

# Investigation report

Report	
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Involved	
Team T-1	Approved by/date Kjell M Aulfem/24 September 2021
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## 1 Summary

An incident with personal injury occurred on 13 May 2021 during a lifting operation while removing a chemical tote tank frame on Equinor’s Johan Sverdrup riser platform (RP). The PSA decided on 14 May 2021 to investigate the incident, and was asked at the same time to support the police inquiry.

Demolition of the frame on the weather deck included small structures being cut from it and transferred to load carriers. Held to the frame by ratchet straps, each structure had an unknown weight and centre of gravity. Lifting chains had been connected to the offshore crane for attaching to the structures, but where these attachments were to be made was not clarified. The incident occurred when Equinor's logistics department on Johan Sverdrup was going to lift the final structure, which lay in the blind zone for the crane operator. With the lifting chains attached, the structure was in the process of being freed from the frame. This was done by releasing the first of two ratchet straps. The structure would then be supported by the crane hook which the chains were hung from as well as the second strap. When the first strap was released, the structure began to shift. At the same time, one of the slingers moved into the lift zone and was crushed in the stomach area between the structure and the frame. They suffered internal injuries and were flown by SAR helicopter to Haukeland University Hospital in Bergen for further treatment. The PSA team's assessment is that the incident could have resulted in the death of the injured person had the structure moved a little closer to the frame.

The direct causes of the incident were that the structure moved out of control at the same time as the injured person moved into the exposed area when the structure was released from the first ratchet strap. This led to them being crushed between the structure and the tote tank frame.

The following underlying causes have been identified.

#### Operational

- Responsibility for releasing the ratchet strap had not been agreed in advance
- No message was given over the communication network that the ratchet strap was to be released before the signaller released it.
- Signaller took the role of slinger.
- The team executing the lifting operation made no use of aids to identify risks, (SJA, checklists, Equinor A standard, etc). See nonconformity 8.1.2 for details concerning risk.

#### Organisational

- Equinor's management system was not followed during the lift operation.
- Nobody in the land organisation, on board, or in Johan Sverdrup's logistics department appreciated that deficiencies existed in the early planning of the lifting operation.
- No role was identified for verification of compliance.

#### Technical

- The structure's centre of gravity was unknown.
- Attachment points on the structure were not identified.
- The hooks used for attachment to the structure (chokes) were not suited for the purpose.

The following nonconformities related to the incident have been identified.

- Inadequate clearance for, management of and execution of the lifting operation.
- Inadequate planning.
- Inadequate barriers.

How far the Covid-19 position and the company's handling of this might have been a contributory cause of the incident has been assessed. In the team's view, that was not a factor.

## **2 Background information**

An incident with personal injury occurred on 13 May 2021 during a lifting operation on Equinor's Johan Sverdrup RP.

### **2.1 Description of the facility and the organisation**

The Johan Sverdrup field lies on the Utsira High in the central part of Norway's North Sea sector, 160 kilometres west of Stavanger. Its field centre comprises the quarters (LQ), production (P1) drilling (DP) and riser (RP) platforms. These four facilities are connected by bridges. The water depth is 110-120 metres, while the main reservoir – which contains oil in Upper Jurassic intra-Draupne sandstone – lies 1 900 metres down. The field is produced with water injection as pressure support as well as gas lift in the production wells. Stabilised oil is exported from the RP through a new pipeline to rock caverns at the Mongstad terminal near Bergen. Gas is exported from the RP to the Kårstø terminal north of Stavanger through a new pipeline tied into Statpipe.

Photo 1 shows the Johan Sverdrup field with the RP in the foreground.



*Photo 1 has been received from Equinor and shows the Johan Sverdrup field.*

The Johan Sverdrup field is organised in Equinor's operations south profit unit, which is managed from Stavanger. Offshore, the logistics department is run by the logistics manager, who reports to the offshore installation manager (OIM).


