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1. INTRODUCTION

1.1 Safety studies, which include hazard identification, risk analysis and consequence analysis, focus on the safety of people, asset, the environment, and the company image, with recommendations to reduce the frequency of accidental scenarios and/or reduce the associated damages, in order to meet the risk tolerance criteria established for the project.

1.2 The Offshore Stationary Production Units (hereinafter referred to as the Unit) project shall be inherently safer and, during risk analysis, appropriate preventive measures shall be taken. A management program of recommendations applied to the phases of execution of the engineering undertaking shall ensure that all recommendations made during the basic design, executive and pre-operation phases are adequately addressed, implemented, and evidenced.

1.3 The recommendations management is a systematic and continuous process that identifies, evaluates, and treats the implementation of the recommendations generated in the various safety studies carried out throughout the phases of the project, considering the multidisciplinary character in the management.

2. OBJECTIVES

2.1 This technical specification has the following objectives:

2.1.1 Define scope, methodology and criteria for the implementation of the safety studies recommendations management program during basic design, executive design, construction, assembly, commissioning, and pre-operation phases of the Unit, in order to ensure that all the recommendations generated during the project are implemented or dealt with.

2.1.2 Guide the planning and monitoring of the safety studies recommendations implementation issued during the various phases of the project until the beginning of operation of the Unit.

2.1.3 Define the standardization, content and minimum requirements that shall be presented by the safety studies recommendations management process.

3. SCOPE

3.1 The safety studies recommendations management of a Unit shall be an ongoing process, part of the technical management of a project, and not only a report that evidences the application of an evaluation at a certain moment of the project. This process must be systematically applied in the various stages of the project, in a traceable and recordable manner, ensuring, at any time during project execution, that these recommendations, and all aspects related to them, can be audited by Petrobras and external bodies.

3.2 The recommendations management shall ensure that all recommendations generated by the safety studies are addressed until the start of the operation of the Unit.

3.3 The recommendations management methodology shall provide the issuance of reports (see item 8) that show, at any time, the actions developed and/or under development throughout the project phases, with defined deadlines, in order to address all recommendations. A

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closeout report shall be issued at the end of the contract of the company responsible for the Unit project, as established in item 9 of this TS and submitted to Petrobras for approval.

3.4 Since the Unit’s project is multidisciplinary, the actions to treat or implement the recommendations must be known to the disciplines impacted by them. Thus, there shall be an information management system that maps to each recommendation which disciplines will be responsible for its implementation.

4. ABBREVIATIONS AND DEFINITIONS

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

4.2 ABBREVIATIONS:

4.2.1 ANP – National Oil Agency, Natural Gas and Biofuels.

4.2.2 PHA - Preliminary Hazard Analysis.

4.2.3 CLP – Programmable Logic Controller.

4.2.4 DAL – *Dimensioning Accidental Load*.

4.2.5 DCBI – Locking Devices.

4.2.6 DCN – *Design Change Notice*.

4.2.7 ECN – *Engineering Change Notice*.

4.2.8 TS – Technical Specification.

4.2.9 FEN – *Field Engineering Notice*.

4.2.10 HULL – Hull and systems that make it up, Unit.

4.2.11 P&ID – Piping and Instrumentation Diagram.

4.2.12 PFD – Process Flow Diagram.

4.2.13 PFP – Passive Fire Protection.

4.2.14 SMP – Request for Project Modification.

4.2.15 TQF – *Technical Query Form*.

4.2.16 TAP – Acceptance and Performance Test.

4.3 DEFINITIONS:

4.3.1 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.

