

# Investigation report

## Report

Report title Report of the investigation into the man-overboard incident on <i>Scarabeo 8</i> on 20 February 2015	Activity number 401003010
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## Security grading

<input checked="" type="checkbox"/> Public	<input type="checkbox"/> Restricted	<input type="checkbox"/> Strictly confidential
<input type="checkbox"/> Not publicly available	<input type="checkbox"/> Confidential	

## Summary

A man fell overboard from the mobile drilling unit *Scarabeo 8* at about 04.08 on Friday 20 February 2015. The Petroleum Safety Authority Norway (PSA) was notified at 05.45 on the same day.

The incident occurred when subsea personnel were preparing to bring the blowout preventer (BOP) back into service after about four weeks of maintenance. Two subsea engineers were working in the moonpool area at the time of the incident. They entered the BOP carrier used to move the unit between the well centre and the parked position. The senior subsea engineer descended the ladder which leads to a small access platform on the carrier. As he stepped off the ladder onto the grating, he fell through a gap directly into the sea. The other subsea engineer observed the fall and threw a lifebuoy to the person in the sea.

The man-overboard alarm was sounded via *Scarabeo 8*'s control room on the bridge to the *Esvagt Aurora* standby ship. The crew of the latter mobilised the MOB boat and picked up the person from the water. He was flown by helicopter from the standby ship to hospital for a check and treatment. No serious injuries were found.

The direct cause of the incident was the missing grating on the BOP carrier platform, probably as a result of high seas ahead of the incident.

Under slightly different circumstances, the senior subsea engineer could have suffered serious injuries or been killed.

## Involved

Main group T-F	Approved by/date Leif J Dalsgaard/14 April 2015
Members of the investigation team Bjørnar Heide and Eva Hølmebakk	Investigation leader Bjarte Rødne

## **Contents**

(må lages på nytt)

## 1 Summary

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Under slightly different circumstances, the senior subsea engineer could have suffered serious injuries or been killed.

### Consequences

The actual consequence was that a man fell overboard.

### Potential consequences

The most serious potential consequence was that the person concerned could have died.

### Investigation

The PSA decided on Friday 20 February 2015 to conduct its own investigation of the incident, with departure for *Scarabeo 8* the following morning.

### Nonconformities

Four nonconformities were identified by the investigation. These related to

- maintenance of gratings
- barrier management
- maintenance management
- expertise and training.

## 2 Introduction

*Scarabeo 8* is a sixth-generation semi-submersible drilling rig. It was completed in 2012 and received an acknowledgement of compliance (AoC) on 4 May 2012. The facility is registered in the Bahamas and classed by DNV GL. *Scarabeo 8* is drilling for Eni on the Goliat field.



Figure 1 Scarabeo 8 – source: [www.saipem.no](http://www.saipem.no).

A man-overboard incident occurred on 20 February 2015 in connection with the completion of BOP maintenance on Saipem's *Scarabeo 8* unit. The PSA decided on the same day to conduct its own investigation of the incident, with departure for *Scarabeo 8* the morning after.

Composition of the investigation team:

- Bjarte Rødne            F-Logistics and emergency preparedness, investigation leader
- Bjørnar Heide        F-Process integrity
- Eva Hølmebakk        F-Working environment

The investigation has been conducted through interviews of personnel in the land and offshore organisations, verification on *Scarabeo 8*, including inspection of the incident site, and assessment of governing documents and Saipem/Eni's own investigation report.

The person who fell into the sea and *Scarabeo 8*'s rig manager were subsequently interviewed on land.

Underlying causes of the incident were identified on the basis of human-technology-organisation (HTO) thinking.

## Mandate for the investigation

- a. *Clarify the incident's scope and course of events (normally with the aid of an HTO diagram), with an emphasis on safety, working environment and emergency preparedness aspects*
- b. *Assess the actual and potential consequences*
  1. *Harm caused to people, material assets and the environment*
  2. *The potential of the incident to harm people, material assets and the environment*
- c. *Assess direct and underlying causes, with an emphasis on HTO aspects, from a barrier perspective*
- d. *Discuss and describe possible uncertainties/unclear aspects*
- e. *Identify nonconformities and improvement points related to the regulations (and internal requirements)*
- f. *Assess the player's own investigation report*
- g. *Prepare a report and a covering letter (possibly with proposals for the use of reactions) in accordance with the template*
- h. *Discuss barriers which have functioned (in other words, those which have helped to prevent a hazard from developing into an accident, or which have reduced the consequences of an accident)*
- i. *Recommend and normally contribute to further follow-up*

Restriction of the investigation:

The investigation team has not gone into the secondary emergency response to the incident.

## 3 Course of events

### 3.1 Background information

On behalf of the licensees in production licence 229 (Goliat), Eni obtained consent on 30 November 2012 for production drilling with *Scarabeo 8*, operated by Saipem Norwegian Branch. Eni estimated a start in December 2012 and a duration of about 1 075 days.

The BOP on *Scarabeo 8* was retrieved from the sea around 24 January 2015 for routine maintenance after about six months in the water. In that connection, the BOP carrier was used to move the BOP from the well centre to its parked position on deck. The BOP carrier is located in the moonpool area on the main deck, about 14.5 metres above sea level.

Standby vessel *Esvagt Aurora* had not been ordered to lie in close standby – in other words, about 500 metres from *Scarabeo 8* – since work on the BOP carrier is not defined as “work over the sea”.

The podlines to the BOP are led between banana sheaves in order to protect them against traction as a result of heave. One banana sheave is attached above and one below on each podline when the BOP is taken into use. The banana sheave is intended to prevent the podline from bending too much when installed.



Figure 2 Banana sheave installed on podline in normal use

The yellow banana sheave (for the yellow podline) due to be installed in connection with readying the BOP lay on the lower access platform on the fore starboard side of the BOP carrier (hereafter called the site). The access platform is shown in figure 3.

