PETROLEUMSTILSYNET

Investigation report

Report	
Report title Investigation of a lifting incident on *Deepsea Atlantic* where a slip joint unintentionally ended up on the seabed	Activity number 405001011

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☐ Not publicly available	☐ Confidential	

Involved	
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Figure 1 Deepsea Atlantic.

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1 Summary

A 35.2-tonne slip joint ended up unintentionally on the seabed on 8 May 2022. This incident occurred in connection with a lifting operation from the *Stril Mar* supply ship to Odfjell Drilling's *Deepsea Atlantic* facility.

The slip joint was to have been despatched from the base to *Deepsea Atlantic* on 12 April, but the lift at the quay was halted because the crane had insufficient capacity. A tandem lift with two cranes on 7 May transferred the slip joint to *Stril Mar*. The manifest specified that the slip joint weighed 32 tonnes.

On 8 May, night-shift personnel on *Deepsea Atlantic* began lifting load carriers from *Stril Mar* with the starboard offshore crane. The facility had completed a well on Statfjord North and cargo was to be lifted both to and from the supply ship. After that, the facility was to up anchor and move to its next location over the coming days. Start-up at the next location was scheduled for about 14 days after completion of this well. A shift meeting and planning for further lifting operations were conducted at 06.45-07.15. The day shift continued lifting load carriers and risers with the crane in single fall mode. After a break at 10.00, the crane was rerigged to double fall mode and continued lifting risers with buoyancy elements followed by the slip-joint lift from ship to facility. After several attempts when overload alarms and the AOPS were both activated, the slip joint was lifted about 10 metres before the AOPS was again activated and the load dropped out of control before hitting the supply ship's bulwark and landing on the seabed.

The investigation has revealed that planning and execution of the lifting operation were inadequate. The crane setting was incorrect, and it was operated outside its design criteria.

This incident causes material damage to the offshore crane, slip joint and ship bulwark. It did not involve a potential for personal injury.

The investigation identified four nonconformities and one improvement point.

Nonconformities

- Inadequate safety clearance of activities
- Safety system for offshore crane
- Deficiencies in weight information for the slip joint
- Use of offshore crane

Improvement point

- Design of the procedure for heavy lifting

2 Background information

This chapter provides a brief overview of personnel and equipment involved in the incident.

2.1 Description of facility and organisation

Deepsea Atlantic is a mobile semi-submersible drilling unit which was operating at the time of the incident for Equinor Energy AS on the Statfjord North field. The facility is equipped with two offshore cranes, on the starboard and port sides respectively. Risers are handled to starboard. *Deepsea Atlantic*'s position in relation to the subsea installations meant that only the starboard crane could be used for operations with ships on 8 May.

The facility's marine department is responsible for operating the offshore cranes. It is headed by a marine and safety section leader on both day and night shifts. The team working with crane and lifting operations on each shift comprises:

- a deck foreman
- a crane operator
- four riggers and roustabouts
- a roughneck (extra personnel).

In addition, the department has two people on each shift who handle dynamic positioning (DP) operations.

The deck foreman for the day shift on 8 May had divided up the work with the crane operator so that they were responsible for port and starboard side activities respectively. Two riggers serving as slinger and banksman respectively formed the crane operator's team.

2.2 Abbreviations and terms

AOPS – automatic overload protection system for the offshore crane
Banksman – participant in lifting operations. Duties include giving the starting signal and directing the safe movement of the lifting appliance and the load on the hook. Communicates with the crane operator and slinger
BOP – blowout preventer, an arrangement of valves for shutting down a well
Template – a load-bearing steel structure standing on the seabed
CCTV – closed-circuit TV
ESD - emergency shutdown system for the facility
H_S - significant wave height, the average height of the highest third of the waves measured over a specified time period (typically three hours)
Load carrier – any kind of receptacle, crate, basket or container
MOPS – manual overload protection system for offshore crane
NCS – Norwegian continental shelf

NOV – National Oilwell Varco
PSA – Petroleum Safety Authority Norway
ROV – remotely operated vehicle
Safecard – used to document toolbox talks
Slinger – person carrying out the practical work of strapping, rigging and slinging to and from the crane while signalling to the banksman when the load is ready to lift
Slip joint – part of the riser system compensating for vertical movement in the sea
SWL – safe working load. The maximum load the lifting equipment is certified to handle in normal use.

