PETROLEUMSTILSYNET

Investigation report

Report	
Report title Odfjell Technology – *Linus* – Investigation of an incident on 10 November 2022 – personal injury from dropped object	Activity number 426001003

Security grading		
☑ Public	☐ Restricted	☐ Strictly confidential
☐ Not publicly available	☐ Confidential	

Involved	
Team T-F	Approved by/date Irja Viste-Ollestad/27 January 2023
Members of the investigation team [redacted]	Investigation leader [redacted]

Figure 1 Linus. Source: ConocoPhillips

Contents

1 Summary

On Thursday 10 November 2022, a person was subjected to crushing during repair work on a cantilever drag chain (linked cable/pipe tray).

The injured person (IP) was undoing the nuts on a damaged side plate in one of the drag chain links. He was lying between the upper and lower drag chain when the upper section collapsed. Parts of the chain dropped and compressed the IP's arm and head. After being released, he was taken to the hospital and then flown by SAR helicopter to the SUS. His left arm had to be amputated.

In minimally different circumstances, this incident could have had a fatal outcome.

The most important direct cause was the collapse of the drag chain over the IP. This occurred after he had undone several nuts on a damaged side plate for workshop repair. The job was not registered, planned or risk-assessed in accordance with the requirements in the company's governing systems.

Underlying causes were a lack of control and management of technical condition, lack of job control, deficiencies in governing documents and procedures, and inadequate handover routines and clarification of roles and responsibilities.

The incident occurred the day after a swing shift from night to day work. It is unclear whether this might have affected the assessment of risk posed by the repair work.

Seven nonconformities and one improvement point were identified.

Nonconformities:

- registration and classification
- procedures and work description for the drag chain
- roles and responsibilities
- decision basis and safety clearance
- compliance with governing documents
- noise
- information at shift and crew changes.

Improvement point:

- mustering and POB.

2 Background information

During maintenance of the drag chain, a serious personal injury occurred on 10 November 2022 on Odfjell Technology's *Linus* facility.

2.1 Description of facility and organisation

Linus is a jack-up drilling facility operated by Odfjell Technology (Odfjell) and working for ConocoPhillips on the Ekofisk field. Built for Seadrill, it received an AoC in 2014. A new AoC was issued in 2022 when Odfjell took it over on 30 September 2022.

A 26-inch hole section for surface casing was being drilled in well 1/9-AB-3 H on Tommeliten Alpha for ConocoPhillips when the incident occurred. Located south-west of Ekofisk, Tommeliten is a gas/condensate field developed with a six-slot subsea template.

Personnel involved in the incident had long experience of and service on the facility, and had worked together for a long time. The work team doing the repair job had remained with *Linus* in the transition from Seadrill to operation by Odfjell at the time of the incident.

2.2 Equipment involved in the incident

The incident occurred during work on the port drag chain. This is a linked cable/pipe tray carrying electrical cables and hoses which supply water, mud and air to the cantilevered drilling module as this is skidded between different well slots. The relevant drag chain allows the cantilever to be moved longitudinally by about 36.6 metres on the facility.

Figure 2 The collapsed drag chain and the surrounding area after the IP had been freed. Source: Odfjell Technology

Measuring 193.5 cm wide, the port drag chain comprises a number of links made up from four metal plates bolted two and two to bushing. The outer plates, including the damaged (bent) one to be removed, are about 92 cm long by 50 cm broad.

Six holes for the bushing have been cut in each plate. The bushing allows the linked cable tray to move from the lower to the upper level so that it can follow the rig between various well slots.

The port drag chain comprises two cable trays, one on top of the other – an inner one for electric cables and an outer one for hoses carrying cooling and fire water. High-pressure lines for mud and cement are carried by the drag chain on the starboard side of the cantilever, which is narrower than the port one.