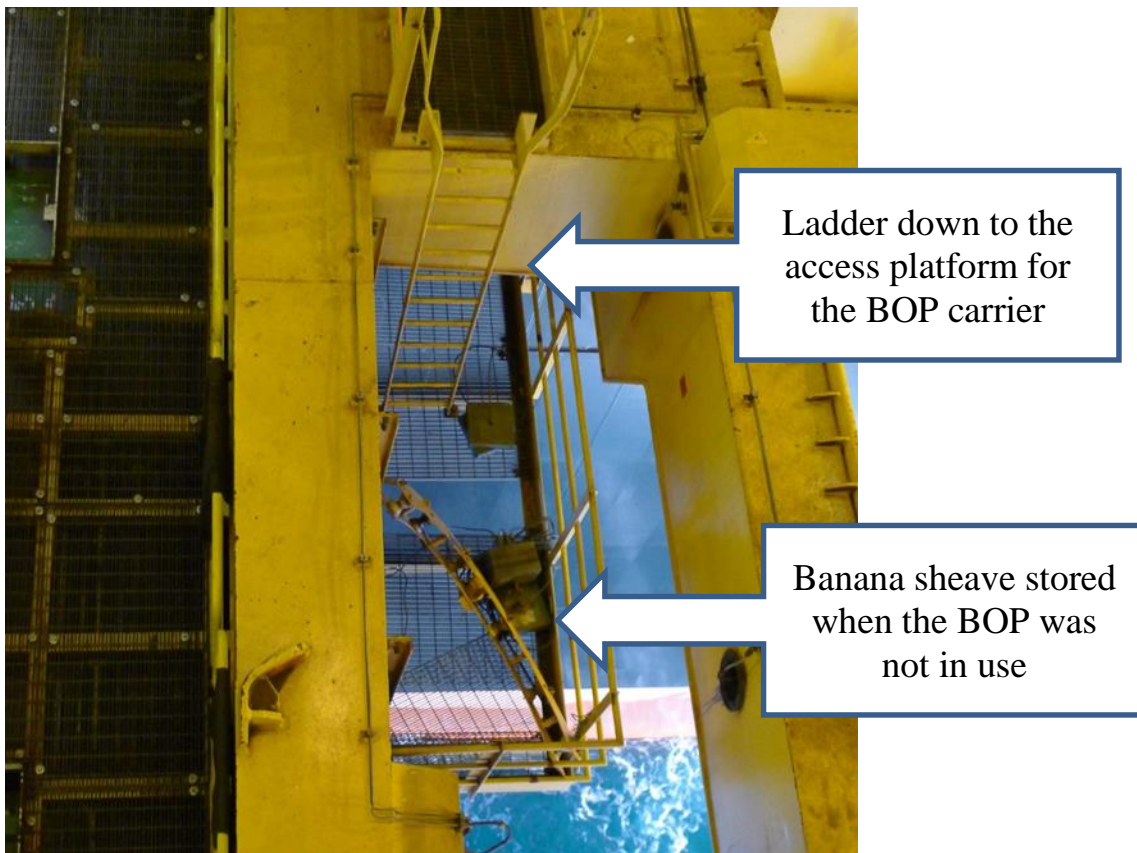


Figure 3 View down to the cordoned-off site/access platform for the BOP carrier.

*Scarabeo 8* has two permanent subsea engineers (SEs) in each crew, one of whom is the senior subsea engineer (senior SE). These two normally work alone on separate shifts. While maintenance was under way on the BOP, Saipem had hired in extra SEs from Petro Support West (hereafter PSW). A hired SE worked on the night shift with the senior SE from 14-20 February 7.

Figure 4 show the site in daylight after the incident when the senior SE fell through the missing grating.

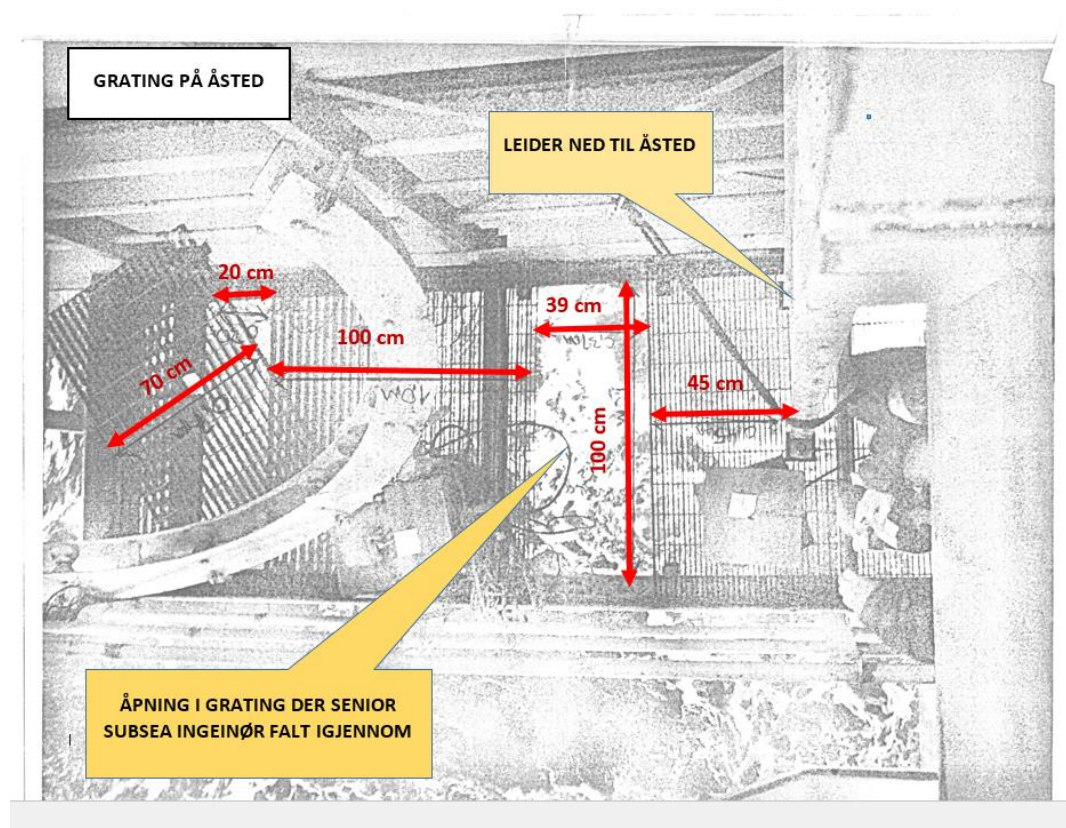


Figure 4 Site with measurements.

Key: Grating at the site; Ladder down to the site; Gap in the grating which the senior SE fell through.

### 3.2 Chronology

15 January 2010

Product certificate issued for the BOP carrier by Det Norske Veritas.

2012-2015

*Scarabeo 8* suffered damage to gratings on gangways from bad weather during its time on the Norwegian continental shelf (NCS). The exact number of incidents and dates were not known to the personnel interviewed, but at least two were suggested.

