



BRAZILIAN NAVY DIRECTORATE OF PORTS AND COASTS

MARITIME ACCIDENT SAFETY INVESTIGATION REPORT

FPSO CIDADE DE SÃO MATEUS

EXPLOSION FOLLOWED BY FLOODING WITH CASUALTIES.

FEBRUARY 11TH 2015



FPSO “Cidade de São Mateus” on the day of the investigation.

Reference

Accident Investigation Code of the International Maritime Organization –
MSCMEPC.3/Circ.2 13 June 2008/Resolution MSC.255(84)



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LIST OF ACRONYMS

- ABS** – Classification Society “American Bureau of Shipping”
- ANP** – National Agency of Petroleum, Natural Gas and Biofuels
- AJB** – Brazilian Jurisdictional Waters
- CCM** – Engine Control Center
- CPES** – Ports Authority of the State of Espirito Santo.
- DHN** – Directorate of Hydrography and Navigation
- DNV-GL** – Det Norske Veritas/Norway and Germanischer Lloyd/Germany
- DPEM** – Mandatory Insurance of Personal Injury Caused by Vessels or Cargo.
- MSDS** – Material Safety Data Sheet
- FPSO** – Stationary Unit of Floating, Production, Storage and Offloading of Oil and Gas Export
- OIM** – Offshore Installation Management
- IMO** – International Maritime Organization
- ISAIM** – Safety Investigation of Maritime Accidents and Incidents
- ISM Code** – International Safety Management Code
- MCA** – Auxiliary Combustion Engine
- NR 33** – Regulatory Standard No. 33 – Safety and Health at Works in Confined Spaces
- HSEQ** – Health, Safety, Environment and Quality.
- STCW 78** – International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978.
- VHF** - Very High Frequency (from 30 MHz to 300 MHz).



I – INTRODUCTION

With the purpose of gathering and analyzing evidences, identifying causal factors and preparing the safety recommendations deemed required in order to prevent future similar maritime accidents and/or incidents, the Directorate of Ports and Coasts (DPC) performed this Safety Investigation of Maritime Accidents and Incident in compliance with the extent set out in the Investigation Code for Maritime Accident Investigation of the International Maritime Organization (IMO) adopted by Resolution MSC.255(84).

This Final Report is a technical document reflecting the results obtained by the DPC regarding the circumstances that contributed or may have contributed to trigger the occurrence and therefore it makes no use of any proof-related procedures to ascertain civil or criminal liability.

Notwithstanding, it must be highlighted the importance of safeguarding the individuals in charge of providing the information related to the occurrence of the accident, and the use of the information herein for purposes other than preventing future similar accidents may induce to erroneous interpretations and conclusions.

II – BACKGROUND

On the morning of February 11th, 2015 onboard FPSO CIDADE DE SÃO MATEUS, it was being performed the transfer of water and condensate mix from the central cargo tank 6C to the portside slop tank with the purpose of inspecting it and testing its valves. This operation started at 8:53am by starting the stripping pump installed in the pump room. At 11:30am the closed-circuit television (CCTV) displayed a leak of condensate in a stretch of the pump discharge main and immediately after a gas alarm was automatically sounded. Following that occurrence, decisions were made, actions were deployed and the crisis reached its peak with an explosion within the pump room, causing severe damages to the platform, killing nine (09) and injuring twenty-six (26) crewmen. The timeframe of the accident will be further detailed below.



III – GENERAL INFO

(a) Details of the FPSO CIDADE DE SÃO MATEUS

The FPSO CIDADE DE SÃO MATEUS (Picture 1) is a Stationary Unit of Stationary Unit of Floating, Production, Storage and Offloading of Oil and Gas Export (FPSO) with capacity to produce 4,000m³/day of oil and 10,000,000m³/day of gas. It bears the flag of Panama, with registry in the Port of Panama at the ownership of PROSAFE PRODUCTION SERVICES PTE. LTD, whose class is maintained by the Classification Society American Bureau of Shipping (ABS). This platform is authorized to operate in Brazilian Jurisdictional Waters (AJB) as per the Concession Contract issued by the National Agency of Petroleum, Natural Gas and Biofuels (ANP), on behalf of Petrobras. Its average production in values related to 2013 corresponds to 2,484,717.79m³/day of gas and 426.66m³/day of condensate (resulting from gas production) without the production of oil.

(1) Main info and physical features:

Operator: PPB DO BRASIL, SERVIÇOS MARÍTIMOS LTD.

Enrollment Number: 341E001031

IMO Number: 8706014

International call sign: 3ENO

Gross Tonnage: 143,323

Hull material: steel

Year of Construction: 1989

Year of Conversion: 2008

Overall length: 311.7m

Length between perpendiculars: 310m

Breadth: 54.50m

Depth: 29.50m

Design Draft: 19.8m

Propulsion: no propulsion

Accommodations: up to 85 individuals



Picture 01 –FPSO CIDADE DE SÃO MATEUS on 13-Feb-2015, two days after the accident.

(b) Documents and Certificates of the platform effective as of the day of the accident:

Verified statutory and classification society-related certificates and documents the platform should be carrying are listed below:

Certificate Name Portuguese/English – Acronym	Issuing Authority	Issuance Date	Validity
<i>Certificado de Classe / Certificate of Classification</i>	ABS	27-Aug-2014	18-Mar-2019
<i>Certificado de Proteção de Segurança / International Ship Security Certificate – ISPS Code</i>	Flag State (Panama)	19-Sep-2014	15-Sep-2019
<i>Certificado de Unidade Móvel de Produção / Mobile Offshore Unit Safety Certificate – MODU</i>	Flag State (Panama)	27-Aug-2014	18-Mar-2019
<i>Gerenciamento de Segurança / Safety Management Certificate – SMC</i>	DNV-GL	02-Feb-2015	15-Sep-2019
<i>Certificado Internacional de Borda Livre / International Load Line Certificate- LL</i>	ABS	27-Aug-2014	18-Mar-2019
<i>Certificado Internacional de Prevenção de Poluição por Óleo / International Oil Pollution Prevention Certificate – IOPP</i>	ABS	27-Aug-2014	18-Mar-2019
<i>Cartão de Tripulação de Segurança / Minimum Safe Manning Certificate – CTS</i>	Ports Authority of Rio de Janeiro	27-Apr-2010	19-Feb-2015
<i>Certificado Internacional de Arqueação / International Tonnage Certificate (1969)</i>	ABS	04-Aug-2008	Indeterminate
<i>Certificado de Registro / Navigation Statutory Registry</i>	Flag State (Panama)	23-Sep-2014	07-Oct-2019



<i>Certificado Internacional de Prevenção a Poluição do Ar / Air Pollution Certificate - IAPP</i>	ABS	27-Aug-2014	18-Mar-2019
<i>Certificado de Prevenção de Poluição por Esgoto / International Sewage Pollution Prevention Certificate</i>	ABS	27-Aug-2014	18-Mar-2019
<i>Atestado de Inscrição Temporária de Embarcação Estrangeira – AIT / Foreign Vessel Temporary Enrollment Certification</i>	Ports Authority of Espírito Santo	20-Feb-2009	19-Feb-2015
<i>Atestado de Inscrição Temporária de Embarcação Estrangeira – AIT / Foreign Vessel Temporary Enrollment Certification</i>	Ports Authority of Rio de Janeiro	14-Jan-2015	03-Oct-2018
<i>Declaração de Conformidade para Operação nas Águas Jurisdicionais Brasileiras / Statement of Compliance for Operation in Brazilian Waters</i>	Ports Authority of Espírito Santo	19-Jul-2013	18-Apr-2015
<i>Seguro Obrigatório de Danos Pessoais Causados por Embarcações ou por sua carga – DPEM / Mandatory Insurance of Personal Injury Caused by Vessels or Cargo</i>	Bradesco Seguros e Previdência	25-Mar-2014	25-Mar-2015
<i>Seguro P&I / Certificate of Entry – Mobile Offshore Unit Entry</i>	Gard P&I	13-Feb-2014	13-Feb-2015
<i>Registro Contínuo de Dados / Continuous Synopsis Record – CSR</i>	Flag State (Panama)	17-Sep-2013	Indeterminate.

