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PROPOSAL FOR RECONNAISSANCE SURVEY (G-4) & GENERAL EXPLORATION (G-2) FOR MANGANESE ORE INTAMIYA BLOCK, DISTRICT-BALANGIR, ODISHA

1.0.0 INTRODUCTION

1.1.1 In order to sustain the current level of production of Mn ores and to meet the future demands, the exploration of Manganese ore is the need of the hour.

1.1.2 In India the Manganese Ore deposits mainly occurs as metamorphosed bedded sedimentary deposits associated with Gondite Series (Archaeans) of Madhya Pradesh(Balaghat, Chhindwara &Jhabua districts), Maharashtra (Bhandara & Nagpur districts), Gujarat (Panchmahal district), Odisha (Sundargarh district) and Kodurite Series (Archaeans) of Odisha (Ganjam & Koraput districts) and Andhra Pradesh (Srikakulam& Vishakhapatnam districts).

1.1.3 The total resources of Manganese ore in the country as on 01-04-2015 are placed at 495.87 million tonnes as per UNFC system. Out of these resources 93.47 million tonnes are categorised as reserves and the balance 402.40million tonnes are in the remaining resources category.

1.1.4 State wise, Odisha tops the total reserves/resources with 44% share followed by Karnataka 22%, Madhya Pradesh 12%, Maharashtra & Goa 7% each, Andhra Pradesh 4% and Jharkhand 2%. Rajasthan, Gujarat, Telangana and West Bengal together shared the remaining about 2% resources.

1.1.5 The Govt. of India enacted the MMDR Amendment Act, 2015 duly introducing the system of auction for allocation of Mineral Concessions. Bauxite, Iron Ore, Manganese and Limestone have been categorized in the Fourth Schedule which needs prospecting and exploration by the State Govt. before auctioning of Blocks

1.1.6 At the backdrop of enactment of the MMDR Amendment Act-2015, Minerals (Evidence of Mineral Contents) Rule 2015 and Mineral Auction Rule-2015, Ministry of Mines, Govt. of India has directed the State Governments to accelerate exploration for different mineral commodities in their respective states through NMET fund as to facilitate the State Government for auction of blocks. Therefore, Directorate of Geology, Govt. of Odisha has indicated 9 blocks of Manganese (5 in Balangir & 4 in Rayagada district) vide letter no. GXV (w)-02/15-7114/DG dated 27.11 2017 & GXV (w)-02/15-7791/DG dated 26.04 2018 for exploration which will lead to availability of more number of blocks for the auction through mining lease or composite licence.

1.1.7 Along with the above mentioned letter, Directorate of Geology, Odisha had provided the details of block coordinates and also indicated that GSI carried out exploration work in stages in and around the proposed area.

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1.1.8 Subsequently, the officials from both Directorate of Geology, Odisha and MECL jointly visited the area during the period from 25.05.18 to 28.05.18 to assess the possibilities of taking up of the exploration in the area. Accordingly MECL prepared proposal for General Exploration (G2) for manganese ore in the already explored part of the Tamiya & Rengali block & Reconnoitery Survey (G4) in rest of the block area and put up to the 15th meeting of TCC, NMET for the approval & issuance work order to MECL.

1.2.1 Location& Accessibility of the Area

The block under exploration lies in the parts of Survey of India Toposheet No 64 P/01 (Plate No I). The coordinate of cardinal points of block boundary are as follows:

Sr No	Indo Nepal		WGS 84		UTM	
	longitude	latitude	longitude	latitude	Easting	Northing
	83°13'35.228"E	20°48'13.566"N	83°13'28.1007" E	20°48'16.4911" N	731530.13946	2302117.23872
	83°13'51.916"E	20°48'13.134"N	83°13'44.7866" E	20°48'16.0594" N	732012.92873	2302110.62529
	83°13'49.691"E	20°46'59.617"N	83°13'42.5628" E	20°47'02.5485" N	731979.84763	2299848.59932
	83°14'11.185"E	20°46'59.553"N	83°14'04.0541" E	20°47'02.4848" N	732601.55270	2299855.23599
	83°14'09.458"E	20°45'33.343"N	83°14'02.3284" E	20°45'36.2820" N	732588.31748	2297203.01365
	83°13'32.418"E	20°45'33.178"N	83°13'25.2932" E	20°45'36.1166" N	731516.90384	2297183.14437

The area is connected by fair weather road from the State High-way No. 1 (Balangir-Patanagarh Road). The fair weather road crosses Suktel River through a ford north of Khuntapalli village and is open to traffic from January to June. During the peak of Monsoon, Rengali & Tamiya blocks can be approached from Balangir via Chandanbhati by an all weather pucca road. The intervening villages are connected by fair weather jeepable unmetalled roads. The nearest railhead is Balangir.

1.2.2. Physiography & Drainage

The area comprises of wide spread plain land, folded ridges, hillocks and mounds. The maximum height of the ridge is 372m and minimum height of the valley is 194m above MSL. Rain-fed easterly flowing Suktel River with network of streams drains the area. The drainage is sub-parallel to sub-dendritic controlled by ridges and lineaments. Thick alluvium accumulated due to the Suktel has helped extreme cultivation in the area.

1.2.3. Climate

The area has a sub-tropical climate with torrential rainfall between June and September. The temperature ranges between 10^0 C in winter and 46^0 C in summer season and the average annual rainfall is around 100 cm. This part of Orissa is very hot in summer with occasional extreme hotness in comparison to other parts of the state.

1.2.4. Flora and Fauna

The areas under exploration are sparse to densely vegetated. Kayaghat reserve forest covers part of the Rengali Block. The floral assemblage includes Sal (Shorea robusta), Shishu (Dalbergia latifolia), Neem (Nekua indica), Tamarind (Tamarindus indica), Jackfruit (Autocarpus intergrifolia), Kendu (Diaspyros melanxylon), Mango, Amla, Harida, Bahada, Boula, Simili, Berries and Bel etc. Wild animals are scarcely observed in this area. The faunal

assemblages include bears, rabbits, snakes, wild boars, jackals, peacocks, wild hens and host of birds.

1.3.0 Previous Work

1.3.1 B.C. Roy (1940) first reported the manganese ore deposits in Balangir district. He observed that: (i) the manganese ore deposits occupy summits and plains (ii) the ore manganese ore bodies have definite strike and dip (iii) the manganese ore comprises mainly of pyrolusite and psilomelane as ore minerals with chert, limonite and wad, (iv) the ore bands are associated with calc-granulites and garnetiferous gneisses.

