

Project Proposal: Procurement of Geophysical Instruments for Capacity Enhancement in Ground Gravity-Magnetic Mapping of GSI

1. Introduction

The present procurement proposal is a follow up to the review meeting held by the Hon'ble Minister, Ministry of Mines, Govt. of India and the Addl. Secretary, Mines, at GSI, CHQ, Kolkata on 22.09.2022. GSI has been directed to ramp up its in house geophysical activities under National Geophysical Mapping (NGPM) programme by procuring additional instruments for the gravity-magnetic mapping. It is recorded at para 6(a) of the approved note on Minister's visit to GSI, CHQ, Kolkata (Annexure-I). The intent of increasing the in house capacity is for supplementing the progress of NGPM outsourcing to achieve the set target.

Gravity and magnetic surveys are intended for delineating the lithology / structures on the basis of their contrasting density and magnetic susceptibility. Such structures sometimes control the occurrence of ore minerals resulting in anomalous gravity and magnetic responses. Integration of gravity-magnetic data with other geoscience data may bring out the existence of concealed and deep seated mineral deposits.

2. Objectives

GSI intends to procure additional geophysical instruments (gravimeters, magnetometers and Differential Global Positioning Systems) to significantly enhance its in house capacity. This is to supplement NGPM work to be carried out through outsourcing, so that the total progress of work is accelerated.

3. National Geophysical Mapping (NGPM)

The National Geophysical Mapping involving combined gravity-magnetic survey on 1:50000 scale is a flagship programme of GSI. The programme was launched in FS 2002-03 with objectives of generating baseline gravity and magnetic data, and identification of new areas (Green fields) for mineral exploration, particularly for the areas where structures having mineralisation prospect remain occult under cover sequence. In NGPM programme, gravity-magnetic survey is carried out with envisaged data density (one observation station per 2.5 sq. km. area), as per SOP, with average production of 280 observation points per toposheet. This program is designed to produce desired outcome of 1 mGal Bouguer Gravity anomaly contour map and 50 nT Total Magnetic Field (TMI) map. Integration of gravity-magnetic data with other geoscience data gives insight into the subsurface geological architecture, and may lead to identification of favourable areas having prospect for mineral exploration. Thus, the NGPM programme has potentiality to give impetus to mineral exploration programmes. Gravity and magnetic maps would provide all the stakeholders with a framework to design exploration strategies. Out of about 26.76 lakh sq. km. mappable area (excluding Himalaya and other inaccessible areas) of the country, NGPM has been carried out in an area of about 10.63 lakh sq. km. till March, 2022. In FS 2022-23, about 1.15 lakh sq. km area will be covered by in house NGPM projects, leaving about 16 lakh sq km for covering after March, 2023. Status of NGPM coverage is shown in **Plate-I**.

4. Geophysical instruments

The gravimeter measures very minute variations in the Earth's gravity field, consequent to the variation in density. It can record gravity value to the order of micro Gal level of resolution. In gravity survey, both the gravimeter and DGPS are used simultaneously to work out the gravity value of a spot. DGPS is used to precisely determine the coordinates and elevation of a gravity station. Rocks and geologic structures sometimes yield magnetic responses of variable degrees because of presence of magnetic constituents. Therefore, magnetic survey using the magnetometer is also done in combination with gravity survey to supplement the gravity observations. In its ground gravity-magnetic survey, GSI deploys mostly advanced instruments to acquire data with the following specifications:

- (1) Gravity data for resolution of 0.001 milli Gal or better
- (2) Magnetic (Total Field) data for resolution of 1 nT
- (3) Ground elevation for accuracy of +/- 1 cm or better
- (4) Location measurement for accuracy of +/- 1 cm or better

5. Instrument availability vis-a-vis in house workload

The region wise present availability of geophysical instruments in working condition for taking up NGPM projects is as follows:

| Regions Instruments | ER | WR | NR | SR | CR | NER | Total |
|--|----|----|----|----|----|-----|-------|
| Gravimeters | 4 | 8 | 4 | 8 | 7 | 2 | 33 |
| Magnetometers (Total Field) | 6 | 10 | 6 | 13 | 9 | 4 | 48 |
| DGPS set (1 Base Unit and 1 Rover Unit) | 7 | 8 | 5 | 9 | 8 | 2 | 39 |

Note: One set instrument comprises 1 gravimeter, 1 magnetometer and 1 DGPS set (1 Base Unit + 1 Rover Unit)

The region wise in house capacity for NGPM coverage is as follows:

| Region | ER | WR | NR | SR | CR | NER | Total projects |
|--|------------------|------------------|------------------|------------------|------------------|----------------|--------------------|
| No. of NGPM projects | 6 | 6 | 4 | 8 | 7 | 2 | 33 |
| Target area (sq. km.)/ No. of Toposheets | 21000 (30 TS) | 21000 (30 TS) | 14000 (20 TS) | 28800 (40 TS) | 24500 (35 TS) | 2800 (4 TS) | 112100 (159 TS) |

Note: Average Toposheet area is 700 sq km, except for SR where it is 720 sq km

Gravity-magnetic survey requires deployment of one set instrument (1 gravimeter, 1 magnetometer and 1 DGPS set) for simultaneous acquisition of gravity, magnetic and

elevation data at a particular station. With its present equipment capabilities, GSI can deploy 33 sets instruments (33 gravimeters, 33 magnetometers and 33 DGPS sets) to carry out survey for an average target of 1.12 lakh sq. km. per year. Remaining instruments are used in mineral exploration projects.