- 5 January 2013  
An event report described damaged gratings found on the seabed by an ROV. The report indicates that they hail from the starboard and port stairs to the sea, dislodged during the first storm at the location.
- 26 February 2013  
An event report described damaged gratings on the fore starboard cantilever gangway and stairs.

Around 24 January 2015

The BOP was retrieved from the sea for maintenance after about six months' use.

6 February 2015

Maintenance carried out on the BOP carrier. The grating was probably in use on this date.

7-13 February 2015

A good deal of bad weather was experienced in this period, including a storm with wind speeds gusting up to 46.3 m/s on 10 February. All helicopter flights were cancelled.

8 February 2015

An event report described damage to gratings on the aft starboard and port stairs. The damage was dated 7 February 2015.

12 February 2015

Report dated 12 February 2015 contained photos and descriptions of damage to aluminium gratings on gangways, including the fore starboard side of the upper deck. The escape route on the fore starboard side of the upper deck was closed off while awaiting equipment to repair the damage, which was about nine metres higher up than the site where the senior SE fell overboard.

14 February 2015

Hired SE arrived on *Scarabeo 8* to assist in readying the BOP.

17 February 2015

Crew change, including senior SE on *Scarabeo 8*. He was informed about the storm which had occurred, and entered night rotation with the hired SE from PSW.

19 February 2015

The rig manager on *Scarabeo 8* went home earlier than planned, with the daytime stability manager taking over this role. A new daytime stability manager arrived on *Scarabeo 8* the same day.

19 February 2015, 19.00

The SEs came on duty. Their job was to ready the BOP. This was a routine operation, with no work permit required.

20 February 2015, 00.00 to about 04.00

The SEs carried out the final checks before the BOP could be moved from its parked position to the well centre. They each had a radio, but these were left in the subsea workshop at some point after the night lunch.

20 February 2015, about 02.00

The *Troms Pollux* service vessel laid to the port side of *Scarabeo 8* for loading of drilling water and diesel oil.

20 February 2015, about 02.35

The *Stril Barents* service vessel laid to the starboard side of *Scarabeo 8* for cargo handling.



20 February 2015, about 03.45

The driller and assistant driller worked on the drill floor to prepare for BOP running.

20 February 2015, 04.00

Wave height 2.1 metres Hs, ref data from *Scarabeo 8*.

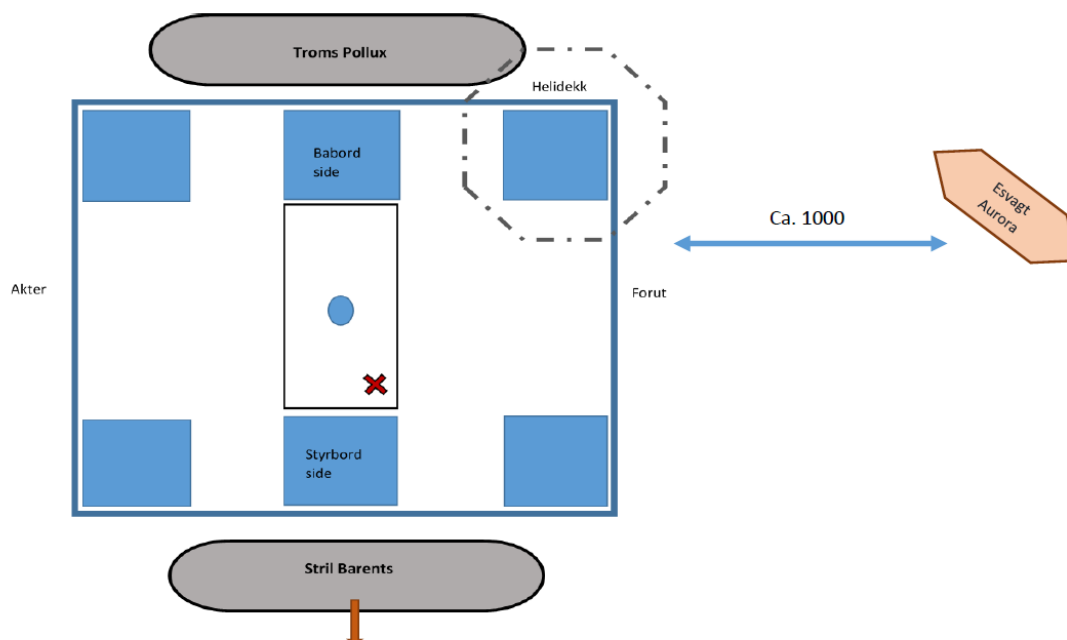


Figure 5 Overview of columns, ships and site around 04.00 on 20 February 2015. The red arrow shows the move of Stril Barents at the request of Scarabeo 8 after the incident occurred.

Key: Helidekk; Port side; Aft; Forepart; Port side

20 February 2015, about 04.XX

The senior SE descended the ladder to the site to check the condition of the rollers on the yellow banana sheave. The hired SE stood at the top of the ladder, and saw the senior SE suddenly disappear.

The hired SE shouted “man overboard”, and concentrated on seeing where the senior SE resurfaced. He then fetched the lifebuoy, threw it down and maintained visual contact while continuing to shout “man overboard”. The senior SE was easy to see in the water. He got up onto the lifebuoy, waved its light and shouted, but it was difficult to hear him.

The hired SI got no response to his shouts, since there were no personnel nearby. He did not want to leave the spot where he could observe the senior SE to fetch a radio.

The senior SE explained later that he looked down at the platform before stepping onto it, but saw nothing abnormal. He suddenly “realised” he was in the water. It was difficult for him to orient himself, and he explained that he swam to where there was most light. He could not see if there were personnel in the moonpool area who saw him, but he saw that the lifebuoy was thrown. He tried to keep in the centre of the light (the moonpool) from the time he secured the lifebuoy until he was rescued at 04.17. Lighting on the BOP carrier’s access platform is also fairly good at night. On the other hand, inspection during the investigation showed that the contrast between grating and sea is limited when the sea is calm and has little white foam on its surface.

20 February 2015, about 04.XX

The assistant driller was told by the driller to go down to the moonpool area and contact the SEs in connection with preparing to run the BOP. It was chance that this happened at just that moment.

20 February 2015, about 04.XX

On arrival at the moonpool, the assistant driller received the man-overboard message from the hired SE. He immediately notified the driller by radio on his way to the subsea workshop, where he called the control room on the bridge.

20 February 2015, 04.10

The control room operator received the man-overboard message. This was logged.

