PETROBRAS	TECHNICAL SPECIFICATION	No. I-ET-3010.00-5400-433-P4X-001	
	CLIENT:		SHEET: 1 of 22
	JOB:		-
	AREA:		-
SRGE	TITLE: **PASSIVE FIRE PROTECTION SYSTEM**		INTERNAL
			ESUP

MICROSOFT WORD / V.2016I-ET-3010.00-5400-433-P4X-001_H.DOC

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SUMMARY

1SCOPE

This document establishes the minimum technical requirements for the design of Passive Fire Protection (PFP) systems for offshore units.

The CONTRACTOR shall incorporate the total set of the additional requirements for ensuring the supply and assembly of reliable, safe and functional systems.

Detailing Design shall be developed in accordance with the requirements herein established. Any modifications have to be submitted to PETROBRAS for approval prior to implementation.

2ABBREVIATIONS AND DEFINITIONS

2.1 Abbreviations

The following abbreviations and definitions are applicable:

- BDV: Blowdown Valves;
- BSDV: Boarding Shut Down Valves;
- DPC: Diretoria de Portos e Costas;
- FPSO: Floating Production Storage and Offloading;
- HVAC: Heating, Ventilation and Air Conditioning;
- JF: Jet Fire
- MCT: Multi Cable Transit.
- PFP: Passive Fire Protection;
- SDV: Shut Down Valves;
- TS: Technical Specification.

2.2 Definitions

"A" class division: Division of steel that went through standard fire test for the "A" class (cellulosic material), capable of preventing the passage of flame and smoke for one hour, and when complemented by fireproofing (non-combustible material) ensures that the temperature on the unexposed face does not exceed the predetermined temperatures for a period of time determined (0, 15, 30 e 60 minutes), according to IMO-SOLAS.

"B" class division: Division of non-combustible material, capable of preventing the passage of flame for half hour, keeping the unexposed face within a temperature limit, and when thermally isolated ensures that the average temperature of the unexposed surface, does not exceed the predetermined temperatures for a period of time determined (0 e 15 minutes), according to IMO-SOLAS.

"H" class division: Attend the same criteria of the bulkhead type A (IMO-SOLAS), except for the standard fire tests, which are done using the heat curves for hydrocarbons (Class H), and is capable of preventing the ingress of fire, gas

and smoke for two hours. In this case, fireproofing shall provide a consistent protection of fire radiation in hydrocarbons pool fire and explosion.

"J" class division: Attend the same criteria of the bulkhead type H, except for fireproofing, which shall confer a consistent protection with jet fire about the same.

"J+H" or "H+J" class division: Attend the same criteria of the bulkheads type J and H.

Passive Fire Protection (PFP):

Coating or cladding arrangement or free-standing system which, in the event of fire, will provide thermal protection to restrict the rate at which heat is transmitted to the object or area being protected. (ISO 13702)

Fireproofing:

A systematic process, including design, material selection, and the application of materials, which provides a degree of fire resistance for protected substrates and assemblies. (API 2218)

3APPLICABLE REGULATIONS, CODES AND STANDARDS

The design criteria herein established are guidance for the application of the Standards and Recommendations included in this chapter and/or as additional requirements.

In case of items in conflict with this document, PETROBRAS shall be consulted.

- Applicable Labor Ministry Regulations (MTE) - Regulating Standards – NRs**;**
- BS EN 476-20 - Fire tests on building materials and structures — Part 20: Method for determination of the fire resistance of elements of construction (general principles). Appendix D: Hydrocarbon curve.
- BS EN 1363-Part 2 - Fire resistance tests - Part 2: Alternative and additional procedures;
- CLASSIFICATION SOCIETY APPLICABLE STANDARDS;
- DR-ENGP-M-I-1.3 – Safety Engineering Guideline;
- IMO-FTP CODE – RESOLUTION MSC. 307(88) – INTERNATIONAL CODE FOR APPLICATION OF FIRE TEST PROCEDURES – 2010;
- IMO – SOLAS – INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA – 1974, AND AMENDMENTS IN FORCE;
- ISO 834 – Fire resistance tests – Elements of building construction;

- ISO 13702 – PETROLEUM AND NATURAL GAS INDUSTRIES – CONTROL AND MITIGATION OF FIRES AND EXPLOSIONS ON OFFSHORE PRODUCTION INSTALLATIONS – REQUIREMENTS AND GUIDELINES;

