GENERAL SPECIFICATION

SURVEYS

GS EP GEO 212

Onshore Geophysical Site Survey
Multichannel surface waves geophysical survey

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01	08/2012	Update following the EP reorganization, March 2011
00	01/2011	First issue
Rev.	Date	Purpose of the revision

Document update realised by standards coordination
Reorganisation 2015

Owning entity: DSO/TEC	Managing entity: DSO/TEC/GEO

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1. Scope

The content of this General Technical Specification indicates the minimum standards required by Company for multichannel surface waves geophysical survey. However, should Company consider that any aspects 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 the award of Contract.

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 surveyed area is acceptable
- **Interpretation phase**.

Reports shall include measured and computed data and interpreted cross-sections as per objectives of the Particular Technical Specifications (Exhibit A2).

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
ISO 80000-1	Quantities and units – Part 1 General

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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 211	Onshore Geophysical Site Survey - Seismic refraction 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. Objectives and methodology

3.1 Objectives

Surface waves methods, also called Multichannel Analysis of Surface Waves (MASW), are primary used to determined shear-wave velocity profiles in near-surface. Shear waves are directly proportional to shear modulus (Gd) required for quantifying the soil stiffness (or soil rigidity).

The MASW method is based on the Rayleigh waves, which propagate in a vertical plane near the surface of the soil. Surface waves are interferences of body waves (P and S) trapped in superficial layers. Only the vertical component is considered in the MASW method.

The penetration depth of surface waves is directly related to their wave length. Small wave lengths have a propagation close to the surface, and large wave lengths have a deeper propagation. Because the wave length is related to the signal frequency and assuming a regular increase of the shear wave velocity with increasing depth, higher frequencies propagate at low velocity in a very shallow horizon and lower frequencies propagate at higher velocity in deeper horizons. This property is used to calculate the dispersion curve which gives variations of Rayleigh wave velocity versus frequency.

Main applications are related to earthquake engineering and characterisation of the soil response to cyclic and dynamic solicitations for critical structures including but not limited to:

- Storage tanks
- Refinery
- Compressors
- Multi-storey buildings
- Nearshore structures.

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3.2 Methodology

Surface Waves analysis is performed in three steps:

- Calculation of Rayleigh waves dispersion diagram
- Selection of the accurate dispersion curve
- Numerical inversion to obtain Vs profiles.

Investigation depth is limited by the low frequency content of the source spectrum, by the natural frequency of the sensors and by the site geology itself.

4. Units and abbreviations

4.1 Units

Only the ISO **International System** of units (ISO 80000-1) shall be used in all relevant measurements, processing and reporting.

4.2 Abbreviations

Ed	Dynamic Young Modulus
Gd	Dynamic Shear Modulus
GIS	Geographical Information System (chart database)
DGPS/GPS	Differential/Global Positioning System
MASW	Multichannel Analysis of Surface Waves
RTK	Real Time Kinematics (DGPS system)
SEG-2	Society Exploration Geophysicists format 2
SEG-Y	Society Exploration Geophysicists format Y
ν	Poisson's ratio
Vp	P-wave velocity
Vs	S-wave velocity
WGS 84	World Geodetic System 1984

5. Seismic spread layout

The standard spread shall comprise a minimum of 24 to 48 receivers with 4 shots (2 at each end and 2 at an offset distance). Details are provided in the following subsections.

Contractor shall endorse Company's requirements in terms of spread layout. If Contractor considers that the proposed spread layout may not achieve the Company's objectives, Contractor shall propose an alternative layout, which shall be properly justified and ultimately approved by Company.

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