

DEP SPECIFICATION

DESIGN OF PILES FOR SUBSEA PIPELINE INITIATION AND ANCHORING

DEP 37.81.10.17-Gen.

February 2017

ECCN EAR99

DESIGN AND ENGINEERING PRACTICE



© 2017 Shell Group of companies

All rights reserved. No part of this document may be reproduced, stored in a retrieval system, published or transmitted, in any form or by any means, without the prior written permission of the copyright owner or Shell Global Solutions International BV.

This document contains information that is classified as EAR99 and, as a consequence, can neither be exported nor re-exported to any country which is under an embargo of the U.S. government pursuant to Part 746 of the Export Administration Regulations (15 C.F.R. Part 746) nor can be made available to any national of such country. In addition, the information in this document cannot be exported nor re-exported to an end-user or for an end-use that is prohibited by Part 744 of the Export Administration Regulations (15 C.F.R. Part 744).

This document has been supplied under license by Shell to:
UOP Honeywell ted.fuger@honeywell.com 19/01/2018 10:13:59

PREFACE

DEP (Design and Engineering Practice) publications reflect the views, at the time of publication, of Shell Global Solutions International B.V. (Shell GSI) and, in some cases, of other Shell Companies.

These views are based on the experience acquired during involvement with the design, construction, operation and maintenance of processing units and facilities. Where deemed appropriate DEPs are based on, or reference international, regional, national and industry standards.

The objective is to set the standard for good design and engineering practice to be applied by Shell companies in oil and gas production, oil refining, gas handling, gasification, chemical processing, or any other such facility, and thereby to help achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to Shell companies for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual Operating Units to adapt the information set forth in DEPs to their own environment and requirements.

When Contractors or Manufacturers/Suppliers use DEPs, they shall be solely responsible for such use, including the quality of their work and the attainment of the required design and engineering standards. In particular, for those requirements not specifically covered, the Principal will typically expect them to follow those design and engineering practices that will achieve at least the same level of integrity as reflected in the DEPs. If in doubt, the Contractor or Manufacturer/Supplier shall, without detracting from his own responsibility, consult the Principal.

The right to obtain and to use DEPs is restricted, and is typically granted by Shell GSI (and in some cases by other Shell Companies) under a Service Agreement or a License Agreement. This right is granted primarily to Shell companies and other companies receiving technical advice and services from Shell GSI or another Shell Company. Consequently, three categories of users of DEPs can be distinguished:

- 1) Operating Units having a Service Agreement with Shell GSI or another Shell Company. The use of DEPs by these Operating Units is subject in all respects to the terms and conditions of the relevant Service Agreement.
- 2) Other parties who are authorised to use DEPs subject to appropriate contractual arrangements (whether as part of a Service Agreement or otherwise).
- 3) Contractors/subcontractors and Manufacturers/Suppliers under a contract with users referred to under 1) or 2) which requires that tenders for projects, materials supplied or - generally - work performed on behalf of the said users comply with the relevant standards.

Subject to any particular terms and conditions as may be set forth in specific agreements with users, Shell GSI disclaims any liability of whatsoever nature for any damage (including injury or death) suffered by any company or person whomsoever as a result of or in connection with the use, application or implementation of any DEP, combination of DEPs or any part thereof, even if it is wholly or partly caused by negligence on the part of Shell GSI or other Shell Company. The benefit of this disclaimer shall inure in all respects to Shell GSI and/or any Shell Company, or companies affiliated to these companies, that may issue DEPs or advise or require the use of DEPs.

Without prejudice to any specific terms in respect of confidentiality under relevant contractual arrangements, DEPs shall not, without the prior written consent of Shell GSI, be disclosed by users to any company or person whomsoever and the DEPs shall be used exclusively for the purpose for which they have been provided to the user. They shall be returned after use, including any copies which shall only be made by users with the express prior written consent of Shell GSI. The copyright of DEPs vests in Shell Group of companies. Users shall arrange for DEPs to be held in safe custody and Shell GSI may at any time require information satisfactory to them in order to ascertain how users implement this requirement.

All administrative queries should be directed to the DEP Administrator in Shell GSI.

