

GENERAL SPECIFICATION

SURVEYS

GS EP GEO 215

Onshore geophysical site survey - Radar Geophysical Survey

01	10/2012	Text removed and replaced by text of GS EP GEO 216
00	01/2012	First issue
Rev.	Date	Purpose of the revision

Owning entity: DEV/TEC	Managing entity: DEV/TEC/GEO
------------------------	------------------------------

General Specification		GS EP GEO 215
Onshore geophysical site survey - Radar Geophysical Survey		
Rev.: 02	Effective date: 10/2012	Page: 2 of 20

Contents

1. Scope	4
2. Reference documents.....	4
3. Ground Penetrating Radar survey objectives and methodology.....	5
3.1 GPR survey objectives.....	5
3.2 Methodology	6
4. Units and abbreviations.....	8
4.1 Units	8
4.2 Abbreviations	8
5. GPR layout.....	8
5.1 Determination of measurement grid	9
5.2 Selection of antenna frequency and acquisition parameters.....	9
6. Equipment.....	11
6.1 Data acquisition unit.....	11
6.2 Antenna	11
7. Positioning.....	11
7.1 Positioning system	11
7.2 Positioning accuracy	12
8. Work procedures.....	12
8.1 Calibration.....	12
8.2 Velocity characterisation	12
8.3 Acquisition - QA/QC	13
8.4 Interpretation.....	13
8.5 Correlation with other available datasets.....	14
9. Personnel.....	14
9.1 Management.....	15
9.2 On site	15
10. HSE.....	15



General Specification		GS EP GEO 215
Onshore geophysical site survey - Radar Geophysical Survey		
Rev.: 02	Effective date: 10/2012	Page: 3 of 20

10.1	Contractor's responsibility	15
10.2	Emergency on site	16
10.3	Incident / Accident reporting	16
11.	Reporting	16
11.1	Project Execution Plan	16
11.2	Daily Work Sheet	16
11.3	Field Report	17
11.4	Final Report	17
11.5	Deliverables	19
12.	Other references	20

General Specification		GS EP GEO 215
Onshore geophysical site survey - Radar Geophysical Survey		
Rev.: 02	Effective date: 10/2012	Page: 4 of 20

1. Scope

The content of this General Technical Specification indicates the minimum standards required by Company for Ground Penetrating Radar (GPR) geophysical survey. However, should Company consider that any aspect of the work requires more detailed investigation, Company reserves the right to apply further Particular Technical Specifications.

All Equipment and Materials necessary to complete the survey in accordance with this Contract shall be supplied by Contractor. Such Equipment and Materials shall include all spare parts and spare Equipment units as may be necessary to provide normal and continuous operations, and shall be in good operating condition prior to start of mobilization.

Such Equipment shall be properly maintained in such a way as to assure accuracy within the tolerances set by the manufacturer for such Equipment. Contractor undertakes to provide a statement of the surveying accuracy of this Equipment.

The Work defined in these Specifications shall be performed in accordance with the Agreement.

The Work shall include the following phases:

- **Data acquisition phase**
- **Data processing phase:** This phase is to be carried out in conjunction with data acquisition in order to be sure that survey objectives have been reached
- **Interpretation phase.**

Reports shall include measured and computed data and interpreted maps as per objectives of the Particular Technical Specifications.

The final product shall be an Expert Report.

The scope of the Work is included in the Particular Technical Specifications.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
ASTM D 6432 -11	Standard Guide for Using the Surface Ground Penetrating Radar Method for Subsurface Investigation
ISO 80000-1	Quantities and units – Part 1 General

General Specification		GS EP GEO 215
Onshore geophysical site survey - Radar Geophysical Survey		
Rev.: 02	Effective date: 10/2012	Page: 5 of 20

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP GEO 210	Onshore Geophysical Site Survey - Cross hole geophysical survey
GS EP GEO 211	Onshore Geophysical Site Survey - Seismic refraction geophysical survey
GS EP GEO 212	Onshore Geophysical Site Survey - Multichannel surface waves geophysical survey
GS EP GEO 213	Onshore geophysical site survey - Micro-Gravity Geophysical Survey
GS EP GEO 214	Onshore geophysical site survey - Electric Geophysical Survey
GS EP GEO 216	Onshore geophysical site survey – Electro-Magnetic Geophysical Survey
GS EP GEO 401	GIS requirements for engineering site surveys and studies
GS EP GPA 202	Seismic HSE for Land Activities
GS EP POS 003	Onshore land surveying and positioning works
GS EP POS 004	The use of Differential Global Navigation Satellite System

3. Ground Penetrating Radar survey objectives and methodology

3.1 GPR survey objectives

Ground Penetrating Radar is an electromagnetic geophysical method for high-resolution detection, imaging and mapping of subsurface soils and rock conditions, from the near-surface to a depth of few tens of meters. In particular cases, such as cold ice environments, a few hundred of meters can be reached.

Field applications are numerous and concern either geological, engineering, environmental or archaeological surveys:

- Determination of the thicknesses of soil horizons and depth to the water table
- Detection of air-filled subsurface cavities, buried channels and tunnels
- Mapping of contamination plumes, hydrocarbon leaks
- Non-destructive checking of road layers, masonry structures and bridge piers
- Detection of buried objects in archeological surveys
- Determination of ice or permafrost thickness
- Water content estimations from GPR velocity analyses.

General Specification		GS EP GEO 215
Onshore geophysical site survey - Radar Geophysical Survey		
Rev.: 02	Effective date: 10/2012	Page: 6 of 20

3.2 Methodology

A typical GPR system has three main components: transmitter and receiver directly connected to an antenna, and a control unit (timing). The transmitting antenna radiates a short high-frequency EM pulse into the ground, where it is refracted, diffracted and reflected as it encounters changes in dielectric permittivity, electric conductivity, and magnetic susceptibility. The strength, or amplitude, of the reflection is determined by the contrast in the respective properties of the two materials. It must be noted that in most geological environments, the magnetic susceptibility equals 1 and only electrical conductivity and dielectric permittivity will affect GPR wave propagation.

This means that a pulse which moves from dry sand (dielectric permittivity of 5) to wet sand (dielectric permittivity of 30) will produce a very strong reflection, while one moving from dry sand (5) to limestone (7) will produce a relatively weak reflection.

In most common surveys, the frequencies used extend from some ten MHz to some GHz. Antenna frequency is one major factor affecting depth penetration and vertical resolution. The higher the frequency of the antenna, the shallower into the ground it will penetrate, whereas the vertical resolution will be higher.

Electromagnetic waves travel at a specific velocity which is proportional to the inverse square root of the permittivity of the material.

$$V = \frac{C}{\sqrt{\epsilon_r}}$$

Where:

- V Velocity of electromagnetic waves
- C Speed of light in vacuum
- ϵ_r Relative permittivity of the material.

Table 1 gives dielectric permittivity and propagation velocity for different materials.