

DEP SPECIFICATION

DESIGN OF OFFSHORE TEMPORARY REFUGES

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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. This DEP 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 TR 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.

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-Gen.) and ISO 15544 (DEP 80.80.00.12-Gen.). 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).

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 January 2011 (amended February 2012); see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

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This DEP is intended for use in facilities related to oil and gas production. 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 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.

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

1.3.2 Specific definitions

Term	Definition
Acceptance criteria	Requirements against which the fulfilment of an objective can be measured.
Command structure	The organisation that is provided to control an emergency.
Command support system	The range of communications, monitoring and control functions that are provided for the management of potential incidents. Certain functions are critical to meeting the primary objective (2.1), while other functions might not be. In order to differentiate between them, they have been categorised as either essential functions or additional functions
Complex	A series of two or more bridge-linked offshore Installations.
Control point	Main installation control and monitoring facility.
EER Assessment	An EER assessment systematically assesses the escape, muster, refuge, evacuation, escape to the sea, and rescue/recovery facilities against the identified major accident hazards to ensure that the facilities meet their design objectives.
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 need to be maintained.
Escape	The act of personnel moving away from a hazardous event to a place where its effects are reduced or removed (ISO 13702)

Term	Definition
Escape route	A route from an area of an installation leading to a muster area, TR, embarkation area or means of escape to sea.
Essential command support functions	The essential command support functions are those whose loss or impairment are deemed to constitute direct loss of integrity of the TR, escape routes, evacuation routes or points of embarkation.
Evacuation	The planned method of leaving the installation in an emergency (ISO 13702)
Evacuation route	An escape route from the TR leading to an embarkation area used for primary or secondary evacuation from the installation.
HEMP	Hazards and Effects Management Process. Process that identifies and assesses HSE hazards, selects control and recovery measures, and maintains a documented demonstration that major HSE risks have been reduced to a level that is ALARP.
Installation	A fixed or mobile facility engaged in offshore oil and gas exploration or production activities.
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
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. 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

Term	Definition
RPE	RPE is a general term covering both breathing apparatus (which is independent of the local atmosphere) and respirators (e.g. smoke hoods and filters that are dependent on the local atmosphere). Smoke hoods of the simple filter type are unlikely to provide sufficient respiratory protection for major incidents on large and complex installations.
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.
Very toxic (substances)	Refer to DEP 01.00.01.30-Gen. for additional details concerning the definitions of "very toxic - acute", "very toxic - chronic", and "very toxic - environment".

1.3.3 Abbreviations

Term	Definition
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	Blow Out Preventer
ECP	Emergency control point
EER	Escape, Evacuation and Rescue
ERP	Emergency radio point
ESD	Emergency Shutdown
HVAC	Heating, Ventilation and Air Conditioning
HEMP	Hazards and Effects Management Process
ICRP	International Committee for Radiation Protection
IMO	International Maritime Organisation
IRPA	Individual risk per annum
LED	Light Emitting Diode
LFL	Lower Flammable Limit
NFPA	National Fire Protection Association

Term	Definition
NIOSH	National Institute for Occupational Safety and Health
OIM	Offshore Installation Manager
PLL	Potential loss of life
POB	Persons on board
PPE	Personal Protective Equipment
QRA	Quantitative Risk Assessment
RAM	Risk Assessment Matrix
RPE	Respiratory protective equipment
SCE	Safety Critical Element
SOLAS	Safety of Life at Sea
STP	Standard temperature and pressure
STEL	Short Term Exposure Limit
TEMPSC	Totally Enclosed Motor Propelled Survival Craft
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 (8).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a full revision of the DEP of the same number dated January 2011 (amended February 2012). The following are the main, non-editorial changes.

Section/Clause	Change
ALL	Rewritten to clarify the requirements; and a reduction in two Process Safety requirements
5.2	Section is renumbered

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
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	form and submit.
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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. GENERAL REQUIREMENTS

2.1 PRIMARY OBJECTIVE

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.

1. Every offshore installation SHALL [PS] have at least one place designated as the primary Temporary Refuge (TR) with sufficient capacity to protect the maximum allowed number of persons on board (POB) the installation for the duration defined in the Basis for Design (for new installations) or in the documented demonstration of ALARP (for existing installations).
2. The TR may be an enclosure, more than one enclosure, or only an area of open deck.
A TR might not be integrated with the living quarters and might not be enclosed.
3. The TR SHALL [PS] maintain the safety of personnel during the period required for the evacuation process to be completed including the following times and activities:
 - a. time to complete the full muster at the TR;
 - b. time to account for personnel not reporting to their assigned muster stations;
 - c. time to evaluate the situation and make decisions;
 - d. time to initiate responses to minimise the consequences and control the emergency, if possible;
 - e. time to complete the evacuation (if required).
 - i. This may be done in a phased manner, initially evacuating non-essential personnel.
 - f. contingency time to allow for the unforeseen.

2.2 FUNCTIONAL REQUIREMENTS

1. The TR shall provide the communications, monitoring and control equipment necessary to ensure personal safety.
2. The escape and evacuation routes and the embarkation areas shall provide the following:
 - a. secure means of escape to the TR;
 - b. secure means for a complete evacuation from the TR.

2.3 DESIGN BASIS

1. The measures required to meet the objectives and acceptance criteria (5) are installation-specific and shall cover the range of major incident scenarios applicable to the installation.
2. The Hazards and Effects Management Process (HEMP) shall be used to identify and manage the range of major incident scenarios.