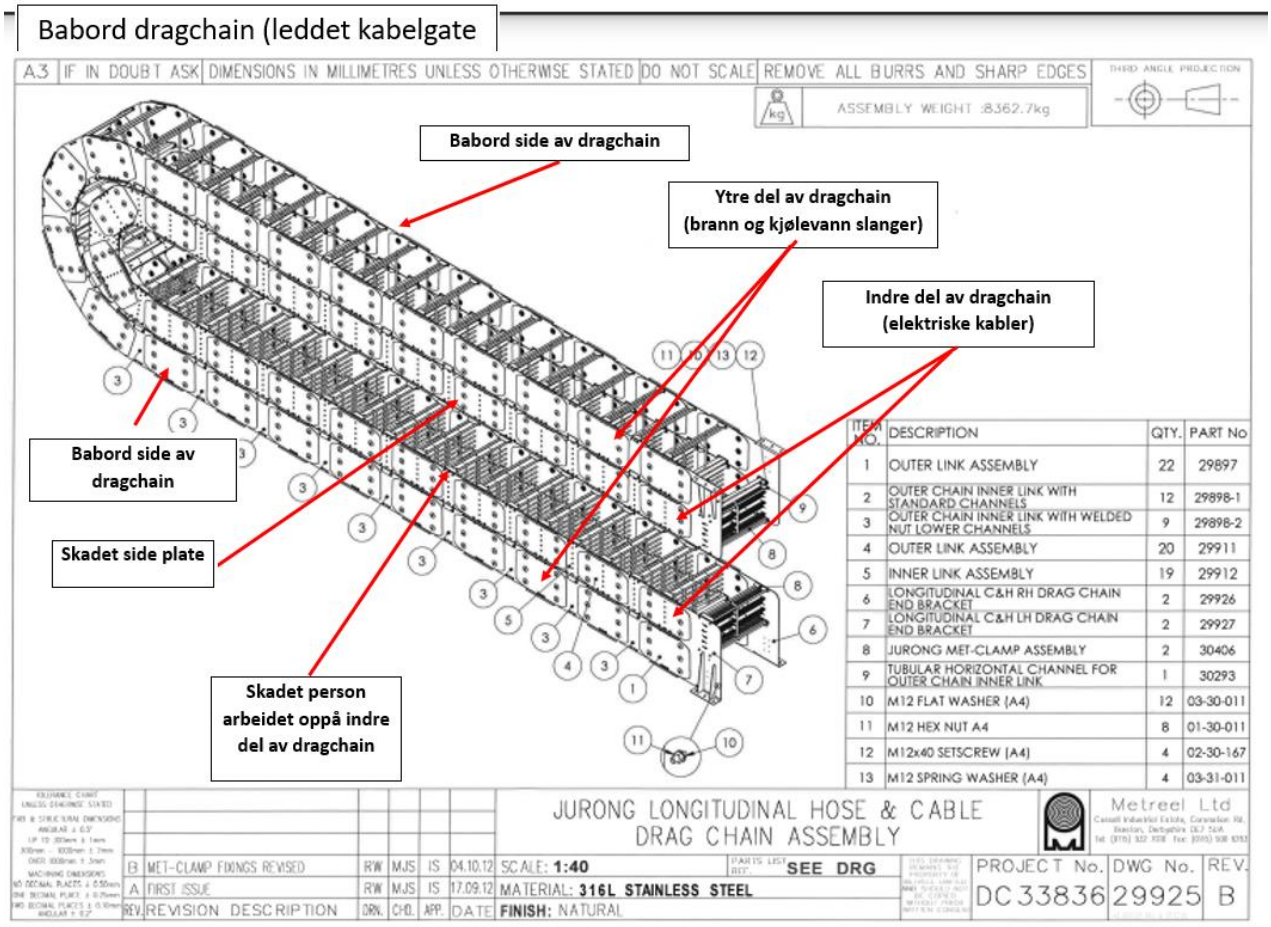

Figure 3 The drag chain (linked cable tray) in its centre position. Electrical cables and hoses are not shown in this diagram. Source: Odfjell Technology

2.3 Position before the incident

Several cases of structural damage to the drag chain were reported in 2019, with consequent recommendations for improvements in connection with classing.

After skidding the cantilever on 3 November 2022, damage to the port drag chain in the form of a bent side plate was discovered. A temporary repair was carried out on 4 November 2022.

A new skid of the cantilever conducted on 9 November 2022 placed the damaged side plate on the drag chain in a new position between two fixed support rollers. It was about five metres from the nearest fixed support.

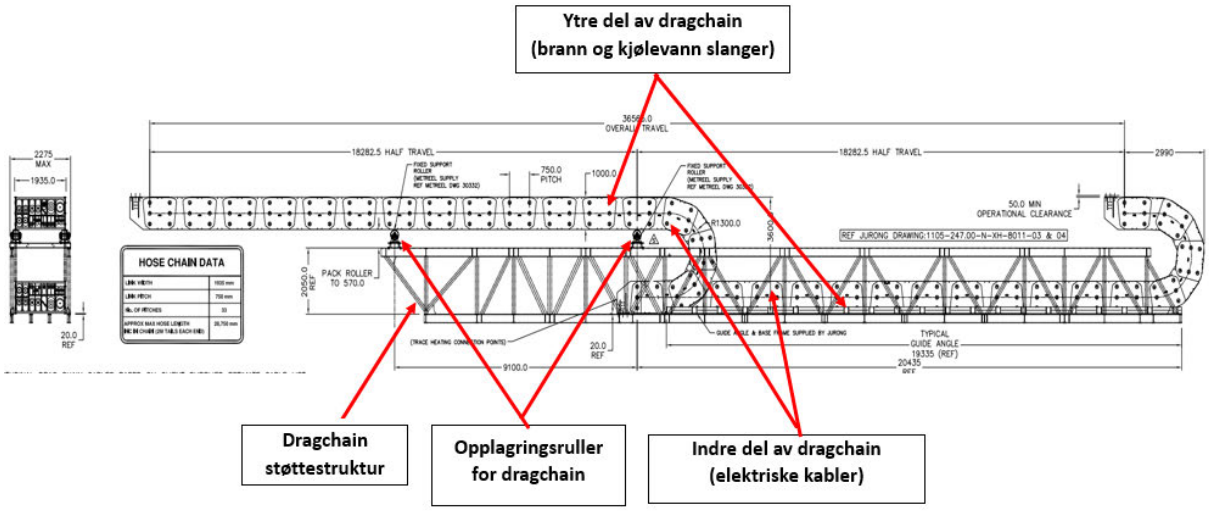

Figure 4 The port drag chain when the cantilevered drilling module is in the innermost (parked) and outermost (over the sea) positions. At the time of the incident, the drag chain was roughly in the centre position. Source: Odfjell Technology

Work to remove the damaged plate for workshop repair was initiated on 10 November 2022.

2.4 Abbreviations

AoC	Acknowledgement of compliance – issued by the PSA to mobile petroleum facilities so that they can work on the NCS
Cantilever	Outrigger carrying the drilling module
CCR	Central control room
CM	Corrective maintenance
Drag chain	Linked pipe/cable tray which permits the cantilevered drilling derrick to move between well slots
DSL	Drilling section leader
FMECA	Failure modes, effect and criticality analysis
GA	General alarm
HSE	Health, safety and the environment
HTO	Human, technology and organisation
IP	Injured person
MSL	Marine section leader
NCS	Norwegian continental shelf
OIM	Offshore installation manager
PA	Public address (system)
PM	Preventive maintenance
POB	Personnel on board
PSA	Petroleum Safety Authority Norway
SAR	Search and rescue
SJA	Safe job analysis
Skid	Move the cantilevered drilling module to a new position
SUS	Stavanger University Hospital
TSL	Technical section leader
WO	Work order
WP	Work permit

3 The PSA investigation

The police and the PSA were notified of the incident immediately. After deciding to investigate, the police requested assistance from the PSA. In addition, the PSA conducted its own investigation. The PSA's investigation team and the police travelled to *Linus* on Friday 11 November 2022.

Composition of the PSA's investigation team

[redacted]

Mandate for the investigation

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 according with the template.*
i) *Recommend – and normally contribute to – further follow-up.*

Five people involved in the incident were interrogated offshore by the police, with the PSA present in all cases. It did not participate in the IP's publicly available deposition to the police at the hospital because its team was still offshore. The PSA team interviewed several people offshore after the police returned to land. In addition, it conducted interviews via Teams with the rig manager and one onshore interview with the IP.

The investigation included reviews of

- governing documents and the maintenance system
- compliance with/use of governing documents
- various routines, handover
- risk assessments of WPs, SJAs and safety checks

- roles and responsibilities
    - area responsibility
    - system responsibility
    - personnel responsibility
- documents describing the equipment
- verification of the experience and competence of personnel involved
- status of training, particularly related to the transition from Seadrill to Odfjell on 30 September 2022
- working hours and work loads
- weather
- emergency response.

A review of the PSA's register of incidents involving drag chains showed a few reported incidents of limited scope. One was an incident on *Linus* where transverse steel stays had fallen off the drag chain. The team is not aware of any comparable incidents on the NCS.