2.3 Position before the incident

Deepsea Atlantic had completed its work on Statfjord North and had been moved 50 metres away from the subsea installations. This was because the BOP was being lifted to the deck. The facility was preparing to move to its next location.

A supply ship arrival was planned, which included swapping out a slip joint because the one in service was due to go ashore for service. A maintained slip joint was to be taken aboard before the move to the next location. Several planned normal and heavy lifts from the supply ship were scheduled for 8 May.

3 The PSA's investigation

The PSA investigation team comprised the following members

- Lars Melkild, logistics and emergency preparedness discipline (leader)
- Dan Herstad, logistics and emergency preparedness discipline
- Bjarte Rødne, logistics and emergency preparedness discipline (on land only)
- Kenneth Skogen, HSE management discipline

After travelling out to the facility on 9 May 2022, the team conducted an inspection of the area on 10 May. Interviews with personnel involved were conducted and a summation meeting held before returning to land. Interviews were conducted via MS Teams on 16, 19 and 25 May. Odfjell's investigation team presented its observations to the PSA on 16 June 2022.

The mandate for the PSA investigation can be found in appendix B to the investigation report.

4 Description of facility, systems and equipment

4.1 Background information

This section provides background information on *Deepsea Atlantic*, the lifting system and equipment involved in the incident.

4.1.1 *Deepsea Atlantic*

Deepsea Atlantic is a sixth-generation mobile semi-submersible drilling unit built to operate on the NCS. Delivered in 2009 from the DSME yard in South Korea, it received an acknowledgement of compliance (AoC) from the PSA in July that year. The unit is operated by Odfjell Drilling AS.

4.1.2 Slip joint

Deepsea Atlantic has two slip joints (serial numbers SJ1 and SJ2), which alternate in operation. According to their certificates, each joint originally weighed 33.3 tonnes. Since delivery, the following modifications have been made:

- lifting clamps installed
- fitted with mechanical protection (melons)
- hydraulic control lines removed.

Following these modifications, the slip joint weighed 35.2 tonnes.

4.1.3 Starboard offshore crane

The offshore crane on the starboard side of *Deepsea Atlantic* is an electrohydraulic knuckle boom type delivered by NOV. Its lifting capacity varies between different configurations, depending on boom deployment and the number of falls on the hook block. Capacity is also reduced with rising wave heights.

Maximum lifting capacity:

- single fall 17 tonnes
- double fall 34 tonnes
- five fall 85 tonnes

Based on wave height at the lift time, the crane operator must adjust the crane's sea-lift capacity to take account of dynamic forces. Capacity at different wave heights is visualised for the operator using the crane's load computer. Set for an H_s of two metres and a 27-metre outreach, for example, the starboard crane will have lifting capacities of 10.2, 23.6 and 23.8 tonnes for single, double and five fall respectively.

The offshore crane is built to the EN13852-1 standard for such units. This includes requirements for alarm levels, and describes these. The alarm level starts when the load reaches 90 per cent of crane capacity and runs up to 110 per cent of capacity. Both visual and acoustic signals alert the crane operator at the various levels. An

acoustic alarm will also be sounded automatically outside the crane cabin to warn personnel on deck when the load exceeds 100 per cent.

4.1.4 AOPS

The automatic overload protection system (AOPS) is an integral safety component in the crane's control system to protect against serious overloads. Where this crane is concerned, the manufacturer specified that the AOPS activates when the load exceeds about 130 per cent of the maximum capacity. Both visual and acoustic signals are given at the various alarm levels to alert the operator. An acoustic alarm outside the cabin is also supposed to alert deck workers of an overload.

4.1.5 *Stril Mar*

Stril Mar is a supply ship delivered in 2016 which includes dynamic positioning to Dynpos Autr class. It is operated Simon Møkster Shipping.

4.1.6 Manifest

The manifest is a document which describes the cargo scheduled either to arrive at or be dispatched from the facility on the supply ships. It includes information on which objects are involved (load carriers, pipelines and so forth) and their identification, markings and weight. This information is used in part to plan lifting operations.

4.1.7 Statfjord North

This field comprises two subsea templates for production and one for water injection. *Deepsea Atlantic* had completed activities on well E-4. In connection with the operation, the wells in the template were shut down and the subsea systems depressurised.

5 Course of events

5.1 Before the incident

Deepsea Atlantic has two slip joints (serial numbers SJ1 and SJ2). One (SJ1) was in use and the other (SJ2) had been on land for storage/servicing prior to the incident.