20 February 2015, 04.11

The bridge called up *Esvagt Aurora*, which was about 1 000 metres from *Scarabeo 8*. The standby ship launched its MOB boat and headed for the rig. *Stril Barents*, handling cargo on the starboard side, was told by the bridge to move away from *Scarabeo 8*. *Troms Pollux* was linked to *Scarabeo 8* by hoses and stayed put on the port side.

20 February 2015, 04.13 to 04.17

A general alarm was sounded on *Scarabeo 8*. The emergency response team mustered. Personnel in the moonpool area readied possible alternative means of rescue, including a Manrider harness.

20 February 2015, 0417

The bridge was informed by *Esvagt Aurora* that the senior SE was on its MOB boat. Personnel in the moonpool area saw the senior SE get picked up from the sea by *Esvagt Aurora*'s MOB boat.

20 February 2015, 04.20

The bridge was informed that the senior SE was on board *Esvagt Aurora*.

20 February 2015, about 04:XX

One person was missing in the first personnel on board (POB) count.

20 February 2015, 04.32

A complete POB on *Scarabeo 8* with the second count, including the man overboard.

20 February 2015, 05.57

Search and rescue (SAR) helicopter arrived at *Esvagt Aurora*.

20 February 2015, 06.25

SAR helicopter took the senior SE from *Esvagt Aurora* to Hammerfest hospital.

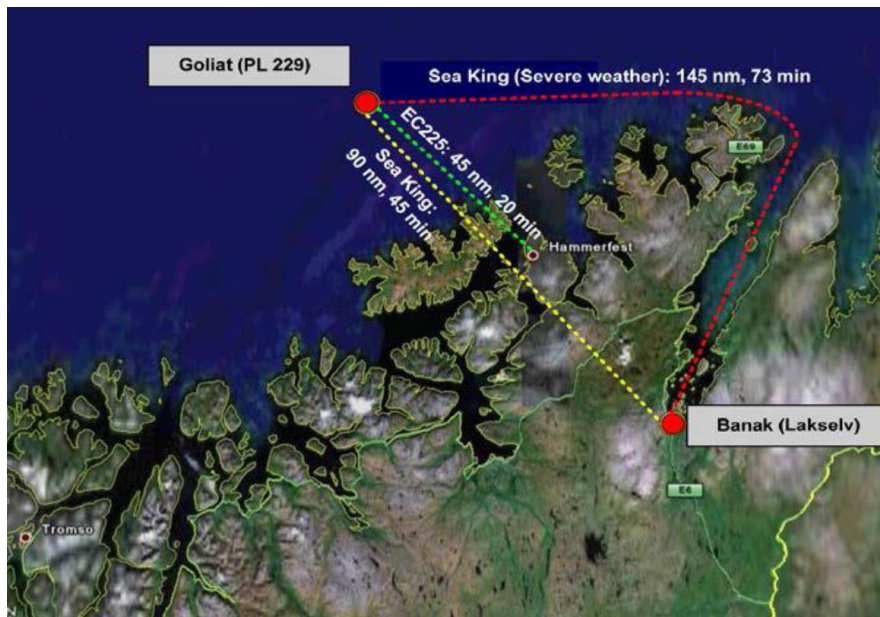
20 February 2015, 07.18

Wave height one metre Hs, according to weather data from *Esvagt Aurora*.

### 3.3 Local conditions

*Scarabeo 8* is conducting production drilling for Eni on the Goliat field at 71°N off Hammerfest. The unit is designed to operate in -20°C, and a number of winterisation solutions have been incorporated – including aluminium gratings with heating cables in various parts of the facility.

Flying time by helicopter to/from Goliat is about 20 minutes for Hammerfest and roughly 50 minutes for Tromsø. The SAR helicopter in Hammerfest has a response time of 15 minutes while flights are under way, and up to an hour for the rest of the day. The Sea King helicopter in Banak has an estimated flight time to Goliat of 45-73 minute, depending on weather conditions.



Weather conditions during the winter season may present challenges for flight regularity. These challenges are not specific to Goliat, but the combination of several factors, such as weather and distance, could be greater overall in the far north than further south on the NCS.

## 4 Potential of the incident

### Actual consequence

The senior SE suffered minor injuries to his face and was generally chilled from his time in the sea. He was flown from the standby vessel to Hammerfest and then to Tromsø hospital. He was discharged two days later without identified injuries.

