# NMDC LIMITED

# PRE FEASIBILITY REPORT

# FOR OBTAINING PRIOR

# ENVIRONMENTAL CLEARANCE FOR

# CONSTRUCTION OF SCREENING PLANT - II

# AT DONIMALAI, KARNATAKA

# IN TERMS OF THE PROVISIONS OF EIA

# NOTIFICATION,2006

June, 2013

## CONTENTS

# 1. Executive Summary

## 1.1 General

NMDC Limited is a Public Sector Company under the Ministry of Steel, Government of India. Primarily engaged in the business of exploring minerals and developing mines to produce raw materials for the industry, it is also expanding its activities towards steel making and other value added products. It has been conferred "NAVARATHNA" status by Government of India. Incorporated in 1958, NMDC has been actively contributing to the development of the nation for five decades and grown from, strength to strength during its journey.

NMDC is India's single largest iron ore producer and exporter, presently producing about 27 million tons of iron ore per annum from 3 fully mechanised mines viz., Bailadila Deposit – 14/11C, Bailadila Deposit – 5, 10/11A (*Chhattisgarh State*) and Donimalai Iron Ore Mines (*Karnataka State*) which are awarded ISO 9001-2000 certification.

NMDC Limited is presently engaged in iron ore mining at Donimalai with a production capacity of about 7 million tons per annum. Donimalai is left with little above 24 million tons reserve of hematite ore. Adjacent to Donimalai deposit, i.e., Kumaraswamy Mines has a reserve of about 130 million tons of hematite ore. Construction of Kumaraswamy Mine facilities for processing 7 MTPA of ROM is already on and expected to be commissioned by end of 2013. The combined production of both the mines is proposed to be about 10 MTPA.

## 1.2 Plant Capacity

Existing Screening Plant of Donimalai was originally constructed to process 4 MTPA of ore and subsequently many equipment were added and one more screening line was installed to process up to about 7 MTPA. Existing Screening Plant cannot process iron ore beyond 7 MTPA. Moreover, the existing Screening Plant has outlived its life, resulting in frequent break-downs which lead to considerable loss in the availability of equipment and hence production. To sustain production without interruption due to frequent breakdown of the existing screening plant, it is proposed to set-up a Screening Plant-II, which can handle/treat ore from either Kumaraswamy mine or Donimalai mine or both the mines. Hence, it is prudent to construct a new Screening Plant of installed capacity for processing ore up to 7 MTPA with a provision for handling additional 3 MTPA in future.

## 1.3 Proposed Scheme

Overall plant layout of the proposed scheme is shown in Plate No. 3 and description of the proposed screening plant (*Refer Plate No. 4.1 & 4.2*) is as follows:

### 1.3.1 Screening & Crushing

- The Run of Mine (ROM)[*(-) 100mm*] of Kumaraswamy mines or Donimalai mines or both the mines is stored in silos of about 4000 tons (*each*) storage capacity. The ore is extracted through apron feeders and fed to double deck primary screens (*with 30mm & 20mm apertures*) through belt conveyor.

- The oversize material of primary screens is fed to tertiary crusher to crush (-) 100mm ROM to (-) 30mm. The middle fraction and the under size material of primary screen are fed to Calibrated Lump Ore (CLO) conveyor and secondary screens respectively.

- The crushed ore of tertiary crusher is fed to double deck tertiary screen (*with 30mm and 6mm apertures*), wherein the oversize material (*+ 30mm*) is re-circulated to tertiary crusher. The middle fraction of tertiary screen (-) 30 (+) 6mm and under size fraction (*- 6mm*) of tertiary screen are fed to CLO product conveyor and fines product conveyor respectively.

- Under size of secondary screen is fed to classifier of wet circuit system. Suitable gate arrangement is envisaged at the bottom of under size chute of secondary screen, which diverts material to launder leading to classifier circuit when operating on wet mode. Under dry mode the gate will be lifted / opened to divert the material to fines conveyor.

- Conveyor receiving middle fraction [*(-) 10 mm (+) 6 mm*] of secondary screen is envisaged with reversible operation to feed the material either to fines conveyor or CLO conveyor based on the requirement.

### 1.3.2 Wet Circuit

Classifier overflow is fed to dewatering screen and the underflow to hydro-cyclones. The overflow of dewatering screen is fed to fines conveyor and the underflow is fed to cyclones. The cyclones (*with separation size of 150 microns*) overflow is diverted to thickener and the underflow to filtrate unit to recover some fines, which in turn is fed to fines conveyor.

## 1.4 Technological Facilities

The new screening plant shall have the following major facilities

- Feeder to receive ore from Kumaraswamy downhill conveyor
- Tripper conveyor
- Storage silos
- Apron feeders
- Belt conveyors
- Double deck primary screens
- Double deck secondary screens

- Tertiary crushers
- Double deck tertiary screens
- Spiral classifiers
- Dewatering screens
- Hydro-cyclones
- Horizontal Belt Filters (HBF)
- Tailing thickeners
- Tailing disposal system
- Tailing dam
- Water storage tanks
- Water reclamation and distribution
- Suitable material handling facilities (*such as EOT cranes, hoists, etc.*)
- Dust control systems

## 1.5 Land

The proposed Screening Plant – II (including for future beneficiation facilities) is planned to be set up towards southern side of the existing Screening Plant on the hillock between existing fine ore belt conveyor number BC 411 and existing lump ore conveyor number BC 501. The location of the proposed facility considered is in between N78200 & N78600 and E81600 & E82000 and in the outside lease area. Tailing thickener facility is considered on eastern side of the proposed screening plant near the co-ordinate N78500 & E81800. About 13.0 Ha of land is required for construction of screening plant.

## 1.6 Water

The source of water for the Project is from Water Treatment Plant (WTP) at Donimalai base camp located about 1km from the proposed plant site. Water from this WTP is pumped to storage tank of about 5000 $m^3$ located adjacent to the plant site. From this point water is brought to Screening Plant by gravity and then distributed to different equipment. Make up water requirement for processing 7 MTPA ore is estimated at about 370 $m^3$/hr (2451 $m^3$/hr is required for operation, out of which make-up water is 370 $m^3$/hr).

## 1.7 Power

The incoming power supply for the proposed Screening Plant- II is planned to be tapped from existing Valley sub-station through over head line (11kV)/ underground HT cable (11kV), which is about 2 km distance.

Estimated power requirement of the proposed plant is as follows:

| | | |
|---|---|---|
| Maximum Demand (Crushing & Screening) | : | 1.5 MVA (Mega Volt Amperes) |
| Annual Energy Consumption | : | 7.2 MU (Million Units) |

## 1.8 Man-power Plan

The overall manpower requirement has been estimated at 10 executives and 71 non-executives. Apart from operation and running maintenance (*mechanical and electrical*), the proposed manpower also caters to preventive maintenance and shut down operations.

## 1.9 Capital Outlay

The capital outlay estimated for the scheme is about Rs. 399.75 crores. The capital cost includes for Mechanical equipment & works of Rs. 148.32 crores (*including all taxes & duties and E&C*), Civil & Structural works of Rs. 108.53 crores, Tailing Dam works of Rs.51.81 crores and Electrical & Control works of Rs. 25.02 crores. Other costs considered in the outlay are design, engineering, consultancy services administration during construction (*@ 5% on the Project basic cost*), contingencies *(@ 5% on the Project basic cost*) and Turnkey Package Concept, overheads and contractor's profit margin (*@ 15% on Project basic cost*).

| Sl. No. | Description | Approx. Basic Cost Estimate (Excludes Spares, E&C, Taxes & Duties) (Rs. In Cr) | Approx. Cost Estimate including all taxes, duties and E & C (Rs. In Cr) |
|---|---|---|---|
| I | Mechanical Equipment & Works | 94.12* | 148.32** |
| II | Electrical & Controls | 17.85 | 25.02 |
| III | Civil & Structural Works | 103.10 | 108.53 |
| IV | Tailing Dam | 49.22 | 51.81 |
| **V** | **Sub-total (A)** | **264.29** | **333.68** |
| VI | Design, Engineering, Consultancy services and administration during construction (@ 5% on Project Basic Cost) | 13.21 | |
| VII | Contingency (@ 5% on Project Basic Cost) | 13.21 | |
| VIII | Turnkey Package Concept, overheads and contractor's profit margin including local conditions prevailing in the region (@ 15% on Project Basic Cost) | 39.64 | |
| **IX** | **Total (V + VI + VII + VIII)** | **-** | **399.75** |

* *Comprises FC component of Rs. 23.89 Cr and Rs. 70.23 Cr for indigenous items.*

** *Comprises FC component of Rs. 43.67 Cr (for supply of equipment, spares and supervision charges during E &C) and Rs. 104.65 Cr for indigenous items.*

## 1.10 Production Cost Analysis

Because of the additional capital investment for construction of the proposed Screening Plant – II for processing ROM from Kumaraswamy Mine, there will be hike in the cost of production as furnished below:

| | |
|---|---|
| Capital outlay | : Rs. 399.75 crores. |
| Depreciation | : Rs. 22.21 crores per year. |
| Cost involved due to additional manpower | : Rs. 8.10 crores per year |
| Therefore, increase in cost of production | = (22.21+8.10) / 0.7<br>= Rs. 43.3 per MT at 100% capacity utilisation. |

The increase in cost of production is primarily due to considering *'Screening Plant'* on standalone unit. However, it is an essential unit required for getting the final product.