Lifting a slip joint to/from a ship is performed two-three times a year. Plans called for slip joint SJ2 to be sent offshore in April 2022. At the CCB base, a discrepancy found between the weight in the manifest (32 tonnes) and the actual weight (35 tonnes) delayed dispatch. Among other requirements, a new lifting sling with higher capacity had to be obtained to transfer the slip joint from the quay to the supply ship. The crane utilised had a capacity of 33 tonnes.

The manifest for the consignment, which was shipped out on 7-8 May, retained the original weight of 32 tonnes even though the slip joint had been checked as weighing 35 tonnes.

7 May

The operation on Statfjord North was completed on 7 May. *Deepsea Atlantic* was moved 50 metres away from the subsea templates on Statfjord North, and the riser and BOP were retrieved to the deck – including the slip joint (SJ1).

Plans called for SJ1 to be lifted from *Deepsea Atlantic* to the ship and for SJ2 to be lifted in the opposite direction on 8 May. No plans were made at the work permit (WP) meeting on 7 May for heavy lifts of the slip joints on the following day. The marine and safety section leader on the day shift asked their opposite number on the night shift to prepare a WP for the planned heavy lifts. This was done on the night shift and approved by the offshore installation manager (OIM) at 22.22 on 7 May 2022.

8 May

The weather forecast for 8 May was for calmer conditions from 06.00 with an H_s of about 1.8 metres, becoming somewhat higher during the day.

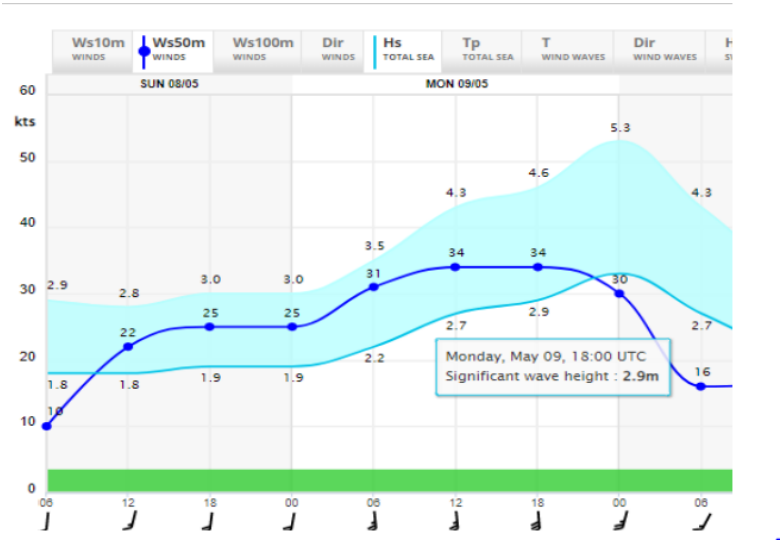

Figure 2 Weather forecast on the handover form on 8 May.

This forecast formed part of the shift handover document for the deck department. It showed that the H_s was more than two metres up to 04.00 on 8 May, declining thereafter to 1.8 metres. It was then due to rise above two metres again from 00.00 on 9 May until 11 May. Historical values obtained from the facility's own weather sensors confirm the forecast.

Stril Mar was asked to sail faster than the planned economy speed out to the location, and entered the 500-metre zone around *Deepsea Atlantic* at 05.55 for discharging and loading deck cargo, including load carriers, risers and slip joints.

Deck crew on the night shift started lifting load carriers from the ship with the starboard crane.

Shift handover meeting 06.45

The morning meeting at 06.45 was conducted with the participation of deck and drilling personnel. Joint activities were reviewed at 07.00, and deck personnel continued to review their activities with the night shift. Plans for the day and the weather forecast were presented. An ESD test planned for 14.00 would mean a temporary halt to normal activities, such as crane operation.

Deck personnel on the day shift then assembled at the deck office. Those with jobs on the portside pipe deck then left the office and began work. Personnel due to participate in lifting activities to starboard stayed for a toolbox talk.

Toolbox talk

Jobs for the day were reviewed in the toolbox talk. The WP for heavy lift was reviewed, including the heavy lift procedure and specified checklists.

According to the crew, toolbox talks are documented using Safecards. These are registered electronically the following day. It was reportedly not unusual to register the cards after the job was concluded.

