

DEP SPECIFICATION

DESIGN OF OFFSHORE TEMPORARY REFUGES

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(DEP Circular 53/11 has been incorporated)

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DESIGN AND ENGINEERING PRACTICE

DEM1



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the design and performance of an offshore Temporary Refuge (TR) and the associated means of escape and evacuation. It describes the objective of the TR and the systems and subsystems which comprise the TR and their acceptance criteria. Guidance on how to meet the objectives is also given.

This DEP is intended for use in offshore oil and gas exploration and production facilities:

- new and existing;
- manned and not normally manned; and
- fixed and mobile.

This is a revision of the DEP of the same number dated January 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 Contractors and Manufacturers/Suppliers nominated by them.

This DEP is intended for use in facilities related to offshore oil and gas production and gas handling. 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 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 AND ABBREVIATIONS

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 its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The lower-case word **shall** indicates a requirement.

The capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Acceptance criteria requirements against which the fulfilment of an objective can be measured.

Command structure	the organisation that is provided to control an emergency.
Complex	a series of two or more bridge-linked offshore Installations.
Control point	main installation control and monitoring facility.
Embarkation area	place from which personnel leave the installation during evacuation.
Emergency control point	a location providing those control, monitoring, coordination and communication functions necessary for responding to an emergency.
Endurance period	the period of time for which the relevant conditions of integrity shall be maintained.
Escape route	a route from an area of an installation leading to a muster area, TR, embarkation area or means of escape to sea.
Evacuation route	an escape route from the TR leading to an embarkation area used for primary or secondary evacuation from the installation.
Installation	a fixed or mobile facility engaged in offshore oil and gas exploration or production activities.
Living quarters	permanently enclosed spaces such as cabins, dining rooms, galleys, recreation rooms, sick-bay, offices, change rooms, ablution areas and similar spaces used for the accommodation and welfare of personnel.
Manned installation	an installation on which people are routinely accommodated.
Muster area	a designated area where personnel gather in response to instructions or a change in the installation safety status.
Offshore installation manager	the person in charge of an offshore installation.
Persons on board	the number of permanent and temporary personnel on an installation at any one time. NOTE: Temporary personnel who are accommodated on a gangway-connected mobile unit do not need to be included, so long as it is established that they are able to rejoin the mobile unit through the gangway under all incident scenarios. Such personnel would in this case muster on the mobile unit.
Temporary refuge	a place or places where personnel will be adequately protected from relevant hazards while they remain on an installation following a major incident, and from where they will have access to the communications, monitoring and control equipment necessary to ensure their personal safety, and from where, if necessary, safe and complete evacuation can be effected.

1.4 ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
AEGL	Acute Exposure Guideline Level
AIDA	Air Infiltration Development Algorithm (model)
ALARP	As low as reasonably practicable
BOP	Blowout preventer
CHIC	Combustion Hazards in Compartments (model)
ECP	Emergency control point
EER	Escape, Evacuation and Rescue
ERP	Emergency radio point
ESD	Emergency shutdown
HVAC	Heating, ventilation and air conditioning
HEMP	Hazard and effects management process
ICRP	International committee for radiation protection
IDLH	Immediately dangerous to life or health
IMO	International Maritime Organisation
IRPA	Individual risk per annum
LED	Light emitting diode
LFL	Lower flammable limit
NFPA	National Fire Protection Association
OIM	Offshore installation manager
PLL	Potential loss of life
POB	Persons on board
QRA	Quantitative risk assessment
RPE	Respiratory protective equipment
SPS	Surface process shutdown
STP	Standard temperature and pressure
STEL	Short term exposure limit
TEMPSC	Totally enclosed motor propelled survival craft
TPS	Total platform shutdown
TR	Temporary refuge
WHO	World Health Organisation

1.5 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).

