

DEP SPECIFICATION

DEEPWATER SUBSEA VERTICAL TREE SYSTEMS (AMENDMENTS/SUPPLEMENTS TO ISO 13628-4)

DEP 37.80.00.36-Gen.

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ECCN EAR 99

DESIGN AND ENGINEERING PRACTICE



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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.

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PART I. INTRODUCTION

1.1 SCOPE

This new DEP specifies requirements for deepwater subsea vertical tree systems, and is based on ISO 13628-4, Second Edition, 2010-12-15.

NOTE: Upon final adoption of the ISO document, it will also be adopted back as API 17D.

The intention of this document is to complement and align the requirements of the industry standard document ISO 13628-4 with the Principal's specific global requirements for deepwater subsea vertical tree systems.

Part III of this DEP contains text that clarifies, amends and supplements the content in the ISO standard. In a number of cases, additional requirements and recommendations are provided pertaining to the various sections/clauses of ISO 13628-4. For ease of reference, the clause numbering of ISO 13628-4 has been used throughout Part III of this DEP.

Where the ISO document addresses requirements for equipment not part of a deepwater subsea vertical tree system, for example horizontal tree systems or mudline suspension systems, those sections are not addressed by this DEP and are not applicable to it.

In addition to ISO 13628-4, there are also references to other Project Specifications and DEPs that contain features and requirements that are specific to the Principal and Project needs.

The ISO document used as the basis for this DEP is part of the ISO 13628 series of documents that are listed under the general title "*Petroleum and natural gas industries — Design and operation of subsea production systems*".

For guidance purposes, and in order to identify the general requirements and recommendations, refer to the following API/ISO document or its equivalent API or DEP document:

ISO 13628-1 (2005) Part 1	General requirements and recommendations
API RP17A (2005)	General Requirements and Recommendations (Endorsement of ISO 13628-1)
DEP 37.80.00.30-Gen.	Design and Operation of Subsea Systems (Based on ISO 13628)
ISO 13628-4:2010	All clauses not modified or deleted by this DEP are accepted as written

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 offshore oil and gas production facilities. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process should 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.

1.3.2 Abbreviations

Abbreviations are as given in ISO 13628-4:2010, with additions in (Part III, Clause 3).

1.4 CROSS-REFERENCES

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

1.5 SUMMARY OF MAIN CHANGES

Versions 0, 1, 2 and 3 of this document were all based on the former DWP being an overlay to the 2nd Draft of ISO 13628-4 Revision 6. The ISO document has now been updated and final approved as ISO 13628-4:2010. The changes to formatting and content from the ISO document have been incorporated into this version of the DEP in (Part III) of the document.

The table below identifies the main changes to the document from earlier versions.

Reference	Details of change
General comments	Document has been re-classified from a DWP to a Gen. document, with sections and titles amended accordingly. Document layout re-formatted per the requirements of the DEP 37.80.00.30-Gen. Various changes to text included to: • Document raised to September 2011 Revision • Add in general comments and findings to the document content from the latest round of equipment bids. • Correct format and text to align with the upgrade of the underlying ISO Document from a "Draft" level to a final.