Two Safecards are registered for the toolbox talk, both dated 9 May. One includes checklists 1, 2, 4, 14, 25, 26, 27, 34, while the other incorporates 1, 2, 3, 4, 5, 6, 7, 9, 16, 26, 27, 34, 35, 39, 40, 45, 47. This card also specifies that a heavy lift will be performed, with conversion to double fall mode.

The heavy-lift WP refers to checklists 1, 2, 4, 7, 9, 16, 17, 26, 34, 35. These numbers refer to checklists in Odfjell's safety handbook, which provide guidance on assessing risk when planning an activity.

Following this, the WP was activated at 07.13 by the crane operator and 07.14 by the central control room.

Lifting operation begins

After the WP had been activated, the crane operator conducted several lifts of load carriers from the ship together with the banksman and slinger. Five risers weighing 13.5 tonnes were then lifted down to the ship from the facility. All these loads were

performed with the crane in single fall mode. Pennants dimensioned for risers were used, with a capacity of roughly 21.5 tonnes. Combining two pennants gave a capacity of about 30 tonnes.

When the lifts had been completed around 10.00, the work team took a break. The crane was then rerigged to double fall mode, but with the same pennants.

A riser with a buoyancy element was first lifted from ship to facility. The ship then lay with its port side against the facility. Before lifting the slip joint down to the latter, the ship was turned to bring its starboard side against the facility.

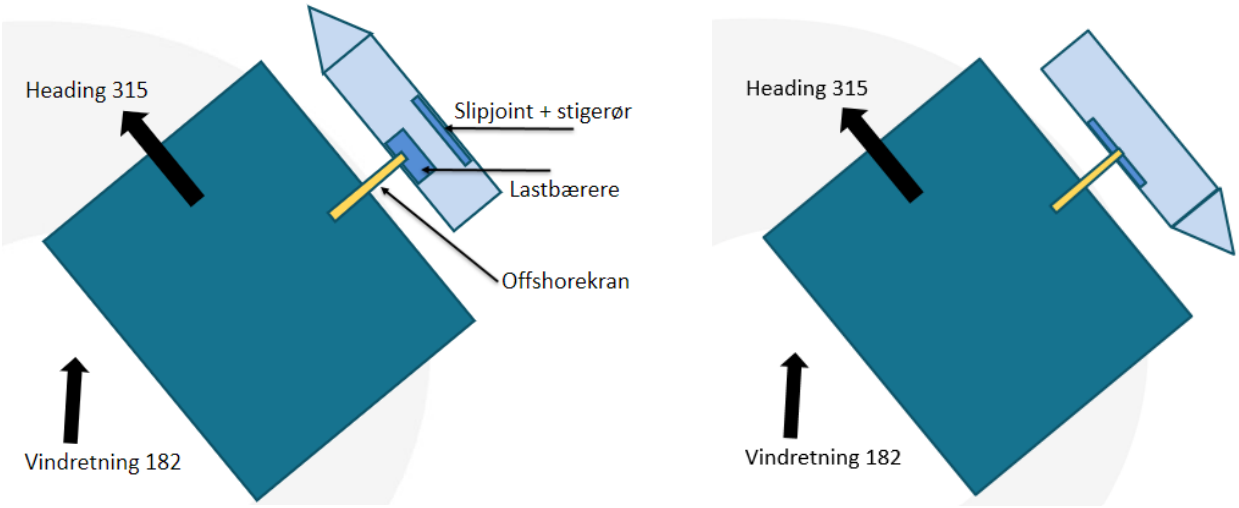

Figure 3 Left: headings of facility and ship in the first part of the lifting operation. Right: headings in the second part.

About 11.18

The crane's alarm log and witness observations revealed the following.

- The crane's load computer was set to an H_s of zero metres.
- The operator lifted the slip joint. Then, with an outreach of about 27 metres, the crane received a series of alarms – 90, 100 and 110 per cent – and the AOPS was activated at 11.18.17. The crane's overload alarm was heard on *Stril Mar*.
- The operator put down the load on *Stril Mar*'s deck. Once that had happened, the status of the overload alarms changed but the AOPS remain active.
- The lift was repeated once more with consequent alarms and overload alarm.
- The crane operator put down the load and the overload alarms were acknowledged by the crane, while the AOPS was acknowledged by the crane operator.
- The crane operator had a discussion with the deck foreman, who was working on the port side of *Deepsea Atlantic*, and they agreed to continue the lifting operation.

- The crane operator agreed with the master of *Stril Mar* that the ship would move closer to the facility.