- ISO 22.899 – Determination of the Resistance to Jet Fires of Passive Fire Protection Materials – Part 1: General Requirements;

- MODU CODE 2009 – Mobile Code For The Construction And Equipment Of Mobile Offshore Drilling Units, 2009;

- UL 1709 – RAPID RISE FIRE TESTS OF PROTECTION MATERIALS FOR STRUCTURAL STEEL – 1989;

4TECHNICAL REQUIREMENTS

4.1 General

Mandatory safety items as established in the DR-ENGP-M-I-1.3 – Safety Engineering Guideline, listed in item 3, shall be considered complementary requirements to this technical specification. In case of items in conflict with this document, PETROBRAS shall be consulted.

All FIREPROOFING systems shall be approved by a recognized institution and designed according to recognized codes/standards. Certifying requirements for the FIREPROOFING systems are to be in accordance to the requirements of Classification Society of the unit.

PFP is required to:

- Segregate main areas;
- Protect areas/rooms which are vital in emergency situations;
- Protect surrounding from areas/rooms which represent a high risk of fire;
- Ensure structural integrity during dimensioning accidental events;
- Protect process equipment and piping which would lead to intolerable consequences upon failure;
- Protect supports of critical or very heavy/large equipment and piping;
- Protect Safety Systems/functions.

The FPSO structural elements that may be exposed in a fire and where a collapse will cause total or partial damage to the FPSO shall be protected according to the results stated in the FIRE PROPAGATION AND SMOKE DISPERSION ANALYSIS. The identification of these elements shall be reviewed in Detailing Design by means of supplementary study, as required in the DR-ENGP-M-I-1.3.

The fire integrity of bulkheads, decks and load bearing structures of the FPSO shall comply with DR-ENGP-M-I-1.3 – Safety Engineering Guideline, applicable IMO and Classification Society requirements, as listed item 3 of this TS.

CONTRACTOR shall remove all materials containing asbestos from the Unit and assure that the materials are disposed of properly. No new materials containing asbestos shall be used.

4.2 Systems components

The PFP shall comprise the following components:

- Classified divisions, as indicated in the reference documents listed in General Arrangement and required according to the fire risk category defined in Safety Data Sheets;
- On pipelines critical items, which would be exposed to a jet fire emanating from a leaking flanged or clamped connection on adjacent or nearby gas piping;
- On equipment and piping which would lead to intolerable consequences upon failure, using the risks acceptance criteria established in the Fire Propagation and Smoke Dispersion Analysis;
- On open areas firewalls;
- On Upper Riser Balcony Primary Structures and Floor.

4.3 PFP

PFP for structural elements shall be applied on the face exposed to fire hazard and shall cover all surfaces of such exposed elements.

The class of the division will depend on the fire type, fire duration and requirement to the systems protected by the firewall.

The PFP shall be designed to withstand the accidental loads for the area such that adjacent equipment, structures and safety systems can be protected to avoid escalation.

PFP shall be designed considering the local ambiental conditions, according defined in Technical Specification of Metocean Data, as: humidity, intemperate weather (sun, rain, minimum/maximum ambient temperature), exposure to seawater (spray and deluge), and the conditions of maximum and minimum temperature of the fluid in pipe and/or equipment, where relevant.

Rigid type of PFP applied by means of spray system shall not be used on closed-in areas.

Cementitious PFP are not acceptable in opened areas and/or enclosed spaces where there can be sea water accumulation.

Where external surfaces are fitted with rigid type fireproofing, corner beads shall be used or the insulation shall be extended right up to the face of a structural member, to provide mechanical protection and to avoid infiltration of water into the fireproofing material, as indicated in APPENDIX I - RIGID TYPE PFP FINISHING DETAILS. At protruding vertical corners, corner beads are to be installed up to a height of 2.0 meters above the floor level to protect the PFP against impacts.

PFP for main load bearing structural elements shall be designed so as to withstand a fire condition as given on the test requirements on the standards on item 3 of this TS, according to the type o fire, and considering the maximum steel design temperature or the heat input as derived from the in the Fire Propagation Study. The resulting insulation thickness required for ensuring such protection shall also comply with the Classification Society requirements and are to be submitted to PETROBRAS for approval.