TABLE OF CONTENTS

1.	INTRODUCTION	4
1.1	SCOPE	4
1.2	DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS	4
1.3	DEFINITIONS	4
1.4	CROSS-REFERENCES	6
1.5	SUMMARY OF MAIN CHANGES.....	6
1.6	COMMENTS ON THIS DEP	6
1.7	DUAL UNITS.....	6
1.8	NON NORMATIVE TEXT (COMMENTARY).....	6
2.	GENERAL	7
2.1	FUNCTIONALITY	7
2.2	EXTERNAL STANDARD	7
3.	DESIGN CRITERIA	7
3.1	GENERAL	7
3.2	GEOHAZARDS.....	8
3.3	SOIL PARAMETERS.....	8
3.4	LOADING CONDITIONS	9
4.	GEOTECHNICAL ANALYSES	10
4.1	GENERAL	10
4.2	RESPONSE ANALYSIS	11
4.3	AXIAL CAPACITY.....	12
4.4	INSTALLATION	13
5.	STRUCTURAL DESIGN	13
5.1	GENERAL.....	13
5.2	ALLOWABLE STRESSES.....	13
5.3	PIPELINE CONNECTING TETHER	14
6.	MATERIALS AND CORROSION PROTECTION	14
6.1	MATERIAL SELECTION	14
6.2	CORROSION PROTECTION	14
7.	MISCELLANEOUS DETAILS	15
7.1	PADEYES	15
7.2	CONNECTORS	15
7.3	MARKINGS.....	16
7.4	INSTALLATION APPURTENANCES	16
8.	REFERENCES	17
9.	BIBLIOGRAPHY	18

1. INTRODUCTION

1.1 SCOPE

This new DEP specifies requirements and gives recommendations for the design of piles for subsea pipeline initiation and anchoring. This DEP is intended to address stand alone piles that may be installed to the desired grade by gravity, drilling (and grouting), jetting, driving or suction and whose primary function are to resist lateral loads acting at or near the pile top.

These lateral loads on the pile may result from:

- a pipeline lay-down operation;
- to restrain thermal growth or walking of pipelines;
- to restrain movement from infrequent environmental conditions for a pile, used as an anchor for a pipeline termination sled.

Herein, the term "pipeline" broadly refers to a pipe intended for the subsea transport of produced oil and gas including export lines, in-field flowlines and near touchdown zones of catenary risers.

The scope of this DEP does not cover piles, plates or other types of anchors that are loaded below the seafloor with an inverse catenary forerunner. See DEP 37.81.10.12-Gen. for the design of such anchors.

The scope of this DEP does not cover subsea foundation structures, such as flowline termination sleds and manifolds including those with integrated pin piles or on suction piles. See DEP 37.81.10.16-Gen.

This DEP is a revision of the same number dated February 2016.

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 authorisation 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. 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
Administrator	Person responsible for administration of the DEP system.
Approve, Approved or Approval	Principal's written approval process, completed prior to ordering material and/or beginning work.
Contract Drawings	Detailed engineering drawings prepared for this project and all official revisions to those drawings. The General Data Sheet contains a list of Contract Drawings.
External Standard	Standard issues under the auspices of a non-Group entity, e.g., ISO, EN, ANSI, BS, API.
Pipeline	Pipe intended for the subsea transport of produced oil and gas including export lines, in-field flowlines and near touchdown zones of catenary risers.
Review	Principal's right, but not obligation, to comment on the submitted item. Contractor may begin construction of the item following submittal

1.3.3 Abbreviations

Term	Definition
CP	Cathodic Protection
DEP	Design and Engineering Practice
DFT	Dry Film Thickness
EPP	Exploration and Production Projects
FEM	Finite Element Method
MBS	Minimum Breaking Strength
MSYS	Minimum Specified Yield Stress
PLET	Pipeline End Termination
SI	International System of Units
USC (Units)	United States Customary (Units)

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 (8).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated February 2016. The only changes are to DEP cross-references to reflect changes in the DEP library in 2017

It is based on the EPP of the same number dated August 2006, updated to refer to ISO 19901-4 and API RP 2-GEO.

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.