Two categories of acceptance criteria are defined:

- *conditions required for integrity;*
- *endurance period.*

3. The following shall be integrated into the overall installation design:

- a. The locations of the TR;
 - b. escape and evacuation routes;
 - c. embarkation points;
 - d. other common facilities and utilities.
4. Protection of the TR and escape and evacuation routes by active protection systems shall be included in the design if HEMP analysis has indicated a significant risk (Level 5 according to the Risk Assessment Matrix (RAM)) to their integrity and the necessary improvements cannot be achieved by passive means.
 5. During the Define phase of the project a decision should be made regarding stand-alone assessment or assessment within sub-models of a Quantitative Risk Assessment (QRA) model for the installation.

A stand-alone assessment is likely suitable for simpler facilities with a small number of impairment mechanisms and small TR.

The assessment within sub models of a QRA should be used for complex facilities with multiple impairments and, particularly, if a frequency of impairment is required to be determined for regulatory purposes.

- a. Assumptions should be documented so that the impact of changes can be assessed during the lifecycle of the installation.

3. TR CONFIGURATION CONCEPTS

3.1 PRIMARY TR

3.1.1 General

1. As a result of HEMP (6.1) analysis, the TR might need to be distributed across several locations. One location shall be designated as the primary TR providing main command support functions.
2. All other TR locations shall be designated as Secondary TR (3.2).
3. The following principles should be incorporated into the design of a TR:
 - a. Choice of a location where other structures provide protection from process events, helicopter accidents and falling structures, e.g., derricks and flare towers;
 - b. Door openings which provide access for large numbers of personnel through air locks,
 - c. Secure communication, command and control facilities from which assessment of the event may be made without exposing personnel or opening doors,
 - d. Sufficient space for mustering, donning appropriate PPE and making way to the means of evacuation and treating casualties
 - e. Evacuation routes and systems.

3.1.2 Living quarters as TR

1. On manned installations, all or part of the living quarters may provide the TR.
 - a. Other TR configurations should be considered.

3.1.3 Incident dependent variable TR

Different TR configurations could be required for different incident scenarios on the same installation. This concept could be appropriate on floating installations where the planned response to loss of buoyancy could be different from that adopted in other circumstances.

1. Incident dependent variable TR should not be used unless this concept is shown to be essential to manage the major accident hazard scenarios.

3.1.4 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).

1. For joint-operation TR, all modes of joint operation should be identified and assessed when determining TR configuration.

3.2 SECONDARY TR

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

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

1. A Secondary TR places an additional burden on TR facilities and installation management. Measures should be taken to avoid using a secondary TR.
Such measures include steps to mitigate the effects of incidents or the provision of alternative escape and evacuation routes.
2. A secondary TR should be subordinate to the main TR, with provision of communications, monitoring and control facilities according to the facility emergency response plan (DEP 32.71.00.12-Gen.).
3. A secondary TR shall have a secure means of communication with the main TR.
4. Secondary TRs shall have independent means of evacuation and escape as determined by an Escape, Evacuation and Rescue (EER) assessment.
5. The secondary TR shall have means to assess the status of its evacuation route.

3.3 CAPACITY

1. The primary TR SHALL [PS] have capacity for the maximum permitted POB.
2. Secondary TRs shall be able to accommodate all individuals potentially isolated from the primary TR according to the EER assessment, plus a contingency that is individually determined for the TR, considering the margin of error in the anticipated numbers.

3.4 MUSTER SPACE

1. When mustering in groups of greater than 20, an area of 1.5 m² (12.0 ft²) per person should be provided.
This is based upon 50 % seated and 50 % standing, without baggage and allowing for cross-flows of personnel.
2. When mustering in groups of fewer than 20, an area of 0.8 m² (8.5 ft²) per person should be provided.
This is based upon 25 % seated and 75 % standing, without significant cross-flows of personnel.
These are clear areas, including loose furniture but excluding fixed furniture and fittings.
3. Based on oxygen depletion and carbon dioxide build-up, the minimum volume of an enclosed TR shall be 1.4 m³ (50 ft³) of air per person per hour of TR endurance (Appendix C).
Heat stress, oxygen depletion and carbon dioxide build-up also affect the space requirement for enclosed TRs, see (5.2.2.6) and (5.2.2.8).

4. The EER assessment should determine the space required for casualty handling and stretchers.
5. The resulting volume of the TR 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

1. 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.
2. 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.
3. All the essential command support functions (5.2.4.1) shall be available in either the ECP or the ERP.

Additional command support functions may be required in the ECP or the ERP (5.2.4.2), depending on whether they can be maintained from the main installation control point following an incident.

4. The ECP and ERP should be adjacent to each other, to facilitate effective management of incidents.

Adjoining spaces will provide the emergency response management team with a more suitable environment for assimilating information and making complex decisions under stress (6.2) than is likely to be achieved in the installation control point.

5. The command support functions within the ECP/ERP should be secured against unauthorised use.
6. HEMP 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.

4. SYSTEMS

4.1 GENERAL

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

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

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

4.2 LIFE SUPPORT SYSTEM

4.2.1 TR leakage rate

For enclosed TRs the prevention of smoke and/or gas ingress is of paramount importance in maintaining integrity. The integrity of the TR is a function of leak tightness and positive pressurisation. Pressurisation will be lost quickly if the heating, ventilation and air conditioning (HVAC) system is shut down in response to smoke or gas reaching the HVAC intakes, or by loss of HVAC power.

1. The design leakage rate for new TRs shall not exceed 0.1 air changes per hour.

Achieving this target will be assisted by the use of dampers complying with ISO 15136 and EN 1751 Class 3 Class B.