Havtil
Havindustritilsynet

Investigation report

Report	
Report title Investigation of oil spill at Njord A on 31.12.2024	Activity number 2025/9

Classification	
☒ Unclassified	☐ Exempt from publication

Parties involved	
Team A1	Approved by / date Elin S. Witsø/24.09.2025
Investigation team participants [redacted]	Investigation leader [redacted]

Contents

1 Summary

On 31.12.2024 at 17:50, an oil spill occurred from the Njord A platform. Equinor is the operator of Njord A.

The oil spill occurred as oily water was discharged via the produced water treatment system.

Over time, level control in the 1st stage separator on Njord A has been problematic. Instability in the water/oil boundary (here referred to as the water level) has been caused both by variations in flow rates into the separator and by weaknesses in the level control valve regulating the flow of water from the separator. The instability has occasionally been handled manual operation of the level control valve.

Prior to the incident, the control room experienced this kind of instability, and the level control was set to manual, thus fixing the level control valve in a set position, in order to overcome the problem. The valve was by mistake left in this fixed position. This triggered the incident as it caused the water level to drop and oil to be discharged through the water outlet on the separator, via the produced water treatment system, and ultimately to the sea.

The cause of the incident was that the established barrier against a spill (the safety system that should close the emergency shut-off valve on the water outlet in the event of low water level) did not function as intended. The level transmitter erroneously showed a stable water level above the shutdown set point throughout the incident, and the water outlet was therefore not closed as it should have been.

There were no other technical barriers that could have prevented the spill.

An online oil-in-water meter normally measures the oil content of the produced water before it is discharged overboard. This meter will trigger an alarm indicating that the oil content in the produced water being discharged overboard is too high. This is normally an aid for the control room to identify issues with the produced water treatment system. The transmitter was out of service at the time of the incident.

The discharge was detected by a person in the facility detecting an unusual odour and reporting this into the control room. The area operator then carried out an inspection round in the field and reported that oil had been observed on the sea surface. The source of the spill was identified within approximately 9 minutes, the produced water outlet from the separator was then closed and the spill stopped.

The control valve was set in the fixed position (the regulator "set in manual") at approx. 17:35. Equinor's review of the process data after the incident showed that it is likely that the spill itself started at approx. 17:50. The discharge lasted until approx. 20:10, when the produced water outlet was closed.

The actual consequence of the incident was a spill which lasted for 2 hours and 20 minutes. The volume of the oil discharge is estimated to be around 75m^3, based on the change in the measured oil rate to export during the period before, during and after the incident.

The spill was discovered by chance, and in different circumstances, it could have taken longer for the spill to be detected, which could have resulted in a larger spill. The investigation team considers that if the spill had not been detected in this way, it is likely that it would have been detected through established routines, such as the process operator's normal inspection round covering the system or through the routine manual sampling of produced water. This could have increased the discharge time to a maximum of approx. 6 hours, resulting in a corresponding increase in the discharge volume to approx. 200 m^3, if a constant discharge rate is assumed throughout the period.

The investigation revealed that the level control valve had no travel stop, which should have been installed to ensure the overpressure protection of downstream equipment. In this case, the fixed valve opening was less than what the travel limitation should have permitted, with the result that a loss of liquid level in the separator would not have resulted in overpressure in downstream equipment. However, it is apparent that the absence of the safety function, combined with the frequent need for manual intervention, could under different circumstances have resulted in overpressure in downstream equipment.

As part of the investigation, we have assessed the direct and underlying causes of the incident. Weaknesses have been identified relating to calibration of the level transmitter and the method used for functional testing of the safety system, which resulted in the safety system not functioning as intended. Factors have also been identified which limited the opportunity to detect the incident.

Our investigation has identified non-conformities relating to:

- Deficiencies in the calibration of level transmitters
- Inadequate testing of safety systems
- Deficiencies in process safety systems
- Single error affecting both control system and safety system

In addition, the investigation identified two improvement points linked to:

- Inadequate implementation of conditions from the project phase
- Inadequate regulation of the process systems

2 Background information

2.1 Description of facility and organisation

The Njord field is part of the PL107 and PL132 production licences at Haltenbanken in the Norwegian Sea, approx. 130 km northwest of Kristiansund and 30 km west of the Draugen field. The water depth in the area is 330 metres. Production started in 1997. The field has been developed with a floating steel facility with drilling and processing systems, Njord A, and the FSO Njord Bravo. Njord A is located above a number of subsea wells that are connected to the platform via flexible risers. The gas from the Njord field is exported to Kårstø gas plant through a 40km-long pipeline connected to the Åsgard Transport pipeline.

In order to make improvements and extend the service life of the fields, Njord A and Njord Bravo were towed to shore for upgrades and modifications in 2016 (the Njord Future project). Production resumed in 2022.

The Hyme (PL348) subsea development, which was put into production in 2013, is located 19 km northeast of Njord A. The new fields Bauge (PL348) and Fenja (PL586) are located 15 km northeast and 31 km southwest of Njord A respectively and were put into production in 2023. Equinor AS is the operator of Njord, Hyme and Bauge. Vår Energi is the operator of Fenja.

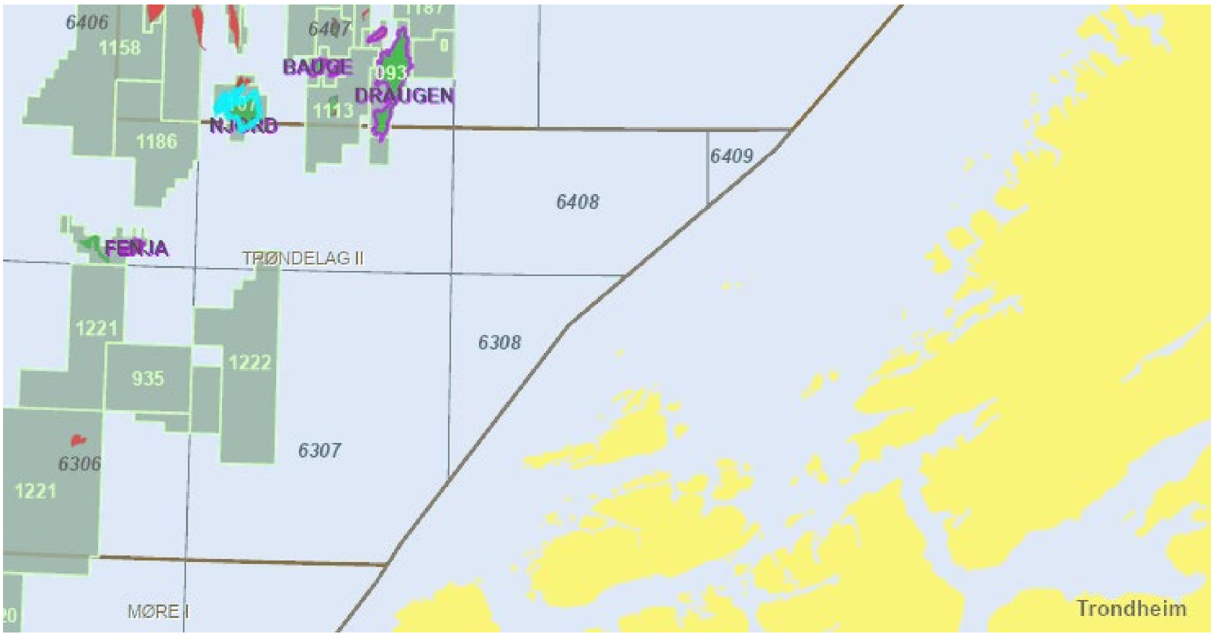

Figure 1 Location of Njord and Fenja (Source: Norwegian Offshore Directorate)

Njord is placed under the Drift Nord areas (Heidrun and Njord) within Equinor's organisation. The onshore organisation located in Kristiansund provides operational support to Njord and Heidrun.

Technical support is provided by Equinor's Global Operation Technology (GOTE), which is located in Stjørdal. GOTE comprises an engineering team, which provides services to Njord and Heidrun. GOTE has, among other things, provided support for Njord in connection with the start-up of the field after the Njord Future project. GOTE has dedicated support functions for process/process integrity and maintenance for Njord, and is responsible for monitoring technical integrity.

