

GENERAL SPECIFICATION

SURVEYS

GS EP GEO 216

Onshore geophysical site survey - Electro-Magnetic Geophysical Survey
--

01	10/2012	Text removed and replaced by text of GS EP GEO 215
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 216
Onshore geophysical site survey - Electro-Magnetic Geophysical Survey		
Rev.: 01	Effective date: 10/2012	Page: 2 of 17

Contents

1. Scope	4
2. Reference documents.....	4
3. Ground Electromagnetic survey objectives and methodology.....	5
3.1 EM survey objectives	5
3.2 Methodology	6
4. Units and abbreviations.....	6
4.1 Units	6
4.2 Abbreviations	6
5. EM layout	7
5.1 Selection of measurement equipment.....	7
5.2 Acquisition array and parameters.....	8
6. Equipment.....	8
7. Positioning.....	9
7.1 Positioning system	9
7.2 Positioning accuracy	9
8. Work procedures.....	9
8.1 Calibration.....	9
8.2 Validation of investigation depth.....	10
8.3 Acquisition - QA/QC	10
8.4 Interpretation.....	10
8.5 Correlation with other available datasets.....	11
9. Personnel.....	11
9.1 Management.....	11
9.2 On site	12
10. HSE.....	12
10.1 Contractor's responsibility	12
10.2 Emergency on site	13



General Specification		GS EP GEO 216
Onshore geophysical site survey - Electro-Magnetic Geophysical Survey		
Rev.: 01	Effective date: 10/2012	Page: 3 of 17

10.3	Incident / Accident reporting	13
11.	Reporting	13
11.1	Project Execution Plan	13
11.2	Daily Work Sheet	13
11.3	Field Report	14
11.4	Final Report	14
11.5	Deliverables	16
12.	Other references	17

General Specification		GS EP GEO 216
Onshore geophysical site survey - Electro-Magnetic Geophysical Survey		
Rev.: 01	Effective date: 10/2012	Page: 4 of 17

1. Scope

The content of this General Technical Specification indicates the minimum standards required by Company for Ground Electromagnetic (EM) geophysical survey using Frequency Domain instruments. 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 are reached
- **Interpretation phase.**

Reports shall include measured and computed data, as well as 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 6639 - 01 (2008)	Standard guide for using the Frequency Domain Electromagnetic Method for Subsurface Investigations
ISO 80000-1	Quantities and units – Part 1 General

General Specification		GS EP GEO 216
Onshore geophysical site survey - Electro-Magnetic Geophysical Survey		
Rev.: 01	Effective date: 10/2012	Page: 5 of 17

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 215	Onshore geophysical site survey - Radar 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 Electromagnetic survey objectives and methodology

3.1 EM survey objectives

Ground Electromagnetic is a geophysical method for measurements of ground conductivity, from the near-surface to a depth of few tens of meters.

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

- Locating gravel deposits, and determining their extent
- Mapping saline intrusions
- Detection of old mine galleries or pits
- Mapping pollution plumes in groundwater
- Mapping bedrock topography
- Mapping terrain conductivity for electrical grounding (cathodic protection)
- Searching for fault and fracture zones
- Archaeological exploration
- Locating buried metallic conductors (pipes, UXO, drums...).

General Specification		GS EP GEO 216
Onshore geophysical site survey - Electro-Magnetic Geophysical Survey		
Rev.: 01	Effective date: 10/2012	Page: 6 of 17

It is important to keep in mind that the Ground Electromagnetic method is more efficient when searching for a conductive target in a resistive medium, than to resolve resistive targets in a conductive medium.

3.2 Methodology

Ground Electromagnetic is an active method based on the transmission of an electromagnetic field of fixed frequency in the ground. This primary field (inductive field) is generated by a transmitter coil energized with an alternating current. The time-varying magnetic field arising from this alternating current in the transmitter coil induces a very small current in the earth, which generates a secondary electromagnetic field superimposed to the primary field, which is recorded by the receiver coil.