## **2.2 Position before the incident**

Johan Sverdrup's size meant that its development was divided into two phases. Phase 1 came on stream in 2019, when the plan for development and operation (PDO) for phase 2 was also approved. Comprising another production platform (P2) and five subsea templates, the second phase is due to come on stream in the fourth quarter of 2022. Preparations for phase 2 have included modifications to the RP, with a lot of the equipment on the weather deck being removed. Aker Solutions Kværner (ASK) was given the job of planning and executing the necessary changes.

A total of 355 people were on board at the time of the incident.

Much of the equipment had already been removed before the incident occurred. Two frames used to store tanks holding various chemicals needed to be lifted off. ASK was commissioned to cut the frames into smaller sections, with Equinor lifting the smaller components in load carriers which would later be taken ashore by ship. The smallest sections comprised stairs and gangways used by personnel dealing with the chemical tote tanks.

### 2.3 Abbreviations and terms

ASK	Aker Solutions Kværner
A standard	Equinor's risk management tool, intended to contribute to safe and efficient operation
Barriers	Measures intended to identify conditions which could lead to faults, hazards and accidents, prevent a specific course of events from occurring or developing, influence a course of events in a desired direction, or limit damage and/or loss
CCR	Central control room
PA	Public address
Pims	Project and risk management programme
PSA	Petroleum Safety Authority Norway
RP	Johan Sverdrup riser platform, where the incident occurred
SAR	Search and rescue
SJA	Safe job analysis
Choking with hook	Using a lifting hook like a noose, as shown in the illustration 
TBT	Toolbox talk
WO	Work order
WP	Work permit

### 3 The PSA's investigation

The PSA's duty officer was notified of a serious personal injury during removal of structures on the Johan Sverdrup RP by phone at 16.20 on 13 May 2021. Further contacts with Equinor occurred on the same day to clarify the circumstances surrounding the incident.

On 14 May 2021, the PSA decided to investigate the incident and an investigation team was appointed. On the same day, the south-west Norway police district requested PSA support for its own inquiry.

The investigation team flew by helicopter from Sola at 09.07 on 15 May 2021 together with the police and Equinor's investigation team.

During its stay on Johan Sverdrup, the team supported the police in their interrogations and site inspections. Assistance was also provided for subsequent work by the police.

### **Composition of the investigation team**

Sigmund Andreassen	logistics and emergency preparedness
Damir Mihajlovic	HSE management
Rune Solheim	logistics and emergency preparedness
Torbjørn Gjerde	logistics and emergency preparedness (leader)

### **Mandate**

The investigation team was given the following mandate

- 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. *the potential of the incident 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.*

### **Support for the police**

In addition to its own investigation, the group was to provide technical support to the police's own inquiry into the incident.

### **Methodology**

After arrival on Johan Sverdrup, a joint kick-off meeting was held with the police and the Equinor and PSA investigation teams. That was followed by a joint site inspection.

Police technicians conducted site investigations with PSA assistance.

The police's tacticians also interrogated witnesses and those involved with PSA support. Nine interrogations and 10 interviews were conducted.

Necessary documentation was acquired by the PSA team during its time on Johan Sverdrup. See the overview in appendix B.

The investigation team returned to land at 18.55 on 16 May 2021.

## 4 Course of events

### 4.1 Before the incident

Photo 2 provides an overview of the RP weather deck before the frame removal job began. The frame is positioned centrally on the deck between the north crane on the right-hand side and the south crane to the left.



