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			ESUP

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INDEX OF REVISIONS

REV.	DESCRIPTION AND/OR REVISED SHEETS
0	ORIGINAL (cancels and replaces I-ET-3010.00-5420-300-PPC-003_H FIRE PROTECTION FOR MACHIERY HOODS)

	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H
DATE	DEC/02/18								
DESIGN	ESUP								
EXECUTION	LNOGUEIRA								
CHECK	DANIELA								
APPROVAL	B.FERREIRA								

SUMMARY

1 SCOPE

This document establishes mandatory requirements for Fire Protection for Machinery Hoods, which shall be installed in the Offshore Units for the protection of equipment enclosed within machinery hoods.

It cancels and replaces I-ET-3010.00-5420-300-PPC-003_H FIRE PROTECTION FOR MACHIERY HOODS.

Basic and detailing design shall be developed in accordance with the requirements herein established.

2 ABBREVIATIONS AND DEFINITIONS

2.1 Abbreviations

- **ASME:** American Society of Mechanical Engineers
- **BDV:** Blowdown Valve
- **CCR:** Central Control Room
- **CSS:** Control and Safety System
- **DPC:** *Diretoria de Portos e Costas* - Brazilian Ports and Coasts Directory
- **ESD:** Emergency Shutdown
- **F&G:** Fire & Gas
- **FGS:** Fire and Gas System
- **FWP:** Fire Water Pump
- **HMI:** Human Machine Interface
- **IEC:** International Electrotechnical Commission
- **IMO:** International Maritime Organization
- **IP:** Ingress Protection
- **LEL:** Lower Explosive Limit
- **SDV:** Shutdown Valve

- **SOLAS**: Safety of Life at Sea
- **UCP:** Unit Control Panel

2.2 Definitions

2.2.1 For the purposes of this specification, the definitions indicated below are adopted:

- **CO_2:** Carbon Dioxide Extinguishing Agent
- **Water Mist:** Water-based fire suppression system that use a specific spray (mist) that absorbs heat, displaces oxygen, or blocks radiant heat to control, suppress, or extinguish fires as required by the application
- **Hood:** Enclosed space in which machinery operates.

3 APPLICABLE STANDARDS AND RECOMMENDATIONS

3.1 General

3.1.1 Basic and/or detailing designs, installation and testing of fire protection for machinery hoods shall be developed in accordance with requirements herein established. It shall always be considered publications in course. Suppliers shall either consider the standards and recommendations of item 3.2 that follows.

3.2 Standards and Recommendations

- **IMO – SOLAS** - International Convention for the Safety of Life at Sea - 1974, and Amendments in Force.
- **FSS CODE**: International Code for Fire Safety Systems;
- **ASME** - American Society of Mechanical Engineers - Section VIII DIV 1, DIV 2 - Pressure Vessels.
- **NFPA 12** - Standard on Carbon Dioxide Extinguishing Systems.
- **NFPA 72** - National Fire Alarm Code;
- **NFPA 750** - Standard on Water Mist Fire Protection Systems;

- **IEC 60079-10-1** - Explosive Atmospheres - Classification of areas – Explosive gas atmospheres.
- **IEC 61892-7** - Mobile and Fixed Offshore Units – Electrical installations – Part 7: Hazardous areas;
- Code of Federal Regulations: Dot Title 49 - 2000, Transportation – Chapter 1 – Part 178, Specifications for Packaging – Subpart C – Specification for Cylinders;
- Requirements of the Classification Society of the Unit.
- **DR-ENGP-M-I-1.3**: Safety Engineering Guidelines.

4 TECHNICAL REQUIREMENTS

4.1 General

4.1.1 For the purpose of this specification, sometimes machinery hood will be treated simply as hood

4.1.2 Mandatory safety items as established in Petrobras Guidelines - DR-ENGP-M-I-1.3, are to be considered complementary requirements.

4.1.3 All equipment of fire-fighting system shall be suitable for operation in marine environment and approved by a recognized institution, designed and tested according to current codes/standards.

4.1.4 Certifying requirements for fire-fighting system equipment and materials shall be in accordance to the Classification Society requirements.

4.1.5 All audible and visual alarms indicated for the Central Control Room (CCR) shall be implemented in the Human Machine Interface (HMI).

4.2 Components of Fire-Fighting Protection

4.2.1 The fire-fighting system comprises the following main components:

- Control Devices, Interlocking and Signaling;
- Safety Devices - Safety Valves
- Ventilation System;

- Gas Detection System;
- Fire Detection System and;
- Local Fire-Fighting System – (CO_2 or Water Mist).

