

DEP SPECIFICATION

ONSHORE AND NEARSHORE SITE INVESTIGATIONS

DEP 34.11.00.10-Gen.

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DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the survey and site investigation activities required for obtaining data with respect to the physical site conditions, and is relevant to both onshore and nearshore projects.

This DEP relates to geological and geotechnical desk studies and field investigations, geophysical surveys and topographic and hydrographic surveys.

Assessment of contamination and environmental conditions is excluded from the scope of this DEP, since different standards apply to drilling equipment, sampling procedures, etc.

Metocean studies are also outside the scope of this DEP.

This is a revision of the DEP of the same number dated February 2014; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

The word **may** indicates a permitted option.

1.3.2 Specific definitions

Term	Definition
Ground	Soil, rock and fill existing in place prior to the execution of the site investigation or construction project
Made Ground	Non-engineered fill (of any type) placed as a result of human activity.
Survey Contractor	Party appointed by the Principal or the Contractor which carries out one or more of the site investigation activities.

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section or clause number is shown in brackets (). Other documents referenced by this DEP are listed in (9).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated February 2014.

Section/Clause	Change
All	Restructured and clarified requirements, enforced use of shall / should / may for normative statements.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the "Give feedback" link, fill in the online form and submit.
DEP Feedback System (Users with access to Shell Wide Web)	Enter comments directly in the DEP Feedback System which is accessible from the Technical Standards Portal http://www.shell.com/standards . Select "Submit DEP Feedback", fill in the online form and submit.
DEP Standard Form (other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

1.8 NON NORMATIVE TEXT (COMMENTARY)

Text shown in italic style in this DEP indicates text that is non-normative and is provided as explanation or background information only.

Non-normative text is normally indented slightly to the right of the relevant DEP clause.

2. GENERAL CONSIDERATIONS

2.1 PURPOSE

1. A site investigation is carried out to acquire and interpret reliable information for one or more of the following aspects of a construction project:
 - a. feasibility;
 - b. site selection;
 - c. basis for design;
 - d. safe and economic design of temporary and permanent facilities;
 - e. assessment of hazards associated with the ground;
 - f. location of resources (e.g., sources of sand or aggregates);
 - g. assessment of materials to be excavated or dredged;
 - h. tendering and construction;
 - i. operation and maintenance;
 - j. extension/upgrading;
 - k. de-commissioning;
 - l. assessment of contamination (outside the scope of this DEP).

2.2 UNITS OF MEASUREMENT

1. SI units shall be used for site investigations, surveys and related activities.
 - a. Refer to DEP 00.00.20.10-Gen.

2.3 FINANCIAL CONSIDERATIONS AND EFFECTS

1. The timing for the soil investigation is to be determined by the following:
 - a. likelihood of the project proceeding beyond FID;
 - b. sensitivity of design to soil investigation data;
 - c. available soil investigation;
 - d. remoteness of site;
 - e. timing data is require;
 - f. cost of mobilisation;
 - g. remoteness of site.

2.4 SITE INVESTIGATION & PROJECT PHASING

The type and scope of a site investigation depends on the purpose for which the investigation is required and on the circumstances under which it is to be carried out.

1. Refer to (5) for various types and scopes of site investigations.
2. A site investigation may consist of the following main elements:
 - a. desk studies and walkover studies;
 - b. remote sensing - e.g., satellite imagery, aerial photography, LIDAR surveys;
 - c. field surveys, such as boreholes, CPTs, in-situ tests, geophysical survey, visual inspection, measurements and sample collection;
 - d. laboratory testing of samples collected during a field survey;
 - e. data processing, integration and interpretation techniques for reporting purposes.

The following can be considered for a site investigation:

- *obtaining adequate site investigation data at an early stage in the project, as uncertainty about site conditions will be reflected in improved design of concept engineering and hence in reduced bid prices by Contractors;*
- *providing specialist supervision of the Survey Contractor's field survey activities, in order to help in ensuring that the technical and HSE objectives are met (e.g., by driving quality and adjusting the site investigation plan and detecting any deficiencies);*
- *preserving samples of ground or groundwater and retaining specific monitoring instruments for ongoing or future use.*

3. TECHNICAL REQUIREMENTS

3.1 CODES AND STANDARDS

1. Site investigations and associated work shall be in accordance with the UK Specification for Ground Investigation.
 - a. In addition, British Standards, ASTM or other local standards appropriate to the specific Scope of Work shall supplement this specification.
 - b. For cold regions, the Canadian Foundation Engineering Manual should be used to supplement this specification.
2. Refer to DEP 34.11.00.12-Gen. for geotechnical design and analysis requirements.

3.2 DESIGN STRATEGY

3.2.1 Extent of investigation required

The extent of information required depends on the nature and complexity of the facilities to be constructed, the nature and complexity of the ground and the acceptable risk level (related to direct effects and economic damage that can result).

The site investigation will include some or all of the survey types described in this document and will in general be phased. The level of detail is appropriate to satisfy the objectives of the site investigation.

3.2.2 Minor projects

For small projects and small extensions to existing facilities and structures, available survey (or design) data can be used.

If any doubt exists regarding the accuracy of the existing data, it is to be verified by means of a 'verification investigation.

Depending on the scope of the project, this can vary from a detailed site investigation to inspection of the exposed base of an excavation for a shallow foundation, supplemented by manual testing.

