

DEP SPECIFICATION

STRUCTURAL FABRICATION OF DEEPWATER FLOATING PRODUCTION SYSTEMS

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DESIGN AND ENGINEERING PRACTICE



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PREFACE

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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.

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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the structural materials, fabrication, tolerances, testing, and weighing of Floating Production Systems (FPSs). This DEP applies in addition to API RP 2FPS and, to the extent they are referenced therein, API RP 2A-WSD, API RP 2T, the AISC 325 "Steel Construction Manual" and AWS D1.1.

This is a revision of the DEP of the same number dated February 2013; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorized by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them.

This DEP is intended for use in floating production systems. 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
Accept	The Principal's written acceptance process that shall be completed for work in progress throughout fabrication as designated in (Appendix B).
Approve	The Principal's written approval process that shall be completed prior to ordering materials and/or beginning the Work and for work in progress throughout fabrication as designated in (Appendix B).
Certifying Authority	Third party that may be appointed by the Principal to ensure design authenticity, fabrication compliance with this DEP and national/local regulations and that the equipment is fit-for-purpose.
Critical Steel	Steel designated as Critical on the Drawings
Drawings	Principal-furnished Drawings, spreadsheets, databases or data files and revisions thereof. Drawings may be released in several stages named 1) Preliminary 2) Approved for Bidding, 3) Released for Material Order, 4) Approved for Construction (AFC), 5) Approved for Installation and 6) As-Built. Drawings may be in the form of summary Drawings, typical details, notes and rules from which the Contractor shall develop the necessary shop and erection Drawings.
Inspection Authority	Third party appointed by the Principal to ensure that the equipment supplied conforms to the requirements of this DEP. In some instances, the Inspection Authority may be the same as Certifying Authority.
Primary Steel	Steel designated as Primary on the Drawings
Review	Principal's right, but not obligation, to review and comment on the submitted document as designated in (Appendix B).
Secondary Steel	Steel designated as Secondary on the Drawings
Special Steel	Steel designated as Special on the Drawings
Tertiary Steel	Steel designated as Tertiary on the Drawings
Zone 1	Zone that includes Zone 1, Zone 1A, Zone 1-FAT and Zone 1-RT, as identified on the Drawings.
Zone(s)	Zones of structural criticality (e.g., Zones 1, 2 and 3), identified on the Drawings. Within this DEP, inspection techniques, acceptance criteria and extent of coverage may be designated by Zone.

1.3.3 Abbreviations

Term	Definition
AFC	Approved For Construction
CJP	Complete Joint Penetration
CTOD	Crack Tip Opening Displacement

Term	Definition
MT	Magnetic Particle Testing
PWHT	Post Weld Heat Treatment
Q&T	Quenched and Tempered
QST	Quenched Self Tempered
RT	Radiographic Testing
TMCP	Thermal Mechanical Controlled Process
UT	Ultrasonic Testing
VE	Visual examination
VIV	Vortex Induced Vibration

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 (9).

The Contractor shall maintain physical or electronic copies of the referenced documents at worksite locations.

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated February 2013. The following are the main, non-editorial changes.

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://swwww.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.

1.9 DOCUMENTS REQUIRING SUBMITTAL

The Contractor shall submit two (2) copies of the documentation as indicated in (Appendix B).

The submittal timing and the Principal's action (e.g., Review, Approve or Accept) that will be taken relative to the submitted document, is stated in (Appendix B).

2. MATERIALS

2.1 SPECIFICATION

1. Material shall conform to the grade designation and base metal testing requirements shown on Drawings.
2. Materials shall be new, unused and free from rust or corrosion, unless specifically approved.
3. The Contractor's proposed material substitutions shall be submitted.
If a higher-grade material is approved for substitution of a lower grade material, only the traceability and NDE requirement of the lower grade material need apply.
4. If CTOD materials are substituted for lower grade materials, the depth and width of backgouging required in the Welding Procedure Specification (WPS) may be omitted.