4 Course of events

4.1 The incident itself

Immediately after the handover meeting on 10 November 2022, two people – the IP and an assistant – from the maintenance department went to the port drag chain to examine the damaged side plate and decided what should be done. The IP installed a cordon on the deck beneath the area where the plate was located and donned a safety harness. He then crawled in between the upper and lower drag chain for easier access to the nuts holding the side plate in place. These nuts were on the outside of the drag chain. The assistant stood on the gangway close to the derrick. When the nuts were loosened, the upper drag chain collapsed and dropped. The IP's head was compressed between the upper and lower (inner) drag chain, with his left arm crushed between the outer side of the drag chain and the support structure.

4.2 After the incident

- The assistant notified the crushing incident in the drag chain by radio at 08.50. He then ran to get help nearby, and three contractor personnel started to rig chain hoists in an effort to raise the drag chain and free the IP.
- The CCR alerted the medic on board via the PA system as soon as the report from the assistant was received, and the medic immediately called the senior medic on Ekofisk Lima to request assistance and a SAR helicopter.
- The OIM heard the CCR call for medic and ran at once to the deck with the TSL, who was in the same meeting, to obtain an overview. They observed the stuck person and then mustered in the emergency response centre.

- A GA was activated at 09.02 – 12 minutes after the incident was reported by radio.
- The emergency response teams were mobilised and the rest of the crew mustered.
- Chain hoists and inflatable air bags were initially used in attempts to free the IP, and managed to free his head. The IP's arm was freed at 09.23 by using the port offshore crane to raise the collapsed drag chain. The IP wriggled out of the drag chain himself. According to the load cell on the offshore crane, the collapsed drag chain weighed some two tonnes.
- The IP was thereafter taken to the hospital and then to land by SAR helicopter at 10.17.

4.3 Timeline

Figure 5 Relevant times and dates in this investigation report.

5 Potential of the incident

5.1 Actual consequences

The IP's head and left arm were compressed. While he suffered no lasting head injuries, his left arm was amputated between shoulder and elbow at the hospital in the wake of the incident. He also suffered some minor fractures in his shoulder and back.

According to Odfjell's matrix for actual consequences, the incident was assessed to be in seriousness category 4 – the second-highest level.

The drilling operation was halted for 48 hours from the time of the incident.

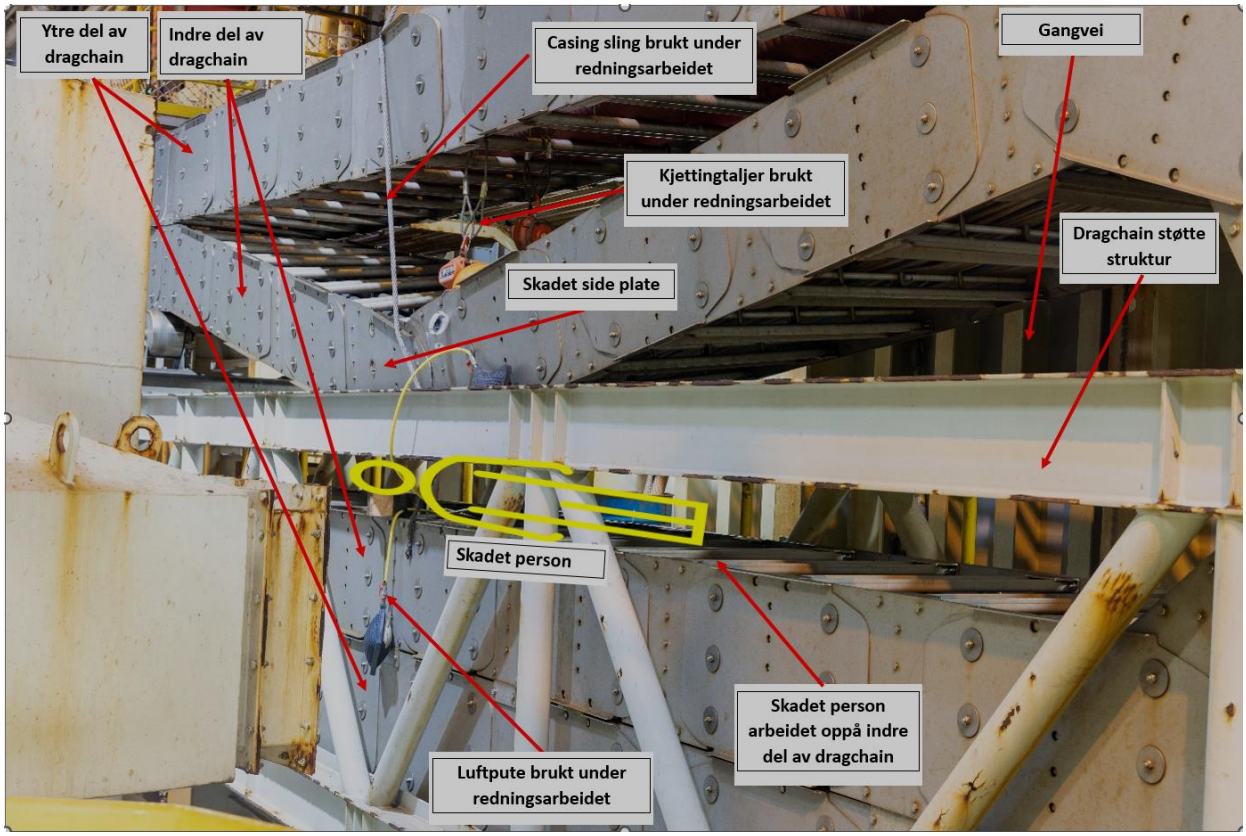

Figure 6 The port side of the gangway after the drag chain was raised, moved to one side and laid on the support structure in order to free the IP (before safeguarding access to permit investigation of the site). Source: South-west Norway police district