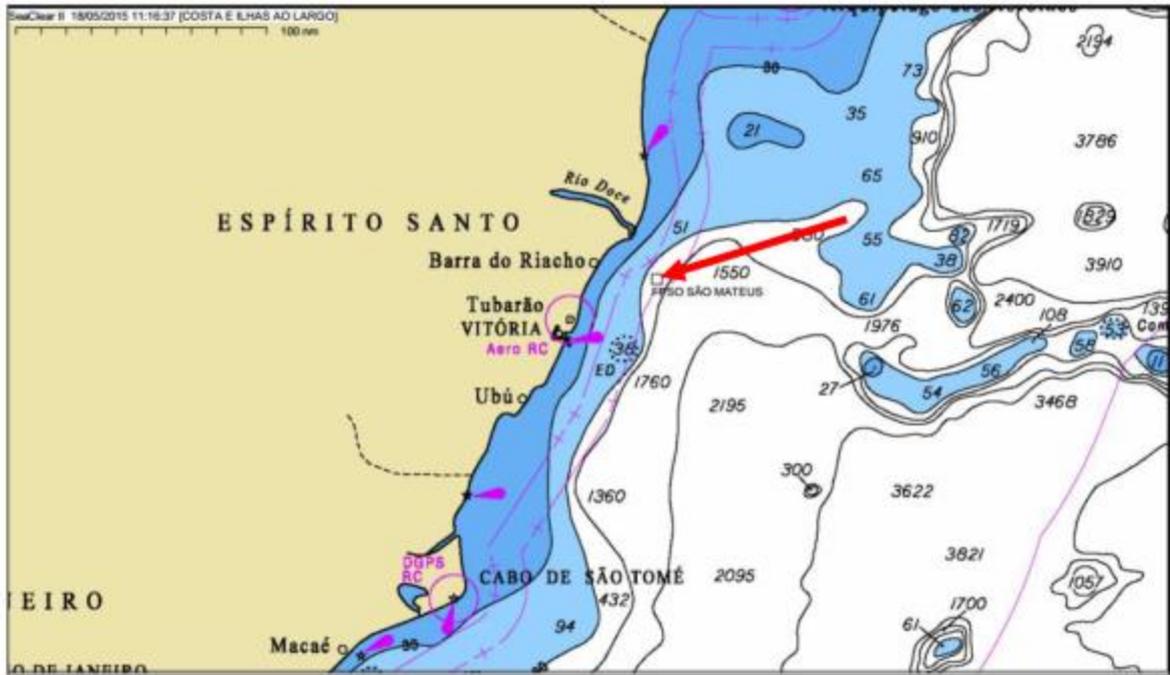
(c) Condition of the platform during investigation

On February 13th, 2015, at the first visit onboard, the platform presented an aft-oriented inclination due to the flooding of the engine and pump rooms. All operations were shutdown. At the main deck, there were kinked lockers, bent doors, damaged pieces of personal protective and communication equipment, as well as a great deal of debris expelled from inner quarters of the superstructure due to the effects of the explosion. Salvage material was incomplete due to the lack of two lifeboats and several life-jackets used during abandon-ship procedures. There was no generation of electric energy onboard due to damages in parts of power cables and circuit breaker panels, which explains the utilization of handheld flashlights. Stairs to access engine and pump rooms were not safe to be used due to deformations and/or gaps resulting from the explosion. Access to the pump room and to the upper levels of the engine room required the monitoring of possible gas leaks by using handheld detectors. Only two crewmen were onboard the unit monitoring its stability and performing procedures to implement salvage plans, whose initial actions were to arrange for the external covering of sea chests (to be performed by divers) in order to isolate the engine and pump rooms from the contact with the sea. Seawater network were damaged following the explosion and such situation prevented the depletion of both the engine and pump rooms, which is required to ensure the safety of the platform and to search the bodies of crewmembers still missing.



IV – ACCIDENT SITE INFO

(a) Location: geographic coordinates at Lat: 19°55.35'S and Long: 039°38.0'W, Camarupim Field, Espírito Santo Basin at a depth of 792m. It is an open seas navigation area 40km far from shore as seen by the plotting in the Nautical Chart DHN 22800, 2nd edition (Picture 02).



Picture 02 – Position of FPSO CIDADE DE SÃO MATEUS in Nautical Chart DHN-22800, 2nd edition, from *Conceição da Barra* to *Vitoria*, Lat. 19°55.35'S and Long. 039°38.0'W.

(b) Environmental conditions at the time of the accident: North wind at 8 knots, calm waters, good weather and visibility. Environmental conditions did not contribute to the accident.

V – HUMAN FACTORS AND CREW

(a) POB list and safety crew.



On the day of the accident there were 74 personnel onboard, among crew and non-crew professionals. Crew certificates and documents (specialization courses, enrollment and registry books, social security and employment record books, employment contracts and record sheets related to BW Offshore) were examined and the following noncompliances were found:

(1) – there is no Vessel Supervisor proficiency certificate as provided in item 0117 item ‘e’ subitem ‘3’ of NORMAM-01/DPC; and

(2) – noncompliance with the Safety Crew Card (CTS) – one of the crewmen (fatal casualty) that should be working as Able Seaman as detailed in the platform’s Safety Crew Card was exercising the job of pumper. Consequently, the platform did not operate in compliance within the extent provided in referred CTS.

(b) Working and rest hours

No lack of compliance was evidenced concerning minimum rest periods as established in Convention STCW/78.

(c) Onboard accommodations

Accommodations were appropriate for the crew and in compliance with the standards of conformity, hygiene, temperature, light and noise found in such platforms.

(d) Alcohol, drugs and medications

It was not found any proof concerning the use of alcohol, drug or medication without medical prescription by the crew.

(e) Safety Management

Platform has a Safety Management Certificate issued by the classification society Det Norske Veritas/Norway and Germanischer Lloyd/Germany (DNV-GL) under the terms of the International Safety Management Code (ISM Code) valid until September 15th, 2019. This document certified the platform was audited and its safety management system meets ISM Code requirements.

VI – TIMELINE OF THE EVENTS

The accident sequence of events described below is grounded in records found in the Status Board of the control room during the emergency situation, information received from crew, examination of documents received by PETROBRAS and BW Offshore, records from the platform’s automation system and in observations by investigators during the four visits performed onboard.



February 11th, 2015:

- 8:30am: crew shift, with emphasis to the shifts of the Offshore Installation Manager (OIM) and of the Maintenance Supervisor. Handover Reports for the OIM and Maintenance Supervisor are detailed in Annexes D and E, respectively.

- 8:53am: opening of valves from suction and discharge network of the oil stripping pump at the pump room in order to transfer water and condensate from cargo tank 6C to slop tank at portside.

- 9:00am: startup of stripping pump.

- 9:30am: starting of videoconference in meeting room between the Onshore Operations Management, OIM, Vessel Supervisor, Maintenance Supervisor, Production Supervisor, Planner and a Safety Technician.

- 10:00am: end of videoconference, OIM returned to his office in order to finish reading the Shift Handover Report.

- 11:30am: waste from condensate leak inside pump room is detected by camera 5 of the CCTV but is not seen by whoever was in the control room at that particular time.

- 11:31am: Gas sensor TAG 73AB370 at the pump room warned about the presence of gas, being automatically sounded and exhaustion was automatically stopped as provided in the ESD, FIRE & GAS SYSTEM CAUSE AND EFFECTS MATRIX. OIM left the office and headed towards the control room. Upon his arrival and aware of what sensor was triggered, he disclose by Public Addressing System an order for the whole crew to head to their muster stations. Next, upon being informed by the Vessel Supervisor about the condensate transfer operation with the stripping pump he ordered the operation to be shut down. It was then started a personnel headcount at the muster stations, coordinated by a designated person from the control room.



- 11:32am: Gas sensor TAG 73AB326 also sounded and accused the presence of gas inside the pump room.

- 11:36am: Gas sensor TAG 73AB327 inside pump room also sounded accusing the presence of gas in the compartment. General alarm resulting from the triggering of several gas sensors was muted in order to improve communication. OIM had doubts concerning the gas leak source and ordered a party composed by a Safety at Work Technician, an Instrumentation Technician and a Pumper, to head to the pump room and identify the gas source.

- 11:40am: emergency situation reported to the company base (BW Offshore), located in Vitoria.

- 11:44am: technical party went down to the pump room while at the control room the OIM, Vessel Supervisor and Maintenance Superintendent assessed the situation.

- 11:47am: technical party returned from the pump room and informed the OIM that there was a pool of liquid on the compartment floor leaking from valve OP-068 and that handheld gas detectors used by the team found high levels of gas in the atmosphere of the pump room and dripping continued near valve OP-068. The OIM asked them if there was another source of gas leak and was informed that there was a single pool, which could be removed by spraying water. The OIM decided the cleaning was to be done by using absorbers and tasked the Maintenance Supervisor to assess how the valve could be repaired.

- 11:58am to 12:02pm: another party was composed and instructed to head to the pump room and investigate what can be done to “solve” the leak. This team was formed by the Safety at Work Technician of the previous party, the Maintenance Supervisor and a Maintenance Technician.

- 12:09pm: at the pump room the party requested shovels and a ladder.

- 12:10pm: the party left the pump room to breathe fresh air and rest.

- 12:15pm: three crewmembers from the fire party at the main deck and surroundings of the pump room arranged absorbing materials to remove the condensate pool. The OIM released the mustered personnel not required for the task to the lunch break.



- 12:20pm: OIM instructed another party to be assembled to go to the pump room and proceed to the cleaning and containment of the leak. Two Roustabouts and three Maintenance Technicians were designated for the task.

- 12:22pm to 12:26pm: the party headed to the pump room and started the containment and cleaning of the leak, first with absorbing blankets then by using seawater from the fire network (a hose of 1.5 inch and 45 meters length was introduced in the location by openings from starboard decks).

- 12:35pm to 12:37pm: explosion occurred in the pump room and immediate effects were felt by the control room, which was filled by smoke and debris. All platform systems were shut down and the room was evacuated. Flooding started inside pump and engine rooms caused by burst of the fire network (pressurized at the time) and of the seawater network (sea chests). The first casualties were identified and the OIM, jointly with PETROBRAS Supervisor, requested helicopters to evacuate the injured. At the deck, disoriented personnel sought shelter at the aft, under the helideck and at the bow of the platform, fearing more explosions and possible sinking of the unit. Procedures to abandon the unit were deployed, all onboard were instructed to head to their muster stations. The Vessel Supervisor guided 32 crewmen to embark on the starboard lifeboat.

