# PROPOSAL FOR THE RECONNAISSANCE SURVEY (G-4) OF POTASH MINERALIZATION IN KALU BLOCK, TEHSIL-LUNKARANSAR, (20.3 SQ.KM AREA), DISTRICT-BIKANER, RAJASTHAN. (PART OF TOPOSHEET NO 44H/15 & 44L/03)

**COMMODITY: Potash**

**BY**

**FCI ARAVALI GYPSUM & MINERALS INDIA LIMITED**
**2, WEST PATEL NAGAR, CIRCUIT HOUSE ROAD RATANADA,**
**JODHPUR, RAJASTHAN**

**PLACE: JODHPUR**

**DATE: 14th August, 2025**

FCI Aravali Gypsum
and Minerals India Ltd.

# Summary of the Potash Mineralization block proposed for the Reconnaissance Survey (G-4)

## General Information about the block

| | Features | Details |
|---|---|---|
| | Block ID | Kalu block |
| | Exploration Agency | FCI Aravali Gypsum and Minerals India Ltd. |
| | Commodity | **Potash** |
| | Mineral Belt | Hanseran Evaporite Group of Marwar Supergroup, halite deposit |
| | Budget and time schedule to complete the project | 10 months |
| | G4 level exploration work | During 1974 to 1991, GSI has investigated the Nagaur-Ganganagar basin to identify the potash-bearing evaporite deposit, and accordingly, 68 boreholes were drilled in parts of Bikaner, Churu, and Hanumangarh. |
| | Objectives | i. To ascertain the continuity of the potash-bearing halite deposit.<br>ii. To assess the mineralogy and K% content of the deposit.<br>iii. To quantify the potash resource (333 category) as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015. |
| | Whether the work will be carried out by the proposed agency or through sourcing, and details thereof.<br><br>Components to be outsourced and the name of the outsourcing agency | The drilling work will be outsourced by 2 Rigs |
| | Name/Number of Geoscientists | Geologist (1) Party days: Field -120 days & HQ-60 days |
| | | Survey Party days: 30 days (for Topographical survey and BH location) |
| | | Sampling Party days: 120 days |
| **1.** | Location | The proposed block area partly falls under Survey of India Toposheet numbers 44H15 & 44L03 & 44L03, in and around the villages of Kalu, Garabdesar, and Adsar, in Tehsil- Lunkaransar, |

<table>
<tr><td></td><td></td><td>District-Bikaner, Rajasthan.</td></tr>
<tr><td></td><td>Latitude and Longitude</td><td>Coordinates of Corner Points of Kalu Block
<table>
<tr><th>Points</th><th>Latitude</th><th>Longitude</th></tr>
<tr><td>A</td><td>28°27'43.24"N</td><td>73°59'11.75"E</td></tr>
<tr><td>B</td><td>28°27'46.02"N</td><td>74° 2'7.11"E</td></tr>
<tr><td>C</td><td>28°25'27.71"N</td><td>74° 2'8.43"E</td></tr>
<tr><td>D</td><td>28°25'24.36"N</td><td>73°59'14.78"E</td></tr>
</table></td></tr>
<tr><td></td><td>Villages</td><td>Kalu, Garabdesar, Adsar</td></tr>
<tr><td></td><td>Tehsil/ Taluk</td><td>Lunkaransar</td></tr>
<tr><td></td><td>District</td><td>Bikaner</td></tr>
<tr><td></td><td>State</td><td>Rajasthan</td></tr>
<tr><td>2.</td><td>Area (Hectares/Square Kilometer)</td><td></td></tr>
<tr><td></td><td>Block Area</td><td>20.3 sq.km</td></tr>
<tr><td></td><td>Forest Area</td><td>0.00 sq. km forest area</td></tr>
<tr><td></td><td>Government Land Area</td><td>Data not available</td></tr>
<tr><td></td><td>Charagaha</td><td>Data not available</td></tr>
<tr><td></td><td>Private Land Area</td><td>Data not available</td></tr>
<tr><td>3.</td><td>Accessibility</td><td></td></tr>
<tr><td></td><td>Nearest Rail Head</td><td>Lunkaransar Railway Station is 20.60 km from the Kalu village via the RJ SA6 road.</td></tr>
<tr><td></td><td>Road</td><td>The proposed block is located 91.70 km North of the district headquarters, Bikaner, via NH 62 and 20.60 km from Lunkaransar via RJ SA6. The area is well connected by motorable metalled roads.</td></tr>
<tr><td></td><td>Airport</td><td>Nal Bikaner Airport (Rajasthan), which is 101.3 km from this block via NH 754A.</td></tr>
<tr><td>4.</td><td>Hydrography</td><td></td></tr>
<tr><td></td><td>Local Surface Drainage Pattern (Channels) Rivers/Streams</td><td>There is not a single perennial stream in the area. The drainage is served by the old course of the river Ghaggar, forming a narrow alluvial belt in which a network of canals has been developed.</td></tr>
<tr><td>5.</td><td>Climate</td><td></td></tr>
<tr><td></td><td>Mean Annual Rainfall</td><td>The mean annual rainfall is 10 to 30 cm.</td></tr>
</table>

| | | |
|---|---|---|
| | Temperatures (December)(Minimum) Temperatures (June)(Maximum) | Minimum temperatures upto 1°C to 25°C (November to February) Maximum temperatures upto 20°C to 45° C (April-June) |
| **6.** | **Topography** | Overall flat topography with ground elevation ranging from 225 to 240m. The entire area is covered by Quaternary alluvium. |
| | Topo-sheet Number | 44H15 & 44L03 |
| **7.** | **Availability of baseline geoscience data** | |
| | Geological Map (1:50K) | Available in the NGDR portal |
| | Geochemical Map | Not available |
| | Geophysical Map (Aeromagnetic, Ground geophysical, Regional as well as local scale GP maps) | Ground gravity and magnetic survey report is present in GSI FS:2022-23, M1AGS-GPM/NC/WR/2022/40210 |
| **8.** | **Justification for taking up Reconnaissance Survey/ Regional Exploration** | GSI conducted investigation on the occurrence of potash bearing zone since 1974. During 1974-91, a total of 68 boreholes were drilled in the Nagaur-Ganganagar basin. A total reserve of 456.02 Mt at an average K% of 4.39% in the Lakhasar sub-basin and 16.13MT at an average K% of 5.81% in the Hanseran sub-basin has been inferred (Probable resource) so far.<br><br>The proposed block area is falling within a very low gravity anomaly zone with a Bouguer anomaly value of <-59mGal. Thus, this area is recommended by GSI for further investigation of the halite deposit.<br><br>The borehole data (P-44) shows the presence of a 490 m thick halite zone, which was intersected. The average K% in P-44 varies between 1.2 to 3.5%.<br><br>Based on the above data, FAGMIL proposes this block to carry out reconnaissance survey (G4) on the potash-bearing zone |

# PROPOSAL FOR THE RECONNAISSANCE SURVEY (G-4) FOR POTASH MINERALIZATION IN KALU BLOCK, TEHSIL-LUNKARANSAR, DISTRICT-BIKANER, RAJASTHAN

## 1.0.0 INTRODUCTION

1.1.1 Potash is an impure mixture of potassium carbonate and potassium salts, primarily sourced from evaporite deposits buried deep beneath the Earth's surface. Over 90% of potash is used as fertilizer, making it one of the three essential agricultural nutrients (N-P-K). The chief ore is sylvinite, a combination of sylvite (KCl) and halite (NaCl).