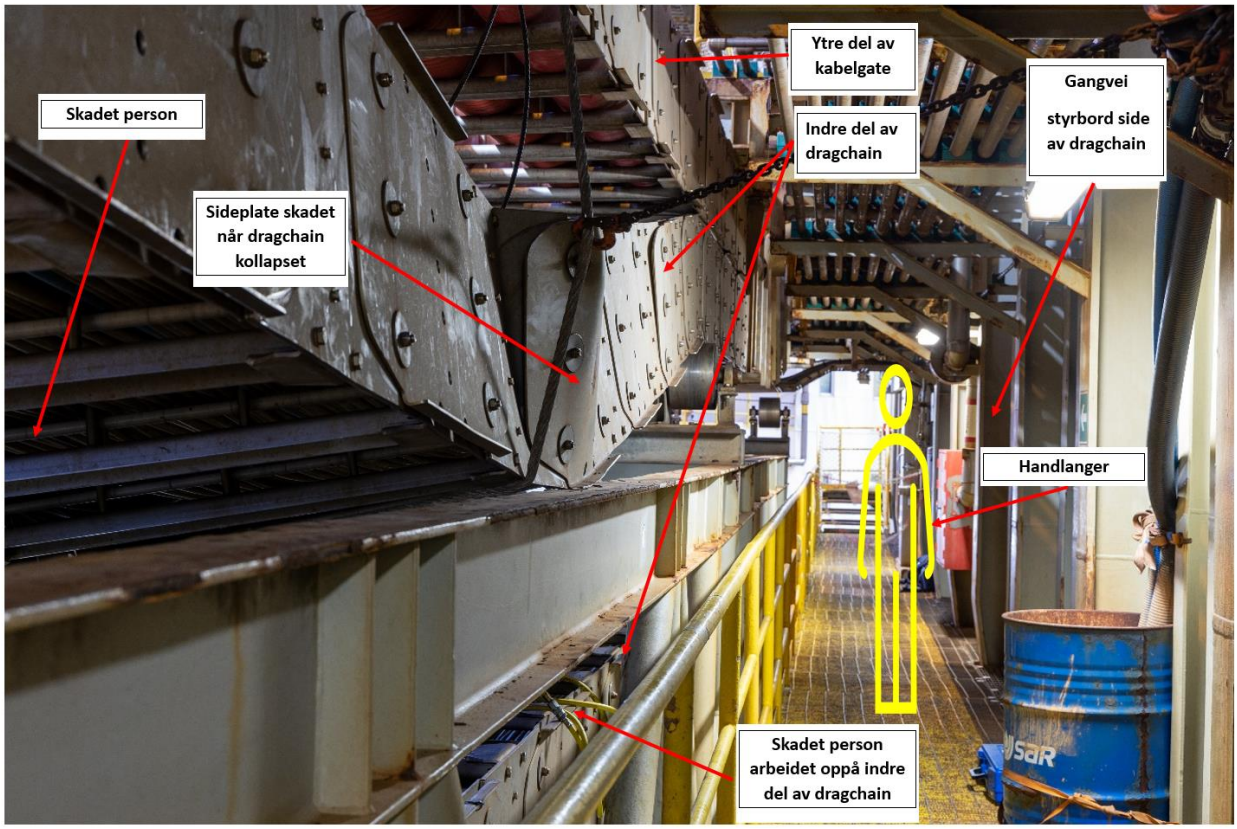

Figure 7 Port side of the drag chain and gangway. This is after the drag chain had been raised, moved to one side and laid on the support structure in order to free the IP (before safeguarding access to permit investigation of the site). Source: South-west Norway police district

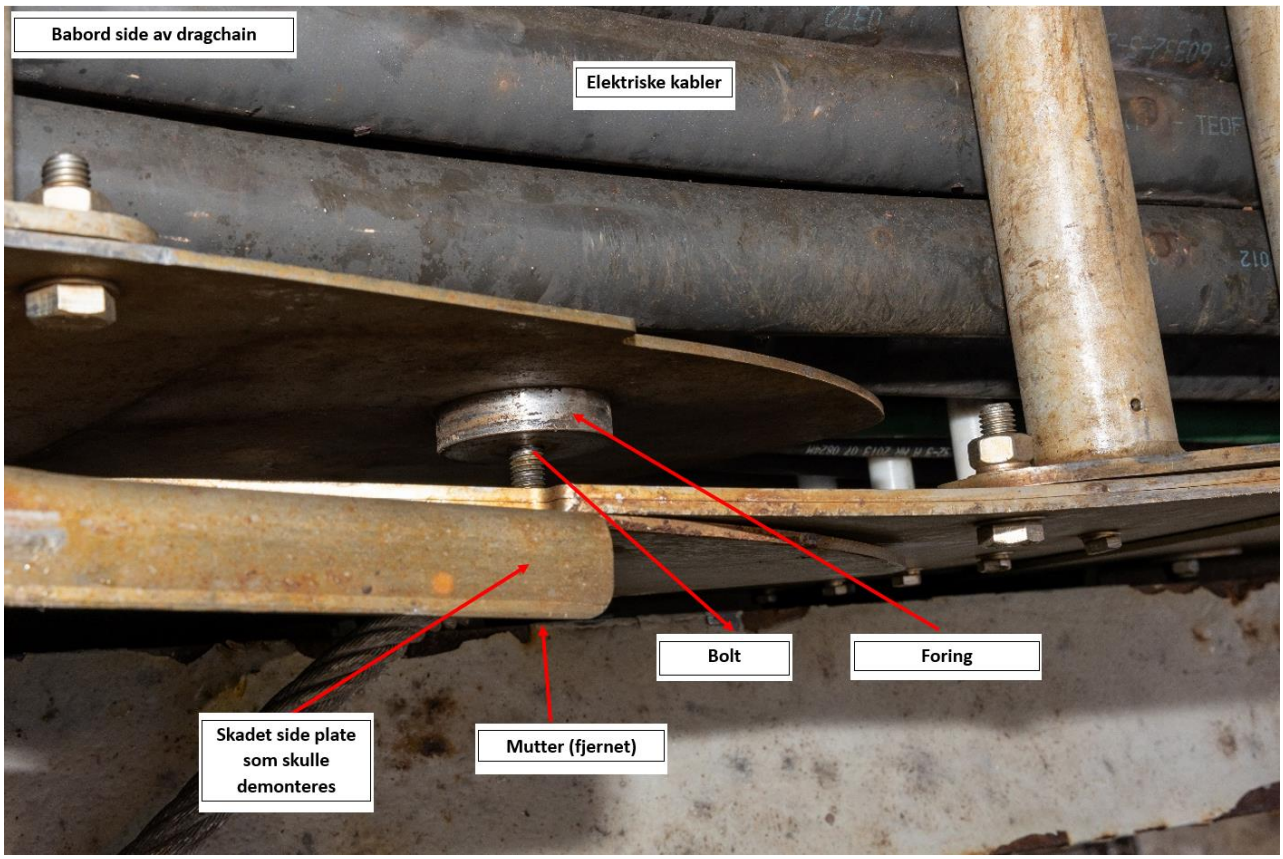

Figure 8 The chain link following the incident with the plate which was to be removed (after the drag chain was safeguarded for access to permit investigation of the site). Source: South-west Norway police district

5.2 Potential consequences

In minimally different circumstances, this incident could have had a fatal outcome. The IP's head was clamped tightly by the upper drag chain. Immediately before the structure collapsed, the assistant had asked whether he should come inside to help loosen the bolts. This offer had been refused. It could have meant that two people might have been crushed under the drag chain.

