

DEP SPECIFICATION

LAYOUT OF OFFSHORE FACILITIES

DEP 80.00.10.12-Gen.

February 2017

ECCN EAR99

DESIGN AND ENGINEERING PRACTICE

DEM1



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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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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the development and optimisation of layouts for all offshore facilities for fixed and floating platforms including Floating Production, Storage and Offloading facility (FPSO). It covers the layout aspects of topsides on single standalone platforms and for platforms forming part of multiple platform complexes.

Field layouts of locating multiple platforms in a complex with their interconnecting subsea hardware are excluded from the scope of this DEP.

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual (DEM) 1 – Application of Technical Standards.

This is a revision of the DEP of the same number dated February 2015; see section (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 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 facilities related to oil and gas production and gas handling. This DEP may also be applied to similar facilities.

Use of this DEP is mandatory for new facilities and it may be used for revamps or expansions of existing 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. The Contractor shall inform the Principal of any necessary deviation from the requirements of this DEP 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 capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

The word **may** indicates a permitted option.

1.3.2 Specific definitions

Term	Definition
ALARP	As Low As Reasonably Practicable - ALARP demonstration shall be executed in accordance with the ALARP guide (SR.13.14005) and include as a minimum appropriate consequence modelling or risk assessment.
Facility	One single supported structure (can be a standalone integrated deck or standalone facility or a facility of a multi bridge linked facility complex)
Human Factors Engineering	Application of human physical and cognitive sciences in conjunction with engineering sciences to achieve optimal human and system performance
SIMultaneous OPerationS	Operations that include simultaneous operation and maintenance activities as well as simultaneous operation and constructions activities
Very toxic (substances)	Very toxic substances are those which are as specified either "very toxic-acute", "very toxic-chronic", or "very toxic-environment" in Part III of DEP 01.00.01.30-Gen.

1.3.3 Abbreviations

Term	Definition
CFD	Computational Fluid Dynamics
EER	Escape, Evacuation and Rescue
FCC	Facility Control Centre
FPSO	Floating Production Storage and Offloading
HAC	Hazardous Area Classification
HEMP	Hazards and Effects Management Process
HF	Human Factors
HFE	Human Factors Engineering
HSE	Health, Safety and Environmental
HSSE	Health, Safety, Security and Environment
HVAC	Heating, Ventilation and Air Conditioning
LQ	Living Quarters
NPSH	Net Positive Suction Head
POB	Personnel on Board
QRA	Quantitative Risk Assessment
SIMOP	SIMultaneous OPerations
SP	Social Performance
TR	Temporary Refuge

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 (7).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated February 2015. The following are the main, non-editorial changes.

Section/Clause	Change
All	Restructured and clarified requirements, enforced shall/should.
2, Clause 1	Updated Hazard Management Philosophies to Project HSSE & SP Philosophies in SHALL [PS] statement.
4.1.4	Moved SHALL [PS] from DEP 37.19.00.13-Gen.
4.5.2, Clause 2	Formerly 4.8.2, Clause 2. Updated SHALL [PS] statement to reference ALARP and reformatted.

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.

2. LAYOUT STRATEGY

The main drivers for the development of an offshore facility layout are costs, lost production and safety. A properly configured facility is a low initial cost system that maximizes its production throughout its life by minimizing downtime due to planned activities and unplanned incidents.

1. The facility layout strategy shall achieve the following elements:
 - a. compact layouts;
 - b. minimum hydrocarbon inventory;
 - c. functional requirements;
 - d. safety requirements consistent with the Project HSSE & SP Philosophies;
 - e. safety risk levels for on-site workforce are ALARP, and escape, evacuation, and rescue facilities are provided to avoid the effects of hazards;
 - f. safety and environmental risk levels for surrounding facilities are ALARP;
 - g. minimum lost production.
2. Compact layouts in offshore facilities shall:
 - a. maximize natural ventilation in process areas to prevent accumulation of a flammable gas cloud;

Forced ventilation may be used when natural ventilation is inadequate to prevent accumulation.
 - b. separate fuel and ignition sources to prevent ignition of flammable releases;
 - c. maintain the minimum required separation distances or provide safety barriers to reduce the risk from fire and blast hazards.
3. The Project HSSE & SP Philosophies SHALL [PS] be incorporated into the layout development at each stage of the project.
4. Safe and unhindered access shall be provided for future foreseeable construction activities including simultaneous operations (SIMOPS).

