REVISIONS INDEX

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PROJECT	ESUP	ESUP	ESUP	ESUP					
EXECUTION	PETERDINIZ	U436	U436	U436					
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CONTENTS

1. INTRODUCTION:

1.1 The objective of the safety studies performed during the design phases of an Offshore Production Unit is to identify hazards and analyze the risks, focusing on the people safety, facilities, environment and image of the company. The studies may present recommendations with the aim of reducing the frequency of accidental scenarios and/or reduce associated damages in order to meet the risk tolerance criteria established for the project.

1.2 The Offshore Production Units design shall be inherently safer and during risk analysis, appropriate preventive measures shall be taken. A management of change program shall be applied during detail design and ensure that all changes occurring during the design, procurement, construction, assembly, commissioning and pre-operation phases are adequately identified and analyzed, and the risks introduced by them are evaluated and controlled.

1.3 Management of change is a systematic and continuous process that identifies changes in a project so that they do not inadvertently introduce new hazards or increase hazards and risks. Therefore, all changes in the project shall be identified, analyzed, and evaluated consistently by a multidisciplinary team and the risks shall be treated to meet the tolerability criteria established for the project.

1.4 Management of change includes a process of analysis and authorization hierarchy to evaluate the proposed changes to the Unit's design ensuring that no risks are introduced without proper identification and treatment.. Management of change also includes measures to ensure that project potentially affected disciplines are notified of the change and that the relevant documents are update.

1.5 Whenever project information changes, the safety studies input data shall be checked so that at the beginning of the operation the studies are in accordance with the Unit as built. The input data of each type of study shall be mapped to facilitate the identification of factors that may affect the results of each study.

1.6 This specification does not cover all aspects of management of change in an engineering project, such as impacts on costs and timing. The focus of this specification is safety studies, by identifying changes that may affect the input data and therefore their results that may indicate reduction, maintenance or increasing of risks. In case of increment, an assessment shall be made to identify the need for new safety barriers or design improvements.

2. OBJECTIVES

2.1 The purpose of this technical specification is:

2.1.1 Define scope, methodology and criteria for the implementation of management of change during the basic design phase, executive project, supply, construction, assembly, commissioning and pre-operation of Offshore Stationary Production Units, hereinafter referred to as Installation, with the objective of assess the impact on safety studies.

2.1.2 Define the dynamics for the planning, development and monitoring of the validity of the security studies issued until the beginning of operation of the Installation.

2.1.3 Define the standardization, content and minimum requirements for submission of the Management of change report applied to safety studies.

3. SCOPE

3.1 The management of change of safety studies' Installation shall be a continuous process, part of the technical management of a project, and not a report that evidences the application of an evaluation at a particular moment in the project. This process shall be systematically applied throughout the project in a traceable and recorded manner, ensuring that safety studies and all aspects related to them, are representative and appropriate to the Installation.

3.2 The Management of change shall eliminate gaps in the safety assessments of an Installation, ensuring that the modifications inherent in the progress of a project do not introduce unmapped risks.

3.3 The methodology for implementing the management of change in the safety studies shall be provided by the issuance of reports, indicating the critical analysis of the impacts of changes that have occurred throughout the development of the project in order to guarantee the adherence of safety studies to the final configuration of the Installation. A final report shall be issued at the end of the contract of the company responsible for the Installation design and submitted to Petrobras.

3.4 Changes made by a discipline shall be known to the other disciplines impacted. It shall be provided a systematic information management in order to identify each change, the affected disciplines and the impacts of the change in the discipline and relevant documentation.