## 1.11 Project Implementation Plan

1.11.1 An EPCM Consultant shall be appointed for Engineering, Procurement, Project Management, Construction Supervision and Inspection Services, who will be responsible for executing the Project through the Lump Sum Turnkey (LSTK) contractor(s).

1.11.2 The total project is proposed to be executed largely on LSTK basis and includes the following:

i) Site levelling
ii) All the facilities including tertiary crushing and screening – Dry circuit
iii) Wet circuit including process water system
iv) Tapping the power from existing 33/11 kV Substation and the power distribution facilities at plant site
v) Auxiliary facilities including construction of office building, Stores, Internal roads, etc.

However, the above packaging philosophy shall be reviewed after engagement of EPCM consultant.

**1.11.3 Statutory clearances:** Following clearances are required for establishment of this Project:

(i) Clearance from MOEF for diversion of forest land for construction of Screening Plant, Tailing Dam and Beneficiation Plant (*at later stage*).
(ii) Environmental clearance for the Project.

(iii) Consent for establishment from Karnataka State Pollution Control Board (KSPCB).

Of the above, Forest clearance for diversion of forest land is most critical. Subsequent to receipt of this only other clearances can be obtained.

The time period required for commissioning of the screening plant including Performance Guarantee (PG) test of 3 months is 27 months from the date of receipt of the last statutory clearance, assuming that the LSTK contractors are in place by that time. Refer Plate No. 16 for the time schedule for implementation of the scheme.

**1.12 Advance actions:** Following actions are to be taken prior to Award of LSTK contracts.

- Clearances to be obtained from the statutory authorities for construction of Screening Plant, tailing dam, laying of overhead electric line and pipe line for slurry transport to tailing dam.
- Survey the plant site area
- Soil investigation to be done in the plant site area
- Enabling works i.e. construction water & construction power

**1.13 Recommendation**

Towards sustaining overall system efficiency and for processing of ores from both Donimalai Iron Ore Mines (DIOM) & Kumaraswamy Iron Ore Mines (KIOM), the installation of this Screening Plant is inevitable and hence recommended for immediate implementation.

## 2. Introduction of the project/ Background information

(i) Identification of project and project proponent. In case of mining project, a copy of mining lease/ letter of intent should be given.

NMDC has started production of iron ore from the Donimalai Iron Ore Mines from the year 1977. The mine is capable of operating at a capacity of 7 million tons per annum (MTPA). At present the ore is being treated in the existing Screening Plant of Donimalai. It is estimated that about 24 million tons of additional ore reserve is proved in Donimalai Mines. The other mine in the area with NMDC is Kumaraswamy Iron Ore Mine. Kumaraswamy Mine is estimated to have a reserve of about 130 million tons of hematite ore. Construction of Kumaraswamy Mine facilities for processing 7 MTPA of ROM is already on and expected to be commissioned by end of 2013.

Existing Screening Plant at Donimalai was originally designed to process 4 MTPA ore with a provision of 3 lines. Subsequently additional equipment and one more line were added to process 7 MTPA ore. Further enhancement of capacity of existing Screening Plant is not possible and therefore, a proposal for construction of new Screening Plant of capacity-10 MTPA was proposed.

(ii) Brief description of nature of the project.
Iron ore crushing, Screening and classification.

(iii) Need for the project and its importance to the country and or region.

The existing screening plant is operating since 1977, which is about 36 years old. Initially the screening plant was installed with 3 lines only to process 4 MTPA ROM but at later stage one more line (fourth line) was installed to treat ore up to 7 MTPA. Out of four (4) lines in the screening plant, any three lines would be in operation and one under maintenance. In order to handle the enhanced production, there is a requirement of additional screening lines. Considering plant layout, creation of additional screening line(s) in the existing screening plant is not feasible.

**Limitations / constrains of the existing Screening Plant for capacity expansion**

a) Congested due to addition of equipment subsequent to Plant construction.

b) Material jamming in many chutes due to inadequate height of fall of material between equipment.

c) Wet circuit needs augmentation.

d) Impossible to augment capacity more than 7 million tonnes per annum due to space constraints within the Plant and around it.

e) In the 'Technical Report on Production enhancement of Iron Ore Mines', Vol-1 (*Donimalai Iron Ore Mine*), submitted by Mecon in 2007, it is stated that - *"The Equipment of the Plant are worn out and the existing Screening Plant would have outlived its life till the commissioning and start of the production from Kumaraswamy Mine. Therefore, it is proposed to erect a new Screening Plant of matching capacity to commensurate with the production from Kumaraswamy and Donimalai Mines."*

Considering the above limitations / constrains of the existing Screening Plant for capacity expansion, it is proposed to construct a new Screening Plant consisting of 4 screening lines (*3 working & 1 standby*) with installed capacity for processing ore up to 7 MTPA. Provision of additional 2 lines is proposed for handling additional 3 MTPA for future requirement, in case the existing Screening Plant is considered for permanent closure and disposal.

(iv) Demand-Supply Gap.

The demand for steel in India is projected to grow in the years to come and this in turn would call for increased demand for iron ore. In this segment,M/s NMDC Limited (NMDC) is gearing up to meet the expected increase in demand by enhancing production capabilities of existing mines, by opening up new mines, by setting up new integrated steel plants and by expanding capacity of existing plants.

(v) Imports vs. Indigenous production.

NA

(vi) Export Possibility.

NA

(vii) Domestic / export Markets.

Prime customers of NMDC are the following:

1 Rashtriya Ispat Nigam Ltd., (VSP)
2 KIOCL Ltd.,
3 Essar Steels Ltd.,
4 JSW Steel Ltd.,
5 Ispat Industries Ltd.,
6 CG based Sponge Iron Units
7 Welspun Max Steel Ltd.,
8 Visveswaraya Iron & Steel Plant
9 Aparant Iron & Steel Co. Ltd.,
10 Tata Metalliks Ltd.,
11 Southern Iron & Steel Co. Ltd.,

12 MMTC Ltd.,
13 Vikram Sponge Iron Ltd.,

Iron Ore is also exported to Japan & South Korea on a smaller scale.

(viii) Employment Generation (Direct and Indirect) due to the project.

Direct employment is estimated at about 81 persons which includes Executives: 10 Nos. and Workmen/Non-executives : 71 Nos. and indirect employment is estimated at about 400 people.

The Executives would be placed during the construction of the project itself, as they have to get acquainted with the plant and equipment for efficient running of the concerned units.

Some of the construction personnel can progressively be absorbed with the tapering of the construction work, particularly in the maintenance and services areas of the plant. A certain portion of junior executives and supervisory staffs may have to be recruited during the construction stage itself as acquaintance with equipment erection will be very much beneficial for them in running the units later.

## 3. Project Description

(i) Type of project including interlinked and interdependent projects, if any.

The proposed Plant is interlinked with existing Donimalai Iron Ore Mine (DIOM), upcoming Kumaraswamy Iron Ore Mine (KIOM) and upcoming Donimalai Pellet plant.

(ii) Location (map showing general location, specific location, and project boundary & project site layout) with coordinates.

Donimalai iron ore deposits are covered in the Survey of India topo-sheet No. 57 A/12 between Lat. $15^0$ 02' 0" and $15^0$ 06'30" and Longitude $76^0$ 36' 0" and $76^0$ 38'30". The deposits are situated in Bellary district of Karnataka.

Donimalai deposits are situated on the southern half of the eastern range of hills flanking Sandur valley. Sandur valley, which is about 40 km long and about 4 – 5 km wide is surrounded by a long range of hills both on the eastern and western flanks, giving an elliptical shape to the valley with its long axis running NW and SE. The two ranges of hills close in towards the southern end and therefore the main opening of the valley is towards the north.

(iii) Details of alternate sites considered and the basis of selecting the proposed site, particularly the environmental considerations gone into should be highlighted.

The most suitable site for the proposed plant is near to existing loading plant, product conveyors (fines & lumps), KIOM downhill conveyor, Thickener and proposed Tailing pond.

(iv) Size or magnitude of operation.

The Plant will process Iron ore up to 7 MTPA with 3 operating lines and a standby line.

(v) Project description with process details (a schematic diagram/ flow chart showing the project layout, components of the project etc. should be given)

The ROM of Kumaraswamy mines or Donimalai mines or both the mines is stored in silos of about 4000 tons (each) storage capacity. The lump ore [(-) 100mm] is extracted through apron feeders and fed to double deck primary screens (with 30mm & 20mm apertures) through belt conveyor.

The oversize material of primary screens is fed to tertiary crusher to crush (-) 100mm ROM to (-) 30mm. The middle fraction and the under size material of primary screen are fed to CLO conveyor and secondary screens respectively.

The crushed ore of tertiary crusher is fed to double deck tertiary screen (with 30mm and 6mm apertures), wherein the oversize material (+ 30mm) is re-

circulated to tertiary crusher. The middle fraction of tertiary screen (-) 30 (+) 6mm and under size fraction (- 6mm) of tertiary screen are fed to CLO product conveyor and fines product conveyor respectively.