For structural profiles other than the tested sample, the same thickness of PFP may be adopted, whenever the ratio "Hp/A" (element perimeter divided by its cross-sectional area) is less than or equal to that one of test sample. Special considerations shall be adopted to structural bulkheads and decks.

The profile shapes used as structural elements which are to be insulated shall be selected in such a manner as to help the PFP application.

Welding type and procedures for fixing devices of fireproofing to FPSO structural elements shall be submitted to PETROBRAS approval, according to the Topsides Structural Requirements.

Since epoxy-based PFP may not be defined as a non-combustible material, its application is allowable in external locations only, where personnel are not normally present. Nevertheless, the application is to be approved by the Administration Flag and the Classification Society during the Detailing Design.

When the adoption of PFP epoxy based, the coating is required to have adequate proprieties to avoid corrosion of the element in a CX atmosphere (ISO12.944-2) and the instructions manual of application issued by the paint manufacturer shall be followed, as well as a certified application report shall be issued. The applied thickness shall be evidenced in the application report for each protected element according to the design requirement. The maintenance required, as well as the lifetime of the PFP, shall be such that minimize gaps and damage of possible interventions.

The PFP to be provided shall have acceptable corrosion protection properties.

In case of requirement of cold passive protection in addition to fire protection, the cold protection material shall be below the fire protection, or a dual protection shall be applied.

NOTE: For dual protection, the understanding is a passive protection material that has a certificate for cold and fire passive protection.

In case of intumescent coating, each coating material forming the coating system shall be produced by the same PAINT MANUFACTURER. The intumescent coating shall receive a topcoat resistant to UV.

For intumescent coating, a qualified paint inspector and PFP manufacturer shall supervise the application.

5CLASSIFIED BULKHEADS

5.1 General

Classified bulkheads shall have a fire test certificates that shall comply with the disposed-on item 13 of this TS and be presented for PETROBRAS approval prior to their purchase.

PFP shall be applied on intersecting classified bulkheads thus preventing escalation of the initial fire. At the intersection between an "H" or "A" class division and another division with lesser degree of protection (e.g., A-60 versus A-0), an extended fireproofing of the higher degree class material is to be provided to a distance of at least 1.0 meter beyond this point.

5.2 Classified doors and windows

The number of doors and windows set into classified bulkheads shall be reduced to the minimum and comply with the functional and safety requirements of the FPSO.

The doors and windows installed in classified class bulkheads shall have at least the same classification of the classified bulkhead.

Doors and windows, besides meeting the PFP requirements, shall also comply with those of watertighting, weatherproofing and mechanical operation, depending on the kind of use involved.

Doors and windows facing to the process plant, especially those located in the Accommodations but not limited to them, shall also comply with DALs determined in the explosion analysis of the FPSO. In these cases, a certificate certifying that these elements stand for the required DAL Calculated on the Explosion Study, shall be issued for PETROBRAS approval, prior to the purchase of these items.

PFP doors and windows shall be of the self-closing type.

The installation of doors and windows shall be avoided in bulkheads H60/A60 classes.

The classified windows and doors of the FPSO shall have fire test certificates that shall comply with the disposed-on item 13 of this TS and be presented for PETROBRAS approval prior to their purchase.

6 FIRE STOPS

The number and area of penetrations passing through classified divisions are to be kept to a minimum, by means of the optimization of the pipe, duct and cable routes.

Penetrations for classified divisions are to have fire stops (fire stops seals or MCT) to provide at least the same fire resistance of the partition.

Fire stops components are to be installed in accordance with the requirements of the certification documents.

Divisions penetrations by set of pipes, where the proximity of the individual members makes it hard to use individual sealing devices, shall be done with special fire stops devices, tested and certified by the classification society of the unit.

MCT used for divisions penetrations by electrical cables shall be of easy installation and that allows the removal, replacement or inclusion of cables, without the need of its complete removal and/or device replacement.

The penetrations of structural elements through "H" and "A" class divisions are to be provided with sealing welds. The PFP shall be specified in order to protect the structural element. The extension of PFP shall be determined in order to ensure temperature limitation requirements on the unexposed face of division, as well as the structure integrity.

For penetrations on classified bulkheads, the coat-back shall minimally follow the recommended distance of least 450 mm established on SOLAS, Chapter II-2 - Construction - Fire protection, fire detection and fire extinction - Part C - Suppression of fire - Regulation 9 - Containment of fire.