Comparison of the magnitude of this secondary field (H_s) with the primary field (H_p) allows the computation of an apparent conductivity (C_a) expressed in the following formulae:

$$C_a = \frac{4}{2\pi f \cdot \mu \cdot s^2} \left(\frac{H_s}{H_p} \right) = K \cdot \frac{H_s}{H_p}$$

Where:

- f Fixed frequency
- μ Permeability of free space
- s Spacing between coils.

Measurement equipments are designed to keep factor K constant by adjusting frequency versus distance between antennas.

The interest of this inductive method over conventional resistivity methods is that measurements don't need any coil-to-ground contact, which allows high speed acquisition surveys.

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

GIS	Geographical Information System (chart database)
DGPS / GPS	Differential / Global Positioning System
RTK	Real Time Kinematics (DGPS system)
EM	Electro-Magnetic
C_a	Apparent conductivity in mS/m (milliSiemens/metre)

General Specification		GS EP GEO 216
Onshore geophysical site survey - Electro-Magnetic Geophysical Survey		
Rev.: 01	Effective date: 10/2012	Page: 7 of 17

5. EM layout

Contractor shall request all available information from Company, to finalize his technical proposal, such as geological context, results of previous geophysical investigations, access to the site and state of the ground surface.

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

5.1 Selection of measurement equipment

Depth of investigation will depend on conductivity at the studied site, and on the equipment characteristics (transmitted frequency, transmitter-receiver distance, coil configuration).

Table 1 gives an idea of the estimated investigation depth relating to technical specifications of the equipment.

Table 1 - Estimation of maximal investigation depth relating to equipment specifications

Maximal investigation depth in m	Coil spacing in m	Operating frequency in kHz	Dipole modes (coil configuration)
1.5	1.5	14.5	vertical
3	3.7	9.8	vertical
6	3.7	9.8	horizontal
7.5	10	6.4	Vertical
15	10 / 20	6.4 / 1.6	Horizontal / vertical
30	20 / 40	1.6 / 0.4	Horizontal / vertical
60	40	0.4	Horizontal

Figure 1 presents equipment operating with 2 coil orientations for 2 different investigation depths.



Figure 1 - Equipment in operation with 10-m spacing

Contractor shall clearly define in his proposal the type of equipment selected for the survey with the associated depth of penetration expected.

5.2 Acquisition array and parameters

Company recommends performing, for each measurement point, acquisition using all the coil spacing and orientation options available from the equipment.

This will yield, for each measurement point, a set of apparent conductivity values giving the vertical distribution of apparent conductivity.

Contractor shall clearly define the parameters selected for data acquisition, including at the least:

- Type of acquisition mode (automatic or point-by-point)
- If automatic mode has been selected: number of measurements/s and acquisition speed
- In a point-by-point procedure: number of stack for each measurement point.

6. Equipment

Ground electromagnetic equipment is composed of one data acquisition unit, one transmitter coil and one receiver coil with connection cables.

Contractor shall provide all necessary equipment to perform the work including 100% spare parts to limit any delays in the operations. All the different equipments shall be regularly maintained and calibrated using the manufacturer's procedure.

Calibration certificates shall be presented to the Company Representative before the start of the acquisition.

The data acquisition unit shall have the following characteristics, at a minimum:

- Digital Stacking capability to enhance signal/noise ratio
- Integrated DGPS compatibility for simultaneous collection of EM and positioning data
- 50 Hz and 60 Hz power line rejection

General Specification		GS EP GEO 216
Onshore geophysical site survey - Electro-Magnetic Geophysical Survey		
Rev.: 01	Effective date: 10/2012	Page: 9 of 17

- Resolution: +/- 0,1% of full scale
- Operating temperature range from at least -20° C to +50° C
- Water resistant for survey in difficult environmental conditions.

7. Positioning

7.1 Positioning system

The spread positioning shall be performed with DGPS or preferably a RTK system. Equipment, procedures and calibration shall comply with General Specifications **GS EP POS 003** and **GS EP POS 004**.

Before the start of the site works, the DGPS or RTK system shall be verified by comparison with a reference point of known coordinates and elevation. At Company's request, or if any doubts remain about the accuracy of the DGPS / RTK positioning system, this check shall be repeated after completion of the work.