1.1.2 In India, limited occurrences of potash minerals are reported from Madhya Pradesh (Sidhi), Uttar Pradesh (Sonbhadra), Bihar (Kaimur), and Rajasthan (Sawai Madhopur & Karauli). These are mainly found as glauconitic sandstone, a potassium-bearing green mica. However, the country meets its entire fertilizer-grade potash requirement through imports.

1.1.3 According to the NMI database based on the UNFC system, as of 1 April 2020, India's total potash resources are estimated at 23,091 million tonnes, all classified under the Remaining Resource category. Rajasthan accounts for the largest share at 89%, followed by Madhya Pradesh with 5% and Uttar Pradesh with 4%.

1.1.4 As per FAI, the all-India consumption of Potassic fertilizer (in K2O content) was at 2.53 million tonnes during 2021-22, whereas it was 2.02 million tonnes in 2022-23. The majority of the Potash is imported from countries such as Belarus (33%), Canada (20%), Israel (17%), Jordan (14%), and Lithuania (9%).

## 1.1.0 BACKGROUND

1.1.1 The Exploration for strategic, critical, rare metals, rare earth elements, PGE, and precious metals is given top priority by the Government of India after the amendment of the MMDR Act 2015. In June 2023, the Indian government identified 30 critical minerals, designating potash as a critical mineral due to its negligible commercial production within the country. Keeping this in view, the present proposal is being put up for reconnaissance survey (G-4 stage exploration) for potash mineralization in the Kalu area, Bikaner, Rajasthan.

1.1.2 During 1974-91, GSI carried out an investigation on the occurrence of potash-bearing halite deposits in the Nagaur-Ganganagar basin, covering parts of Bikaner, Churu, and Hanumangarh. This area is covered by a thick sequence of Quaternary alluvium. Therefore,

68 successful boreholes were drilled in this area to evaluate the potential of the potash mineralized zone. The core hole data indicate the presence of a thick halite deposit with good potash content.

Based on the previous borehole data provided by GSI, FAGMIL has prepared a proposal for the G-4 level of exploration in the Kalu area and put it up for the upcoming meeting of TCC, NMET, for technical evaluation. Hence, the proposal is being put up for a reconnaissance survey, which may facilitate the Central government in auctioning the block

## 2.0.0 BLOCK DESCRIPTION

2.0.1 The Kalu Block falls under toposheet no. 44H/15 and 44L/03 with an area of 20.3 sq. km. The block is located in and around the villages – Kalu, Garabdesar, Adsar, Tehsil – Lunkaransar, Bikaner, Rajasthan. The location map is provided in Annexure I. The coordinates of the corner points of the block area are provided in the table below (dd:mm:ss.ss).

Co-ordinates of Cardinal Points for Kalu Block, Tehsil: Lunkaransar, Dist: Bikaner (Table -1).

| Points | Latitude | Longitude |
|---|---|---|
| A | 28°27'43.24"N | 73°59'11.75"E |
| B | 28°27'46.02"N | 74° 2'7.11"E |
| C | 28°25'27.71"N | 74° 2'8.43"E |
| D | 28°25'24.36"N | 73°59'14.78"E |

## 2.1.0 LOCATION AND ACCESSIBILITY

2.1.1 The Kalu area is located 91.7 km North of the district headquarter, Bikaner and is well connected via. NH62. The Lunkaransar area is 20.6 km far from Kalu via RJ SA6. Lunkaransar Railway Station is 20.6 km from the Kalu village via 6A road. The area is well connected by motorable metalled roads.

The Nal Bikaner Airport (Rajasthan) is 101.3 km from this block via NH 754A.

## 2.2.0 PHYSIOGRAPHY

2.2.1 The general topography of NE-SW trending longitudinal dunes and interdunal areas in the northwestern and southeastern part of the block, whereas the sand dunes show NW-SE orientation. Overall flat topography with elevation varying between 225 and 240 m in this block.

2.2.2 There is not a single perennial stream in the area. The drainage is served by the old course of the river Ghaggar, forming a narrow alluvial belt in which a network of canals has been

developed.

2.2.3 The area experiences a semi-arid climate with extreme climatic conditions of varying temperatures from freezing point during winter months to as high as 50°C during summer months. Dust storms are quite common during the summer months. Rainfall is scanty and averages from less than 10 cm to 30 cm annually and is mainly received during July-August.

## 2.3.0 FLORA & FAUNA

2.3.1 Gajner Wildlife Sanctuary is located 32 km west of Bikaner city. Permanent features of the vegetation of the Thar Desert include trees and shrubs like *Acacia nilotica, Prosopis cineraria, Tamarixaphylla, Lyciumbarbarum, Salvadoraoleoides, Zizyphusnumularia, Capparis deciduas, Acacia jacquemontii, Calligonumpolygonoides,* and *Leptadeniaphytotechnica*. Khejri (*Prosopis cineraria*) covers about two-thirds of the total geographical area of the State. A variety of animals, birds, mammals, and reptiles are found in Bikaner's semi-arid environment. Insects such as Anopheles mosquito, Caterpillar, Scorpions, Spiders, Lice, Ants, Butterflies, Moths, and Roaches. Snakes such as Vipers and Sand Cobra are c Mammals such as Ratel, Fox, Wild Goat. Camels and rattle snakes and many more animals such as elephants and lions are common desert species. There are around 600 resident vultures at Jorbeer. The region is host to another 1200 migratory vultures.