Under size of secondary screen is fed to classifier of wet circuit system. Suitable gate arrangement is envisaged at the bottom of under size chute of secondary screen, which diverts material to launder leading to classifier circuit when operating on wet mode. Under dry mode the gate will be lifted / opened to divert the material to fines conveyor.

Conveyor receiving middle fraction [(-) 10 mm (+) 6 mm] of secondary screen is envisaged with reversible operation to feed the material either to fines conveyor or CLO conveyor based on the requirement.

(vi) Raw material required along with estimated quantity, likely source, marketing area of final product/s, Mode of transport of raw Material and Finished Product.

Finished products fines & lumps are transferred through conveyors to loading plant and despatched through railway wagons using mechanised loading facilities.

(vii) Resource optimization/ recycling and reuse envisaged in the project, if any, should be briefly outlined.

About 85 % of process water is recovered from Tailing pond & thickener. About 4 to 5 % of slimes generated will be stored in tailing pond which will be later reclaimed for use at Pellet Plant as a raw material

(viii) Availability of water its source, Energy/ power requirement and source should be given.

Source of water is from water treatment Plant which gets water from nearby Narihalla dam.

(ix) Quantity of wastes to be generated (liquid and solid) and scheme for their Management/disposal.

About 4 to 5 % of slimes generated will be stored in tailing pond which will be later reclaimed for use at Pellet Plant as a raw material.

(x) Schematic representations of the feasibility drawing which give information of EIA purpose.

Proposed Screening plant facilities and tailing dam locations are shown in the drawing 3-2-148 in the feasibility report

## 4. Site Analysis

(i) Connectivity.

The Plant is located at 50 km from Bellary, district head quarters and 38 km from Hospet town. The area is connected by road as well rail to Bangalore & Hyderabad.

The Plant area is approachable by a fair-weathered metal road from Toranagallu town. Toranagallu is well served by the National Highway and Trunk rail/roads. The distances to important places are as follows:

- Donimalai to Bengaluru - 350 km
- Donimalai to Hyderabad - 460 km
- Donimalai to Toranagallu - 28 km

The nearest rail head is Toranagallu Railway Station, which is 28 km from the plant site. Chennai port is about 600 km by rail line from Ranjithpura railway station and is connected to western coast via Sanvardom by about 389 km.

(ii) Land Form, Land use and Land ownership.

Forest land

(iii) Topography (along with map).

Proposed Screening Plant facilities are shown in drawing no. 3-2-148 & 3-2-131

(iv) Existing land use pattern (agriculture, non-agriculture, forest, water bodies (including area under CRZ)), shortest distances from the periphery of the project to periphery of the forests, national park, wild life sanctuary, eco sensitive areas, water bodies (distance from the NFL of the river), CRZ. In case of notified industrial area, a copy of the Gazette notification should be given.

Forest Land

(v) Existing Infrastructure.

No facilities exist.

(vi) Soil classification

The rock formations of the region consist of phyllites (locally designated as shales), the well known Banded Hematite Jaspers and Quartzites (BHJ & BHQ) and quartzites and basic igneous rocks (green stones) which have been generally metamorphosed to the "Green Schist facies. According to Fermor, it is a folded synclinorium in which the apparently large number of hematite-quartzite bands is due to repetition by folding.

(vii) Climatic data from secondary sources.

The area receives an annual rainfall ranging from 600 mm to 800 mm. The predominant rainy season in this area is between July and October. Rain also occurs occasionally in the months of November and January due to northeast monsoon. The maximum temperature is around 400 C in summer while minimum temperature is around 150 C in winter, which occasionally goes to as low as 120 C.

(viii) Social Infrastructure available.

Well developed township/colony exists in Donimalai.

## 5. Planning Brief

(i) Planning Concept (type of industries, facilities, transportation etc) Town and Country Planning/Development authority Classification.

Only Iron Ore Process Plant is proposed

(ii) Population Projection

Roughly about 15000 populations exist.

(iii) Land use planning (breakup along with green belt etc).

NA

(iv) Assessment of Infrastructure Demand (Physical & Social).

NA

(v) Amenities/Facilities.

Well developed township/colony exists in Donimalai.

## 6. Proposed Infrastructure

(i) Industrial Area (Processing Area).

Total area required for Screening Plant & associated facilities is 39.32 Ha which includes – Screening Plant-II (13 Ha), Tailing Dam-I (16.2 Ha), Tailing dam-II (9.0 Ha), Pipe line-I (0.06 Ha), Pipe line-II (0.34 Ha) and OHE line (0.72 Ha)

(ii) Residential Area (Non Processing Area).

NA

(iii) Green Belt.

Afforestation measures shall be taken-up through developing barrier platforms all around the plant. To maintain ecological balance in the area, plantations of suitable species of ever green/locally grown trees shall be made. Adequate tree plantations shall substantially abate dust pollution, filter the polluted air and ameliorate the plant environment without any hazards in public health.

The Screening Plant includes development of a green belt that is expected to reduce noise levels, limit the propagation of fugitive dust and produce a better occupational / aesthetic environment. The implementation of a green belt around the plant and side of the roads and the selection of plant species will be carried out in co-operation with Horticulture Department.

(iv) Social Infrastructure.

Well developed township/colony exists in Donimalai.

(v) Connectivity (Traffic and Transportation Road, Rail/Metro/Water ways etc)

Existing road adjacent to the Proposed Plant will be used for connectivity. Internal roads will be layed inside the Plant premises for man & material movement.

(vi) Drinking Water Management (Source & Supply of water)

The source of water for the Project is from existing Water Treatment Plant (WTP) at Donimalai base camp located about 1km from the proposed plant site.

(vii) Sewerage System.

Sewerage system is already available at the adjacent plant which is at 300m distance.

(viii) Industrial Waste Management.

NA

(ix) Solid Waste Management.

The slimes stored in tailing pond will be used as raw material for upcoming Pellet Plant.

(x) Power Requirement & Supply / source.

The estimated power requirement of the proposed plant is as follows:

- Maximum Demand (*Screening Plant - II*) : 1.5 MVA
- Annual Energy Consumption : 7.2 MU

The incoming power supply for the proposed Screening Plant-II is planned to tap from existing Valley sub-station through over head line (11kV) / underground HT cable(11kV), which is about 2 km distance.

## 7. Rehabilitation and Resettlement (R & R) Plan

(i) (Policy to be adopted (Central/State) in respect of the project affected persons including home oustees, land oustees and landless laborers (a brief outline to be given).

There is no settlement of Human population at the proposed Plant location.

## 8. Project Schedule & Cost Estimates

(i) Likely date of start of construction and likely date of completion (Time schedule for the project to be given).

Clearances to be obtained from the statutory authorities for construction of Screening Plant, tailing dam, laying of overhead electric line and pipe line for slurry transport to tailing dam. Thereafter an EPCM Consultant shall be appointed for Engineering, Procurement, Project Management, Construction Supervision and Inspection Services, who will be responsible for executing the Project through the Lump Sum Turnkey (LSTK) contractor(s).

**Implementation schedule**

By initiating advance action for some of the activities, considering some are parallel actions and based on minimum time period required for certain activities like appointment of EPCM consultant, supply of long lead item such as cone crusher etc., setting up of the proposed system will require 45 months from the date of approval of TEFR (TEFR approved on 05.11.2013). The time frame required for construction of the Plant is 24 months after obtaining forest clearance. An indicative time schedule is presented in the form of 'Bar Chart', placed at Plate No. 16.

(ii) Estimated project cost along with analysis in terms of economic viability of the project.

The capital cost estimated for creation of additional facility by construction of Screening Plant – II, is Rs. 399.75 crores. The detail of the break-up is as below:

| Sl. No. | Description | Approx. Basic Cost Estimate (Excludes Spares, E&C, Taxes & Duties) (Rs. In Cr) | Approx. Cost Estimate including all taxes, duties and E & C (Rs. In Cr) |
|---|---|---|---|
| I | Mechanical Equipment & Works | 94.12* | 148.32** |
| II | Electrical & Controls | 17.85 | 25.02 |
| III | Civil & Structural Works | 103.10 | 108.53 |
| IV | Tailing Dam | 49.22 | 51.81 |
| **V** | **Sub-total (A)** | **264.29** | **333.68** |
| VI | Design, Engineering, Consultancy services and administration during construction (@ 5% on Project Basic Cost) | | 13.21 |

| | | | |
|---|---|---|---|
| VII | Contingency (@ 5% on Project Basic Cost) | | 13.21 |
| VIII | Turnkey Package Concept, overheads and contractor's profit margin including local conditions prevailing in the region (@ 15% on Project Basic Cost) | | 39.64 |
| **IX** | **Total (V + VI + VII + VIII)** | - | **399.75** |

** Comprises FC component of Rs. 23.89 Cr and Rs. 70.23 Cr for indigenous items.*

*** Comprises FC component of Rs. 43.67 Cr (for supply of equipment, spares and supervision charges during E &C) and Rs. 104.65 Cr for indigenous items.*

**Cost of Production**

Because of the additional capital investment for construction of the proposed Screening Plant – II for processing ROM from Kumaraswamy Mine, there will be hike in the cost of production as furnished below:

| | |
|---|---|
| Capital outlay | : Rs. 399.75 crores |
| Depreciation | : Rs. 22.21 crores per year |
| Cost involved by additional manpower required | : 81 X 10 lacs<br>= Rs. 8.10 crores per year |
| Increase in cost of production | : (22.21+8.1) / 0.7<br>= Rs. 43.3 per ton at 100% capacity utilization |

**Notes**

1. Depreciation is considered for 18 years of life for Kumaraswamy Mines.

2. Only manpower cost towards fixed cost of production cost is considered keeping variable cost for producing 7 MTPA of CLO & Fines unchanged. Increase on Rs. 43.3/- per ton is at 100% utilisation and will vary according to the utilisation of the facility.