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4.3.2 Discipline - Branch of technically specialized engineering in each subject. 4.3.3 Study executor - 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 workforce. 4.3.4 Safety Studies - All studies of hazard identification and risk analysis, consequence studies and other complementary safety studies carried out in the project. 4.3.5 Frequency - Physical quantity indicating the number of occurrences of an event in a given time interval. 4.3.6 Main Safety Functions (FPS) – Function that a safety item shall fulfill to make possible and/or to ensure the availability of the emergency response strategy, escape and abandonment of the Unit during an accidental event. These main functions are defined on the Safety Engineering Guidelines and shall be available for the period of 1 (one) hour after the beginning of the incident. 4.3.7 Integrator - Company responsible for joining all Unit systems, with the function of managing all the recommendations generated in the various phases of a Unit's design. 4.3.8 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 persons, environment, asset or image of the Company. 4.3.9 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 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. 4.3.10 Recommendations - Proposed measures to reduce the likelihood of an accidental scenario or to mitigate its consequences whenever existing safeguards are considered insufficient. 4.3.11 Close Out Report - Final report on the management of safety studies recommendations for each project phase. This report shall reflect the management of the recommendations of the safety studies, evidencing the implementation of the recommendations and technical justifications of those not implemented. 4.3.12 Partial Reporting of Recommendations - Reports issued periodically or on demand from Petrobras to follow up on the management of recommendations of the project safety studies. 4.3.13 Risk - Combination of the expected frequency of occurrence of a scenario with the severity of its consequence. 5. RESPONSABILITIES 5.1 It is the responsibility of the designer / integrator to consider the changes that have occurred in the various phases of the project that can impact the safety studies, performing the					

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management of those changes according to the reference [1], and keeping the recommendations management process updated accordingly.

5.2 The designer / integrator shall follow up the implementation of the recommendations of the other parties involved in the project (example: module contractor, HULL, subsea and other project contracts), ensuring compliance with the requirements established in this TS.

6. METHODOLOGY AND CRITERIA

6.1 The safety studies recommendations management of a Unit shall be an ongoing process, part of the technical management of a project, and not only a report that evidences the application of an evaluation at a certain moment of the project. This process shall be systematically applied in the various stages of the project, in a traceable, registrable, and auditable way, ensuring, at any time during project execution, that these recommendations, and all aspects related to them, can be audited by Petrobras and outside.

6.2 The management of recommendations shall ensure that all recommendations generated by the safety studies are addressed until the start of the operation of the Unit.

6.3 The methodology for the management of recommendations shall provide for the issuance of reports (see item 7) that show, at any time, the actions developed and/or under development throughout the project phases, with defined deadlines, in order to address all recommendations. A closeout report shall be issued after all the recommendations have been handled by the company responsible for this management, as established in item 8 of this TS, and submitted to Petrobras for approval.

6.4 There shall be an information management system that maps to each recommendation which disciplines will be responsible for its implementation.

6.5 The process of management of safety studies recommendations shall start from the beginning of the first project safety study, usually PHA or HAZOP, and shall be followed up until the conclusion of the designer's contract for all phases of the project.

6.6 The recommendations management process shall consider the changes that have occurred in the various phases of the project that may impact the safety studies, carry out the management of those changes according to the reference [1], and keep the recommendations management program updated accordingly.

6.7 The recommendations of the safety studies shall have the following status:

6.7.1 Implemented;

6.7.2 In Progress, or

6.7.3 Justified.

6.8 The use of the term "canceled" is prohibited.

6.9 Recommendations that are not implemented shall have a technical justification that establishes the impracticability of implementing the recommendation and ensures that the project has sufficient layers of protection to mitigate the risk identified in the risk analysis.