The local geodetic system to be used shall be the one provided by Company.

7.2 Positioning accuracy

The coordinates of each measurement point (X, Y, Z) shall be known with a decimetric accuracy (+/- 10 cm).

Company will not accept a positioning procedure based on a separate collection of EM data and GPS satellite data, based on synchronization of the internal clock of the acquisition system and GPS satellite time. Contractor shall propose equipment with a simultaneous recording of both EM and GPS data to the same data file, which gives more accurate results.

8. Work procedures

8.1 Calibration

The acquisition equipment shall be well maintained and properly tested / calibrated as per the manufacturer's procedures. Calibration / test certificates shall be made available to Company before the start of acquisition.

If an encoder survey wheel is used in the positioning procedure, a specific calibration of the device shall be carried out at the beginning of the survey.

If data acquisition is performed with equipment mounted on a vehicle support (trailer or quad-type), a control of the magnetic drift induced by the support (influence of metallic parts) shall be performed by comparing the conductivity values obtained with and without the support. This drift is not a fundamental problem in case of simply qualitative interpretation, but is more critical when the survey objective is to evaluate the true conductivity of the terrain.

The same problem of true conductivity characterization exists when transmitter and receiver are operated at a certain height from ground surface. Measured conductivity values include the air thickness, which has to be compensated for, in order to calculate the true conductivity of the soil.

General Specification		GS EP GEO 216
Onshore geophysical site survey - Electro-Magnetic Geophysical Survey		
Rev.: 01	Effective date: 10/2012	Page: 10 of 17

Reference profile:

A reference profile shall be defined, in agreement with Company's representative, at the beginning of the survey.

This reference profile shall be used to:

- Check the instrument drift during survey
- Check the reliability of measurements; for example in case of heavy rain occurring during a survey, which could change the apparent conductivity value of subsurface soils. Decision to continue the survey in bad weather conditions will be made by comparison with the quality of the reference profile.

This reference profile shall be rerun at least once, at the end of the survey, to insure that no variation has affected data acquisition reliability along the survey.

8.2 Validation of investigation depth

Contractor shall include in his technical proposal the records of some reference 1-D Vertical Electrical Sounding (VES) data, to validate the investigation depth obtained by interpretation of vertical apparent conductivity sounding.

8.3 Acquisition - QA/QC

QA/QC of acquired data shall be performed on site by Contractor. The raw data shall be of high professional quality, yielding no ambiguities in measurements.

Contractor shall inspect all connectors and cables jumpers for dirt, oxide and damage that may cause data quality problems.

Contractor shall be vigilant about the risk of battery weakness developing during an acquisition session, especially over long profiles.

Contractor shall also take care about interference from high-voltage power lines, and from metallic or electric fences. Contractor shall be watchful for electrical storms and shall suspend measurements to wait for less noisy recording conditions.

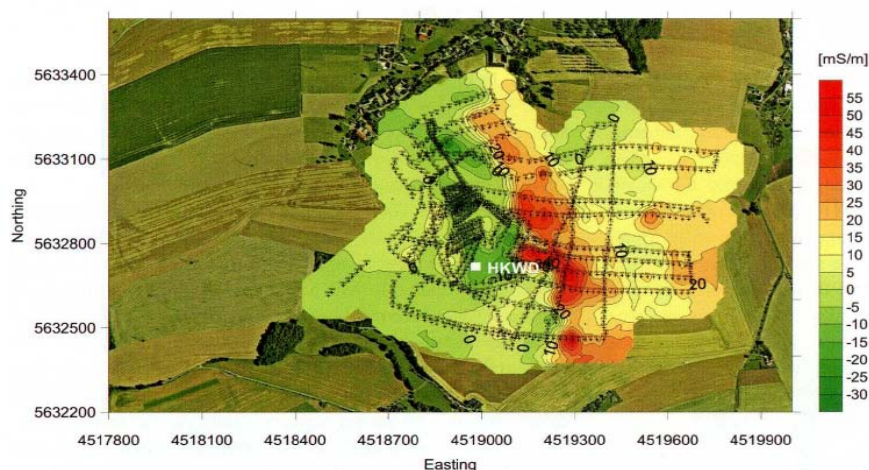
Contractor shall mobilize the equipment necessary for the Geophysicist to perform a pre-interpretation on site, which includes data interpretation software, a PC and printer for the production of QC documents.