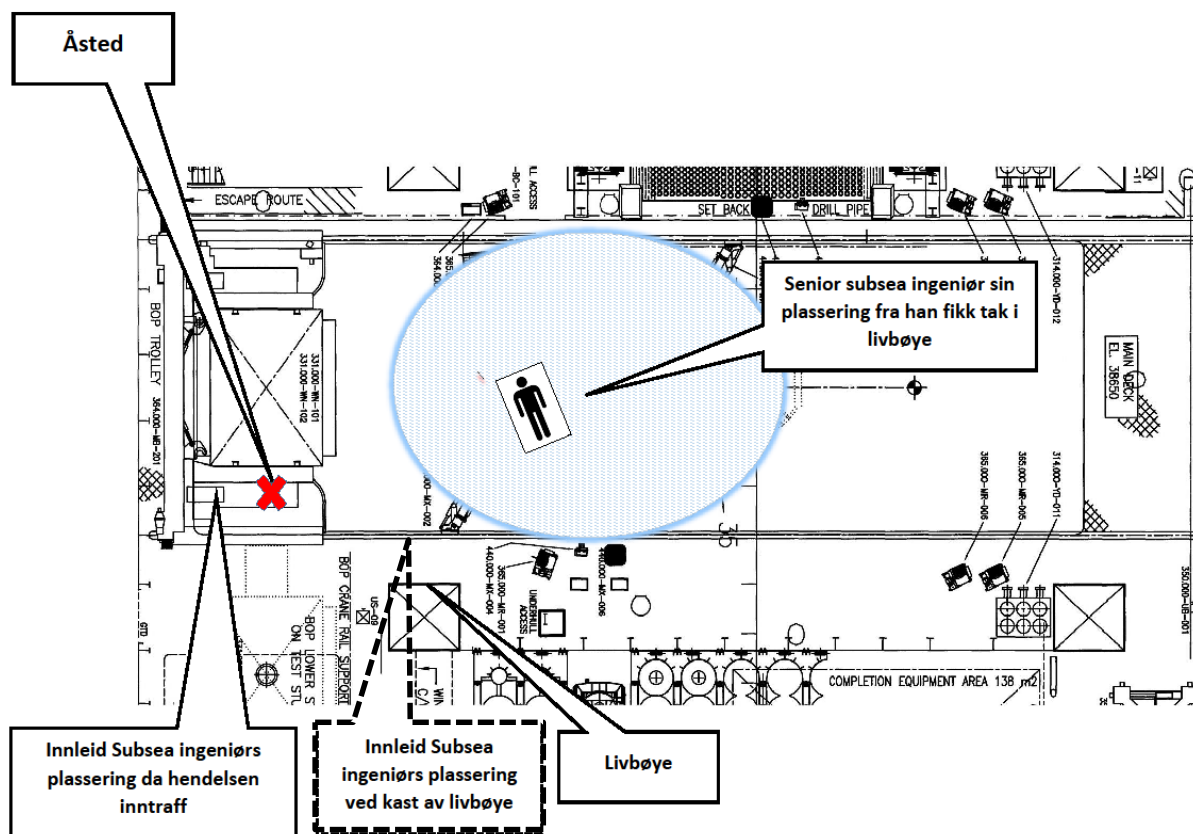


Figure 6 Overview of moonpool area when the incident occurred.

Key: Site; Senior SE's location after he secured the lifebuoy; Hired SE's location when the incident occurred; Hired SE's location when he threw the lifebuoy; Lifebuoy

## Potential consequences

SEs normally work alone. Extra personnel may be deployed for BOP maintenance, as in this case, but it is not unusual for subsea personnel to work alone in various parts of the moonpool area. The chance that such an incident would have been unobserved is high.

A fall from 13.5 metres is characterised as a high-energy trauma since it can cause life-threatening internal injuries – bleeding and crushing (*Norsk indeks for medisinsk nødhjelp*).

Poorer weather with more waves and wind would have increased the threat to the senior SE. He could have been thrown against the structure or one of the vessels lying by *Scarabeo 8*.

The actual rescue of the person in the sea with an MOB boat would have been harder and riskier under tougher weather conditions.

Had the fall through the grating caused head, arm or leg injuries, the senior SE could have hit the water without being able to reach the lifebuoy, and in the worst case been unable to remain afloat. The water temperature and exposure to cold from immersion (sinking in the sea) can be life-threatening and is a direct cause of many fatalities.

If weather conditions had been worse, with higher waves, stronger wind, lower sea temperature or a combination of these, the risk would have increased of cold shock (0-3

minutes), reduced muscle function/coordination (3-30 minutes), hypothermia (after 30 minutes) and injury during and after rescue.

These factors are described in more detail below.

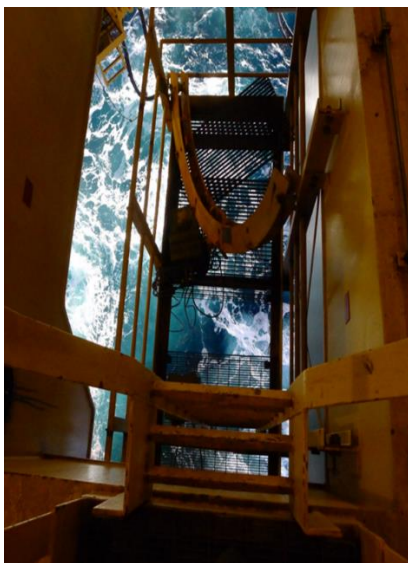
- In extreme cases, cold shock can cause cardiac arrest. It can also cause hyperventilation with possible inhalation of water and drowning. The water temperature was 6°C when the incident occurred.
- In addition, even good swimmers may have problems swimming two-three metres during the initial minutes after immersion in cold water, probably because of problems coordinating swimming strokes with lung ventilation.
- Chilling of the muscles can cause muscle fatigue and reduced muscular coordination, which can result in downing if the necessary buoyancy aid is lacking.
- The speed of body cooling is determined by water temperature, waves and currents in the sea and the insulating ability of clothing. The senior SE was wearing ordinary cotton clothes and coveralls in addition to protective equipment such as gloves, hard hat and boots. His garments had little insulating effect, and also reduced his buoyancy.
- Twenty per cent of deaths from immersion occur in the rescue phase. This is partly because reduced blood flow to the cardiac muscle in chilled condition, combined with increased cardiac activity owing to expectations of rescue, can cut oxygen supply to the heart.

To sum up, the senior SE could, under slightly different circumstances, have suffered serious injuries or died.

## 5 Direct and underlying causes

### 5.1 Direct cause

The direct cause of the incident was the missing grating on the BOP carrier platform.



*Figure 7: The gap in the grating on the BOP carrier platform which the person fell through.*

## 5.2 Underlying causes

### 5.2.1 Bad weather

Much bad weather was experienced in the area where *Scarabeo 8* is operating during the two weeks before the incident. Damage to gratings at the aft end of *Scarabeo 8* is documented on 7 February. A separate report dated 12 February documented further areas of damage. This damage was caused by a combination of heavy weather and design of the unit. The shape of its six columns, with broad vertical surfaces combined with fairly fine-meshed gratings on external gangways, has given wind and waves good conditions to build up with great force. The bad weather probably also displaced part of the grating on the BOP carrier access platform. That left gaps somebody could fall through. See nonconformities 6.1.1 and 6.1.2.

