

DEP SPECIFICATION

STRUCTURAL FABRICATION OF DEEPWATER FLOATING PRODUCTION SYSTEMS (BASED ON API RP 2FPS)

DEP 37.81.10.34-Gen.

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DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

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

The Principal shall have the right to apply professional judgment to revise the requirements set forth in this DEP on a case-by-case basis

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.

This DEP is intended for use in floating production systems.

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 may 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 regard 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 Specific definitions

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.

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
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.
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.
Review	Principal's right, but not obligation, to review and comment on the submitted document as designated in Appendix B.
Critical Steel	Steel designated as Critical on the Drawings
Special Steel	Steel designated as Special on the Drawings
Primary Steel	Steel designated as Primary on the Drawings
Secondary Steel	Steel designated as Secondary on the Drawings
Tertiary Steel	Steel designated as Tertiary 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.
Zone 1	Zone that includes Zone 1, Zone 1A, Zone 1-FAT and Zone 1-RT, as identified on the Drawings.

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 (8).

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

1.5 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.

1.6 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.

1.7 DUAL UNITS

In this DWS, the International System of units (SI) shall be understood to prevail over US Customary (USC) units. USC units are provided in brackets following the SI units for information.

2. MATERIALS

2.1 SPECIFICATION

Material shall conform to the grade designation and base metal testing requirements shown on drawings. Materials shall be new, unused and free from excessive rust and/or corrosion, unless specifically Approved. 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. 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

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

2.2.2 Steel Manufacturer's markings

- a. 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 may be used in the future by the Contractor. Low-stress die stamps in accordance with MIL-STD-792F, shall be used on critical steels and special steels for material identification markings. If used in lieu of actual heat/plate numbers, unique reference numbers shall be identified on each mill certificate or shall be traceable through a cross-reference list. The cross-reference list shall be submitted.
- b. Material that does not have original or verifiable markings, as required by this DEP, shall be physically segregated and clearly marked as nonconforming. For use of such materials, a sample from each piece shall be removed and the chemical composition and mechanical properties, including any applicable NDE, shall meet the requirements of the applicable material specification. These materials shall be submitted on a case-by-case basis.

2.2.3 Contractor's steel marking system

A unique marking system for the different steel grades shall be applied to each piece of steel. The marking system shall also uniquely identify steel with through-thickness (Z) properties. Low stress die stamps shall be used on Critical and Special steels.

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

- a. All material shall have the following material verification checks performed by the Contractor:
 - Material identification as specified in the Contractor's purchase order.
 - Check of mill certificates to verify that the chemical composition and mechanical properties meet the applicable specification.
 - Transfer of identification markings to each piece cut from all plates. Material and cut piece identification markings shall remain legible throughout fabrication.
 - For critical steels and special steels, quality control verification that material identification marks are properly transferred.
 - Material grade and thickness shall be verified by the Contractor's quality control personnel to be in accordance with the drawings during the fit-up phase of fabrication.

- b. The following components require “two-way” traceability, defined in (2.2.4.c) unless noted otherwise on the drawings.
- Materials in Zone 1 (Refer to drawings)
 - Outer plating of vessel/hull (all plating exposed to atmosphere/sea in-place)
 - Critical steels
 - Special steels
 - Primary steels (for modules/decks)
 - Vessel/hull to deck/module connections
 - Upper column frame or temporary transport frame
 - Tendon porches
 - Riser baskets
 - Mooring equipment, fair leader and chain jack supports
 - Oil and gas import/export riser pipe
 - Hull fluid storage tank plating (e.g. oil, methanol, diesel and corrosion inhibitor tanks)
 - Castings
 - Crane pedestals
- c. For material that requires “two-way” traceability the following requirements shall be met in addition to those defined in (2.2.4.a):
- A computerized traceability system, with database sorting capability shall be utilized.
 - Traceability shall exist without physically locating the material identification mark(s). Traceability shall exist 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.
 - Using the original plate heat number as the starting reference data, all pieces shall be traceable to their respective final locations in the structure.
 - Using the final location of the piece in the structure as the starting reference data, all pieces shall be traceable to their original plate heat numbers.

2.3 MATERIAL HANDLING

2.3.1 General

Material and equipment, including Principal-furnished items, shall be stored on suitable supports above the ground and above standing water. Materials and equipment shall be kept free from dirt, grease, over-spray, or other foreign matter and shall be protected from corrosion through all phases of fabrication. Structural materials shall have a temporary holding primer applied unless they are painted within a 12 month period from when the material was delivered. Steel surfaces that are excessively rusted, corroded and/or pitted shall be repaired with an Approved procedure or shall be replaced.

Chains shall not be used in direct contact with materials during handling operations. The use of friction type clamps to handle materials shall be prohibited unless specifically submitted and Approved. Components and plates shall be handled in a manner that avoids permanent deformations and/or local buckling.

Care shall be taken to avoid damage to coatings. Coating damage shall be repaired using Approved materials and an Approved procedure.