4.3 Control Devices, Interlocking and Signaling

4.3.1 The Unit Control Panel (UCP) shall be responsible for the equipment control and safety systems. These systems include equipment operation, control, monitoring, and safety. The UCP is also responsible for the interface to the automation system of the Production Unit.

4.3.2 An independent and dedicated section of the UCP or remote I/O panel shall be responsible for carrying out F&G detection, monitoring the fire-fighting system automatic actions and other actions concerning the safety of the equipment, when necessary. All hood F&G detectors, push-buttons, control solenoids and other safety devices shall be directly hardwired to the respective UCP or remote I/O panel.

4.3.3 The UCP shall send a summary of the F&G detections and their actions to the Production Unit Fire and Gas System in order to allow remote alarming in the Central Control Room and initiate the relevant safety actions.

4.3.4 A summary of the fire-fighting system status and their actions shall be sent by the UCP to the Production Unit Fire and Gas System in order to allow remote alarming in the Central Control Room and initiate safety actions.

4.4 Safety Devices - Safety Valves

4.4.1 One shutdown valve (SDV) shall be installed at the fuel gas supply piping to shut off the fuel supply and, one blowdown valve (BDV) shall be installed at the fuel gas supply piping to depressurize the line and vent the gas to a safe location. These valves shall be activated by the equipment control/protection system.

4.5 Ventilation System

4.5.1 The ventilation system of the hood shall ensure an internal atmosphere outside the bounds of flammability.

4.5.2 The loss of the ventilation system in one of the hoods shall initiate an audible and visual alarm in the CCR, shutdown the respective equipment, shut off the fuel supply and depressurize the fuel gas supply piping located inside the affected hood. In case of gas compressors units, it shall also, close the process gas inlet and outlet, shutdown valves and depressurize the affected compressor.

4.5.3 The ventilation system control shall be included in the UCP.

4.5.4 The pressurization inside a hood shall be negative in case of the equipment installed in non-classified area.

4.5.5 The pressurization inside a hood shall be positive in case of the equipment installed in classified area.

4.5.6 In both cases, the loss of pressurization shall start actions for shutdown the affected equipment.

4.5.7 The loss of pressurization inside a hood shall initiate an audible and visual alarm in the CCR.

4.5.8 Air intakes for combustion and/or ventilation systems shall be located, at least, three (3.0) meters far away from any classified area.

4.5.9 The distance between air intakes and any exhaust points shall not be less than four and a half (4.5) meters.

4.5.10 The fan of the hood exhaust system shall be suitable to remain in operation after ESD-3T. In this way, the manufacturer shall check if the power supply is considered in equipment batteries. Otherwise, the same shall be powered by the platform essential power system.

4.5.11 Fire dampers shall be used at air intakes and exhaustions of the hood ventilation system, according to the requirements of Classification Society and SOLAS

4.5.12 Hoods ventilation system shall consider internal air distribution in order to avoid stagnation points (no air movement).

4.5.13 It shall be installed two fans (2x100%) for each hood, in order that only one (01) fan is sufficient to keep operational conditions.

4.5.14 Equipment located within the hood that remain in operation after ESD3 or ESD3T shall be suitable for Zone 1, Group IIA, Class T3. Other equipment located inside the hood shall be suitable for Zone 2, Group IIA, Class T3. The emergency shutdown level shall be taken for different types of hoods, as foreseen at the Safety Engineering Guidelines - DR-ENGP-M-I-1.3.

4.5.15 In case of FWP Units, since ventilation air intake for the hood are segregate from combustion air intake, and, at same time, the pressure inside combustions air intake is negative, there is no need to equipment located within the hood of FWP units be suitable for Zone 1, Group IIA, Class T3.

4.6 Gas Detection System

4.6.1 Point optical infrared methane gas detectors shall be installed at the following locations:

- Inside the hood;
- At the hood ventilation air intake;
- At the exhaustion;
- At the combustion air intake in case the ventilation air intake is separated from combustion air intake.

4.6.2 For all locations above-mentioned, the methane gas detectors shall be installed in a voting logic of 2oon (n>=3) configuration.

Note: “n” to be defined by supplier.