4. ABBREVIATIONS AND DEFINITIONS

4.1 For the purpose of this specification the following abbreviations and definitions should be considered:

4.2 ABBREVIATIONS

4.2.1 **APR (PHA)** - Preliminary Hazard Analysis

4.2.2 **CSI** - Critical Safety Items

4.2.3 **DCN** – *Design Change Notice*

4.2.4 **ECN** – *Engineering Change Notice*

4.2.5 **EERA** - *Escape, Evacuation, and Rescue Analysis*

4.2.6 **TS** - Technical Specification

4.2.7 **FEED** - Front End Engineering Design;

4.2.8 **FEN** – *Field Engineering Notice*

4.2.9 **INFALT** - Change Information

4.2.10 **MSF** – Main Safety Fu

4.2.11 **POB** – *People on board*

4.2.12 **SMP** - Request for Project Modification;

4.2.13 **TQF –** *Technical Query Form.*

4.3 DEFINITIONS:

4.4 Scenario - It is an event considered at the point of interest having the combination of: hazard, causes, effects and associated risk classification, considering Frequency and Severity;

4.5 Causes - These are the initiators of the deviation, the reasons why deviations can occur. They may include equipment failure, human errors, unanticipated changes in operational conditions and others.

4.6 Confinement - Condition of an environment or area where there is a solid barrier that prevents the acceleration of the flames in a particular direction. Eg. floors and bulkheads in metal plate;

4.7 Congestion - Condition of an environment or area where there is a porous barrier, or set of obstructions, that generate turbulence when passing a fluid, modifying the acceleration of the flames in a particular direction. Eg.: Pipes beam, groupings of small objects;

4.8 Deviations - Changes in design intentions or normal operating conditions. The relation of the applicable deviations is obtained from the combination of the process parameters (variables) with the guidewords.

4.9 Effects - Consequences resulting from the realization of the deviation, which may affect the people, environment, facilities and image of the Company.

4.10 Escalation - Propagation of the impact of a fire to other equipment or areas not involved in the initial scenario, aggravating the consequences of the accidental event;

4.11 Study Performer - Is responsible for the execution of the Safety Study and may be a contracted company, either by the Designer or Petrobras, the Designer himself or an internal Petrobras body;

4.12 Frequency - Physical quantity indicating the number of occurrences of an event in a given time interval.

4.13 Main Safety Function (MSF) - Function that a safety item shall fulfill to enable and/or guarantee the effectiveness of the emergency response strategy, escape and abandonment of the Unit during an accidental event. These functions are defined in Safety Engineering Guidelines [1] and should remain available for a period of one (1) hour after the start of the incident;

4.14 Critical Safety Items (CSI) - These are items of the Installation that shall be maintained intact and functional in a flare-burning condition so that they can perform their safety function for a certain period of time. It includes the Main Safety Function (MSF) and other critical items defined in the Safety Engineering Guidelines;

4.15 Detection modes - Devices, systems or other means already existing in Unit or provided in the design, used to identify the occurrence of the accidental scenario. Examples: alarms, fire and gas detectors, through visual, auditory, olfactory, etc.;

4.16 Parties involved - Are the Designer, Study Performer and Petrobras involved in the preparation or monitoring of the study;

4.17 Danger - Condition or property inherent in a substance, an activity, a system or a process, with potential to cause harm to the physical integrity of the people, environment, asset or image of the Company.

4.18 Designer - company responsible for the elaboration of the engineering project, which may be conceptual design, basic design or executive design, being Petrobras itself or contracted company.

4.19 Recommendations - Proposed measures to reduce the likelihood of an accidental scenario or to mitigate its consequences whenever existing safeguards are considered insufficient.

4.20 Risk - Combination of the expected frequency of occurrence of a scenario with the severity of its consequence.

4.21 Safeguards - Safeguards are considered only those existing or already provided in the project that are properly sized and in operational conditions that allow effective prevention or mitigation of the scenario analyzed.

4.22 Depressurizing System - Valve, piping and vessel protection system, with manual or automatic actuation, to provide a rapid reduction of the pressure in the equipment, by releasing the inventory of the process plant to atmosphere in a safe place.

5. REFERENCE DOCUMENTATION

5.1 As input to the Management of change of safety studies, the documents of all safety studies issued during a given phase of the project, as well as all project documents used in the preparation of these studies, in the previous review and in the available review.

5.2 Other project management tools foreseen in the execution of these are also inputs for Management of change, such as: SMP, TQF, INFALTs, DCNs, ECNs, FENs, among others.

6. METHODOLOGY

6.1 The responsibility for carrying out the management of change process and issuing the final report described in this Technical Specification is the responsibility of the Contractor.