3. The environment and forest clearances are yet to be obtained. In case of delay in obtaining the same, the calculation may also need to be revised.

4. Considering the production target of Donimalai complex, the level of production may sustain at about 10 MTPA for few years from 2016-17, as more reserves are identified in Donimalai Mines. With the existing screening plant, the production targets cannot be met. Moreover if there is any break down in the existing screening plant, which affects the total production link and the loss on this account could not be measured in terms of money. Hence, to sustain the continuity of

production and for better working environment with better maintenance facility, it is required to consider construction of Screening Plant – II. Even at later date if the situation arises, the screening plant – II can be augmented with by installing additional two lines to process ore up to 10 MTPA, and the existing screening plant can be discarded. Equipment of existing screening plant in serviceable conditions can be used for augmentation of SP-II in phased manner. However, the increase in cost of production due to this Screening Plant is Rs. 43.3/ton, which is primarily due to depreciation and additional manpower considered.

## 9. Analysis of proposal (Final Recommendations)

(i) Financial and social benefits with special emphasis on the benefit to the local people including tribal population, if any, in the area.

- Direct employment of about 81 people (Executives & non executives).
- Indirect employment of about 400 people.
- Uninterrupted production of Iron ore products to supply Steel industries.
- Increased level of production to match with future increased demand of Iron Ore.

Towards sustaining overall system efficiency and for processing of ores from both Donimalai Iron Ore Mines (DIOM) & Kumaraswamy Iron Ore Mines (KIOM), the installation of this Screening Plant is inevitable and hence recommended for immediate implementation.

# ADDITIONAL TECHNICAL DETAILS OF FEASIBILITY REPORT

# 10. ORE GEOLOGY & RESERVES

## 10.1 Geology of Deposits of Donimalai & Kumaraswamy

### 10.1.1 Donimalai Iron Ore Deposit

#### (1) Location

Donimalai iron ore deposits are covered in the Survey of India topo-sheet No. 57 A/12 between Lat. $15^0$ 02' 0" and $15^0$ 06'30" and Longitude $76^0$ 36' 0" and $76^0$ 38'30". The deposits are situated in Bellary district of Karnataka.

Donimalai deposits are situated on the southern half of the eastern range of hills flanking Sandur valley. Sandur valley, which is about 40 km long and about 4 – 5 km wide is surrounded by a long range of hills both on the eastern and western flanks, giving an elliptical shape to the valley with its long axis running NW and SE. The two ranges of hills close in towards the southern end and therefore the main opening of the valley is towards the north.

#### (2) General Geology

The rock formations of the region consist of phyllites (*locally designated as shales*), the well known Banded Hematite Jaspers and Quartzites (*BHJ & BHQ*) and quartzites and basic igneous rocks (*green stones*) which have been generally metamorphosed to the "Green Schist facies. According to Fermor, it is a folded synclinorium in which the apparently large number of hematite-quartzite bands is due to repetition by folding.

#### (3) General description of the Deposit

The iron ore range in Donimalai constitutes prominent ridges extending over a total strike length of about 7.0 km having trend of NW to SE following general strike of the country rocks with steep ($70^0$) to vertical beds dominantly towards the east.

The deposit is conveniently divided in to two blocks, namely North Block and South Block. In South block, one ore zone followed NNW for about 2.6 km after which it splits into two, one limb following the original trend for another 0.6 km and the eastern limb making a small angle with the main zone and traceable for about 0.8 km. These two limbs do not join up and are separated by a small band of shale. The main western ore zone has been designated as Deposit 1 and the small eastern limb as Deposit 1A. The south block ends to the south against a private lease hold in which the main ore body is found to extend for about 100 m.

Further north, the continuity of Deposit 1 and 1A is lost and outcrops of lateritised shale and BHJ are found. This break in the continuity of ore has

been taken as the boundary between the North and South Blocks of Donimalai.

In the general strike continuity of Deposit 1 further north, two isolated ore bodies are observed. Those ore bodies have been designated as 2W and 3W. Similarly, in the general strike continuity of Deposit 1A further north and occurring to the east of Deposit 2Wand 3W, two isolated ore bodies are found. These have been designated as Deposit 2E and 3E.

### 10.1.2 Kumaraswamy Iron Ore Deposit

#### (1) Location:

Kumaraswamy Iron Ore deposits situated at the southern closure of the hill ranges of Bellary – Hospet sector. The Kumaraswamy deposits in turn consists of 5 iron ore blocks namely, A,B,C,D & E. Out of which 'B' & 'C' blocks are within the mining lease of NMDC Ltd. covers an area of 647.50 ha.

The ore bodies 'B' & 'C' of Kumaraswamy are covered in the survey of India topo-sheet No. 57A/12 and lie between latitude $15^0$0'10" to $15^0$0'50" and Longitude $76^0$34'5" to $76^0$36'20".

#### (2) Geology of the Ore Deposits

Kumaraswamy 'B' and 'C' blocks lie on the Southern flank of Sandur Basin, which is grouped under Dharwarian schist belt. The range forms the eastern continuation of the Ramanadurg Range. "B' Block is contiguous to 'C" Block on eastern side except for the small patch of non-mineralised valley portion.

The general strike of the ore body is WNW – ESE which is almost parallel to the trend of Kumaraswamy range i.e., East-West. The dip is towards North with an angle varying from $15^0$ to $16^0$. All along the strike length of the ore body the foot wall is characterised by Ferrugenous shale / tuff. Cherty quartzite and banded hematite quartzite occur on the Northern flanks.

#### (3) Ore Types

NMDC has grouped all the ore types into 5 individual ore types, viz., Hard ore (*Type-1*), Limonitised Laminated ore (*Type-2*), Soft Laminated Ore (*Type-3*), Powdery Ore (*Type-4*) and Lateritic ore (*Type-5*). NMDC conducted laboratory tests at R&D Laboratory on individual ore types.

### 10.2 Mineable Reserves

Estimation of Ore Reserves and Grade of Donimalai & Kumaraswamy Deposits

Mineable ore reserves have been computed within the pit limits of drawn on each of the slice plans. Ore reserves following within the pit limits thus designed are considered mineable reserves for mechanized operations.

**(1) BLOCKWISE MINEABLE RESERVES, GRADE AND LUMP RECOVERY OF DONIMALAI BLOCKS AS ON 01.04.2012**

| Sl. No. | Block | Reserves in Million Tons (MT) | Grade % | | | | Lump Recovery (%) |
|---|---|---|---|---|---|---|---|
| | | | Fe | $SiO_2$ | $Al_2O_3$ | P | |
| 1 | South Block | 7.880 | 65.95 | 2.03 | 1.60 | 0.045 | 31.14 |
| 2 | 3E Deposit | 8.246 | 65.36 | 2.89 | 1.49 | 0.045 | 25.42 |
| 3 | 2W Deposit | 0.130 | 63.53 | 4.35 | 2.20 | 0.060 | 26.20 |
| 4 | 3W Deposit | 0.245 | 64.19 | 3.52 | 2.00 | 0.030 | 28.00 |
| 5 | Beyond MM Cross Section | 7.503 | 65.66 | 2.14 | 1.83 | 0.034 | 31.51 |
| | **Total** | **24.004** | **65.63** | **2.39** | **1.64** | **0.041** | **29.23** |

**(2) BLOCKWISE MINEABLE RESERVES, GRADE AND LUMP RECOVERY OF KUMARASWAMY 'B' & 'C' BLOCKS AS ON 01.04.2012**

| Sl. No. | Block | Reserves in MT | Grade % | | | | Lump Recovery (%) |
|---|---|---|---|---|---|---|---|
| | | | Fe | $SiO_2$ | $Al_2O_3$ | P | |
| 1 | Kumaraswamy - 'B' Block | 29.559 | 65.00 | 1.55 | 1.92 | 0.070 | 35.70 |
| 2 | Kumaraswamy - 'C' Block | 100.421 | 63.85 | 1.85 | 3.15 | --- | 30.72 |
| | **Total** | **129.980** | **64.11** | **1.78** | **2.87** | **0.070** | **31.85** |

## 10.3 Ore Characteristics

It is conceptualised that the feed material to the proposed screening plant is (-) 100 mm, either from Kumaraswamy deposit or from Donimalai or from Kumaraswamy and Donimalai deposits together. To generate data in respect of:

(i) Physical & Chemical properties of Lump ore (-) 100 mm size
(ii) Product studies of proposed sized material (-) 30 (+) 6 mm size.
(iii) Product studies of proposed sized material (-) 6 mm
(iv) Product characterization and material balance

Representative samples of Kumaraswamy Mines were collected and mineralogical tests conducted by R&D. Relevant data from test results have been considered for the purpose of preparation of this Report.