- 12:47pm: it was ordered the abandonment of the platform by the starboard lifeboat. The OIM and the Medic remained onboard along with other crewmembers to take care of the medevac of casualties.

February 12th, 2015:

- 2:00pm: platform is completely abandoned, no personnel onboard.

VII – POST-ACCIDENT PROCEDURES

After the accident it was carried out the shutdown of the whole operation of the platforms followed by procedures of abandonment and rescue of the casualties with onshore support. After abandonment the platform stayed under monitoring to check its stability and floatability by using offshore supply vessels, while the salvatagem plan was being prepared.

VIII – ACCIDENT CONSEQUENCES



(a) – Personal Damages:

This accident killed nine (09) and injured twenty-six (26) workers. Qualification of the casualties, as well as the Death Certificates and medical information on the health condition of the injured workers are provided in the List of Deaths and Injuries. There is no missing person.

(b) – Environmental Damages:

No environmental damages.

(c) – Property Damages:

The platform suffered several structural damages at the aft section, the explosion affected living quarters, engine room, pump room and structural fittings and equipment located in those quarters. Such damages are characterized by kinking, falling and breaking of bulkheads, ribs and girders. Additionally, effects from flooding in the engine and pump rooms caused the disabling of engines, pumps, switchboards and general equipment that cannot be watered. The pictures below show the severity of the damages that caused the shutdown of all operations and the abandonment of the platform. There is no evidence of damages to the condensate and oil cargo existing in cargo tanks.

(1) – Aft outer deck, living quarters hallways and access to the elevator.



Picture 03



Picture 04

Lockers deformed by the explosions and expelled from the inner quarters of the superstructure.



Picture 05 – watertight door to access pump room, portside, destroyed by the explosion.



Picture 06 - parts of a flashlight used onboard.



Picture 07 – access door to the elevator in the superstructure deformed by the explosion.



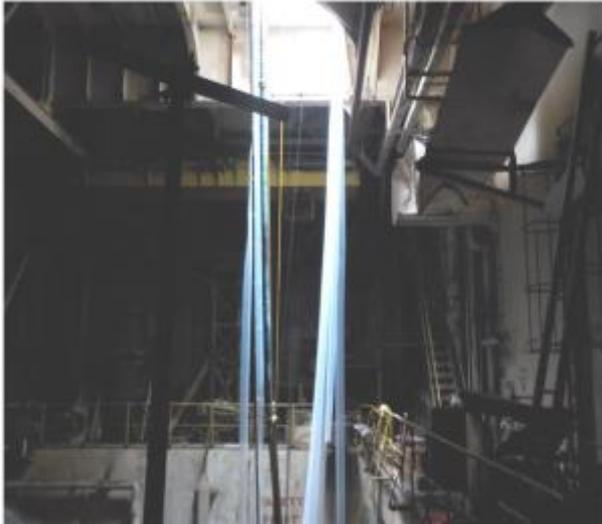
Picture 08 – hallway to access control room at the main deck level.

(2) – Engine Room

Flooding of the engine room after explosion disabled the Auxiliary Combustion Engines (MCA) and switchboards, including the Main Switchboard. Structural reinforcing elements and the network system running through the room were severely damaged by the explosion. The Engine Control Center (CCM) was destroyed by the pressure wave caused by the explosion, which was originated in the Pump Room.



Picture 09 – Flooding in the engine room seen by the hatch on the main deck, aft



Picture 10 – Upper portion of the Engine Room partially destroyed.



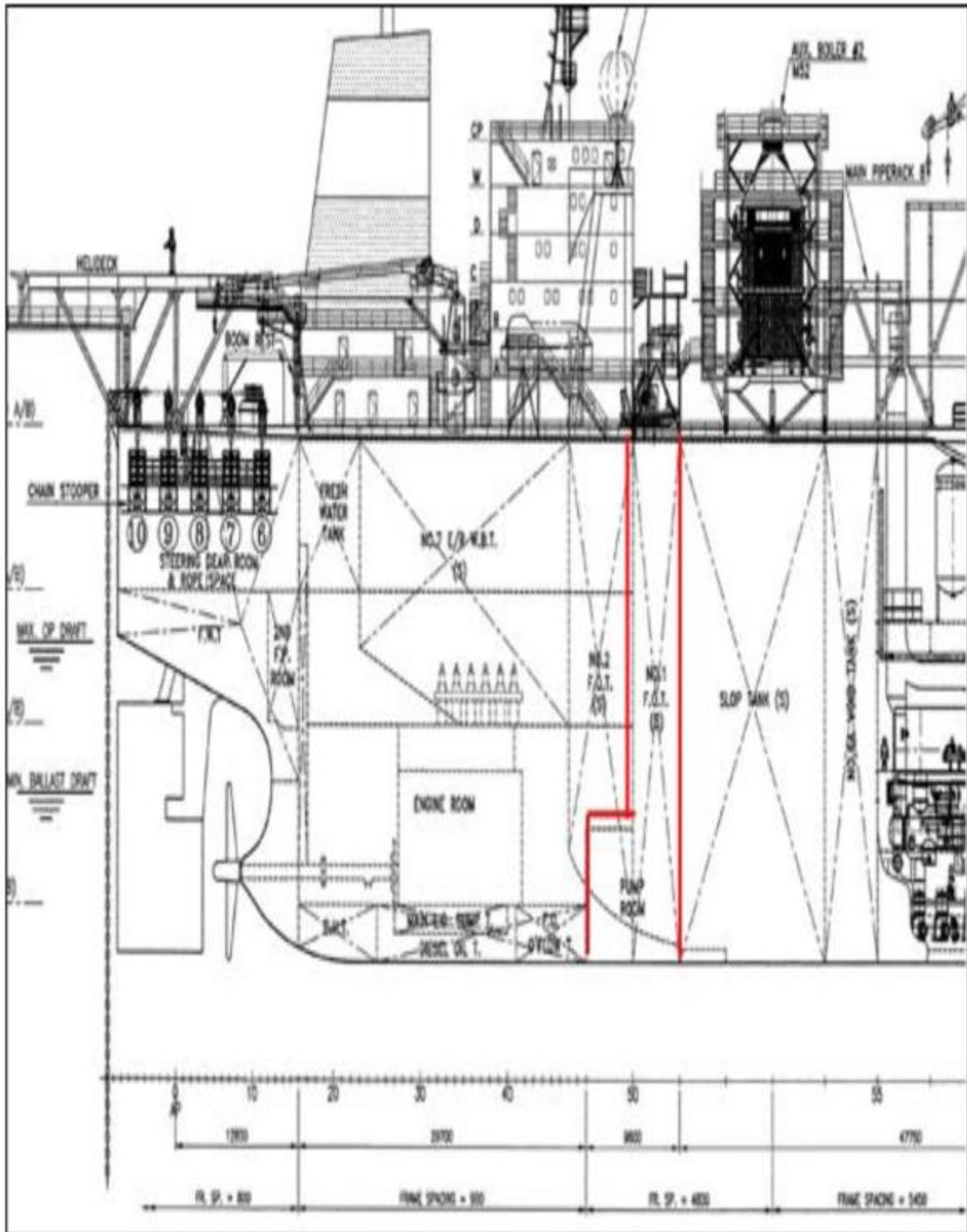
Picture 11 – Engine Room next to the starboard broadside presented signs of destruction in network and structural elements.