Risks were also faced in lifting the upper drag chain in order to free the IP's head and arm. The weight of the collapsed structure was considerable, with the load cell on the offshore crane showing about two tonnes when the police came to secure the injury site for their investigation.

6 Direct and underlying causes

6.1 Direct cause

The direct cause of the incident was that the IP loosened bolts on the upper drag chain plate whilst lying between the upper and lower parts of the cable tray. When several of the nuts had been removed, the side plate came loose and the drag chain collapsed onto the IP.

6.2 Underlying causes

The following underlying causes have been identified by the investigation.

- Operational
    - inadequate compliance with governing documentation
    - inadequate registration and classification of faults with equipment and work
    - inadequate decision basis and safety clearance
    - insufficient information at shift and crew changes.

- Organisational
    - unclear roles and responsibilities
    - deficiencies in the procedure and work description for the drag chain.

6.3 Barriers and management of risk

The management loop illustrates how risk is managed by systematically monitoring and identifying it, choosing to implement measures and then verifying their effect. In addition to ensuring the company's management and control of risk, the loop is intended to contribute to continuous improvement. Requirements in the HSE regulations for the petroleum sector are built up around the components in the loop.

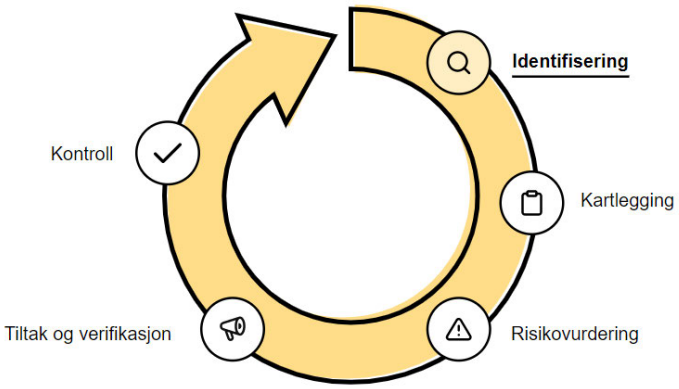

Figure 9 The management loop with the various steps. Source:Arbeidsmiljøportalen.no
Key (clockwise from top right): Identification Mapping Risk assessment Measures and verification Checks

The management loop for maintenance work can be illustrated as in figure 10.

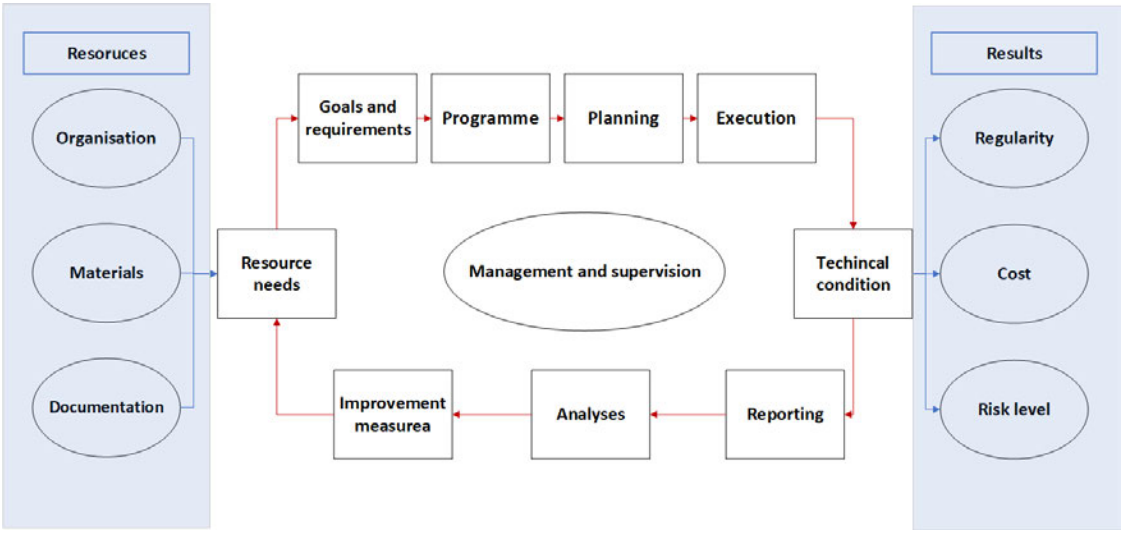

Figure 10 The management loop related to maintenance Source: PSA basis study 1998

In principle, faults or damage must be registered to form the basis for decisions on correction. The result is a WO entered in a work plan. Planning for jobs includes requirements for equipment, customisation, work description, governing documentation, risk assessment and measures, as well as coordination. Faults and/or work not registered or followed up in established systems break the management loop and result in inadequate management and control.

The investigation identified failures at several points in the loop, leading to inadequate control and management of work and technical condition on *Linus*. That applied particularly to a lack of fault registration for the drag chain and inadequate communication about and risk assessment of the repair work. Overall, these breaches meant a deficient decision basis for assessing and implementing risk-reduction measures.

Deficient registration and documentation of work on the drag chain included:

- The drag chain was inspected in 2019 when classing the rig. Several cases of damage to side plates were identified and recommended for correction. These observations were never logged as nonconformities or for CM.
- Damage to the drag chain was detected during skidding on 3 November 2022. This was not registered in the maintenance system.
- A temporary repair was made to the damaged side plate on 4 November. No WO was produced or WP issued for this job.
    - The damage was reported to the incoming DSL at the 14-day handover, but without reference to or confirmation of registration or that a temporary repair had been made.
- Work was initiated on 10 November to repair the damaged side plate.
    - No WO, WP or SJA was produced for the job. The investigation also found no documented work planning or coordination for it.
    - No similar maintenance work with the drag chain had been done previously on *Linus*.
    - No job description or checklist existed for the job.

7 Emergency response

Timeline

- 08.50 The assistant radios the CCR to report a crush accident at the drag chain.
- 08.51 The CCR calls up the medic over the PA system.
- 08.56 The medic hears the PA report of a crush accident at the drag chain and immediately contacts Ekofisk Lima (where the SAR helicopter and the acute-care medic are located) to request SAR assistance, and then asked the CCR to mobilise the first-aid team.
- The OIM and TSL heard the accident message over the PA, but did not muster directly to the emergency response centre. They ran down to the deck to check what sort of crush injury was involved.
- 09.02 A GA was activated by the OIM, who had then arrived in the response centre.
- 09.10 A full POB overview was obtained, according to the incident log.
- 09.13 The first-aid team with medic and on-scene commander arrived at the scene.
- Chain hoists and air bags were initially used to free the IP. When these proved insufficient to raise the drag chain, the offshore crane was deployed.
- 09.21 The SAR medic arrived at the scene. With the Linus medic, they prepared the IP for transport.
- 10.17 The IP was flown to the SUS.