## 3.0.0 REGIONAL GEOLOGY

The Nagaur-Ganganagar Evaporite Basin (NGEB) is an intra-cratonic basin in which marine sediments of the Marwar Supergroup were deposited on the basement rocks of the Malani Igneous Suite and/or Delhi metamorphites. This basin is considered the southernmost continuation of this large Eocambrian basin of which the Salt Range of Pakistan forms the northern part (Jones, 1970). The Halogenic deposits in Iran, Oman, and Pakistan are considered to form a single basin (Zharkov, 1984) situated on the south-western Asiatic continent at the time of its formation, but moved to its present geographic location due to plate tectonic movements. This large evaporate basin extends approximately 700 km from north to south and 350 km from east to west, notwithstanding a void area corresponding with the Delhi-Lahore uplift. The northern part of this evaporite basin, close to the northern edge of the Indian plate, has been thrust southwards (Salt Range and Potwar Plateau). The thrust is still active (Baker, 1987, as in Jaillard 1992), and has brought the Eocambrian salt to the surface (Jaillard, op. cit.). Several salt mines, including those of Khewra and Warcha, are located in the Salt Range of Pakistan. Nagaur-Ganganagar basin, covering over 1,00,000 sq

km and in parts of Ganganagar, Hanumangarh, Churu, Bikaner, Nagaur, Jodhpur, Jaisalmer, and Pali districts of Rajasthan, Sirsa district of Haryana, and Faridkot and Bhatinda districts of Punjab. It is bounded by the Delhi-Lahore subsurface ridge to the north and northeast, the Aravalli range in the east, the Jodhpur-Pokhran-Chhotan (Malani) ridge in the south, and the Devikot-Nachna (subsurface) high in the southwest. The Birmania basin, about 120 km to the southwest, probably forms the extension of the main evaporate basin in the southwest. The halite-bearing evaporate sequence within the basin appears to extend up to the Sardarshahr- Bidasar Fault in the east, up to Balesar in the south, and up to the Devikot-Nachana subsurface high in the southwest, inferred from Oil India boreholes located at Baghewala and Tabriwala. The salt deposits in the south and southeast in the Nagaur area show a gradual litho-facies variation to a thick sulphate predominating facies where thick gypsum/anhydrite beds are developed within the sequence. The absence of unmetamorphosed sediments older than those of the Marwar Supergroup in its contact with Precambrian rocks suggests that the basin floor comprises metamorphites belonging to the Delhi Supergroup and gneisses, granites, and rhyolites of the Malani Igneous Suite (Dasgupta et at, 1988). In the southern part of the basin, rocks of the Marwar Supergroup and their time equivalents, the Randha and the Birmartia Formations, overlie the Malani Igneous Suite (at Jodhpur, Balesar, Kul, and Pokaran) and the Delhi Supergroup of rock (at Khatu, Bidasa Ratangarh, etc).

Litho-Stratigraphic Succession of Nagaur-Ganganagar Basin (After Kumar et. al, 1993 GSI)

| **Age** | **Supergroup** | **Group** | **Thickness (m)** |
|---|---|---|---|
| Recent to Sub recent (Quaternary) | ----- | ----- | 0 – 373 |
| ---------- Unconformity ---------- | | | |
| Lower Eocene (Tertiary) | ----- | ----- | 38 – 120 |
| ---------- Unconformity ---------- | | | |
| Upper Proterozoic to Lower Cambrian | Marwar | Nagaur | 50 – 290 |
| | | Bilara/HEG | 100 – 300 |
| | | Jodhpur | 240 – 423 |
| ---------- Unconformity ---------- | | | |

| | | | |
|---|---|---|---|
| Precambrian | Malani Igeneous Suite / Delhi Supergroup | Ajabgarh | Basement rocks |

**3.1.0 GEOLOGY OF THE BLOCK AREA**

3.1.1 The block area is dominantly covered by aeolian sand (Quaternary period) of fine to medium grain size. The sub-surface data reveal the presence of rocks of the Marwar supergroup. A thick sequence of Hanseran evaporite is overlain by the Nagaur group and underlain by the Jodhpur group of rocks. The stratigraphic sequence obtained from the GSI's borehole data is given below.

| **Age** | **Super Group** | **Group** | **Formation** | **Unit** | **Rock Types** |
|---|---|---|---|---|---|
| Upper Proterozoic to Lower Cambrian | Marwar Super Group | Nagaur | - | - | - |
| | | Hanseran | Lakhusar | E 16 | Clay, Claystone, Anhydrite |
| | | | Sataiyan | E 15 | Halite (H7) ± Polyhalite |
| | | | | E 14 | Clay, anhydrite, dolomite |
| | | | Harsinghpura | E 13 | Halite (H6) ± Polyhalite |
| | | | | E 12 | Clay, anhydrite, dolomite |
| | | | Kupli | E 11 | Halite (H5) ± Polyhalite |
| | | | | E 10 | Dolomite, Dolomitic Anhydrite + clay |
| | | | Malkisar | E 9 | Halite (H4) ± Polyhalite |
| | | | | E 8 | Dolomite + Anhydrite + clay |
| | | | Chattargarh | E 7 | Halite (H3) ± Polyhalite |
| | | | | E 6 | Dolomite + Anhydrite + clay |
| | | | Kalu | E 5 | Halite + Polyhalite (H2) ± sylvite + Langbeinite |
| | | | | E 4 | Anhydrite + Dolomite + clay |
| | | | | E 3 | Halite (H1) ± Polyhalite + sylvite |
| | | | | E 2 | Anhydrite + dolomite |
| | | | Lakhasar | E 1 | Clay with Anhydrite |
| | | | | E 0 | Clay + marl + |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | calcilutite gyp + LS |
| | | Jodhpur | - | - | - |

## 4.0.0 PREVIOUS WORK/ BACKGROUND INFORMATION

4.1.1 Since 1930, the presence of gypsum and halite in the Nagaur–Ganganagar Evaporite Basin (NGEB) of Rajasthan has been documented. Investigations by the Central Ground Water Board (CGWB) for groundwater and by the Oil and Natural Gas Corporation (ONGC) for oil exploration revealed significant potash occurrences. Evaluations by George I. Smith (USGS, 1968) and other researchers identified the NGEB as geologically favourable for potash-bearing marine evaporites. Subsequent studies reported halite at depths of 469–541 m, correlating it with Pakistan's Kohat Salt sequence. Gravity surveys by R.S. Jain and Premchandra identified several negative Bouguer gravity anomalies, indicating a thick evaporite sequence, and recommended 12 gravity-low sites in the southern basin for drilling.

**4.1.2** Between 1974 and 1991, V. Kumar, C.R. Saha, and R.S. Rajawat conducted drilling across ~28,500 km² of the NGEB, completing 68 boreholes. Based on the results, eight depocentres with potash mineralization containing over 2% K were identified: Lakhasar, Bikaner, Gharsisar, Hanseran, Arjunsar, Jaitpura, Bharusari, and Satipura.

**4.1.3** GSI concluded that the Hanseran Evaporite Group (HEG) comprises cyclic deposits of halite (the most dominant constituent) alternating with anhydrite, clay, dolomite, and magnesite. Halite contains potash minerals like polyhalite, sylvite, sylvinite, rare langbeinite, and traces of carnallite. Thickness of the HEG ranges from 130.20m to 488.50 m. A maximum of 7 halite cycles, numbered H1, H2,... H7 from the bottom to the top had been identified.