1.3.2 Later on, Jhingran (1947) investigated and Krishnaswamy (1950) estimated the ore reserve to the tune of 650 thousand tonnes up to 1.5 m depth. Later on, host of workers from Geological Survey of India have carried out field work from 1962-65 and onwards. Finally, investigation aided by drilling was taken up in 1994-95. The average grade of ores from Balangir district range from 19-39% Mn, 10-28% Fe, 4-46% SiO_2 and 0.12-0.48% P.

1.3.3 A.G. Jhingran (1947) envisaged that the Dunguripalli manganese ore deposit (T. S. No. 64 P/5) was of considerable magnitude. Shri S. Krishnaswamy (1950) observed numerous occurrences of Mn ore mainly as lenses and pockets in calc-silicates, being parallel to regional foliation trend and assessed a reserve of 6,60,000 tonnes up to a depth of 15 m in T.S. P/1 & 5. M.W. Tak (1964-65), P. Bose (1965-66) and D. Mitra (1964-65) had mapped on 1:63,360 scale in Toposheet No. 64 P/5 & 9, 64 P/5, and 64 P/1 & 5 respectively.

1.3.4 M.W. Tak carried out mapping in the northern part of the present area and found that Mn mineralisation is associated with calc-gneiss, diopside granulite and highly weathered khondalite. P. Bose (1967) observed numerous lensoidal and pocket type deposits within khondalite and partly in calc-silicate rocks. D. Mitra observed the occurrences of Mn ore within khondalite suite of rocks. He envisaged that the presence of quartz-garnet-rhodonite association in deposits indicate probably a gonditic rock and closeness of calc-silicate within ore deposits suggest a calc-magnesian association common in sedimentary environment.

1.3.5 Patel, N.K. et al. (1983) of D.M.G., Orissa carried out systematic mapping of 60 sq. km on 1;25, 000 scale in Babja-Dumerijharam area and 2.5 sq. km detailed mapping on 1;2000 scale in Bijapatti east Belpali-Bhaludungri area. He computed the total probable reserve of all grades to be 95,677 tonnes up to a depth of 3m. They observed that Mn ores occurs at the contact of khondalite and calc-granulites in the form of discontinuous bands and pockets of irregular dimensions. Twelve numbers of Mn ore occurrences were reported in the area such as: near southeast of Banipali, NW of Dandapani, NW of Dumerijharam, NE of Gerdi and SE of Thakurpalli. Besides, disintegrated manganese float ores were reported near Barkani, Babja and Uchhabpalli. They had done 410 cu.m of trenching and pitting and 249 nos. of channel and grab sampling.

1.3.6 Jena, S.K. et al (1993-94) carried out large scale mapping on 1:25,000 scale in Gadashankar-Dandapani area of Balangir district between latitude 20^0 44' to 20^0 55'N and longitude 83^0 15' to 83^0 21'E and delineated four major ore zones.

1.3.7 Patel, M.C. (1996) initiated preliminary exploration work by drilling in 1994-95 F.S. Mishra U.S. and Hussain, A. (1997) carried out E-1stage (G3 of UNFC, Ref: letter No 2692/K-1(Vol-II)/TC/ODS/2017 dated 07/11/2017 of GSI) exploration work over four blocks, viz., Biarpalli, Khagsabahal. Tabalbanji and Dunguripalli (north) blocks aided by detailed mapping and drilling in Toposheet No. 64 P/5 & 6.

1.3.8 Behera, S.N. (1996-97) carried out large scale mapping of an area of 115 sq.km on 1:25,000 scale in Babja ($20^0$50'00"-$83^0$20'36"E)- Thelkuchhapur ($20^0$50'15"N-$83^0$46'00"E), Dandapani,

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Tamiya and adjoining areas under P-II stage investigation to study manganese occurrences viz-a-viz their nature and to grade and to identify potential blocks for detailed exploration.

1.3.9 During F.S.P. 1997-98 and 1998-99, Hussain et. al. carried out exploration of manganese deposits in Dunguripalli, Dandapani and Rengali blocks and had taken up E-1 Stage exploration in these three blocks along with Tamiya block during F.S.P 1999-2000 & 2000-2001 by Stage Review Committee's recommendation in 1998. The details of the boreholes drilled by GSI in Tamiya block is given in Table No 1.1.

BH No	Angle	Azimuth	R.L at Collar	Total depth (in m)
BTY-1	45°	E	225.80	71.10
BTY-2	45°	W	220.30	71.00
BTY-3	45°	N60°W	229.50	47.60
BTY-4	90°	-	216.20	50.50
BTY-5	45°	N60°W	214.10	47.80
BTY-6	45°	N77°W	215.70	50.05
BTY-7	45°	W	207.04	51.00
BTY-8	45°	W	222.80	56.00
BTY-9	45°	N83°W	196.40	54.00
BTY-10	45°	N60°W	192.60	56.00
BTY-11	45°	S82°W	188.20	55.05
BTY-12	45°	N65°W	208.60	50.50
BTY-13	45°	N85°E	208.60	51.00
Total				711.60 m

1.4.0 Findings & Recommendations

A possible reserve of 0.54 million tonnes in Babja block, **0.97 million tonnes in Tamiya block**, 0.31 million tonnes in Dunguripalli South block, 0.06 million tonnes in Rengali block, 0.6 million tonnes in Biarpalli block and 0.11 million tonnes in Dunguripalli North block were estimated at cut-off grade of 20% Mn up to a vertical depth of 45 m.

On basis of findings of E-I stage of exploration, authors recommended that,

(1) Drilling may be continued based on the encouraging geochemical result, in the present area to prove the strike and depth continuity of the ore zone up to 60 m vertical depth.

(2) Large scale mapping followed by detailed mapping in adjacent areas with an emphasis on structure is to be carried out to delineate more ore bodies.

(3) Extensive sampling work should be taken up to know the average grade as well as for the purpose of beneficiation.

(4) Petrographical and ore microscopic studies are to be carried out in more detail to know the origin and genesis of the ore.