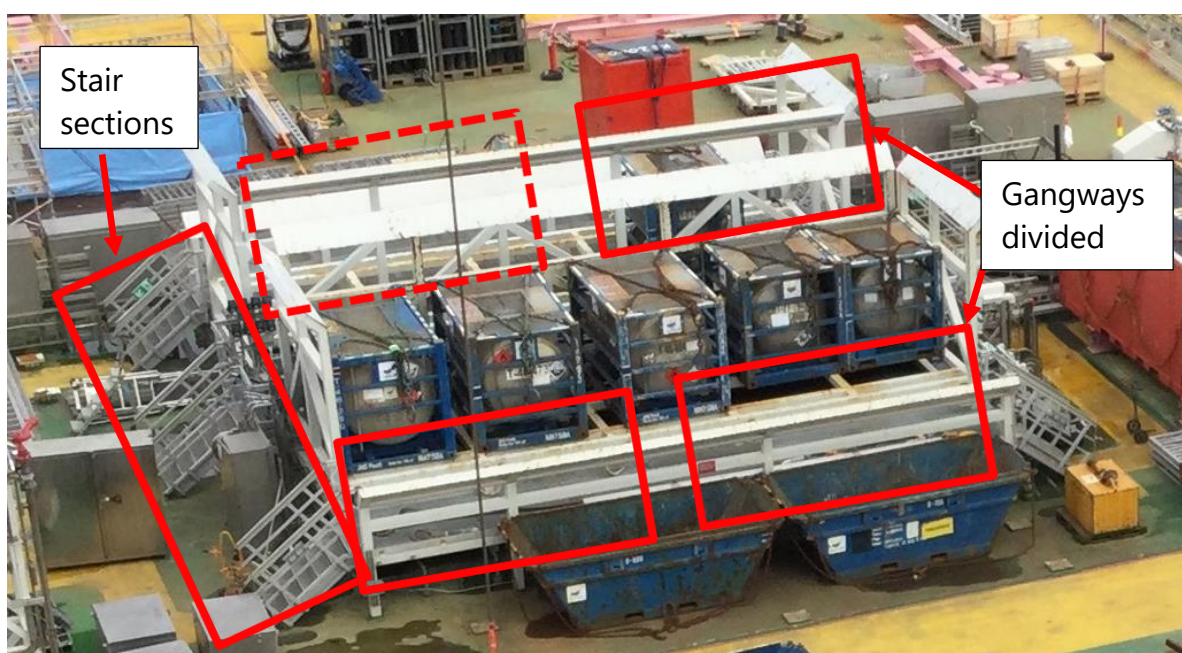
*Photo 2 has been received from Equinor and shows the RP.*

It was considered sensible to break up the frame for lifting. ASK had been given the job of reducing it to smaller components which could be lifted separately. This job was described in work order WO 32617 – “Cut tote tank frames (east and west) and secure with latches until removal of cut loose items”. Lifting away the remaining frame after the removal of stairs and gangways was planned in WO 3494 “Remove tote tank frames (east and west) (use of crane)”, and was intended to be a single lift by the offshore crane from the weather deck down to the ship.



Photo 3 shows the tank frame in use, with box superimposed around the sections to be cut for lifting. The plan was to remove the six stair sections and then split the gangway on each side into two sections and lifting these one at a time. Once ASK had completed the dismantling job, the frame would be left with loose stair sections and four gangway sections secured to it with ratchet straps.

ASK had completed WO 32617, which comprised cutting up the frame, before the incident. Furthermore, the stair sections had been lifted away by Equinor's logistics department. The next operation, lifting the four gangway sections into load carriers, was also to be done by the logistics department.



*Photo 3 has been received from Equinor and shows the frame to be removed. Notations by the PSA.*

Photo 3 shows the angle for the crane operator, who had a good view of the west side (bottom of the photo) while much of the east side was in the blind zone.

All four gangway sections were due to be lifted by the logistics department during 13 May. Each of these sections was treated by the team doing the job as a separate lifting operation, and was subject in advance to a TBT. The team had done a number of lifting operations over a long period during removal activities on the RP, and therefore considered a TBT to be sufficient for risk assessment and planning. It had also agreed roles and responsibilities, and discussed the importance of staying well away from the sections when the actual lift started.

