

DEP SPECIFICATION

OFFSHORE PIPELINE AND UMBILICAL/CABLE CROSSINGS

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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 following:

- a) crossing design and engineering analysis requirements for both the crossed (pipeline or umbilical) and crossing pipeline;
- b) typical pipeline and umbilical crossing configurations;
- c) crossing construction procedure;
- d) monitoring requirements during crossing mat installation work operation, and;
- e) the post installation as-built survey.

Only offshore pipeline and umbilical crossings are covered in this DEP.

This is a revision of the DEP of the same number dated March 2010; 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 the 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 subsea facilities related to exploration and production. This DEP may be applied also in other similar facilities.

When DEPs are applied, a 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 consumables, materials, equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorized 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

Term	Definition
Crossed pipeline or umbilical	The pipeline or umbilical already existing and in place on the seafloor. The crossed pipeline or umbilical may be Principal owned and operated or owned and operated by a third party.
Crossing pipeline	The pipeline that is crossing over an already existing pipeline or umbilical in place and on the seafloor.
Umbilical	Any subsea production umbilical, power cable or communications cable.
Projected width	A length typically wider than the crossing corridor that provides for the defined corridor width along the crossing pipeline, taking into account the angle of the crossing. The corridor width shall be 12.20 m (40 ft) unless the Contractor proposes a narrower corridor and is approved by the Principal.
Separation	The distance between the existing and proposed crossing pipeline, (i.e., outside diameter to outside diameter).
Work	The word Work is used to define the work to be executed by the Contractor as defined in the Invitation to Tender or Contract Scope of Work.

1.3.3 Abbreviations

Term	Definition
API	American Petroleum Institute
ASME	American Society of Mechanical Engineering
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
CFR	Code of Federal Regulations
FEA	Finite Element Analysis
ITT	Invitation to Tender
MOC	Management of Change
ROV	Remotely Operated Vehicle
VIV	Vortex Induced Vibrations

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).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated March 2010. The following are the main, non-editorial changes:

- Sections of this DEP that were informative in nature have been moved to a new companion DEP Informative document.
- More detail on design analysis has been added therein.
- Clarifications have been added where requirements are specific to the Gulf of Mexico region.

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.

2. GENERAL APPROACH TO CROSSINGS

The degree to which additional loads may be permitted on an existing pipeline shall be a function of one or more of the following:

- a) Size of the pipeline crossing;
- b) Size of the pipeline being crossed;
- c) Design or operating margin for pressure containment or collapse, or both;
- d) Accessibility of the crossing for purposes of remediation;
- e) Magnitude of additional load to be placed on the pipeline;
- f) Seafloor soils and bottom conditions;
- g) General condition of the crossed pipeline (e.g., internal/external corrosion, etc.), and;
- h) Final computed state of stress and structural integrity and the certainty thereof;
- i) Physical constraints on the bottom pipeline such as nearby spoolpiece connections or riser connections that could be impacted by the weight of the top line;
- j) Understanding that if the bottom pipeline can be lowered to sufficient depth to allow the top line to rest on the seabed. This is sometimes impacted by service conditions and design code restraints for the operating line.

Crossing may significantly increase the working stresses of the crossed pipeline since the original design will likely not have considered the added stress of a crossing pipeline.

The crossing of existing pipelines or umbilicals should be at right angles whenever possible. Where impractical, the crossing angle may be less than 90°, but the acute angle between the crossing pipelines/umbilical shall not be less than 30°. Typical pipeline and umbilical crossing configurations are included in (7). These drawings are included as basis for crossing design. Ultimately, the final crossing design configuration shall depend on governmental regulations, project specific conditions and analysis of both, the crossed and crossing pipelines or umbilical.

Unless detailed, project-specific crossing design and drawings are provided in the Principal's Invitation to Tender (ITT), the Contractor shall be required to prepare and submit for Principal approval detailed crossing drawing specific to the project.

The design concept of a pipeline or umbilical crossing and the detailed design shall be discussed at an early stage to ensure the agreement of all operators involved and Statutory Authorities where applicable. In case a formal crossing consent is needed sufficient time shall be allowed to agree, draft and accept the details.

NOTE: This DEP is generally applicable to deep water installations across all regions of the world, with possible exception of deep water North Sea / Norwegian projects. The shallow water crossing requirements are generally applicable to Gulf of Mexico region, and specific requirements in other regions may differ. In such cases, project-specific specifications and drawings will be supplied with the ITT and Contract.

3. PROJECT PLANNING

3.1 GENERAL

The Principal will provide required crossing parameters for both the crossed and crossing pipeline to the Contractor as part of the pipeline installation ITT package or contract requirements, should this be necessary for crossing design by the Contractor. Typically the required information will include the following:

- a) Pipe size (diameter and wall thickness),
- b) Product type, density, pressure and temperature information in so far available
- c) Internal pressure and temperature
- d) Pipe strength properties,
- e) Coating properties, both corrosion coating and weight coating
- f) General soil information
- g) Proposed crossing design as shown in Contract Drawings (if applicable)

Unless specified otherwise in the ITT documents, the Contractor shall perform the necessary calculations to show that the proposed crossing design meets and/or exceeds the Principal's crossing requirements. At a minimum, the Contractor shall provide to the Principal for review and approval the following:

- a) Proposed construction procedures,
- b) Detailed design drawing(s) of crossing (if applicable, i.e., not included in the Principal's ITT),
- c) Global analysis results used to establish loads on the crossed pipeline,
- d) Stress analysis of the crossed and crossing pipeline, including vortex induced vibration (VIV) analysis, if applicable,
- e) Structural analysis of any proposed pipe support structures,
- f) Lifting analysis for the top pipeline if pre-crossing separation is not installed,
- g) Safety plan,
- h) Project scope of work, and
- i) Project schedule.

3.2 PRE-CROSSING INSTALLATION

The Contractor shall verify the location and exact depth, if buried, of all existing pipelines or umbilicals that will be crossed by the Principal's new pipeline. Further, the Contractor shall survey any spans (if applicable) in existing pipeline and record all pertinent data including profile, height above seafloor and length. The Contractor shall record the exact location of the existing installation(s). The existing pipeline or umbilical shall be lowered, covered or otherwise protected prior to installation of the crossing pipeline.

The Contractor shall perform an as-built survey of the crossing at the proposed crossing location. For buried pipelines or umbilicals, the survey shall document the length and depth of the burial of the pipeline/umbilical along the entire projected width of the crossing. Subsea visual buoys clearly marking the edges of the crossing corridor shall be put into place. If mats are used to cover or bridge an existing pipeline or umbilical, the survey shall document (with video) the placement of mats on or near the existing pipeline/umbilical and take fixes on the four perimeter corners of the pre-installed mattresses. Any span remediation (if applicable) shall be "as-built" with appropriate remotely operated vehicle (ROV) fixes of sand/cement piers or mats, and shall be documented with ROV video survey.

The as-built survey of the pre-crossing configuration shall subsequently be compared with crossing design drawings. Deviations from specified tolerances between the pre-crossing