6.2 The process of management of change of the safety studies described in this TS shall start after the first safety study of the respective project phase is issued, usually PHA, and shall be followed up until the end of the contract of the company responsible for the installation design for all design phases until the start of operation.

6.3 Prior to the implementation of any change in the project, the contractor shall initiate the change management process, applying safety studies checklists (see examples of checklists in Annex I) to support the decision of reviewing those studies. The Contractor shall Indicate whether the listed aspects affect "YES" or "NO" and register critical analysis, justifications, recommendantions and treatment on the last column of the checklist. If any item is filled in with "YES", the respective study shall be reviewed. In addition, after developing each safety study, the Contractor shall systematically apply the respective checklist, at a frequency to be determined in agreement with Petrobras. This systematic application has the purpose of managing the changes that occur to the development of the project.

6.4 The following documents are possible sources of impact on safety studies: documents used as a reference for developing these studies, documents of construction and assembly modifications (eg. FENs - Field engineering notice or INFALTs - Change information), SMPs, TQFs, among others.

6.5 Analyzes of changes that do not involve changes in the risks or safety studies already performed shall be highlighted and justified in the final report.

6.6 The Contractor shall implement a system/tool for monitoring the process of management of change of the safety studies described in this TS. The system shall allow the extraction of partial reports.

6.7 The management of change shall be performed by qualified multidisciplinary team, who assess the possible impacts resulting from the change, defining the need for review the studies or implement additional measures to manage risks.

6.8 The recommendations from change management process shall be monitored and implemented in order to ensure effective risk management, according to the requirements I-ET-3000.00-5400-947-P4X-002 (Management of Safety Studies Recommendations).

6.9 The aspects presented in this item shall be evaluated in order to verify if the changes impacts the safety studies. Other aspects that may impact the safety studies shall also be considered.

6.9.1 PRELIMINARY HAZARD ANALYSIS - PHA

6.9.1.1 Aspects whose changes may impact the findings of the study:

- Flammability of process streams;
- Toxicity of the process streams;
- Asphyxiating characteristic of the process streams;
- Equipment layout and mounting;
- Process settings;
- Configurations and connections in drainage systems;
- Values of process variables;
- Arrangement and positioning of containment barriers, or coamings, for flammable or combustible products and also chemical products;
- Positioning of equipment and tank vents;
- Positioning of discharges of internal combustion equipment;
- Positioning of gas or flame detectors;
- Positioning of CSIs;
- Load handling equipment positioning;
- Removal, installation or repositioning of equipment or instruments, sampling points, structures, modules or pipes (including VAC and container ducts) or accessories, such as: valves, PSV, rupture disc, vent, hoses, etc.;
- POB;

– Technological routes.

6.9.2 HAZARD AND OPERABILITY ANALYSIS (HAZOP)

6.9.2.1 Aspects whose changes may impact the findings of the study:

- Flammability of process streams;
- Toxicity of the process streams;
- Asphyxiating characteristic of the process currents;
- Equipment layout and mounting;
- Composition of the process streams;
- Interconnections between process streams;
- Configuration of process control loops;
- Configuration of interlocking loops;
- Set points of the process variables;
- Temperature and pressure data of equipment and piping design;
- Constructive characteristics of equipment;
- Modes of operation of the plant;
- Removal, installation or repositioning of equipment or instruments, sampling points, accessories, such as: valves, PSV, rupture disk, vent, hoses, etc.;
- Technological routes.

6.9.3 FIRE PROPAGATION AND SMOKE DISPERSION STUDIES

6.9.3.1 Aspects whose changes may impact the findings of the study:

- Flammable product inventory between isolated segments;
- Arrangement of equipment;
- Meteoceanographic data;
- Installation Positioning;
- Process plant depressurizing time;
- Containments barriers;
- Drainage points;
- Type of floor that separates the decks;
- Composition of flammable fluids;
- Degree of confinement and congestion of areas;
- Quantity of equipment, components and lines that constitute sources of leakage;
- Capacity of drainage and depressurising systems;

- Positioning of SDVs and BDVs;
- Mechanical loading of structures;
- The amount of ignition sources;
- Positioning of CSIs;
- Accidental scenarios identified in the Preliminary Risk Analysis (APR) that involve the effects of fire and smoke dispersion;
- Structural arrangement;
- Sequencing of risers on riser balcony.