**4.1.4** GSI has estimated Potash and Halite resources in three sub-basins, i.e., Satipura (10 boreholes), Bharusari (6 boreholes), and Lakhasar (4 boreholes), based on the intersection of potash mineralization at 3% K cut-off and 1.50 m minimum stopping width by Isochore/Isograde method. GSI estimated a total of 2476.58 mt. (409.19 mt probable and 2072.39 mt possible) potash resources with 4.70 % K and 23.54% Na in Satipura, Bharusari and Lakhasar basins and geological resources of more than 6 trillion tonnes of halite with above 90% NaCl in Nagaur-Ganganagar basin.

The resources estimated in three basins are given in the Table:-

| Sub- Basin | Area (Sq. Km) | Ore Resource (Million Tonne) | | | Grade | |
|---|---|---|---|---|---|---|
| | | Probable | Possible | Total | K% | Na % |
| Satipura | 245.61 | 202.30 | 1429.95 | 1632.25 | 4.80 | 25.08 |
| Bharusari | 71.00 | 88.16 | 300.15 | 388.31 | 4.68 | 17.17 |
| Lakhasar | 29.50 | 113.73 | 342.29 | 456.02 | 4.39 | 23.51 |
| **Total/Average** | **346.11** | **404.19** | **2072.39** | **2476.58** | **4.70** | **23.54** |

4.1.5 FSP:2022-23- GSI conducted a ground gravity and magnetic survey in toposheet numbers 44H/10, 11, 13, 14 & 15. The Kalu area, which falls between the Hanseran and Gharsisar sub-basins, shows a negative Bouger anomaly (-59mgal) and was recommended for the mapping of the potash mineralized zone.

4.1.6 Between 1974 to 1991, a borehole was drilled in the Kalu area by GSI. The borehole data (P-44) shows the presence of a 490 m thick halite zone, which was intersected. The average K% in P-44 varies between 1.2 to 3.5%.

4.1.7 Based on the previous data, FAGMIL proposed the Kalu block to carry out a reconnaissance survey (G4) for detailed subsurface geological mapping and to delineate the potash-bearing zone in this area.

## 4.2.0 JUSTIFICATION FOR TAKING UP THE BLOCK

**4.2.1** GSI conducted investigation on the occurrence of potash bearing zone since 1974. During, 1974-91 a total of 68 boreholes were drilled in the Nagaur-Ganganagar basin. A total reserve of 456.02 Mt at average K% of 4.39% in Lakhasar sub-basin and 16.13Mt at average K% of 5.81% in Hanseran sub basin have been inferred so far.

4.2.2 The proposed block area is falling within a very low gravity anomaly zone with Bouger anomaly value <-59mGal. Thus, this area is recommended by GSI for further investigation for the halite deposit (Annexure-III).

4.2.3 The borehole data (P-44) shows the presence of a 490 m thick halite zone, which was intersected. The average K% in **P-44 varies between 1.2 to 3.5%.**

The borehole data (P-8) shows presence of 550.54 m thick evaporite bed with a total of 430.48m thick halite zone was intersected. The average K% in P-8 was reported as 1.5%. However, the polyhalite sample shows K% of 9.89%.

4.2.4 Based on the above data, FAGMIL proposes this block to carry out Reconnaissance survey (G4) on the potash-bearing zone.

## 5.0.0 OBJECTIVES OF THE PROPOSED RECONNAISSANCE SURVEY

- To ascertain the continuity of the potash-bearing halite deposit.
- To assess the mineralogy and K% content of the deposit.
- To quantify the potash resource (334 category) as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015.

## 6.0.0 PLANNED METHODOLOGY

6.0.1 In accordance with the objective set for Reconnaissance Exploration (G-4) of the block, the exploration programme is proposed. The Exploration shall be carried out as per the Minerals (Evidence of Mineral Contents) Rule 2015. Accordingly, the following scheme of exploration is formulated in order to achieve the objectives. The details of different activities to be carried out are presented in the subsequent paragraph.

## 6.1.0 GEOLOGICAL MAPPING

6.1.1 Geological mapping will be carried out over an area of 20.3 sq. km at a 1:12,500 scale. The survey will focus on the sub-surface mapping of the halite cycle and correlate each cycle with the regionally developed halite deposit. Other structural and geological features will be systematically studied in the core samples.

## 6.2.0 DRILLING

6.2.1 A total of **4 boreholes** are planned to drill in a 1600×1600m interval; one borehole (P-44) of GSI is present at the center of the proposed block. Therefore, the initial boreholes will be planned 1600m away from P-44 and will progress accordingly. The tentative BH locations are provided in Annexure-III. The location of these boreholes may change slightly, subject to approachability, owing to the surface conditions. The Quaternary / Tertiary sediments, part of the Nagaur Group, will be drilled using non-coring. The Hanseran Evaporite Group and Jodhpur Group will be drilled by coring.

## 6.3.0 BOREHOLE GEOPHYSICAL SURVEY/WIRELINE LOGGING

**6.3.1** As per current exploration practices, all boreholes shall be subjected to dual density, neutron, resistivity, spectral gamma, and caliper logging. Based on the interpretation of the geophysical data, sampling of the identified potash-bearing zones will be undertaken for further analyses.

## 6.4.0 DRILL CORE LITHOLOGGING

**6.4.1** Detailed core logging will be conducted for all boreholes, documenting various aspects such

as lithological units/formations, intercalations and partings, core recovery, colour, structures, textures, and other relevant features. Within the Hanseran Evaporite Group, special emphasis will be given to identifying polyhalite and other potash-bearing minerals such as sylvite, langbeinite, etc.

**6.5.0 SAMPLING**

**6.5.1**

Primary samples will be collected at 0.50 m intervals in potash-bearing zones (Polyhalite and Sylvite) based on variations in potash content, and at 3 m intervals in non-potash-bearing Halite zones. Rock layers within 5 m above and below the Halite cycle will be sampled at 1.00–2.00 m intervals.

After defining the potash-rich zones at different cut-off grades, composite samples will be prepared using standard procedures.

From 4 drill holes, approximately **500 primary samples** will be obtained. Of these, 50 samples (10%) will be for external checks.

Composite samples will be prepared at 2%, 3%, and 5% potassium cut-off grades, with an estimated total of 110 composite samples.

**6.6.0 LABORATORY STUDIES**

**6.6.1** Chemical Analysis:

A total of **500 core samples** (primary) will be analysed for 9 radicals, i.e, K, Na, Mg, Cl, Br, I, Li, CaSO4 & Water insolubles. Of these, 10% (50) samples will be taken for external check.

**6.6.2** 5 samples from each borehole with a total of **20 samples** will be taken for XRD analyses, and 5 samples from each borehole will be selected for the polished section petrographic study.

