	TECHNICAL SPECIFICATION		No.: I-ET-3000.00-5430-947-P4X-001							
	CLIENT:						SHEET: 1 of 11			
	JOB: -						-			
	AREA: -						-			
DPP-SRGE	TITLE: ESCAPE, EVACUATION AND RESCUE ANALISYS						NP-1			
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MICROSOFT WORD / V. 2016 / I-ET-3000.00-5430-947-P4X-001_0.DOC										
INDEX OF REVISIONS										
REV.	DESCRIPTION AND/OR REVISED SHEETS									
0	ORIGINAL									
	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H	
DATE	DEC/23/19									
DESIGN	ESUP									
EXECUTION	RUBENSC									
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APPROVAL	PAOLO									
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1. INTRODUCTION

This Technical Specification (TS) for the execution of the Escape, Evacuation and Rescue Analysis (EERA) covers various aspects related to the escape, evacuation and rescue of Personnel on Board (POB) of a particular Unit, in order to ensure that the incidents analyzed do not impede the rescue of personnel, escape and evacuation of the facility.

The conditions related to the means of escape, evacuation and rescue from the accidental scenarios analyzed shall be adequate to the risks and included in the ALARP region, considered as low as reasonably practicable.

In addition, the study shall address the evacuation and rescue means that allow the definition of an Escape, Evacuation and Rescue Strategy (EER), according to ISO 13702 and ISO 15544.

2. OBJECTIVES

This document has following goals:

- Define scope, methodology and criteria for the execution of the EERA for the basic design phase, Front End Engineering Design (FEED), executive project and assisted operation of a Floating Production Unit or a Fixed Unit, hereinafter referred to as the Unit. This TS may be optionally used as a guide in the operation phase of the Installation at the time of a review of the study;
- Provide guidelines for the planning, development and follow-up on the study and its final approval by the parties involved;
- Define the standardization, content and minimum requirements for presentation of the study report.

The main objective of this study is to analyze all the resources that guarantee the escape and evacuation of the Unit in a safe way, in the event of an accidental scenario arising from safety studies that may lead to possible evacuation of the Unit.

3. SCOPE OF THE STUDY

The scope of work required for the EERA is the following:

- Describe the EER strategy for a particular Unit and the resources provided;
- Identify the diverse accidental scenarios which could give rise to the need for escape, evacuation or rescue of personnel;
- Determine escape and evacuation times.

4. ABBREVIATIONS AND DEFINITIONS

For the purpose of this specification, the following abbreviations and definitions shall be considered:

Abbreviations


DAL - Dimensioning Accidental Load

EER – Escape, Evacuation and Rescue

EERA - Escape, Evacuation, and Rescue Analysis

FEED - Front End Engineering Design

FPSO - Floating Production Storage and Offloading

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- MSF - Main Safety Functions
- PHA - Preliminary Hazards Analysis
- SIGEM - Integrated System of Project Management
- TR - Temporary Refuge
- TS - Technical Specification

Definitions

Abandonment - Act to remove in an orderly manner all personnel on board involved in emergency control. It is proceeded when all emergency control resources are exhausted. The abandonment shall be done using lifeboats, life rafts or jumping to the sea;

Designer - Company responsible for the execution of the engineering project such as conceptual project, basic project, FEED or executive project, being Petrobras itself or outsourced company hired to carry out the project;

Embarkation Stations - Place for mustering of personnel before the entrance in the evacuation means;

Escape - Act of moving away from a dangerous event to a place where its effects are reduced or inexistent (safe place);

Escape Route - Demarcated route linking an area to safe places such as muster areas and Embarkation Stations;

Evacuation - The planned method of leaving the facility in an emergency. Primary means of evacuation are by lifeboats, secondary mean of evacuation is by helicopter (the possibility of using the helicopter shall be evaluated since there is restriction of landing according to the inclination of the ship in normal conditions of operation) and tertiary mean of evacuation is straight to the sea by stairs;

Muster Points - A designated muster area for personnel not involved in emergency control while awaiting specific instructions for evacuation;

Parties Involved - Includes the parties involved in the execution or follow-up on the EERA: the Designer, the Study Consulting and Petrobras;

Study Consulting - Responsible for the execution of the EERA. Study Consulting may be an outsourced company hired by either the Designer or Petrobras, or it can be the Designer itself or an in-house Petrobras department.

Rescue - The process of rescuing the people from the sea (using lifeboats, life raft or directly from the water) to a safe place - usually a support vessel.

5. REFERENCE DOCUMENTATION

As inputs for the execution of the EERA, the following documents shall be considered (when applicable to the respective phase of the project), in its most current version and with RELEASED or RELEASED WITH COMMENTS status by Petrobras at SIGEM or another electronic document management system defined in contract.