6.9.4 GAS DISPERSION STUDY

6.9.4.1 Aspects whose changes may impact the findings of the study:

- Routing of lines with flammable, combustible, toxic or asphyxiating products;
- Arrangement of equipment;
- Meteoceanographic data;
- Installation Positioning;
- Position, height and diameter of vents, vent post and equipment´s discharges;
- Velocity, composition and temperature of fluids in vent discharge, vent post and equipment´s discharges;
- Containments barriers;
- Drainage points;
- Type of floor that separates the decks;
- Composition of the fluid;
- Degree of confinement and congestion of areas;
- Quantity of equipment, components and lines that constitute sources of leakage;
- Capacity of drainage and depressurizing systems;
- Accidental scenarios identified in the APR that involve effects of release of flammable, combustible, toxic or asphyxiating fluid;
- Plant classification of areas;
- Location and arrangement of indoor air intakes;
- Structural arrangement.

6.9.5 EXPLOSION STUDY

6.9.5.1 Aspects whose changes may impact the findings of the study:

- Routing of lines with flammable products;

- Arrangement of equipment;
- Meteoceanographic data;
- Installation Positioning;
- Type of floor that separates the decks;
- Composition of flammable or combustible fluids;
- Degree of confinement and congestion of areas;
- Quantity of equipment, components and lines that constitute sources of leakage;
- Capacity of drainage and depressurizing systems;
- Accidental scenarios identified in the APR involving explosion scenarios;
- Plant classification of areas;
- Structural arrangement.

6.9.6 ESCAPE, EVACUATION AND RESCUE STUDY (EERA)

6.9.6.1 Aspects whose changes may impact the findings of the study:

- Positioning of the main escape routes;
- Positioning of secondary escape routes;
- Positioning of meeting points and abandonment points;
- Evacuation and rescue resources;
- Accidental scenarios evaluated in the consequence studies;
- Types of ladder and access of environments;
- POB of the Installation;
- Starting time of fire-fighting systems;
- Environment protected by CO_2.

6.9.7 FLARE GAS RADIATION AND DISPERSION STUDY

6.9.7.1 Aspects whose changes may impact the findings of the study:

- Flammable product inventory between insulated passages;
- Meteoceanographic data;
- Installation Positioning;
- Process plant depressurizing time;
- Logic of process plant depressurizing;
- Position and height of the flare;
- Type flare of used;
- Height of the points most sensitive to the incidence of flare radiation;

- Heat shield installation data;
- Flare capacity;
- Flare stages;
- Composition of released gases.

6.9.8 DROPPED OBJECTS STUDY

6.9.8.1 Aspects whose changes may impact the findings of the study:

- Position of the Main Safety Functions;
- Design of protection systems for structures, equipment and accessories;
- Load movement routes;
- Positioning of cranes;
- Crane capacity;
- Accidental scenarios identified in the PRA that involve falling loads;
- General Arrangement;
- Subsea arrangement;
- Characteristics of the loads involved in the operations;
- Frequency of operation of movement of loads;
- Meteoceanographic data;
- Installation Positioning.

6.9.9 SHIP COLLISION ANALYSIS

6.9.9.1 Aspects whose changes may impact the findings of the study:

- Position of the Main Security Functions;
- Positioning of embarkation stations, primary structures of the riser counter, riser lines, anchor lines;
- Offloading station positioning;
- Accidental scenarios identified in the PRA involving vessel collision;
- Anchorage plan;
- Subsea arrangement;
- Meteoceanographic data:
- Installation Positioning.

6.9.10 VIBRATION AND NOISE ANALYSIS

6.9.10.1 Aspects whose changes may impact the findings of the study:

- General arrangement and arrangement of the habitable environments of the Installation;

- Quantity of equipment that contributes to the noise level;
- Change in the characteristic of the equipment that lead to increase of the sound power;
- Constructive characteristics of structures, floors, walls and bulkheads;
- HVAC equipment and ducts;
- Meteoceanographic data;
- Sound power of alarm systems.

