Foreword

Trends in the risk level in the petroleum activities concern all parties involved in the industry, as well as the general public. RNNP is an important tool for helping to establish a common picture of the trends in selected conditions that affect risk. RNNP is consequently of particular significance for interaction between the social partners within the petroleum activities, and their ownership of the process and the results are important both in terms of the implementation of the activity and the follow-up of results.

The petroleum industry has considerable HSE expertise, and this expertise is a critical success factor for an activity such as RNNP. We are therefore pleased to acknowledge the active contribution to this work of the industry participants, as well as key personnel from operating companies, vessel owners, helicopter operators, consultancies, research and teaching.

Stavanger, 30 March 2023

Finn Carlsen,
Technical Director, PSA

CONTENTS

1. Objective and limitations

1.1 Purpose

The "Trends in risk level on the Norwegian Continental Shelf" project started in the year 1999. The background to the project was the participants' need to clarify uncertainties concerning the safety consequences of the major structural changes that the petroleum industry underwent in the late 1990s.

The industry has traditionally used a selection of indicators to illustrate safety trends in the petroleum activities. Indicators based on the frequency of lost-time incidents have been particularly widespread. It is generally accepted that this only covers a small part of the overall safety picture. Recent developments have moved towards using several indicators to measure trends. For the parties in the industry, it is important to establish methods for measuring the impact of the industry's overall safety work.

In this report, the Petroleum Safety Authority Norway wishes to set out a description of key factors that affect risk based on sets of information and data from the activities, in order to allow key aspects of the impact of the overall safety work in the activities to be measured.

1.2 Objective

The objective of the work is to:

- Measure the impact of the industry's HSE work.
- Contribute to identifying areas that are critical for HSE and where the effort to identify causes must be prioritised in order to prevent undesirable incidents and accidents.
- Increase insight into potential causes of accidents and their relative significance for the risk profile, to provide better decision support for the industry and authorities concerning preventive safety and emergency preparedness planning.

The work may also contribute to identifying focus areas for amending regulations, as well as research and development.

1.3 Key limitations

In this report, the spotlight is on personal risk, which here includes major accidents and work accidents. Reactive and proactive indicators, both qualitative and quantitative in nature, are used.

The work is restricted to matters that are included in the PSA's area of authority as regards safety and the working environment. All passenger transport by helicopter is also included, in cooperation with the Civil Aviation Authority Norway and the helicopter operators on the Norwegian Continental Shelf (NCS). The following areas are covered:

- All production and mobile facilities on the NCS, including subsea facilities.
- Passenger transport by helicopter between the helicopter terminals and the facilities.
- Use of vessels within the safety zone around the facilities.

Onshore installations in the PSA's administrative area are included as of 1 January 2006. Data collection started from this date, since when separate reports have been published. Outcomes and analyses for onshore installations and the results from these installations are not included in this summary report. Since 2010, an annual report has been published, with the spotlight on acute spills to sea from offshore petroleum activities. The next report on acute spills is expected in autumn 2023.

2. Conclusions

Through RNNP, we seek to measure trends in safety, the working environment and the external environment using a series of indicators. The basis for the evaluations is the triangulation principle, i.e. assessing developments by using several instruments to measure changes in factors that affect risk.

In an indicator-based model, it is to be expected that some indicators, particularly within areas with relatively few near-misses, will sometimes display large annual variations. The main focus of this report is therefore trends. A positive trend in the number of near-misses may indicate that the industry's risk-management efforts are having an effect, but it provides no guarantee that future incidents will be avoided. Consequently, the petroleum industry, especially in the light of the Norwegian Parliament's ambition for the Norwegian petroleum activities to be world-leading in HSE, should maintain a constant focus on the effective management of conditions that affect risk.

Data for the indicators for noise, chemical working environment and ergonomic risk factors are not reported for 2022. Unfortunately, the development of new indicators, which is taking place in collaboration with the industry, is taking longer than expected.

Ideally, it should be possible to reach a summary conclusion on the basis of information from all the measurement instruments used. In practice, this is difficult, partly because the information used reflects HSE conditions at different levels.