The extension of the PFP shall comply with the Classification Society requirements and are to be submitted to PETROBRAS approval.

Penetrations for HVAC ducts through classified divisions shall be provided with fireproofing, when applicable, extended beyond the dampers. The fireproofing extension shall comply with Classification Society requirements of the Unit.

The fire stops of the FPSO shall have fire test certificates that shall comply with the disposed-on item 13 of this TS and be presented for PETROBRAS approval prior to their purchase.

7PFP ON STRUCTURAL ELEMENTS

7.1 General

The application of PFP identified in Fire Propagation and Smoke Dispersion Analysis is based upon the loads found in the preliminary studies. This identification shall be reviewed in Detailing Design by means of the

supplementary study, as required in the DR-ENGP-M-I-1.3 – Safety Engineering Guideline.

A minimum coat-back of 450 mm shall be considered when applying PFP on structural elements. If there is a higher value recommended by the Fire Propagation and Smoke Dispersion study executioner or by class or by standard, the more restrictive value shall be used.

7.2 Structural Elements

PFP for the main load bearing of structural elements shall be designed to provide protection for a duration and type of fire necessary to prevent a structural collapse scenario.

7.3 Critical Equipment Supports

PFP for the main load bearing of critical equipment supports shall be designed to provide protection for a duration and type of fire necessary to avoid escalation of the fire scenario.

The PFP on structural elements of the FPSO shall have fire test certificates that shall comply with the disposed-on item 13 of this TS and be presented for PETROBRAS approval prior to their purchase.

The critical temperature to be considered for PFP on structural elements shall be 450°C or less.

7.4 Service conditions

The PFP shall be designed for service in a marine environment, suitable for the design life of 30 years, or more, when specified in the project.

The PFP is required to be suitable for use in an exposed location within the risers' area and shall be suitable for continuous service in the following conditions:

1) Temperature:

   - Minimum/maximum ambient temperature, according to Metocean data;

   - Maximum fluid temperature in pipework;

   - Flare induced temperature rise.

2) Humidity: Up to 100% in highly saliferous conditions.

The PFP shall be designed to prevent the entrapment of moisture, rainwater or seawater from the deluge system, and to ensure that a build-up of flammable gas cannot occur within the enclosures.

The PFP shall be capable of withstanding, at least, the following hazard scenario, unless otherwise required by specific study:

- A hydrocarbon jet fire with properties as derived from the required study. The PFP shall reduce the heat input to the material providing a maximum material core temperature in accordance with supplier's temperature tolerance data.

8PFP ON PIPELINE CRITICAL ITEMS

8.1 General

The largest ignitable hydrocarbon inventory is from the seabed isolation valve to the BSDV at riser hang-off.

The main purpose of the PFP systems, with respect to hydrocarbon hazards, is to prevent significant escalation of a scenario such that the integrity of the FPSO and the safety systems should not be threatened within the time required for safe evacuation. The fireproofing shall ensure protection under the specified service conditions.

A PFP system shall be provided to protect pipeline critical items, such as valves/actuators, piping and connections. In case of the use of enclosures, the system shall be easily removable to allow inspection. The guidelines provided by "typical PFP applications", as required by ISO 13702 - Annex C.4, shall also be considered.

8.1.1 Flexible Risers

The PFP shall be applied on the production and injection lines, import and export gas piping at the riser balcony area. The "J60" PFP division class shall be applied onto the SDV's, comprising the valve and actuator, on the risers hang-off at the balcony area which would be exposed to a jet fire emanating from a leaking flanged or clamped connection on adjacent or nearby gas piping; this application does not depend on the impairment frequency, that is, the requirement is compulsory and deterministic. In this case, applied PFP shall be certified (see item 13) to ensure that valve surface temperature does not reaches 200°C, or the recommended temperature by the valve manufacturer, in 60 minutes.

8.1.2 Hard Pipe Risers

The PFP shall be applied on the production and injection lines, import and export gas piping at the riser balcony area. The "J60" PFP division class shall be applied onto the SDV's, comprising the valve and actuator, on the riser´s top supports at the upper riser balcony area which would be exposed to a jet fire emanating from a leaking flanged or clamped connection on adjacent or nearby gas piping; this application does not depend on the impairment frequency, that is, the requirement is compulsory and deterministic. In this case, applied PFP shall be certified (see item 13) to ensure that valve surface temperature does not reaches 200°C, or the recommended temperature by the valve manufacturer, in 60 minutes.