1.5.0 Manganese ore zones intersected in the boreholes drilled by GSI in Tamiya Block

Bore hole No.	Depth of ore zones intersected in BH		Thickness of mineralised / ore zone (m)		Analysis	
	From (m)	To (m)			Mn%	Fe%
BTY-1	24.50	30.30	5.80	5.80	25.43	17.57
BTY-2	-	-	-	-	-	-
BTY-3	4.00	12.00	8.00	17.55	23.89	12.99
	23.00	32.25	9.55		20.78	12.66
BTY-4	11.30	11.60	0.30	1.90	23.13	5.88
	12.80	14.40	1.60		24.95	11.25
BTY-5	26.00	32.00	6.00	6.00	24.82	17.03
BTY-6	-	-	-	-	-	-
BTY-7	-	-	-	-	-	-
BTY-8	6.00	15.00	9.00	10.00	22.14	13.42
	28.85	29.85	1.00		23.05	16.66
BTY-9	-	-	-	-	-	-
BTY-10	18.25	19.25	1.00	1.00	27.62	10.64
BTY-11	18.50	19.50	1.00	7.15	24.54	18.76
	26.40	28.40	2.00		23.68	15.89
	29.40	33.55	4.15		26.91	13.85
BTY-12	21.10	23.10	2.00	2.00	22.44	15.75
BTY-13	6.10	9.70	3.60	3.60	23.75	16.87

2.0.0 Regional Geology

2.1.1 The exploration area lies in the northern part of the Eastern Ghats Super Group of rocks belonging to the meta-sedimentary sequence of Precambrian khondalite. The sequence of para-metamorphic is made up of pelitic, psammitic and calcareous formations, which are represented by khondalite, quartzite and calc-silicate rocks. These have been intruded by granites. All the hill ranges in this area are composed of either khondalite or garnetiferous quartzites or both. Calc-silicate bands adjoining to the ore horizons form denudational hillocks or mounds and are 1 to 2m thick. Granite gneiss occupies the valleys. The whole sequence has been metamorphosed to granulite facies. Structurally the area exhibits a complex picture.

2.1.2 On the basis of contact relationship, presence of xenoliths/caught up patches of one particular unit within the other, and structural and stratigraphical relationship the tentative stratigraphic succession of the area may be given as follows:

Recent to Sub-recent	Soil and Alluvium
	Laterite/Latsol
Precambrian	Aplite, Pegmatite and Quartz veins
	Granitoids: Equigranular, non-garnetiferous granite gneiss, garnetiferous granite gneiss and granulite, leptinitic gneiss, Migmatite
	Charnockite Suite: Hypersthene bearing gneisses and Granulites (mostly acid to intermediate charnockitic type)
	Khondalite Suite: Pyroxene granulite quartzite Khondalite with manganiferous horizons
	Calc-silicate rocks with manganese ore
Base Not Seen	

2.2.0 Geology of Study Area

2.2.1 The rock types exposed in the area are calc-silicate, quartzite (Mn bearing), granite gneiss, amphibolite and quartz and pegmatite vein. From the disposition of individual members of khondalite it is difficult to ascertain the stratigraphy, as the units have been subjected to different cycles of sedimentation as well as deformation. Description of different litho unite is given below.

2.2.2 **Calc-silicate rocks:** The calc-silicate rocks occur as bands and lenses within khondalites and also with Mn-ore bearing silicate-carbonate rock in the form of denudational hillocks and mounds and are intricately folded and exhibit rib and furrow weathering structure and crude layering. Their trend generally confirms the regional foliation direction and the contact of these rocks with khondalite and granite is sharp. The calc-silicate bands are 100m to 1km in length and 20 to 50 m in width.

The calc-silicate rock is usually a dark grey to greenish, fine to medium grained, hard and massive to foliated. It contains green diopside, hornblende, plagioclase (andesine), garnet (grossularite), scapolite, sphene and quartz. Accessories include zircon, calcite, apatite and epidote.

2.2.3 **Khondalite** (quartz- feldspar- garnet- sillimanite +graphite schist/gneiss):

It occurs typically in bouldery outcrops (highly weathered) on narrow, steep hill ranges and low lying mounds and in valley interbanded with quartzite and calc-silicate rocks. This is coarse grained, brownish yellow to reddish grey coloured, foliated and highly weathered rock. Due to varying degree of weathering its colour changes to pinkish/purplish at places, when highly kaolinised, it becomes very light. It is highly sheared and mylonitised at places. The rock is manganiferous and secondary manganese minerals occur along the foliation, fracture and joints planes. The rock is intimately associated with quartzite and both grade into each other along as well as across the foliation. They are highly migmatised and the quartzofeldspathic neosome bands that have traversed the rock along the regional foliation plane of the rocks.

2.2.4 **Quartzite:** The quartzites are medium to coarse grained, white to buff coloured, granular to faintly schistose in nature and are invariably garnetiferous. Pegmatite and quartz veins traverse the rock along foliation planes. Quartzites grades laterally to khondalite. It is predominantly made up of large xenoblastic grains of quartz with pale pink garnet and clusters of sillimanite. Quartzite is highly brecciated in a number of places such as in Dandapani block. Brecciated quartzite, in general contains ore bodies. Manganese

manganiferrous mineralisation is noticed within brecciated and feldspathised quartzites at places. Manganiferous quartzite is exposed in Dandapani and Dunguripalli (south) blocks.

2.2.5 **Granulite:** It is coarse grained black massive rock and occurs as small lenticular inclusions parallel to foliation within granite gneiss and at places occur in boulder form along small ridges in association with khondalite and quartzite. It is mainly a plagioclase (andesine-labradorite)-pyroxene rock with subordinate amount of amphibole, biotite, garnet, perthite and quartz and accessories include sphene, ilmenite, zircon and apatite.

2.2.6 **Migmatite:** Migmatites occupy the low lying areas in the east of Bijapati and around Dunguripalli. It exhibits gneissose structure and the palaeosome includes, hypersthene, diopside and biotite and the neosome comprises of K-feldspar and plagioclase.

2.2.7 **Granite Gneiss:** This is medium to coarse grained rock occupying low-lying areas with migmatite, consisting mainly of quartz, plagioclase, K-feldspar, biotite, garnet, epidote and few opaques. The whole sequence has been metamorphosed to granulite facies. The alkali-feldspar gneiss is fine to coarse grained and contains porphyroblasts of microcline and perthite within quartz-feldspar-garnet aggregates.

2.2.8 **Pegmatite and quartz veins:** Pegmatite and quartz veins traverse the rocks at a number of places close to manganese mineralisation in all the rock types both along and across the foliation. At places pegmatite contains few crystals of beryl which are of less significance.

2.2.9 **Laterite:** Laterite is developed mainly over khondalite and granite gneiss and is very common in areas close to manganese mineralised zones as in Dunguripalli (south) Block. Extensive development of latsol over laterite has been developed in northeast of Rengali.

2.3.0 Regional Structure

The entire area covered by detailed mapping exhibits a complex structural fabric as the whole sequence has been subjected to multiple cycles of deformation. As a result, the existing structural elements are completely altered rendering it difficult to decipher the complete structural geometry. However, the secondary planar structural elements like, foliation and gneissosity and joints are well preserved in the rock types of the area. The different structural features as observed are described below:

2.3.1 **Primary structures:** The primary structures have been mostly obliterated due to granulite facies metamorphism. However, relict bedding is observed along the contact between khondalite, quartzite and calc-silicates. Interbanding of different litho units within the Khondalite Group is seen clearly in many outcrops.