4.6.3 Table 1 presents the actions to be tkaken when gas is detected at machinery hoods.

Table 1 – Alarms and interlocking

Location of gas detectors	Low level alarm	Actions to be taken in case of 1oon detection at low level alarm	High level alarm	Actions to be taken in case of 2oon detection at high level alarm
Inside the hood	10% LEL	- Initiate an audible and visual alarm in the CCR (HMI) - Start the standby fan (Note 1)	15% LEL	- Initiate an audible and visual alarm in the CCR (HMI) - Shut down the affected equipment (Note 2) - Shut off the affected equipment fuel supply - Depressurize the fuel gas supply piping located inside the affected hood (Note 3)
Ventilation air intake/ Combustion air intake	20% LEL	- Initiate an audible and visual alarm in the CCR (HMI)	60% LEL	- Initiate an audible and visual alarm in the CCR (HMI) - Activate Level ESD-3P and Emergency General Alarm at the Production Unit - Shut down the affected equipment (Note 2) - Shut off the fuel supply for the affected equipment - Depressurize the fuel gas supply piping located inside affected hood - Stop and inhibit restart of all ventilation fans and close affected hood dampers (Note 3)
Ventilation air outlet	10% LEL	- Initiate an audible and visual alarm in the CCR (HMI) - Start the standby fan (Note 1)	15% LEL	- Initiate an audible and visual alarm in the CCR (HMI) - Shut down the affected equipment (Note 2) - Shut off the affected equipment fuel supply - Depressurize the fuel gas supply piping located inside the affected hood (Note 3)

Note 1: Start standby fan of the ventilation system of the hood where the detection took place, without shutting down the operating working fan, in order to increase the exhaust airflow and dilute the detected gas.

Note 2: Except to Emergency Generators and Fire Fighting Pump Units. For these cases, gas confirmation shall inhibit its start up or shall keep them operating if already started.

Note 3: In case of gas compressors units, it shall also close the process gas inlet and outlet shutdown valves and depressurize the affected compressor.

4.7 Fire Detection System

4.7.1 The Fire Alarm System shall be designed according to NFPA 72.

4.7.2 Any fire inside the hood shall be detected by means of flame detectors (UV+IR or IR3) and fixed temperature heat detectors of electronic type. At least two detectors of each type shall be provided.

4.7.3 For each hood, the activation of any fire detector shall initiate an audible and visual alarm in the CCR.

4.7.4 The activation of any two (02) fire detectors in the same hood shall:

- Initiate an audible and visual alarm in the CCR;
- Shutdown the affected equipment;
- Shut off the affected equipment fuel supply;
- Depressurize the fuel gas supply piping located inside the affected hood;
- Stop and inhibit restart of the ventilation fans and close the dampers of the affected hood;
- Ad activate the fire-fighting system inside the affected hood.

Note: For hoods where the extinguishing agent used is CO_2, it shall be provided an automatic interlocking between the door opening and the system activation (lock-in-place switch).

Note: In case of gas compressors units, it shall also close the process gas inlet and outlet, shutdown valves and, depressurize the affected compressor.

4.8 Local Fire-Fighting System - General

4.8.1 Each hood shall be protected by a fire-fighting system, actuated manually and automatically. The extinguishing agent can be high pressure water mist or CO_2.

4.8.2 Inhibition of the extinguish agent releasing shall be alarmed on respective UCP and in the CCR.

4.8.3 The fire-fighting system operation, including activation, signaling and monitoring shall be controlled by the respective UCP.

4.8.4 The fire-fighting system shall be configured to allow its automatic activation when fire detection confirmed and manually through push-button located externally to the hood or directly on the cylinders battery. The push-button for manual activation shall be of type "lift and push the button" and painted in safety yellow color with safety red colored stripe.

4.8.5 The discharge of extinguish agent shall be preceded by a visual and audible alarm inside the respective hood to be activated 30 (thirty) seconds before when protected by CO_2 and 15 (fifteen) seconds when protected by Water Mist. The alarm system shall consist of a flashing light alarm and an uninterrupted local sound alarm.

4.8.6 Each hood shall be provided with a local visual alarm consisting of a red lamp of intermittent lightening, located above the hood access door. Warning signs shall be located outside hoods, beside the hood access door, with the following legend: “GÁS CARBÔNICO (CO_2) PODE CAUSAR DANOS OU MORTE. QUANDO ACIONADO O ALARME NÃO ENTRE ATÉ QUE O AMBIENTE ESTEJA VENTILADO”, when protected by CO_2 or ““SISTEMA DE ÁGUA NEBULIZADA ACIONADO”, when protected by Water Mist. The red light will light up indicating that the system is activated. A pressure transmitter to be installed in the piping downstream of the fire-fighting system activation valve shall be supplied for monitoring the extinguish agent release. This device shall transmit the measured pressure to the CCR. If release confirmation does not happen after 30 (thirty) seconds, an audible and visual alarm at CCR must be activated.

4.8.7 All the system components (signaling, push-buttons, etc.) shall be line monitored (continuity, short-circuit, etc.).

4.8.8 When activated, the system shall initiate an alarm in the CCR, initiate an alarm at the Production Unit. It shall shutdown the affected equipment, shut off the affected equipment fuel supply, depressurize the fuel gas supply piping located inside the affected hood; stop and inhibit restart of the ventilation fans, close the dampers of the affected hood and activate the fire-fighting system inside the

affected hood.