2.2 MATERIAL CONTROL PROCEDURE

2.2.1 General

1. The Contractor shall establish, submit, implement and audit the Material Control Procedure.

2.2.2 Steel Manufacturer's markings

1. The Contractor shall transfer the Manufacturer's material identification mark (i.e., heat/plate number) or, alternatively, a unique reference number onto cut pieces and remnants that can be used in the future by the Contractor.
2. Low-stress die stamps in accordance with MIL-STD-792F shall be used on critical steels and special steels for material identification markings.
3. If used in lieu of actual heat/plate numbers, unique reference numbers shall be identified on each mill certificate or be traceable through a cross-reference list.
 - a. The cross-reference list, if used, shall be submitted.
4. Material that does not have original or verifiable markings, as required by this DEP, shall be physically segregated and clearly marked as nonconforming.
 - a. For use of such materials, a sample from each piece shall be removed to confirm that the chemical composition and mechanical properties, including any applicable NDE, meet the requirements of the applicable material specification.
 - b. These materials shall be submitted on a case-by-case basis.

2.2.3 Contractor's steel marking system

1. A unique marking system for the different steel grades shall be applied to each piece of steel.
2. The marking system shall uniquely identify steel with through-thickness (Z) properties.
3. Low stress die stamps shall be used on Critical and Special steels.
4. Painted material identification or metal markers are acceptable for materials other than critical steels and special steels, provided the marks are legible at the time of the final "in-place" material quality control verification.

2.2.4 Verification and traceability

1. All material shall have the following material verification checks performed by the Contractor:
 - a. Material identification as specified in the Contractor's purchase order.
 - b. Check of mill certificates to verify that the chemical composition and mechanical properties meet the applicable specification.
 - c. Transfer of identification markings to each piece cut from all plates, ensuring that material and cut piece identification markings remain legible throughout fabrication.
 - d. For critical steels and special steels, quality control verification that material identification marks are properly transferred.
 - e. Material grade and thickness are be verified by the Contractor's quality control personnel to be in accordance with the Drawings during the fit-up phase of fabrication.
2. The following components shall have "two-way" traceability, defined in (2.2.4.3) unless noted otherwise on the Drawings.
 - a. Materials in Zone 1 (Refer to Drawings).
 - b. Outer plating of vessel/hull (all plating exposed to atmosphere/sea in-place).
 - c. Critical steels.
 - d. Special steels.
 - e. Primary steels (for modules/decks).
 - f. Vessel/hull to deck/module connections.
 - g. Upper column frame or temporary transport frame.
 - h. Tendon porches.
 - i. Riser baskets.
 - j. Mooring equipment, fair leader and chain jack supports.
 - k. Oil and gas import/export riser pipe.
 - l. Hull fluid storage tank plating (e.g., oil, methanol, diesel and corrosion inhibitor tanks).
 - m. Castings.
 - n. Crane pedestals.
 - o. Life boat davit supports.

3. For material that requires “two-way” traceability, the following requirements shall be met in addition to those defined in (2.2.4, Item 1):
 - a. A computerized traceability system, with database sorting capability.
 - b. Traceability without physically locating the material identification mark(s).
 - c. Traceability between mill certificates (i.e., heat/plate number) and the Contractor's piece identification scheme.

The material identification marks will only be used to verify the accuracy of the traceability system.

- d. Traceability, using the original plate heat number as the starting reference data, of all pieces to their respective final locations in the structure.
- e. Traceability, using the final location of the piece in the structure as the starting reference data, of all pieces to their original plate heat numbers.

2.3 MATERIAL HANDLING

2.3.1 General

1. Material and equipment, including Principal-furnished items, shall be stored on supports above the ground and above standing water.
2. Materials and equipment shall be kept free from dirt, grease, over-spray, or other foreign matter and be protected from corrosion through all phases of fabrication.
3. Structural materials shall have a temporary holding primer applied unless they are painted within a 12 month period from when the material was delivered.
4. Steel surfaces that are corroded or pitted shall be repaired with an approved procedure or be replaced.
5. Chains shall not be used in direct contact with materials during handling operations.
6. The use of friction type clamps to handle materials shall be prohibited unless specifically submitted and approved.
7. Components and plates shall be handled in a manner that prevents permanent deformations, local buckling and contact with either the ground or adjacent material.
8. Coatings shall not be damaged.
9. Coating damage shall be repaired using approved materials and an approved procedure.