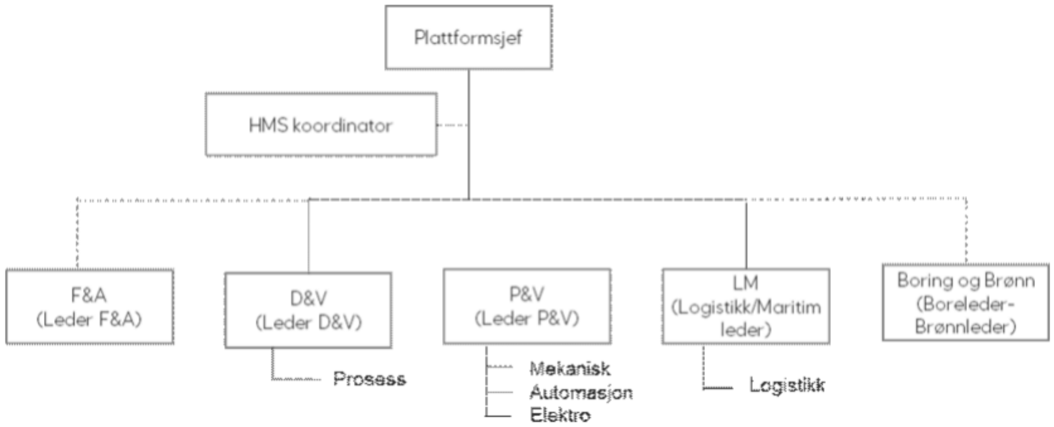

Figure 2 Operating organisation for Njord (Source: Equinor)

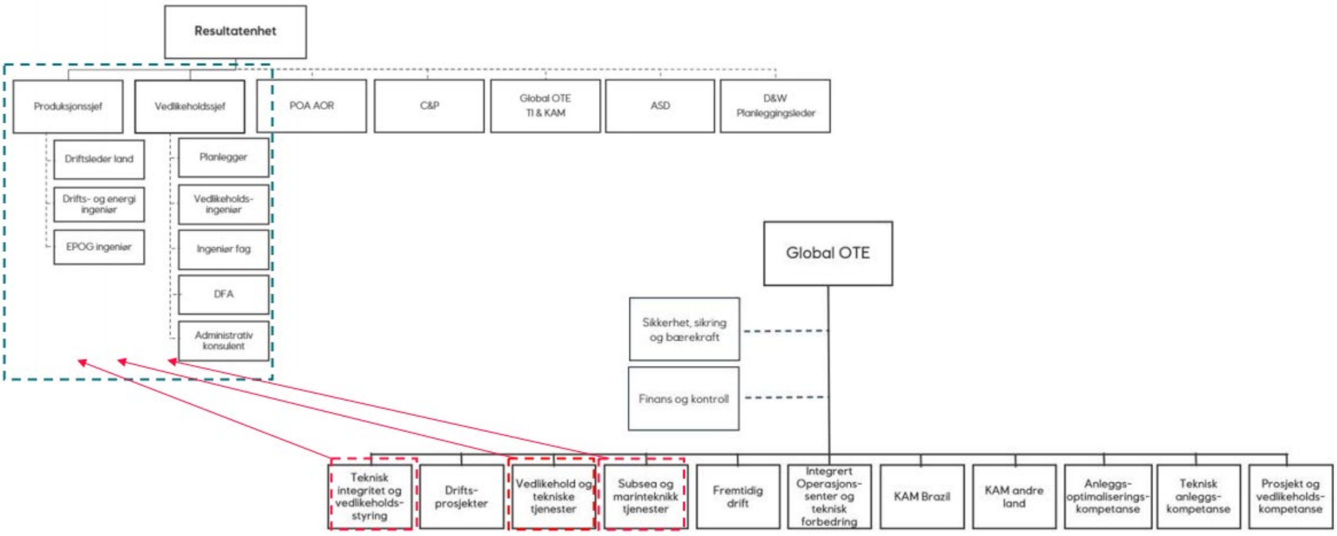

Figure 3 Onshore operating organisation and Global OTE (Source: Equinor)

2.2 Situation before the incident

On the afternoon of New Year's Eve 2024, Njord A was operating under normal conditions. Fenja was producing for the 1st stage separator, and Bauge for the test separator. As usual, the control room was staffed by two CCR operators.

The operators experienced unstable operation, and from 14:00 until the time of the incident, there were several alarms relating to level control in the 1st stage separator.

No planned activities were being carried out other than ongoing drilling, and a shift changeover between day and night was approaching.

2.3 Abbreviations

CCR (SKR)	Central Control Room
CFU	Compact Flotation Unit
CV	Circulation Volume (value which indicates valve capacity). Flow coefficient
EV	Emergency Shutdown Valve
GOTE	Global Operations Technology
Havtil	Norwegian Ocean Industry Authority
HP	High Pressure
LAL	Level Alarm Low
LALL	Level Alarm Low Low
LP	Low Pressure
OIW	Oil In Water
PCS	Process Control System
PS	Performance Standard
PSD	Process Shutdown
SAP	Maintenance management program
STEP	Method for analysing and visualising the sequence of events over time. The diagram shows the flow of information between the actors involved in the incident (Sequential Timed Events Plotting)
Water level (in separator)	Oil-water interface in the separator

3 The Norwegian Ocean Industry Authority's investigation

On 01.01.2025, the Norwegian Ocean Industry Authority (Havtil) received notification from Equinor about the incident on Njord A. On 07.03.2025, a meeting was held during which representatives from Equinor gave a briefing on the incident. On 10.03.2025, Havtil decided to investigate the incident.

3.1 Mandate of the investigation group

The investigation group's mandate was established on the basis of Havtil's responsibilities as an authority relating to operations and systems on board Njord A.

Assessments of oil spill preparedness and the impact of discharges on the external environment are the responsibility of the Norwegian Environment Agency and are therefore not covered in this report.

The following mandate was approved for Havtil's investigation team:

a. *Determine the scope and course of the incident (using a systematic review that typically describes timeline and events).*
b. *Assess the actual and potential volume of the spill.*
c. *Assess direct and underlying causes of the spill, including barriers that did not function.*
d. *Identify regulatory non-conformities and improvements relating to regulations (and internal requirements).*
e. *Discuss and describe any uncertainties/ambiguities.*
f. *Consider barriers that did function (i.e. barriers that helped to prevent a hazard from developing into an accident, or barriers that mitigated the consequences of an accident.)*
g. *Assess the company's own investigation report.*
h. *Prepare a report and cover letter (where appropriate, including suggestions for the use of sanctions) according to the template.*
i. *Recommend – and normally contribute to – further follow-up.*

3.2 The investigation team

The investigation team was established with the following composition:

[redacted] [redacted]

3.3 Methodology

The investigation involved interviews with both personnel from the onshore organisation who follow up and support Njord A and with personnel from the operations organisation, in addition to a visit to the Njord A facility. Governing procedures and other documentation of relevance to the incident were reviewed and assessed, including extracts of relevant information from the maintenance management system (SAP) for the equipment involved and data from the control system covering the period before and during the incident.

The investigation has mapped factors that triggered the incident and its underlying causes – including decisions and behaviours that affected the sequence of events.

A STEP diagram was prepared in order to show key points in the development of the incident over time and the flow of information between relevant actors involved in the incident. The time period takes into account the flow of information/events from the Njord Future project between 2016 and 2022, the start-up of Fenja/Bauge in 2023 and through until the day of the incident, 31.12. 2024. Oil spill preparedness is not included in the STEP diagram, as this falls outside Havtil's mandate.

4 System descriptions

4.1 General description of the separation and produced water system

Production on Njord A consists of internal production from the Njord field, as well as the Fenja, Bauge and Hyme satellite fields.

Production from the wells is routed to the separation system via either high pressure (HP) or low pressure (LP) production manifolds. From the HP production manifold, the well fluid from the Njord HP wells, as well as Fenja and Bauge, is routed to the 1st stage separator (VA-20-0001), while well fluid from the Njord LP wells and Hyme is routed to the 2nd stage separator (VA-20-0002).

The properties of the oil produced from the various fields, including density, vary. Density variations will affect level control in the separators, as described in more detail in the next chapter. The oil from the Bauge field has a lower density than other production into Njord A.

The separation train at Njord A consists of three separators arranged in series, as well as a test separator. The oil is stabilised through the separation train before being pumped to Njord B. The gas is recompressed and transported to Kårstø in a pipeline.

Produced water is treated before being discharged into the sea. There is a water outlet on the 1st stage separator, the 2nd stage separator and the test separator.

The produced water treatment system consists of hydrocyclones, a compact flotation unit (CFU) and a degassing tank.