6. Target enhancement for in house NGPM coverage

With a view to scaling up mineral exploration activities through identification and demarcation of promising areas, there is a need for fast-tracking the baseline data generation through gravity-magnetic mapping. NMET has approved outsourcing of ground gravity-magnetic survey in 2099 toposheets (13.50 lakh sq km) under NGPM programme for speedy completion of mapping work in the country (OM No. 6/2/2015-NMET/130 dated 08.09.2021). GSI endeavours to complete work in priority area of about 3.50 lakh sq km under 500 toposheets in first phase of outsourcing by March, 2024. However, the responses of vendors are very poor and, as such, they have very limited capacity. Therefore, GSI envisages covering of about 1.15 lakh sq km priority area of phase-1 target by increasing its in house capacity, which necessitates deployment of 35 additional instruments for NGPM survey. Remaining area can be covered through outsourcing of work.

NMET has approved the procurement of 11 sets of gravimeters, magnetometers and DGPS in one year for data validation of outsourced ground gravity-magnetic survey and follow up survey over areas recommended from NGPM and NAGMP projects (Ref. NMET OM No. 23/274/2022-NMET/102 dated 15.07.2022). Procurement of the instruments is in progress. These instruments can also be used for conducting in house NGPM projects to expedite the progress of work.

Moreover, GSI requires 24 additional sets of gravimeters, magnetometers and DGPS to augment its existing capacity to complete the survey in priority areas. Subsequent to the achievement of target for priority areas, all the instruments (68 no.) can be deployed for fast completion of survey in remaining toposheets with double capacity (@2.29 lakh sq km/ year). In addition, the instruments can be used in follow up surveys over recommended mineral targets derived from NGPM and NAGMP projects.

7. Fund requirement for instruments

The details of requirements of instruments and budget are as follows:

| Instrument | Units (no.) | Estimated Price per unit (INR) | Estimated Total Cost (INR) | CAMC* charge (INR) | Remarks |
|-------------------|-------------|--------------------------------|----------------------------|--------------------|--|
| Gravimeter | 24 | 12500000 | 300,000,000 | 150,000,000 | USD/-127935.00 including packing forwarding freight & insurance charges, Purchase on 24.01.2019 (Equivalent INR 10561034 as on 04.11.2022) |
| Magnetometer (TF) | 24 | 1000000 | 24,000,000 | 12,000,000 | 1. CAD 7379.75 per unit purchased on 18.10.2016 (Equivalent INR 445811) 2.CAD 9797.5 per unit was purchased on 08.08.2018 |

| | | | | | |
|--|----|-----------|------------------------------------|--------------------|--|
| | | | | | (Equivalent INR 591867 as on 04.11.2022) |
| DGPS set (1 Base Unit and 1 Rover Unit) | 24 | 60,00,000 | 144,000,000 | 72,000,000 | INR 49,85,760 (purchased on 11.08.2021) |
| Total | | | 468,000,000 | 234,000,000 | |
| Grand total (Instrument cost and 5 years' CAMC charge) | | | 70,20,00,000 (Rs. 70.20 Cr) | | |
| Total Rupees seventy crores and twenty lakhs only (inclusive of GST @18%) | | | | | |

* CAMC (Comprehensive Annual Maintenance Contract) charge: 50% of the total cost of instruments for five years (@10 % per year) to be effective after expiry of two years' warranty period. The payment for CAMC will be made in five instalments following the expiry of warranty period.

CAMC is necessary for getting the assured technical support from the manufacturer for keeping the instruments in proper working condition after expiry of warranty period.

Therefore, 24 no. each of gravimeter, magnetometer (TF) and DGPS set can be procured for an estimated cost of Rs 70.20 Crores (inclusive of GST@18%), including charges for 5 years' CAMC.

8. Time line for procurement:

The proposed high-end and costly instruments are manufactured by overseas companies. Time line for their procurement through Global Tender Enquiry (GTE) as per applicable Govt. rules may be approximately one year after receiving the approval and financial sanction from the competent authority.

9. Cost recovery estimate

Proposed estimated cost for procurement of 24 sets instruments may be recovered in 4 years through their deployment for in house NGPM projects, as follows:

| Field Season | Area coverage (sq km) | Data production* (Estimated) (A) | Data validation\$ (Estimated) (B) | Total data points (C= A+B) | Rate# (INR) (D) | Estimated Recovery (in INR) = C*D |
|--------------|-----------------------|----------------------------------|-----------------------------------|----------------------------|-----------------|---|
| 2023-24 | 80000 | 32000 | 2000 | 34000 | 5300 | 180,200,000 |
| 2024-25 | 80000 | 32000 | 2000 | 34000 | 5300 | 180,200,000 |
| 2025-26 | 80000 | 32000 | 2000 | 34000 | 5300 | 180,200,000 |
| 2026-27 | 80000 | 32000 | 2000 | 34000 | 5300 | 180,200,000 |
| Total | | | | | | 720800000 (Rupees seventy two crores and eight lakhs only) |

* Data production - one observation per 2.5 sq km area, as per SOP of GSI

\$ Repeatability check for about 6% of data (5-10% of total data, as per SOP of GSI)

Charge per gravity-magnetic station = Rs 5300 (Rs 4500 plus GST@18%, as per SOC of NMET F.No. 61/1/2018-NMET, dtd 31.03.2020)

Plate-I. Status of National Geophysical Mapping as on 01.11.2022