2.3.2 Damaged materials

1. Damaged materials or components shall be segregated and not used.
2. Procedures for repair of damaged materials shall be submitted;
 - a. The repair of damaged materials shall be subject to approval on a case-by-case basis.

2.3.3 Anodes

1. For temporary storage, anodes with their shipping pallets shall be stacked on wooden timbers, at least 150 mm (6 in) high, so that anodes are free of any contact with the ground or any standing water.
2. Anode pallets shall not be in contact with each other.
3. Any accumulation of aluminum oxide (i.e., white powder) on the anode surface or between anodes shall be removed by rinsing with fresh water.

2.4 MILL CERTIFICATES

1. Original mill certificates for steel signed by the mill's testing lab shall be maintained in a permanent record system with a copy maintained at the job site until completion of the Work.
 - a. If original mill certificates are not available, then certified copies (Lloyd's, DNV, ABS or approved other) of original certificates shall be submitted.
 - b. Third party or reformatted substitutes for original mill certificates are unacceptable and shall not be submitted.
 2. The mill certificate shall show the results of testing required by the material specification and by this section.
 3. Mill certificates without a complete reporting of elements, as required by this section, shall be submitted.
 - a. The corresponding material shall be physically segregated and clearly marked as non-conforming.
 - b. The use of any such materials shall require testing for all chemical elements in accordance with the applicable specification and approval in accordance with (2.2.2, Item 4).
 4. In addition to the requirements of the material specification, mill certificates shall include the following:
 - a. Complete composition, showing all elements in accordance with the material specification and elements in the Pcm formula given in Equation 1.
 - i. In addition, Nitrogen (N), Aluminum (Al), and Titanium (Ti) shall be reported.
 - b. Pcm, calculated using the formula given in Equation 1 and reported on the Mill Certificate.
 - i. Heat analysis shall be used for chemical composition.
- $$\text{Pcm} = \text{C} + \text{Si}/30 + (\text{Mn} + \text{Cu} + \text{Cr})/20 + \text{Ni}/60 + \text{Mo}/15 + \text{V}/10 + 5 \times \text{B} \quad \text{Equation 1}$$
- c. Manufacturing process used (e.g., TMCP, quench and tempered)
 - d. Results of mechanical tests required by the specification.

2.5 DIMENSIONAL TOLERANCES

2.5.1 Plates and shapes

1. Plates shall be ordered to the specified thickness and shall be within the permissible variations in thickness, flatness, and waviness as specified in ASTM A20.
2. Structural shapes shall conform to the dimensional tolerances given in ASTM A6.
 - a. Euro-Norm or JIS proposed equivalents, other than those specifically shown on the Drawings, shall be submitted.

2.5.2 Tubulars

1. Fabricated (rolled) tubular sections used as structural members shall meet the dimensional tolerances specified in API Spec 2B.
2. The minimum wall thickness shall not be more than 0.25 mm (0.01 in) below the nominal wall thickness.
3. Surface conditioning for the removal of imperfections or depressions on the outside or inside surface of the pipe may be done by grinding, provided the area ground is well-faired without abrupt changes in contour and the grinding does not reduce the thickness below the stated minimum.
4. Imperfections that reduce the thickness below the stated minimum may be gouged or ground to sound metal and repaired by welding if the total repaired surface area is 2 % or less of the surface area of the piece.

2.5.3 Purchased pipe

1. Purchased pipe shall meet the dimensional tolerances of the standard under which it was manufactured.

3. FABRICATION**3.1 GENERAL**

1. The sequence of fabrication and welding shall minimize the effect of built-in stresses.
2. Longitudinal butt weld offset requirements listed in API RP 2T shall apply.
3. Plate orientation requirements listed in API RP 2T shall apply.
4. All Shop Drawings shall be submitted.

3.1.1 Cutting high strength steel

1. For steels with a minimum yield strength ≥ 552 N/mm² (80 ksi) qualification tests shall be performed to establish the minimum preheat required prior to cutting with fuel gases with the objective of limiting the hardness to 350 Hv10.
 - a. The test shall be performed for materials with cut edges left exposed in the final component (i.e., not incorporated into a weld).
 - b. The tests shall be performed on the thickest plates used in production representing the different manufacturing processes and Manufacturers that will be used in production.
 - c. A high strength steel cutting qualification procedure shall be submitted.