1.6 SUMMARY OF CHANGES

The previous edition of this DEP was dated January 2010. In this revision, content that was background information, explanation and guidance, and therefore not required to be

communicated to the Contractor, has been removed. Furthermore, all process safety requirements have been reviewed, and confirmed or modified accordingly

1.7 DUAL UNITS

**Amended per
Circular 50/12**

Dual units have been incorporated throughout this DEP.

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 DEVIATIONS FROM INTERNATIONAL STANDARDS

A number of International standards are available that provide guidance on TRs and the associated emergency response facilities; namely ISO 13702 (DEP 80.80.00.11) and ISO 15544 (DEP 80.80.00.12). The intent of this DEP is to provide additional information on:

- the systems required to meet the stated objectives of a TR and associated means of escape and evacuation (4);
- the acceptance criteria and conditions required for integrity (5);
- the design process (6); and the
- facilities (7).

Generally, this DEP is consistent with the above-mentioned standards. In some cases the choice is made to deviate from the standards above, for good reasons and with sound alternatives being applied where needed.

1.9 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://swww.shell.com/standards> and on the main page of the DEPs DVD-ROM.

2. GENERAL REQUIREMENTS

2.1 PRIMARY OBJECTIVE

Every offshore installation SHALL [PS] have at least one place designated as the TR. The TR SHALL [PS] have sufficient capacity to protect the maximum persons on board (POB) the installation.

The TR may be an enclosure, more than one enclosure, or only an area of open deck.

The TR is required to maintain the safety of personnel during the period required for the evacuation process to be completed. This period includes the following times and activities:

- time to complete the full muster at the TR;
- time to account for personnel not reporting to their assigned muster stations;
- time to evaluate the situation and make decisions;
- time to initiate responses to minimize the consequences and control the emergency, if possible;
- time to complete the evacuation (if required). This may be done in a phased manner, initially evacuating non-essential personnel; and
- contingency time to allow for the unforeseen.

On small platforms, a TR may not be integrated with the living quarters and may not be enclosed. The primary purpose of the TR is to serve as a temporary muster point with protection against fire, heat and explosions for a short period, until the platform can be safely evacuated. Such short duration protection can be provided by partially enclosing the TR or by locating the TR away from the consequences of possible hazardous events.

2.2 FUNCTIONAL REQUIREMENTS

The main function of the TR shall be to provide a place where the total POB can muster without undue risk and have access to the communications, monitoring and control equipment necessary to ensure their personal safety, and from where, if necessary, safe and complete evacuation can be effected.

The functions of the escape and evacuation routes and the embarkation areas shall be to provide, without undue risk to POB:

- secure means of escape to the TR; and
- secure means for a complete evacuation from the TR.

2.3 DESIGN BASIS

The measures required to meet the objectives and acceptance criteria are installation specific and shall cover the range of major incident scenarios applicable to the installation. The HEMP (6.1) shall be used to identify and manage the range of major incident scenarios.

Two categories of acceptance criteria are defined. These are:

- conditions required for integrity (5.1);
- endurance period (5.2) - the period of time during which the conditions required for integrity shall be maintained.

The design of the TR shall be considered in relation to the overall design of the installation so as to achieve the optimum design. In particular the locations of the TR, escape and evacuation routes, embarkation points and other common facilities and utilities shall be integrated into the overall installation design. Protection of the TR and escape and evacuation routes by active protection systems should only be considered if HEMP analysis has indicated a significant risk to their integrity and the necessary improvements cannot be achieved by passive means.

When assessing the performance of the TR concept or assessing an existing TR, an early decision should be made regarding stand alone assessment or assessment within sub models of a QRA model for the installation. The former is likely to be suitable for simpler facilities with a small number of impairment mechanisms and small TR. The latter method lends itself to complex facilities with multiple potential impairments and, particularly, if a frequency of impairment is required to be determined for regulatory purposes. Whichever method is chosen it is important that critical assumptions are documented so that the impact of major changes can be assessed during the lifecycle of the installation.