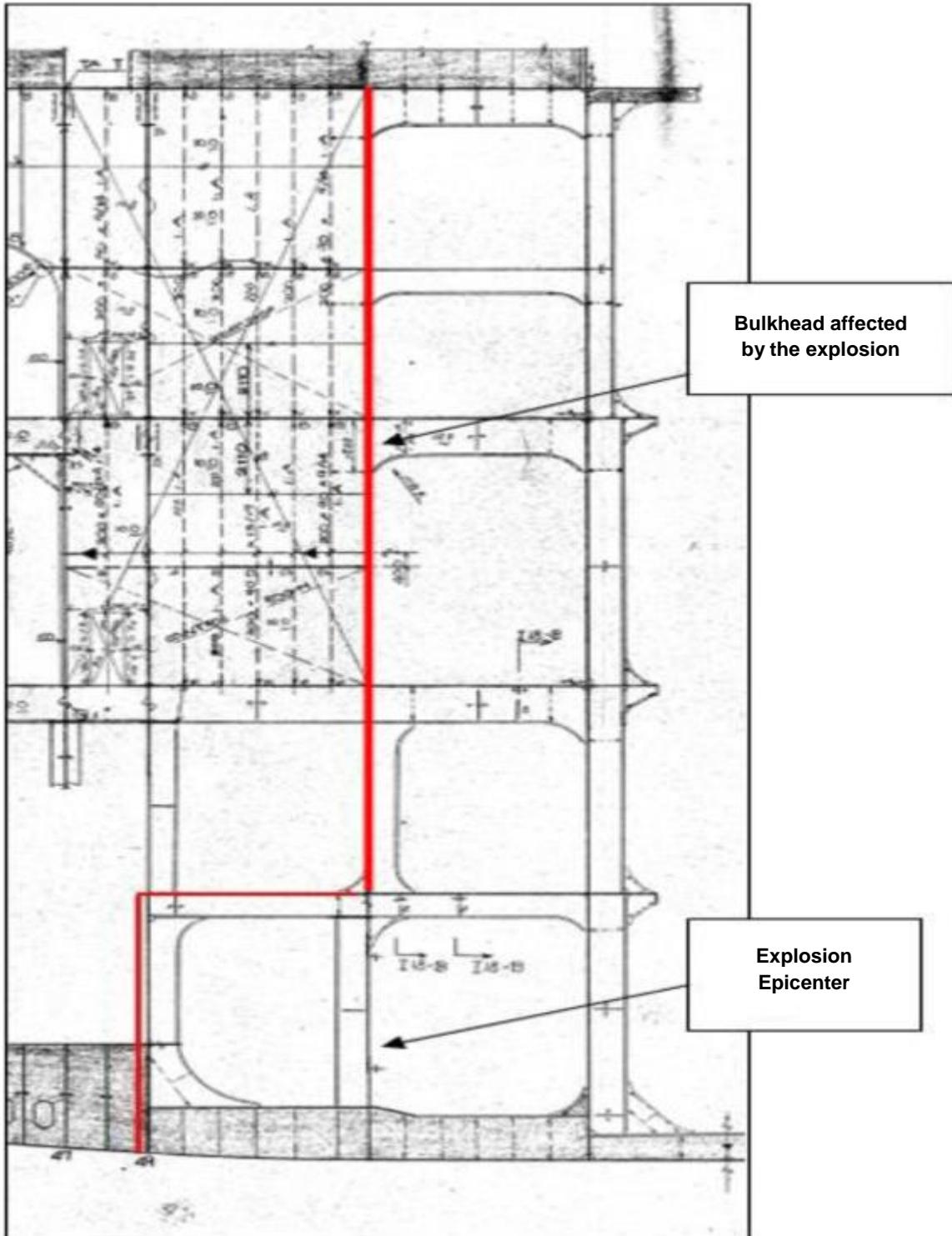
Picture 12 - CCM in the Engine Room destroyed by the effects of the explosion.

(3) - Pump Room:

Pump Room is vertically divided in five levels from the main deck down to the bottom of the compartment, as per the following drawings:



Picture 13 – Aft side view of the platform, highlighting the Pump Room.



Picture 14 – Vertical Structure of the Pump Room

Damages in that compartment are partially shown in the pictures below:

Ceiling of the pump room: located above the main deck, it was displaced and severely damaged by the explosion. Right under the 1st level the vertical plumb reinforcements of the aft bulkhead that isolates the Pump Room from the Engine Room were severely kinked and unable to perform their role of increasing the rigidity of the panel formed by the bulkhead.



Picture 15 – Pump Room Ceiling in the main deck
Fire network damaged by the explosion, which contributed to the flooding of the compartment as it was kept pressurized

2nd level of the Pump Room: damaged floor near the starboard air extraction pipeline.



Picture 16 – Floor located at the 2nd level presenting severe deformation



Picture 17 – Vertical air vent totally destroyed by the explosion pressure wave



3rd level of the Pump Room: air extraction pipes were destroyed by the pressure caused by the explosion. Access stairs were also destroyed. Access to the lower levels of the Pump Room was only possible after installation of scaffolds by the crew. Bulkhead that separates the Pump and Engine Rooms were deformed and tumbled to aft, opening sections bordering both rooms. Bulkhead was separated in its upper welded joint with the unit structure due to the ascending pressure caused by the explosion at the lower part of the compartment.



Picture 18 – Tumbled aft bulkhead between the Pump and Engine Rooms was tumbled



Picture 19 – Collapsed bulkhead between the Pump and Engine Rooms

5th level of the Pump Room: the lower level of the Pump Room is divided by an intermediate floor formed by skids that allow access to equipment such as the stripping pump. Such skids were severely affected by the explosion. The stripping pump presented superficial damages on the thermal isolation of the housing and of the draining system manifold.



Picture 20 – Stripping pump presented superficial damages

At the Pump Room floor it was noticed a strong deformation at the junction of the sixth girder (longitudinal structural reinforcement of the bottom plating) from the starboard bulkhead with a Samson post (vertical beam that supports the ceiling at the lower panel).



Picture 21 – Severely damaged 6th bottom plating reinforcement girder of the Pump Room



Picture 22 – Vertical detail of the collapsed and deformed structure



Picture 23 – Severely damaged 6th bottom plating reinforcement girder of the Pump Room



Picture 24 – Under the damaged structure there are remnants of oily mixture

The shape of the deformation on these structural reinforcements means that the pressure caused by the explosion was concentrated at the compartment bottom near the condensate leak and then expanded vertically upwards, which explains the deformations found in the structure and bulkhead of Pump Room upper levels. The compartment also presented oily water at the bottom between the structural reinforcements of the compartment's bottom plating.

IX – EXPERT SURVEYS

Expert surveys started soon after the platform's safety conditions were deemed satisfactory. Four visits took place in order to map equipment and network of the pump room, estimate damages and evaluate the conditions of network and valves of the stripping pump.

In addition to the visits onboard, platform's certificates and plans were inspected, along with several documents provided by PETROBRAS and BW Offshore, upon request by the surveyors. They also analyzed data from the automation system and heard people that could assist in elucidating the accident.

X – CAUSAL FACTORS AND ANALYSIS

(a) Data from automation system



Data from the automation system referred herein were in the computers and data disks taken from the platform after the accident and transported to BW Offshore’s office in the capital city of Vitoria, State of Espirito Santo. The recorded information will aid in the technical understanding of the operation and activation of equipment and in the visualization of the condensate leak, including the activation of a gas alarm lamp inside the pump room by means of images from the CCTV. For this survey, in addition to the CCTV images, data related to valves, oil stripping pump and gas sensors within the pump room were also extracted. This information, obtained as electronic spreadsheets, are in the data disk.

(b) – Data recovery and reading

Recovery and reading of data by technicians from BW Offshore Navy – at the facilities of Petrobras, city of Macaé, State of Rio de Janeiro, from 24th to 28th of February, 2015.

(c) – Criterion adopted to select data for this investigation

CCTV images and data selected to be inspected were those contained in the HD Cargo Ballast N/S 9RX7JG4S (Cargo-EventLog.xlsx) and HD Server B – N/S 3LN2CQ1H (1E4F-AlarmLog-MostRecent.xlsx) dated February 11th, 2015 concerning the equipment located inside the platform’s pump room, as that is the date when the condensate leak occurred (stripping pump discharge network), followed by automatic sounding of gas sensors and explosion.

(d) – Synchronism method of the computers and CCTV hours

(1) - Computers.

When computers were turned on it was verified that there was no synchronism of the respective hours. Considering the need to use information to describe the chain of events that led to the explosion, technicians compared the hours of the computers against information from a cell phone and then prepared photographic reports. The following images show the results from the comparisons concerning the aforementioned systems.



Picture 25 - HD Cargo Ballast N/S 9RX7JG4S
 Computer that controls the ballast and cargo maneuvers of the platform

Date and time of the computer: 26/02/2015 10h07m01s

Date and time of the cell phone: 27/02/2015 09h03m

The picture shows that:

a) The computer had a delay of one day in relation to the date on the cell phone.

b) The computer time was ahead 1h4m01s.

Synchronizing – seconds not included:

Considering that the computer was in a delay of one day and that it was taken during summer time (from 12:00am of October 19th, 2014 to 12:00am of February 22nd, 2015) sync is done by:

a) adding 1 day to the computer date.

b) reducing 1h4m from the computer time.

Therefore, considering this sync criteria, the following example is now presented:

The text on the first row of table Cargo-EventLog.xlsx, Appendix 2:

Time	Description
2/10/2015 12:29:17	Wrote new value (1) to ICONICS.ModbusEthernetDA.2\Sixnet.DO.HMI_BA002_Close

Now reads:

Time	Description
2/11/2015 11:25:17	Wrote new value (1) to ICONICS.ModbusEthernetDA.2\Sixnet.DO.HMI_BA002_Close



Picture 26 - HD Server B – N/S 3LN2CQ1H
 Server that records the platform alarms

Date and time of the computer: 27/02/2015 12h09m

Date and time of the cell phone: 27/02/2015 11h02m

The picture shows that the computer time was for 7 minutes in advance.

Synchronizing:

Reduce the computer time in 7 minutes.

Therefore, considering this sync criteria, the following example is now presented:

The text on the row of table1E4F-AlarmLog-MostRecent.xlsx:

ActiveTime	EventTime	Source
2/11/2015 13:51:31	2/11/2015 13:51:31	P_73BF319-FAULT

Now reads:

ActiveTime	EventTime	Source
2/11/2015 13:51:31	2/11/2015 13:44:31	P_73BF319-FAULT

(2) - CCTV.

The CCTV recording system was delayed 1h23m16s in relation to the local time in Brasilia “BRT” (conference held on 27-02-2015 at 16h19m – Brasilia Time).