A simplified drawing showing the 1st stage separator and the produced water system is shown in Figure 3 below.

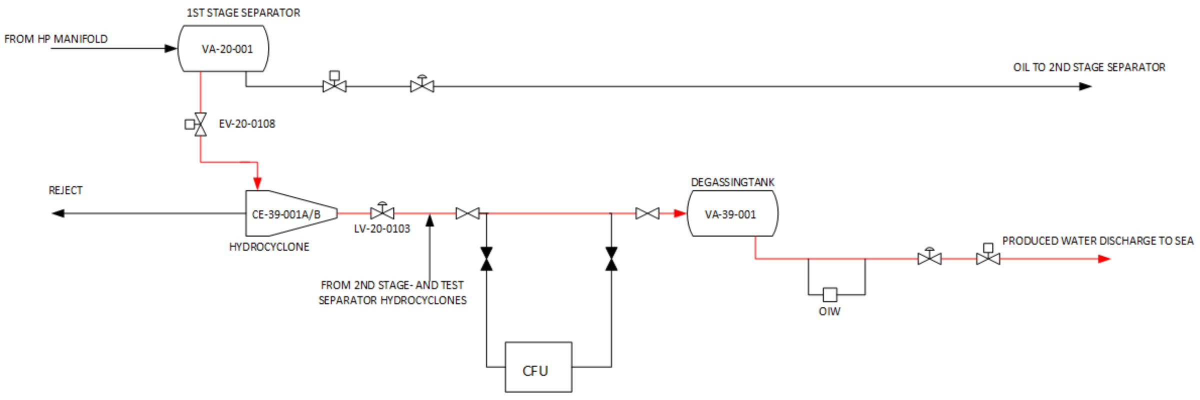

Figure 3 Simplified drawing showing the 1st stage separator and produced water system

In the 1st stage separator, separation of gas, oil and produced water takes place. The produced water is then treated further in order to meet the relevant oil in water specification before discharge to sea.

The first step in the treatment process for produced water involves the hydrocyclones, where oil droplets are removed from the water. Each separator has two dedicated hydrocyclone units, and the capacity of each hydrocyclone unit can be varied by adjusting the number of liners in the unit.

The driving force across the hydrocyclones is the pressure difference, meaning that the hydrocyclone needs a minimum available pressure drop in order to function optimally. In turn, the pressure drop across the cyclone is a consequence of the flow rate, so that the number of liners is optimised relative to the anticipated flow rate. If the flow rate through a cyclone is too high relative to the number of liners installed, this may result in an excessive pressure drop and erosion damage to the liners. The required operating range for the installed liners is a pressure drop of the order of 5-6 bar, and the pressure drop should not exceed 20 bar.

From the outlet on the hydrocyclones, the water is routed either to the CFU, where the flotation principle is applied for further treatment, or directly to the degassing tank.

The main purpose of the degassing tank is to flash off hydrocarbon gas from the produced water. However, any remaining oil residue accumulating on the surface of the water in the degassing tank may also be skimmed off here. Treated produced water from the degassing tank is routed overboard via a dump caisson.

The quality of the produced water is monitored by taking manual samples every six hours. There is also an oil in water meter on the outlet (OIW) of the degassing tank, which continuously measures the oil content in the water and triggers an alarm if this exceeds 15 ppm.

The incident was triggered in the water outlet from the 1st stage separator, where oily water was being routed via the produced water system and overboard. This is indicated in red on the drawing in Figure 3.

At the time of the incident, the status of the produced water treatment system was as follows:

- water production from the 1st stage separator was of the order of 46 m^3/h
- the same number of liners was installed in each hydrocyclone unit downstream of the 1st stage separator, and both cyclone units were in operation
- Bauge production was routed to the test separator
- the produced water was, as normal, being routed directly from the hydrocyclones to the degassing tank (bypassing of the CFU)
- The OIW meter was out of service.

4.2 Level control (regulation and shutdown)

4.2.1 General

The inlet separator is a horizontal separator with an inner diameter of approx. 3 m and a length of 9 m. The inlet is from the side. Internals are installed in the separator to improve separation. There are two gas outlets (one on each side), and the oil and water outlets are set at different elevations in the separator.

The water level in the 1st stage separator is controlled by a level controller (LT-20-0103), which measures the interface between the oil and water (referred to as the "water level") and adjusts the level control valve (LV-20-0103) located downstream of the hydrocyclones in the produced water system.

The level transmitter (LZT-20-0104) forms part of the process safety system (PSD). It is set to measure the water level and should trigger shutdown if the level becomes either too high or too low. High level (LAHH) closes the inlet to the separator, and low level (LALL) closes the water outlet.

A level gauge (LG-20-1104) is mounted on the separator for local level readings, as well as for use in connection with the calibration and testing of the level transmitters.

A sketch showing the 1st stage separator with functions for level control and shutdown is shown below:

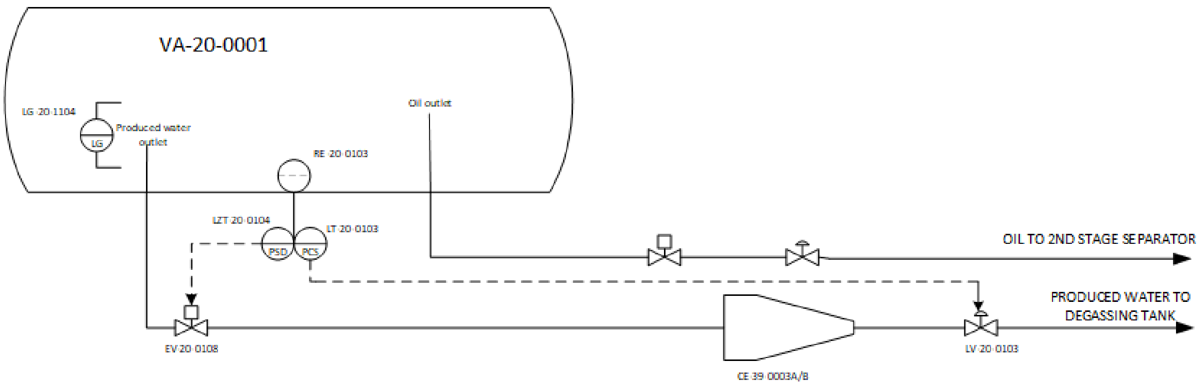

Figure 4 Simplified view of level control and safety functions for shutdown in the event of low water level

In connection with the Njord Future project, a number of modifications were carried out as a consequence of the anticipated increase in production water volume relative to the original design, including:

- A new vortex switch was mounted on the water outlet, which raised the water outlet by approx. 10cm.
- A new level control valve with a higher capacity (higher CV) was fitted.

During the project phase, calculations demonstrated that the flow volume through the new control valve in the event of gas blowby would exceed the capacity of the overpressure protection system for downstream equipment. In addition, this gas flow rate could have resulted in excessive loads on the downstream piping. To overcome this, the project decided that the valve should be equipped with a travel stop, which was both mechanical and logic-based, in order to limit the maximum opening of the valve so that downstream equipment could cope with the flow caused by gas blowby. However, this travel stop was never installed.

4.2.2 Measurement principle and calibration

Level measurement for both control and shutdown is based on the same principle, i.e. gamma measurement.

The main principle used for measurement is that gamma rays are transmitted from one side of the separator through the medium in the separator to receivers on the other side. Gamma radiation is weakened as it passes through different media, the degree of absorption of the radiation depending on the density of the medium. Produced water has a higher density than oil.

The receivers measure the amount of radiation that has not been absorbed, and this is "translated" to a level.

To ensure that the radiation value is "translated" to the correct level, the transmitter must be calibrated. A calibration curve is developed based on selected specific measurement points, using the level gauge to physically establish their levels. To establish the rest of the measuring range, the curve is extrapolated based on the measured values and a defined zero point. The calibration curve is not linear but has an S shape, which means that both the number of actual points and a correctly defined zero point are important to ensure a representative calibration curve for the entire range.

The level transmitter was calibrated following a functional test in October 2024. The calibration curve from this calibration is no longer available.

The level transmitters are equipped with a common radioactive source and separate receivers. When performing a calibration, the receiver for the transmitter initiating shutdown/PSD (LZT-20-0104) is used to prepare the calibration curve. The level transmitter in the control system (LT-20-0103) is calibrated by verifying that it displays the same level as the LZT, which means that any error in the calibration process will affect both the control and the safety function.