3. TR CONFIGURATION CONCEPTS

3.1 PRIMARY TR

The TR shall be viewed as a system rather than simply a protected space. There is no standard configuration for providing a TR. Depending on the installation and potential incident hazard scenarios, different concepts may be acceptable. Examples include an open area or a platform in a series of bridge-linked platforms.

As a result of HEMP (6.1) analysis, the TR may need to be distributed across several locations. One principal location is then the primary TR which shall provide all main command support functions. Other locations shall form secondary TRs (3.2).

For a large installation the following principles should be incorporated into the design of a TR;

A single location in which other structures provide protection from process events, helicopter accidents and falling structures e.g. derricks and flare towers,

Minimal door openings which provide access for large numbers of personnel through air locks,

Secure communication, command and control facilities from which assessment of the event may be made without exposing personnel or opening doors,

Sufficient space for mustering, donning appropriate PPE and making way quickly to the means of evacuation and treating casualties, and Protected evacuation routes and systems.

3.1.1 Living quarters as TR

On manned installations, due to the compatibility between several of their respective functions, all or part of the living quarters may provide the TR. However, this is not the only concept and consideration should be given to other TR configurations.

3.1.2 Incident dependent variable TR

Different TR configurations may be required for different incident scenarios. This concept may be appropriate on floating installations where the planned response to loss of buoyancy may be different from that adopted in other circumstances. This concept should be avoided unless essential.

3.1.3 Joint operations

It is acceptable and may be necessary to have different TR configurations when installations are temporarily linked in joint operations. Examples include flotels, work barges and drilling tenders alongside a fixed installation (i.e. connected by a gangway). All likely modes of operation should be identified and assessed.

3.2 SECONDARY TR

If it is demonstrated by HEMP (6.1) that escape to the primary TR may not be possible from a particular area, one option is the establishment of a secondary TR.

All practical measures should be taken to avoid having to establish a secondary TR on an installation, as this would place an additional burden on TR facilities and installation management. Such measures include steps to mitigate the effects of incidents and/or the provision of alternative escape and evacuation routes.

A secondary TR should be subordinate to the main TR, with a lesser requirement for the provision of communications, monitoring and control facilities. It shall have a secure means of communication with the main TR and it should be possible to assess the ability to traverse the evacuation route from the secondary TR.

Secondary TRs shall have independent means of evacuation and/or escape as determined by an EER assessment

NOTE: In some regions a Secondary TR is referred to as a Protected Muster Point (PMP).

3.3 CAPACITY

The primary TR SHALL [PS] have capacity for the maximum permitted POB. If access routes are available, all personnel should go to the primary TR. Individuals should not be assigned to secondary TRs prior to an incident.

NOTE: The above does not apply to joint operations (3.1.3), where personnel accommodated on the mobile unit should normally muster at the TR of the mobile unit.

Secondary TRs shall be able to accommodate all individuals potentially isolated from the primary TR according to the EER assessment, plus a contingency. The contingency shall be individually determined for each case, considering the margin of error in the anticipated numbers.

3.4 MUSTER SPACE REQUIREMENT

If personnel are mustered within the TR in groups of more than 20, then an area of 1.25 m² (13.5 ft²) per person should be provided. This is based upon 50 percent seated and 50 percent standing, without baggage and allowing for cross-flows.

If personnel are mustered in groups of 20 or less, such as in multiple muster stations, an area of 0.8 m² (8.5 ft²) per person should be provided. This is based upon 25 percent seated and 75 percent standing, without significant cross-flows.

These are clear areas, including loose furniture but excluding fixed furniture and fittings.

Heat stress, oxygen depletion and carbon dioxide build-up also affect the space requirement for enclosed TRs (5.1.1.4 and 5.1.1.6). Based on oxygen depletion and carbon dioxide build-up, the minimum volume of an enclosed TR is 1.4 cubic metres of air per person per hour of TR endurance (Appendix 3). Consideration should also be given to providing adequate space for stretcher cases. The resulting volume should be checked to confirm that there are no unintended consequences resulting from thermal stress under external thermal loads.

