

# EXECUTIVE SUMMARY INCIDENT INVESTIGATION

## P-20 PLATFORM



OPERATIONAL SAFETY AND ENVIRONMENT  
SUPERINTENDENCY  
(SSM)

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## Executive Summary

In December 26<sup>th</sup> 2013, ANP received an Incident Communication reporting a major fire at P-20 platform, one of the 7 production units from Marlim Field/Campos Basin. The operator informed that the fire started at chemical storage tanks area and spread towards other modules quickly.

P-20 is a semi-submersible production platform, converted from a drilling rig in 1984. The unit is located 172 km offshore, in a 620 meters water depth and started its production in 1992. At the day of the accident, the platform was producing 20.000 bbl/d.

Just before the accident, a hot work was proceeded in order to install a support for a H<sub>2</sub>S scavenger injection pump in the chemical unit area. The task executor heard a noise and saw the fire at its beginning phase, inside the chemical storage skid. Immediately, he started trying to extinguish it using a portable fire extinguisher. Thus, after the use of a second one, an ethanol tank located nearby exploded, throwing the worker about one-meter distance away. The ethanol content spread over the unit main deck and increased the initial fire.

At that time, the supervisory system alarmed due to low pressure in central/portside process area firefighting water lines. In the course of the accident, some automatic deluge valves (ADV) were automatically activated due the pressure drop on the line, but others were manually activated.

As the fire was consuming the skid, several chemical product lines ruptured, leading tanks content to leak in the chemical unit skid and overflow, spreading over the unit main deck. Therefore, the fire reached a storage area close to the chemical unit, which led more fuel to increase fire.

While the material propagated in flames through the unit deck, the crew acted in order to avoid the fire propagation towards the accommodation module. To this end, the unit was deliberately heeled, with the consent of the Installation Manager. Therefore, the flame front moved towards the unit forward, far from the accommodation block.

The supervisory system received pressure drop signals related to the firefighting water lines, which should activate the firefighting pumps. Although, the electrical firefighting pumps failed to start due to damage in the electrical cables and the instrumentation bus caused by the fire. In addition, the diesel firefighting pumps had to be manually activated. During firefighting, firefighters felt water pressure decrease in the hoses.

The crew that were not related to the firefighting proceeded to the meeting point as oriented. At that time, the flame reached out and destroyed one of the portside lifeboats

access ladders, made of composite material, which could cause restriction to abandon capability.

Firefighting using only the resources available onboard was not enough to extinguish the fire, requiring mobilization of firefighting vessels. Fire was extinguished at 20:50 of the same day.

ANP convened a team to conduct an investigation, which identified the accident root causes and direct actions to avoid similar accidents.

The first causal factor was flammable material accumulated in the chemical unit skid base and its root cause was a failure in the open drainage system inspection routine. The inspections were not conducted in a weekly basis, as defined in the existing routine. Also, the inspection records did not specify the problems identified and the resulting corrective actions. An adequate functioning of the open drainage system could prevent the accident, since it would not allow flammable material to accumulate in the skid.

The second causal factor was the ignition of the flammable material accumulated in the skid. The investigation was not able to determine the ignition source; however, the most likely source was from the hot work performed in the chemical unit, shortly before the fire beginning. The work permit presented failures in the task monitoring and approval, as well as in the job safety hazards analysis. These failures potentially contributed to the ignition of the accumulated flammable material, causing the initial fire.

The third causal factor related to the accident was the ethanol tank rupture caused by overpressure, which was generated by vaporization of its content due to the fire. The deluge system, which aimed to cool down the tanks in case of fire, had been resized in the scope of the chemical unit management of change and should have more fusible plugs and water nozzles than the original one. Nevertheless, the modifications, although identified as required, were never implemented, having the deluge system remained in its original condition.

In this way, as the ethanol tank was exposed to the heat of the fire, its content was evaporated, leading to overpressure inside the tank. In addition, the pressure relief device installed in the tank was a vent, which did not take into account fire condition, as API 2000 standard requires. Thus, the system was only able to relieve pressure caused by tank inbreathing/outbreathing or ambient temperature variation. As a result, the vent diameter was insufficient to relieve the vapor flowrate derived from the fire and the tank collapsed.

The fourth causal factor was the flammable material spreading over the unit deck. The tank collapsed in its side-welded joint, in such a position that the leakage could not be restricted to the skid. Moreover, there was loss of containment from the other chemical products tanks inside the skid. The open drainage dimensioning was based on criteria that

were not supported by engineering standards or good practices, thus the drainage system was not able to manage all the flowrate resulting by the tank rupture.