2.3.2 **Secondary structures:** The secondary planar structures such as foliation, gneissosity, schistosity, joint and cleavages are well preserved in rocks. S1 is defined by compositional banding, preferred orientation of prismatic, acicular and flaky minerals in the rock.

2.3.2.1 **Foliations:** Foliation (S1) is most pervasive and trends in NNW-SSE to NE-SW direction with moderate to steep easterly to south-easterly dip. Planar arrangement of minerals like garnet, biotite, sillimanite, graphite, quartz and feldspar mark the foliation plane in khondalite, quartzite, calc-silicate rocks and granite.

2.3.2.2 **Joints:** Altogether, two sets of joints are observed in the blocks under exploration. These are E-W dipping 70^0 to 80^0 to south and N 65^0 E-S 65^0 W dipping 60^0-80^0 to southeast.

2.3.2.3 **Lineations:** Two types of lineations are noted in the area:

(I) slickenside lineation: This is observed in manganiferous quartzite and calc-silicate rocks.
(ii) Mineral lineation: The mineral lineation is defined by minerals like sillimanite, biotite and garnet.

2.3.2.4 **Folding:** The area exhibits at least three generations of folding. The first generation of folds (F1) is tight isoclinal, intrafolial, upright and reclined in nature. The F1 folds are developed

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conspicuously in calc-silicate rocks and to a lesser extent in quartzites. The axial planes of F1 folds have a general trend in NNW-SSE direction. The second generation of folds (F2) is moderate to steeply plunging, open and broad type on NE-SW axis and third generation fold (F3) is characterised by upright, open to broad warps with E-W trend.

2.3.2.5 **Faults and Shear:** Faulting and shearing are evidenced by brecciation, silicification, vug filling, slickensides and mylonitisation in quartzite and khondalite. Quartzite and khondalites are intensely silicified and brecciated resembling chert breccia in the vicinity of manganese ore bands in a number of places such as west of Bijapali village in Dunguripalli south block. Shifting and missing of ore bands are due to local fault and pinching and swelling nature of ore bodies in the area.

2.4.0 Metamorphism

High grade metamorphism under granulite facies conditions characterise the Eastern Ghats Super Group of rocks. The mineral assemblages of khondalite (quartz-feldspar-garnet-sillimanite+graphite), granulite (plagioclase-hypersthene-diopside) and calc-silicate (diopside-plagioclase-calcite-quartz-scapolite) indicate pyroxene granulite subfacies under granulite facies of Eskola.

2.5.0 Mineralization (Surface manifestation)

On the surface the Mn ore mineralization presents a rugged bouldery outlook. In general oxide minerals show granoblastic to granulitic fabric. Gravity filling, stalactitic, botryoidal, box work and colloform structures are commonly observed within the ore. The ore is in general steel grey to dull grey in colour and is soft or powdery in nature. Pyrolusite, psilomelane and cryptomelane are seen replacing each other. Silica in rhodonite is seen replaced by the manganese oxides.

Manganese ore bodies occur as bands, lenses, pockets, veins, tabular bodies and disseminations within the khondalite group of rocks. The ore is more enriched at the central part. The lensoidal/discontinuous ore bodies are arranged in an en-echelon pattern. These are lateritic and have been weathered to a considerable depth along with the enclosing rocks. The ore bodies are conformably interstratified with and enclosed in different stratigraphic levels with calc-granulite at its contact with khondalite. Detailed mapping and available subsurface data suggest that the ore is concentrated along the fold axes of minor and mesoscopic folds. Intense brecciation, shearing, fracture form the important loci for mineralisation and the granitic intrusion have influenced the depth persistence of the ore. The lensoidal discontinuous ores owe their origin to the flowage or drag folds. Hence it may be concluded that manganese ores are both lithologically and structurally controlled.

3.0.0. Proposed programme for Exploration

The present exploration programme has been formulated in accordance with the previous work carried out by GSI in the part of the blocks, on basis of earlier findings and recommendations, recommendations of CGPB committee I (Ref: IBM Publication, Manganese Ore Vision 2020 & Beyond) on Manganese ore exploration and also as per Mineral (Evidence of Mineral Contents) Rule-2015 & Mineral Auction Rule-2015 to fulfil the following objectives:-

3.1.1 Objective of the proposed General Exploration (G-2) work in the area already explored by GSI in G-3 level:

i) To carry out detailed geological gapping on 1:5000 scale and demarcate the rock types of manganese bearing formations with the structural features i.e. strike, dip, lineations / foliations etc.

ii) To drill boreholes in the 100m section interval considering data of boreholes drilled by GSI.

iii) To drill boreholes to prove depth continuity up to 70m vertical depth from the surface as per the recommendation of GSI in their previous work.

iv) To estimate manganese ore resources (332) in the block as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015.

3.1.1 Objective of the proposed Reconnaissance Survey (G4) work in the rest of the area:

i) To carry out geological mapping on 1:5000 scale and demarcate the rock types of manganese bearing formations with the structural features i.e. strike, dip, lineations / foliations etc.

iii) To carry out Surface Geolphysical survey (Gravity, Magnetic & Resistivity) to demarcate concealed manganese ore body.

iii) To carry out trenching/pitting to expose manganese body under soil & lateritic cover.

iv) To drill 5 no scout boreholes to prove the existence of manganese ore body and establish persistence of manganese body over a promising strike length.

v) To estimate manganese ore resources (334) in the block as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015.

5.0.0 Methodology of Proposed Exploration

5.1.0 In accordance to the objectives set for reconnaissance (G-4) survey and General Exploration (G2) in Tamiya Block, District- Balangir, Odisha, geological mapping, geophysical survey and scout drilling programme associated with other geological, sampling and analytical work is proposed in the block. The exploration shall be carried out as per Mineral (Evidence of Mineral Contents) Rule-2015 and Mineral Auction Rule-2015.

Accordingly, the details of different activities to be carried out are presented in subsequent paragraphs.

5.2.0 Topographic Surveying

Topographical survey will be carried out in the block area in which G-2 stage of exploration will be carried out. All the surface features will be picked up and marked on a map on 1:5000 scale. The prospect area would be tied up with the triangulation network. The reduced levels and co-ordinates of boreholes would be determined. The locations of the channels and pits will be surveyed. The block boundary will be surveyed by DGPS & total station in WGS-84 Datum for demarcation of Block Boundary points and ancillary area to facilitate the state governments for auctioning of blocks.