4.2.3 Functional testing of PSD (LALL)

A preventive maintenance programme has been established to test the PSD function of LZT-20-0104. It is a requirement that functional tests are performed annually, and the activities for these are specified in SAP, with reference to a maintenance concept (TI0710-0005), which describes at a generic level how the PSD function test should be performed. It is stipulated here that testing of the trip level must be carried out by pressurising by the process medium (here: the water level is <u>lowered</u> to the LL level in the tank) to confirm that the logic for LL is activated. Provision is made so that "if, for practical reasons, it is not possible to test the sensor", the input to the PSD system can be simulated as an alternative.

The maintenance concept does not provide any details regarding the practical execution of this functional test, such as requirements regarding the number of test points or the minimum level that must be tested.

Verification of measurement accuracy is also included in the functional test. If the measurement accuracy falls outside the defined acceptance criterion of +/- 5%, it is stated that the level transmitter must be recalibrated.

Completed tests must be documented through the provision of technical feedback in SAP. As regards tests performed on LZT-20-0104, the investigation showed that these tests had been reported as "Done", with the status "OK". None of the tests had been logged as requiring further follow-up or non-conformance management. No technical feedback has been given indicating the number of measurement points used or whether the trip levels of the PSD system were simulated or measured.

4.3 Operational challenges

During the period since the modifications to Njord A were completed and production commenced, operational challenges have been encountered which have caused several unscheduled shutdowns.

These challenges have largely been related to the gas treatment/compression system, but also to some extent oil and water treatment.

Extensive work has been done since startup to improve the stability of the processing plant, including adjustments to the regulation parameters in the control system.

Fenja production is controlled through two parallel chokes upstream of the production manifold. One choke on the Fenja manifold has on occasions travelled unintentionally, which is a likely cause of liquid slugs entering the separator.

Meeting the established requirements for maximum oil content (ppm) in produced water discharged to sea (hereinafter referred to as 'water quality') has periodically been challenging, and work has also been done in this area to bring about improvements.

Due to the low volumes of water encountered during the first year after the modifications, the 1st stage separator was operated as a two-phase separator, without a water outlet, and the produced water from the 1st stage passed with the oil for further treatment in the 2nd stage separator. In February 2024, the volume of water entering the 1st stage separator increased, and the water outlet was opened. This also helped to improve the water quality.

To ensure that operation was as stable as possible, including water quality in line with the requirements and limiting erosion in the hydrocyclones, a practice has been developed where the control room operators actively intervene to assist the control systems. During interviews and meetings, examples of two operational disturbances have been described which affect both level control in the 1st stage separator and the water quality, and which have sometimes been managed by setting the level control in a manual mode:

- Increased volume of liquid entering the separator caused by flow conditions upstream of the separator (slug management/choke travel)
- High pressure drops across the hydrocyclones

The chokes were later cleaned and lubricated, which has improved the situation.

As regards the pressure drop across the hydrocyclones, the operator has experienced challenges relating to both the number of liners installed in the cyclones and the functionality of the level control valve located downstream of the cyclones. In September 2024, a notification was established which described challenges associated with the level control valve operating in the area of 4–15% opening for long periods. A notification was also created to determine the capacity (CV) of a new valve in relation to the anticipated water production forecasts and adjustment of the number of liners installed. At the time of the incident no need for compensatory measures had been identified during the handling of this notification.

As described above, the hydrocyclones have a defined operating range relative to the pressure drop in order to achieve the required water quality. Elevated pressure drops across the cyclones have previously caused erosion damage within the hydrocyclones, and it has on two occations been necessary to replace the liners as a result of this. The operators have therefore been careful to keep the pressure drop across the hydrocyclones below the recommended 20 bar by limiting the flow rate through them. By manually choking the level control valve, more water is forced over to the 2nd stage separator.

4.4 Responsibilities relating to the testing and follow-up of safety functions

Global Operations Technology (GOTE) is responsible for monitoring safety functions and has a dedicated team whose responsibility includes the Process Safety Performance Standard (PS 12). This includes the evaluation of test results, TIMP assessments and establishing an overview of barrier weaknesses.

Methods (maintenance concepts) for the testing and calibration of safety functions for level control are established by GOTE, while actual testing and calibration is performed by automation technicians with support from operations personnel at Njord.

5 Sequence of events

During the incident, Njord A was in normal production. Other than ongoing drilling, no planned activities were in progress.

The CCR operators encountered some instability in the 1st stage separator and decided, at 17:35, to set the valve on the water outlet to “manual” (fixed opening of 26%) in order to control the flow of water, thus reducing the pressure drop, across the hydrocyclones.

The valve was erroneously left in this position. Its capacity then exceeded the water production, which meant that the water level in the separator dropped to an extent where oil began to flow out with the water at approx. 17:50.

The drop in water level in the separator was not detected by the relevant level transmitters. Neither the control system, by LT-20-0103, nor the safety system, by LZT-20-0104, triggered an alarm or shutdown signal. A log from these systems shows that the level during the period concerned was “read” and displayed approx. 37% for both LT and LZT, which is above the levels for both LAL (alarm) and LALL (shutdown).

A workshift changeover took place at 19:00. The process operators met with the operations manager to share status and plan the night shift’s activities.

The discharge continued for 140 minutes, through the shift change, before a person reported smelling “diesel” within the process area at 20:01. A process operator was then sent out to investigate. The smell of oil was confirmed and, soon after, considerable amounts of oil was observed on the surface of the sea. After a further search to find the source, including sampling from the hydrocyclones, it was ascertained that the oil spill had originated via the produced water system. At 20:10, the CCR discovered that the level control valve on the water outlet (LV-20-103) was locked in the open position. The valve was put back in automatic mode and the emergency shut-off valve (EV-20-0108) on the water outlet was closed.

The platform management has confirmed that they considered shutting down production when the oil was observed on the surface of the sea. However, the search for and mapping of possible sources, including identification of the cause and closing of the outlet, was completed so rapidly (9 minutes) that it was decided that a production shutdown would not be appropriate.

The emergency preparedness organisation met at 20:27 and further actioned on the basis of DSHA2 Acute oil discharge. They notified NOFO, c/o Stril Poseidon, who took over responsibility for coordinating the oil spill emergency response operation and SAR, which arrived at the field at 21:49 and then started mapping the spill.

A timeline showing key events/decisions is shown below – see Annex A for a STEP diagram and description.

Date	Time	Incident/Experiences
2016-2024		*Before the incident*
2016-2022		The Njord Future project is carried out; structural reinforcements and process upgrade – provision for tie-in of Fenja and Bauge
2022 – 2023		Njord A is started up with modified systems and new wellstreams Njord Q4 2022, Bauge and Fenja April 2023
2023-2024		Some operational incidents in connection with start-up of the new fields, especially in the compressor train. Optimisation of regulation parameters (including removal of "dead bands") and overhaul of the Fenja chokes carried out to improve control. Instability in the 1st stage separator is considered to be slugging to a varying degree
February 2024		Commencement of water removal from the 1st stage separator after increases in water volumes from Fenja and the level control valve on the water outlet (LV-20-0103) is put into service.
March/April 2024		Erosion in the hydrocyclone pack for the 1st stage separator resulted in the liners being replaced
September 2024		Notification established for repair of LV-20-0103. The valve has too high a capacity and is difficult to regulate (regulates only 4-15%).
October 2024		Preventive maintenance programme with testing and calibration of the PSD level transmitters in the 1st stage, 2nd stage and test separators. Oil composition from the various fields not taken into account. Low water level based on simulated signal and not physically verified
November2024		OIW meter out of service. As a result, the CCR will not receive an alarm if the oil content in the produced water exceeds 15 ppm
31.12.2024		*During the incident*
		Normal operation on this day. No jobs in progress
	14:00-17:35	Multiple alarms linked to issues and instability in the 1st stage separator
	17:35-17:50	Water level in the 1st stage separator drops without an LAL alarm or LALL shutdown signal, and oil is expelled together with produced water
	17:50	Estimated start of oil discharge to the sea
	19:00	Work shift changeover
	20:01	CCR receives report of oil/diesel smell on deck
		Troubleshooting starts: 1) Oil on the surface of the sea detected by operator, 2) Loss of water level in 1st stage separator observed on LG, 3) Sampling of hydrocyclones

Date	Time	Incident/Experiences
	20:10	LV identified as the cause of the discharge and returned to automatic operation. EV is closed. Discharge into the sea ceases
	20:27	The emergency response management contacts SAR and carries out further emergency response actions (not covered by Havtil's investigation)

6 Potential of the incident

6.1 Actual consequences

The incident caused a spill to sea. The volume of the oil spill has been calculated by the operator to approx. 75m^3, based on the measured oil flow rate during the periods before, during and after the incident. The investigation team has considered the operator's method and has no comments to it.