The SDVs in the process area do not require PFP, considering the safe position for these items in case of fire confirmation.

The PFP shall be designed to withstand the accidental loads estimated for the area such that the risers adjacent to the point of the initial accident scenario can be protected to avoid escalation.

The PFP shall be applied on BDVs with time delay, comprising the valve actuator. The PFP shall be certified to ensure that the valve surface temperature does not reach 200°C, or the recommended temperature by the valve manufacturer, in 15 minutes.

New materials, homologated and certified by the classification society, but not used commercially for offshore industry, shall be submitted to PETROBRAS for approval prior to be applied.

The PFP on pipeline critical items of the FPSO shall have fire test certificates that shall comply with the disposed-on item 13 of this TS and be presented for PETROBRAS approval prior to their purchase.

Intumescent coatings, or similar, and cementitious materials, or similar, shall not be applied on instruments, valves, and their accessories (e.g.: valve actuators, etc.).

8.2 Service conditions

The PFP shall be designed for service in a marine environment, suitable for the design life of 30 years, or more, when specified in the project.

The PFP is required to be suitable for use in an exposed location within the risers' area and shall be suitable for continuous service in the following conditions:

1) Temperature:

   - Minimum/maximum ambient temperature, according to Metocean data;

   - Maximum fluid temperature in pipework;

   - Flare induced temperature rise.

2) Humidity: Up to 100% in highly saliferous conditions.

The PFP shall be designed to prevent the entrapment of moisture, rainwater or seawater from the deluge system, and to ensure that a build-up of flammable gas cannot occur within the enclosures.

The PFP shall be capable of withstanding, at least, the following hazard scenario, unless otherwise required by specific study:

- A hydrocarbon jet fire with properties as derived from the required study. The PFP shall reduce the heat input to the material providing a maximum material core temperature in accordance with supplier's temperature tolerance data.

9PFP ON PIPING ITEMS

9.1 General

Whenever PFP is recommended for piping from the Escalation Analysis Due to Collapse of Equipment and Piping Under Fire and on the FIRE PROPAGATION AND SMOKE DISPERSION ANALYSIS, it shall comply with the items herein this topic. In these cases, the main goal of the fireproofing is to protect piping and associated accessories from collapse due to fire radiation.

It is forbidden to use intumescent coatings, or similar, and cementitious materials or similar in piping accessories such as valves, valves actuators, instruments, etc.

The PFP rating shall be the one recommended on Escalation Analysis Due to Collapse of Equipment and Piping Under Fire.

The PFP shall comply with the critical temperature determined on the Escalation Analysis Due to Collapse of Equipment and Piping Under Fire and on the FIRE PROPAGATION AND SMOKE DISPERSION ANALYSIS, such that the protection critical temperature shall inferior to that indicated on as collapse temperature of the piping on the analysis.

The PFP on piping items shall have fire test certificates that shall comply with the disposed-on item 13 of this TS and be presented for PETROBRAS approval prior to their purchase.

All valves attached to the piping to be protected by PFP shall also be protected by the same PFP rating. In these cases, Fire Tested valves do not need to be protected, as long as, this certification is properly demonstrated and approved by the responsible discipline of PETROBRAS. This is not applicable to time delayed BDVs and BSDVs.

Instruments attached to piping do not need to receive fireproofing.

Intumescent coatings, or similar, and cementitious materials or similar, shall not be applied on instruments, valves and their accessories (e.g.: valve actuators, etc.).

In case of existence of valves by-passes and instruments by-passes on pipes recommended to receive PFP, these items shall also be protected with PFP with the same rating of the one applied on the protected pipe.

Pipes that ramify from a pipe recommended to be protected with PFP, the PFP applied on the recommended line shall be extended to these pipes by 1 (one) meter.

9.2 Service conditions

The PFP shall be designed for service in a marine environment, suitable for the design life of 30 years, or more, when specified in the project.

The PFP is required to be suitable for use in an exposed location within the risers' area and shall be suitable for continuous service in the following conditions:

1) Temperature:

   - Minimum/maximum ambient temperature, according to Metocean data;

   - Maximum fluid temperature in pipework;

   - Flare induced temperature rise.

2) Humidity: Up to 100% in highly saline's conditions.