5.2 The incident

About 11.25-11.27
The crane's alarm log and witness observations revealed the following.

- The starboard offshore crane started lifting the slip joint.
- Once the slip joint had been lifted a few metres and the height of the load was above the ship's bulwark, *Stril Mar* began to draw away from the facility.
- When slip joint has been lifted about 10 metres, several alarms were activated – including 110 per cent overload. In accordance with its logic, the crane then locked further operation. The AOPS activated immediately afterwards.
- The crane's lifting winch began to pay out steel wire and the slip joint was lowered swiftly towards *Stril Mar*.
- The slip joint hit *Stril Mar*'s bulwark and continued into the sea.
- The crane operator activated the MOPS after the slip joint had entered the sea, and then on the crane's emergency stop.
- When the MOPS was activated, all steel wire ran out and the load, including the hook block, went to the bottom. The wire parted at its end attachment to the drum, and the end attachment on the boom tip remained hanging.

5.3 After the incident

One person in the central control room observed via CCTV that the slip joint hit *Stril Mar* and fell into the sea.

The starboard offshore crane was shut down and the crane operator went down to the deck office, where he was looked after by the deck personnel. After launching an ROV, the slip joint was found on the seabed at 12.56.

Figure 4 Image from ROV after the incident, showing where the slip joint ended up on the seabed.

Wire
Waypoint 1 is one end cover of the slip joint
Waypoint 2 is the NW end of the slip joint
Waypoint 3 is the SE end of the slip joint
Waypoint 4 is one of the protective covers from the slip joint
The other protective cover was not found

The PSA was notified of the incident at 20.30 on the same evening.

6 Potential of the incident

Actual consequences
No personal or environmental harm was identified as a result of this incident.

Material damage was caused to the slip joint and the ship's bulwark. In addition, the winch was damaged by the incident. Part of the railing on the boom was also damaged and a section weighing about four kilograms fell to the deck within the cordoned-off area.

The starboard offshore crane was out of operation for a period after the incident.

No damage was caused to the subsea installations.

Potential consequences
Under slightly different circumstances, the load could have fallen with full force against the ship's deck or the bulwark and caused greater material damage to the ship. Given the location of the facility, possible damage to subsea structures from the slip joint is considered unlikely.

The PSA team does not find it likely that personal injuries might have been caused.

7 Direct and underlying causes

7.1 Direct cause

Overloading of the crane occurred when lifting the slip joint from the supply ship. The load exceeded the crane's capacity, which in turn activated the crane's APOS and the load was rapidly lowered.

7.1.1 Underlying cause – safety clearance of activities

Lifting the slip joint was planned and executed as a routine job. During the planning process, reference was made to several procedures and a large number of checklists from Odfjell's safety handbook. The timeline and the period allocated to planning and the toolbox talk made it impossible to go through all these in the short time available.

Odfjell has a separate work instruction for heavy lifts. That document describes heavy lifting as a lift over 17 tonnes for the starboard crane, which requires a WP. A safe job analysis (SJA) is required for complex lifting operations. This job was not regarded by Odfjell as a complex lifting operation.

Odfjell's WP system is based on the Offshore Norge recommended guidelines for a common model for work permits. In that connection, the PSA team saw the following in Odfjell's WP form:

- page 2 is used to list risks/hazards related to the activity, associated measures, preconditions and who is responsible for the measures
- page 3 is used for the toolbox talk, with a table for listing tasks, hazards, consequences and measures.

In the WP prepared for the slip-joint heavy lift, "Lack of required safety standard" was entered in the box for hazards, while 11 checklists from Odfjell's safety handbook were listed in column for measures.

Interviewees told the PSA team that this is established practice for jobs with a WP. The signature field on page 3 is normally used when an SJA is also carried out.

Two Safecards were registered for the toolbox talk. These also referred to checklists.

7.1.2 Underlying cause – safety system for offshore crane

The weather forecast presented at the handover meeting showed an H_s of about 1.8 metres. Crane status after the last lift is documented and shows that the H_s was set at zero metres in the crane computer. The PSA investigation established that the crane was operated with H_s = zero metres set in crane's control system for lifting both five risers of 13.5 tonnes in single fall mode and the slip joint in double fall mode.

With such weather constraints, the crane's load chart for a sea lift showed:

- with single fall, capacity was 8.4-11.5 tonnes depending on work radius
- with double fall, it was 19.3-25.1 tonnes depending on work radius
- with five fall, the crane could lift, for example, 36.7-47 tonnes with a work radius from 19 to 15 metres.