The sections being removed were regarded as scrap iron. The team believed that each of them weighed about 1.5 tonnes, and all four had a different geometry with regard to attachment points for lifting equipment and centre of gravity. It opted to use a chain sling with shortening hooks which were attached to the sections by using the lifting hooks on the chains as chokes. Photo 5 shows the chain sling and how it

was choked to the structure. The shortening hooks allowed the team to adjust the length of each chain until a suitable attachment solution was identified when it started the lift. This adjustment required the crane hook to be tensioned in order to gain an overview of how the individual chain lengths looked in relation to each other and the structure as a whole. If something was unsuitable, the team adjusted the chain lengths or the positioning of the relevant hook (choke) until it felt that a good attachment for the chain had been found. This approach had been used on the three sections removed before the lift of the final section, when the incident occurred.

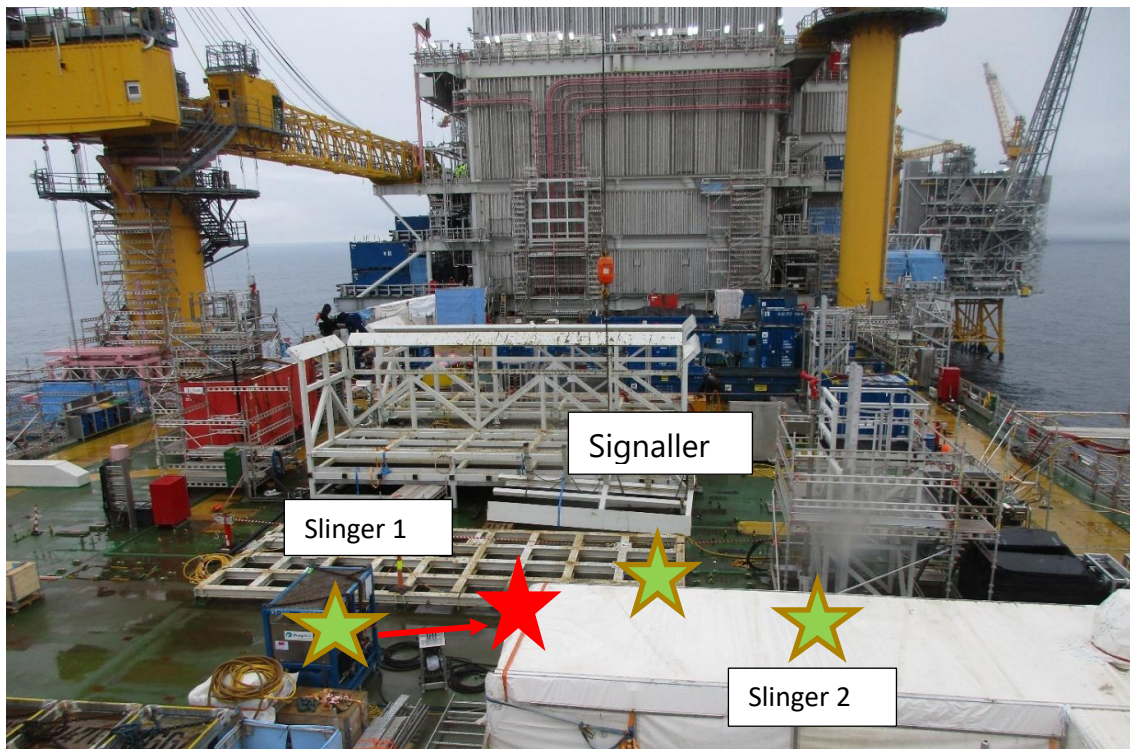
## **4.2 The actual incident**

The incident occurred during work to attach section four to the offshore crane for lifting into a load carrier. Outlined by the box with dashed lines in photo 3, this section is located on the north-east side and in the blind zone for the crane operator.

This job was being done by a team comprising two slingers and a signaller, in addition to the crane operator.

In addition to being responsible for directing the crane operator, the signaller was meant to keep an eye open to ensure that the slingers on deck were in a safe area. Attaching and adjusting the chains was done by the slingers.

The gangway section was still attached to the main frame as ASK had left it, and the team worked to attach the chains and adjust each chain length. It had opted to use a two-part chain sling, giving four chains to be attached to the section and adjusted for length. When the incident occurred, the team was making a third attempt to tension the crane hook to see how the chains and attachments looked. The positions of the signaller and slingers during this phase of the operation are shown by green stars in photo 4.