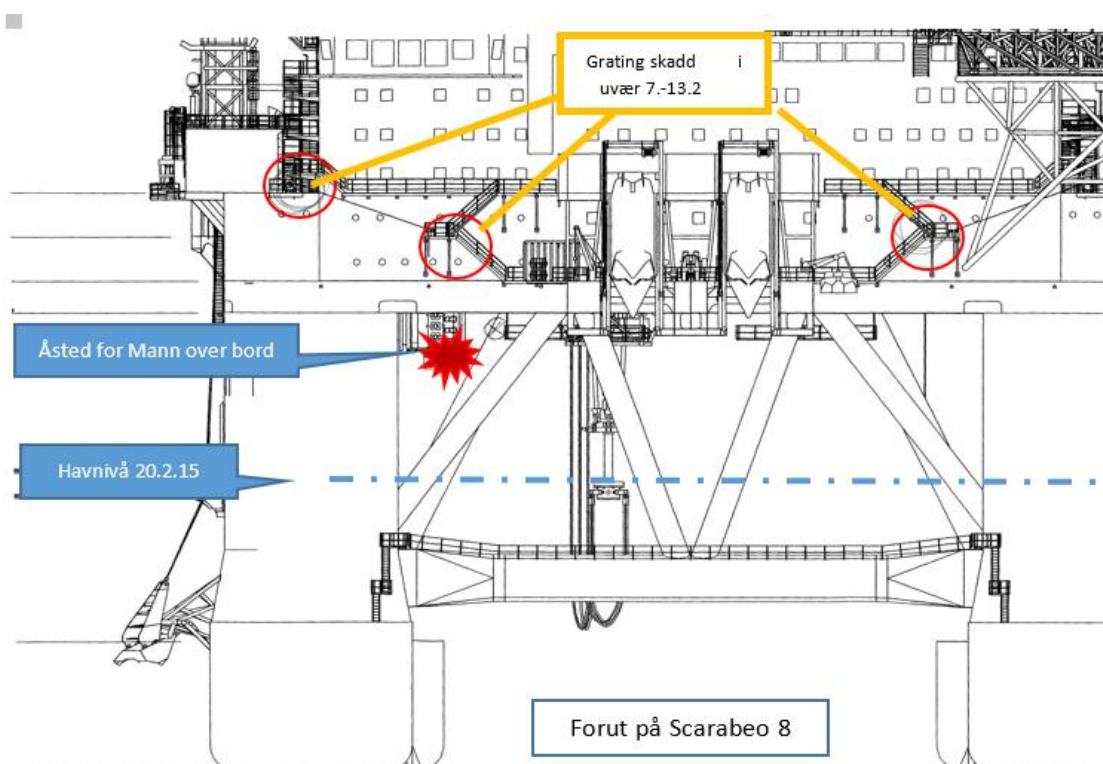


Figure 8 Overview of damaged gratings at various levels following the bad weather on 7-13 February 2015.

Key: Grating damaged in bad weather 7-13 Feb; Man-overboard site; Sea level 20 Feb; Forepart of Scarabeo 8

### 5.2.2 Maintenance

Gratings do not have their own tag in the *Scarabeo 8* maintenance system. They are checked periodically in connection with dropped object inspections, but no adequate check was made to detect missing gratings was made after bad weather. See nonconformities 6.1.1 and 6.1.2.

### 5.2.3 Location of banana sheaves

Banana sheaves on *Scarabeo 8* have no dedicated stowage location when not in use. Three of these sheaves are used on *Scarabeo 8*, coloured yellow, white and blue. The white and blue were stowed on the actual BOP carrier deck, while the yellow was located at the time of the incident on the BOP carrier platform. This placement meant that the senior SE had to descend to the platform to check the yellow sheave's condition. See improvement point 6.2.1.

## 6 Observations

The PSA's observations fall generally into two categories:

- nonconformities: observations where the PSA believes that regulations have been breached
- improvement points: observations where deficiencies are found, but insufficient information is available to establish a breach of the regulations.

### 6.1 Nonconformities

#### 6.1.1 Maintenance of gratings

##### Nonconformity

After periods of bad weather, inspections did not cover all affected areas in order to prevent faults and hazard/accident conditions on *Scarabeo 8*.

##### Grounds

Sections of the drilling area, such as around the moonpool, were not checked after the bad weather in February. The drilling area forms part of the responsibility of the onboard drilling section leader. Communication and the division of responsibility between the various departments on board appears to be good in the daily work done. On the other hand, it is unclear how information and follow-up were dealt with between departments after the grating damage which occurred during the period of bad weather.

It emerged from interviews with both operators and managers on *Scarabeo 8* that no procedure existed to describe which areas had to be checked after periods of bad weather.

A dropped object check of the whole unit is conducted at regular intervals, but no special attention is paid to gratings during this inspection. Findings here are corrected in connection with the check, and possible finds can be determined from an event report. Damage histories for the gratings are difficult to find and nobody on *Scarabeo 8* has a full overview.

Gratings were damaged as a result of bad weather from 7 to 13 February 2015 in several areas, including the fore escape route on the upper deck, the stairs down to the lifeboat deck from the upper deck, the aft upper deck escape route and the platform at the ROV hangar level. An event report described damaged gratings on starboard and port aft steps, which was dated to 7 February 2015.

It emerged from interviews that *Scarabeo 8* had experienced aluminium gratings with heat tracing being pushed up and out of their position on at least two previous occasions in the past couple of years. The damage had been repaired and the incidents closed.

Maritime areas which are the responsibility of the stability section leader did not include the moonpool section, which was the responsibility of the drilling section leader. The stability manager drew up a separate damage report for the maritime areas, dated 12 February 2015.

##### *Requirement*

*Section 45 of the activities regulations on maintenance*

#### 6.1.2 Barrier management

##### Nonconformity

Inadequate identification of conditions which could lead to failures, hazards and accident conditions on *Scarabeo 8*.

### **Grounds**

Saipem is working at present to complete the barrier strategy for *Scarabeo 8*. The PSA investigation team has not seen this strategy, but the application for the current consent indicates that many important conditions have been identified.

Nevertheless, the incident is clearly a result of inadequate identification of conditions. The *lost grating* condition after storms had not been identified, and systematic routines for inspecting gratings were lacking.

### **Requirement**

*Section 5 of the management regulations on barriers*

## **6.1.3 Maintenance management**

### **Nonconformity**

Insufficiently systematic approach to dealing with outstanding maintenance on jobs with low criticality.

### **Grounds**

Saipem has classified its maintenance jobs with differing priorities, based in part on an assessment of the equipment's criticality. The company has a dedicated criticality analysis, document number SCA-PRO-TEC-001-E rev A0 dated 15 April 2012, where chapter 7.4 deals among other subjects with overdue maintenance. Senior personnel on board were not familiar with this analysis.

A weekly job on the BOP carrier, for example, involves lubricating various points. This was last done on 21 January. It had not been done since, and had not been treated as a nonconformity in the maintenance system since it has low criticality and thereby a low priority. Chapter 7.4 in the above-mentioned criticality analyses refers to guidelines which describe how long jobs can overrun the defined maintenance schedule. Where the weekly job on the BOP carrier is concerned, these guidelines were not followed up and no nonconformity assessment was carried out. Nor was there any system which picked up jobs with low criticality which had been skipped for a long time.

Generally speaking, little outstanding high-priority maintenance existed on equipment with high criticality, while a number of low-priority maintenance jobs had been delayed for longer than Saipem's own criteria.

### **Requirement**

*Section 45 of the activities regulations on maintenance*

## **6.1.4 Expertise and training**

### **Nonconformity**

Inadequate training of safety delegate.