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In addition, these recommendations shall have the status of "Justified" and the technical evaluation proving this justification shall be present in the recommendations management system. 6.10In the case of "In Progress" recommendations, the actions already performed and pending actions that intend to implement or justify the recommendation shall be highlighted. In this case, the provisions of item 6.1of this specification may also be used. 6.11As inputs to the management of safety studies recommendations, the following shall be considered: 6.11.1 Reports of safety studies issued at each stage of the enterprise. 6.11.2 Design documents with their respective revision, including the documentation "as built". 6.11.3 Documents related to project and field change (SMP, TQF, DCNs, ECNs, FENs). 6.11.4 Commissioning documents (TAP, functional test reports, etc.). 6.12 All recommendations that are not addressed in a project phase shall be addressed in the next phase, except for the construction, assembly, commissioning, and pre-operation phase where all recommendations shall be addressed. 6.13 Recommendations from previous revisions of the same report that do not remain in the most updated revisions of the studies, shall have the status of “Justified” and follow the contents of items 6.9 and 6.14 of this TS (ex: fire propagation study evolution from revision A to B). 6.14 The evidence / justifications shall follow the requirements described below. 6.14.1 The evidence of implementation and justifications for non-implementation of safety study recommendations shall be submitted to Petrobras. 6.14.2 The justifications for failure to implement recommendations shall be supported by technical assessments that evidence that the identified risks have been properly addressed. 6.14.3 For recommendations indicating the need for additional project evaluations or verifications, a technical document shall be issued to demonstrate that the necessary assessments are carried out. 6.14.4 Conceptual / Basic / Executive / Project / Construction, Assembly, Commissioning and Pre-Operation In these project phases, the implementation of the recommendations shall be highlighted according, at least, as Table 1.					

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Table 1- Minimum requirements for safety studies recommendations fulfillment.

Impacted Disciplines	Recommendation Type	Evidence of Implementation		
		Project Phase		
		Basic (Basic Design)	Executive (Detailed Design)	Field (Construction, Assembly, Commissioning and Pre-Operation)
Instrumentation/ Automation	Implementation or change in voting logic	P&ID	P&ID AND Cause and Effect Matrix	Presentation of the extract of the programming code that evidences the implementation in the CLP.
Instrumentation/ Automation	Implementation or change in voting logic of safety interlocks	P&ID	P&ID AND Cause and Effect Matrix OR Cause and Effect Matrix of Fire and Gas (Note 1)	Presentation of the extract of the programming code that evidences the implementation in the CLP.
Instrumentation/ Automation	Implementation or change in control logic	P&ID	P&ID AND Cause and Effect Matrix	Presentation of the extract of the programming code that evidences the implementation in the CLP.
Instrumentation/ Automation	Implementation or change in alarms	P&ID	P&ID OR Cause and Effect Matrix OR Cause and Effect Matrix of Fire and Gas (Note 1)	Presentation of the extract of the programming code that evidences the implementation in the CLP.
Instrumentation/ Automation	Implementation or change in interlocks	P&ID	P&ID AND Cause and Effect Matrix	Presentation of the extract of the programming code that evidences the implementation in the CLP.
Safety Instrumentation/ Automation	Installation of fire and gas detectors	Fire and Gas Detection Plan AND Safety Data Sheet	Safety Plan AND Fire and Gas Cause and Effect Matrix AND	Field evidence that coordinates and installation angles are according to those recommended by the gas dispersion study and fire detector location study (the last

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Impacted Disciplines	Recommendation Type	Evidence of Implementation				
		Project Phase				
		Basic (Basic Design)	Executive (Detailed Design)	Field (Construction, Assembly, Commissioning and Pre-Operation)		
			Safety Data Sheet	one required by item 7.2.1.2 of DR-ENGP-M-I-1.3-R.4). AND Evidence that the gas and fire detectors are functional. H ₂ S and H ₂ gas detectors also shall fulfill the contents in Note 5.		
Piping/ Accessories	Installation, relocation or removal of valves	P&ID	P&ID AND Valves/Accessories Data Sheet OR VALVE LIST OR SPECIAL ITEMS LIST (in case of installation of new element)	Pipe run photography.		
Piping/ Accessories	Piping installation, realignment or removal	P&ID	P&ID AND 3D model (snapshot - refer the date of the model)* *in addition to the P&ID, when it is not sufficient to evidence compliance with the recommendation (e.g. valve installed in vertical position)	Pipe run photography.		
Piping/ Accessories	Indication of "Normal" Position of the Valve	P&ID	P&ID	Not applicable.		
Piping/ Accessories	Change of Failure mode of the valve	P&ID	P&ID AND Valve Datasheet	Actuator Photography OR Test Evidence		
Piping/ Accessories	Valve Locking and DCBI	P&ID	P&ID	Photography with the TAG of the valve, highlighting the possibility of valve locking. AND Management control of DCBI from operation highlighting the		