The PFP shall be designed to prevent the entrapment of moisture, rainwater or seawater from the deluge system, and to ensure that a build-up of flammable gas cannot occur within the enclosures.

10 PFP ON EQUIPMENT

10.1 General

Whenever PFP is recommended for equipment from the Escalation Analysis Due to Collapse of Equipment and Piping Under Fire and on the FIRE PROPAGATION AND SMOKE DISPERSION ANALYSIS, it shall comply with the items herein this topic. In these cases, the main goal of the fireproofing is to protect the equipment from collapse due to fire radiation.

It is forbidden to use intumescent coatings, or similar, and cementitious materials or similar on equipment.

The PFP rating shall be the one recommended on the Escalation Analysis Due to Collapse of Equipment and Piping Under Fire.

The PFP shall comply with the critical temperature determined on the Escalation Analysis Due to Collapse of Equipment and Piping Under Fire, such that the protection critical temperature shall be inferior to that indicated on as collapse temperature of the piping on the analysis.

The PFP on piping items shall have fire test certificates that shall comply with the disposed-on item 13 of this TS and be presented for PETROBRAS approval prior to their purchase.

Instruments attached to the equipment do not need to receive PFP.

10.2 Service conditions

The PFP shall be designed for service in a marine environment, suitable for the design life of 30 years.

The PFP is required to be suitable for use in an exposed location within the risers' area and shall be suitable for continuous service in the following conditions:

1) Temperature:

   - Minimum/maximum ambient temperature, according to Metocean data;

   - Maximum fluid temperature in pipework;

   - Flare induced temperature rise.

2) Humidity: Up to 100% in highly saline's conditions.

The PFP shall be designed to prevent the entrapment of moisture, rainwater or seawater from the deluge system, and to ensure that a build-up of flammable gas cannot occur within the enclosures.

11 FIREWALLS IN OPEN AREAS

11.1 General

Whenever firewalls are provided on the design in open areas to mitigate and/or reduce the impacts of fire scenarios from adjacent open areas, they shall minimally comply with:

- There shall be no openings and/or gaps (horizontal and vertical) on it without being protected by PFP or fire stops. For firewalls located in areas where there is no deck above it, the horizontal fireproofing is not required on the upper side;

- All penetrations on the firewall shall be filled with fire stops according to item 6 of this TS. The coat-back on these penetrations shall follow the recommended distance of least 450 mm established on SOLAS, Chapter II-2 - Construction - Fire protection, fire detection and fire extinction - Part C - Suppression of fire - Regulation 9 - Containment of fire.

- If the firewall intersects a classified bulkhead of lesser degree than J-60 rating, this PFP rating shall extend over the lesser degree bulkhead by at least 1.0 m beyond the point of intersection.

- The firewall shall comply with the blast load calculated on Explosion Study for the area where it is located, and this shall be proved by the test's certificates issued by the classification society;

- Firewalls located between the main deck and the BSDVs deck of the Unit:

- ✓ Shall be J-60 rated on the BSDV deck side;
- ✓ Shall have access doors J-60 classified located throughout the firewall spaced no more than 35 meters from each other;
- ✓ The doors shall comply with 5.2 of this TS and with the blast loads of the Explosion Study which shall be proved by the test's certificates issued by the classifying society;
- ✓ The doors shall open towards the BSDV deck in order to easier the firefighting due to fire scenarios on the BSDV deck;
- ✓ The doors shall be at least 1,00 m wide (free);
- ✓ Access pathways to the doors shall be provided on the coaming areas of the main deck starting from the starboard side main escape route on the main deck, shall be at least 1,00 m wide, 2,10 m high (free) and construction/painting details shall comply with item 4.2 of Escape Route TS I-ET-3010.00-5400-947-P4X-008.

- All PFP used on the firewalls shall have fire test certificates that shall comply with the disposed-on item 13 of this TS and be presented for PETROBRAS approval prior to their purchase.

NOTE: For bulkheads that segregates/protect closed areas from open areas hazards, it shall be followed item 5 of this TS.

11.2 Service conditions

The PFP shall be designed for service in a marine environment, suitable for the design life of 30 years.

The PFP is required to be suitable for use in an exposed location within the risers' area and shall be suitable for continuous service in the following conditions:

1) Temperature:

- Minimum/maximum ambient temperature, according to Metocean data;
- Maximum fluid temperature in pipework;
- Flare induced temperature rise.