Based on the test results of composite samples of Kumaraswamy Mines, Material & Water Balance Diagrams are prepared (*Refer Plate No. 1.1 & 1.2*).

# 11. PLANT DESIGN AND LAYOUT

## 11.1 Layout considerations

- The proposed screening plant is planned to ensure best possible interconnection with minimal disturbance to the existing facilities.
- The new screening plant is planned to make best use of contours between existing lump ore Conv. 501 and fine ore Conv. 411 from EL 722m to EL 690m.
- Considering the topography, storage silos are envisaged instead of open stockpile in order to have more live volume, clean & safe storage and easy retrieval of material, which are eco-friendly.

## 11.2 Process flow sheet development

NMDC has adopted the screening, crushing and wet screening facilities based on the results of the following tests conducted on composite sample of Kumaraswamy ore.

- Mineralogy and liberation studies
- Chemical analysis
- Characterisation studies
- Settling studies
- Filtration studies

Based on the above, a conceptual process flow diagram (*Refer Plate No. 2.1 & 2.2*) along with material and water balance is prepared by NMDC, which forms basis for the design of plant and selection of equipment.

### 11.2.1 Material Balance

a) ROM input : 1800 TPH
b) CLO production rate : 819 TPH
c) Fines production rate : 938 TPH
d) Tailings / Slimes : 43 TPH

## 11.3 Feed Ore Characteristics

The screening plant is designed to handle ROM from Kumaraswamy mines or Donimalai mines or both the mines and the specifications of feed material are as follows:

a) Size of ROM : (-) 100mm
b) ROM Bulk density : 2.2 to 2.5 T/$m^3$ (approx.)
c) Specific gravity : 4.5 to 5.2
d) Compressive strength : 4500 kg/$cm^2$
e) Angle of repose : $35^0$
f) Surcharge angle : $20^0$
g) Bond work index : Up to 11
h) Moisture content : about 5%
i) Quality : Fe-63%, $SiO_2$-2.74%, $Al_2O_3$-3.23% & LOI – 3.8%

j) Typical size analysis of feed to the proposed plant :

| | | |
|---|---|---|
| (+) 100 mm | - | 2.49 % |
| (-) 100 mm (+) 80 mm | - | 3.33 % |
| (-) 80 mm (+) 50 mm | - | 4.75 % |
| (-) 50 mm (+) 30 mm | - | 8.19 % |
| (-) 30 mm (+) 6 mm | - | 26.25 % |
| (-) 6 mm (+) 3 mm | - | 11.38 % |
| (-) 3 mm (+) 1 mm | - | 8.67 % |
| (-) 1 mm | - | 34.94 % |

(*The above size analysis may vary by 3 to 5 % points at each size*)

**11.4 Product Specification expected:**

| Products & Size | CLO (-) 30 mm (+) 6 mm | Fines (-) 6 mm |
|---|---|---|
| Fe | 64.29 % | 62.44 % |
| $SiO_2 + Al_2O_3$ | 6.0 (*max.*) | 7.00 % (*max.*) |
| Over size | (+) 30 mm – 5 % (*max.*) | (+) 6 mm - 5 % (*max.*) |
| Under size | (-) 6 mm – 15 % (*max.*) | (-) 100 mesh - 25 % (*max.*) |

**11.4.1** As per the present scenario in the iron ore market and recent Government directives for selling of iron ore products, the product size of calibrated lump ore (CLO) shall be ( - ) 40 ( + ) 10mm and fines size shall be ( - ) 10mm. Though the test works for the scheme was carried out and results were analyzed considering the product size of CLO as ( - ) 30 ( + ) 6mm and fines as ( - ) 6mm, some tests were redone and analyzed for product size of CLO as ( - ) 40 ( + ) 10mm and fines as ( - ) 10mm. Accordingly, the recovery rate of CLO, fines, slimes, chemical analysis such as %Fe, $Al_2O_3$, $SiO_2$, apertures of the primary screen and secondary screen are estimated. For change in specifying the product size, there will not be any change in the process, whereas layout & design care is taken while developing the proposed scheme. An indicative comparative statement for the different products size is as below:

| | CLO | | Fines | |
|---|---|---|---|---|
| | (-) 40 (+) 10 mm | (-) 30 mm (+) 6 mm | (-) 10mm | (-) 6mm |
| Primary screen aperture size (mm) | 40 & 20 | 30 & 20 | | |
| Secondary screen aperture size (mm) | 10 & 3 | 10 & 6 | | |
| % Fe | 63.75 | 64.29 | 62.26 | 62.44 |
| % $SiO_2$ | 1.65 | 1.08 | 2.73 | 2.91 |
| % $Al_2O_3$ | 2.88 | 3.53 | 4.08 | 3.31 |
| % Weight recovery | 41.00 | 45.50 | 51.00 | 52.12 |

*While preparing Tender Document for implementation of the Project, the above aspect needs to be taken care in finalizing the specification of above screens including tertiary screens.*

## 11.5 Design Criteria

The total estimated available quantity of iron ore reserve available as on 01.04.2012, from Kumaraswamy Deposit and Donimalai Deposit is about 150 million tons. Therefore, new screening plant processing capacity has been considered to be 7 MTPA similar to the existing screening plant and matching with capacity of Kumaraswamy Project.

Hence, to take feed @ 2000 TPH (*design*) from Kumaraswamy downhill conveyor, Screening Plant-II is envisaged with 4 lines (*3 working and 1 standby*) for processing ROM of 7 million tons per annum (MTPA) for reliable & continuous trouble free operation. Each screening line is envisaged to operate at 650 TPH rated capacity with design capacity of 750 TPH.

Taking a view of in-built operational allowance, it has been considered that the Screening Plant will be operating at rated capacity of 1800 TPH to achieve projected target of 7 MTPA ROM handling.

## 11.6 Scheme Proposed

Overall plant layout of the proposed scheme is shown in Plate no. 3 and description of the proposed screening plant (*Refer Plate No. 4.1*) is as follows:

### 11.6.1 Screening & Crushing

- The ROM of Kumaraswamy mines or Donimalai mines or both the mines is stored in silos of about 4000 tons (*each*) storage capacity. The lump ore [*(-) 100mm*] is extracted through apron feeders and fed to double deck primary screens (*with 30mm & 20mm apertures*) through belt conveyor.

- The oversize material of primary screens is fed to tertiary crusher to crush (-) 100mm ROM to (-) 30mm. The middle fraction and the under size material of primary screen are fed to CLO conveyor and secondary screens respectively.

- The crushed ore of tertiary crusher is fed to double deck tertiary screen (*with 30mm and 6mm apertures*), wherein the oversize material (*+ 30mm*) is re-circulated to tertiary crusher. The middle fraction of tertiary screen (-) 30 (+) 6mm and under size fraction (*- 6mm*) of tertiary screen are fed to CLO product conveyor and fines product conveyor respectively.

- Under size of secondary screen is fed to classifier of wet circuit system. Suitable gate arrangement is envisaged at the bottom of under size chute of secondary screen, which diverts material to launder leading to classifier circuit when operating on wet mode. Under dry mode the gate will be lifted / opened to divert the material to fines conveyor.

- Conveyor receiving middle fraction [(-) 10 mm (+) 6 mm] of secondary screen is envisaged with reversible operation to feed the material either to fines conveyor or CLO conveyor based on the requirement.

### 11.6.2 Wet Circuit

- Process water after washing of iron ore contains high concentration of suspended solids (*iron ore fines*) and is called as slurry, which is collected from underflow chute of secondary screens in a ore processing plant for beneficiation to attain the following objectives:

  (i) To minimise slime loss by more fines recovery
  (ii) To recover process water for recirculation
  (iii) To deposit less tailings (iron ore bearing) in tailing dam

- Classifier overflow is fed to dewatering screen and the underflow to hydro-cyclones. The overflow of dewatering screen is fed to fines conveyor and the underflow is fed to cyclones. The cyclones (with separation size of 150 microns) overflow is diverted to thickener and the underflow to filtrate unit to recover some fines, which in turn is fed to fines conveyor.

## 11.7 Technological Facilities

The plant shall comprise of tertiary crushing, screening, classifying, filtering and conveying facilities to be set up in an integrated manner and consists of the following technological units. The description of the technological facilities specified in this chapter is as proposed for this plant and as per the drawings enclosed.

### 11.7.1 Travelling Tripper & Tripper Conveyor

Ore conveyed either from KIOM or DIOM or both is extracted from a storage bunker at the discharge of downhill conveyor BC 723 of KIOM and feed to a 1200mm wide tripper conveyor (@ 2500 rated capacity with 10% design margin) provided with travelling tripper, which feeds to silos.

### 11.7.2 Silos

Four numbers - RCC silos of about 8m square (*inner dimension*) and about 40m height for storage of 4,000 tons (*each silo*) of ROM ore from secondary crushers of either KIOM or DIOM or both are envisaged.

#### 11.7.2.1 Functional Design of Silos/Bins of Reliable Gravity Flow

The extraction of the ore from the silos is based on gravity flow. The problems associated with the silos/bunkers, hoppers and transfer chutes while handling Iron ore are numerous particularly when the bulk solid contain a significant portion of fines at higher moisture levels. The typical flow problems include "No flow", "Reduced live capacity", "Segregation" etc., which significantly affect the performance of the plant in general.