**10** core samples will be taken for bulk density determination of the potash-bearing zone.

**7.0.0 QUANTUM OF WORK**

The details of the quantum of work for the Kalu Block, Tehsil-Lunkaransar, Dist. Bikaner is furnished below:

| Sl. No. | Item of Work | Unit | Proposed Quantum of work |
|---|---|---|---|
| 1 | Geological Mapping (1:12,500) | sq. km | 20.3 |
| 2 | DGPS topographic survey | sq. km | 20.3 |
| 3 | Drilling of 4 BHs at 1600×1600m interval (4×650m) | m | 2,600 |
| 4 | Borehole Geophysical Logging – a. Dual density, b.Neutron, c. Gamma, d. Resistivity, e. Caliper | m | 1600 |
| 5 | Sample Preparation & Chemical Analysis | | |
| | i. Primary samples for 9 radicals, i.e., K, Na, Mg, Cl, Br, I, Li, CaSO4 & Water insolubles. | Nos. | 500 |
| | iii) External Check sample (10 % of Primary samples) for 9 radicals i.e. K, Na, Mg, Cl, Br, I, Li, CaSO4 & Water insoluble | Nos. | 50 |
| 7 | Whole rock analysis | Nos. | 25 |
| 9 | Petrographic Studies | Nos | 20 |
| 10 | XRD Studies | Nos | 20 |
| 11 | Bulk Density studies | Nos | 10 |
| 12 | Report Preparation (Digital format) | Nos. | 1 |

## 8.0.0 APPROVED COST

Tentative Cost has been estimated based on the Schedule of Charges (SoC) of projects funded by National Mineral Exploration Trust (NMET) w.e.f. 01/04/2020. The total approved (12$^{th}$ TCC-II, August,2025) cost is Rs. **416.83** Lakhs. The summary of cost estimates for the Reconnaissance Survey (G-4 Level) is given in Table 4, and details of cost estimates are given in Annexure-V. The tentative Time schedule/action plan for the proposed Reconnaissance Survey (G-4) for potash is given in Table No.5.

**Table-4.** Approved Cost for The Reconnaissance Survey (G-4) for Potash Minerals. In Kalu Block, Tehsil-Lunkaransar, District: Bikaner, Rajasthan.

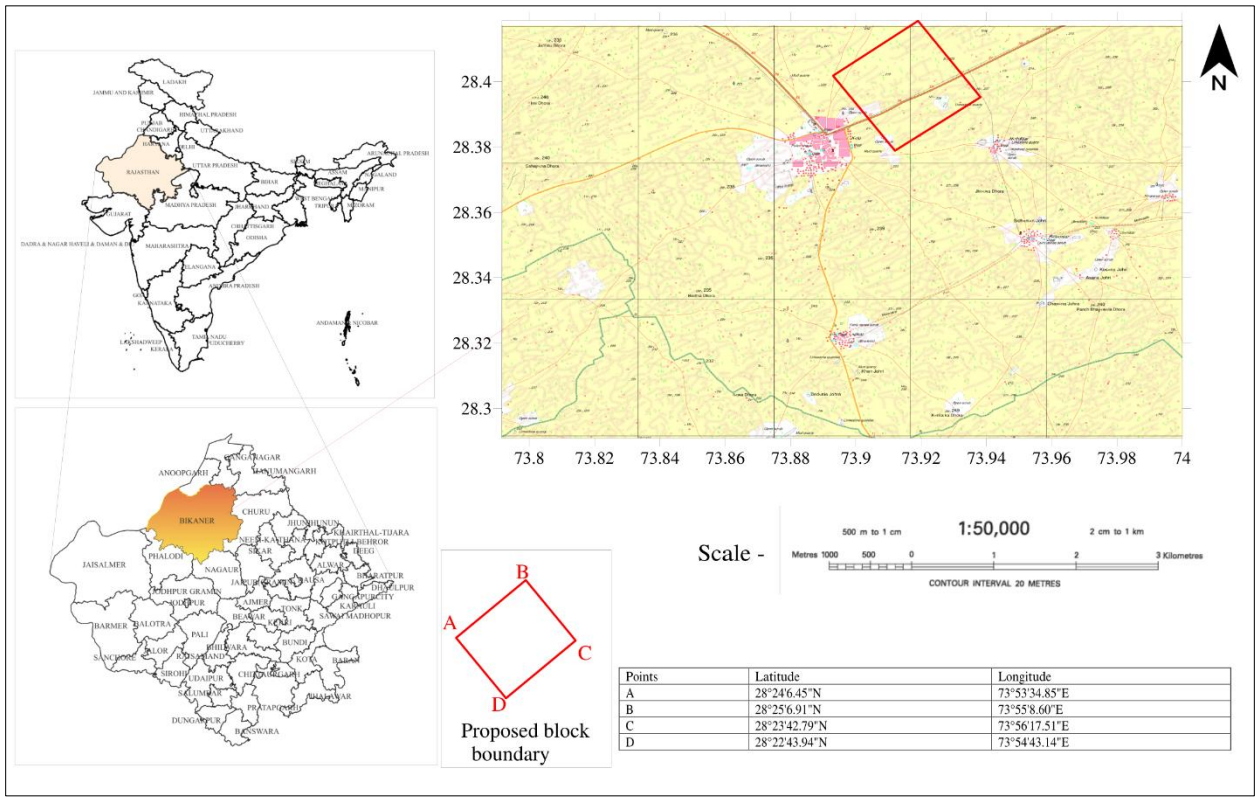
| S.N | Item of Work | Total Amount (Rs) |
|---|---|---|
| A | Geological Work (Mapping, Borehole logging, Sampling, Report writing, and Survey) | **28,05,432** |

| | | |
|---|---|---|
| B | Drilling | **2,52,32,640** |
| C | Borehole Geophysical Survey/Well logging | **9,36,800** |
| D | Laboratory Studies (Chemical Analysis, Physical, Petrographic and Minerologic Study) | **48,05,985** |
| E | Preparation of Exploration Proposal (5 Hard copies with a soft copy) | **5,00,000** |
| F | Preparation of Geological Report | **10,13,423** |
| G | Peer review Charges | **30,000** |
| H | Total Estimated Cost without GST | **3,53,24,190** |
| I | Provision for GST (18% of GST) | **63,58,354** |
| J | Total Estimated Cost with GST | **4,16,82,544 or 416.83 Lakhs** |

**Table-5.** The tentative time schedule/action plan for the proposed Reconnaissance Survey (G-4) for Potash Mineralization.