(e) Transfer of water and condensate content from cargo tank 6C to the portside slop tank:

The operation consisted in the transfer of water and condensate from central cargo tank 6C to the portside slop tank. The valve and network arrangement is shown in drawing 1. The stretch in question (suction and discharge flow) is marked in red. From the start of the center suction header up to the pump, there are valves OP-041, OP-050 OP-047 and OP-071 and from the discharge to the slop tank there are valves OP-079 and OP-084. All such valves should be opened during transfer.

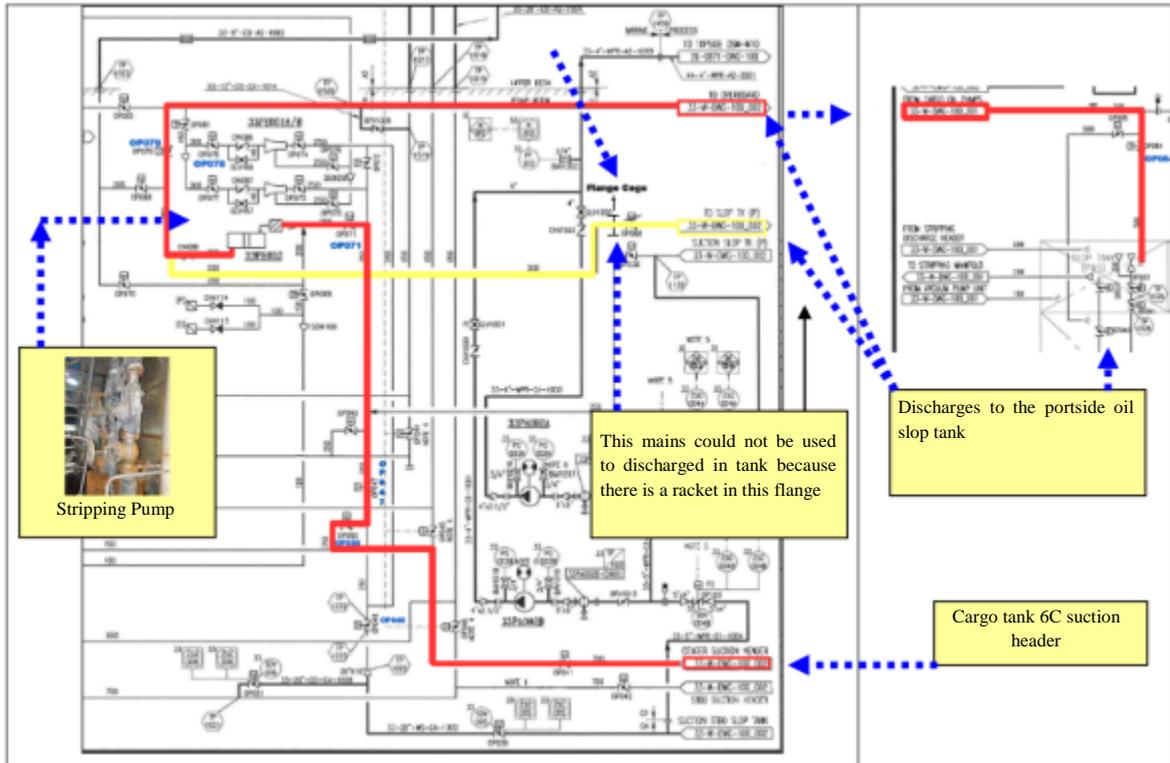
The diagram also shows another derivation in the pump discharge to the slop tank highlighted in yellow color. This stretch comprises a flanged connection¹ and valve OP-068 and is shorter than the



representation of the arrangement in red. However, it could not be used because valve OP-068 was damaged (internal passage). Therefore, this valve was unable to retain the tank’s content was the reason why the flanged connection was obstructed by a ratchet² on January 12th, 2014. This change will soon reveal itself as the weak spot of the network system used in the maneuver that will lead to the accident as will be further detailed.

¹ Flanged connections are easily disassembled connections mostly used for 51mm (2”) pipes or larger in the following cases: to connect pipes to valves and equipment (pumps, compressors, tanks, etc.) and also in certain stretches throughout the pipeline to facilitate disassembly. Note: as a general rule it is recommended to use the minimum amount of flanged connections as possible. A flanged connection is composed by two flanges, a set or case of bolts or case with threads and a sealing joint. (MARITIME, Professional Learning. Ministry of the Navy – Directorate of Ports and Coasts. **Principles of Machinery**. Rio de Janeiro, 1989).

² Rackets: used in network when it is needed a rigorous and absolute block. It is widely used onboard to isolate from pipes that are sporadically used. They are normally installed between two flanges forming a perfect sealant. (MARITIME, Professional Learning. Ministry of the Navy – Directorate of Ports and Coasts. **Principles of Machinery**. Rio de Janeiro, 1989).



Drawing 1 – network diagram

(f) Change in the alignment of the aspiration and discharge network during transfer maneuver and condensate leak:

On February 11th, 2015 after starting transfer it was seen that the level of tank 6C failed to lower, even with the stripping pump still running. Such fact may be explained by the malfunctioning of inner valves in tank 6C and slop tank, as the used suction network passed through both tanks. In an attempt to solve the issue the Vessel Supervisor decided to change the suction network of tank 6C from the central section to starboard (*stbd suction header*) through valves OP-042, OP-051, OP-048 and OP-071 in order to avoid passage through valves that could be defective. The temporary discharge destination in this arrangement was changed from the slop tank to cargo tank 2C through valve OP-080 as the starboard suction line was filled with raw condensate that should not be stored in the portside slop tank, also by decision of the Vessel Supervisor. Therefore, valve OP-084 should be closed. Consequently, by implementing this arrangement, the discharge network should be free up to tank 2C.



It was detected that, indeed, valve OP-084 was closed, but it was done while the stripping pump was still running at 8% of its working capacity, without the discharge flow to tank 2C (according to the new arrangement) being unblocked by valve OP 080. Table 1 clarifies this issue with the records of opening and close of valves, as well as the stripping pump start and stop commands obtained from the automation system logs.

Table 01 – valve and stripping pump – HD Cargo Ballast N/S 9RX7JG4S.

Events related to start and stop of stripping pump and handling of valves from the suction and discharge network.

Suction line valves **OP047, OP048, OP050 and OP071**

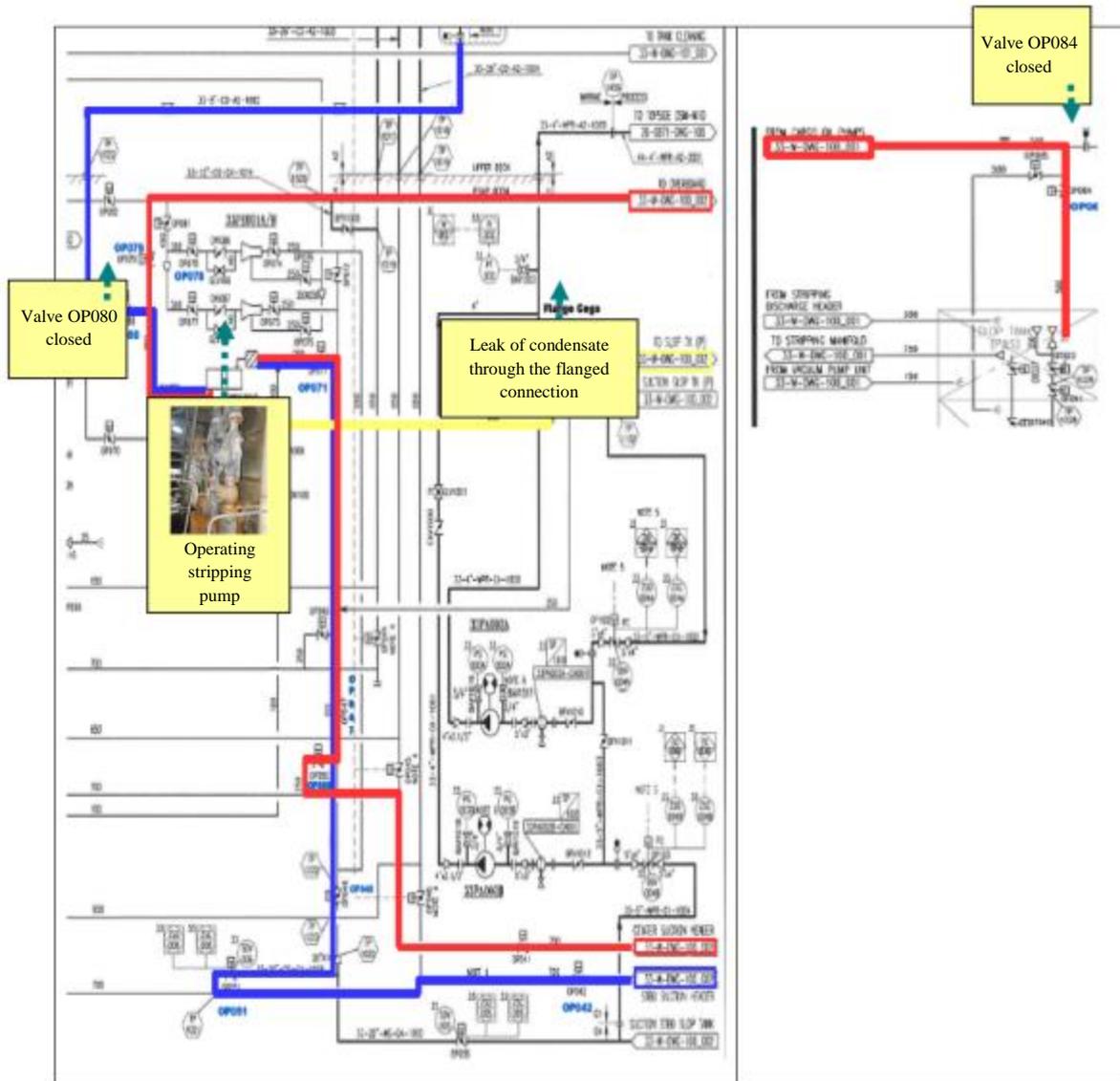
Discharge line valves: **OP079 and OP084.**

