up gradation of ROM. Only sizing separation is being done on crusher, whereas quality sorting done manually. In Bhandarbodi mine, sorting and sizing is done manually.

- As Kandri and Munsar mines are being worked by underground method, the air pollution is restricted to bare minimum. All protective measures are being taken to control the air pollution, water pollution, dust pollution in both the mines. There is no adverse impact on environment due to mining in both the mines. But in Bandarbodi mine though the proposal is given for environment monitoring in scheme of mining, but the same is not being followed.
- Huge quantity of resources is already established in Kandri and Munuar mine and ongoing exploration has also proved the mineralization at deeper level. Hence, at present, there is no possibility of closure plan and issue of retrenchment of employees, rather with present status locals will be benefited through fresh employment.

Recommendation:-

- considering the regional setup of the area, established existence of mineralization by drilling in the study area and structure of the area, the area between Kandri and Munsar is recommended for detailed exploration by Government agencies like GSI, MECL or State Government of Maharashtra as per the provisions of MMDR-Bill 2015. The area may also be granted under prospecting license cum mining lease.
- The present RMDS has recommended the immediate need for a systematic evaluation and mine planning of Manganese ore deposits particularly within the private leaseholds, (Bhandarbodi manganese mine).

Regional Mineral Development Study (RMDS) of Chikla & Dongri Buzurg Manganese Mines, Distt. Bhandara, Maharashtra, of M/s MOIL Ltd. (For the year 2014-15)

The Chikla & DongriBuzurg Manganese Mines are located about 108 & 121 kms respectively by road from Nagpur .The mine can also be approached by rail from Nagpur upto Tumsar Road Railway Station (B.G.) on Nagpur-Hawrah line of South Eastern Railway and then upto Dongari Buzurg Railway Station (B.G.) on the branch line of Tumsar Road – Tirodi of South Eastern Railway. The rail distance from Nagpur to DongriBuzurgis 107 kms.

Chikla Manganese Ore Mine is having an area of 150.646Ha & DongriBuzurg Manganese Mine is comprises of four leases having contiguous boundaries with total area of 174.80Ha. These are located at i) BalapurHamsha - 46.25 Ha ii) DongriBuzurg - 53.98 Ha iii) DongriBuzurg, Kurmuda -70.50 Ha. & iv) BalapurHamsha - 4.07 Ha.

M/S MOIL Ltd drilled 55 boreholes aggregating total meterage of 6859.64 m. GSI in the year 1977-78 drilled 21 boreholes aggregating total meterage of 2855.35 m covering part of the lease area. Recently in the year 2006-07, MECL did exploration by drilling 16 boreholes on contractual basis for M/S MOIL Ltd. The exploration has revealed the presence of ore body up to 320 m from the surface.

In DongriBuzrug Manganese Mine for confirmation of subsurface behavior of ore body for its depth, thickness and quality variation, M/S MOIL Ltd since 1954-55 drilled 27 boreholes aggregating total meterage of 4369.76m. GSI in the year 1977-78 drilled 14 boreholes aggregating total meterage of 1823.20 m. Recently in the year 2006-07, MECL did exploration by drilling 13 boreholes on contractual basis for M/S MOIL Ltd. The exploration has revealed the presence of ore body up to 420 m from the surface.

The reserves/resources have been estimated considering 10% Mn content as threshold value. As on 01.04.2014, total resources in Chikla mine are 49,13,505tonnes, out of which 26,09,151 tonnes are reserves and 23,04,354 tonnes are resources. In DongriBuzurg Mine, total resources are 1,09,81,273tonnes out of which 48,27,695 tonnes are reserves and 61,53,578 tonnes are resources. The resources may increase with the systematic exploration.

The major exploitation in Chikla Mine is being carried out by underground method .using overhand cut & fill, followed by sand stowing. In DongriBuzurg Manganese

Mine, mining is being carried out by open cast method. The principal bed mining activities are limited to Lease I (46.25 Ha). The other Leases (53.98 Ha, 69.50 Ha and 4.07Ha) are in support of development and as ancillary to mining activities. This includes, dump mining, stacking of waste, beneficiation of ore & Electrolytic Manganese Dioxide plant etc.