Major accidents

In 2022, there were no accidents that resulted in fatalities, hence no major accidents according to the definition of major accident used in this report. As in 2021, nor were there any exceptionally serious near-misses assessed as having the potential for a large number of fatalities.

The number of near-misses with major accident potential has been at a stable level since 2005. The level in recent years is lower than in the period preceding 2005. In 2022, there were 32 such incidents (helicopters not included). This is at the same level as the last eight years. When the number of incidents is normalised against working hours, the frequency in 2022 is within the expected range.

Ten non-ignited hydrocarbon leaks were recorded in 2022 (six in 2021). Eight were below 1 kg/s, and two were between 1 kg/s and 10 kg/s. It is now nine years since a hydrocarbon leak above 10 kg/s was recorded. In 2022, there were 11 well-control incidents, all in the lowest risk category. The frequency of these types of incidents, normalised against the number of wells drilled, is within the expected range in 2022. In 2022, six incidents of damage to structures and maritime systems that satisfy the damage criteria used in RNNP were registered. This is an increase from 2021 (three incidents), but is close to the average for the last 10 years, which is 7 incidents per year.

If the near-misses with major accident potential are weighted by factors identifying their inherent potential for causing fatalities were they to develop into an accident, it can be seen that, in 2022, the indicator (the total indicator) is at the same level as in 2021. The total indicator shows an underlying positive trend since 2005. Since particularly serious incidents are assigned a relatively high risk weighting, the annually variation in the total indicator is large, but the positive trend is nevertheless clear. As described in chapter 6.3, the total indicator is a composite indicator that reflects the industry's ability to influence and manage a variety of risk-related factors. The underlying positive trend in the indicator indicates that the industry has improved at managing factors that affect risk. Although an indicator based on historical figures provides relevant information on factors that affect future risk, it in no way provides sufficient information about future risk itself.

Helicopter risk constitutes a large share of the overall risk exposure to which employees on the NCS are exposed. The purpose of the risk indicators used in this work is to capture risks associated with incidents and to identify opportunities for improvement.

In the period in which RNNP has collected helicopter-related data, the Turøy accident in 2016 is the only helicopter accident involving a fatality that falls within the scope of the survey.

In the helicopter expert group's assessment of incidents in 2022, one was classified in the most serious category. The expert group assessed that, in these three incidents, there was a single remaining barrier. The one incident involved a possible close pass of a jack-up rig under sail on approach to the airport. Visibility was low and it is uncertain how close the pass was and whether the rig was higher than the approach minima.

Barriers

Leading indicators are used to describe robustness in withstanding incidents. Barrier indicators are an example of these. Notably, this type of indicator describes the barriers' ability to function when called on. The barrier indicators show that there are large differences in levels between the facilities. Over time, for many barriers, there is a positive trend that exceeds the industry's self-defined requirements. In recent years, the level has been fairly stable with some exceptions. For some of the barriers, this is a positive development when the level over time is considered. This may be because the participants have become more aware of quality in respect of the testing of barriers, and that the current level is a better reflection of the true value than was the case a few years ago.

The maintenance data in RNNP 2022 for the fixed facilities show that there are few hours of backlog in preventive maintenance, but a number of facilities have not performed the HSE-critical preventive maintenance in accordance with their own deadlines. The total backlog in preventive maintenance in 2022 is higher than that reported in 2021. The backlog in HSE-critical preventive maintenance has fallen somewhat in recent years. Some facilities have a high total number of hours of corrective maintenance not performed at 31.12.2022. Overall, there is a significant number of hours of corrective maintenance not performed as of 31.12.2022 and the extent in 2022 is at about the same level as in 2020 and 2021. The hours for preventive and corrective maintenance carried out for the fixed facilities in 2022 are approximately the same as the year before, but the number of hours for modifications and projects has decreased somewhat compared to recent years.

The data for mobile facilities show large variations in the backlog in preventive maintenance and in outstanding corrective maintenance. This corresponds to what we have seen in recent years. A number of facilities have not carried out HSE-critical preventive maintenance and corrective maintenance in accordance with their own deadlines.