8 Regulations

Mobile facilities registered in a national ship register are covered by section 3 of the framework regulations on the application of maritime regulations in the offshore petroleum activities. This provides that relevant technical requirements in maritime regulations can be applied for conditions of a maritime character on board.

To be able to operate on the NCS, mobile facilities such as *Linus* must have an AoC as specified in section 25 of the framework regulations. An AoC was issued in 2014 to Seadrill for operation of *West Linus*. When Odfjell took over operational responsibility for *Linus* on 30 September 2022, it was issued with a new AoC. The AoC application and its consideration were conducted in accordance with the regulations and the handbook for AoC applications.

Facilities, including those with an AoC, are subject to the framework, management and activities regulations.

Requirements for managing activities on facilities with an AoC are specified in section 17 of the framework regulations on the duty to establish, follow up and further develop a management system. This requires the responsible party to establish, follow up and further develop a management system to ensure compliance with requirements specified in the HSE legislation.

Other key provisions in the petroleum regulations related to risk, barriers and work processes are also among the requirements which apply.

9 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.

9.1 Nonconformities

9.1.1 Registration and classification

Nonconformity

Odfjell had failed to ensure that relevant information was registered and processed in an overall plan for management and control of planned and corrective maintenance activities.

Grounds

- The investigation identified a number of conditions which led to maintenance management deficiencies. See, in particular, figure 10 and the text in section 6.3.**Feil! Fant ikke referansekilden.** Findings from the inspection report produced in 2019 in connection with classing were not registered or documented other than in the report.
- The temporary repair carried out on 3 November 2022 was not registered, logged, coordinated or discussed across departments. The TSL was informed of the work done, but did not inspect or register it.
- Work done on 10 November was not registered, logged, coordinated or discussed across departments.
- The PSA team conducted verifications in Maximo (the *Linus* maintenance management system) for equipment involved in this incident. These showed that basic analyses which contribute to management and control were not linked to the equipment. Examples are the specified priority for logged work and spare parts.

Interviews and verifications revealed that practice varied in registering quality deviations. The effect of the work must be evaluated to help improve the maintenance programme. *Linus* had no follow-up of medium- and low-criticality jobs. The onshore organisation only followed up jobs classified as high-criticality.

Requirements
Section 19 of the management regulations on collection, processing and use of data
Section 48 of the activities regulations on planning and prioritisation

9.1.2 Procedures and work description for the drag chain

Nonconformity
Lack of procedures and descriptions for work on the drag chain.

Grounds
The PSA team conducted a review of the maintenance system on board in order to gain an overview of and go through available documentation on the drag chain. No work descriptions for the drag chain were found. Available documentation was confined to general conceptual drawings, lists of recommended spare parts, and the operating and maintenance manual. The latter specified that maintenance on the drag chain structure would be minimal, but included a general description of hoses and cables. In addition, the manual was deficient. Examples were:

- no guidance or work descriptions were provided for repair work in the event of possible damage to the actual drag chain structure
- no description was provided of risk associated with work on repairing the structure or replacing cables or hoses in the drag chain.

It was also unclear who had area or equipment responsibility for the drag chain. See nonconformity 9.1.3.

Requirement
Section 24 of the activities regulations on procedures

9.1.3 Roles and responsibilities

Nonconformity
Roles and responsibilities for the drag chain and the area where it was located were not clearly defined or clarified across the departments on board.

Grounds

- Coordinating duties calls for clarified interfaces between parties responsible for areas and equipment. No common understanding prevailed on board about where responsibility for the drag chain rested. This equipment was not described in any of the predefined areas of responsibility on *Linus*, such as *L3-JU-ALL-HSE-PR-033 – Duties for area and system responsible*.
- It emerged from interviews that some believed the equipment and area belonged to the drilling department, others that they were part of the technical department, and a few that they were shared between both.
- Since no registrations had been made of the damage to the drag chain or that a skid operation was imminent, the *Skid cantilever L4-JU-LIN-B-PR-105* procedure was not utilised. This specified that the toolpusher is responsible for skidding, the TSL must verify that the skid system has no outstanding PM **before** skidding and a mechanic/hydraulic technician must monitor lubrication and the hydraulic system during the operation.
- See also nonconformity 9.1.2 on procedures and work description.

Requirements
Section 6, paragraph 2 of the management regulations on management of health, safety and the environment
Section 11, paragraphs 1 and 3 of the management regulations on the basis for making decisions and decision criteria

9.1.4 Decision basis and safety clearance

Nonconformity
Odfjell had not ensured that decisions about and coordination of work on the drag chain were adequately assessed and coordinated. No safety clearance had been given for the work before it began.

Grounds
The following emerged from verifications of the management system and interviews with personnel.

- Registrations and underlying information in Maximo were incomplete and provided an inadequate decision basis for work on the drag chain. See also nonconformity 9.1.1
- No agreed decision was taken on repairing the damage to the drag chain in handover/coordination meetings on the facility on either 4 or 11 November 2022. The work was not coordinated as required by the company's management system.
- Interviewees differed over the level of/need for WPs in certain jobs.
- Despite the lack of procedures, descriptions, history and maintenance experience for work on the drag chain plates, no safety review and clearance were done for the job.
- Governing documentation did not define a party with area responsibility for the drag chain system. See nonconformity 9.1.3.

Requirements
Section 11 of the management regulations on the basis for making decisions and decision criteria
Section 30 of the activities regulations on safety clearance of activities

9.1.5 Compliance with governing documents

Nonconformity
Inadequate compliance with procedures in planning and executing work operations. Lack of safety clearance for activities before they were executed.

Grounds
Governing documents and procedures were not complied with prior to the incident.

- Work on repairing damage to the drag chain was initiated without a WO, ref *L3-JU-ALL-TO-PR-020 Maintenance management*.
- The work team failed to conduct an adequate safety check before starting the job, ref *HMS risikostyring prosedyre L1-CORP-HSE-PR-002N*, og *L3-JU-ALL-HSE-PR-032 - SAFETY STANDARD*
- No WP was sought, ref *L3-JU-ALL-HSE-PR-009 Permit to work*.
- An SJA was not prepared for the work, ref *HMS risikostyring prosedyre L1-CORP-HSE-PR-002N*.
- The *Arbeid i høyden* procedure with checklists was not followed.