3.2.3 Projects with an “over-water” component

If there is surface water in the area to be investigated, the cost of the site investigation will be substantially greater than that of a similar dry-land project. Mobilisation, moving, access and standby costs are generally much higher. The inter-tidal zone causes particular problems because it can be difficult to reach with either onshore or marine equipment.

Consideration to be given to factors such as:

- *minimising the number of site investigation phases of a nearshore site investigation because of the limited availability and high mobilisation cost of adequate floating craft and special field survey apparatus;*
- *progress is often closely dependent on tides, currents, weather conditions and safety aspects;*
- *feasibility and timing of a geophysical survey is particularly important with respect to the scope of the geotechnical survey;*
- *geophysical and hydrographic survey data may be acquired simultaneously from the same vessel.*

3.2.4 Procurement of site investigation/survey contracts

1. Contractors and personnel shall conform to ISO/TS 22475-2 or ASTM D 3740 in North America.

3.2.5 Procurement of site investigation specialists

1. Specialist expertise may have to be procured for:
 - a. carrying out desk studies;
 - b. supervision of field work;
 - c. review of Survey Contractor submissions;
 - d. design review.

4. GEOPHYSICAL SURVEY

4.1 OBJECTIVE

The primary objectives of an engineering geophysical survey are one or more of the following:

- *data acquisition for geological purposes, such as establishing the general stratigraphy between boreholes/CPTs etc., weathering profiles, erosional or structural features (buried channels, faults, dykes etc.);*
- *Derivation of ground parameters (shear wave velocity and stiffness, electrical and thermal conductivity;*
- *resource assessment, such as location and nature of aquifers, sand and gravel deposits, rock for aggregates;*
- *detection of voids and buried objects, such as mine workings, natural cavities, old foundations, buried tanks;*
- *detection of environmental hazards, such as hydrocarbon pollution, mine tailings, etc.*

1. Geophysical surveys should be calibrated against intrusive investigations such as boreholes and CPTs.

5. GEOTECHNICAL INVESTIGATION

5.1 OBJECTIVE

The objective of a geotechnical site investigation is to reduce project risk and uncertainty by providing information on ground and groundwater conditions for design purposes and to verify previously collected (desk study) data. The information gathered will be sufficient to provide an adequate level of geotechnical design data for the relevant project stage(s).

1. The site investigation shall provide information on properties and behaviour under the full range of conditions that can be expected on the site and include the following:
 - a. temporary or permanent changes as a result of the construction project or natural phenomena such as: changes in stress and associated strain, changes in water content and associated volume changes, changes in groundwater level and flow pattern, changes in temperature and electrical potential, and changes in soil properties such as strength and compressibility;
 - b. effects of earthquakes - e.g., liquefaction;
 - c. aggressivity to materials placed in the ground, such as concrete and steel;
 - d. potential borrow areas and quarries for construction materials (fill and aggregates).

5.2 FIELD SURVEY

5.2.1 General

Techniques are to be selected depending on following:

- *availability;*
- *the ground type at the site;*
- *the type of project;*
- *the site location, and*
- *the level of information that is required for the project phase.*

5.2.2 Scope of investigation

The exploratory holes (e.g., boreholes, CPTs) are to have locations and depths sufficient to provide sufficient information for the relevant stage(s) of the project. They must make a general geological site assessment feasible.

1. If layouts are known, more detailed information should be obtained at positions of important structures and earthworks, at points of special engineering difficulty or importance and where ground conditions are complicated.
 - a. In the absence of other criteria, a regular array of exploration points may be used in the initial design of the field investigation.
2. Supervision and flexibility should be provided to allow adjustments to be made to the initial pattern as the survey proceeds, in order to ensure that the objectives are met.

If the (preliminary) plant layout is known, points can be concentrated in relevant areas, or the overall grid made finer in areas where construction will occur (and coarser elsewhere). The density of site investigation for each project phase is defined based on the quality of the anticipated ground conditions and the sensitivity of the proposed facility.

The quality of the ground can be quantified in terms of the Ground Factor, which is defined in Table 5.1 below.

Table 5.1 Definition of Ground Factor

Ground Conditions	Ground Factor
Stratigraphy is simple with little variation. Materials are not problematic and no potential geohazards are identified. Competent ground	3
Multiple soil layers, potential for lateral variation. Potential geohazards identified, but these can be quantified and mitigated using established engineering solutions that are both technically and financially viable	2
Multiple soil layers, with diverse and/or difficult materials. Potentially significant geohazards those are difficult or costly to quantify or mitigate.	1
Potential geohazards that may not be technically or economically feasible to mitigate.	1*

In addition to the quality of the ground, site investigation scope is also dependent on the complexity of the proposed structures and, primarily the sensitivity of them to geotechnical factors.

This can be described using a second parameter, Structure Factor.

Refer to Table 5.2 for Structure Factor as second parameter:

Table 5.2 Definition of Structure Factor

Structure and Risk/Opportunity Description	Structure Factor
Structure is simple and insensitive to geotechnical factors. Few major risks or opportunities.	3
Structure is moderately complex and moderately sensitive to geotechnical factors or significant risk/opportunity for optimisation.	2
Structure is complex and highly sensitive to geotechnical factors or major potential for opportunities or high risk of problems	1

From these two parameters, a Scope Criticality Factor can be defined, from which the level and quality of information that is required from a Site Investigation can be determined.