A properly designed silo system results in better capacity utilization, better flow rate control and an improved uniformity in the extraction of the ore. For this, proper geometrical configuration of silos suitable for specific iron ore application is important, in order to minimize or avoid the flow problems.

The functional design of proposed silos/bins shall conform to IS 9178 (Part 3) for reliable gravity flow. The flow properties of Iron ore proposed to be handled in the silos at different moistures is to be established in the laboratory by using the Jenike shear tester. The parameters like Internal angle of friction, wall angle of friction and flow function thus established form the inputs to arrive at the silo design parameters like minimum slope and outlet dimensions. The minimum slope and outlet dimensions of the silo vary with the geometry and the wall liner used for specified flow regimes like Mass Flow or Expanded Flow. Normally, an abrasive ore like iron ore shall be stored in a silo designed to promote Expanded Flow (bottom portion Mass Flow and top self emptying Funnel Flow).

The trouble free movement (flow) of ore from the silos/bunkers/hoppers and transfer chutes play a vital role in the productivity of the screening plant. It is also required to exercise due care while designing the transfer bin / transfer chutes in order to avoid plugging and excessive wear. The minimum wall inclination to initiate flow after impact depends on the ore moisture content as well as the friction between the liner used and ore.

The outlet size and slope of the bins envisaged in this report are largely in order for the envisaged application based on flowability tests conducted (May, 2012) by R&D Centre on Kumaraswamy composite sample. However, fine tuning of functional

design of silo/bin and transfer chute shall be carried out based on flow properties of combined sample of Kumaraswamy & Donimalai Deposits after required test works at NMDC R&D Centre during further course of engineering.

### 11.7.3 Apron Feeders

Apron feeder - one number for each line for extracting ore from silo to feed primary screen feed conveyor. The design capacity of apron feeder and belt conveyors (1200mm wide) is 800 TPH.

### 11.7.4 Primary Screen

The double deck vibrating screen of circular motion/linear motion vibrating screen of 2400mm x 6100mm size is considered in each line. The screen is mounted on rigid structural support in the screen building. The rated capacity of the screen is 650 TPH. The design capacity of the screen is 750 TPH.

### 11.7.5 Secondary Screen

The double deck vibrating screen of circular motion/linear motion vibrating screen of 2400mm x 6100mm size is considered in each line. The screen is mounted on structural trolley in the screen building. The design capacity of the screen is 550 TPH.

### 11.7.6 Tertiary Crusher

Two Nos. (*1 working & 1 standby*) 7' cone crushers for crushing (-) 100mm ROM to 30mm are considered with operating capacity of each about 750 TPH (*500 TPH fresh feed & about 250 TPH recirculation load*). The crusher foundation is designed for dynamic loading and is isolated from main building foundations.

### 11.7.7 Tertiary Screen

The double deck vibrating screen of circular motion/linear motion vibrating screen of 2400mm x 6100mm size. The decks are of 30 mm & 6 mm aperture panels for screening the material. The screen is mounted on rigid structural support in the screen building. The rated capacity of the screen is 650 TPH. Two nos. screens (One working and one standby) are envisaged. The design capacity of the screen is 750 TPH.

### 11.7.8 Classifiers

Secondary screen underflow is diverted to classifier (4 Nos. - 72" dia. and 37' long) for separation of 150 microns. The raking capacity of each classifier is considered as 350 TPH. The raked sand is diverted to fines product conveyor and the overflow is fed to hydro-cyclone.

### 11.7.9 Dewatering screens

4 Nos. Dewatering screens of 2400mm X 6100mm are envisaged to dewater the classifier sand.

### 11.7.10 Hydro-cyclones

Classifier overflow and dewatering underflow is fed to cluster of hydro-cyclones for separation size of 150 microns. The underflow of cyclone is fed to filter circuit. The overflow of hydro-cyclone is fed to tailing thickener. Two circuits of cyclones are considered in series, one circuit of desliming cyclone and one circuit of densifying cyclone.

### 11.7.11 Tailing Thickener

The overflow from the cyclone is fed to ϕ35m hi-rate thickener (1 number) for thickening. The capacity to handle feed is approximately 150 TPH solid. The thickener is of civil construction and it consists of flocculent system for faster settling.

The under flow is pumped to the tailing dam by slurry pump provided below the thickener. A stand-by pump is also considered. The slurry is transported through rubber lined MS pipeline of approximately 1.2 km length. Density meter and flow meter is provided in the discharge line for measuring the density of the slurry. The pump suction is provided with automatically operated knife gate valve for isolation. Flush water is provided in the suction line for cleaning the pipeline before starting and after stopping of pump.

### 11.7.12 Slurry Pumps and Sumps

The sumps are fabricated with MS plate and rubber lined for abrasion resistance. The sumps are provided with ultrasonic level sensor for measurement of level. Make-up water line with automatic modulating valve is provided for each sump. The level measurement from ultrasonic level sensor is interlocked with the automatic modulating valve to ensure the sump level is maintained within the pre determined level to avoid starving of the pump.

The slurry pumps are of heavy duty abrasion resistance centrifugal pumps. The impeller and casing are rubber lined / hard metal for handling abrasive slurry. The slurry pumps are driven through Variable Frequency Drive (VFD).

The suction lines are of MS pipe with rubber lined and provided with automatic knife gate valves for isolation purpose. The flush water line is provided to clear the slurry, if any before starting and after stopping of the pumps. A drain valve is provided for draining out slurry from the pipeline. All discharge lines are of MS pipe with rubber lined and provided with the magnetic flow meter to measure the flow rate. Nucleonic type density meter is provided in tailing disposal pipe line.

### 11.7.13 EOT Cranes

EOT cranes and suitable handling facilities at various locations are considered in the Plant for servicing and maintenance of equipment and facilities.

### 11.7.14 Belt Conveyors

All belt conveyors are 1200mm wide provided with skirt-boards, chutes, safety switches, scrapers, take-up units etc. Skirt-board shall be suitably lined with liner plates (preferably chrome-carbide liners) while chutes with Mn-steel liners at impact/abrasive zones. The belt conveyors running at out-door are provided with covered structural gallery with maintenance walk-ways on both sides.

### 11.7.15 Horizontal Belt Feeders (HBF)

Horizontal belt filters are considered to recover some iron values and also to recover some water in the process, from under flow of densifying cyclones. Slurry from densyfying cyclone underflow is passed on to a moving perforated belt conveyor, which allows filtrate (water) to drain through the perforations on the belt and collected suitably by vacuum principle. Filter cloth fastened on the belt top of perforated belt conveyor retains slurry at the feeding end and as it moves towards discharge it holds the cake to be discharged at the head end. Three units are considered in the circuit with two operating and a standby.

## 11.8 Service & Common Facilities

### 11.8.1 Process Water Circulation System

The process water requirement for Screening Plant is as follows:

| Sl. No. | Consumer | Qty. ($m^3$/hr) |
|---|---|---|
| | **INPUT** | |
| 1 | Process water for Primary screen | 1440 |
| 2 | Process water for Secondary screen | 1011 |
| | Total | **2451** |
| | **OUTPUT** | |
| 1 | CLO | 55 |
| 2 | Fines | 156 |
| 3 | Thickener underflow | 64 |
| 4 | Thickener overflow | 1117 |
| 5 | Cyclone overflow | 736 |
| 6 | HBF Filtrate | 322 |
| | Total | **2451** |
| | **MAKE UP WATER** | |
| 1 | Products | 276 |
| 2 | Extra for floor washing , dust control etc., | 90 |
| | | **366** |

A recirculation water tank of 5000 $m^3$ capacity is envisaged to receive the cleaned water from the tailings thickener and the size of tank is 35m dia. & 5.5m height.

The makeup water requirement for the process will be brought by a pipe line from the Donimalai filter house / WTP to make up water storage tank located at +745.00 m level near the Screening plant II. Water balance for the plant is indicated in Plate no. 1.2.

### 11.8.2 Make-up Water Supply System

The make-up water required for the project is pumped from the water treatment plant at Donimalai base. 2nos. (1W+1S) pumps of capacity 500 $m^3$/h with a head of about 700m are envisaged to pump water from Sump at WTP to 5000 cu.m recirculation tank near the Screening plant. A pump room is envisaged to accommodate make-up water pumps adjacent to the water storage sump at WTP.

Currently the sanctioned quantity of water from Narihalla dam is 745 cum/hr. Presently Project is withdrawing water @ 350 cum/hr. The proposed augmentation of water supply from Narihalla dam for another 400 cum/hr (total 745 cum/hr) is under progress for additional water requirement of proposed Screening Plant, Pellet Plant and BHJ Beneficiation Plant. Further, Project is required to identify alternate source of water to meet additional water requirement for future increased demands, if any.

### 11.8.3 Dust Control System

Dry Fog Dust Suppression System is considered for various material transfer points at Screening Plant. The fugitive air borne dust generated during material transfers at conveyors, crushing, screening, etc., will be suppressed by superfine atomization of water droplets produced with the help of compressed air to form a blanket of extremely fine fog to entrap the fugitive air borne dust such that the suppression is achieved due to agglomeration by impact of dust particles with water droplets until mass becomes heavy enough to cause the particle to settle on the main material without wetting the product being handled.