| **COST SHEET FOR THE RECONNAISSANCE SURVEY (G-4) OF POTASH IN KALOO BLOCK, DISTRICT: BIKANER, RAJASTHAN** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total Area - 20.3 Sq Km; Nos. of BH-4, BH Depth-650m, Completion Time - 10 Months** | | | | | | | | | | | | |
| | | **Months** | | | | | | | | | | |
| **Sr. No** | **Activities** | **1** | **2** | **3** | **4** | **5** | **REVIEW** | **6** | **7** | **8** | **9** | **10** |
| 1 | Camp Mobilisation | | | | | | | | | | | |
| 2 | Geologist Days Field | | | | | | | | | | | |
| 3 | Drilling | | | | | | | | | | | |
| 4 | Wire line logging | | | | | | | | | | | |
| 5 | Sampling Party | | | | | | | | | | | |
| 6 | Laboratory Studies | | | | | | | | | | | |
| 7 | Camp Demobilisation | | | | | | | | | | | |
| 8 | Geologist Party in HQ | | | | | | | | | | | |
| 9 | Geologist Report Writing with Peer Review | | | | | | | | | | | |
| ***The commencement of the project shall be deemed effective from the date the exploration acreage is made available, along with the receipt of all necessary statutory clearances.*** | | | | | | | | | | | | |
| ***Any time lost due to monsoon conditions, agricultural activities, forest clearance delays, or local law and order issues shall be considered an addition to the above timeline.*** | | | | | | | | | | | | |

# Annexure -I




| Points | Latitude | Longitude |
|---|---|---|
| A | 28°24'6.45"N | 73°53'34.85"E |
| B | 28°25'6.91"N | 73°55'8.60"E |
| C | 28°23'42.79"N | 73°56'17.51"E |
| D | 28°22'43.94"N | 73°54'43.14"E |

Figure 1. Location map of the Kalu Potash Block, Bikaner, Rajasthan.

# Annexure -II

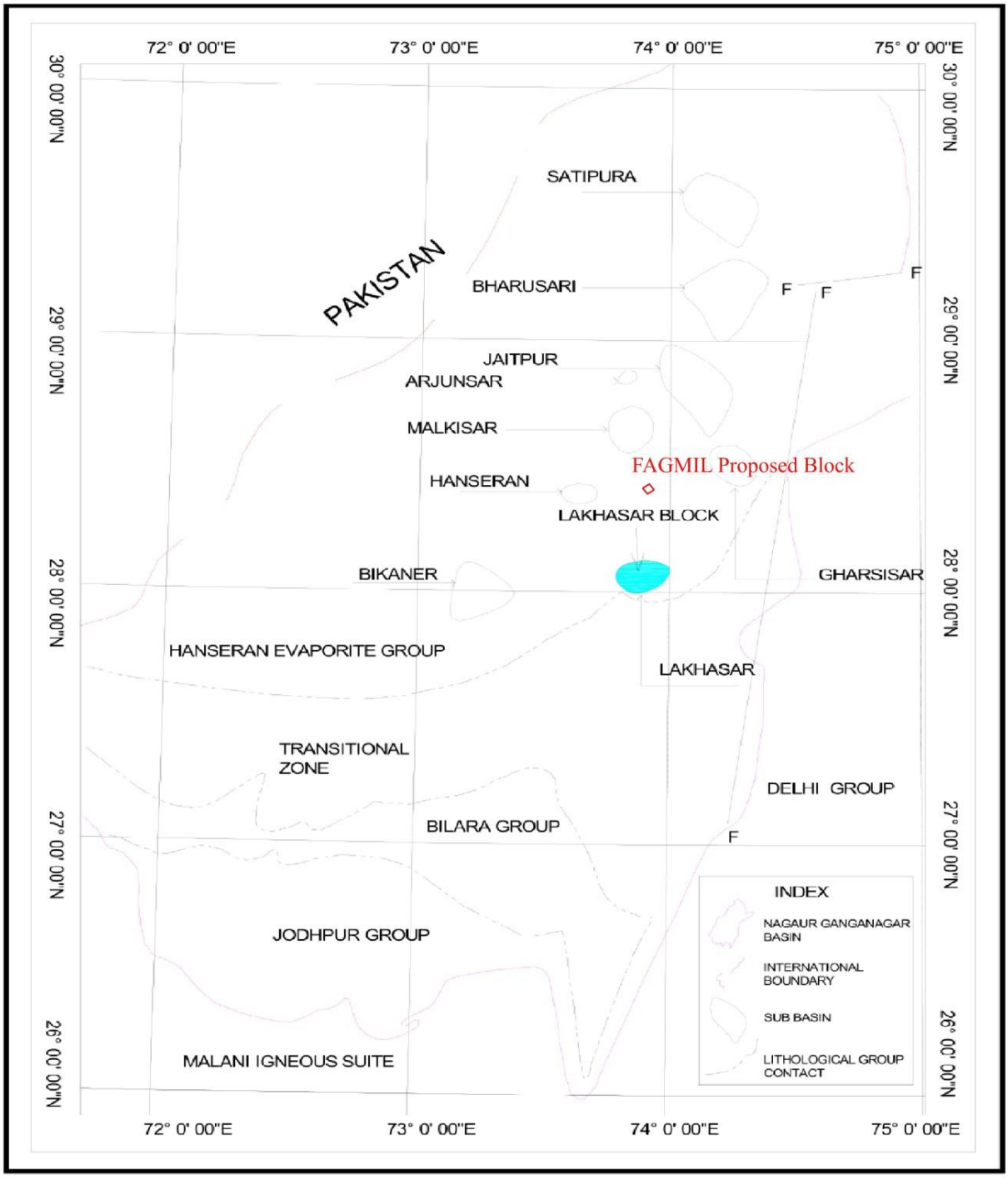



Figure 2. Geological map in Kalu area at a scale of 1:50,000. (after GSI)