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Impacted Disciplines	Recommendation Type	Evidence of Implementation					
		Project Phase					
		Basic (Basic Design)	Executive (Detailed Design)	Field (Construction, Assembly, Commissioning and Pre-Operation)			
				identified valves on the recommendation, and the respective standard where this control is performed.			
Process Equipment	Equipment Installation	PFD AND P&ID AND Equipment Data Sheet	Mass&Energy Balance AND P&ID AND Equipment Data Sheet	Photography with equipment's identification number.			
Operational	Operational Procedure	In this phase of project, this type of recommendation shall be transferred to the executive phase of the project for implementation.	It shall be requested to Petrobras the procedure code approved on SINPEP and the item where it was implemented.	Not applicable			
Operational	Operation Manual	In this phase of project, this type of recommendation shall be transferred to the executive phase of the project for implementation, if the recommendation is not applicable on this phase of project.	It shall be presented the manual's code and the item where it was implemented.	Not applicable			
Operational	Maintenance Requirement	In this phase of project, this type of recommendation shall be transferred to the executive phase of the project for implementation, if the recommendation is not applicable on this phase.	It shall be requested to Petrobras the maintenance plan registered at SAP.	Not applicable			
Architecture Safety Piping Structures	PFP Application	<u>Structures, Equipment Supports and Bulkheads</u> Structural design with the structural elements highlighted that shall receive PFP, as well as the indication of the protection rating	<u>Structures, Equipment Supports and Bulkheads</u> Structural plants with the structural elements highlighted that shall receive PFP, as well as the indication of the protection rating (ex: -15, J-60, H-30, H-60, etc.).	Note 2 Note 3 Note 4			

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Impacted Disciplines	Recommendation Type	Evidence of Implementation		
		Project Phase		
		Basic (Basic Design)	Executive (Detailed Design)	Field (Construction, Assembly, Commissioning and Pre-Operation)
		(ex: -15, J-60, H-30, H-60, etc.). <u>Valves</u> Valve datasheet highlighting the applied kind of material, as well as the PFP rating (ex: J-15, J-60, etc.). <u>Piping</u> P&IDs where piping is located with highlight of the segments that shall receive PFP, as well as the PFP rating (ex: J-15, J-60, etc.).	<u>Valves</u> Valve datasheet highlighting the applied kind of material, as well as the PFP rating (ex: J-15, J-60, etc.). <u>Piping</u> Isometrics plants where piping is located with highlight of the segments that shall receive PFP, as well as the PFP rating (ex: J-15, J-60, etc.).	
Safety Piping Structures Equipment	Explosion loads and triangular impulses verification on safety functions	Calculation report proving that the safety functions were evaluated for the explosion loads or triangular impulses calculated on the explosion study of the unit.	Calculation report proving that the safety functions were evaluated for the explosion loads or triangular impulses calculated on the explosion study of the unit.	Not applicable.

Note 1 - Applicable for gas, fire or smoke detectors.
Note 2 - Structures, Equipment Supports and Bulkheads
Passive fire protection certificate, fulfilling, at least, the displaced on Annex II – Minimum Requisites for Passive Fire Protection Certificate – of this TS; Field evaluation report containing the thickness measurements of the applied material, highlighting the number of applications, number of measurements, local applied and the evaluation responsible signature, issued by the project field inspection team.
Note 3 – Valves
Passive fire protection certificate, fulfilling, at least, the displaced on Annex II – Minimum Requisites for Passive Fire Protection Certificate – of this TS; Field evaluation report highlighting that the type of applied material is accordingly and signed by the report responsible, issued by the project field inspection team with the protected valve identified.
Note 4 - Piping
Passive fire protection certificate, fulfilling, at least, the displaced on Annex II – Minimum Requisites for Passive Fire Protection Certificate – of this TS; Field evaluation report highlighting that the type of applied material is accordingly and signed by the report responsible, issued by the project field inspection team with the protected piping identified.
Note 5 – In case of H ₂ S and H ₂ gas detectors, there also shall be evidenced that the detector's cells are within the validity date.