5.3.0 Geological Mapping

Detailed geological mapping on 1:5000 scale will be carried out in the entire block are by taking geological traverses in the block. The contacts of different formations, identification of different rock formation, structural features, etc., will be carried out in detail. The geophysical

survey data could help in updating of map provided by GSI. The geological map on 1:5000 scale will be generated based on the detail geological mapping of the block and interpretation of G-4 as well as G-2 level exploration data.

5.4.0 Channel Sampling:

Seven number trenches of 40 m length each, 1m width and 2 m depth is proposed to be cut directly on the fresh outcrop/rock exposures across the Mn ore body. The channel of 5cm x 2cm dimension will be cut on the floor of the trenches to collect the channel samples. The length of each channel sample will be kept as 0.50m uniformly in the same type of lithology, whereas, the length of the sample may be adjusted with variation/change in lithology. The length of channel sample may not exceed 1.00 m in any case. The representative powdered samples of (-) 200 # size will be obtained by stage wise grinding of the chips collected from the channels and by reducing the weight of sample by repeated coning and quartering. A final finished sample of 500 gram (- 200 mesh) will thus be prepared. One part around 100gm sample will be sent to chemical laboratory for analysis, second part will be preserved in the camp as duplicate sample, the third part will be utilized for preparing composite sample for individual ore band and the fourth part will be kept as either check sample or sample to be used for any other specific purpose. Thus total 600 nos of Primary channel samples will be generated. 10% of Primary channel samples (60 samples) will be sent to Chemical Laboratory, MECL, Nagpur for analysis as internal check samples. Around 5% of Primary samples (Approx.30 Nos) will be sent to NABL accredited External Laboratory for analysis. All primary, internal check and external check channel samples will be analyzed for 6 radicals. (Mn, SiO_2, P_2O_5 Fe_2O_3, MnO_2 and Insolubles.)

Mineralized zones will be delineated at cut off grade based on the chemical results of primary channel samples. Composite samples would be prepared from the mineralized zones of primary channel samples for each channel. It has been envisaged that 50 Nos. of composite sample would be generated and will be analyzed for 6 radicals i.e. Mn, SiO_2, P_2O_5 Fe_2O_3, MnO_2 and Insolubles.

5.5.0 Geophysical Survey–

The proposed area (Tamiya Block) consists of a sequence of para-metamorphic made up of pelitic, psammitic and calcareous formation, which were represented by Khondalite, quartzite and Calc-Silicate rocks. From the earlier geological reports of GSI it seems there are few Mn exposures which strike NNE and SSW dipping around 60 □- 65 □ towards East. The rock types exposed in the area are calc-silicate, quartzite (Mn bearing), granite gneiss, amphibolites, quartz and pegmatite vein. Physical properties of Manganese ore and expected host rocks are given in table below.

Ore/ rock	Chemical composition	Mn content	Density (g/cc)	Magnetic Susceptibility. 0-CGS
Pyrolusite	MnO_2	63%	4.70-5.00	Paramagnetic
Psilomelane	$MnOMn_2OH_2O$		3.70-4.70	
Braunite	$Mn_2O_3Mn_6O_2$	64.3%	4.75-4.82	
Rhodonite	$MnSiO_3$	41.8%	3.40-3.6	Paramagnetic
Rhodochrosite	$MnCO_3$	47.8%	3.40-3.60	100
Jacobsite	$MnFe_2O_4$		4.95	200-300
Quartz			2.6-2.8	.00063
Mica			2.15	

In addition to above the resistivity contrast between Manganese ore and host rocks is also remarkable, based on the above physical properties of the manganese ores and its host hocks in typical geological settings. The magnetic, density & resistivity properties of the manganese ore deposit varies significantly in order of magnitude, which depends on the chemical composition and Mn content of the ore. In view of these physical properties of rock types Magnetic, Gravity and Resistivity survey has been proposed in the area for demarcating the ore mineralization zones.

Geophysical traverses are laid in E-W direction at 50m traverse interval with station spacing of 25m proposed for gravity, magnetic and resistivity survey. Total number of stations proposed are 3296 on 100 traverses for gravity, magnetic and 79.9 L.Km. for Resistivity survey (Detail stations and line km was given below in Table). However the station interval may be reduced to 15/20m in certain lines to have more control while acquiring the data. A period of 6 working months is required for completing and submitting the report (4 months for acquiring data and 2 months for processing and interpretation).

Details of stations and Ikm of Tamiya block

Tamiya Block					
Lines Numbers		Stations per line	Cum Stations	Individual Line Km	Cum Line Km
From	To				
1	54	44	2376	1.075	58.05
55	100	20	920	4.75	21.85
Total			3296		79.9

5.6.0 Exploratory Drilling:

Based on the outcome of geological mapping, analytical results of surface channel samples and delineation of manganese ore body on the basis of surface geophysical survey by using gravity, magnetic & resistivity methods, 5 numbers of scout borehole is being proposed be drilled (for shallow level i.e. 50m vertical depth from surface) for intersection of mineralised zones of Manganese. Approximately a total of **310.00 m** of core drilling will be done in the 5 proposed scout boreholes.

The exploration work of phase-I will bring the deposit to G-4 level of exploration. The detail drilling at close spaced grid is proposed in the part of the block where GSI had already carried out G-3 level exploration to bring the deposit to G-2 level which will help the State Govt. of Odisha to facilitate auctioning of the blocks. Thus, a total of 28 no of exploratory boreholes involving **1590.00 m** of exploratory drilling have been earmarked for G-2 level of exploration. The borehole locations, azimuth, inclination and depth of the proposed boreholes are given in the table below and shown on the geological map and geological cross sections. (Plate-III & IV)

(9)

Details of Proposed Boreholes to be drilled in G-4 Level					
Sr. No	Borehole No	Total epth (m)	Thickness of expected ore zone (m)	Inclination	Azimuth
1	PBH-G4/1	55	55	45^0	N84^{0}W
2	PBH-G4/2	70	70	45^0	N84^{0}W
3	PBH-G4/3	30	30	45^0	S80^{0}W
4	PBH-G4/4	70	70	45^0	S80^{0}W
5	PBH-G4/5	85	85	45^0	S80^{0}W
Total		**310.00 m**			