Part I	The following sections have been added to the document: 1.1 Scope 1.2 Distribution, intended use and regulatory considerations 1.3 Definitions 1.4 Cross-references 1.5 Summary of main changes since previous edition 1.6 Comments on this DEP NOTE: The above sections provide the definitions as used in this DEP.
Part III	This section is a direct overlay to the ISO 13628-4:2010, and content has been realigned with the appropriate sections of the ISO document.
1.1	General - Document reference and purpose of DEP definition added.
1.2	Equipment covered by document definition added.
2	Normative References – Note that due to re-formatting, these documents are now listed in (Part III).
3	Some additional terms now referenced.
4	Document reference, the details of Service conditions and PSL levels added.
5.1	Document reference updated.
6.1.1	Landing the tubing hanger in the wellhead is allowed, provided it is a slimbore design
6.1.1.1	Bullet for the assembled XT package weight amended to include the 15 000 psi weight of 54.4Tonnes (120,000lbs).
6.2	ROV override devices on valves no longer required to be linear.
6.2	Figures of tree schematic have been moved from the body of the document to (Appendix A.)
6.3.2	Note added about PSL3G Gas testing of tree assemblies now being only required for trees in gas service.
7.5.5, 7.8.1.2, 7.10.2.1.3	Requirement for integral torque indicator studs for non-API valve blocks added.
7.8.3	Requirement for secondary sealing profile only applied to upward facing profile of H4 VX gasket.
7.10.2.2	Sea chest volume requirement reduced to 125% of swept volume.
7.21.1	A flange mounted choke in a retrievable flow module is allowed.
7.19.2, 7.19.3	These sections have been added to Part III of the DEP to cover for the Control Pod (SCM) Running Tool and Choke Flow Module Running Tool respectively.
9.1.1	Landing the tubing hanger in the wellhead is allowed, provided it is a slimbore design
Appendices	Appendices have been added to the DEP with sections for tree system schematics.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at standards@shell.com, using the DEP Feedback Form. The DEP Feedback Form can be found on the main page of “DEPs on the Web”, available through the Global Technical Standards web portal <http://www.shell.com/standards> and on the main page of the DEPs DVD-ROM.

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.

PART II GENERAL

Part III of this DEP is written as clarifications, amendments and supplements to ISO 13628-4, Second Edition, 2010-12-15. Wherever reference is made to ISO 13628-4, it shall be understood to mean ISO 13628-4, Second Edition, 2010-12-15, as amended/supplemented by this DEP.

For ease of reference, the clause numbering of ISO 13628-4 has been used throughout Part III of this DEP.

Clauses in ISO 13628-4, which are not mentioned in this DEP, shall remain valid as written.

NOTE: Where the ISO document addresses requirements for equipment not part of a deepwater subsea vertical tree system, for example horizontal tree systems or mudline suspension systems, those sections are not addressed by this DEP and are not applicable to it.

PART III AMENDMENTS AND SUPPLEMENTS TO ISO13628-4:2010**1 SCOPE**

1.1 This DEP shall be used with reference to the following documents:

- DEP 37.80.00.30-Gen., and;
- ISO 13628-4:2010 (Part 4: Subsea Wellhead and Tree Equipment)

In addition, the following statements are applicable:

This document follows the same format and content as the ISO 13628-4. Any comments are included to identify the Principal's requirements as an exception or addition to those in the ISO document and/or to illustrate the purpose of those requirements. Where no comments are made the statements within the ISO document are accepted.

Any requirements relating to Environmental conditions, Water Depths, Pressure/Temperature ratings, Materials etc. will be provided within the Tender Documentation Package, Basis for Design and project equipment specific documentation packages. In (Appendix B) an example data sheet package which can be used to specify project specific information is supplied.

1.2 This DEP addresses only deepwater vertical subsea tree systems. Of the listing in the ISO document, only the following categories are addressed:

- a) Subsea trees
- e) Tubing hanger systems

The associated tools and equipment of both categories are also addressed.

Other items listed in section 1.2 of the ISO document are outside the scope of this DEP.

2 NORMATIVE REFERENCES

Refer to (Part IV) of this DEP.

3 TERMS, ABBREVIATED TERMS, DEFINITIONS AND SYMBOLS

As per the ISO document, with the following additions:

HCLS	Heave Compensated Landing System
SCM	Subsea Control Module
SID	Subsea Isolation Device
THS	Tubing Head Spool

4 SERVICE CONDITIONS AND PRODUCT SPECIFICATION LEVELS

4.1 SERVICE CONDITIONS

Actual project specific service condition details are to be found in the Project Tender Documentation Package and/or the supporting Specification or Data Sheet. (Appendix B) of this document gives an example data sheet package.

4.2 PRODUCT SPECIFICATION LEVELS (PSL)

Apply quality control requirements for PSL3/3G per Table 17 in section 7.4.2.2.2 of the API 6A/ISO 10423:2009(E) document.