- a) Design Safety Engineering Guidelines;
- b) General arrangement of the installation;
- c) Safety Plan indicating the MSF;
- d) Fire Control and Life Saving Appliance Plans;
- e) Hazardous area classification drawings;
- f) Equipment list;

- g) List of electrical equipment in hazardous areas;
- h) Safety Studies reports (Fire Propagation and Smoke Dispersion, Gas Dispersion, Explosion, Dropped Objects and Ship Collision) and the PHA;
- i) Telecommunications System.

The review of each document used in the development of the study shall be clearly indicated in the study report.

6. RELEVANT ASPECTS OF THE STUDY

EERA shall take into account at least the following aspects that influence the time needed for escape, evacuation and abandonment of the Unit:

- Existing risk analyzes (PHA) for the Unit;
- Accidental scenarios arising from the safety studies performed for the Unit (Fire Propagation and Smoke Dispersion, Explosion, Gas Dispersion, Dropped Objects, and Ship Collision);
- Confinement of areas due to the presence of bulkheads, floors and large equipment;
- Congestion of areas due to the presence of equipment, structures and piping among other items;
- Geometry and arrangement of the evaluated areas;
- Maximum time for displacement, as well as walking speed of people and decision time;
- All escape routes (main and secondary) and their characteristics;
- Muster areas and embarkation stations provided at the Facility;
- Evacuation and rescue mean and resources provided in the Facility;
- Fire and explosion protection systems designed/provided in the Unit;
- Confined spaces and spaces which are difficult to access readily.

7. STUDY METHODOLOGY

In case of the emergency general alarm being triggered at the Unit, all personnel on board shall make workplace safe and proceed to the nearest muster area, where they shall wait for further instructions on how to proceed. Depending on the severity and location of the accidental scenario, it may be necessary to evacuate the Unit.

To perform the EERA, the primary means of evacuation (lifeboats) shall be considered.

7.1. Assessment Of Escape And Evacuation Times

The time required for Escape and Evacuation shall be assessed for each accidental scenario selected, as per Chapter 9. All escape routes that may be impaired shall be evaluated.

For calculations of these times, different starting points shall be considered for all selected accidental scenarios. These starting points shall be chosen by a critical evaluation of the worst possible location a person may be in and can move towards the nearest muster area.

A table with the selected starting points shall be presented and their locations shall be marked in the figures, indicating the elevation and the module considered.

The abandonment sequence shall account the following stages, after the alarm is triggered:

- 1) Making workplace safe;

- 2) Displacement to muster area;
- 3) Roll call at muster areas and put into action the Emergency Response Team, if necessary;
- 4) Displacement to the embarkation stations;
- 5) Boarding and launching the lifeboats.

The occurrence of only one accidental scenario at a time shall be considered and the following assumptions:

- The reaction time for personnel to recognize the alarm plus the action of making the workplace safe and choose the suitable escape route is 2.0 (two) minutes, according to the reference *A Guide to Quantitative Risk Assessment of Offshore Installation, 1999 - CMPT*;
- The maximum time for a person to move anywhere from the Unit to the nearest muster area is 10 minutes. If the calculated time is higher, the considered escape route shall be discarded, and an alternative route shall be indicated;
- The time required for roll call at the muster area is 5 minutes;
- Average people displacement speeds:
 - a) 1.0 m/s on horizontal escape routes;
 - b) 0.8 m/s on stairways;
 - c) 0.3 m/s on vertical ladders;
- After the abandonment order, 11 minutes shall be considered for boarding all personnel and lowering the lifeboat, as per *OGP Risk Assessment Data Directory, Report n° 434-19 (March 2010) - Evacuation, Escape and Rescue*;
- If there are doors along the chosen escape route, 5 seconds shall be considered for opening each door.

For each pair starting point X selected scenario, the usable escape routes shall be indicated in order to ensure the safety of personnel as they move to the muster area.

7.2. Main Safety Functions (MSF)


For the execution of the EERA, the following MSF shall be analyzed:

- Accommodations;
- Embarkation Stations;
- Lifeboats;
- Rescue Boat;
- Muster areas;
- Central Control Room and/or rooms containing essential equipment;
- Escape routes.

8. DESCRIPTION OF ESCAPE, EVACUATION/ABANDONMENT AND RESCUE SYSTEMS

During the execution of EERA, all systems deemed essential shall be listed and detailed:

- Public Address and General Alarm (PAGA);

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- Emergency lighting;
- Escape routes;
- Muster areas (including primary and secondary TR) and Embarkation Stations;
- Resources for Evacuation/Abandonment and Rescue.