Details of Proposed Boreholes to be drilled in G-2 Level						
Sr. No	Section No	Borehole No	Total Depth (m)	Thickness of expected ore zone (m)	Inclination	Azimuth
1	A-A'	-	-	-	-	
2	B-B'	PBH-1	50	20	45^0	W
3		PBH-2	60	30	75^0	W
4		PBH-3*	55	15	75^0	W
5	C-C'	PBH-4	70	10	60^0	E
6	D-D'	PBH-5	45	15	45^0	W
7		PBH-6	80	15	45^0	W
8	E-E'	PBH-7	55	40	90^0	W
9	F-F'	PBH-8	60	15	60^0	W
10		PBH-9	80	20	45^0	W
11	G-G'	-	-	-	-	
12	H-H'	PBH-10	25	5	75^0	W
13		PBH-11	55	20	75^0	N60^{0}W
14		PBH-12*	55	15	75^0	N60^{0}W
15	I-I'	PBH-13	55	20	45^0	N60^{0}W
16		PBH-14*	55	15	75^0	N60^{0}W
17	J-J'	PBH-15	65	20	45^0	N60^{0}W
18		PBH-16*	65	10	45^0	N77^{0}W
19	K-K'	-	-	-	-	-
20	L-L'	-	-	-	-	-
21	M-M'	PBH-17	35	10	75^0	N77^{0}W
22		PBH-18*	65	10	75^0	N85^{0}W
23	N-N'	PBH-19	50	10	75^0	N85^{0}W
24	O-O'	PBH-20	45	10	75^0	N85^{0}W
25		PBH-21*	80	10	75^0	N85^{0}W
26	P-P'	PBH-22	70	15	45^0	N85^{0}W
27	Q-Q'	PBH-23	25	10	75^0	N65^{0}W
28		PBH-24*	55	10	75^0	N65^{0}W

29	R-R'	PBH-25	60	15	45^0	N65^{0}W
30	S-S'	PBH-26	75	20	45^0	N63^{0}W
31	T-T'	PBH-27	35	15	75^0	N82^{0}W
32		PBH-28	65	20	75^0	N82^{0}W
		TOTAL	**1590.00 m**			

***Conditional Boreholes will be drilled if 1st level boreholes found positive.**

5.7.0 Core Logging

The borehole cores would be logged systematically. Viz. details of the litho units, colour, structural feature, texture, mineralization, besides the recovery, rock quality designation (RQD) and manganese ore type would be recorded.

5.8.0 Core Sampling: The mineralized part of drill core will be splitted into two equal halves and one part will be preserved in the core box for future reference and will be handed over to core library, GSI after completion of the project. The other half will be powdered to (-) 200 # size by grinding and stage wise coning and quartering. One part around 100gm sample will be sent to Chemical Laboratory, MECL, Nagpur for analysis, second part will be preserved in the camp as duplicate sample, third part will be utilized for preparing composite sample for individual ore band and the fourth part will be kept as either check sample or sample to be used for any other specific purpose. The length of each sample will be kept 0.50m within the ore zone depending upon the width of particular type of manganese ore and its physical character. The primary core samples will be analysed for 6 radicals' i.e. Mn, SiO_2, P_2O_5 Fe_2O_3, MnO_2 and Insolubles.

The cores of rocks 3 m immediate below footwall and 3 m immediate above hanging wall of mineralized zones (5 m length each) would be sampled at 1.0 m interval, as far as possible, depending upon the intensity of mineralization, change in lithology and core recovery etc.

a) Around 660 nos of core samples (600 No **Primary &** 60 No **Check samples)** would be generated in G-4 level and 990 nos of core samples (900 No **Primary &** 90 **No Check samples)** in G-2 level of exploration from the mineralized zone intersected in the boreholes of **Tamiya Block**. All the primary and internal check samples would be analysed for 6 radicals i.e. Mn, SiO_2, P_2O_5 Fe_2O_3, MnO_2 and Insolubles (Core Sample. + Check Sample)

b) Around 5% of Primary samples (Approx.10Nos) will be sent to NABL External Labs for analysis of for 6 radicals i.e. Mn, SiO_2, P_2O_5 Fe_2O_3, MnO_2 and Insolubles as External Check Samples. (30 nos samples in G-4 and 45 nos samples in G-4)

c) Composite samples would be prepared from the mineralized zones of primary drill core samples of each borehole as well as from the mineralized zones demarcated in the channels. 100 Nos. of composite sample would be generated from drill cores in G-2 level and 100 nos (50 nos drill core composite samples and 50 nos channel composite samples) will be generated in G-4 level of exploration and be analyzed for 6 radicals (Mn, SiO_2, P_2O_5 Fe_2O_3, MnO_2 and Insolubles).

d) A total of 20 nos composite samples in G-2 level and 10 nos composite samples in G-4 would be analyzed by X-ray diffraction to ascertain the presence of different mineral phases.

e) A total of 10 nos composite samples in G-2 and 10 nos composite samples in G-4 would be analyzed by ICP-MS method to ascertain the presence of 14 no trace elements associated with the Manganese deposit.i.e. Cd, Sn, W, Sb, Ce, Nb, Ba, La, Bi, Co, Ni, Sr, Mo, V

5.9.0 Petrological and Mineragraphic Studies: Thin and polished section studies on drill cores samples would be done for ascertaining the petrographic and mineragraphic characteristics. These samples would be drawn from ore zones and host rocks. A provision of 20 specimens for petrographic and 20 specimens for mineragraphic studies has been kept in G-2 level. Similarly a provision of 10 specimens for petrographic and 10 specimens for mineragraphic studies has been kept in G-4 level.

5.10.0 Specific Gravity Determination: To derive the tonnage factors, 20 nos. of samples in G-4 and 30 nos samples in G-2 are proposed to be subjected for specific gravity determination. The samples are to be drawn from ore zones/ mineralised zones.

5.11.0 Bulk Density Determination: Provision of 5 nos pits in Mn ore zone is kept for assessment of bulk density of manganese ore. The dimension of the pit will be 1m x 1m x 1m.

5.12.0 Quantum of work

The quantum of work proposed by MECL in Tamiya Block (G-4 and G-2 Level of Exploration) is given in Table 5.1.

(6)