Event	Computer Time	Local Time corrected (-)4min	Stripping Pump	Suction network' valves				Discharge network' valves	
				OP047	OP048	OP050	OP071	OP079	OP084
01	08:57:09	08:53:09							open
02	08:57:14	08:53:14						open	
03	08:57:20	08:53:26					open		
04	08:57:26	08:53:26		open					
05	08:57:34	08:53:34				open			
06	08:57:55	08:53:55						open	
07	09:04:31	09:00:31	start (10%)						
08	11:31:35	11:27:31	started (8%)						
09	11:31:48	11:27:48							close
10	11:32:02	11:28:02				close			
11	11:33:44	11:29:44			open				
12	11:34:28	11:30:28	started (7%)						
13	11:34:30	11:30:30	stop (0)						
14	11:34:33	11:30:33							open
15	11:42:52	11:38:52					close		
16	11:42:59	11:38:59		close					
17	11:43:02	11:39:02							close
18	11:43:08	11:39:08						close	
19	11:43:14	11:39:14			close				
20	11:43:38	11:39:38						close	
21	11:43:52	11:39:52							close
22	12:10:03	12:06:03						open	

- Event 09 - at 11h31m48s valve OP084 (pump discharge line) was closed while the pump was still running.
- Event 13 – pump stopped at 11h34m30s.



As the stripping pump is of the positive displacement type³, its operation for more than two minutes with both valves OP-080 and OP-084 closed, caused the pressure to build up inside the discharge network provoking the leak of condensate by the flanged connection joint at upstream of valve OP-068. This arrangement is marked in blue color on Drawing 2 below.



Drawing 2 – network diagram indicating closed valves during operation of the stripping pump.

³ Positive displacement pumps have one or more cameras, where inside the movement of a propulsion component communicates pressure energy to the liquid, causing its flowing. They are of the type that each complete revolution demands the same amount of liquid and in order to vary the demand we have to alter the speed. The resistance imposed to the flowing does not change the demand (it is the amount of liquid a pump discharges in the time unit and at a certain discharge pressure, expressed in m³/h or l/min). (MARITIME, Professional Learning. Ministry of the Navy – Directorate of Ports and Coasts. **Ancillary Machinery II**. Rio de Janeiro, 1989).

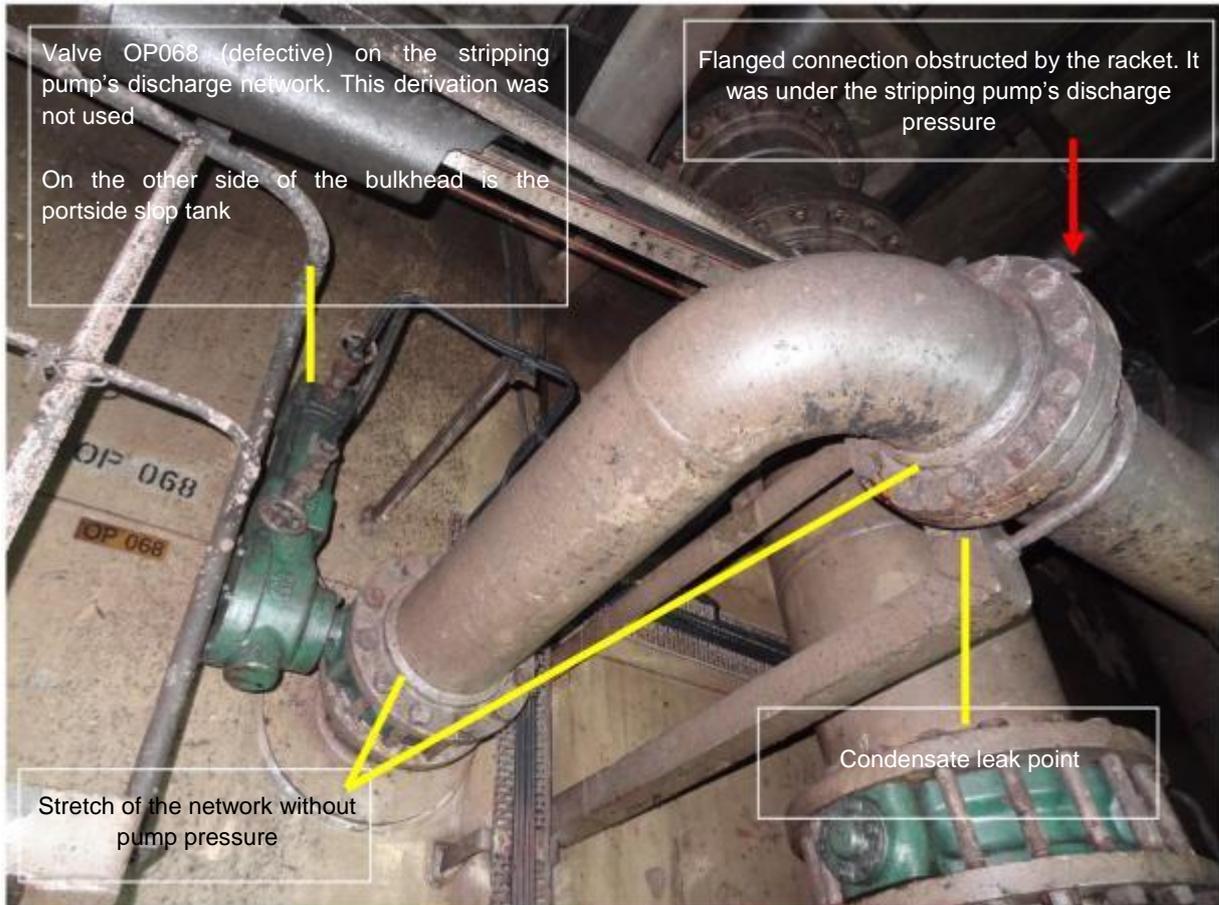


CCTV images extracted from the recording of camera 05 installed at the portside pump room show the leak of condensate:

<p>Picture 27 Camera 05 – 11-Feb-2015 – 10h07m01s – local time 11h30m17s no signs of leak.</p> <p>Leaked condensate will be seen dripping in this sector. Its source is in a positioned network, approximately 03 meters above that point as shown by the following image.</p>	<p>Picture 28 Camera 05 – 11-Feb-2015 – 10h07m07s – local time 11h30m23s the first signs of condensate leak appear (red circle).</p> <p>Camera lens with drops from condensate waste.</p>	<p>Picture 29 Camera 05 – 11-Feb-2015 – 10h28m55s – local time 11h52m11s 22 minutes later – traces of leak are considerable reduced. At this time the stripping pump was already shut down. (11h30m30s).</p> <p>The black spot with traces of condensate on the pipe is smaller, but the camera lens is more blurred with the product drops.</p>

(g) The weak point of the network system used in the maneuver

Considering the operational error of closing valve OP-084 while the pump was still running, this action alone would not cause the leak of condensate if the integrity of the flanged connection (obstructed by the racket) had been kept. It is worth emphasizing that the pump worked at 8% of its working capacity, its hydrostatic pressure was of 30kg/cm² and it had a safety system that would relief the pressure after reaching 16.5 Kg/cm², in addition to the whole cargo network being tested after manufacturing and installation with 1.5 times the working pressure (item 4.6.2 – 7.3 and 4.6.2 – 7.3.3 of ABS’ Rules).



Picture 30 – portside pump room



Picture 31



Picture 32

Details of the flange joint wearing
(Images obtained after leak – source PETROBRAS)

BW Offshore was asked about the installation racket and informed that the installation of such component was treated as routine operation without the need of approval by the Classification Society. The Classification Society ABS was also inquired, as the whole cargo as ballast transfer system was maintained in class, and ABS responded that it received no request from the Shipowner to install rackets and that it had not enough information to assess if the used material met all technical parameters involved. Facts demonstrated that the fragility of the flanged and ricketed connection allowed leak of condensate to the inside of the pump room.



(h) Hydrocarbon inside pump room:

Condensate that leaked as per the information from the Material Safety Data Sheet (MSDS) is a petroleum compound capable of forming hydrocarbon vapors, as provided by PETROBRAS. Effectively, this gas cloud existed and was generated from the condensate that leaked by the joint, sprinkled by the pressure and pool that was left on the floor. Moreover, soon after leak gas sensors were automatically triggered along with the corresponding gas alarm. Table 2 shows the dynamics of the gas sensors in the pump room according to the automation system logs.