Overall, the PSA team can see that inadequate compliance with procedures has contributed to the incident.

Requirements

Section 24, paragraph 2 of the activities regulations on procedures
Section 30 of the activities regulations on safety clearance of activities

9.1.6 Noise

Nonconformity

A high level of noise from the alarm siren and PA loudspeaker in the crane cabin hindered communication during necessary execution of lifting at the injury site.

Grounds

- It emerged from interviews that the crane operator could not communicate with personnel at the injury site using the communication system in the crane cabin when lifting the collapsed drag chain to free the IP. The level of noise in the cabin was very high because of the alarm siren/PA loudspeaker, and the operator had to leave his seat to fetch his hard hat with ear protectors/radio to be able to communicate with deck personnel. The injury site was in the operator's blind zone, making him wholly dependent on clear and precise information to conduct the lifting operation, which was critical in preventing the incident from escalating and required great precision.
- The PA loudspeaker and alarm siren in the offshore crane cabin have no volume control and are the same type used to cover the whole facility. This means that the volume when using the PA system/alarm became disproportionately high in the cabin. To reduce the volume to an acceptable level, the loudspeaker had been filled with rags/paper, but even that did not diminish the noise enough for precise communication to be possible.
- A high level of impulse noise can damage the hearing of personnel in the cabin. Loudspeakers/sirens must be tailored to the room/area where they are installed. This factor was addressed in the PSA's audit report covering logistics and maintenance management on *West Linus* in 12-13 May 2014 (activity 404009003) in connection with the AoC consideration for the facility.

Requirements

Section 23 of the facilities regulations on noise and acoustics
Section 92, paragraph 2 of the activities regulations on lifting operations

9.1.7 Information at shift and crew changes

Nonconformity

The handover information provided at shift and crew changes was inadequate in relation to significant information and communication for HSE.

Grounds
The investigation identified weaknesses in handovers for crew and shift changes.

- It emerged from interviews that people's understanding differed over what had been decided at the handover meeting of 10 November 2022 concerning damage to the drag chain. The minutes fail to make it clear what had been discussed or which decisions were taken.
- The quality shortcomings of the drag chain were not part of the TSL handover.
- The line managers (TSL, DSL and MSL) used different formats, set-ups and structures in their handover minutes.
- Handover documents for checks of the action taken have been lacking. An assumption exists that it is taken care of, but with no references to responsible manager or WOs.
- A number of activities are excluded from shift handovers and the natural coordination. Planned maintenance to be executed, for example, is not normally included. This conflicts with Odfjell's handover procedures.
- The handover documents seen by the investigation have a format which deviates from the template described in Odfjell's governing documents.

Odfjell's procedures state: "In connection with shift and crew changes, the responsible party shall ensure necessary transfer of information on the status of safety systems and ongoing work, as well as other information of significance for health, safety and the environment during the execution of activities". A direct quote from the HSE regulations, this also conflicts with the bullet points above.

Requirements
Section 32 of the activities regulations on transfer of information at shift and crew changes
Section 11, paragraph 4 of the management regulations on the basis for making decisions and decision criteria

9.2 Improvement point

9.2.1 Mustering and POB

Improvement point
Necessary measures were not initiated as quickly as possible after the incident.

Grounds
- When a crush injury at the drag chain was reported, the OIM opted to go out on deck to form an overview of the position before mustering to the response

centre and activating a GA. This was done 12 minutes after the incident. *Linus* could have lost critical time in the acute rescue effort and the incident could have developed further.

- The incident occurred at 08.50. According to the response log for the incident, *Linus* had control over POB at 09.10. However, it is uncertain whether the response leadership had full POB control during the rescue work, since many people were at the injury site. Interviewees reported that the on-scene commander was asked by radio to count the number of people involved in the rescue effort, but answered that it was difficult to gain an overview of personnel in the area. Eighteen people were missing from the muster station, and the response leadership took the view that this could accord with the people involved in the rescue work.

Requirements
Section 16, paragraph 1 of the management regulations on barriers
Section 77, litera a and c of the activities regulations on handling hazard and accident situations

10 Barriers which functioned during the incident

In the PSA team's view, emergency response measures on board – including first aid and transport to hospital – functioned as described in the emergency response plans for the enterprise. From that perspective, they have served as effective operational and organisational barriers which helped to reduce the consequences of the accident and prevent escalation.

Examples of barriers and measures related to the incident include the following.

- Emphasis in the rescue work was given to ensuring that personnel who helped free the IP did not expose themselves to risk if the drag chain collapsed further.
- Use of the offshore crane to ensure that the drag chain did not collapse further and made the position worse.
- The medic's rapid response in calling for an SAR helicopter meant that the IP received treatment and transport as soon as he was freed from the drag chain.
- Debriefing and follow-up of personnel – both those directly involved and others on board – were prioritised both on the incident day and in subsequent days/weeks. That included one-to-one and group talks by the medic with personnel involved. At an early stage, the company draw an information plan and an offer of further follow-up for personnel.

11 Discussion of uncertainties

The investigation team also looked at number of other conditions which could have been significant for the incident, but where it was unable to determine whether they had affected the outcome.

- The team verified working time, with the emphasis on shift arrangements and overtime before the incident occurred. Executing personnel on board swung from night to day shift on Wednesday 9 November 2022. Interviewees explained that major or more complex tasks are not planned for the day after such a swing because personnel might be affected by the change in daily rhythm. The team cannot exclude the possibility that the swing might have affected the ability of personnel to assess risk or contributed to misunderstandings about what was communicated and decided in the handover meeting on Thursday 10 November 2022. It is uncertain whether the latter was a little simplified to take account of people who had just swung.
- Interviews and verifications revealed that management and control of maintenance were inadequate. Since the investigation looked only at equipment related to the incident, it is uncertain how far the failure to register equipment faults affected planned and corrective maintenance.
- The investigation has built on interviews with personnel involved, inspections and document reviews. It has not been possible to reconstruct the exact weight of the drag chain structure. Certain of the answers given in interviews and written witness statements differ to some extent. Recall of an incident can be influenced by other people and their perception of the event. However, the PSA team does not consider that this has had consequences for the investigation's conclusions.

12 Assessment of the player's investigation report

Odfjell investigated the incident together with representatives from ConocoPhillips. The incident was ranked as level 2 in Odfjell's own investigation categorisation. The PSA received the report on 20 January 2023.