6.9.11 HELIDECKS SAFE USE STUDY

6.9.11.1 Aspects whose changes may impact the findings of the study:

- Meteoceanographic data;
- Installation Positioning;
- Positioning of the helideck and nearby obstacles such as the structures of the accommodation;
- Geometry and physical arrangement of the helideck;
- General arrangement and detailed arrangement of the region near the helideck;
- Position, diameter and height of Vents and discharge of internal combustion engines, mainly turbogenerators;
- Velocity, composition and temperature of fluids in the discharge of vents, vent post and discharges in the region near the helideck.

6.9.12 ESCALATION ANALYSIS DUE TO COLLAPSE OF EQUIPMENT AND PIPING UNDER FIRE

6.9.12.1 Aspects whose changes may impact the findings of the study:

- Flammable product inventory between isolated segments;
- Arrangement of equipment;
- Meteoceanographic data;
- Installation Positioning;
- Process plant depressurizing time, including BDVs FOs diameter modifications;
- Containments barriers;
- Drainage points;
- Type of floor that separates the decks;
- Composition of flammable fluids;
- Degree of confinement and congestion of areas;

- Quantity of equipment, components and lines that constitute sources of leakage;
- Capacity of drainage and depressurising systems;
- Positioning of SDVs and BDVs;
- SDVs closing times;
- Mechanical loading of structures;
- The amount of ignition sources;
- Positioning of CSIs;
- Accidental scenarios identified in the Preliminary Risk Analysis (APR) that involve the effects of fire and smoke dispersion;
- Structural arrangement;
- Sequencing of risers on riser balcony
- Inclusion of equipment handling hydrocarbon regardless of phase and combustible liquids and/or inflammable;
- Change of equipment handling hydrocarbon regardless of phase and combustible liquids and/or inflammable material, spec, outer diameter, thickness, operational pressure, operational temperature and design code;
- Addition of Isolated piping segments between SDVs, check valves or control valves (therefore, non-depressurizing), containing liquid fluid and/or flammable gas, which inventory is higher than 100 kg;
- Change of piping material, spec, outer/inner diameter, thickness, operational pressure and operational temperature;
- Inclusion/removal of PSVs, PRVs, and others relieve system on equipment/piping;
- Change on physical-chemical operational streams properties;
- Addition of personal protection (PP) and/or heat containment (HC) on equipment and/or piping.

6.9.13 CO2 HIGH CONTENT GAS LEAKAGE – EMBRITTLEMENT STUDY

6.9.13.1 Aspects whose changes may impact the findings of the study:

- Arrangement of equipment;
- Containments barriers;
- Change on physical-chemical operational streams properties that have 50%, or more, of CO_2 on the composition and pressure of 50 barg, or higher;
- Positioning of SDVs;
- Mechanical loading of structures;

- Positioning of MSFs and CSIs;
- Accidental scenarios identified in the Preliminary HAZARD Analysis (PHA) that involve CO_2 high content gas leakage;
- Structural arrangement;
- Sequencing of risers on riser balcony;
- Quantity of equipment, components and lines that constitute sources of leakage.

6.9.14 FIRE DETECTORS IN OPEN AREAS OF OFFSHORE PRODUCTION UNITS – FLAME AND FUSIBLE PLUG

6.9.14.1 Aspects whose changes may impact the findings of the study:

- Degree of confinement and congestion of areas;
- Equipment layout and mounting;
- Arrangement and positioning of containment barriers, or coamings, for flammable or combustible products and also chemical products;
- Load handling equipment positioning;
- Position of escape routes;
- Type of flame detector;
- Equipment with water deluge;
- Inclusion/removal of piping areas, PSVs areas on the fire zone.

6.9.15 RISK ASSESSMENT

6.9.15.1 Aspects whose changes may impact the findings of the study:

- Impairment frequencies of MSFs on the Fire Propagation and Smoke Dispersion Study;
- Impairment frequencies of MSFs on the Explosion Study;
- Impairment frequencies of MSFs on the Ship Collision Study;
- Impairment frequencies of MSFs on the Dropped Objects and Swinging Loads Study;
- Impairment frequencies of MSFs on the Gas Dispersion Study;
- Impairment frequencies of MSFs on the CO_2 High Content Gas Leakage - Embrittlement Study.