6.2 Potential consequences

6.2.1 Increased emissions

The timing of the detection of the spill was a matter of coincidence, and under different circumstances, it might have taken longer to detect it, which could have resulted in a larger spill.

The discharge was detected by someone on the facility detecting an odour that they considered to be diesel, reporting it to the CCR. The area operator then conducted an inspection round out in the field and observed oil on the surface of the sea around and under the platform.

As the workshift changeover had only recently been completed at the time the smell was detected, the process operators were gathered in the meeting room to discuss the planned activities for the night shift. According to normal routines, they would have gone to the process areas after this meeting. It is considered likely that, had the circumstances otherwise been similar, they would have detected the smell, instigated troubleshooting and stopped the spill. We estimate that, under such circumstances, the discharge could have continued for approx. 30 min longer and released an estimated total volume of oil of 90m^3. [1)]

Weather conditions were calm at the time of the incident. If these conditions had been different, for example with stronger winds which could have transported the

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[1)] Based on Equinor's estimate of the discharged volume and assuming a constant discharge rate discharge and associated smell away from the platform, the discharge might have continued for longer before it was detected. The procedures established to measure the oil content in the produced water specify sampling every six hours. The last sample was taken before the discharge began, and the next sample was due to be taken at approx. 24:00. It is likely that this sample would have revealed that the water was heavily contaminated. This would have led to troubleshooting and subsequent closure of the water outlet. The spill would then have lasted about 4 hours longer, with an estimated total volume of oil of 200 m^3 being discharged.[1)]

6.2.2 Possibility for overpressure in equipment downstream of the level control valve

The investigation revealed that the level control valve on the water outlet of the 1st stage separator had no travel stop, which should have been installed as overpressure protection of equipment downstream of the level control valve. An overpressure situation might have occured if all liquid in the separator had been lost causing a gas blowby situation, provided that the valve had had an opening greater than intended limitation by the travel stop.

However, the degree of opening of the control valve was now set to 26%, which is less than what the travel stop should have limited the opening to. Although it has subsequently been shown that the control valve had suffered erosion damage, and thus permitted a higher flow rate than the position of the valve would indicate, overpressure in downstream equipment is not considered to be a likely consequence of this incident. However, the investigation team notes that the absence of this safety function, combined with the constant need for manual intervention, under different circumstances could have resulted in overpressure in downstream equipment.

7 Direct and underlying causes

Through an assessment of the documentation that was submitted and interviews with relevant personnel, the investigation has mapped out relevant aspects of systems and practices linked to measurement of the water level in the 1st stage separator, and to the calibration and testing of the safety system.

7.1 Direct causes

[1)] Based on Equinor’s estimate of the discharged volume and assuming a constant discharge rate

The triggering cause of the incident was that the level control valve on the water outlet from the 1st stage separator on Njord A was locked and left in the open position following a manual intervention.

The spill occurred because the established barrier, the safety system which should have triggered shutdown in the event of the loss of water level, did not function as intended. The drop in level was not detected and the emergency shut-off valve on the water outlet was not closed.

The investigation team believes that the reason why the level transmitter did not measure the actual level was due to operational circumstances linked to the calibration of the instruments and performance of function testing.

7.2 Underlying causes / discussion

The investigation has identified a number of elements that have had, or might have had, an influence both related to the incident occurring in the first place and to the duration of the spill. These elements are described in the following sub-chapters.

7.2.1 Need for manual intervention

As discussed in section 4.3, the operators on Njord A have encountered operational challenges that, for various reasons, occasionally have triggered a need to set control functions to manual.

A precursor to the incident, was the control valve on the water outlet being set in the fixed position. The purpose of this was to reduce the pressure drop across the hydrocyclones in order to prevent erosion damage to the liners in the hydrocyclones.

In addition to the valve being dimensioned for a large operating range, it has become apparent since the incident that the valve had suffered erosion damage, which was a contributory factor in the valve often operating outside its optimal control range.

The data concerning valve opening received for the level control valves on the oil and water outlets from the 1st stage separator for 31.12.2024 is shown in Figure 5 below. Data is missing for the period from 11:00 to 18:00 on the day of the incident, which is illustrated by breaks in the curves.

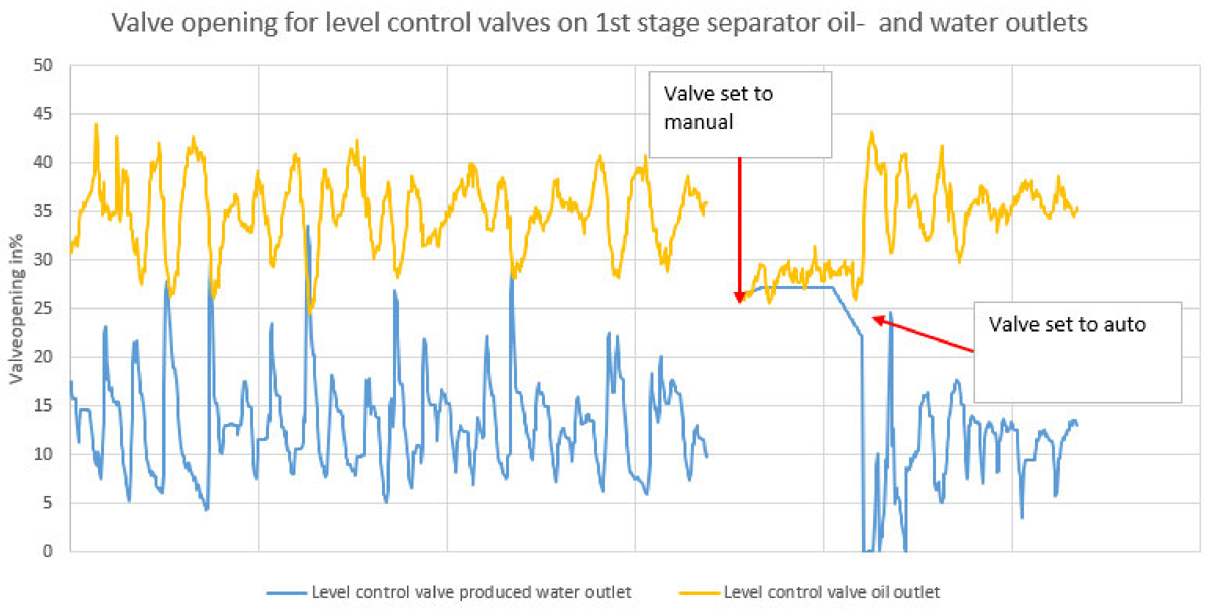


Figure 5 Plot showing valve opening for the level control valves for water and oil respectively

The figure shows that, during the period when the water level control valve was set to auto, the valve openings fluctuate considerably, and that the control valve for oil level then responded in order to compensate for changes in the liquid level. It is also apparent that the fluctuations in valve opening on the oil outlet was dampened during the period when the level control valve on the water outlet was set to manual. It is likely that the erosion damage caused to the water level control valve, combined with the fact that the valve was dimensioned for a higher water flow rate, prevented the level control from operating optimally. This resulted in fluctuations both in the levels in the separator and in the volume of water exiting it.

7.2.2 Measurement concept and calibration of safety systems and control systems

During the incident, the level transmitters for both control and process shutdown indicated the same water level. The measured level was (falsely) stable at approx. 37% throughout the entire incident, which is higher than the set limit value for both alarm level (LAL) and trip level (LALL). As a result, no alarm was sent to the CCR upon reaching the LAL level, neither was any alarm nor shutdown initiated sent upon reaching the LALL level. This caused the presence of oil in the produced water discharging to sea to go undetected.

During the investigation, we were informed of two factors that may have contributed to the level transmitters not detecting the actual water level:

- Miscalibration

  - No account taken of density variations
  - Not calibrated against correct zero point
  - No real measurement points in the lower part of the measurement range
- Media phase
  - Oil and water in mixed phase

On Njord A, production takes place from several fields, and the density of the oil varies between the fields. In turn, this means that if production takes place with a different oil composition than that for which the level instrumentation was calibrated, the value that is displayed will not reflect the actual level in the tank. Since the incident, Equinor has assessed the margin of error related to density differences in the oil as being up to 20%. During the incident, the Bauge field, which produces oil that has a lower density than the other oils produced on Njord A, was producing for the test separator.