Several risers to be discharged weighed 13.5 tonnes. These were conducted as single fall lifts. The slip joint was specified to weigh 32 tonnes, but proved to be 35.2 tonnes. This lift was conducted in double fall mode.

Pursuant to Odfjell's procedures for heavy lift, necessary certificates as well as the weight verification certificate must be sent to the facility in good time before the lift arrives. This was not done, and the manifest from the logistics base was taken as the starting point. That was normal practice for all lifts on *Deepsea Atlantic*.

7.1.3 Underlying cause – slip-joint weight

The slip-joint weight specified in the manifest, and which formed the basis for planning the lift, did not accord with its actual weight.

The slip joint weighed 33 286 kilograms on delivery from the manufacturer, but two modifications had subsequently been made. Lifting clamps had been retrofitted, which added 856 kilograms, plus two melons for mechanical protection, which amounted to 1 304 kilograms. In addition, hydraulic control lines totalling about 100 kilograms had been removed.

The manifest from the logistics base, which formed the basis for planning the lift, specified 32 tonnes. The actual weight of the slip joint was subsequently measured to 35.2 tonnes. According to a manifest from 2021 used with a slip-joint lift, the weight was 33 tonnes. The riser including slip joint is part of the facility's equipment and owned by Odfjell.

7.1.4 Underlying cause – heavy-lift procedure

The heavy-lift procedure specifies that such a lift is one exceeding 17 tonnes for the starboard crane and 20 tonnes for the port crane. It does not take account of the crane's load chart and restrictions related to H_s.

7.1.5 Underlying cause – halting crane use after overload alarm activated

The crane operator did not halt the operation on receiving indications of crane overload.
Odfjell Drilling's procedure is based on Norsok-R003 concerning safe lifting operations for the NCS.

Appendix H of this standard states that an enterprise of competence must conduct an extraordinary check of lifting equipment if overloading or damage is suspected. Odfjell's own lifting procedure repeats this requirement. In the event that lifting equipment is overloaded, continued operation must cease and checks have to be conducted – which was not done in this case.

8 Emergency response

The emergency response organisation on *Deepsea Atlantic* did not muster during the incident. No information emerged during the investigation which indicted that this should have happened.

9 Regulations

Section 3 of the framework regulations on the application of maritime regulations in the offshore petroleum activity applies to mobile facilities. This gives the opportunity to apply maritime regulations to maritime conditions on board. In order to operate on the NCS, a drilling facility like *Deepsea Atlantic* must have an AoC as specified in section 25 of the framework regulations. An application for an AoC and its consideration are governed by the regulations and the handbook for AoCs.

Facilities with an AoC are otherwise subject to the activities regulations. This means that section 93 of these regulations on lifting operations, which refers in its guidelines to Norsok R-003N on safe use of lifting equipment, provides guidance on such matters as how lifting operations are to be organised, planned and executed. Guidance is also provided here on how lifting equipment is to be followed up, both technically and operationally. Odfjell has chosen to incorporate Norsok R-003N on safe use of lifting equipment in its management system. Furthermore, key provisions in the petroleum regulations covering risk, barriers and work processes also apply.

The guidelines to section 69 of the facilities regulations on lifting appliances and lifting gear state in part that: "For the design and selection of lifting appliances and lifting gear for use on permanently placed and mobile facilities, [the] Norsok R-002 standard should be used". Reference is also made to EN13852-1 for offshore cranes.

10 Observations

The PSA's observations fall generally into two categories.

- Nonconformities: this category embraces observations which the PSA believes to be a breach of the regulations.
- Improvement points: these relate to observations where deficiencies are seen, but insufficient information is available to establish a breach of the regulations.

10.1 Nonconformities

10.1.1 Inadequate safety clearance of activities

The activity involving the lifting of risers and the slip joint had not been cleared with regard to safety in order to reduce the likelihood of mistakes which can lead to hazards and accidents.

Grounds

Through conversations and the document review, the PSA observed the following.