5 COMMON SYSTEM REQUIREMENTS

5.1 DESIGN AND PERFORMANCE REQUIREMENTS

As per the ISO document with changes and additions to the sections as noted:

5.1.1.4 Materials

Details of allowable materials are given in documents referenced in the Informative companion document under Materials and Corrosion Specifications.

5.1.2.3 Material Class Ratings

Material Class Ratings are per Table 1 of the API 6A/ISO 10423:2009(E) document. Specific project decisions regarding material class ratings are detailed within the Tender Documentation Package either in the Project Specification or Equipment Data Sheet for subsea trees, tools and equipment.

5.1.4.7 Coatings (external)

Details of allowable coatings are given in the documents covering Materials and Corrosion Specifications referenced in the Informative companion document.

5.1.4.8 Cathodic protection

Details of allowable cathodic protection systems are given in the documents covering Cathodic Protection Specifications referenced in the Informative companion document.

5.2 MATERIALS

Details of allowable materials are given in documents covering Materials and Corrosion Specifications referenced in the Informative companion document. All materials shall meet the required material class ratings.

5.2.3 Product specification level

Apply quality control requirements for PSL3/3G per Table 17 in section 7.4.2.2.2 of API 6A/ISO 10423:2009(E).

5.3 WELDING

5.3.1 Pressure-containing/controlling components

Apply quality control requirements for PSL3/3G per Table 17 in section 7.4.2.2.2 of API 6A/ISO 10423:2009(E).

5.4 QUALITY CONTROL

5.4.2 Product specification level

Apply quality control requirements for PSL3/3G per Table 17 in section 7.4.2.2.2 of API 6A/ISO 10423:2009(E).

5.4.8 Cathodic Protection

Per the ISO document and with details of allowable cathodic protection systems referenced in the Informative companion document.

6 GENERAL DESIGN REQUIREMENTS FOR SUBSEA TREES AND TUBING HANGERS

6.1 GENERAL

Requirements as per the ISO document with changes and additions to the sections as noted.

Additional subsections (6.1.7), (6.1.8), and (6.1.9) which do not exist in the original document, have been added.

6.1.1 Introduction

As per the ISO document and with the following addition:

Principal requirements are provided in the list below and in the Project Specification or Equipment Data Sheets:

- Each individual wellhead may have a Tubing Head spool mounted on it. If not, then the wellhead shall be slimbore compatible.
- The tree system shall be a conventional dual bore vertical configuration with the production bore concentrically located and the annulus bore offset.
- The tree system and its components shall be suitable for deepwater guidelineless deployment, installation and recovery. Refer to (Part III Annex K) and the documents referenced in the Informative companion document, Appendix B, Section B1.
- Tree system shall be capable of being deployed, installed and recovered using the completion riser, HCLS, downline or drill pipe using ROV support.
- The tubing hanger systems shall be compatible with 13-5/8" BOP drift diameter and surface BOP operations
- The tubing hanger and tree systems shall be compatible with wireline and coiled tubing well servicing operations.
- All subsea installed equipment shall have a "minimum" operating life of 20 years without the need for planned maintenance. Similarly support and intervention equipment shall be maintained for that 20 year life span.
- All items of the completion system shall be designed to be recoverable after installation for maintenance, de-commissioning or abandonment.
- The assembled weight of the tree package (ready for shipping and/or installation) shall have the following not to exceed targets:
 - o 40.8 Tonnes (90,000 pounds) for 10 000 psi rated systems;
 - o 54.4 Tonnes (120,000 pounds) for 15 000 psi rated systems.
- Both the Subsea Control Module and Choke Valve Module Insert or Flow Module shall be capable of being recovered and re-installed with the tree still installed subsea.
- The tree re-entry mandrel interface shall allow for the attachment of the following:
 - A surface BOP system
 - A tree running and/or handling tool for either drill pipe or wire rope deployment
 - A subsea BOP Package
 - A completion/workover LRP/EDP package
 - An ROV deployable non-orienting tree cap

6.1.3 Orientation and Alignment

As per the ISO document and with the following addition:

When using a Tubing Head Spool, all equipment orientation and alignment systems shall be passive and any component of the system that is more damage prone than its mating part shall be the easier of the two to recover and rework. If completing in the wellhead the orientation and alignment system may require a combination of active and passive methodologies, with the focus on minimizing critical path rig activities in setting up the orientation and alignment system.