Note: In case of gas compressors units, it shall also close the process gas inlet and outlet shutdown valves and depressurize the affected compressor.

4.9 CO_2 Fire-Fighting System

4.9.1 The CO_2 flooding system shall be designed according to NFPA 12.

Note: For Floating Units it shall be considered the disposed in IMO SOLAS and its amendments.

4.9.2 During CO_2 dimensioning, in calculating the quantity of CO_2 required for fire-fighting in the hood, it shall be considered tightness requirements for total flooding.

4.9.3 Hoods shall be tight enough, that is, all openings must be sealed to prevent loss of agent fire extinguisher.

4.9.4 Each hood shall be supplied with a high pressure CO_2 system. The system shall be automatic, independent and skid mounted inside a cabin with access door, installed in an easily accessible location and enabling the realization of inspection and maintenance of the system, including the exchange of the cylinders.

4.9.5 A battery backup of CO_2 shall be installed. The selection of the main battery or backup shall be for a key located in the skid.

4.9.6 The control solenoids of the cylinders pilot valves and system actuation valve shall be normally de-energized, and the control circuits shall have line supervision to check continuity and short-circuit.

4.9.7 The reset of the actions commanded by the system activation, except the control of solenoids, shall be done by the respective UCP.

4.9.8 The alarm system drive shall be in accordance with NFPA 12. In case CO_2 system, the horn shall be according to NFPA 12. The acoustic pattern of the horn shall be clearly differentiated from other acoustic alarm systems adopted by the Production Unit.

4.9.9 Hoods shall be supplied with internal red rotational or stroboscopic lamps activated when fire is confirmed.

4.9.10 In case of the CO_2 system actuation be necessary, the actuation shall be automatic, however, the automation shall be inhibited if any doors are open,

guaranteed by a safety lock-in-place switch, that does not allow the system activation.

4.9.11 The lock-in-place switch have two positions with possibility of locking in each of them, such as: Extinguish agent release “Inhibited” or “Automatic”. These positions must be flagged and manifold valves and connections shall have their positions marked on the UCP.

4.9.12 Calculation notes of fire-fighting system shall be approved by PETROBRAS.

4.10 Water Mist Fire-Fighting System

4.10.1 The water mist system shall be designed according to NFPA 750.

Note: For floating units it shall be considered the disposed in IMO SOLAS and its amendments.

4.10.2 The fire-fighting system shall be supplied with a high pressure water mist, automatic, autonomous and skid mounted.

4.10.3 The water supply vessel is to be designed for fresh water storage and pressurization in accordance with ASME VIII, manufactured in stainless steel and epoxy coated for maximum corrosion protection. It shall be provided with pressure relieve valves and with water level remote monitoring by UCP.

4.10.4 The propellant gas for the system shall be supplied in cylinders and certificates, and in quantity that allows the configuration of main and reserve.

4.10.5 External connections for fresh water refilling shall also be provided, so that the supply for the vessels shall be made by means of permanently connected arrangements.

4.10.6 Pressure gauges to indicate propellant and water pressure shall also be provided. In addition, a low pressure switch shall be supplied to provide propellant gas continuous monitoring and signaling in the CCR in case of low pressure.

4.10.7 Nozzles shall be manufactured in stainless steel. Each one shall be provided with integral filter unit and blow-off cap. Furthermore, they are to be designed to withstand vibration, normally present in machinery environments.

4.10.8 All piping and fittings shall be made of stainless steel. All lines shall be properly supported and arranged in order to avoid damage during operation.

4.10.9 A test facility shall be incorporated to the distribution pipework which may

enable a fully system test to be conducted. The tests shall be performed with water being diverted to the drain system rather than discharged through the nozzles manifold.

4.10.10 For the safety of electrical and electronic equipment located inside the hood, and submitted to water mist application, these shall be provided with the suitable IP type.

4.10.11 Hoods placed side by side in the same module shall have the corresponding water mist distribution systems interconnected, by means of a discharge manifold with valves, in order that each machinery hood could be supplied by any of the water mist skids.

4.10.12 The manifold valves and connections shall have their positions marked on the UCP.

5 MINIMUM DOCUMENTS REQUIRED

5.1 General

5.1.1 In order to comply with safety requirements, supplier must deliver, in addition to the other hood documents, the following:

- Classification Society Certificates of Approval issued by Ministério da Marinha – DPC;
- Flowcharts and calculation notes of CO_2 fire-fighting and ventilation systems;
- Flowcharts and calculation notes of water mist fire-fighting and ventilation systems.