- Hazards and compensatory measures were not identified when preparing the WP. Reference was made instead to checklists in Odfjell's safety handbook. These are to be reviewed by the executing personnel in a toolbox talk.
- The checklists named in Odfjell's safety handbook specify more than 150 points to be reviewed in the toolbox talk. The number of points is unmanageable and the time taken for the toolbox talk also indicates that these were not reviewed.
- Verified information on the slip-joint weight was not obtained in good time before the lift, as described in the heavy-lift procedure. The manifest from the logistics base specified 32 tonnes.
- Weather constraints and the set-up of the crane in single, double and five fall modes were not an issue when preparing the WP. In the toolbox talk, plans were made to convert to double fall mode for the slip joint, even though the crane design calls for five fall mode with the given weather constraints.
- The pennants for the risers were used for lifting the slip joint. These lacked sufficient capacity to perform this task.

Requirement

Section 30 of the activities regulations on safety-clearance of activities

10.1.2 Safety system for offshore crane

Settings in the safety system on the starboard offshore crane using wave height was not adequately known to and understood by the crane operator.

Grounds
The starboard offshore crane was set at H_s zero metres throughout the lifting operation during the day shift on 8 May. The wave height when planning and executing the lifting operation was just under H_s two metres, which requires a setting of H_s two metres for the crane. It was not possible to execute the slip-joint lift with the selected H_s within the crane's capacity using a double fall configuration.

Requirement
Section 26 of the activities regulations on safety systems

10.1.3 Deficiencies in weight information for the slip joint

Steps were not taken to ensure that the necessary information was obtained, processed and communicated to relevant users at the right time.

Grounds
Pursuant to the original certificate, the slip joint involved in the incident was delivered from the manufacturer with a weight of 33 286 kilograms. Modifications made after the delivery have increased this figure by 856 kilograms. Installing two melons has also added a further 1 304 kilograms. About 100 kilograms of hydraulic control lines had been removed.

Ahead of the planned dispatch of the slip joint on 21 April 2022, the base which was to load and dispatch the unit checked the weight and found it to be more than 35 tonnes, compared with the 32 tonnes reported in the manifest. It emerged from interviews that the information in the manifest is used as the basis for heavy lifts.

Requirement
Section 15, paragraph 2 of the management regulations on information

10.1.4 Use of offshore crane

The lifting operation was not cleared, managed and conducted in a prudent manner after the crane became overloaded.

Grounds
The starboard offshore crane was subject to an overload and possible excessive strain with the first slip-joint lift. Lifting operations continued with repeated attempts to lift the load, even though overload alarms were activated. Pursuant to appendix H of Norsok R-003, an extraordinary check by an enterprise of competence must be carried out in the event of overloading or damage to lifting appliances.

Requirement
Section 92 of the activities regulations on lifting operations, see the guidelines which refer to appendix H of Norsok R-003

10.2 Improvement point

10.2.1 Design of the procedure for heavy lifting

Odfjell had failed to ensure that the procedure for heavy lifting was designed and used in a way which fulfilled its intended functions.

Grounds
Odfjell's procedure for heavy lifting describes a heavy lift as a lift greater than 17 tonnes with the starboard crane and 20 tonnes with the port crane. The procedure does not take account of constraints imposed by weather criteria and the crane's load chart.

Requirements
Section 24, paragraph 2 of the activity regulations on procedures
Section 13 of the management regulations on work processes

11 Barriers which have functioned

The offshore crane has functioned as intended. That includes notification of overloading, overload alarms (notified on the display and by acoustic alarms) the AOPS and the MOPS.

The steel wire parted at the end attachment on the drum as intended.

Personnel on the ship were in the safe zone.

12 Discussion of uncertainties

The investigation has found that the AOPS functioned as intended, but a discussion is under way between Odfjell and the crane manufacturer on the correct release level. That had not been clarified when this report was completed.

13 Assessment of Odfjell's investigation report

Odfjell's investigation largely coincides with the observations made by the PSA team. The Odfjell investigation report has devoted greater attention to routines at the logistics base. In connection with weighing cargo at the bases, Odfjell has observed big variations in the weights specified in the manifests. When the slip joint was dispatched after the incident, it was weighed and recorded in the manifest with a weight of 28 tonnes.

Appendix A – Documentation

The following documents have been drawn on in the investigation.