If necessary, a second phase of complementary measurements can be decided on the basis of the first results, in order to better ascertain the extent and amplitude of the main anomalies.

Contractor shall inform the Company's representative, when discrepancies occur between EM data results and geotechnical information (e.g. boreholes) provided by Company.

8.4 Interpretation

Interpretation of EM data is mainly based on an analysis of the 2D map of apparent conductivity. Contractor shall process results with a powerful mapping software, using a gridding algorithm well suited to high-density line-based data, with a high dynamic range (see example on Figure 2).



**Figure 2 - Example of 2D apparent conductivity map
(Near Surface Geophysics, 2011, vol. 9)**

Contractor shall clearly illustrate on the 2D map of apparent conductivity, the borehole locations selected to identify EM anomalies.

Interpretation in terms of depth and true conductivity:

EM equipments are not designed for the high resolution detection of true conductivity variations with depth in complex geological environments, but rather for approximate interpretations using 2 layer-models applied to vertical data sets of apparent conductivity. Interpretation will give useful results when the terrain can be approximated by a 2-layer model.

8.5 Correlation with other available datasets

Contractor shall present, in the final report, a specific chapter to comment on the correlation between electromagnetic survey results (map of apparent conductivity) and all other available information, such as borehole logs, geological maps and data from outcrops. This correlation may be extended to other available surface or borehole geophysical results.

Contractor shall propose a complementary borehole campaign to identify the areas of anomalies. This recommendation shall be clearly illustrated using a set of correlation charts, for each of the selected anomaly areas.

9. Personnel

Contractor shall provide in his proposal the organisation and composition of the team involved in the survey. Curricula Vitae of all personnel shall be included in the technical tender.

9.1 Management

Contractor shall nominate a **Project Manager** who shall be in charge of whole project on both technical and administrative grounds; he shall be the Contractor Representative. If he cannot be involved in the site survey, the Project Manager shall nominate a **Party Chief** to be responsible

General Specification		GS EP GEO 216
Onshore geophysical site survey - Electro-Magnetic Geophysical Survey		
Rev.: 01	Effective date: 10/2012	Page: 12 of 17

for the whole acquisition and interpretation work. The Project Manager and/or Party Chief shall be fully experienced in Ground Electromagnetic survey (EM) data processing and interpretation.

During the operations, the Party Chief shall act as sole Contractor Representative and shall sign the Daily Work Sheets.

The Project Manager and Party Chief shall remain assigned by Contractor to the project for the whole duration of the project. The Project Manager and Party Chief shall be entirely familiar with the Contract.

9.2 On site

The Contractor survey crew shall consist nominally of a minimum of 3 personnel, comprising the following roles and responsibilities:

- 1 x Party Chief in charge of the survey, liaison with Company's Representative, data QA/QC and pre-interpretation on site
- 1 x Operator geophysicist in charge of acquisition recording
- 1 x Surveyor in charge of positioning.

One to three local helpers could assist the team for line clearing, and equipment transportation.

10. HSE

Contractor is required to adhere at all times to Company's Health, Safety and Environment standards. In particular, reference is made to General Specification **GS EP GPA 202**.

10.1 Contractor's responsibility

As part of the Project Execution Plan, a complete hazard identification and risk assessment (HAZID and HIRA) shall be provided by Contractor. The procedure for evacuating injured personnel (MEDEVAC/EVASAN procedure) shall be included in this safety plan.

Company's general safety instructions will be supplied to Contractor who shall read them critically, and point out any incompatibility there may be with his own safety plan.

When the survey works take place at an oil or gas production site operated by Company, Contractor shall report to the Company site manager. Before commencement of the field works, Company will provide to Contractor any specific regulations and/or work permit procedure relating to the survey site.