# Annexure -III

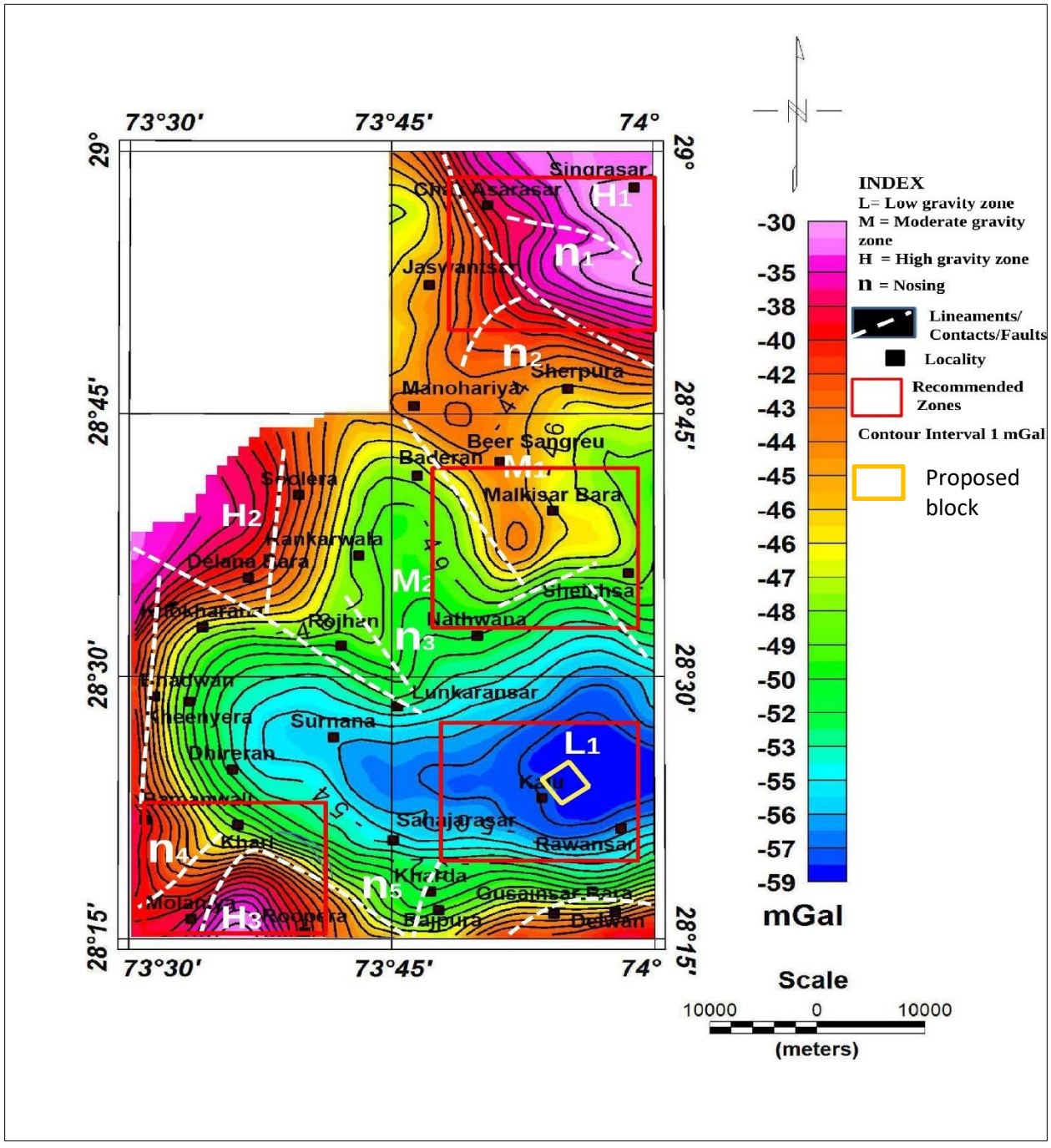



Figure 3. Gravity anomaly map of toposheet no - 44H/10, 44H/11, 44H/13, 44H/14, 44H/15.

# Annexure-IV

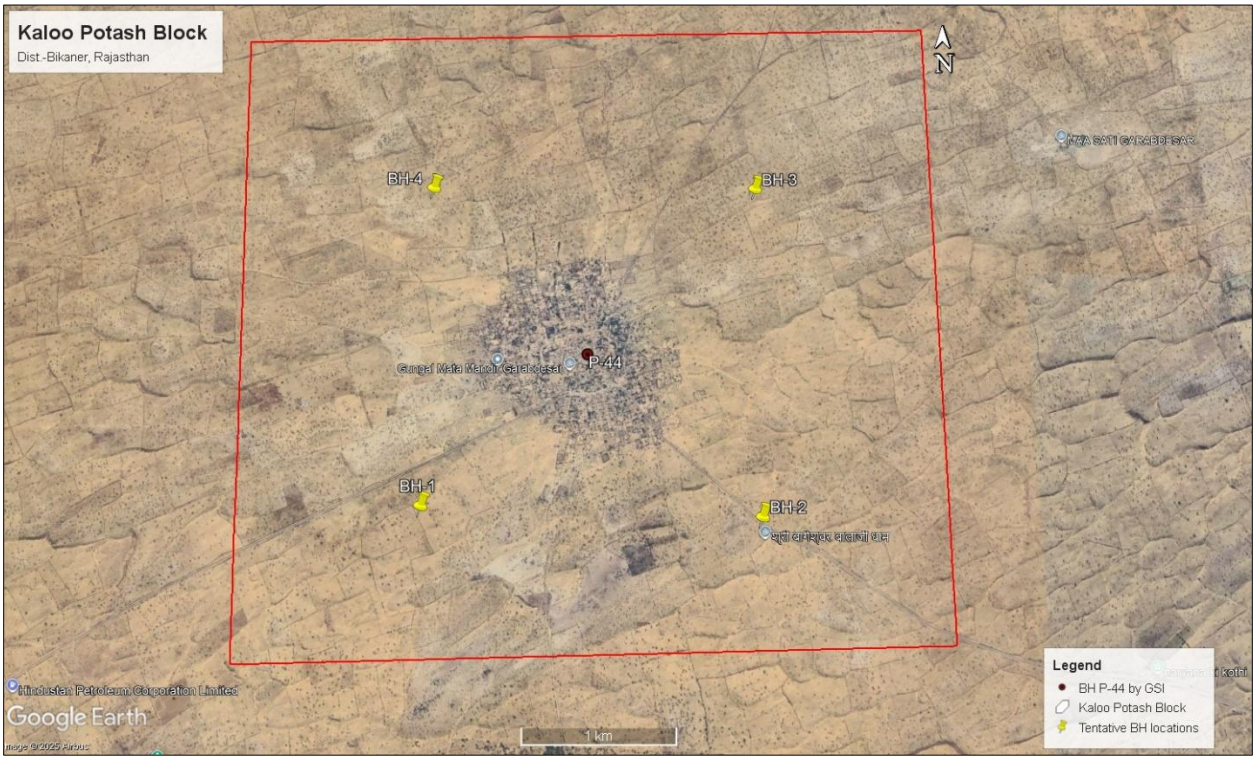



Figure 4. Proposed Kalu block with tentative borehole locations.

FCI Aravali Gypsum and Minerals India Ltd.