- Failure Mode Charts - KBC No 1 - T7250-Z-RD-009
- Load Charts and derating tables - T7250-RD-003
- Third party survey report incl. review of MRB, KBC No 1 - T7250-Z-VA-033
- Sertifikat 2 stk Lifting Clamp til Slip Joint - 67820.1
- Lifting Equipment Operations - L3-MODU-ALL-TO-PR-042
- Tegning av Lifting Clamp 35T - 30087
- AOPS Function test - PS-SCE-S4-01-T
- MOPS Function test - PS-SCE-S4-02-T
- Recertification Starboard Crane - 8GN18-9156
- Guideline, Kontroll og vedlikehold av løfteutstyr - L3-MODU-NO-TO-GL-009N
- Sertifikat kran wire 34mm Bridon DYF 34LR GAL - 1320440-1 / 1
- Sikker bruk av løfteutstyr - L3-MODU-NO-TO-PR-012N
- 5-year Re-certification of Telescopic joint #2 - Deepsea Atlantic - 196936
- Sertifikat offshore crane forerunner - 416807
- Manifest slip joint, 14.09.2021, kl 0730
- Materialhåndteringsplan - L4-MODU-DSA-C-PR-109N
- Instruks treing av wire fra whipline til storblokk - L4-MODU-DSA-C-WI-123N
- Systematic Familarisation KBC - L4-MODU-DSA-C-TR-209N
- Kontrollrapport styrbord Offshorekran - DNV-8239-2022
- HMS-Risikostyring - L1-CORP-HSE-PR-002N
- Sikker jobbanalyse (SJA) - L1-CORP-HSE-PR-002 Vedlegg 1
- Brukerinstruksjoner for Permit Vision - L3-MODLI-ALL-HSE-PR-014-01
- Control of work – offshore - L3-MODU-ALL-HSE-MA-049
- Arbeidsinstruks tungløft med dekkskran - L4-MODU-DSA-C-WI-114N
- Daglig Marine Handover, Deepsea Atlantic, 07.05.2022 (0600)
- Manifest Mongstad base, 07.05.2022

- Manifest til DSA, 07.05.2022
- POB Deepsea Atlantic, 07.05.2022
- First Alert Form - Deepsea Atlantic - L1-CORP-QU-PR-008 Appendix 2
- Epost, FW Property Damage på Cargorail
- Hendelsesforløp-Kranfører
- Mandate for investigation team, level 2, Deepsea Atlantic Dropped slip joint
- Plassering av dekkspersonell under hendelse ved styrbord kran
- Tegning plassering av dekkspersonell under hendelse ved styrbord kran
- Rapport fra DSA bro
- Rapport skade på Cargorail Stril Mar 2022/031
- Slip joint ROV rapport
- AT Tungløft med styrbord kran
- QHSE bulletin - Utilsiktet låring av slip joint
- Synergi rapport - Utilsiktet låring av Slip joint - 226030
- Epost vitner Simon Møkster
- Epost FW Slip joint til DSA
- Deltakerliste oppstarts møte gransking Deepsea Atlantic
- WO Knuckle Boom Crane No 1 SB T7250 - 11097993
- Teknisk underlag og totalvekt Slip joint
- Epost - Teknisk underlag med vektestimat og CoC for Slip joint #2
- Epost - Vær data
- Presentasjon - L2 investigation DSA dropped slip joint Ptil presentation
- Epost gransking DSA
- Bilder kran alarmlogg og status
- Årlig kontroll T7250 and T7251 - NOV-2170268-MC-1
- Organisasjonskart Deepsea Atlantic
- Historical Work Orders SB KBC
- Historikk Alarmlogg Oppdatert med forklaringer
- Innrapporterte safekort fra hendelsen
- Lastedekk Stril Mar – Wells
- Lasteliste-Cargo Sheet
- Løfterute Statfjord Nord E-4 - DOCS-#2295112-v1
- Technical service report DSA, MCV Troubleshooting - NOV-2164620-MC-1

Appendix B – Mandate for the PSA investigation

The following mandate has been determined for the investigation team.

a. Clarify the incident's scope and course of events (with the aid of a systematic review which typically describes time lines and incidents).
b. Assess the actual and potential consequences:
    1. harm caused to people, material assets and the environment

2. potential to harm people, material assets and the environment.

c. Assess direct and underlying causes.
d. Identify nonconformities and improvement points related to the regulations (and internal requirements).
e. Discuss and describe possible uncertainties/unclear points.
f. Discuss barriers which have functioned (in other words, those which have contributed to preventing a hazard from developing into an accident or reduced the consequences of an accident).
g. Assess the player's own investigation report.
h. Prepare a report and a covering letter (possibly with proposals for the use of reactions) in accordance with the template.
i. Recommend – and normally contribute to – further follow-up.

Appendix C – Overview of personnel interviewed