2) Humidity: Up to 100% in highly saline's conditions.

The PFP shall be designed to prevent the entrapment of moisture, rainwater or seawater from the deluge system, and to ensure that a build-up of flammable gas cannot occur within the enclosures

12 PFP ON UPPER RISER BALCONY PRIMARY STRUCUTURES AND FLOOR

12.1 GENERAL

All primary structures and floor on the Upper Riser Balcony shall be protected by PFP J-60 rating regardless of the Fire Propagation and Smoke Dispersion Study impairment frequencies. This requirement is compulsory and deterministic.

A minimum coat-back of 450 mm shall be considered when applying PFP on structural elements and floor on this area. If there is a higher value recommended by class or by standard, the more restrictive value shall be used.

All PFP used shall have fire test certificates that shall comply with the disposed-on item 13 of this TS and be presented for PETROBRAS approval prior to their purchase.

12.2 Service conditions

The PFP shall be designed for service in a marine environment, suitable for the design life of 30 years.

The PFP is required to be suitable for use in an exposed location within the risers' area and shall be suitable for continuous service in the following conditions:

1) Temperature:

   - Minimum/maximum ambient temperature, according to Metocean data;

   - Maximum fluid temperature in pipework;

   - Flare induced temperature rise.

2) Humidity: Up to 100% in highly saline's conditions.

The PFP shall be designed to prevent the entrapment of moisture, rainwater or seawater from the deluge system, and to ensure that a build-up of flammable gas cannot occur within the enclosures

13 MINIMUM DOCUMENTS REQUIRED

All PFP system shall have a fire test certificate, which shall be approved by PETROBRAS prior to the purchase of the protection, and it shall have, at least, the following contents:

1) Shall be "Certificate of Fire Approval" or "Type Approval Certificate";

2) Shall contain the type of fire which the PFP was tested to be certificated (ex: jet fire, hydrocarbon fire, or both);

3) Shall contain the standard which fire test was performed (ex: ISO 22.899, UL 1.709, etc.);

4) Shall be within the expiration date;

5) Shall have name and signature of the responsible person to issue certificate;

6) Shall be issued by an independent certification entity (ex: DNV, Loyds Register, ABS, BSI, etc.);

7) 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 stablished required time (ex: 25 mm thickness do not allow temperature on protected surface to be higher than 200°C for at least 15 min).

In case of application of intumescent coating, in construction and assembly phase of the project there also shall be issued a 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.

For other cases of fire protection systems, it shall be issued a field evaluation report attesting that protection and protected elements on site are accordingly to those specified on the fire test certificate, by the protection manufacturer and required on the Fire Propagation and Smoke Dispersion Analysis / Escalation Analysis Due to Collapse of Equipment and Piping Under Fire / DR-ENGP-M-I-1.3 – Safety Engineering Guideline / General Arrangement / Safety Data sheet. The report shall also contain the evaluation responsible signature, issued by the project field inspection team.

A procedure for installation shall be issued by the PFP manufacturer, including all details and equipment required for the applications. The quality plan for execution and inspection testing shall be included at this document.

A log for installation report shall be issued stating the results of inspection and material traceability.

All documents issued shall be a part of a passive protection data book for the UNIT.

14 DESIGN DOCUMENTATION

Detailing Design shall issue documents that include, at least, the following information:

- Architectural plan with classified divisions and structural elements provided with FIREPROOFING;

- Detailed specifications of classified divisions indicating the type of PFP, as well as, doors, windows, square and penetrations and their respective devices;

- Details of construction and installation of classified divisions, their PFP, classified doors and fire stops;

- Specifications of the structural elements, with details of supporting and structural stiffeners required for installations in classified divisions and respective PFP;

- Details of the interfaces between classified divisions, their PFP, fire stops doors, including PFP finishing, in order to ensure the extension of the properties all over the insulated area;