6.1.4 Rating

As per the ISO document and the Project Specification or Equipment Data Sheet.

6.1.5 Interchangeability

Major items of equipment within the systems shall be designed to meet as a minimum the following interchangeability requirements. Per the definition contained in the Project Scope of Work, the Contractor may achieve the desired level of interchangeability by using actual equipment or by providing and maintaining tools or jigs that can achieve the same.

- Any subsea tree with any tubing head spool assembly
- Any tubing head spool with any wellhead
- Any tubing hanger with any subsea tree and with any tubing head spool assembly
- Any SCM on any subsea tree or manifold SCM mounting base
- Any controls jumper to any subsea tree stab plate and test plate
- Any tree cap and LRP assembly with any subsea tree, and any LRP with any EDP
- Tree deployment tool with any tree
- Any choke insert with any choke body
- All running tools and riser joints
- All test equipment
- Any tie-in connector with any hub
- All sets of ROV tools with all ROV interfaces on the equipment
- ROV tool systems with the proposed drilling and installation vessel ROVs
- Retrievable sensors

6.1.7 Protection Philosophy *(new section not in ISO 13628-4:2010)*

The protection philosophy used in the design of the tree system is required to meet the following Principal requirements in the stated order of importance:

- a) Avoidance of hazard to human life
- b) No release of hydrocarbons to the environment
- c) Loss of control over tree system functions
- d) Rendering well impossible to kill or re-enter by direct vertical means

The tree system shall be provided with protection against the risk of damage due to accidental loads.

Installed subsea tree equipment shall possess local protection against dragged objects such as installation equipment, but not fishing trawls. Loads resulting from such snagging shall be transmitted into the well conductor. The provision of such protection shall not restrict the ability to re-enter and service the well and perform maintenance activities.

Special consideration shall be given to equipment protection during transportation and handling when undertaking offshore operations. Additional protection equipment shall be included where necessary to minimize damage to equipment during offshore loading from supply boat to rig and vice versa.

Designs shall minimize the risks of ROV tethers and installations lines snagging during installation, operation, maintenance and intervention activities.

At a detail level, sensitive components shall be located in non-exposed, or suitably protected positions provided that access for remote intervention, where necessary, is not compromised.

6.1.8 Installation, Maintenance and Repair (IMR) Philosophy *(new section not in ISO 13628-4:2010)*

Installation activities and the requirements for ROVs and tooling are given in the documents referenced in the Informative companion document, Appendix B, Section B1.

The general IMR philosophy is stated as follows:

- All installation and intervention operations shall therefore be achieved by guidelineless means with the assistance where necessary of a standard deepwater work class ROV
- The tubing head spools and trees shall be run and installed either on wire, by HCLS, by drill pipe, by the surface BOP and marine riser system, or by the completion riser system.
- In all cases it shall be possible to lock the tree to the tubing head spool, and to verify the connection and performance of the seal arrangements with an ROV.
- All subsea valves shall have the facility for ROV override unless specified otherwise. During ROV operation the hydraulic control system shall not allow the ingress of seawater, with or without the controls flying lead made-up to the manifold, or the forming of a hydraulic lock.
- All minor tree components shall be assessed for in-situ ROV repair and the tree design shall maximize the possibility for unplanned maintenance by this means. The Contractor shall prepare a summary report of all contingency ROV intervention and repair tasks for Principal review.
- The sensitivity of equipment during installation and retrieval to adverse weather conditions and/or vessel motions shall be considered during the equipment design phase.
- The equipment Contractor is required to liaise with the Principal and installation Contractor to agree the requirements for, location of, and items needed to mount transponders on equipment during installation and metrology operations.