The level transmitter was calibrated in October 2024. The calibration did not take into account an elevated water outlet, and it is uncertain whether the extrapolation of the calibration curve took into account the correct zero point. The calibration curve for this calibration is no longer available, but during an interview it emerged that no calibration points were established down to the trip level for this transmitter.

After the incident (11.01.2025), a job was performed in order to verify the water level transmitter. During this job, it was observed that the level measurements as read in the CCR did not fall below 33% at any stage, despite the fact that the actual level had been reduced to approx. 5%. Work was then started to define how the transmitter could best be verified and calibrated. On 23.03.2025, the transmitters were recalibrated by checking and correcting points throughout the measurement range against supplier data (normalised points / % value). After the calibration had been completed, the read and measured levels corresponded for all measurement points, indicating that the transmitter was functioning and that the cause of the previous failure was miscalibration.

During the incident, the level control valve was manually set to a position that resulted in a fixed flowrate through the water outlet. The volume flowing out of the water outlet was then greater than the water production, which in time resulted in oil being drawn out through the water outlet. This led to a mixture of oil and water in what is normally a water phase, which may have contributed to the transmitters misinterpreting the level.

Density variations, combined with calibration errors and the oil content in the produced water, resulted in the level transmitters showing higher levels than the actual level in the tank, and thus never reaching the preset trip values for LAL and LALL.

When determining the trip level (LALL), no account was taken of possible density variations or the consequences of oil in the water phase. As a compensatory measure immediately after the incident, the LAL set point was increased to 40%.

7.2.3 Follow-up of safety functions

As described in section 4.2.3, LZT-20-0104 is defined as a safety-critical element in the maintenance system and, as such, is linked to a maintenance concept for the testing of PSD functions. A verification in the maintenance system showed that the annual test programme had been performed since the start-up of the Njord Future project. The feedback given concerning completed tests in the maintenance system was that the tests had been completed and were "OK" – without any further comments being given.

The maintenance concept (in SAP) for the functional testing of transmitters in PSD states that it is possible to simulate the action without actual pressurising by the process medium (i.e. without physically lowering the level), if for practical reasons it is not possible to test the sensor.

During interviews, it emerged that, when the PSD transmitters in the separators on Njord A are tested, "the water level is lowered as much as operations allow". The automation technicians perform the tests in the field, in dialogue with the control room operators in the CCR. The control room operators have no defined role during the testing of this safety system, other than that (after isolating the shutdown functions) they adjust the water level up and down as requested by the automation technicians. This can influence both risk understanding and the dialogue during planning and the performance of the tests. The control room operators do not generally wish to lower the level physically to as low as LALL, as this could lead to oil being drawn into the water outlet, thereby increasing the likelihood of an increased concentration of oil in produced water which will then be discharged into the sea. As a result of this limitation, the automation technicians simulate tripping at LALL.

The tests are, then, performed using a method that is in line with the guidelines for the maintenance concept (which allows for the possibility of simulating the trip level), but the method has weaknesses which can lead to possible deficiencies not being detected, e.g. errors during calibration or errors in transmitter function.

Feedback given on the tests make no mention of the fact that the test was performed without physically taking the water level down to the trip value, or that activation of the PSD input was only simulated. There is also no mention of the number of points that were verified. The feedback on the tests will therefore not provide the person responsible for following up the safety function (the "PS Manager" within GOTE) with sufficient information to assess any weaknesses in the system, or to provide a basis for requesting that the method be adjusted to ensure that physical testing takes place.

7.2.4 Scope to detect the incident

The only established technical safety function that is intended to prevent the discharge of produced water with elevated oil content is tripping due to low water level in the separator.

However, some control functions during operation may have given indications that the level control had failed. In this case, no such indications were detected. Among other things, the investigation showed the following:

- The level transmitters for PCS and PSD were based on the same measurement principle and were calibrated in the same way, and as a result both incorrectly displayed the same level during the incident. As a result, it would have been impossible to detect faults in the shutdown function as a consequence of discrepancies between the transmitters for control (PCS) and shutdown (PSD) respectively.
- The oil-in-water meter (OIW) on the outlet of the degassing tank, which would have triggered an alarm due to the high oil content in the water, was out of service at the time of the incident.
- There were several alarms indicating high differential pressure across the hydrocyclones during the period while the spill was in progress that could have indicated a high water flow rate out of the separator
- The level measurement in the separator "flattened out" during the period when the LCV opening was fixed. This was abnormal behavior and could have provided an indication that something was wrong

The possibility for detecting the incident was limited to routine sampling of oil in water (which was carried out approximately every six hours), as well as possible visual observation of the oil spill on the surface of the sea.

7.2.5 Transition from project to operation

In connection with the Njord Future project, a number of upgrades were made to the separation- and production water system, where the consequences were not taken into account in operation.

During the project phase, it was planned that the level control valve for produced water would be equipped with a travel stop to limit the maximum opening of the valve, so that downstream equipment would be able to cope with the flow rate in the event of gas blowby. This travel stop was not installed.

In connection with the phasing-in of Fenja and Bauge, the 1st stage separator was upgraded with a vortex breaker on the water outlet. The vortex breaker raised the water outlet by approx. 10 cm, which was not taken into account in connection with level setting.

The level transmitter was calibrated using water and air as part of the project completion process in 2022. The produced water outlet in the 1st Stage Separator was opened in February 2024, before the level transmitter had been calibrated with actual flow media.

The oil originating from Bauge, Fenja and Njord has different densities. The density of the medium in the separator will affect the level measurement. Insufficient consideration was given to assessing the impact of possible fluctuations in mixing ratios of the different oils on the level measurement, or the need to change the set points for LALL and LAL to ensure that they provide the necessary protection for all mixing ratios.

Experience from the start-up phase and the initial operating period after the upgrade project showed challenges caused by unstable operation and a need for corrections, including concerning regulatory parameters. During the investigation, we received information indicating that erosion damage to liners and valves was already being observed after just a couple of months of operation.

8 Audit findings

We have two main categories of audit findings:

Non-conformity: Audit findings where we *prove* the existence of a breach/non-compliance with respect to the regulations.

Improvement point: Audit findings where we *believe we have seen a* breach/non-compliance with respect to the regulations, but do not have sufficient information to be able to prove it.

Non-conformities and improvement points from the HSE regulations related to the incident are identified and justified in Chapter 8. Other factors which, in the opinion of the investigation team, were unlikely to have had an impact on the sequence of events, but which the team still considers to be relevant are briefly discussed in Chapter 10.

8.1 Non-conformity

8.1.1 The level transmitters in 1st stage separator were not calibrated correctly

Non-conformity
The barrier that was established to detect low water level in the 1st stage separator was unable to identify conditions that could lead to failures, hazard and accident situations

Requirements:
Management Regulations, Section 5 concerning barriers, letter a.

Rationale:
In connection with calibration and determination of the trip level for the water level transmitters, insufficient consideration was given to conditions which impact on the measurement results. Thus, the level transmitter, and the trip level for low water level in the separator, did not provide the necessary protection.

The following emerged during interviews and a review of the received documentation:

a) Density variations for the different oils produced on Njord A were not taken into account when determining the trip level
b) During calibration in October 2024, the importance of possible variations in the density of the medium was not taken into account
c) Calibration was not performed using physical measurements throughout the measuring range, and the correct zero point was not verified during the extrapolation of the calibration curve.
d) As part of the project completion phase, the transmitter was calibrated using water and air. The water outlet was opened in February 2024 without the level transmitter being calibrated accordingly. Thus, the system was in operation for about six months without recalibration of the transmitter.

8.1.2 Inadequate testing of safety systems

Non-conformity:
There were deficiencies in the procedure described for testing parts of the safety system on Njord A, which led to failure modes not being identified, corrected or reported.

Requirements:
Activities Regulations, Section 47 concerning maintenance programme, second paragraph, cf. Activities Regulations, Section 24 concerning procedures, second paragraph.