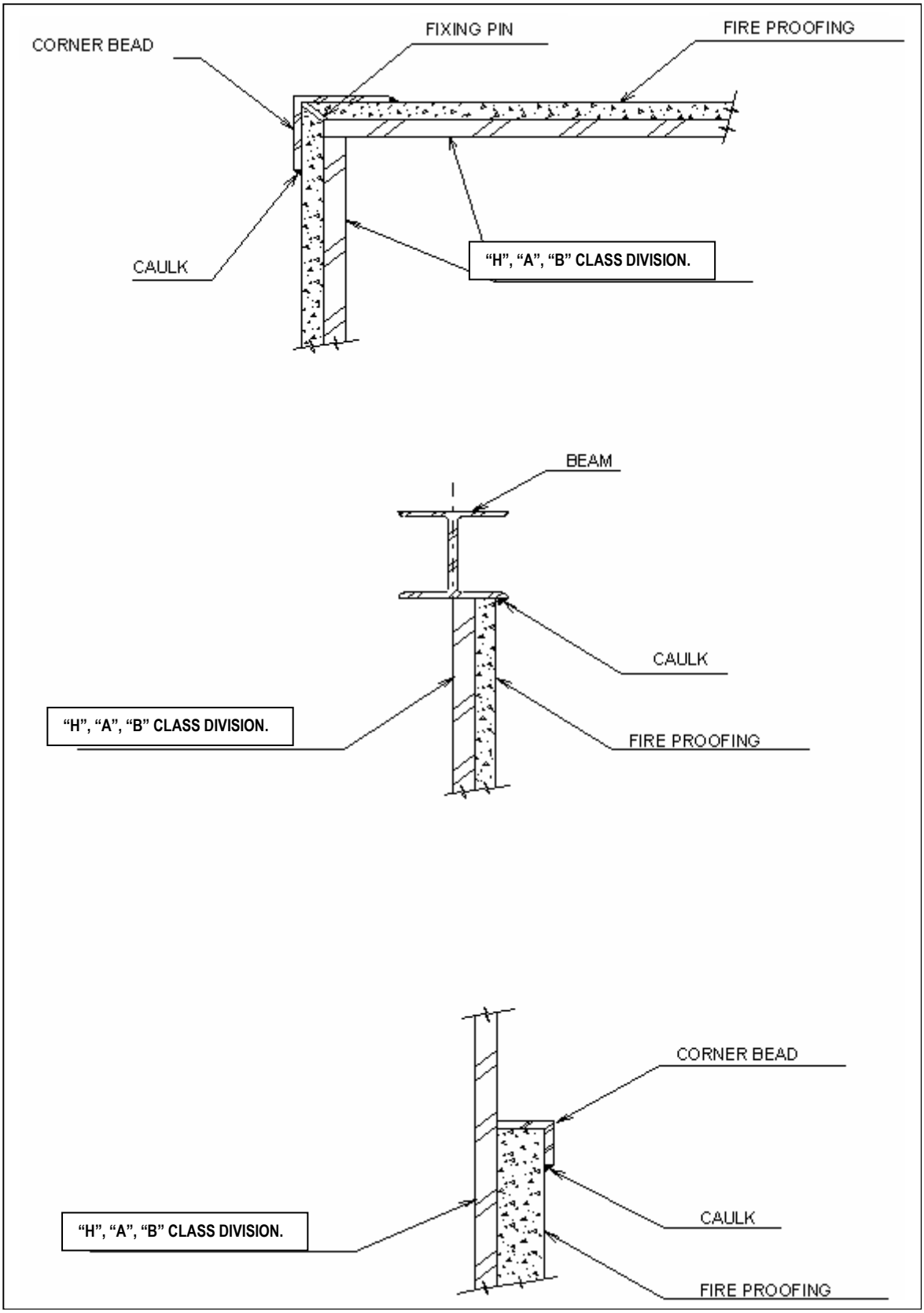
- Drawings of each classified division, giving the respective dimensions, size and type of PFP to be applied, and location plans of all fire stops doors (penetration drawings) installed, indicating applicable construction and installation details;

- List of materials needed for the installation of all the "J", "H", "A" and “B” class divisions, their PFP, classified doors and fire stops;

- A Description Data Book, listing and justifying methods, procedures and solutions adopted, indicating the respective design documents;

- A worksheet having all PFP protection of the installation having, at least, the content on the file on APPENDIX II – UNIT PFP CONTROL . Fire Stops (see item 6) do not need to be inserted on this list. NOTE: These controls is only required for detailing engineering phase.

15 APPENDIX I - RIGID TYPE PFP FINISHING DETAILS



16 APPENDIX II – UNIT PFP CONTROL

APPENDIX II - INSTALLATION CONT