All matters concerning the safety of all survey personnel present during the field works at the survey site shall be Contractor's responsibility. Contractor's responsibility also includes briefing any Sub-Contractors on the safety procedures for the different equipment and tasks.

Before commencement of the survey works, a pre-job/kick-off meeting shall be organized by Company and Contractor. This meeting shall be attended by the Representatives of Company, Contractor and Sub-Contractors, and any other parties involved in the survey works, including the Company site manager and safety manager, and local authority (if required). The purpose of this meeting shall be to review the scope of the survey works to be carried out, and to identify any other activities involved on or off site. Minutes of the meeting shall be drawn up and signed by both Company and Contractor Representatives.

General Specification		GS EP GEO 216
Onshore geophysical site survey - Electro-Magnetic Geophysical Survey		
Rev.: 01	Effective date: 10/2012	Page: 13 of 17

In adverse weather conditions, Contractor may be required to cease the survey operations, when it is considered that such adverse conditions may affect the safety of survey personnel and equipment, or the quality of the acquired data. Such adverse conditions shall be defined by common agreement between the Contractor and Company Representatives.

10.2 Emergency on site

As mentioned above, Contractor is required to submit his safety plan to Company, for each project or different area within a project, before mobilisation, and including Emergency Response Plan (ERP) and medical evacuation from the worksite. Such planning shall explicitly involve the structures and facilities of Company where appropriate (vicinity of worksite). The Contractor safety plan shall be submitted to Company for endorsement before the start of the operations.

Contractor shall submit to Company a crew list of all persons actually on site, by the time of the initial mobilisation, or any subsequent crew changes during the Work.

10.3 Incident / Accident reporting

Any incident or accident shall be investigated, even if not resulting in lost time injury (near-misses). The reports shall be forwarded to Company's Representative within 24 hours. An investigation form shall be included in an appendix to Contractor's safety plan.

11. Reporting

11.1 Project Execution Plan

Contractor shall provide to Company a Project Execution Plan at least one week before the start of the survey. The Project Execution Plan shall detail in particular:

- The work procedures
- The safety plan including ERP and source handling
- The project management and organisation, including all contact details.

11.2 Daily Work Sheet

Daily Work Sheets are prepared by Company and shall be signed by Contractor Representative. Details are provided in the Particular Technical Specifications. In addition, Contractor shall provide to Company the following information:

- Daily data records and QA/QC of the data records
- List of personnel on site.

Whenever a profile has been completed, a QA/QC sheet of the profile shall be issued to the Company Representative no later than 24 hours after the completion of the profile.

General Specification		GS EP GEO 216
Onshore geophysical site survey - Electro-Magnetic Geophysical Survey		
Rev.: 01	Effective date: 10/2012	Page: 14 of 17

11.3 Field Report

This Report shall include but not limited to:

- Log of daily events
- Site location map
- List of equipments and technical descriptions
- The number of measured profiles with location map
- Positioning procedure
- Example of raw data and associated profiles or 2D maps.
- Example of Vertical Electrical Sounding (VES) interpretation and correlation with Vertical Conductivity Sounding interpretation
- Preliminary conclusions.

The Field report shall be provided to Company at the completion of the demobilisation.

11.4 Final Report

The report shall be an **Expert Report**. It shall be structured, concise and include clear and practical conclusions with respect to the survey objectives.

The final Report shall be presented in two (2) volumes:

- Volume 1: Survey Results including data examples, track plots and charts.
- Volume 2: Technical appendices including Equipment description, logs and other technical documents as required by Company Representative.

Title: The final report shall be entitled:

- Name of recipient - Company affiliate/subsidiary/project
- Site reference and location name, Country
- "Survey Report for:"
- Title: name of Survey
- Name of the structure(s), field(s)
- Contractor name
- Start/end dates of onshore work.

Certification: THE first page of the report shall show certification, specifically:

- Name of Party Chief in charge of the field work
- Name of person responsible for interpretation
- Name and signature of QA/QC issuing authority
- Date of issue.