## COST SHEET FOR THE RECONNAISSANCE SURVEY (G-4) OF POTASH IN KALOO BLOCK, DISTRICT: BIKANER, RAJASTHAN

**Total Area - 20.3 Sq Km; Nos. of BH-4, BH Depth-650m, Completion Time - 10 Months**

| S. N | Item of Work | Unit | Rates as per NMET SoC 2020-21 | | Estimated Cost of the Proposal for | | Remarks |
|---|---|---|---|---|---|---|---|
| | | | SoC-Item -Sl No. | Rates as per SoC | Qty. | Total Amount (Rs) | |
| **A** | **GEOLOGICAL WORK** | | | | | | |
| **1** | **Geological Mapping (1:12,500), Borehole logging, sampling & Report writing** | | | | | | |
| a | Charges for one Geologist per day at HQ for monitoring, data processing etc. | day | 1.3 | **9,000** | 60 | 5,40,000 | |
| b | Charges for one Geologist per day at field for core logging. | day/geologist | 1.3 | **11,000** | 120 | 13,20,000 | |
| c | Labour Charges( 02Nos) for one Geologist; (Base rate - Rs.526/-+PF Rs.63.12/-+ESI- Rs.17.10/-+Bonus- Rs.43.82/-+EL- Rs.29.46/-=Rs. 679.50/-) | day | 5.7 | **541** | 240 | 1,29,840 | |
| d | Charges for Sampler (1 party) | one sampler per day | 1.5.2 | **5,100** | 78 | 3,97,800 | For Core Sampling |
| e | Labour Charges (2 Nos)for Sampling Work; (Base rate - Rs.526/-+PF Rs.63.12/-+ESI- Rs.17.10/-+Bonus- Rs.43.82/-+EL- Rs.29.46/-=Rs. 679.50/-) | day | 5.7 | **541** | 312 | 1,68,792 | Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher |
| **2** | **Survey** | | | | | | |
| a | Topographical Survey | day | 1.6.1a | **8300** | 30 | 249000 | Topographical Survey on 1:12,500 (5 m contour interval) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | **Total A** | **28,05,432** | | |
| | | | | | | | | |
| **B** | **Drilling** | | | | | | | |
| a. | Non core drilling upto 300m | Meter | 2.2.5 | **3932** | **1200** | 47,18,400 | | |
| b | Drilling up to 301-600m (Hard rock) | Meter | 2.2.1. 4b | **12,420** | 1200 | 14904000 | | |
| c | Drilling up to 601-900m (Hard rock) | Meter | 2.2.1. 4c | **13,225** | 200 | 2645000 | | |
| b | Land /Crop Compensation (in case the Bh falls in agricultura land) | per Bh | 5.6 | **20,000** | 4 | 80000 | **As per actuals** | |
| c | Construction of Concerte pillar (12"x12"x30") | per hole | 2.2.7 a | **2,000** | 4 | 8000 | | |
| d | Transportaion of Drill rig & Truck Associated per drill (1 rig) | km | 2.2.8 | **36** | 700 | 25200 | **From Jaislamer to Kalu, Bikaner for 1 rig** | |
| e | Monthly Accomodation Charges for drilling Camp (for 1 rig) | Month | 2.2.9 | **50,000** | 8 | 400000 | | |
| f | Drilling Setting Cost camp | Nos | 2.2.9a | **2,50,00 0** | 1 | 250000 | | |
| g | Drilling Camp Winding up cost | Nos | 2.2.9 b | **2,50,00 0** | 1 | 250000 | | |
| h | Road making (Flat terrain) | km | 2.2.1 0a | **22,020** | 2 | 44040 | **As per actuals** | |
| i | Drill Core Preservation | per m | 5.3 | **1,590** | 1200 | 1908000 | **300m of core from each 4BHs** | |
| | | | | | **Total B** | **2,52,32,640** | | |
| **C** | **Borehole Geophysical Survey/Well logging** | | | | | | | |
| a | Duel Density | m | 3.11d | **102** | 1600 | 1,63,200 | 400m in each BH in the Hanseran Evaporite Formation | |
| b | Spectral gamma | m | 3.11o | **164** | 1600 | 2,62,400 | | |
| c | Resitivity | m | 3.11c | **39** | 1600 | 62,400 | | |
| d | Caliper | m | 3.11g | **19** | 1600 | 30,400 | | |
| e | Neutron | m | 3.11f | **74** | 1600 | 1,18,400 | | |
| f | Expert charges for Geophysicist in HQ | day | 3.18 | **9000** | 15 | 1,35,000 | | |
| g | Expert charges for Geophysicist in Field | day | 3.18 | **11000** | 15 | 1,65,000 | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | **Total - C** | **9,36,800** | |
| **D** | **LABORATORY STUDIES** | | | | | | | |
| **1** | **Chemical Analysis** | | | | | | | |
| **a** | **Primary & Check samples for Potash mineralization** | | | | | | | |
| i | i. Primary samples for 9 radicals, i.e., K, Na, Mg, Cl, Br, I, Li, CaSO4 & Water insolubles (300 samples from each 4 boreholes). | Nos | 4.1.1 | **8,157** | 500 | 4078500 | | |
| ii | iii) External Check sample (10 % of Primary samples) for 9 radicals i.e. K, Na, Mg, Cl, Br, I, Li, CaSO4 & Water insoluble | Nos | 4.1.2 | **8,157** | 50 | 407850 | | |
| **2** | **Physical, Petrographic and Minerologic Study** | | | | | | | |
| i | Polished section preparation (8*5cm) (6 from each BH) | Nos | 4.3.3 | **1,185** | 20 | 23,700 | | |
| ii | Mineralographic study | Nos | 4.3.4 | **4,232** | 20 | 84,640 | | |
| iv | XRD study (6samples from each BH) | Nos | 4.5.1 | **4,000** | 20 | 80,000 | | |
| vi | Bulk Density studies | Nos | 4.8.1 | **1,568** | 10 | 15,680 | | |
| vii | Whole Rock Analysis (SiO2, Fe2O3, MnO2, Al2O3, MgO, CaO, BaO, K2O, P2O5, TiO2, V2O5, LOI, S, V) | Nos | 4.1.1 5a & b | **4,621** | 25 | 1,15,525 | | |
| | | | | | | **TOTAL -D** | **48,05,895** | |
| | **TOTAL(A+B+C+D)** | | | | | | **3,37,80,767** | |
| **E** | **Preparation of Exploration Proposal (5 Hard copies with a soft copy)** | **5 Hard copies with a soft copy** | 5.1 | **2% of the Cost or Rs. 5 Lakhs whichever is lower** | 1 | **5,00,000** | | |
| **F** | **Preparation of Geological Report** | **6 Hard copies with a soft copy** | **5.2** | | | **10,13,423** | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **G** | **Peer review Charges** | | As per EC | | | **30,000** | | |
| **H** | **Total Estimated Cost without GST** | | | | | **3,53,24,190** | | |
| **I** | **Provision for GST (18% of GST)** | **%** | | | | **63,58,354** | GST will be reimburse as per actual and | |
| | | | | | | | as per notified prescribed rate | |
| **J** | **Total Estimated Cost with GST** | | | | | **4,16,82,544** | | |
| | | | | ***or Say Rs. In Lakhs*** | | ***416.83*** | | |
| ***Note - If any part of the project is outsourced, the amount will be reimbursed as per the Paragraph 3 of NMET SoC and Item no. 6 of NMET SoC.*** | | | | | | | | |