3.5 STAND ALONE/ INTEGRATED MONITORING

If the main installation control point is not part of the primary TR, there shall be an emergency control point (ECP) located in the primary TR. If the main installation radio room is not part of the primary TR, there shall be an emergency radio point (ERP) located in the primary TR. All the essential command support functions (5.1.3.1) shall be available in either the ECP or the ERP.

Additional command support functions may be required in the ECP or the ERP (5.1.3.2), depending on whether they can be maintained from the main installation control point following an incident.

The ECP and ERP should be adjacent to each other, or integrated with each other, to facilitate effective management of incidents. The command support functions within the ECP/ERP should be secured against unauthorised use.

The HEMP tools shall be used to identify the major incidents by which the main installation control point may be threatened and for which retreat to the TR may be necessary.

If the main installation control point is part of the primary TR, consideration should be given to having a separate, but adjacent or nearby, space designated as the emergency control point. This space will then provide the emergency response management team with a more suitable environment for assimilating information and making complex decisions under stress (6.2) than may be achievable in the main control point.

4. SYSTEMS

The systems required to meet the primary objective of the TR (2.1) are:

- life support;
- structural support;
- command support; and
- escape and evacuation.

The acceptance criteria for the various systems are given in (5).

4.1 LIFE SUPPORT SYSTEM

The function of the life support system is to maintain an environment which is not hazardous to personnel and which maintains their ability to take rational action.

The scope and extent of the life support system will vary, from little or no specific provision (where environmental conditions are predicted to be largely unaffected) to a purpose-designed enclosure incorporating specialist environmental control facilities.

4.1.1 TR leakage rate

For enclosed TRs the prevention of smoke and/or gas ingress is of paramount importance in maintaining integrity. The risk of loss of integrity of the TR is a function of leak tightness, if the forced ventilation of and positive pressure in the TR are lost by fire closing down the HVAC system, by smoke or gas reaching the HVAC intakes or by loss of HVAC power. The leakage rate for new TRs should be the lowest that is reasonably practicable. For new designs it should be possible to achieve a leakage rate of 0.1 air changes per hour or lower. The maximum acceptable air change rate should be stated as part of the TR performance standard (6.1).

Operating experience shows that the leakage rate can be significantly higher than this, leading to a risk of rapid TR impairment if the seals around doors or penetrations deteriorate or are damaged. To ensure that the TR delivers its intended design function a test should be performed during commissioning and regularly during operations to measure the leak rate. If the tests show significant increase in the leakage rate above the design rate, the leak paths shall be investigated in order to identify and fix the source of leakage.

A predictive model (AIDA) is available from the Custodian of this DEP to enable air change rate prediction and assist with the optimisation of TR concepts.

4.2 STRUCTURAL SUPPORT SYSTEM

Various components of the topsides and substructure are essential for maintaining the structural integrity of the TR and the associated means of escape and evacuation. These together comprise the structural support system and include:

- TR structure, including bulkheads and decks;
- supporting structures, including bulkheads and decks;
- components providing for buoyancy, stability and station keeping (in mobile units).

Structures directly and indirectly supporting escape and evacuation routes and survival craft embarkation areas are covered as part of the escape and evacuation system.

Where applicable, the requirements for bulkheads and decks SHALL [PS] also apply to doors, windows, penetrations and connections.

The use of windows should be minimised since fire and blast rated windows can add substantially to weight and therefore cost. Windows facing the process should not be installed and consideration given to reflection and negative blast wave effects for windows on the side and back faces of any permanent TR structure.

Adjacent structures which could collapse onto and significantly damage the TR or its systems, or could obstruct escape and evacuation routes, SHALL [PS] also be evaluated.