Table: 5.1 Proposed Quantum of Exploratory Work in Tamiya Block for G-4 level

Proposed Quantum of Work (G-4) in Tamiya Block, District-Balangir, Odisha			
Sl. No.	**Item of Work**	**Unit**	**Proposed Quantum of work**
1	Topographic Survey (on 1:5000 Scale).	Sq. Km.	-
2	Geological Mapping (on 1:5000 Scale).	Sq. Km.	3.92
3	Geophysical Work		
	i) Gravity Survey	No of Station	3296
	ii) Magnetic Survey	No of Station	3296
	iii) Resistivity Survey	Line Km	79.9
4	Core Drilling (5 Scout Boreholes)	m.	310.00
5	Trenching & Pitting: i) 7 Trenches (1m x 2m x 300m) ii) 5 Pit (1m x 1m x 1m) for Bulk Density Determination	Cu.m	600 5 (Total 605)
6	Sample Preparation & Laboratory Studies		
A.	Primary samples (Channel Sample+ Core Samples)		
	i) Chemical Analysis: Primary for 6 radicals i.e. Mn, SiO_2, P_2O_5, Fe_2O_3, MnO_2 and Insolubles	Nos.	(600+600)= 1200
	iii) Internal Check samples (10% of Primary samples) for analysis of 6 radicals i.e. Mn, SiO_2, P_2O_5, Fe_2O_3, MnO_2 and Insolubles	Nos.	(60+60)= 120
	iv) External Check sample (5 %of Primary samples) for analysis of 6 radicals i.e. Mn, SiO_2, P_2O_5, Fe_2O_3, MnO_2 and Insolubles	Nos.	(30+30)= 60
B.	Composite Samples (Channel Sample+ Core Samples)		
	i) composite samples will be analyzed for 6 radicals i.e. Mn, SiO_2, P_2O_5, Fe_2O_3, MnO_2 and Insolubles	Nos.	(50+50)= 100
7	Trace Element Study by ICP-MS Method (14 Elements)	Nos	10
8	XRD study	Nos	10
9	Petrographic Studies	Nos	10
10	Mineragraphic Studies	Nos	10
11	Specific Gravity Determinations	Nos	20
12	Bulk Density Determination	Nos	5
13	Report Preparation (Digital format)	Nos.	1

(5)

Table: 5.2 Proposed Quantum of Exploratory Work in Tamiya Block for G-2 level

Proposed Quantum of Work (G-2) in Tamiya Block, District-Balangir, Odisha			
Sl. No.	**Item of Work**	**Unit**	**Proposed Quantum of work**
1	Topographic Survey (on 1:5000 Scale).	Sq. Km.	3.92
2	Geological Mapping (on 1:5000 Scale).	Sq. Km.	-
3	Core Drilling (28 Boreholes)	m.	1590.00
4	Pitting: 5 Pit (1m x 1m x 1m) for Bulk Density Determination	Cu.m	5
5	Sample Preparation & Laboratory Studies		
A.	Primary samples (Core Samples)		
	i) Chemical Analysis: Primary for 6 radicals i.e. Mn, SiO_2, P_2O_5, Fe_2O_3, MnO_2 and Insolubles	Nos.	900
	iii) Internal Check samples (10% of Primary samples) for analysis of 6 radicals i.e. Mn, SiO_2, P_2O_5, Fe_2O_3, MnO_2 and Insolubles	Nos.	90
	iv) External Check sample (5 %of Primary samples) for analysis of 6 radicals i.e. Mn, SiO_2, P_2O_5, Fe_2O_3, MnO_2 and Insolubles	Nos.	45
B.	Composite Samples (Core Samples)		
	i) composite samples will be analyzed for 6 radicals i.e. Mn, SiO_2, P_2O_5, Fe_2O_3, MnO_2 and Insolubles	Nos.	100
6	Trace Element Study by ICP-MS Method (14 Elements)	Nos	10
7	XRD study	Nos	20
8	Petrographic Studies	Nos	20
9	Mineragraphic Studies	Nos	20
10	Specific Gravity Determinations	Nos	30
11	Bulk Density Determination	Nos	5
12	Report Preparation (Digital format)	Nos.	1

6.0.0 Time schedule and Cost estimates

6.1.0 Time schedule:

The proposed exploration programme is planned for G-4 as well as G-2 Level. The work activities like camp setting, survey and associated geological work, geophysical studies, drilling& laboratory work at G-4 level will be completed within 9 months' time. Report writing (including peer review) will take another 4 months' time with overlapping of two month's laboratory studies. Thus the total duration of the project shall be 11 months from the date of commencement of the project.

The bar chart showing activities wise time schedule is placed at Table-6.1.

The work activities like survey, geological work, geophysical studies, drilling & laboratory work at G-2 level and camp winding will be completed within 9 months' time. Report writing (including peer review) will take another 4 months' time with overlapping of two month's laboratory studies. Thus the total duration of the project shall be 11 months from the date of commencement of the project. The bar chart showing activities wise time schedule is placed at Table-6.2.

6.2.0 Cost estimates:

The Project cost with provisional escalation is estimated at **Say. Rs.246.431 Lakhs**for**G-4** level of exploration and **248.780 Lakhs** for**G-2** Level of Exploration. The details of item wise cost estimate with inbuilt actual escalation as on 31.3.17 and same has been considered for subsequent years for geological and laboratory studies and is given in Table No. 7.1 &7.2 andthe summary is given below:

Table- 6.1: Summary ofCost Estimates

Sl. No.	Item	Total Estimated Cost (Rs.) G-4 Level	Total Estimated Cost (Rs.) G-2 Level	Total
1	Drilling	4525535	13584065	18109600
2	Geophysical Work	8787711	-	8787711
3	Geological Activity	2171160	3248010	5419170
4	Pitting	1012165	8365	1020530
5	Laboratory Studies	3970465	3183650	7154115
6	Preservation of Core Boxes	200300	840300	1040600
	Sub Total	**20667336**	**20864390**	**41531726**
7	Report 1% of Exploration Cost	206673	208644	415317
8	Peer Review	10000	10000	20000
9	**Sub Total (1 to 8)**	**20884009**	**21083034**	**41967043**
10	GST @ 18% of Sl. No 9	3759122	3794946	7554068
	Total	**24643131**	**24877980**	**49521111**
		Say, Rs. 246.431Lakhs	**Say, Rs. 248.780Lakhs**	**Say, Rs. 495.211Lakhs**

(3)

7.0.0 Justification

i. The Govt. of India enacted the MMDR Amendment Act-2015 duly introducing the system of auction for allocation of Mineral Concessions. Bauxite, Iron Ore, Manganese and Limestone have been categorized in the Fourth Schedule which needs prospecting and exploration by the State Govt. before auctioning of blocks.

ii. In view of this, Govt. of India directed State Governments to speed up exploration work for different mineral commodities in their respective states. GSI had already carried out G-3 (E-1) level exploration in 10-12 blocks in the region and some of the blocks explored seem to be potential. Hence Directorate of Geology, Govt. of Odisha proposed G-2 level exploration in the already explored GSI blocks and some adjoining area near these blocks for G-4 level exploration. The Directorate of Geology, Govt. of Odisha identified five prospective manganese blocks in Balangir District and four in Rayagada District for G-4/G-2 level exploration.

iii. Accordingly directorate of Geology, Government of Odisha requested MECL to take up exploration work for manganese in 9 Blocks in Balangir and Rayagada District of Odisha under NMET funding. Tamiya Block is one of the prospective manganese blocks identified for auction. MECL decided to take up the work through NMET fund.

iv. The proposed study area falls in the vicinity of nearby old manganese quarries.

v. Since most of the block area is covered with soil, geophysical survey (gravity, magnetic & resistivity survey) will be carried out in the block to demarcate the geophysical anomaly/mineralized zones of manganese, which will help in the formulation of G-4/G-2 level exploration programme.

vi. The G-4 level exploration will be helpful in estimation of Reconnaissance (334) Resources and will help in planning G3/G2 level of exploration programme which in turn will lead to estimation of indicated (332) category resources and will facilitate the State Govt. Odisha for auctioning of blocks.