General Specification		GS EP GEO 216
Onshore geophysical site survey - Electro-Magnetic Geophysical Survey		
Rev.: 01	Effective date: 10/2012	Page: 15 of 17

11.4.1 Draft Final Report

One draft copy of the final report, with all relevant maps and illustrations, shall be submitted to Company, for review and approval.

Contractor shall issue the final report after incorporation of Company's amendments or addenda.

11.4.2 Final Report Content

The Final Report shall comprise the following:

- **Volume 1: "survey results"**

Section 1: Abstract giving a brief description of the operations

- Date of survey
- Location of measured profiles with key coordinates and situation plan
- Summary of main survey results
- Conclusion and recommendations.

Section 2: Results

- Introduction
- General situation plan
- Summary of local geological / geotechnical information
- Objectives defined by Company
- Comments on final results synthesis profiles or maps with location of EM anomalies
- Comments on estimated investigation depth based on the interpretation of Vertical Electrical Sounding and Vertical Conductivity Sounding
- Comments on correlation between EM results and all available complementary information such as borehole logs, or results from other geophysical methods
- Conclusion summarising the main results
- Recommendations for the positioning and the depth of boreholes to identify EM anomalies.

Location maps and situation plans shall comply with the Total General Specifications **GS EP GEO 401**.

Section 3: Charts & profiles

- Location map of measured profiles
- Topographical charts
- Final results summary map
- Charts illustrating correlation between electromagnetic maps and other available geophysical results as Vertical Electrical Sounding, microgravity, electrical resistivity tomography or Ground Penetrating Radar profiles.

General Specification		GS EP GEO 216
Onshore geophysical site survey - Electro-Magnetic Geophysical Survey		
Rev.: 01	Effective date: 10/2012	Page: 16 of 17

Charts scales will be defined in Technical Particular Specifications.

- **Volume 2: “Operations report”**

Section 1: Technical Report

- Achieved scope of work
- List of equipments
- Time allocation-durations of operations, transit, stand-by and breakdowns, as percentage of total
- Positioning procedure
- The results of the positioning system accuracy check and monitoring
- Results of Vertical Electrical Sounding interpretation
- Results of Vertical Conductivity Sounding interpretation
- Comments on data quality
- Geological / Geotechnical logs (if any).

Section 2: Appendices

- Appendix 1: Log of daily events
- Appendix 2: Personnel involved
- Appendix 3: Detailed description of the equipment including positioning system
- Appendix 4: All positioning data
- Appendix 5: Raw Data of the whole set of investigated profiles with field notes (electronic format).

11.5 Deliverables

Reports and charts shall be compiled as specified in these General Specifications, and delivered in paper and electronic formats. All reports and charts shall thus comply with the following requirements:

- a) Five paper copies, unless otherwise specified in the Particular Technical Specifications
- b) Electronic data (charts and reports) shall be also provided as two copies.

Final Survey Report

Electronic files shall be provided in the following formats:

- Text documents: Word for Windows 2003; and unprotected Adobe Acrobat PDF
- Drawings, charts: AutoCad 2008 and unprotected Adobe Acrobat PDF
- Images: geo-referenced JPG or TIFF format.

General Specification		GS EP GEO 216
Onshore geophysical site survey - Electro-Magnetic Geophysical Survey		
Rev.: 01	Effective date: 10/2012	Page: 17 of 17

GIS Requirements

As a separate deliverable, the data acquired and the charts shall be provided in a format fully compatible with requirements of the Company's GIS (Geographical Information System, or survey database). Reference is made to General Specification [GS EP GEO 401](#).

Ancillary Data

In addition to the above results of the survey, Contractor shall include the ancillary data detailed below. Items to be included as annex to Final Report, in digital form (stored on CD / DVD or storage disk):

- Raw data
- Observer's log (ascii)
- Positioning data (ascii)
- Apparent conductivity map in ascii format giving X, Y, and apparent conductivity values.

12. Other references

Following documents are applicable:

- Standards: [ASTM D 6639 - 01 \(2008\)](#)
- Total General Specifications: [GS EP GEO 210](#), [GS EP GEO 211](#), [GS EP GEO 212](#), [GS EP GEO 213](#), [GS EP GEO 214](#) and [GS EP GEO 215](#).