The cases not foreseen on Table 1 shall be previously consulted and aligned with Petrobras before their implementation.

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6.15 The management of recommendations for safety studies shall be carried out by qualified personnel, who shall determine the impacts on the various disciplines responsible for the implementation/justification of the recommendations. 6.16 The computerized system of item 6.18 shall allow Petrobras to extract reports, as well as consult the various necessary information related to them at any time. 6.17 The minimum information of the recommendations to be considered by the computerized system are: 6.17.1 Identification (number); 6.17.2 Project Phase (that the recommendation was originated); 6.17.3 Implementation Phase 6.17.4 Description; 6.17.5 Report Title; 6.17.6 Report Number; 6.17.7 Scenario / node; 6.17.8 Status (see item 7.3); 6.17.9 Deadline; 6.17.10 Associated System (ex: injection system, gas lift system, oil treatment system, etc.); 6.17.11 Company/subcontractor responsible for implementation; 6.17.12 Disciplines responsible for implementation; 6.17.13 Evidence of implementation or justification. 6.18 The computerized system also shall provide a control of the PFP recommend by the safety studies of the unit (see example on item 14 of this TS), containing, at least, the following information: 6.18.1 PFP application location (ex: M-09 – EL. 51.400 mm); 6.18.2 Element that shall receive the PFP (ex: BDV, SDV, piping, structure, bulkhead, etc.); 6.18.3 Project reference documents that contain the indication of PFP application (ex: structural drawing, valve data sheet, P&ID, etc.); 6.18.4 Field evaluation report containing the thickness measurements of applied PFP (applicable only in case of PFP application of intumescent coatings or equivalents, and in the phases of Construction, Assembly and Pre-Operation);						

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6.18.5 Document origin of the need of PFP application (ex: safety guideline, fire propagation study, elastoplastic analysis, standard, etc.); 6.18.6 PFP applied area, in m²; 6.18.7 PFP total applied weight, in kg; 6.18.8 PFP classification (ex: Jet Fire (J) or Pool Fire (H)); 6.18.9 PFP resistance protection time, in minutes; 6.18.10 Type of applied PFP (ex: intumescent coating, blanket, etc.); 6.18.11 Data from PFP test fire certificate, containing, at least, the following information (applicable only in case of PFP application of intumescent coatings or equivalents, and in the phases of Construction, Assembly and Pre-Operation): 6.18.11.1 Certificate number; 6.18.11.2 Certification entity; 6.18.11.3 Type of fire the PFP was certificate; 6.18.11.4 Resistance time which the PFP was certificate; 6.18.11.5 Standard used in the test for the PFP certification; 6.18.11.6 Certificate expiration date. 6.19A web-based computerized system with password and encryption must be provided that allows permanent access by Petrobras accredited personnel. 6.19.1 It is responsibility of the company contractually responsible for the management of recommendations that, at the end of the project phase, transfers the information contained in its database to the Petrobras database. 6.19.2 It is also responsibility to request from Petrobras the technical information necessary to ensure compatibility between your database and that of Petrobras so that data transfer can be performed. 7. MANAGEMENT REPORTS OF RECOMMENDATIONS 7.1 The management system of the contractor's recommendations shall enable the issuance of partial reports for consultations by Petrobras at any time. 7.2 The report shall be issued in Portuguese (mandatory) and in English, in accordance with the official language of the project. 7.3 The report shall include evidence of the implementation of the management of recommendations throughout project development, treatment of recommendations and evidence / justification. The codification of the report and its stamp must identify the						