*Photo 4 is from the PSA team's inspection of the incident site.*

The crane operator raised the hook and reported that he had about one tonne of tension. Still standing on the deck, the load was attached to the main frame by two ratchet straps. The team considered attachment of the chain hooks to be acceptable, and the signaller released the first strap located where he was standing. He also told the two slingers to keep their distance.

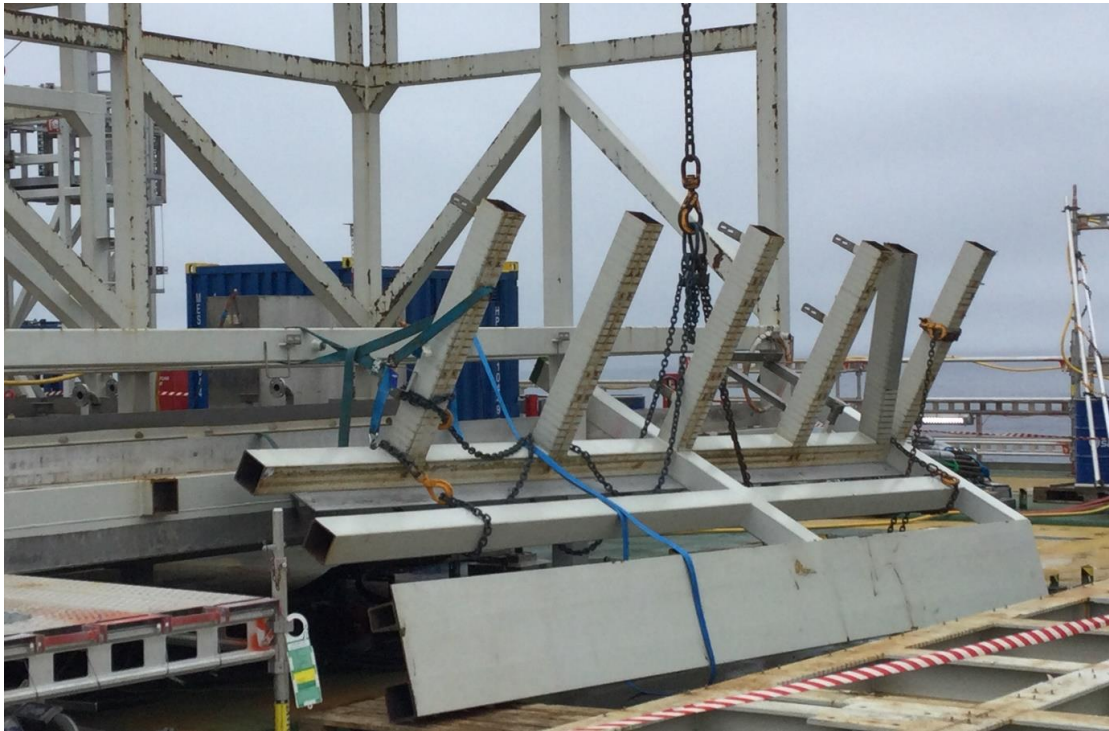
When the signaller released the strap, the structure shifted forward towards the east. That was as planned, since the team wanted the structure at an angle to the deck in order to make placing it in the carrier easier and safer. It emerged from interviews that the signaller was not fully satisfied with the way the structure fell, and wanted to re-fasten it to the frame in order to make further adjustments to the attachments.

In addition to shifting forward, the structure also twisted a little. This could have been because its centre of gravity was not quite as expected and also because the structure was still attached to the frame with a strap. At the same time, slinger 1 moved towards the structure in order to release the other strap holding it to the frame. This was attached near the red star in photo 4. That resulted in the person concerned being crushed between a protruding part of the structure and the frame. Slinger 1 was at the red star in photo 4 when this happened.