All items that are part of the EER system shall be presented with plans and illustrations of the Unit under analysis, in order to clarify and facilitate the understanding of the study.

9. SELECTION OF REPRESENTATIVE ACCIDENTAL SCENARIOS

For the execution of the EERA, representative accidental scenarios that may impact or hinder the means of escape, rescue and/or evacuation of the Unit shall be selected.

The main safety functions related to escape and evacuation shall be described, as well as a list of the representative accidental scenarios chosen for the calculation of the evacuation time.

In order to assess the evacuation capacity of the Unit, the accidental scenarios identified in the PHA and Safety Studies (Fire Propagation and Smoke Dispersion, Gas Dispersion, Explosion, Dropped Object and Ship Collision) shall be selected when they:

- refer to the release of toxic and asphyxiating gases obstructing escape routes or hindering the rescue of workers in the Facility;
- impair the Main Safety Functions, according to the criteria used in the reference Safety Studies;
- reduce visibility to less than 3.0 (three) meters;
- have Accidental Loads capable of impacting the primary and secondary structures of the modules, thus blocking the escape routes.

All selected accidental scenarios shall be presented in tabular form, showing evacuation times calculated for the various Starting Points and illustrations showing the various decks, levels, elevations and modules, thus facilitating the understanding of the scenario of impediment.

10. REQUIREMENTS FOR FOLLOW-UP MEETINGS

The meetings for the follow-up on the study shall follow the guidelines below:


10.1. General

The follow-up on the study development shall be carried out by a team of Designer with Petrobras' participation in cases mentioned in this specification.

The follow-up meetings shall be held in the Study Consulting office, except for the meetings for planning and analysis of project documentation, which shall be carried out at Designer's office. The meeting venue may be amended in common agreement among the parties involved. Petrobras' participants may attend meetings by videoconference.

The minutes of the meeting shall be drawn up by Designer and made available as a project document or included as an annex to the report, in its final review.

All validation decisions (of premises, of data, of geometry among others) shall be included in the final study report as an annex. The validations shall be signed by the representatives of each party involved.

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10.2. Planning Meeting

This meeting is for a brief presentation of the project, clarification of aspects related to the objectives and scope of the study, delivery of project documentation, evaluation and necessary adjustments in the work schedule and resources required for the study. At least the following items shall be covered in the meeting:

- Safety briefing - (by Designer);
- Presentation of the Project for Study Consulting - (by Designer);
- Clarifications on objectives, scope of analysis and requirements for the study (by Designer and Petrobras);
- Sizing the teams of the Designer and Study Consulting that will participate in the execution and follow-up on the study, with definition of the matrix of responsibilities;
- Presentation of the focal points of each involved party and identification of the responsible for each discipline from each involved party that will participate in the follow-up meetings and the validations required in this TS;
- Presentation of planned schedule for the execution of the study in accordance with the project schedule (by Study Consulting and Designer);
- Definition of locations, resources needed and duration of follow-up meetings (by Designer and Study Consulting).

Meeting participants: The focal points of the parties involved, representatives of the Study Consulting and discipline leaders from Designer responsible for the follow-up on the study.

Note: The schedule shall include twenty working days for comments on the reports (partial and final) by Petrobras, as well as the time needed for implementing those comments by the Study Consulting.

10.3. Meeting for Project Documentation Analysis

The purpose of this meeting is to analyze and validate the project documentation necessary for the development of the Study and a pending document list, whenever needed. The objective is to avoid errors and reworking in the studies, due to possible failures or omissions of information in the documentation, which is the input data for carrying out of the study.

From the analysis of the documents provided, and considering the document list for the project, Study Consulting may request clarification and solve your doubts about the information in the documents.


In case of identification of pending documents or the need to provide other documents, Designer shall inform the deadline for resolving the pending issues and/or sending the documents, in a way that does not affect the schedule of the study.

At the end of the meeting, Study Consulting shall sign terms of acceptance containing the list of pending items, if any.

Note: Designer, as responsible for the management of changes for the project, shall inform the parties involved about any change in the project that impacts the study. Documents modified as a result of the changes affecting the study shall be sent to Study Consulting.

Study Consulting shall evaluate the changes and inform the impacts of the changes on the analysis and schedule. This information shall be formally sent to Designer and communicated to Petrobras.

Meeting participants: Representatives from Study Consulting and discipline leaders from Designer responsible for the follow-up on the study. Petrobras' participation in this meeting is optional.

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10.4. Assumptions and Methodology Meeting

The purpose of this meeting is to present and define assumptions to be used in the study, clarification of the methodology and confirmation of basic data of the Unit.