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Designer as the issuer of the document. The coding shall be in accordance with reference [2] and the format in accordance with reference [3]. 7.4 The Report contains at least the requirements: 7.4.1 Executive Summary; 7.4.2 Introduction; 7.4.3 Objective; 7.4.4 Reference Documents; 7.4.5 Description of the management process of the recommendations of the safety studies of the designer; 7.4.6 Statistical treatment of recommendations containing at least the following data and graphs: 7.4.6.1 Recommendations per project phase; 7.4.6.2 Recommendations by type of study (by project phase and general); 7.4.6.3 Recommendations implemented and justified; 7.4.6.4 Recommendations by managers (companies/Petrobras); 7.4.6.5 Indicator of recommendations implemented according to the formula below: $\frac{(NREI + NRNJ) * 100}{NTRI}$ NREI – Number of recommendations with implementation evidences NRNJ – Number of Justified Recommendations NTRI – Total number of recommendations with proper implementation in the current phase Note: The "Implemented Alternative" recommendations shall be considered as NREI in this calculation. 7.4.7 Annexes with lists of treatment records of safety study recommendations containing at least: 7.4.7.1 Item (sequential indicator); 7.4.7.2 Project Phase; 7.4.7.3 Identification Code of the Study Report/Analysis with identification of the review; 7.4.7.4 Title of the Study/Analysis Report;			

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7.4.7.5 Number of the Recommendation;

7.4.7.6 Description of the Recommendation;

7.4.7.7 Responsible for Implementation (responsible company and responsible discipline);

7.4.7.8 Deadline for implementation;

7.4.7.9 Date of implementation;

7.4.7.10 Status of the Implementation;

7.4.7.11 Associated System (ex: injection system, gas lift system, oil treatment system, etc.);

7.4.7.12 Observations;

7.4.7.13 Evidence of Implementation or Justification of Non-Implementation (photographic records shall not be presented in the report);

7.4.7.14 Amended Documents according to Recommendation (with identification of the revision containing the change of affected documents).

7.4.8 Item 12 contains an example from the list in item 7.4.7;

7.4.9 Annex containing the control of the PFP recommend by the safety studies of the unit, containing, at least, the described on item 6.18 of this TS.

8. FINAL REPORT OF RECOMMENDANTIONS (Close Out Report)

8.1 The contractor shall issue at the end of the Unit project a final report with the contents of item 7.

9. DEADLINES

9.1 According to the complexity of the project, the scope of the study and the deadlines established in the contract, it must be defined by the designer, in agreement with the Petrobras, the deadlines required for the implementation of safety studies recommendations.

10. INFORMATION SECURITY

10.1 In addition to the disposed on Safety Guidelines of the project [4], the Project Designer and the Study Performer must 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 must be preserved against accidental or information security events for at least five years.

11. REFERENCE DOCUMENTS

[1] I-ET-3000.00-5400-947-P4X-001- Management of Change for Safety Studies.

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[2] Petrobras Standard - N-1710 – Technical Engineering Documents Codification

[3] Petrobras Standard- N-381 - Drawing Execution and Others Technical General Documents

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

12. ANNEX I – Safety Studies Recommendations Verification Control



 Annex I - Safety Studies Recommend

13. ANNEX II – Minimum Requisites for PFP Certificate

Certificates to be presented for Petrobras verification shall contain, at least, the following information, which shall be presented for Petrobras approval before the installation of the PFP:

- Shall be “Certificate of Fire Approval” or “Type Approval Certificate”;
- Shall contain the type of fire which the PFP was tested to be certificated (ex: jet fire, hydrocarbon fire, or both);
- Shall contain the standard which fire test was performed (ex: ISO 22.899 –1, UL 1.709, etc.);
- Shall be within the expiration date;
- Shall have name and signature of the responsible person to issue certificate;
- Shall be issued by an independent certification entity (ex: DNV, Loyds Register, ABS, BSI, etc.);
- When PFP is applied on piping or valves, the certificate shall contain the minimum thickness which do not allow the maximum temperature of protected surface of piping or valve to be heated by the stablshed required time (ex: 25 mm thickness do not allow temperature on protected surface to be higher than 200°C for at least 15 min).

14. ANNEX III - Control of the PFP Recommend by the Safety Studies



 Annex III - Control of the PFP Recomme