The structure hit the slinger in the stomach area, crushing them against the frame while also lifting them. According to the deck team, the structure's motion was slow and the slinger succeeded in getting free without assistance when it came to a halt. However, they were in pain and doubled-up on the deck.

The signaller saw what had happened and ran to slinger 1 to help. At the same time, slinger 2 asked the crane operator to notify the CCR and sound the alarm.

Photo 5 shows the structure as it was positioned when the PSA team arrived at the incident site. The structure had then been lowered to the deck and had folded over so that the beams which had supported the deck gratings are sticking up in the photo. It was part of this structure which struck slinger 1.



*Photo 5 is from the PSA team's inspection of the incident site.*

### 4.3 After the incident

The crane operator secured the load by lowering the structure to the deck as shown in photo 5. It twisted through about 110 degrees and moved roughly half a metre north in relation to where it was hanging before the incident.

### 4.4 Timeline

The timeline specifies activities from ASK receiving the job to produce the lifting plan for the frame and until the injured person arrived in hospital.

Date	Time	Event
24 Oct 19		WO 32617 – “Cut tote tank frames (east and west) and secure with latches until removal of cut loose items” established in Pims.
2 Jan 20		WO 34949 – “Remove tote tank frames (east and west) (use of crane)”. Job established in Pims.

13 Oct 20		WO 32617 – “Cut tote tank frames (east and west) and secure with latches until removal of cut loose items” is given status W40, which means issued for construction.
13 Oct 20		WO 34949 – “Remove tote tank frames (east and west) (use of crane)” is issued for construction.
1 Nov 20		Job WO 32617 – “Cut tote tank frames (east and west) and secure with latches until removal of cut loose items” received offshore.
21 Mar 21		Job WO 34949 – “Remove tote tank frames (east and west) (use of crane)” received offshore.
6 May 21		Job WO 32617 - “Cut tote tank frames (east and west) and secure with latches until removal of cut loose items” commenced (this is the first day when progress with the work was reported).
12 May 21		ASK had completed its WO, and Equinor waited for load carriers to transport the cut structures to land.
13 May 21	06.30	Morning meeting of the logistics team, when the day was planned.
	morning	Arrival of ship, load carriers for the structures received.
	afternoon	Work of shifting structures to load carriers begins.
<b>13 May 21</b>	<b>15.52</b>	<b>Incident occurs</b>
	15.53	Notification of personal injury on RP weather deck over the PA system. Medic and first aiders musters in accordance with instructions.
	15.56	First patient contact.
	16.20	Injured person reaches the hospital on Johan Sverdrup.
	16.20	PSA receives notice of the incident by phone
	16.35	Patient transport from hospital to helideck.
	16.42	SAR takes off from Johan Sverdrup.
	17.42	SAR lands at Haukeland.

## 5 Potential of the incident

### Actual consequence

Personal injury with lost time.

The incident caused no substantial material damage or consequences for the environment.

### Potential consequence

Under slightly different circumstances, the incident could have caused a fatality.

## **6 Direct and underlying causes**

### **6.1 Direct causes**

The direct causes of the incident were that the structure moved out of control at the same time as the injured person moved into the exposed area when the structure was released from the first ratchet strap. This led to them being crushed between the structure and the tote tank frame.

### **6.2 Underlying causes**

#### **6.2.1 Operational**

- Responsibility for releasing the ratchet strap had not been agreed in advance
- No message was given over the communication network that the ratchet strap was to be released before the signaller released it.
- Signaller took the role of slinger.
- The team executing the lifting operation made no use of aids to identify risks, (SJA, checklists, Equinor A standard, etc). See nonconformity 8.1.2 for details concerning risk.

#### **6.2.2 Organisational**

- Equinor's management system was not followed during the lift operation.
- Nobody in the land organisation, on board, or in Johan Sverdrup's logistics department appreciated that deficiencies existed in the early planning of the lifting operation.
- No role was identified for verification of compliance.