Table 02 – gas sensors - subsystem HD Server B – N/S 3LN2CQ1H. Events that led to the activation of gas sensors in pump room followed by the corresponding alarm level. Gas cloud was concentrated at the lower levels of the compartment causing the triggering of the existing sensors at the lower level of the compartment (main floor): **TAG 73AB326, TAG 73AB327 and TAG 73AB37.**

Event	Computer time	Local time (corrected - 7min)	TAG 73AB326	TAG 73AB327	TAG 73AB370	TAG 73AB368	TAG 73AB369
01	11:38:04	11:31:04			HI		
02	11:38:18	11:31:18			HIHI		
03	11:39:16	11:32:16	HI				
04	11:40:27	11:33:27	HIHI				
05	11:41:59	11:34:59			FAULT		
06	11:42:46	11:35:46	FAULT				
07	11:43:06	11:36:06		HI			
08	11:43:32	11:36:32		HIHI			
09	11:44:34	11:37:34		FAULT			
10	11:44:36	11:37:36	NORMALIZED				
11	11:45:33	11:38:33			NORMALIZED		
12	11:45:36	11:38:36	HI - HIHI				
13	11:46:33	11:39:33			HI - HIHI		
14	11:47:22	11:40:22		HI - HIHI			
15	11:50:26	11:43:26	INHIBIT				
16	11:50:28	11:43:28			INHIBIT		
17	11:50:31	11:43:31		INHIBIT			
18	12:07:04	12:00:04	NORMALIZED				
19	12:08:03	12:01:03	HI - HIHI				
20	12:08:48	12:01:48				INHIBIT	
21	12:08:52	12:01:52					INHIBIT
22	12:09:54	12:02:54	NORMALIZED				
23	12:10:53	12:03:53	HI - HIHI				
24	12:12:20	12:05:20	NORMALIZED				
25	12:13:19	12:06:19	HI - HIHI				
26	12:44:52	12:37:52	NORMALIZED	NORMALIZED	NORMALIZED		



- HI (High level): indicates 20% of the lower explosive limit (LEL).
- HIHI (High-High level): indicates 80% of the LEL. With this indication the automation system closed automatically the compartment dampers and stops venting.
- FAULT: it means that the gas level is above 100% of the LEL (more than the sensor is capable of recording).
- NORMALIZED: sensor resumes its normal gas detection conditions.
- HI – HIHI (High and High-High level): it means the activation of the high and high-high levels were too close and marked at the same time.
- INHIBIT: it means that the sensor keeps detecting gas (if any) but it does not stop venting nor close compartment dampers.

Gas alarm signaling light. Images taken from camera 04, positioned at starboard of the pump room.

	
<p>Picture 33 Camera 04 - local time 11h31m52s. Camera is positioned to visualize the red signaling light that is triggered when the gas alarm is sounded as shown in the following image.</p>	<p>Picture 34 Camera 04 - local time 11h31m56s Red signaling light was turned on when the gas sensor TAG 73AB370 was activated with HIHI (11h31min18s) – delay of 18 seconds.</p>

It must be noticed that the platform’s automation system turns off the exhausters of the pump room in the event of a gas alarm as per the Matrix of Cause and Effect. Therefore, when alarms were sounded, the properties of the atmosphere inside the pump room were changed creating an emergency situation and turning the place into an area of high explosion risk. Therefore, the pump room presented characteristics similar of a confined space as per the provision of the Regulatory Standard No. 33 – SAFETY AND HEALTH AT WORKS IN CONFINED SPACES (NR-33) of the Ministry of Labor and Employment, which reads: “33.1.2 Confined Space is any area or environment not designed for continuous human presence, which has limited means to get in and out and whose inherent ventilation is not sufficient to remove contaminants or where there may be deficiency or enrichment of oxygen”. This Standard also sets out the concept of deficiency of oxygen as “atmosphere containing less than 20.9% oxygen in volume at normal atmospheric pressure, unless the reduction of said percentage is duly monitored and controlled”.



(i) Explosion:

Hydrocarbon cloud remained at the lower portion of the compartment as only the gas sensors installed at the bottom of the pump room were triggered, thus evidencing the presence of flammable gas (fuel) and oxygen (combustible). The source of the ignition that led to the explosion is still unknown, it could have occurred by a spark following the use of tools by the crew in the attempt to contain the leak, generation of static electricity following the use of fire hose during cleaning, or even utilization of handheld VHF radios, or also by the natural heating the compartment was submitted to after exhaustion stoppage, or an unknown cause. The CCTV images below show the exact moment of the explosion.

		
Picture 35 Camera 01 – local time 12h38m01s	Picture 36 Camera 01 – local time 12h38m03s	Picture 37 Camera 01 – local time 12h38m09s



<p>Picture 38 - camera 03 - 11/02/2015 – 11h14m42s - local time 12h37m58s</p>	<p>Picture 39 - camera 03 - 11/02/2015 – 11h14m45s - local time 12h38m01s</p>	<p>Picture 40 - camera 03 - 11/02/2015 – 11h14m48s - local time 12h38m04s</p>

(j) Noncompliance with the effective laws (standards, resolutions and codes):

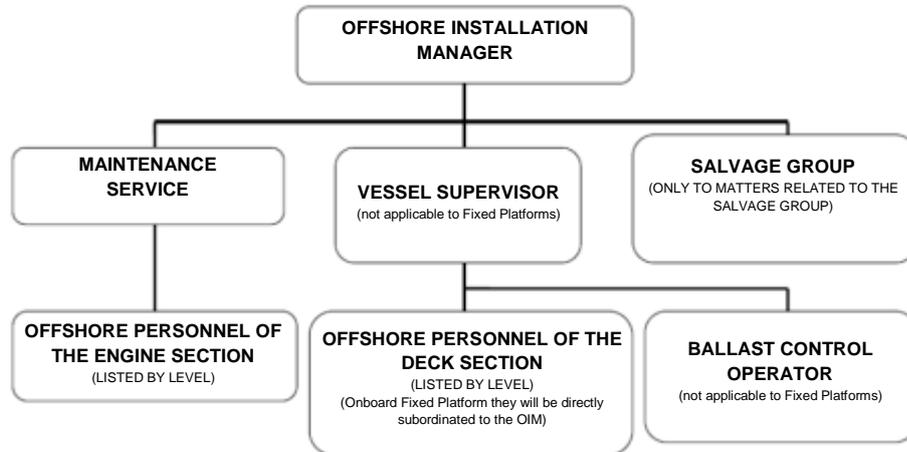
- **NORMAM-01/DPC** sets out in item 0117 that the safety crew of fixed and mobile platforms, FPSO, FSU and drillship of prospection or exploration of oil, is composed by offshore and non-offshore crewmembers due to the operational circumstances in which the units are involved. The non-offshore safety crew is set out in Resolution A.891 (21) of the International Maritime Organization (IMO), known as Operations Section and depending on the type of platform, it can be composed by:

- Offshore Installation Management (OIM) – Person officially designated by the shipowner, owner of company, **as the ultimate person in charge of the platform, to which every personnel onboard is subordinated to;**

- Vessel Supervisor – In charge of the control and operation of ballast in mobile units (not applicable to fixed platforms);

- Ballast Control Operator – Person in charge of carrying out ballast operations in mobile units (not applicable to fixed platforms); and

- Maintenance Supervisor – Person in charge of the inspection, operation, test and maintenance of machinery and equipment that is vital to the safety of the human life onboard and to prevent pollution that may be caused by the platform or its operations. Level and hierarchy of the personnel onboard platforms, FPSO, FSU and drillships will be prepared as per the flowchart below:



Therefore, according to the aforementioned standard, it is clear that the OIM is the one with ultimate responsible for the platform to whom every one onboard is subordinated to.

When performing his/her responsibility and authority onboard the platform, it shall fall upon the OIM to assess risks and decide on the entry of personnel inside the pump room as described in the **Chronologic Summary of the Accident**, although there was no doubt concerning the presence of gas in its interior.

The decision made, submitting crewmembers to risk situations, contradicted the safety procedures set out for such cases in several standards and instructions as described below:

- **Code for the Construction and Equipment of Mobile Offshore Drilling Units (MODU Code 1989)**, adopted by Resolution A.649(16), on October 19th, 1989, by which the platform was certified. Item 14.1 thereof, concerning the Platform’s Operations Manual, sets out that the referred manual must provide special procedures for events of uncontrolled leak of hydrocarbon and emergency shutdowns. In item 14.5 is set out that procedure to enter confined spaces must be those established in Resolution IMO A.1050(27).

- **Resolution IMO A.1050(27)** brings recommendations to get inside confined spaces onboard ships. This Resolution sets out the need to assess risks, permit to entry, general precautions, atmosphere tests, precautions during the staying of personnel inside confined spaces, etc. and also clarifies that accidents may occur, among other reasons, due to lack of caution by the involved personnel, and explicitly recommends the adoption of safety procedures.