Personal injuries and accidents

In 2022, 227 reportable personal injuries were recorded on the NCS. 178 such injuries were reported in 2021. 21 of these were classified as serious in 2022, against 27 in 2021. When normalised, serious occupational injuries have fallen from 0.63 injuries per million hours worked in 2021 to 0.48 in 2022.

Qualitative study – drilling

This qualitative study concerns causes of and measures related to well-control incidents in the Norwegian petroleum industry.
The purpose of the study was to identify potential measures that can be further developed with a view to reducing the number of well control incidents.

Survey questionnaire for divers
The 2022 diving survey has a high number of responses (n=208) compared to previous years, which is a positive development. This provides a good basis for saying something about the working environment, HSE climate and health among diving personnel in 2022. It is somewhat more challenging to say anything about developments over time, since the samples in 2018 and 2020 were significantly smaller.
The diving survey was first conducted in 2018, and it still shows signs of being in development and having improvement potential. Based on this year's experience, revisions will be made to the form ahead of the next survey (2024), with the aim of making the questions even more relevant to the target group and better in terms of quality.

The results from 2022 show that divers (saturation and surface oriented) have some working environment exposure, especially related to heavy lifting and cold, exposed areas. Skin contact with chemicals or similar (oil, drilling mud, cleaning agents) is also something that many divers experience occasionally or often. This should be seen in connection with the negative assessments also given when divers are asked whether they have received information about the potentially harmful effects of chemicals/pollution. There are also many who rarely or never experience the cleaning of suits/equipment being prioritised. There are also somewhat negative results associated with the use of procedures, harmonisation/information about procedures and routines, as well as the reporting and processing of non-conformities. In terms of health, in the survey, the vast majority of divers (regardless of job category) consider themselves to be in good or very good health, and there is a slight decline in the prevalence of health complaints.

3. Implementation

The results from RNNP are presented in annual reports. This report covers the year 2022. Work on the report was carried out mainly in the period December 2022 – March 2023.

The detailed objective for 2023 was to:

- Continue the work carried out in previous years
- Maintain and develop the total indicator method
- Evaluate correlations in the datasets.

3.1 Performance of the work

The following participants contributed to the work on this year's report:

- Petroleum Safety Authority Norway: Responsible for execution and further development of the work
- Operating companies and vessel owners: Contribute data and information about activities on the facilities
- The helicopter operators: Contribute data and information about helicopter transport activities
- HSE specialist group: (selected specialists) Evaluate the procedure, input data, viewpoints on the development, evaluate trends, propose conclusions
- Safety Forum: (multipartite) Comment on the procedure and results and recommend further work
- Advisory group: (multipartite) Multipartite RNNP advisory group that advises the Petroleum Safety Authority regarding further development of the work

The PSA's working group consists of: Mette Vintermyr, Tore Endresen, Marita Halsne, Morten Langøy, Trond Sundby, Inger Danielsen, Elisabeth Lootz, Roar Høydal, Jan Ketil Moberg, Semsudin Leto, Eivind Jåsund, Kenneth Skogen, Bente Hallan, Torbjørn Gjerde, Øyvind Loennechen, Roar Sognnes, Astrid Schuchert and Torleif Husebø.

The following external parties have assisted the Petroleum Safety Authority with specific assignments:

- Terje Dammen, Jorunn Seljelid, Torleif Veen, Jon Andreas Rismyhr, Mads Lindberg, Ragnar Aarø, Kaia Stødle, Marie Horn Saltnes, Christine Alstad Grønlund, Rolf Johan Bye, Lars Mogstad, Askild Underbakke, Martin Dugstad, Hans Laupsa and Marita Pytte, all from Safetec.
- Qualitative study – drilling: Lonan Kierans (Proactima), Willy Røed (Proactima), Caroline Metcalfe (Proactima), Gaeme Dick (Reflekt), Mike Pollard (Reflekt), Øystein Arild (project member) and Ole Andres Engen (project member)
- Survey questionnaire: Kari Kjestveit from NORCE.