#### **6.2.3 Technical**

- The structure's centre of gravity was unknown.
- Attachment points on the structure were not identified.
- The hooks used for attachment to the structure (chokes) were not suitable for the purpose.

## **7 Emergency response**

The PA announcement of personal injury on the RP weather deck was made on the facility at 15.53. A general alarm was also sounded and all personnel were told to muster. Notification to the CCR was made by the crane operator. The CCR alerted the emergency response leadership and organisation.

The injured person was assisted away from the area to the logistics department's container close to the injury site.

The medic was with the patient at 15.56 and started treatment. They contacted the emergency response leadership and requested SAR transport of the patient with priority red. The SAR helicopter on Johan Sverdrup was ready at 16.03 for the patient, who arrived in the hospital on board at 16.20.

Taking off from Johan Sverdrup at 16.42, the helicopter landed at Haukeland University Hospital at 17.42.

The PSA team's assessment is that notification, establishing emergency response, and response measures conformed with response plans for the operation.

## **8 Observations**

Equinor has opted to base its Aris management system for lifting operations on Norsok R-003N – *Safe use of lifting equipment*.

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.

### **8.1 Nonconformities**

#### **8.1.1 Inadequate clearance for, management of and execution of the lifting operation**

##### **Nonconformity**

The lifting operation was not cleared, managed and executed in a prudent manner.

##### **Grounds**

It emerged from interviews that the logistics department on Johan Sverdrup had conducted lifting operations of the type which led to the incident over a long period. The early planning of these operations failed to identify special risks which required more detailed planning than an ordinary TBT by the team doing the job. Risks related to the lifting operation are identified in nonconformity 8.1.2. This nonconformity from the requirements for clearance, management and execution of lifting operations had not been appreciated by Equinor either. The nonconformity in the conduct of early planning was not picked up by the land organisation, on board or in the logistics organisation on Johan Sverdrup. An important element in early planning is to ensure adequate clearance of and management for safe execution of lifting operations.

The person with operational responsibility was insufficiently involved in the lifting operation. See nonconformity 8.1.3 on inadequate barriers.

Roles and responsibilities with regard to who was signaller and who was slinger had been clarified in advance. However, releasing the ratchet straps had not been discussed and agreed by the deck team. As a result, nobody knew who was responsible for this important part of the job, which made the structure unstable.

The signaller took the slinger role by releasing the ratchet on the strap, which meant the team lost the important function of one person with an overview of all participants in the lifting operation who can intervene as required. This is particularly important with a blind lift, and provides an additional barrier.

No message was given over the communication network that the ratchet strap was to be released before the signaller released it. The crane operator therefore failed to appreciate what had happened when the load moved.

### **Requirements**

*Sections 30 and 92 of the activities regulations on safety clearance of activities and on lifting operations respectively*

*Section 6 of the management regulations on management of health, safety and the environment*

### **8.1.2 Inadequate planning**

#### **Nonconformity**

Planning had failed to take account of important contributors to risk.

#### **Grounds**

It emerged from several interviews that the logistics department on Johan Sverdrup assessed the job during early planning as routine, and that there was no need for risk evaluations beyond a TBT. Nor was a WP established for the job, since lifting operations of this kind were not normally planned in the WP system on board.

In the PSA team's view, this lifting operation involved several risk elements and should therefore have been thoroughly risk-assessed in both early and detailed planning to identify hazards. Risk elements identified by the investigation include the following.

- Lifting an asymmetric structure of unknown weight and centre of gravity.
- Points for attaching lifting gear to the structure had not been identified.
- Ratchet straps had been used to secure the section to the fixed structure. This meant that control of the load would be lost when the strap was released.
- Work at a height to attach the lifting gear.
- The load was in the crane operator's blind zone.
- Choice of appropriate lifting gear.



The team executing the lifting operation made no use of check lists, an SJA, the A standard or other tools intended to ensure that all risks were identified and understood and that everyone in the team was clear about the risks.