Table-7.1 Cost Estimate for Manganese Ore Mineralisation in Tamiya Block (G4).

SL. NO.	Item of Work	Unit	Base Rate	Escalated rates (2018-19)			Escalated rates (2019-20)			Grand Total	
				Esc. Rate	Qty.	Amount	Esc. Rate	Qty.	Amount	Qty.	Amount
			1.4.90	(Rs)		(Rs)					(Rs)
A	DRILLING										
1	Surface Drilling (2 rig)	m	2035	8177	310	2534870	8177		0	310	2534870
2	Transportation	Km	6.8	31.0	2600	80600	31.0		0	2600	80600
3	Accomodation (One time/ Drill)		185925	663715	2	1327430	663715		0	2	1327430
4	Camp Setting / Winding	- do-	68606	244910	2	489820	244910		0	2	489820
5	Road Making (Flat Terrain)***	Km	5200	18563	5	92815	18563		0	5	92815
	Sub Total A					4525535			0		4525535
B	GEOPHYSICAL WORK										
1	Magnetic Survey	Nos	107	467	3296	1539232	449		0	3296	1539232
2	Gravity Survey	Nos	445	1842	3296	6071232	1974		0	3296	6071232
3	Resistivity Survey	Line Km	3473	14734	79.9	1177246.6	14734		0	79.9	1177246.6
	Subtotal B					8787710.6			0		8787711
C	GEOLOGICAL WORK										
1	Survey Party days (1 party)	day	1180	5840	30	175200	5840		0	30	175200
2	Geologist Party days (1 party)	day	1541	7802	90	702180	7802		0	90	702180
3	Bulk Sampling Party days (1 party)	day	2566	13439	90	1209510	13439		0	90	1209510
4	Core Sampling Party days (1 party)	day	525	2809	30	84270	2809		0	30	84270
	Sub-Total C					2171160			0		2171160
D	Pitting & Trenching										
	a) Pitting 5 Nos (1m x 1m x 1m) & Trenching (1m x 2mx 800 m) 7 Nos	Cu.m	395	1673	605	1012165	1673		0	605	1012165
	Sub Total D					1012165					1012165
E	LABORATORY STUDIES										
1	Chemical Analysis										
	i) Primary & Check samples										
	a. Primary Samples For 6 radical (Mn, SiO_2, P_2O_5, Fe_2O_3, MnO_2 and Insolubles)	Nos	490 (110 +76x5)	2580	1200	3096000	2580		0	1200	3096000
	b) Check Samples for 6 radical (Mn, SiO_2, $P2O_5$, Fe_2O_3, MnO_2 and Insolubles)	Nos	490 (110 +76x5)	2580	120	309600	2580		0	120	309600
	d) External Check Samples from NABL Labs for 6 radical (Mn, SiO_2, P_2O_5, Fe_2O_3, MnO_2 and Insolubles)	Nos	490 (110 +76x5)	2580	60	154800	2580		0	60	154800
	ii) Composite Samples										
	a) Composite Samples for 6 Radicals (Mn, SiO_2, P_2O_5, Fe_2O_3, MnO_2 and Insolubles).	Nos	490 (110 +76x5)	2580	100	258000	2580		0	100	258000
2	Physical Analysis										
i)	a) X-RD Studies on composite	Nos	1137	5605	10	56050	5605		0	10	56050
ii)	b) ICP-MS studies (14 Trace elements- Cd,Sn,W,Sb,Ce,Nb,Ba,La,Bi,Co, Ni, Sr, Mo, V**	Nos		4620	10	46200	4620		0	10	46200
iii)	Preparation of thin section	Nos	100	538	10	5380	538		0	10	5380
iv)	Petrographic Studies	Nos	228	1436	10	14360	1436		0	10	14360
v)	Preparation of polished section	Nos	100	538	10	5380	538		0	10	5380
vi)	Mineragraphic Studies	Nos	364	2023	10	20230	2023		0	10	20230
vii)	Specific Gravity determination	Nos	32	188.5	20	3770	188		0	20	3770
viii)	Bulk Density	Nos	24	139	5	695				5	695
	Sub-Total E					3970465			0		3970465
F	Preservation of Core										
i)	GI Core boxes			2000	80	160000	2000		0	80	160000
ii)	Transportation of Core Boxes	Km	6.8	31.0	1300	40300	31.0		0	1300	40300
	Sub-Total F					200300					200300
	Total A+B+C +D+E+F					20667336			0		20667336
G	EXPLORATION REPORT 1% of A+B+C +D+E+F									1	206673
H	PEER Review						10000	1	10000	1	10000
	Total A+B+C +D+E+F+G+H										20884009
I	GST @ 18%										3759122
	Grand Total :										24643131
									Say 246.431 Lakhs		

Note:

1 Gool Committee rates for Manganese ore are not available, hence Gold rates are taken on actual escalation as per RBI Indices as on

2 ** Rate has taken from Schedule of Charges of differen activities of GSI as on 2014-15 and 40% escalation on the same has been concidered

TABLE- 6.1 TIME SCHEDULE / ACTION PLAN FOR EXPLORATION PROPOSAL FOR MANGANESE ORE IN TAMIYA BLOCK,
(G-4 Level) DISTRICT - BALANGIR, ODISHA

			1	2	3	4	5	6	7	8	9	10	11	
1	Camp Setting	Month	←	→										1 month
2	Geophysical Work	Month		←	—	—	—	→						4 month
3	Geophysical Report	Month						←	—	→				2 month
2	Surface Drilling (2 rigs)	m.						←	→					310m (in 5 BHs)
3	Pitting Trenching (5 Pit & 7 Trenches)	Cu.m						←	—	—	→			1605.00
4	Survey Party days (1 Party)	Party days						←	→					30 Days
5	Geologist Party days (1Party)	Party days						←	—	—	→			90 Days
6	Bulk Sampling Party days, (1 party)	Party days						←	—	—	→			90 Days
7	Sampling Party days, Core Sampling (1 party)	Party days							←	→				30 Days
8	Laboratory Studies	Nos.							←	—	—	→		2695 Nos.
9	Camp Winding	Months	Continue to G2											
10	Report Writing with Peer Review	Months								←	—	—	→	4 months