The system shall comprising of MS water tanks, pipe work, nozzles, solenoid valves, manual shut-off valves, pumps (one working and one stand-by), air compressor (one working and one stand-by), all necessary electrics with MCC and instrumentation required for operation of the system through PLC etc.,

### 11.8.4 Fire Fighting

Fire fighting extinguishers will be suitably located in transfer towers and buildings in their respective maintenance and operating floors.

### 11.9 Tailing Reservoirs

The locations of the proposed tailing ponds of 8 MT & 5.4 MT capacity are indicated in the Plate No. 14 will be used for storage of tailings of the new screening plant. Area of tailing dams considered is about 9 Ha (*initial stage*) and 16.2 Ha (*second stage*).

11.10 The final products Fines & CLO are proposed to be carried to stockyard through existing fine ore conveyor and CLO conveyor systems. To meet the increased production rate, a proposal for augmentation of BC 411 is ready and to be implemented appropriately. In a similar manner augmentation of CLO conveyor systems should be taken up appropriately.

Existing stocking and loading facilities are proposed for the utilization of dispatch of the products. However, a proposal for additional fine ore stockpile for increased production fines and a loading line is in pipeline. This additional loading line will take care of the increased production rate of CLO, fines and other products like pellets, etc.

11.11 The requirements / facilities described / envisaged here are indicative and may undergo change for design improvement, process and layout optimization, if any, during further engineering stage.

# 12. CIVIL AND STRUCTURAL WORKS

**12.1 The following facilities are envisaged for the subject work**

1. RCC Silos 4000T cap. each-4 nos., with lift & staircase,
2. RCC Silos for future provision- with foundation & walls up to plinth,
3. Primary & Secondary Screening Plant buildings with EOT crane of 30/5 & 15/3T capacity
4. Tertiary Crusher House (TCH) building with EOT crane of 30/5T capacity,
5. Tertiary Screening House (TSH) ,
6. Conveyor galleries nos. 801, 806, 810, 812, 813, 814, 819, 823, 829 & 832.
7. Junction Houses nos. JH-1 to JH-4,
8. Horizontal Belt Filter Building,
9. Thickener – 1 no. of dia. 35m,
10. Ground Level Reservoir (GLR) of 5000 cu.m capacity,
11. Plant office, Canteen & Rest shelter buildings,
12. Service roads (2.0 km) to all facilities with drains, culverts, metal crash barriers on Valley side at turnings,
13. MCC Buildings – 2 nos., size 18m x 10m.

**12.2 For the above facilities, the following civil & structural works are considered**

**A. Civil Works**

1. RCC Silos of 4 nos. each 4000T capacity of size 8m x 8m with top elevation fixed at RL (+) 762.25 (approx). Accordingly, earthwork, RCC quantities etc. have been worked out. Further, for future provision, 2 nos. of silos kept and foundation & walls up to plinth level has been considered for easy vertical rising of superstructure only, if required, later. 25mm thick Mn steel liners are suitably considered in the walls and hopper area of silos.

2. Earthwork excavations in over area and in foundations are considered including back-filling. An average lead of 5 km considered for disposal of 280,000 cu.m excavated earth. This is proposed to be dumped in an area to be identified by project, later.

3. RCC M25 grade (conforming to IS: 456-2000) are considered in RCC silo, Screening plant, TCP, TSP, Junction houses, MCC buildings, Office building, Canteen, Rest shelter building etc. Design mix for RCC in silo structure shall be used.

   RCC M20 grade (conforming to IS: 456-2000) is considered in retaining walls, drains, cross drainage works etc. All steel reinforcement shall be of Fe-415 grade conforming to IS: 1786 (latest version).

   In Junction houses, RCC floor slabs (M25 grade) supported on structural beams are considered to support machines/equipment. CC flooring above hard soling

at ground levels of junction houses is considered including CC apron around with drains all-round.

Mud mat PCC (1:4:8) below foundations.

4. Service roads of 10m wide (7m bitumen carpet width & 1.5m shoulders width) with 1 in 16 longitudinal gradient and 1 in 20 on curves are considered for access to all plant facilities and connecting to existing road. Double W-Beam metal crash barriers on valley side of roads are considered with RCC drains & culverts.

   In the construction stage, only soling and metalling works in roads shall be carried out with proper consolidation. The bitumen carpet work shall be done after opening to traffic and after one rainy season.

5. Automatic Fire Detection and Suppression System (FDSS) is considered for conveyor between down-hill conveyor system of KIOP and Tripper Conveyor.

6. NMDC shall carry out preliminary soil investigation works in the plant areas for inclusion of the sub-soil test results in tender documents, which will serve as a general guidance to tenderers about the sub soil type and strength in the area.

   However, turnkey contractor shall carry out both detailed survey and soil investigation works in the plant areas for doing engineering of plant structures and their design of foundations; earth cut slopes and benches etc.

**B. Structural Works**

1. Supply, fabrication and erection of all structural steel works in plant buildings, junction houses, conveyor galleries & supporting trestles, HGTU's/VGTU's are considered.

2. The structural steel shall be of Grade Fe-410WA & Fe-410WB as required conforming to IS: 2062.

   Pre-coated colour galvalume sheeting (Steel grade 550 Mpa, Zn coating not less than 120 gsm, 0.50mm TCT) in both roof and side sheeting of all houses and galleries are considered.

   FRP translucent sheeting of 2mm thick (conforming to IS: 12866 having matching corrugations to galvalume sheets) are also considered on side sheeting only. The quantity of FRP sheeting shall be 15% of total sheeting in both roofing and cladding put together.

3. Both primer and finish paintings (total DFT of 205 microns) to structural steel surfaces are considered.

4. Necessary modification/dismantling works at interfacing areas of new galleries with existing conveyor nos. 504 & 411 are considered.

5. Clearance of 6m (min.) below structural conveyor gallery at road crossing points is considered. Muck tray plates below galleries at these crossing points are also considered.

6. Monorails of sufficient capacity at all floor levels in Junction houses / Plant buildings to handle machine / equipment are considered. Doors of sufficient size in all buildings / houses are considered towards approach road side.

**C. Enabling Works**

These works include construction of site office (semi-permanent) required during survey, soil investigation works in the area. Construction water supply required during construction shall be drawn from existing near-by sources. Provision for enumeration of trees in the area is kept in the estimate. Enumeration shall be done by project with local forest department.

## 12.3 Scope of Major Civil Work

The scope of major civil works includes, but not limited to, the following

- RCC Silos
- Screening & Tertiary Crushing Plant building foundation, platform slabs and Equipment foundations
- Conveyor foundations
- Junction Houses
- RCC Elevated Thickener
- Makeup water pump house with pipe line (500 cum/hr)
- Filter water tank (63 $m^3$/hr)
- Main water pump house with RCC recirculation tank of 5000 $m^3$/hr.
- Office building with store rooms
- Roads, Drains and Cross Drainage
- Electrical Substation and MCC / control room building etc.

### 12.3.1 General

The general specifications / details in respect of type of structures, grade of concrete, materials, etc. for all major units have been assumed to be similar to standard practice of civil works as per relevant latest Indian standard codes.

### 12.3.2 Site Grading/Plant Level Philosophy

The general topography of the site for SP II is undulating and surrounded by hills. Proposed plant area has been divided into number of sub-areas. Finished ground levels of the unit and other non plant areas have been fixed to minimize cut and fill.

This has resulted in step formation due undulating area of the site. Overall grading pattern is such that it facilitates good drainage.

### 12.3.3 Roads

The principal roads are 6 m wide whereas other roads are 4 m wide. Road width covers carriage way and berm but excludes drain or bund. Generally the finished road level is 300mm above FGL. Being hilly terrain, maximum permissible gradient is limited to 1:20 and occasionally 1:16.

### 12.3.4 Drains

Concrete apron shall be provided around the Plant building with side drains. From plant & non plant building area, the rain water is collected through drains in a settling pond and finally discharged to existing Nala, as is the present practice at Donimalai. A plant drainage system of trenches for collection and disposal of rain water has been developed to meet environmental objectives. Drains are self cleaning with a minimum slope of 0.2%.

Open trapezoidal and rectangular shape drains are provided along with pipe culverts and box culverts are considered for drainage system. The sanitary waste is collected and treated through septic tanks and soak pits. Existing network of water supply is extended to cater to the proposed area requirements with suitable storages, pumps and piping network.

### 12.3.5 Layout Plan

The overall Layout plan (*Refer Plate No. 4.1*) is developed keeping in view the overall material flow and vacant areas available for locating new facilities. Efforts were made to locate the new facilities within the land available with NMDC. The Overall layout Plan shows all process & non process units and other Plant facilities.

### 12.3.6 Primary Screening Building

Primary & Secondary screening building is located on the adjoining hill near to the existing screening plant. The arrangements of facilities are indicated in the drawings enclosed.

### 12.3.7 Tertiary Crushing & Screening Building

Tertiary crushing plant building is located on the slope adjoining the Primary Screening Building at a suitable distance to permit transfer of material to feeding Tertiary Crusher and tertiary Screens.