Study Contractor shall present the proposed assumptions for the development of the study and its questions about the methodology proposed in this TS. The questions shall be clarified by the Designer with participation of Petrobras.

Assumptions shall be defined by mutual agreement among the parties involved and shall be included in the study report.

In addition to the assumptions and methodology, Designer shall confirm the basic information for the start of the study, such as meteorological conditions, confirmation of the positioning coordinates of the Unit, risers arrangement (submarine and surface - arrangement of risers balcony) and the MSF that shall be evaluated in the study. The information shall be confirmed or amended by Petrobras.

Meeting participants: Representatives from Study Consulting, discipline leaders from Designer and Petrobras' representatives who are responsible for the follow-up on the study.

10.5. Follow-up and Validation Meetings

The purpose of these meetings is to follow-up on the study by Designer with the participation of Petrobras, when the requirements stated in the methodology shall be addressed.

Designer, in agreement with Study Consulting and considering the schedule for the study, shall present the agenda of meetings to monitor development of the study. The meetings shall contemplate the study steps foreseen in item 7 (Methodology) of this TS.

Meeting participants: Representatives from Study Consulting, discipline leaders from Designer and Petrobras representatives who are responsible for the follow-up on the study.

10.6. Final Report Presentation Meeting –Preliminary Version

This meeting is to present the final report (preliminary version) before its release to Petrobras. The final report is under the responsibility of the Designer and shall be issued by him. The final report shall include the report issued by Study Consulting and the treatment of the study recommendations to be implemented in the project by Designer. The codification of the report and its stamp shall identify the Designer as author of the document. The report coding shall be in accordance with Petrobras standard N-1710 - Coding of Technical Engineering Documents, and the format in accordance with N-381 - Execution of Drawing and Other General Technical Documents.


The EERA shall cover the representative accidental scenarios that may impact the escape, evacuation and rescue means of the Facility.

Meeting participants: Representatives from Study Consulting, discipline leaders from Designer and Petrobras representatives who are responsible for the follow-up on the study.

11. STUDY REPORTS

The final report shall be issued in Portuguese and English. The report shall meet the content required in the Safety Engineering Guidelines and the one specified in this document.

All the hypotheses of simplification and assumptions adopted for the study shall be presented and explained in the report. In addition, the minutes of the meetings shall be prepared by the Designer and annexed to the report, especially those for validation of methodology steps. The charts and figures of the reports shall be presented with the respective scales, legends and the winds rose with indication of predominant wind direction. For elaboration of the tables, graphs and figures, the units of the

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International System of Units shall be applied.

All charts and figures that support the conclusions and recommendations of the study shall be presented in the final report.

11.1. Partial Report

At least one partial report shall be submitted by the Study Consulting to Petrobras for acceptance prior to the release of the final report.

The Partial Report shall contain the following, at least:

- List of Abbreviations;
- Executive summary;
- Introduction;
- Goals;
- Reference documents;
- Unit Description;
- Description of ERR Strategy and EER Systems;
- Technical Assumptions;
- Identification of Accidental Scenarios;
- Calculation of Escape and Evacuation Times;
- Conclusions and Recommendations;
- Annexes.

11.2. Final Report

The Final Report corresponds to the release of the report under review 0. It shall include all the requirements from item 11.1, take into account the comments made to the Partial Report, and additionally contain:

- Minutes of meeting presented as an Annex of the report (item 10.1);
- Checklist presented as an Annex of the report (item 14);


Additional revisions shall be provided for cases where there are project changes that affect the study or if failures in the final emission are identified.

12. DEADLINES

The deadlines required for the study and the release of the partial and final reports shall be defined by Designer, in agreement with Study Consulting, considering the complexity of the project, the scope of the study and the deadlines established in the contract. These deadlines shall be included in the schedule mentioned in item 10.2 of this TS.

13. COMPETENCE FOR CARRYING OUT THE STUDY

Due to the importance of this study for the safety of the Unit, it shall be performed by a qualified company pertaining to Petrobras' pre-approved list of suppliers and outsourced companies.

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14. APPLICATION OF THE CHECKLIST

Designer shall provide a checklist of the follow-up on Study Consulting's activities, which shall be included as an annex to the report. The checklist shall contain the EERA requirements from the Safety Engineering Guidelines and from this TS. The verification of each requirement shall have the identification and signature of the person in charge of the verification.

15. INFORMATION SECURITY AND DATA PROTECTION

In addition to the requirements from Safety Engineering Guidelines, Designer and Study Consulting shall have a security information and data protection system that ensures the integrity, reliability, traceability, confidentiality and inviolability of the data contained in the study and the data provided by Petrobras. All information shall be preserved against accidental or information security events for at least five years.