The centre of gravity was not known by the team working to lift the structures. Choosing a way to attach the lifting gear to the structure was characterised by trial and error, which added to risk in the lifting operation. No lifting plan was prepared or other analyses conducted to ensure integrated planning and risk understanding so that the load could be attached to the crane hook in a safe and efficient manner.

In addition, the PSA investigation has found that the hooks used as chokes were not suitable for the purpose. They were only designed for use with loads in the direction of lift, and using these as chokes subjects them to a lateral load they are not designed to take. However, the investigation has not found that this contributed to the incident, and the assumption is that the hooks were so strong that they would not be deformed or damaged during use.

### **Requirements**

*Sections 29 and 92 of the activities regulations on planning and on lifting operations respectively*

#### **8.1.3 Inadequate barriers**

##### **Nonconformity**

No organisational and operational barriers were established which adequately reduced the possibility that faults, hazards or accidents could occur.

##### **Grounds**

Equinor had not put the person with operational responsibility in a position to serve as an operational barrier for safe lifting operations. The operational responsibility role for such operations was described in Equinor's management system – see SO10260-Opr – *Safe use of lifting equipment (Norsok R-003) – Johan Sverdrup*. Where this operation was concerned, the person with operational responsibility was identified as the person with discipline responsibility for logistics.

The operational responsibility role on the facility includes providing guidance and information on how lifting operations should be planned, risk-assessed and conducted in accordance with governing documentation, and working to build appropriate attitudes to lifting operations. It is also responsible for ensuring compliance with official requirements and governing documentation. The role must be assigned the necessary time, authority and expertise required to discharge it, and must also have an overview of all activities within its area of responsibility.

The team would also refer to the PSA audit of Johan Sverdrup in 2019, case number 2020/164-3, nonconformity 5.1.3 Inadequate management and inadequate exercise of roles and responsibilities in logistics.

### **Requirements**

*Section 5 of the management regulations on barriers*

*Section 92 of the activities regulations, see the guidelines which refer to Norsok R-003N on safe use of lifting equipment*

## **9 Barriers**

### **9.1 Barriers which have functioned**

In the PSA team's view, notification and emergency response on board, including first aid and transport of the patient to hospital, functioned as described in the emergency response plans for the operation and have thereby been effective barriers.

## **10 Discussion of uncertainties**

The investigation builds largely on interviews with personnel involved and on document reviews. It has not been possible during the work to reconstruct the suspension of the structure in the crane hook. That would have made it possible in part to acquire a better understanding of what hit the injured person, and how the attachment related to the centre of gravity. The reason the team chose not to reconstruct the suspension was that hooks used as chokes on the structure were not permitted to be used in this way. However, the team has found that this has not been significant for the conclusions of its investigation.

## **11 Assessment of the player's investigation report**

Findings in Equinor's investigation report accord to a great extent with those made by the PSA team and provide a good picture of the actual incident and its causes. The report's conclusions accord with the nonconformities observed by the PSA team.

Generally speaking, the PSA team believes that the Equinor investigation does not go far enough in identifying measures and lessons learnt, over and above its own verification activities, which will ensure compliance with its own management system. Chapter 9 on similar incidents and lessons learnt from these covers incidents with similar underlying causes. Equinor has failed in this investigation to take the opportunity to delve more deeply into the incidents mentioned in the chapter. That would have aimed to identify underlying causes and to look at the connections between these and the lessons learnt from them with regard to management and leadership related to the incident on Johan Sverdrup. Furthermore, the Equinor

investigation fails to address adequately the reason why the logistics department on Johan Sverdrup developed a method of working over time which does not accord with the company's own governing documentation. As a result, the recommendations for learning in chapter 10 are insufficient to ensure future compliance with the management system by the department on Johan Sverdrup.

The report fails to assess relevant observations from the PSA's audit and investigation reports on Equinor's operations. Such an assessment could have contributed to identifying connections and drawn important lessons across the organisation.

## **12 Appendices**

A: Relevant photographs

B: Documents used in the investigation

C: Overview of personnel interviewed