The following people have contributed to the work on indicators for helicopter risk:

- Øyvind Solberg, Maj Brit Fjermestad, Offshore Norge represented by LFE
- Nils-Rune Kolnes, Morten Haugseng, Inge Løland, CHC Helikopter Service
- Øyvind Øglænd, Kjetil Hellesøy, Sondre Nordseth, Bristow Norway AS

Numerous other people have also contributed to the work.

3.2 Use of risk indicators

Data have been collected for hazard and accident situations associated with major accidents, work accidents and working environment factors, specifically:

- Defined situations of hazard and accident, with the following main categories:
  - Uncontrolled discharges of hydrocarbons, fires (i.e. process leaks, well incidents/shallow gas, riser leaks and other fires)
  - Structure-related incidents (i.e. structural damage, collisions and risk of collision)
- Test data associated with the performance of barriers against major accidents on the facilities, including data concerning well status and maintenance management
- Accidents and incidents in helicopter transport
- Work accidents
- Other hazard and accident situations with consequences of a lesser extent or significance for emergency preparedness.

The term 'major accident' is used in many places in the reports. There are no unambiguous definitions of the term, but the following are often used, and coincide with the base definition employed in this report:

- A major accident is an accident (i.e. entails a loss) where at least three to five people may be exposed.
- A major accident is an accident caused by failure of one or more of the system's built-in safety and emergency preparedness barriers.

In light of the definition of major accident in the Seveso II Directive and in the PSA's regulations, the definition used here is closer to a 'large accident'.

Data collection for the DSHAs (Defined situations of hazard and accident) related to major accidents is founded in part on existing databases in the Petroleum Safety Authority (CODAM, DDRS, etc.), but also to a significant degree on data collection carried out in cooperation with the operating companies and vessel owners. All incident data have been quality-assured by, for example, checking them against the incident register and other databases of the PSA.

Table 3.1 shows an overview of the 21 DSHAs, and which data sources have been used. The industry has used the same categories for registering data through databases such as Synergi.

Table 3.1 List showing the primary source of data on incidents

DSHA	*Description*	*Database*
1	Unignited hydrocarbon leak	Industry
2	Ignited hydrocarbon leak	Industry
3	Well incidents/loss of well control	PSA
4	Fire/explosion in other areas, not hydrocarbon	PSA/Industry
5	Ship on collision course	Industry
6	Drifting object	Industry
7	Collision with field-related vessel/facility/shuttle tanker	PSA
8	Damage to a facility's structure, stability/anchoring/positioning failure	PSA/Industry
9	Leak from riser, pipeline and subsea production facility*	PSA
10	Damage to riser, pipeline and subsea production facility*	PSA
11	Evacuation	Industry
12	Helicopter incidents	Industry
13	Man over board	Industry
14	Work accidents	PSA
15	Work-related illness	Industry
16	Full loss of power	Industry
18	Diving accident	PSA
19	H_2S emission	Industry
20	Crane and lifting operations	PSA/Industry
21	Dropped objects	PSA/Industry

* Also includes wellstream pipeline, loading buoy and loading hose where relevant.

3.3 Developments in the activity level

Figure 3-1 and Figure 3-2 show the development, over the period from 2005 to 2022 for production and exploration activities, of the parameters used for normalisation against the activity level (all figures are relative to the year 2005, which is defined as 1.0). Appendix A to the main report (PSA, 2023a) presents the underlying data in detail.

There was a rise of 9% in working hours on production facilities in 2022 compared to 2021. For mobile facilities, there was decrease of around 12% from the previous year. The number of exploration and production wells drilled fell.

Production volume increased somewhat compared to 2021.

A presentation of DSHAs or contributors to risk can sometimes vary according to whether absolute or normalised values are stated, depending on the normalisation parameter. In the main, normalised values are presented.