Conclusion

The rock types exposed in the area belongs to Tirodi, Sitasawangi and Munsar formation of Sausar series of Pre-cambrian Age. The manganese ore occurs at the contact of upper Sitasawangi and lower Munsar formation. The area is also traversed with younger intrusive consisting of quartz veins and pegmatite's, granite and granitic gneisses.

In Chikla Mine the strike of the formation is almost east-west with southerly dips varying from 60° to 85° . The thickness of ore body varies from 5 to 30 m. and Mn contents ranges from 10% to 46%.. The Ore body is repeatedly folded with tightly isoclinal nature with plunging 20° - 25° towards east.

In DongriBuzrug Mine, the general trend of the rocks is roughly east-west, but at the western end there is gradual swing to WSW with southerly moderate to steep dips varying from 50° to 70° . The thickness of ore body is maximum 36 m in the central part of the lease and thins out at both the ends to about 6.0 m. with Mn contents ranges from 10% to 46%. The thickening of ore body in the central part of the mine may be due to internal folding or a depositional feature.

Exploration has established the presence of mineralization upto 320m and 420m depth from the surface in Chikla and DongriBuzrug mines respectively. The mineralization further continues at depth in both mines and its continuity needs to be established.

Total resources in Chikla Mine, as per UNFC are 49,13,505 tones and in DongriBuzrug mines are 10,98,1273 tones. With the intersection of mineralization at deeper level during recent exploration the total resources will increase considerably.

All protective measures are being taken to control the air pollution, water pollution, dust pollution in both the mines and there is no adverse impact on environment due to mining. Sufficient quantity of resources is already established in both the mines. In addition, ongoing exploration has also proved the mineralization at deeper level.

The MOIL Ltd. do not envisaged any change in present working system, afforestation system, to preserve top soil degradation, stabilize and reclamation of old dump will continue till the life of mines. Therefore, this mine has sufficient capacity to sustain production without harming the regional environment. Still the study revealed that both mines having more potential to employment generation for region. Plantation and other infrastructures are well developed by the company which will be benefitted to this region.

Recommendation:-

1. The established ore body in the Chikla main and Chikla 'B' section continues further along west direction beyond the lease area up to Bawanthari River over a distance of five kms. Exploration details, established structure of the area, past and present mining history revealed the probability of presence of manganese ore mineralization up to Bawanthari river outside the lease area. The area in the west direction falls under freehold category. It is recommended that this area may be taken up on priority for exploration by Government agencies like GSI, MECL or State Government of Maharashtra as per the provisions of MMDR-Bill 2015. The area may also be granted under prospecting license cum mining lease.
2. The ore body of Chikla "A" section continue beyond lease area in southerly dip direction , which has been established through exploration by GSI. Part of the area falls in the lease and part outside the lease. The area falling outside the lease area is recommended for detail exploration by Government agencies and brings the deposit under 111 category of UNFC. It is also recommended that, as per the provisions of MMDR Bill 2015, area may be granted through auction under prospecting cum mining lease .
3. In ore body established in Dongri-Buzurg mine continue along the strike in the east direction beyond the lease towards DongriBuzurg Railway Station. Reduction of thickness is reported along both the ends of ore body. This continuity needs to be established by detail exploration either by Geological Survey of India /Mineral Exploration Corporation Ltd/ Directorate of Geology and Mining, Government of Maharashtra. It is also proposed that the area may also be granted through auction under prospecting cum mining lease.

4. Regionally entire area is structurally highly complex which has disturbed the original trend of mineralization and resulted discontinuity of mineralization between these two mines. The possibility of displacement of original trend of ore body due to structural disturbances cannot be ruled out. It is recommended that the area between these two mines may be explored by drilling for confirmation of mineralization.

5. The above proposal may be discussed in State Geological Programming Board (SGPB)/Central Geological Programming Board (CGPB) meets and to know the true potential of the deposit detail exploration strategy may be chalked out on priority. This will result into augmenting the resource/reserve base of the country and in term generation of additional revenue by the State Government by auctioning the deposit.