### 12.3.8 Others

Outdoor switch yard is proposed for feeding the electrical loads of the new facilities.

### 12.3.9 Foundation system

Open cast foundations are envisaged for all plant structures. The costing for this Report is based on the assumptions that open foundations will be used for all structures.

### 12.3.10 Water proofing for underground RCC basement structures

All underground basement structures like sumps, etc. in contact with earth shall have standard water proofing treatment mainly consisting of the following:

- Water proofing paint to be provided in outside faces of walls and base raft in contact with soil.
- Pressure grouting through perforated and threaded nozzles (to be inserted during concreting) along the constructions joints only.
- All underground RCC basement structures (base raft, walls, etc.) have been assumed to be designed as cracked section. However, water retaining structure like underground/partly underground/on ground water reservoirs/ sumps etc. have been assumed to be designed as uncracked section as per relevant Indian standard codes.

### 12.3.11 Concrete grade

In general the following concrete grades will be adopted for RCC & PCC works.

- **RCC works**
  - M – 25 RCC works for all foundation works, substructures, superstructure elements of all plant buildings
  - M – 20 RCC works for drains, base slab of grade floors and intermediate floor slab and roof slab supported on steel superstructures and cable trenches, etc.
- **PCC works**
  - M – 10 Lean concrete below foundations, etc.
  - M – 15 For PCC works in drain, screed concrete, etc.

### 12.3.12 Building material

- **Cement**
  In general cement shall be ordinary Portland cement conforming to latest IS standards.
- **Reinforcement steel for RCC**
  For all RCC work, reinforcement bars shall be TMT bars of Fe415/500 grade with strength requirement conforming to IS 1786-1985.
- **Brick/ solid concrete block masonry work**
  Brick/solid concrete block shall be of locally available best quality conforming to the architectural requirements.

## 12.4 Design of steel structures

- Steel structures will be designed to meet the technological requirements and general conditions of the projects on totality basis.

- In order to achieve maximum economy in the use of steel, the frames will be designed as rigid portals.

- Design of steel structures will be carried out as per IS: 800-2007and/ or any other recognized standards approved/ accepted by the agencies concerned. Adequate ventilation will be provided in the buildings for successful operation of the plant & equipment installed therein.

- All staircases will have a minimum width of 800 mm formed from chequered plates or Open grid panels. The slope of staircases will be preferably within 36 to 40 degrees.

- Hand rails of platforms will be of tubes. The top rail will be 1.1 m above platforms level. The top rail, knee rail and the posts will be tubes and toe guards will be of steel plates (i.e. skelp plate).

- The thickness of structural elements will not be less than 6 mm (except for webs of rolled Sections). An allowance for corrosion is kept for structures exposed to outside atmosphere. In case of load bearing welds the thickness of fillet welds shall not be less than 6 mm.

### 12.4.1 Loading

Superimposed loads to be considered in the design of steel structures are as per IS: 875-1987 in addition to technological loads, if any. Live loads for platforms, stairs, etc. are 300 kg/$m^2$ unless other-wise specified.

Design of buildings and structures for the effect of wind load shall be carried out as per IS: 875 (Part-3)-1987. Design of buildings and structures for the effect of seismic loads shall be carried out as per IS: 1893-2002.

### 12.4.2 Method of construction

All steel structures are generally of welded construction. However, structural members like roof purlins and side runners will be of bolted construction.

### 12.4.3 Material of construction

- All structural steel sections and plates up to and including 20 mm thick shall conform to IS: 2062-2006 Grade A and plates of thickness more than 20 mm thick shall conform to IS: 2062-2006 Grade B.
- Crane rails shall conform to IS: 3443-1980.
- Non designed sections such as walkways shall be of steel conforming to IS: 977-1995 and Handrail tubes shall conform to IS: 1161-1198 and toe guard skelp plate shall conform to IS: 1079-1994.
- Roofing and Side sheeting shall be of 0.68 mm thick Industrial Troughed Colour Coated Steel Sheets.
- Electrodes shall conform to IS: 814-2004
- Black hexagonal bolts, nuts shall conform to IS: 1363-1992.
- Primer paints conforming to IS: 2074-2002 and Finish paints conforming to IS: 2932-1993 will be used.

## 12.5 Standard and codes of practices

Standard and codes of practice referred to do this job shall be as per Indian code of practice.

## 12.6 Basis of Working of Quantities & Rates

The Civil & Structural works have been worked out based on the scheme layout and site contour drawings.

The earthwork quantities for all plant buildings and service roads are calculated based on the contours and finished floor levels shown in the scheme drawings. The RCC and structural steel quantities have been worked out based on the geometry of plant sizes and general sizing of various civil & structural members arrived in similar works of Dep.10&11A, Dep.11B, Kumaraswamy Project etc.

**12.7** The works and requirements listed above are indicative and may undergo change for improvement / optimization of the scheme if any, during further engineering stage.

# 13. ELECTRICAL & CONTROLS

## 13.1 Power Required

The estimated power requirement of the proposed plant is as follows:

- Maximum Demand (*Screening Plant - II*) : 1.5 MVA
- Annual Energy Consumption : 7.2 MU

## 13.2 Source of Power Supply

The incoming power supply for the proposed Screening Plant-II is planned to tap from existing Valley sub-station through over head line (11kV) / underground HT cable(11kV), which is about 2 km distance. 3.3kV HT supply shall be considered for the equipments whose power rating is 160kW and above. One number 11kV HT switch board (*Incomer, Power Transformer feeder & Lighting transformer feeder and one no. of 3.3kV HT switch board, 14 feeders app.*) is envisaged. As the number of LT equipments are more, two number of intelligent LT MCCs (80 feeders of various ratings) are envisaged. One number of 2.5 MVA, 11kV/3.3kV Power transformer, one no. 2.0 MVA, 3.3kV/440V distribution Transformer, one no. 125 kVA, 11kV/230V Lighting Transformer is considered.

## 13.3 Power distribution system

The 11 kV over head power line / underground HT cable at proposed screening plant from the proposed 33/11 kV substation shall be terminated in a DP structure. For further power distribution it is envisaged to provide one number 11/3.3 kV transformer of suitable rating, 11kV & 3.3 kV switch boards, 3.3/0.433 transformer of suitable rating 125kVA, 11kV/230V, Ph-Ph for, lighting transformer, LTMCC, MLDBs, LDBs & other equipment as required. All connections from the DP structure onwards are foreseen by means of cables.

## 13.4 Design Considerations

- The design of power distribution system and selection of equipment shall be based on the main considerations of reliability, ease of operation & maintenance, simplicity, safety and as well as convenience of future expansion.

- The equipment shall conform to relevant IS/IEC specifications and code of practice to meet the operational requirements and to ensure reliable and trouble free service in the plant.

- Electrical switchgear rooms shall be of ventilated design maintaining slight positive pressure to exclude dust from entering. The enclosure class of switchgears shall be IP42 or better.

## 13.5 Basic Design Parameters

| | | | |
|---|---|---|---|
| Incoming Power supply | | : | 3.3 kV, 3 Ph, 50 Hz |
| Utilisation voltage | | : | 3.3 and 415 V, 3 ph, 50 Hz |
| Motors rated above 160 kW | | : | 3.3 kV, 3 Ph, 50 Hz |
| Motors rated 160 kW & below and other LT consumers | | : | 415V, 3 ph, 50 Hz |
| Illumination | | : | 240 V, phase to phase, 50 Hz |
| Auxiliary supply | | : | 240 V, 1Ph-Nuetral, 50Hz |
| Control power supply | | | |
| | AC | : | 240 V, 1Ph-Nuetral, 50Hz |
| | DC | : | 110 V |
| System Earthing | | | |
| | - 3.3 kV | : | Resistance earthed |
| | - 415 V | : | Solidly earthed |
| Maximum Symmetrical Short Circuit level considered for the system | | | |
| | - 3.3 kV bus | : | 13.1kA (rms) for 1 sec |
| | - 415 V bus | : | 35kA (rms) for 1 sec |

## 13.6 Major Facilities

### 13.6.1 HT Switchgear

11kV switch board with required incomer is also envisaged. The 3.3 kV switchgear envisaged shall be indoor, sheet metal clad type with draw-out VCB circuit breakers and shall be provided with necessary protection, control gear, metering and audio-visual alarm annunciation system. The circuit breaker mechanism shall be mechanically and electrically trip free. The circuit breakers shall be electrically operated, stored energy type and shall be operated on 110 V DC control power supply.

### 13.6.2 415 V Switchgear

The 415 V switchboard shall be sheet steel enclosed, non-draw out type in multi tier formation. The switchboard shall be provided with incomer of draw-out type and required number of outgoing motor and power supply feeders as per requirement and shall include spare feeders of each type/rating. The air circuit breaker shall be electrically operated and equipped with microprocessor based direct acting releases for over load and short circuit as well as earth fault protection.

The motor feeders shall be provided with MPCB/MCCBs with magnetic release, thermal overload relay and contactor so as to provide Type 2 co-ordination. In addition, motor feeders shall be equipped with CBCT and Earth leakage relay.

MCCBs shall be provided for outgoing power supply feeders. The MCCBs shall be equipped with direct acting O/L, S/C releases and earth fault module with in-built