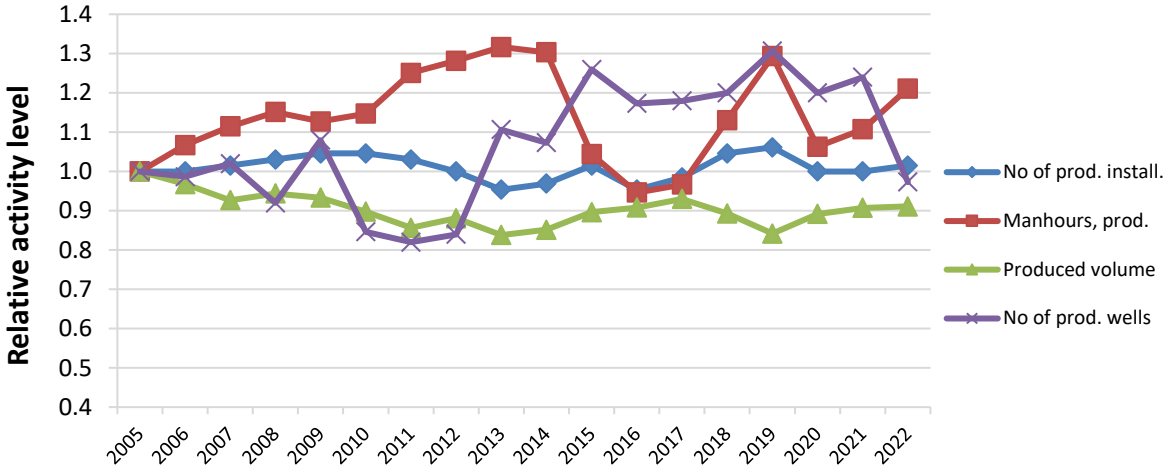

Figure 3-1 Relative trend in activity level for production facilities. Normalised against the year 2005

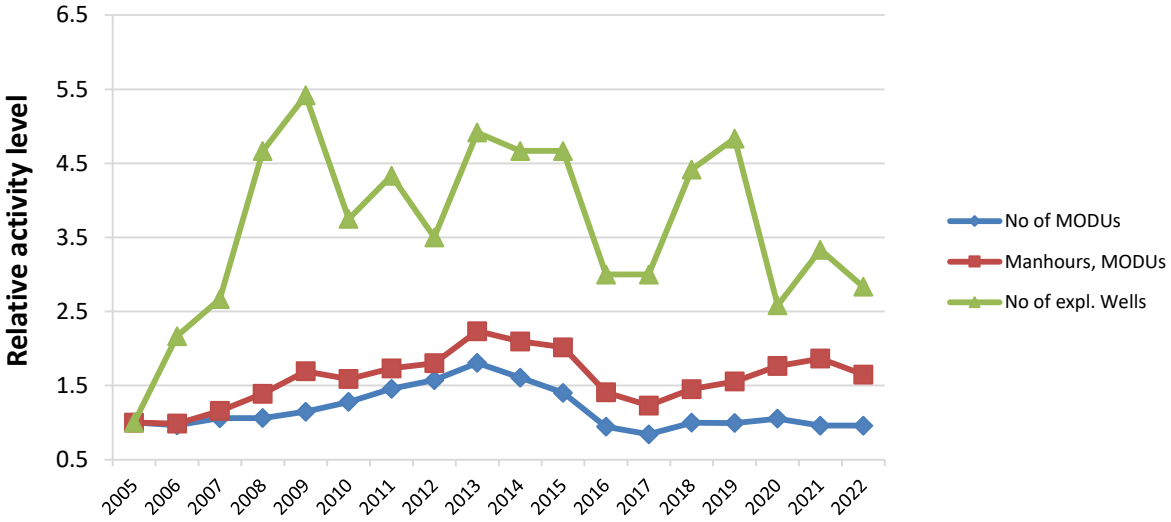

Figure 3-2 Relative trend in activity level for mobile facilities. Normalised against the year 2005

A corresponding activity overview for helicopter transport is shown in sub-chapter 5.1.

3.4 Documentation

Analyses, assessments and results are documented as follows:

- Summary report – the Norwegian Continental Shelf for the year 2022 (Norwegian and English versions)
- Main report – the Norwegian Continental Shelf for the year 2022
- Report for onshore facilities for the year 2022
- Report for acute spills to sea for the Norwegian Continental Shelf 2022, to be published in the autumn of 2023
- Methodological report, 2023

The reports can be downloaded from the Petroleum Safety Authority Norway's website (www.ptil.no/rnnp).