### **Grounds**



It emerged during the investigation that the safety delegate in the drill department on *Scarabeo 8* had not received the legally required training (a 40-hour course), even though the person concerned had functioned in this role for about two years.

***Requirement***

*Section 22 of the activities regulations on safety and working environment training pursuant to the Working Environment Act*

**6.2 Improvement points**

**6.2.1 Positioning of the banana sheaves**

**Improvement point**

The banana sheaves on *Scarabeo 8* had no dedicated stowage space when not in use.

**Grounds**

The banana sheaves are stowed arbitrarily on the BOP carrier, depending on who disassembles them after use. It emerged from conversations and verifications that the banana sheaves are placed on the lower platform or on the actual deck of the BOP carrier.

Space on the BOP carrier's lower platform is limited, and at least two people need to be present during disassembly/assembly. More appropriate stowage could help to improve conditions for inspection and maintenance work.

***Requirements***

*Section 33 of the activities regulations on the organisation of work*

**6.2.2 Work process – Move of BOP**

**Improvement point**

Unclear procedure and checklist for personnel doing the work.

**Grounds**

The work process with associated checklists for the operation to move a BOP seems unclear and not very precise on a number of points.

***Requirements***

*Section 24 of the activities regulations on procedures*

**6.2.3 MOB boat drills**

**Improvement point**

Failure to implement MOB boat drills.

**Grounds**

Documentation from Saipem showed that the MOB boat had not been launched to the sea in line with the company's own plans and requirements as well as government requirements.

***Requirement***

*Section 23 of the activities regulations on training and drills*

**6.2.4 Personnel checks**

**Improvement point**

Mustering and personnel check did not accord with Saipem's own requirements.

**Grounds**

It took 19 minutes from sounding a general alarm until the emergency response leadership on *Scarabeo 8* had checked all personnel. Saipem's own requirement for POB is 16 minutes.

**Requirement**

*Section 24, sub-section two of the activities regulations on procedures*

**6.2.5 Form for reporting incidents****Improvement point**

The internal injury report form used by Saipem does not seem appropriate in providing decision support for assessing the seriousness of an incident.

**Grounds**

A form to be used as part of the initial internal reporting in Saipem includes a risk matrix (a simple risk analysis) which classifies the incident's seriousness and potential. This form was used with the incident of 20 February 2015. The personnel who filled it out had not been instructed how the matrix was to be understood and completed, and this contributed to the incident being classified as "green".

Incidents can be classified as green, yellow or red on the form, but no explanation of what the colours signify is provided. The form appears to be intended to contribute to making the right choice on the level of investigation on the basis of the incident's potential consequence, but the chosen level of investigation in the form is based on its actual consequence. The probability categories are unrefined, and no explanation is offered about what these mean or how they should be used.

It emerged during the interviews that there was a desire to remove the matrix from the form, since a certain amount of training was required to fill it out and since this could get in the way of rapidly determining the correct level of seriousness.

**Requirement**

*Section 17 of the management regulations on risk analyses and emergency preparedness assessments*

**6.2.6 Radio****Improvement point**

Absence of guidelines on and assessments of the need for communication equipment for personnel in areas where a risk exists of falling into the sea.

**Grounds**

Each SE carries a radio when they go on duty. However, this is often put aside when working on the BOP or BOP carrier because these spaces are confined and the radio equipment can easily become snagged. After the night lunch before the incident, the SEs had left their radios in the subsea workshop before starting on the last part of the shift's jobs, including work on the BOP carrier. This meant that the hired SE did not have a radio available to give a man-overboard alert to other personnel when the incident occurred.

User-friendly communication equipment for work in confined spaces or where access is difficult appears to be a challenge. It is unclear whether this issue has been assessed in relation to work in particularly vulnerable areas.

***Requirement***

*Section 80, sub-section one of the activities regulations on communication*

**6.2.7 Location of lifejackets**

**Improvement point**

Users on board are not familiar with the location of lifejackets.

**Grounds**

Lifejackets were available in the subsea workshop during the incident, but this was not known to the personnel on board. Whether this was because they were deliberately moved or were simply lacking is unclear to the PSA.

***Requirement***

*Section 21 of the activities regulations on competence*

**6.2.8 Access to the BOP carrier**

**Improvement point**

Access to the BOP carrier in its parked position was awkward and poorly designed for usability.

**Grounds**

The ladder up to the BOP carrier from the main deck was configured in such a way that access was awkward and required people to be particularly careful when leaving the BOP carrier to avoid stepping directly onto a pipetrack. There was also little to hold onto at the top and bottom of the ladder.

***Requirement***

*Section 13 of the facilities regulations on materials handling and transport routes, access and evacuation routes*

**7 Other comments**

**7.1.1 Securing of the incident site**

When the investigation team arrived on *Scarabeo 8*, the site was cordoned off and the equipment untouched. That gave the team the opportunity to inspect the relevant site in untouched condition.

**7.1.2 Winterisation**

The type of aluminium grating used on a number of *Scarabeo 8* gangways can provide better opportunities for heat tracing, and has been chosen as part of the unit's winterisation. However, its design provides reduced opportunities for water throughflow. In high seas and strong wind, damage can occur earlier than with traditional steel gratings which allow water and wind to pass through more easily. The grating at the site was a steel type.

### 7.1.3 Similar incidents

In addition to the two documented occurrences of grating damage on *Scarabeo 8*, a search has been conducted in the PSA's incident database for similar events. That identified about 10 incidents since 2006 with damaged or missing gratings as a result of bad weather on other facilities. This is not a complete list, but shows that gratings in various areas and heights could be vulnerable to damage in rough weather, and personnel can be exposed to hazard/accident conditions without having a conscious attitude to this type of risk. One facility suffered the loss and displacement of gratings in the same area during the same type of bad weather experienced on *Scarabeo 8*.

### 7.1.4 Saipem/Eni report

The Saipem/Eni investigation of the incident has been conducted in accordance with Eni's incident investigation guideline ENINO - #1938360.

The report's description of the course of events and direct causes accords in large part with the PSA's data and assessments.

Eni/Saipem have assumed a point in time for the fall into the sea on the basis of an incident description which the PSA is not sure is correct. The possibility that the fall occurred earlier than described by Eni/Saipem cannot be excluded.

Recommendations from Eni/Saipem do not deal with the stowage of the banana sheaves, as detailed in section 4.4 of the report, or whether the need to tag gratings in the maintenance system should be assessed as mentioned in chapter 1.