7. REQUIREMENTS FOR MEETINGS

7.1 The follow-up meetings shall follow the guidelines below.

7.1.1 Monitoring of the safety studies Management of change process shall be carried out by the team of the Designer with Petrobras participation in the cases mentioned in this specification.

7.1.2 Monitoring meetings shall be held at the designer's premises. The meeting local may be changed by common agreement between the parties involved. Petrobras, at its discretion, may attend meetings by videoconference.

7.1.3 The meeting minutes shall be drawn up by the Designer.

7.2 Planning Meeting

7.2.1 Meeting aimed at clarifying aspects related to the Management of change process and the impact on safety studies, evaluation and necessary adjustments in the work schedule and resources required to carry out the process, in which the minimum content should be:

7.2.1.1 Safety briefing - (Designer);

7.2.1.2 Clarifications on objectives, process systematic and requirements (Designer and Petrobras);

7.2.1.3 Presentation of the focal points of each involved part;

7.2.1.4 Presentation of the planned schedule for the systemization of the process according to the project schedule (Designer);

7.2.1.5 Definition of locations, resources needed and duration of follow-up meetings (Designer and Study Performer).

7.2.2 Participants in the planning meeting: The focal points of the parties involved, the Study Executives involved, and the designers' disciplinary leaders responsible for the follow-up of the study should be involved.

7.2.3 The schedule should include a period of 10 working days for comments on the final report by Petrobras and a 10-working-day period for the implementation of these comments by the Designer.

7.2.4 The planning meeting shall take place before the start of the first project safety study.

7.3 Presentation of the Management of change Report

7.3.1 Meeting to present the report before its issuance to Petrobras. The final report is the responsibility of the Designer.

7.3.2 The focal points of involved parties and discipline leader of the designer and Petrobras in charge of process monitoring shall take part in the report presentation meetings.

8. MANAGEMENT OF CHANGE REPORTS

8.1 The report shall be issued in Portuguese (mandatory) and in English (optional, if required by the technical management of the project).

8.2 The report shall include evidence of the application of the Management of change process throughout the development of the project and the treatment of any recommendations generated. The codification of the report and its stamp shall identify the Designer as the document issuer. The coding shall be in accordance with Petrobras N-1710 and the format in accordance with N-381.

8.3 The minutes of the meetings shall be prepared by the Designer and presented in an annex, especially those that have validation of the methodology steps.

8.3.1 The report shall contain at least, the requirements:

- Executive summary;
- Introduction;
- Objective;
- Reference documents;
- Description of the installation;
- Description of the process of Management of change of the safety studies of the designer;
- List of safety studies and technical documentation, with the respective review, used for the execution of each study and the mapping of design changes and their development in safety studies;
- Result of applying the methodology and evaluation for each safety study;
- Record of treatment given to changes and risks arising from them;
- Conclusions;
- Annexes.

8.4 The contractor's Management of change system should enable the issuance of partial reports for consultation by Petrobras at any time. Annex I presents, for information purposes, an example of a Management of change record for safety studies.

9. DEADLINES

9.1 According to the complexity of the project, the scope of the studies and the deadlines established in the agreement shall be defined by the designer, in agreement with the safety studies performer and Petrobras, the deadlines required for safety study Management of change and issuance of the final report. These deadlines should be included in the project schedule.

10. INFORMATION SECURITY

10.1 In addition to the provisions of the Safety Engineering Guidelines [1], the Project Designer and the Study Performer shall have a data security system that guarantees 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.

11. REFERENCE DOCUMENTS

[1]I-DR-ENGP-M-I-1.3 – Safety Engineering Guidelines

ANNEX I

Annex I provides an example of the Management of change record format for safety studies. The Designer has autonomy to present a report or systematic that provides for the issuance in a format different from the presented one as long as it meets the requirements presented in this Technical Specification.