4. The survey

In 2022, for the third time, a questionnaire-based survey was conducted among diving personnel. Everyone who participated in diving operations on the NCS during calendar year 2022 was invited to participate. The questionnaire is essentially the same as the one used in the regular survey, with some adaptations and extra questions specifically aimed at diving-related topics.

The diving survey received 208 responses, which is significantly more than in 2020. The sample consisted of 67.9% divers, of whom 77% were saturation divers and 23% surface-oriented divers. Four job categories are defined as 'managers' and, together, these constituted 9.8% of the total sample. 46.2% of all participants were aged ≤ 40 years, and the sample is "fresher" than before, in age, seniority and experience of diving on the NCS. Managers are on average older than divers, and saturation divers are on average older than surface-oriented divers. More than half of the sample worked on the same vessel in the last 12 months. Only 13% have permanent employment, and day rate is the most common form of employment. British citizens constitute 69.3% of the sample, 7.8% are Norwegian and 22.9% have "other nationality". The most common working hours arrangement is 12/12 hours (88.8%) with both day and night shifts (59.2%).

4.1 Diving-related topics

In the section of the questionnaire that was aimed specifically at diving-related topics, the divers and diving managers were asked to evaluate general working environment factors. The divers rated these more positively than the managers, and they were particularly satisfied with "use of NORSOK saturation/decompression tables" and "mandatory breaks in bell". Most diver-specific hazard situations are assessed as having a lower perceived risk in 2022 compared to 2020. Among the divers (saturation/surface), perceived risk was assessed highest for "work within structures", "gas loss" and "human error during diving operations". Divers assess the risk as higher than managers in most areas, but one exception is "lifting operations from diving vessels (cranes or lifting balloons)" which a larger proportion of managers associate with high risk.

When asked about safety-related behaviour during diving operations on the NCS, 25% of managers believe that they fairly/very often or always have to follow procedures that they believe should have been different. 20% say that they fairly/very often or always worked with divers whom they do not trust.

The divers were also asked about safety-related behaviour, but with different questions. 39.8% of saturation divers have sometimes/quite often needed a break during a dive (surface oriented: 24.1%). With regard to exposure in the work situation, we found that the two questions with the most negative assessment were related to information about potentially harmful effects of chemicals and pollution, as well as to whether cleaning of suits/equipment is given priority. On the last of these, the assessments of surface-oriented divers were more negative than those of saturation divers.

4.2 Assessment of the HSE climate

Some results are measured using indices, which are a compilation of questions that naturally belong together. There are six indices for HSE climate, and five of them are assessed more positively in 2022 than in 2020. The exception is the index for "conflicting goals", which 14.4% rate at the most negative end of the scale (versus 6.3% in 2020). If we compare with the results of the ordinary survey (RNNP 2021), this result closely matches the assessments of the offshore employees, where 16.1% gave negative ratings on this index. The index of "freedom to speak up" (16.7%) is most negatively assessed, and this is almost the same result as for offshore employees in 2021.

If we look at individual statements, there are some "regulars" among those which are assessed most negatively in the RNNP forms. For diving personnel too, we also find challenging results for statements such as 'I find it uncomfortable to point out breaches of

safety rules and procedures', 'Reports of accidents are often 'sanitised'', and 'Different facilities have different procedures and routines for the same circumstances, and this constitutes a threat to safety'.

4.3 Working environment

When asked about physical, chemical and ergonomic working environment exposures, most respondents reported exposure to heavy lifting and cold, exposed areas. This corresponds to the results in 2020. With regard to the psychosocial and ergonomic working environment, the most negative answers concerned the ability to determine one's own work pace. This question also came out worst in 2020, and shows a negative development in 2022. At the index level, job control is assessed more negatively in 2022, while a larger proportion rate the following indices more positively: job demands, management support, colleague support and workload.

4.4 Sleep quality

The sleep quality index contains questions about the respondent's sleep before, during and after an offshore trip. 21.6% rate the sleep quality index negatively. This is relatively high, but it is nonetheless a positive development from 2020, when the proportion was 31.3%. Concerning the individual statement 'I sleep well when offshore', there are differences connected to shift arrangements. Those working fixed day shifts have the best quality of sleep, while those who work fixed night shifts have the poorest experience of sleeping well when offshore.