Rationale:
The maintenance procedure, and the performance of functional tests, did not ensure that the established safety function to provide protection against loss of water level functioned as intended. Weaknesses were not detected.

a) The generic maintenance concept (TI0710-0005) in SAP which is relevant for the testing of level transmitters in the PSD system (LZT-20-104 in this case) allows for simulating, rather than physically testing, the level transmitter to ensure that it is triggered at the defined level. Simulation can be performed as per the description if, for practical reasons, it is not possible to test the sensor. There is no definition of what the phrase "practical reasons" might cover, nor is it clarified whether the use of such an alternative testing method should be discussed with, or communicated to, the responsible department (PS responsible) in the support organisation (GOTE), or otherwise handled as a non-conformity. The concept thus allows for a test that is deficient both as regards confirming whether the safety function works, and as regards providing information about this to the PS responsible.

   The annual testing of LZT-20-0104 has been consistently performed in the field without the physical water level being lowed to the LL level.

b) Testing has been carried out and the results reported as completed and in order ("done" and "OK"), without the uncertainty inherent in the use of the "alternative method" being discussed or communicated to the PS responsible in GOTE. Thus, the PS responsible does not receive any information indicating that LALL has not been physically tested and that they have therefore not received verified activation of PSD. This provides an inadequate basis for their evaluation of PS12 in connection with their barrier assessment/TIMP review.

c) The control room operators are responsible for making the decision to lower the water level which determines whether automation technicians can carry out the physical testing of LSLL, or whether they need to simulate this. However, the control room operators (CCR) do not have a formal role in the work order/test procedure for the functional testing of this safety system. This may affect both the risk understanding and the dialogue during the planning and implementation of the tests.

d) The maintenance concept specifies that, in the event of a deviation of +/-5% between the reference and measured values, calibration must be performed as a separate activity. The uncertainty in the measurement concept due to density variations is greater than the specified acceptance variation. During the inspection in the field, the investigation team observed that access to, and the design of, the level gauge covering the separator water level (LG-20-1104) makes it very challenging to identify such a deviation in practical terms. None of the tests conducted identified any such deviations.

e) The same measurement principle and corresponding test procedures are used for both the 2nd stage separator (VA-20-002) and the test separator (VA-13-001). Testing of the LALL level on the water side has been conducted in the same way there.

8.1.3 Deficiencies in process safety systems

Non-conformity

There were deficiencies relating to the requirement for two independent levels of protection against overpressure in parts of the produced water system.

Requirements

Facilities Regulations, Section 82(2), cf. Regulations on process and auxillary facilities in the petroleum industry from 1992; Section 40 concerning pressure vessels and atmospheric vessels, third paragraph.

Facilities Regulations, Section 82(2); cf. Regulations relating to safety and communication systems from 1992; cf. Section 19 concerning process safety systems.

Rationale

There were deficiencies relating to the overpressure protection of equipment downstream of the level control valve in the produced water system.

The system documentation that was received for the separation system states that gas blowby via the level control valve on the water outlet from the 1st stage separator could result in flow rates greater than the overpressure protection system for the downstream equipment can cope with. The flow rate could also result in vibration challenges on downstream piping. In order to address this scenario, the system documentation states that a travel stop must be installed on the valve to limit the flow rate to a level that the downstream protective equipment is able to cope with. This travel stop was not installed.

8.1.4 Single fault affecting both control system and safety system

Non-conformity

The system for water level control and shutdown system of the water level in the 1st stage separator system was designed with a dependency so that any miscalibration had unacceptable consequences in the form of oil spills.

Requirements

Facilities Regulations, Section 82(2); cf. Regulations on process and auxillary facilities in the petroleum industry from 1992; Section 13 concerning general requirements relating to safety, second paragraph

Rationale

The same measurement concept is used for the shutdown function and level control of the water level in the three-phase separators on Njord A.

During calibration, the level transmitter for shutdown (in the PSD system) is calibrated, while for the level transmitter for control (PCS), only an assessment is made to confirm that the transmitter displays the same value as the level transmitter for shutdown.

The method of calibrating the level transmitters for water level in the separator will cause any miscalibration to affect both the trip function and the control function. An oil spill could occur as a consequence of such miscalibration.

See also non-conformity 8.1.2 that the method used for testing the trip function will not detect the error calibration either.

8.2 Improvement points:

8.2.1 Inadequate continuation and awareness of conditions from the project phase

Improvement point
Updating of governing documents, including technical operating documents appear to be inadequate.

Deficiencies in overpressure protection of equipment in the produced water system, downstream of the level control valve, were not corrected during modification activities

Requirements
Management Regulations, Section 5 concerning barriers, last paragraph

Activities Regulations, Section 20 concerning start-up and operation of facilities, second paragraph letter b

Rationale
The investigation revealed deficiencies relating to ensuring that changes in conditions for the operation of Njord A after the Njord Future project have been adequately addressed.

During the investigation, we observed the following:

a) The system documentation identifies a need for a travel stop on the level control valve downstream of the hydrocyclones to ensure overpressure protection of downstream equipment. This is a consequence of a new control valve with a larger capacity than the original design, dimensioned for a possible future low-pressure case. This larger valve will give a higher gas flow rate in the event of loss of liquid level. As discussed in non-conformity 8.1.3, this travel stop was never installed. In connection with the modification of the valve after the incident, a new trim was installed with the same CV as before, still without any travel stop.
b) Flow assurance assessments for Fenja during the project phase have identified a need for slug management under certain flow conditions. This has been physically facilitated through the selection of chokes with provision for active slug control and through provision for the use of gas lift. However, these measures are not included in the system descriptions or the operating procedures for Njord A.

8.2.2 Regulation of the processing plant

Improvement point
It appears that the process control for regulation of the water level in the 1st stage separator was not suitable for the production conditions, which could increase the likelihood of process incidents.

Requirements
Management Regulations, Section 4 concerning risk reduction, first paragraph

Rationale
Through the investigation, it has become clear that deficiencies in equipment, and in the configuration of equipment, have resulted in challenges associated with level control in the 1st stage separator. No need for compensatory measures for known deficiencies has been deemed necessary.

In September 2024, a notification was created relating to challenges associated with the level control valve on the water outlet from the 1st stage separator. The notification described operational challenges associated with the level control valve operating in the area of 4–15% opening for long periods. Logs that have been received show that the level control valve fluctuates. There were also weaknesses in equipment components which could have helped to detect operating issues (OIW out of service).

9 Barriers that did function:

As described in section 7.1, the only technical barrier that could have prevented the spill failed.

It is reasonable to assume that established operating routines, such as the operators' inspection round in the field and sampling every six hours, would have detected the spill.

When the spill was observed on the surface of the sea, effective troubleshooting took place, which resulted in the slip being stopped.

10 Other comments

10.1 Need for manual intervention in the control system to help ensure stable operation

During the start-up phase after the upgrade project on Njord A including the connection of new fields, there were challenges linked to unstable operation and unplanned descents, especially in the gas treatment/compression system. Technical support from onshore was resource-intensive during this phase, and manual adjustments to the control system were required in order to achieve stable operation.

10.2 Learning after the incident

Key underlying causes of the incident are linked to the method for level measurement, and to the calibration and testing of these. Through the investigation, the operator confirmed that there have been, and will be, further initiatives to ensure that learning from this incident is shared both within the company and with other stakeholders in the industry.

10.3 Alarm level

Through the investigation, we have received information on both the number of standing alarms and the number of new alarms received per hour. The figures show that the number of standing alarms was higher than Equinor’s own requirements.

Although the number of new alarms per hour was largely within the requirements, there were a large number of “noise” alarms caused by two equipment faults that were not filtered out. A high number of alarms, even if they are not relevant, could impact on the ability of personnel to detect relevant alarms.

11 Discussion concerning uncertainties

11.1 Background to instability in the separation train

Through the investigation, information has come up which indicates challenges associated with unstable operating conditions in the 1st stage separator (referred to as “slugging”). There is some uncertainty as to whether this instability was due to incoming liquid slugs from the wells, the accumulation of liquid slugs at the bottom of the risers, or instability further down the in production chain.

The CCR operators have occasionally found it necessary to operate the level control valve manually in order to “help” the system, both to keep the water level relatively stable and to limit the flow rate through the hydrocyclones, to avoid erosion of the liners.

No information is available from the control system for the period from 11:00 to 18:00. It is therefore uncertain whether the fluctuations in level at the time of the incident, in addition to poor functionality of the level control valve, was also due to incoming slugs.

11.2 The reason why water levels of less than 37% were not measured

Through the investigation, a number of elements relating to challenges with the level measurement have emerged. Density variations in the oil, calibration errors and the flow regime (mixed phase) during the incident may have been contributory factors behind the transmitters not detecting the actual level.