2.3.2 Damaged materials

Damaged materials or components shall be segregated and shall not be used. Procedures for repair of damaged materials shall be submitted; however, the repair of damaged materials shall be Approved on a case-by-case basis.

2.3.3 Anodes

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. Anode pallets shall not be in contact with each other. Any accumulation of aluminum oxide (i.e. white powder) on the anode surface or between anodes shall be periodically removed by rinsing with fresh water.

2.4 MILL CERTIFICATES

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. Certified copies (Lloyd's, DNV, ABS, or Approved other) of original certificates are acceptable. A certified copy shall be submitted. Third party or reformatted substitutes for original certificates are unacceptable.

The mill certificate shall show the results of testing required by the material specification and by this section. Mill certificates without a complete reporting of elements, as required by this section, shall be submitted. The corresponding material shall be physically segregated and clearly marked as non-conforming. 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.b).

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 below. In addition, the following elements shall be reported:

Nitrogen (N), Aluminum (Al), Titanium (Ti).

- b) Pcm shall be calculated using the formula given below and reported on the Mill Certificate. Heat analysis shall be used for chemical composition.

$$\text{Pcm} = \text{C} + \text{Si}/30 + (\text{Mn} + \text{Cu} + \text{Cr})/20 + \text{Ni}/60 + \text{Mo}/15 + \text{V}/10 + 5 \times \text{B}$$

- c) Manufacturing process used (e.g. TMCP, Quench and Tempered, etc.)
- d) Results of mechanical tests required by the specification.

2.5 DIMENSIONAL TOLERANCES

2.5.1 Plates and shapes

Plates shall be ordered to the specified thickness and shall be within the permissible variations in thickness, flatness, waviness, etc. as specified in ASTM A 20. Structural shapes shall conform to the dimensional tolerances given in ASTM A 6. Euro-Norm and/or JIS proposed equivalents, other than those specifically shown on the drawings, shall be submitted.

2.5.2 Tubulars

Fabricated (rolled) tubular sections used as structural members shall meet the dimensional tolerances specified in API Spec 2B and the following:

- a) Thickness - The minimum wall thickness shall not be more than 0.25 mm (0.01 in) below the nominal wall thickness. 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. Imperfections exceeding this depth 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

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

3. FABRICATION

3.1 GENERAL

The sequence of fabrication and welding shall minimize the effect of built-in stresses.

Longitudinal butt weld offset requirements listed in API RP 2T should be applied.

Plate orientation requirements listed in API RP 2T should be applied.

3.2 IDENTIFICATION OF WELDING

Each weld or weld lot, as defined in DEP 37.81.10.33-Gen., shall be identified with a weld identification number that can be correlated to weld type, size, and Zone designation on the adjacent steel surface using an indelible paint marking system. The Zone designation is required to ensure that the proper percentages of NDE are applied. The weld identification procedure shall be submitted and shall specifically address weld repair identification and proposed weld lot grouping identification for welds where grouping is permitted. Other identification systems may be submitted

The work of each welder, welding operator, and tack welder shall be identified at each weld or portion of weld with his unique identifying symbol using an indelible marking system. Other identification systems may be submitted for Approval.

3.3 FABRICATION ENGINEERING

3.3.1 Design/analysis premises and calculations

Design/Analysis Premises describing the engineering scope of work to be performed, including but not limited to basic assumptions, environmental conditions, proposed codes, analysis techniques, results, acceptance criteria, etc. shall be submitted for each major construction phase and each unique loading or stressing condition. The Approved Design/Analysis Premises shall form the basis for the calculations to be performed and the engineering reports and operational procedures that will be generated as a result. Typical engineering deliverables shall consist of:

- a) a design/analysis premise;
- b) calculations, including all test data; and
- c) operational manual and/or procedure(s).

If herein calculations are specified for submittal, a specific design/analysis premise shall be submitted before performing the specific calculations.

3.3.2 Fabrication procedure

A Fabrication Procedure shall be submitted for Approval. This procedure shall show the assembly method of major blocks, panels, truss rows, etc., shall detail the erection sequence with dimensions, weights, painting stage, appurtenance/secondary steel installation and work location and shall meet all the requirements of 3.3.1 and 3.3.3.

Typical sequences for welding of plate seams, tubular or shapes, intersection welds, radiused corners of insert plates, and stiffened panel construction, and shrinkage and distortion control techniques and objectives shall be included in the Fabrication Procedure.

3.3.3 Fabrication loads and stability

The Contractor shall calculate temporary fabrication and erection stresses imposed on the structure from supports, jacks, slings, etc. at each stage of fabrication and assembly.

The Contractor shall calculate local stresses, perform buckling capacity and overall stability checks, including floating hull stability, if applicable and report out the maximum support reactions, component deflections, associated stresses and buckling utilization due to the structure self-weight and environmental loads (e.g., wind, seismic, snow and ice, etc.) during all stages of fabrication. Temporary stresses in the structure during fabrication shall be minimized and shown to be less than those allowed by API RP 2A-WSD and API RP 2T