The fifth and last causal factor was the decrease in water availability during firefighting activity. Firefighters reported irregularities in water pressure, demanding the diesel firefighting pumps to be manually activated, when the pumps should be automatically activated. Electrical pumps should have actuated, nonetheless, their electrical feed cables were not fire retardant and were routed only through the fire extension zone, even though the classification society had noticed the operator to comply with its standards, which included requirements regarding the cables, in the occasion of the management of change concluded in 2011.

Emergency response actions comprised mobilization of the unit fire brigade and firefighting vessels. The investigation pointed deficiencies in the fire brigade and non-compliances with Emergency Response Plan, as well as malfunctioning of the emergency alarm and communication radios.

ANP investigation team has also assessed the action plan proposed by the Operator's investigation commission. It concluded that the majority of the recommendations were corrections, which allowed the unit to recover its operational condition, to the detriment of preventive actions, which would be improvements in the management system that could prevent a similar accident to happen again.

As result of the investigation, ANP issued seven mandatory recommendations for the industry, which aim to prevent the recurrence of similar incident in production platforms operating in Brazil.

The present accident, although not having caused fatalities or irreversible damage to the unit, proved to have potential for that. The circumstances reveal that, if some factors were slightly different, the accident could have had more severe consequences. The existence of fire fighting vessels near the unit location and the success of the heeling maneuver are examples of fortuitous events that have contributed to lessen the consequences of the accident.

The fire analyzed in this investigation was a typical process safety accident, since several factors contributed to its occurrence, ranging from the design of the unit, to problems related to change management, maintenance of integrity and failures in work permit. These aspects are among the management practices that comprise the greater amounts of non-compliances in SSM inspection activities, reinforcing the importance of ANP continuous presence in the regulated facilities.

An important issue raised by the investigation is the disparity between the safety philosophy from the unit design and newer revisions of that document. P-20 safety

philosophy, which dates back to 20 years ago, reveals itself more a descriptive of the unit's safety systems than a set of requirements governing the design of these systems. In this way, older units, which are at the end of their lifecycle, do not comply with current requirements, in terms of safety systems. Considering that a significant number of units in operation in Brazil, mainly in the Campos Basin, is in this situation, this issue should motivate studies and actions by the Regulatory Body.

As a result of this investigation, seven mandatory recommendations for the industry were elaborated, whose objective is to avoid the occurrence of this type of accident in other production platforms operating in Brazil:

Root cause	Recommendation	Deadline <sup>1</sup>
RC 1: Accumulation of combustible material at the skid base	R1: Elaborate, document and control open drains inspection and cleaning procedures, including conducting tests of effectiveness.	6 months
RC 4: Lack of fusible plugs and sprinkler nozzles	R2: Ensure that the management of change system comprises the assessment of the safety systems affected by the change and the actions required to adapt these systems. Operator shall ensure that the management of change process is considered completed only after the implementation of the necessary actions.	12 months
RC 5: Failure in the dimensioning of the tanks vents	R3: Operator shall verify the design of relief devices installed at tanks containing flammable chemical products, taking the necessary actions in accordance with standards and best practices if nonconformities are identified. The result of this verification must be registered in a report.	6 months
RC 6: Inadequate design of the drainage system	R4: Operator shall verify the design of open drains inside skids of flammable chemical units, taking the necessary actions in accordance with standards and best practices if nonconformities are identified. The result of this verification must be registered in a report.	6 months
RC 7: Malfunctioning of the electrical fire pumps	R5: Operator shall verify the design of feed cables for electrical firefighting pumps, taking the necessary actions in accordance with standards and best practices if nonconformities are identified. The result of this verification must be registered in a report.	6 months

<sup>1</sup> Deadline for implementing the recommendations will start from the date (in March 2018) Operators are notified to implement them,

Root cause	Recommendation	Deadline <sup>1</sup>
RC 8: Malfunctioning of the diesel fire pumps	R6: Review the firefighting pumps actuation in relation to the cause and effect matrix, and verify the operation of these equipment in the specified condition.	6 months
-	R7: Ensure that the executing a critical analysis of the response after the activation of Emergency Response Team (due to an accident or a drill) is mandatory. The analysis report shall mention Emergency Response Team members with their functions in the ERT.	6 months

Some of the lessons learned from this investigation are already being put into practice by ANP inspection teams. As an example we can mention the contribution of failures related to the design and maintenance of the unit open drainage system to the circumstances of the accident. This system is the object of a specific project carried out by ANP, which aims to diagnose the situation of drainage systems in production platforms operating in Brazil.

Likewise, operators are expected to proceed in order to apply knowledge derived from the investigation report, seeking continuous improvement of their operational safety management systems.