Based on the points below, it is reasonable to assume it was miscalibration/definition of the measurement range that was the main reason why the level did not drop below 37% during the incident:

- Verification of the level transmitter after the incident showed that the level read in the CCR did not fall below 33%, despite the actual level being lowered to almost empty on the water side
- Following recalibration on 23.03.2025, when points were checked throughout the range and corrected against supplier data (normalised points/% value), checks in the field against the level gauge showed that all the measurement points corresponded closely.

12 Annexes

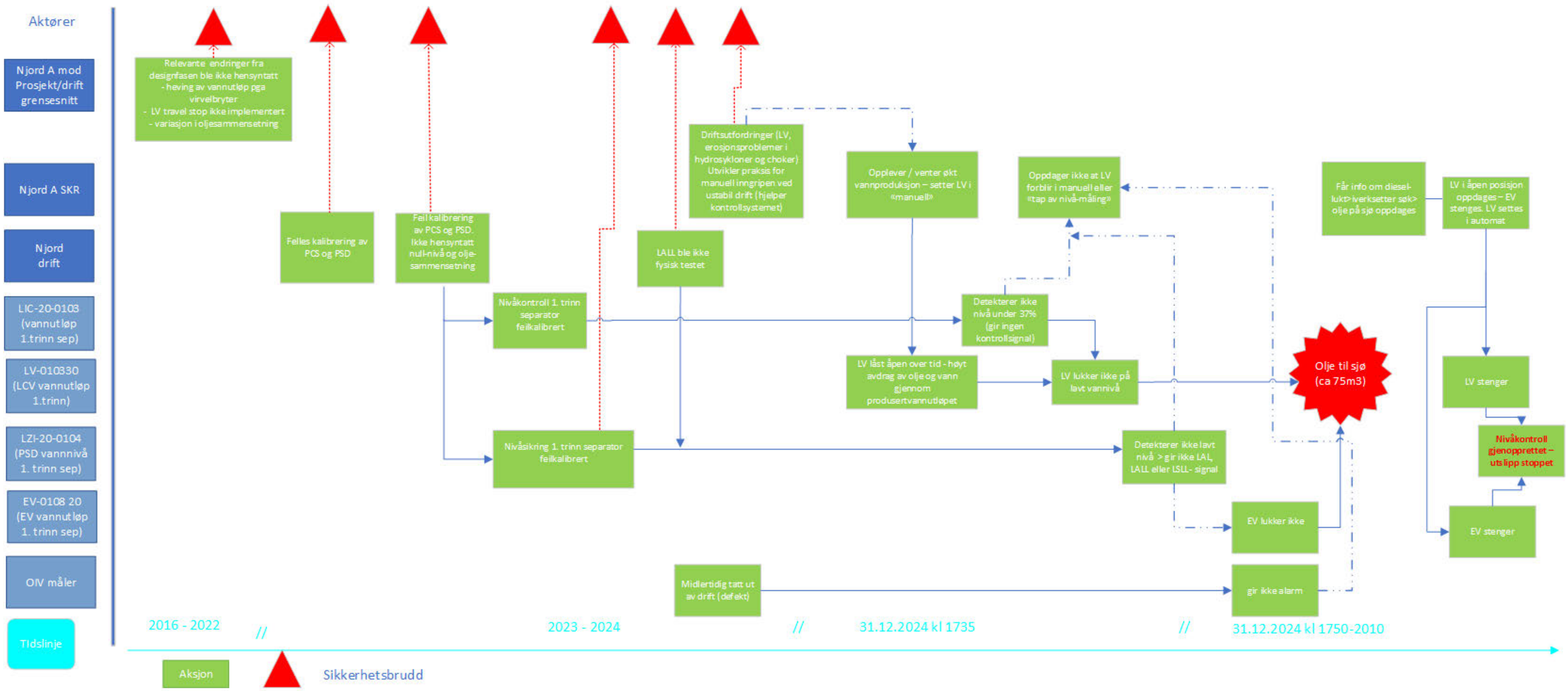
Annex A STEP diagram with explanation

The STEP diagram shows an overview of the development of the incident over time. The time period takes into account the chain of key events from Njord Future 2016-2022 through until the day of the incident, 31.12. 2024. Oil spill preparedness has not been included in the STEP diagram.

Horizontally, developments are displayed over time and the actors involved are shown along the vertical axis. The actors that have been selected are equipment and organisations that were involved in actions and incidents, and the diagram describes the communication and flow of information between the actors.

The marked safety breaches (1-4) in the STEP diagram are included in the report's identified non-conformities and their rationale.

STEP DIAGRAM Oljeutslipp Njord A 31.12.2024 – Havtils gransking



Annex B Documents used in the investigation

1. 18-1A-AS-C87-02000 - Sys 20 – Engineering manual
2. SO06120 - Sys 20 - Separation and Stabilisation, System description
3. 18-1A-AS-C87-03900 - System Engineering Manual, System 39 - Produced water treatment
4. SO06139 - Sys 39_51 - Prod water and Flush water, System description
5. Level measurement LZT-20-0104 (Plot)
6. Level measurement 1st stage sep (other measurements)
7. EQN Presentation during start-up meeting 21.3.2023
8. Synergi case 3831486
9. Overview drawing, main process 1 (separation and injection compressor)
10. Overview drawing, main process 2 (oil treatment and recompression)
11. The following P&IDs:
    a. Fenja topside production flowline 18-1A-KV-C78-01316
    b. Flow line #13 well A-13, 18-1A-AS-C78-01306
    c. Flow line #17 well A-20, 18-1A-AS-C78-01301
    d. High pressure production manifold, 18-1A-AS-C78-02000
    e. 1st stage Separator, 18-1A-AS-C78-02010
    f. 2nd stage separator 18-1A-AS-C78-02020
    g. Test separator 18-1A-AS-C78-01360
    h. Produced water system hydrocyclones. 18-1A-AS-C78-03915
    i. CFU package produced water 18-1A-KV-C78-03901
    j. Produced water system degassing drum, 18-1A-AS-C78-03920
    k. Produced water system disposal caissons 18-1A-AS-C78-03930
12. J74704A-P-RT-15002/d1 – Fenja Detailed Design – Steady State Flow Assurance Report
13. J74302a-P-RT-15001/d2 - Arrow and Bue Steady Flow Assurance Report
14. Raw data for the following components 24.12.2024:

- LT-20-0103 (PCS IF)
- LZT-20-0104 (PSD IF)
- LV-20-103 (LV water outlet)
- LT-20-0101 (PCS oil)
- LZT-20 – 0102 (PSD oil)
- LV-20-0101 (LV oil outlet)

15. Presentation from investigation interview
16. Plot for the time period (24 hours) 31.12.24
17. 1828-LZT-20-104 - Presentation shown during interview with GOTE aut 10.4.25
18. Maintenance concept for testing of transmitter with PAS function MI 10289698
19. SO06113 System 13 - Platform production and injection system towards risers - System description
20. 18-1A-ST-X03-00200, Commissioning procedure, system 20 Product manifold and separators
21. SAP M2 48279893
22. 18-1A-KV-M58-21129-0001 and 18-1A-AS-M58-01021-0001 (drawings of separator)
23. 18-1A-HM-I87-30292-0007 - Function description
24. EQN timeline/log
25. Photographs of the discharge
26. Email SAP reports:
    - Test Separator:
        - Technical feedback 1820-LZT-13-0604
        - LZT AO overview
    - Second Stage Sep
        - 1820-LZT-20-0024 example technical feedback (representative)
    - List of preventive maintenance (PM) jobs
    - Extract from longtxt AO 26734284
    - 1st stage separator
        - 1820-LZT-20-0104
    - General considerations concerning maintenance concept
    - Maintenance concept for TI0710 – code 39

- Activity 005
- Njord Maintenance portfolio/KPIs
- KPIs for CMR overdue and Reqd end overdue (Njord A+B)

27. LG-20-1104: Photographs of sight glass and calibration data/Overview of set points and % level for water LZT-20-0104 LG, LT-20-013
28. Notification 48156293
29. Data from completed tests LZT
30. Process data sheet 20-LV-0103
31. Instrument data sheet 20-LV-0103
32. Alarms and events 31.12.24 (from CCR)
33. EQN presentation from the start-up meeting on 3.2.25
34. Response to clarifying questions through the investigation linked to alarm management, sampling procedures, slug management procedures, etc.
35. Organisation chart, Njord