3. LAYOUT DEVELOPMENT ACTIVITIES

3.1 OBJECTIVES OF LAYOUT DEVELOPMENT AND LAYOUT OPTIMISATION

The application of Quantitative Risk Assessment (QRA) and the concept of Risk Tolerability Criteria, in comparing alternative layout designs, is considered valuable as part of the decision-making process. In addition, it will help in demonstrating that the risk criteria have been achieved and that the risks are indeed ALARP.

1. The layout shall be subject to approval by all engineering disciplines involved in the design, as well as construction, operations, maintenance, and HSE staff.

At the early stages of development there could be a significant level of weight and dimensional uncertainty, as equipment sizes have to be assumed. As a result, a degree of iteration is inevitable as the layouts are developed.
2. Sufficient space and weight allowance should be provided to accommodate increases in equipment sizes as the process design is finalised and vendor information becomes available.

3.2 PHASING OF LAYOUT DEVELOPMENT ACTIVITIES AND DELIVERABLES

Layout development activities to assure that the layout is ALARP, will take place at various distinct stages during a project development cycle including all changes during the course of the project.

3.2.1 Identify and assess phase

The Identify and Assess phase closes with the feasibility of project concept options.

1. As part of the IDENTIFY and ASSESS phase, schematic layouts shall be prepared for proposed developments in order to assess the feasibility of the possible concepts.

3.2.2 Select phase

1. As part of the SELECT phase, layouts shall be developed to support the SELECT phase risk assessment, activity planning, costs estimating, and to assist with concept selection across all options being considered.

3.2.3 Define phase

1. As part of the DEFINE phase, layout shall be developed to support the DEFINE phase risk assessment, activity planning, constructability, installation, commissioning, technical integrity, maintainability, operability and costs estimating for the selected concept.

3.2.4 Execute phase

1. A detailed as-built layout design shall be produced for the facility.

3.3 APPLICATION OF FACILITY LAYOUT METHODOLOGY

1. The method used for optimising the layout shall be documented to provide an auditable framework.

3.4 REVIEWS PER PROJECT PHASE

1. The layout reviews shall use a structured and auditable assessment methodology.

This review ensures that the requirements of other disciplines have been incorporated in the layout design and to eliminate possible clashes and to ensure the design is ALARP.

4. GENERAL LAYOUT CONSIDERATIONS AND ORIENTATION**4.1 LAYOUT DESIGN CRITERIA**

Facilities with good layout are economic, safe and easy to operate and maintain. Good layout is a key factor in preventing escalations of fires and explosions and in minimising the effects of emergencies.

4.1.1 HSE**4.1.1.1 Maximize natural ventilation**

Wherever possible, maximum use should be made of natural ventilation and open structures to disperse flammable vapours and reduce the likelihood of flammable clouds accumulating.

1. Refer to DEP 37.76.10.10-Gen for requirements for non-natural ventilated areas

4.1.1.2 Minimise escalation of ignited flammable release or release of very toxic substances

Very toxic substances are those which are as specified either "very toxic-acute", "very toxic-chronic", or "very toxic-environment" in Part III of DEP 01.00.01.30-Gen.

1. In the event of explosions, large fires, vessel rupture, or major leaks, personnel, environment and assets shall be protected against escalation (domino effect).
2. Distance or suitable physical barriers shall be provided to prevent the potential escalation of incidents from the hazardous areas towards the support function areas such as the control room, offices, accommodation, temporary refuge (TR), and safety