The Odfjell investigation report is thorough and detailed, and its description of the course of events and the causes of the incident largely coincide with the PSA team's observations and assessments

Four nonconformities and a number of measures were identified by the report related to:

1. the maintenance system
2. work permits
3. risk management

4. lack of correspondence between operation/maintenance manuals and work descriptions in Odfjell's maintenance system.

The PSA team takes the view that Odfjell has set reasonable deadlines for the 24 identified measures listed in its report. Eight of the nine immediate measures have already been implemented. Plans call for most of the long-term measures to be implemented in the second quarter of 2023. The PSA team's assessment is that the measures described are relevant.

13 Appendices

13.1 Appendix A: the following documents have been drawn on in the investigation

Document title	Description
Aktiv-00356.pdf	Printout of WP
Aktiv-00357.pdf	Printout of WP
Aktiv-00365.pdf	Printout of WP
Aktiv-00385.pdf	Printout of WP
Aktiv-00392.pdf	Printout of WP
Aktiv-00397.pdf	Printout of WP
Aktiv-00423.pdf	Printout of WP
Aktiv-00426.pdf	Printout of WP
Aktiv-00446.pdf	Printout of WP
Aktiv-00453.pdf	Printout of WP
Aktiv-00455.pdf	Printout of WP
Aktiv-00468.pdf	Printout of WP
Aktiv-00471.pdf	Printout of WP
Aktiv-00478.pdf	Printout of WP
Aktiv-00480.pdf	Printout of WP
Aktiv-00483.pdf	Printout of WP
Aktiv-00492.pdf	Printout of WP
Aktiv-00495.pdf	Printout of WP
[redacted]23 okt. -3 Nov.xlsx	Handover TSL (technical section leader)
Dagsplan 04.10.2022.png	Shift handover
Daily drilling report 04.11.2022.pdf	Daily drilling report
Daily drilling report 10.11.2022.pdf	Daily drilling report
Docs#2407352 LINUS ERP ENG .PDF	Emergency response plan
Handover DSL - Til [redacted]09.11.22.docx	Handover DSL (drilling section leader)
Handover mellom skift.pdf	Shift handover
Historiske WO 25.11.2018 - 23.06.2022.xlsx	Overview of WOs

Historiske WO 27.08.2014 - 27.05.2018.xlsx	Overview of WOs
L1-CORP-HSE-PR-002N HMS RISIKOSTYRING (1).DOCX	
L1-CORP-HSE-PR-002 HMS Risikostyring.pdf	
L1-CORP-HSE-PR-002 HSE RISK MANAGEMENT.pdf	
L3-JU-ALL-HSE-PR-009 PERMIT TO WORK (1).DOC	
L3-JU-ALL-HSE-PR-032 - SAFETY STANDARD.pdf	
L3-JU-ALL-HSE-PR-033 DUTIES FOR AREA AND SYSTEM RESPONSIBLE.DOC	
L3-JU-ALL-QU-PR-004 HANDLING NON-CORMITIES FOR JACK-UPS.doc	Procedure
L3-JU-ALL-TO-PR-020 - Maintenance Management.docx	
L3-JU-ALL-TO-PR-020 Maintenance Management.pdf	
L3-MODU-ALL-QR-PR-029 Barrier Management Manual.pdf	
Logg aksjonsliste, hendelse 10.11.22.docx	Incident information
Odfjell KPI informasjon til Ptil.docx	
Offshore organisasjon Linus.pdf	
Oversikt over timer Okt. - Nov. DOCS 2419343.XLSX	
POB 10.11.pdf	
Safe card.pdf	
Screenshot Maximo.png	
Synergi 1570253.docx	Content in Synergi register
Synergier med referanse til Drag chain.xlsx	
Tegninger og Bilder.pptx	Sundry info from startup meeting
Work Order Details R10510286.pdf	
09.11.-14.11.22 Beredskaps organisasjon Linus.ppt	
0050_001.pdf	Technical drawings of drag chain outer and inner link assemblies
405-2308 - WEST LINUS - DERRICK SKIDDING SYSTEMS.doc.docx	System description
1105-VCD4-M-057-MET-GA-001_26664 Rev. X0- DRAG CHAIN - Longitudinal cable & hose Drag chain sht. 1 and 2 - 19.05.2014.PDF	
1105-VCD4-M-057-MET-MA-002 Rev. X0- DRAG CHAIN - OPERATING AND MAINTENANCE MANUAL - 20.05.2014.PDF	
1105-VCD4-M-057-MET-MS-001 Rev. X0- DRAG CHAIN - RECOMMENDED SPARE PARTS - 20.05.2014.PDF	
2308-10098500 Rev. 0- TRATEC Condition Assessment Cantilever Drag chain, 2019 - 26.03.2019.pdf	
Aktiv-00294.pdf	Printout of WP
Aktiv-00351.pdf	Printout of WP
Crack Topdrive CompLog	Info related to WO 10510048
Crack Topdrive	Info related to WO 10510048
Svar fra DSL på spørsmål ifm. med hendelse på Linus 10112022 gransking	E-mail with response to questions from PSA
Svar på spørsmål ifm. med hendelen på Linus 10112022	E-mail with response to questions

gransking	from PSA
Sklidde prosedyre 93543 (L4-JU-LIN-B-PR-105)	
SF EQUIPMENT MECHANICS (L4-JU-LIN-D-TR-216)	
Skidding Systems A	
Competence Assurance Matrix – SF for Linus 20.11.22	Overview of personnel training on rig in connection with change from Seadrill to Odfjell
SKID CANTILIVER (L4-JU-LIN-B-PR-105)	Procedure
ARBEIDS I HØYDEN L3-JU-ALL-HSE-PR-014N)	Procedure
Sjekkliste for arbeid I høyden (L3-JU-ALL-HSE-PR-014 Appendix 1)	Checklist
Offshore handover (L3-JU-ALL-HSE-PR-004)	Requirements document
Synergi 1450279	Audit management - audit - rig audit
L3-JU-ALL-HSE-PR-004 Appendix 2 - HANDOVER MELLOM SKIFT – BORING	Checklist for handover
L3-JU-ALL-HSE-PR-004 Appendix 1 - HANDOVER MELLOM CREW	Handover between crew CMS
Four images of the IP's hard hat	
Granskningsrapport etter hendelse personskade på Linus - Personnel injury during work on drag chain 10112022	Report
Witness statements	Printout attached with the start-up documents

13.2 Appendix B: overview of personnel interviewed

Separate document not publicly available.