Recommendations 3 and 5 in chapter 7.2 of Eni/Saipem's report could help to prevent a recurrence of exactly the same incident, but would not help to prevent it happening in another location or with different personnel.

The recommendations from Eni/Saipem deal to only a limited extent with the findings on underlying causes in the report. First, no mention is made of organisational conditions, such as different departments being responsible for inspections after periods of high seas. The stability section leader is often the person on board with the greatest nautical expertise. This could be one of the measures related to recommendation 1 in chapter 7.2 of Eni/Saipem's report.

Second, the incident was a result of inadequate identification of conditions which could lead to failures, hazards and accident conditions. The lost grating condition after a storm had not been identified, and systematic routines for grating inspection were lacking. The PSA team does not see that the measures proposed by Eni/Saipem would be able to identify further conditions which could lead to failures, hazards and accident conditions.

## 8 Barriers

The investigation has not identified failed barriers other than those mentioned above in chapter 6. The grating and MOB preparedness barriers are presented below in a simplified bow-tie figure. These barriers are presented in appendix C. A bow-tie provides a visual way of displaying the course of events with relevant barriers before and after the incident.

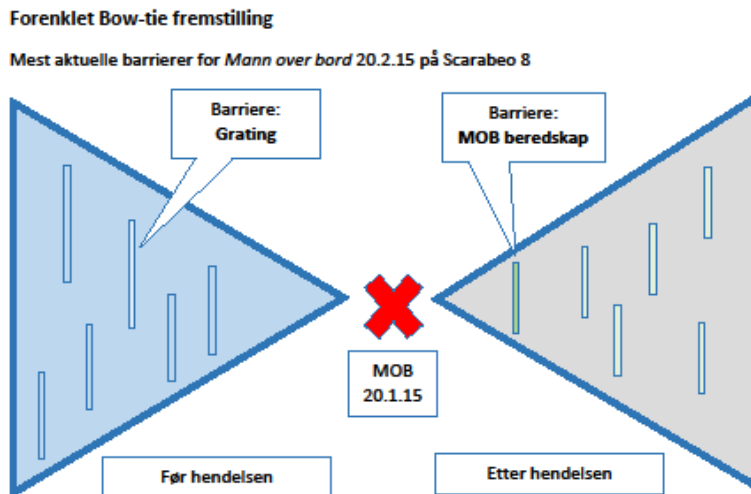


Figure 9 The **grating** and **MOB preparedness** barriers are described in more detail from an HTO perspective in appendix C.

Key: Simplified bow-tie presentation; Most relevant barriers for man overboard 20 February 2015 on Scarabeo 8; Barrier: grating; Barrier: MOB preparedness; MOB 20 February 2015; Before the incident; After the incident.

## 9 Discussion of uncertainties

The most probable cause of the man-overboard incident on 20 February 2015 is that high waves have displaced the grating. On the other hand, it is not clear whether waves, high winds or a combination of these caused damage to gratings higher up the outside of the facility.

It is a little unclear when the grating damage on *Scarabeo 8* occurred, since there were two episodes of bad weather in the weeks before the incident. Grating damage on the outside of the rig is documented at two different times, and the site of this incident (the access platform for the BOP carrier) is unlikely to have been in use since 6 February 2015.

## 10 Appendices

### A: The following documents have been used in the investigation

1. Plan of the moonpool
2. Weather reports 20 February 2015 + 13-20 February 2015
3. Maintenance history moonpool trolley 470 t – *Scarabeo 8*/FRS Main Department
4. Product certificate for BOP moonpool trolley. KRS 10-3042
5. Expertise overview
6. Checklist subsea
7. Maintenance instructions BOP moonpool trolley *Scarabeo 8*. T9704-Z-MA-005
  - a. Hilman Rollers Maintenance and Installation Manual
8. Callout of standby vessel – *Esvagt Aurora* for close standby
9. Organisation chart
  - a. *Scarabeo 8* Personnel Manual – *Scarabeo 8* Drilling Unit Administration Manual – Doc no SCA8-MAN-PER-004E. Rev 2, 11.11.2014

10. Summary of safety tour 17 November 2014. Moonpool, BOP and sackstore
11. Log – control room
12. Damage report after storms in week 7-12 February 2015. Grating (marine dep)
13. Message from standby ship *Esvagt Aurora* 20 February 2015, 07.18
14. Statement NSTSL
15. HSE Procedure – Work over the side. SCA8-PRO-HSE-014-E. Rev. 1, 6 April 2010
  - a. HSE Procedure – Operation of man riding winch and mechanical workbasket. SCA8-PRO-HSE-016-E. Rev 1, 18 June 2010
  - b. Pre-use check list for Manrider. SCA8-FORM-HSE-023-E. Rev 01, 28 December 2009
16. Drilling Procedure. *Scarabeo 8* operation manual running 183/4 EVO BOP stack. SCA8-PRO-DRL-005-E. Rev 3, 28 May 2014
17. Drawing of facility + notation of wave-damaged gratings
18. Photo – moonpool
19. Corporate standard form – incident notification. Form–COR-HSE-105-E
20. Overview hours worked, subsea engineer
21. Contract PSW/Saipem – 1022784
22. Criticality analysis – SCA8-PRO-TEC-001-E
23. Job description senior subsea engineer
24. MOB boat drills 2013
25. Overview of planned drills 2013, 2014, 2015
26. Onshore emergency plan
27. MOB boat drills 2014
28. Emergency preparedness manual rev 01
29. Safety introduction rev 01
30. Overdue maintenance, week 7, *Scarabeo 8*
31. Daily reports subsea engineers *Scarabeo 8*
32. Handover subsea engineers
33. Event reports damaged gratings 2013-2015
34. Eni/Saipem investigation report ENINO/HSEQ/6088060

## **B: Overview of personnel interviewed**

## **C: Barriers in an HTO perspective**

## **D: Abbreviations/definitions**

Banana sheave	Prevents excessive bending in podlines when these are installed
Standby ship	Vessel which provides standby services during exploration, development, production, offloading or cessation
BOP	Blowout preventer
BOP carrier	Equipment for moving the BOP
DNV GL	Det Norske Veritas Germanischer Lloyd
Hs	Significant wave height
Hired SE	Hired subsea engineer
MOB boat	Man-overboard boat

Service ship	Vessel which provides supply, anchorhandling, ROV/ROT operation and inspection during exploration, development, production, offloading or cessation
Senior SE	Senior subsea engineer
SE	Subsea engineer
Podline	Line used to communicate with a BOP
Site	The platform on the BOP carrier which the senior SE fell through