- **Technical Regulation of the Operating Safety Management System of Offshore Installations of Drilling and Production of Oil and Natural Gas (SGSO)**, from the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (ANP), approved by Resolution ANP No. 3, of December 06th, 2007, published in Federal Official Gazette on December 07th, 2007, amended by the Federal Official Gazette on December 10th, 2007 and on December 12th, 2007. This Regulation applies to all platforms operating within Brazilian waters and deals, among other subjects, with the execution of works inside platform’s risk areas as described below: “**17.2 Permit-to-Work** - 17.2.1 The Installation Operator should establish a permit-to-work system and other means of control to manage activities inside risk areas. During the preparation of said system it must be considered: 17.2.1.1 The Installation Operator must set out the activity types that may pose risks to the Operating Safety and that require Permit-to-Work. 17.2.1.2 The Permit-to-Work must include additional precaution and mitigation measures that might be required for the execution of task with safety. 17.2.1.3 The need for previous analysis of the safety conditions to execute tasks, as well as of the existing hazards in the workplace. 17.2.2 The Installation Operator must ensure that the permit-to-work system: a) is documented and instructions and authorization forms are clear and concise and b) Sets out that controls and permits to work are approved by the appropriate level of management / supervision onboard the Installation. **17.3** - Monitoring – The Installation Operator will be in charge of: 17.3.1 Monitoring the performance of activities in compliance with the requirements set out in approved procedures, in permits-to-work and in related documentation and information. 17.3.2 Assuring permits-to-work and controls are used up to the conclusion of the works”.

- **Emergency Response and Contingency Plan of the FPSO Cidade de São Mateus**. This Plan, in item 4.1, presents the organizational chart of the emergency response and item 5 describes the role of the OIM as the “Strategist and Commander of Incidents”. At the control room, he/she would have the roles of implementing a command structure that would satisfy the organizational needs to protect life, environment and the installation, as well as deploying quick and efficiency actions to control incidents, as well as managing response actions to ensure that the escalating potential, risks of injury to personnel and damages to the installation are minimized.



Entry of personnel in the pump room without previous risk analysis, without the issuance of the permit-to-work document and without monitoring the room’s atmospheric conditions, represents a blatant case of noncompliance with the applicable standards.

(k) Failures in the onboard safety management system:

Platform has a Safety Management Certificate issued by classification society Det Norske Veritas/Norway and Germanischer Lloyd/Germany (DNV-GL) under the terms of the Internal Safety Management Code (ISM Code) valid until September 15th, 2019. This document attests that the platform was audited and that its safety management system meets the requirements of the ISM Code.

ISM Code is expressed in wide terms, capable of being applied in different management levels, both onshore and offshore, requiring varied levels of knowledge and awareness. According to the provision of the aforementioned Code, the groundings of a good safety management are the attitudes, commitment, competence and motivation of individuals, in all levels. Therefore, the Safety Management System must be structured and documented in order to allow the effective implementation of the company’s safety and environmental protection policy.

The goals of the Code are to ensure the safety at sea, prevention of human injuries and loss of life, as well as prevention of damages to the environment, particularly to the marine environment and to assets. In order to meet those goals the company’s safety management must continuously improve the personnel’s safety management skills both onshore and offshore, including emergency responses related to safety and environmental protection by ensuring compliance with mandatory rules and standards. Codes, guidelines and other applicable standards recommended by the Organization, Administrations, classification societies and maritime industrial agencies must also be taken into consideration.

The Code classifies the noncompliance of mandatory rules and standards in two types:

“**Noncompliance** – an observed situation where an objective evidence indicates the noncompliance of a specified requirement; and



Major noncompliance – an identifiable deviation that poses a serious threat to the safety of the personnel and/or of the ship, or a serious risk to the environment that requires immediate corrective action or lack of effective and systematic implementation of a requirement from the Code”.

In this particular event, the following failures were recorded:

(1) Document presented by BW Offshore do Brasil Ltda as the Safety Management Manual provides on its cover page the warning that procedures contained therein must be checked before being used as they concern a manual under development. Such warning shows that there is no procedure for immediate action in the event of emergency onboard, contradicting the safety management certification issued by DNV-GL;

(2) The stripping pump’s discharge network suffered change after installation of racket without the knowledge or consent of the classification society ABS;

(3) change in alignment of the stripping pump’s suction and discharge networks during condensate transfer maneuver from cargo tank 6C not taking into account the fragility of the discharge network against the installation of racket at the network’s flanged connection;

(4) Undue block of the stripping pump’s discharge network during the pump’s operation when draining cargo tank 6C by closing valve OP-084;

(5) Failure during shift handover between OIM’s due to incomplete operational information. Transfer maneuver of condensate from tank 6C was not mentioned in the Shift Handover Report of the relieved OIM. OIM of the next shift was only aware of the mentioned maneuver after sounding of the gas alarm;

(6) entrance of parties inside the pump room after detecting the presence of gas did not include identification and analysis of risks nor the issuance of the corresponding permits-to-work; and

(7) Nonexistence – in the manuals onboard – of special procedures for events of uncontrolled hydrocarbon leaks and emergency shutdowns inside pump room.

Such failures attest the inconsistency of the management system implemented onboard, allowing the adoption of improvised decisions that resulted in the noncompliances.



XI – PRELIMINARY LESSONS LEARNED AND CONCLUSION

(a) The existence of the Safety Management Certificate issued under the terms of the ISM Code is not enough to ensure safe operations onboard the platform. The company and the platform’s crew must adhere to the safety principles in order to establish safe working conditions during all operations onboard platforms.

(b) Inconsistency of the platform’s operation manuals and of the contingency plan may reflect disastrous consequences during emergency situations. Manuals need to be correctly prepared, understood and followed by the platform’s crew.

(c) It is required the commitment of operators and clients in maintaining the safety management principles of the platforms.

(d) Ignore the importance of a hydrocarbon leak may lead to devastating consequences to assets and lives onboard.

(e) Management of the platforms must be clear and adequately exercised. Shift changes must allow the transmission of all information related to ongoing operations in order to ensure the continuous control of planned actions. Shift changes must be done personally by following a preset schedule rather than being based only on written reports.

(f) The classification society must always be informed on changes to equipment maintained in class. In this particular case, it was verified that the change of the network without the knowledge and consent of the classification society proved to be a disaster to the accident’s outcome.

(g) Eventual modification needs in the selection of networks to perform pumping of hydrocarbons must consider the current situation of equipment and risks resulting from such modifications must be all assessed.

(h) Operations of the ballast system must have a training program with the purpose of keeping operators updated with the technical skills that allow them to be able to assess failure consequences in the command of valves and pumps.



(i) Training programs must emphasize requirements from the applicable laws concerning platform operations with special attention to the Regulatory Standards of the Ministry of Labor and Employment, of the Maritime Authority and of the National Agency of Petroleum, Natural Gas and Biofuels. During crises onboard this knowledge must be applied to avoid accidents, for example, unauthorized entrance inside compartment with confined space characteristics.

(j) Atmosphere inside a confined space may become lethal.

(k) It is mandatory to never get inside a space containing explosive atmosphere.

(l) The Platform’s Operation Manual and Contingency Plan must contemplate all requirements set out by the applicable laws.

(m) Crewmembers must comply with the procedures set out by Companies concerning safety standards, especially those concerning the correct utilization of safety equipment related to each task.

In face of everything that was investigated, it can be concluded that the accident resulted from leak of flammable substance in the pump room, which later allowed the formation of gas and consequent creation of explosive atmosphere that caused the explosion, not being possible to determine the ignition source.

XII – SAFETY RECOMMENDATIONS

(a) The Company must establish in its Annual Training Program for the crew, regular drills on procedures to get inside confined spaces and must designate, formally, the person in charge of the compliance;

(b) The Company must establish controls to ensure the entrance of personnel inside confined spaces to be done only after performing a risk analysis and issuing a Permit-to-Work, as well as to prevent entrance inside spaces containing explosive atmospheres;

(c) The whole safety management system –related to both the platform and the company – must be submitted to eventual audits by the classification society that issued the Safety Management Certificate and the Compliance Document;



(d) Platform’s Operation Manual and the Contingency Plan must be revised and updated according to the applicable laws;

(e) the company must carry out the rigorous supervision of the procedure of informing the classification society about changes in equipment and systems maintained in class; and

(f) ballast system operators must be submitted to a permanent training program with this system.

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XIII - ANNEX

Features of Unit “FPSO CIDADE DE SÃO MATEUS”.



**FEATURES OF UNIT
“FPSO CIDADE DE SÃO MATEUS”:**

2.1. Main features of the Unit:

Description

FPSO Cidade de São Mateus is a floating unit of production, storage and offloading of oil, as well as processing and exporting of gas with the following characteristics:

2.1.1. Physical Characteristics:

- a) Overall length = 322.07 m
- b) Length between perpendiculars = 310.00 m
- c) Boca = 54.50 m
- d) Depth = 29.50 m
- e) Tonnage = gross: 143,323; net: 42,996 metric tons
- f) Design draft = 19.8 m
- g) Accommodations = 85 personnel

This number may vary according to the life cycle of the installation or the need to perform activities requiring extra manpower, and it will be determined by the maximum allowed number of available slots for salvage equipment and depending on the rules set by specific regulations of the MODU Code, Ministry of Labor and Employment and of the Ministry of the Navy.