4.5 Health complaints and sickness absence

The vast majority of diving survey respondents consider their health to be good or very good. This result is roughly the same as in 2020, but for sickness absence the development is negative: 11.4% report having taken sick leave in the last year. 2.2% say that they have been the victim of a work accident involving personal injury in the last year. We find a (non-significant) decline in the proportion who have experienced various health complaints during the last three months, but the proportion linking the symptoms to their work situation has increased. There are some differences between saturation divers and surface-oriented divers in the prevalence of health complaints. For the sample as a whole, these are the most prevalent health complaints: Neck/shoulders/arm pain, fatigue, mental health problems, joint pain, back pain, anxiety and ringing in the ears/tinnitus.

5. Status and trends – helicopter incidents

Cooperation with the Civil Aviation Authority and the helicopter operators on the work on risk indicators was continued in 2022. Aviation data obtained from the helicopter operators involved includes incident type, risk class, severity, type of flight, phase, helicopter type and information about departure and arrival.

5.1 Activity indicators

Figure 5-1 shows activity indicator 1 which includes volumes in the number of flight hours and the number of passenger flight hours per year in the period 2005-2022. The sharp reduction in the number of flight hours and passenger flight hours from 2014-2016 is due to the reduction in the number of hours worked on the NCS.

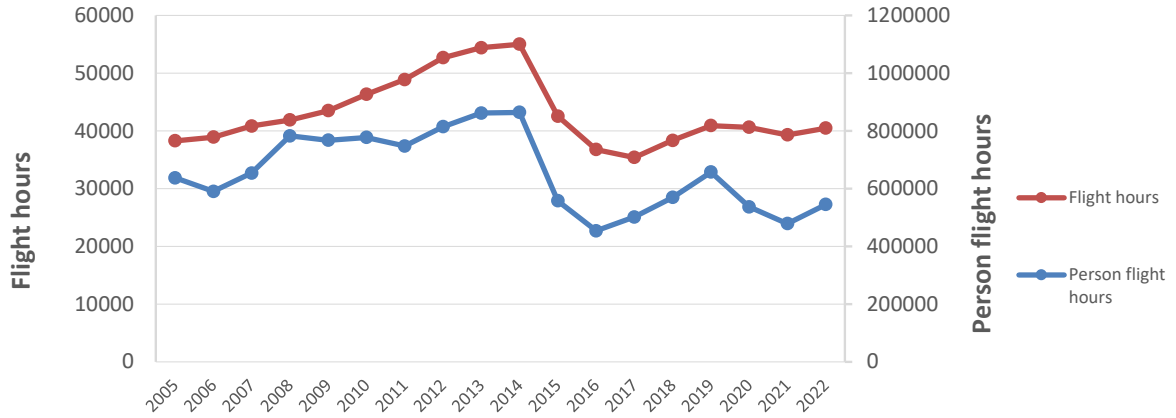

Figure 5-1 Flight hours and passenger flight hours per year, 2005-2022

The volume of helicopter flights per year must be viewed in the context of the activity level on the NCS; see main report. From 2014 to 2016, the number of passengers fell by 40%, the number of passenger flight hours fell by 47%, while the number of working hours fell by 28%. This means that fewer people were on short stays on the facilities, and that a greater proportion than before were on the facilities for a full 14 days.

5.2 Incident indicators

5.2.1 Incident indicator 1 – serious incidents and near-misses

Figure 5-2 shows the number of incidents included in incident indicator 1. From 2009 (and subsequently for 2006, 2007 and 2008), the most serious near-misses which the companies reported were reviewed by an expert group consisting of operational and technical personnel from the helicopter operators, from the oil companies and from the PSA's project group in order to classify the incidents based on the following categories:

Little remaining safety margin against fatal accident: *No remaining barriers*
Medium remaining safety margin against fatal accident: *One remaining barrier*
Large remaining safety margin against fatal accident: *Two (or more) remaining barriers.*

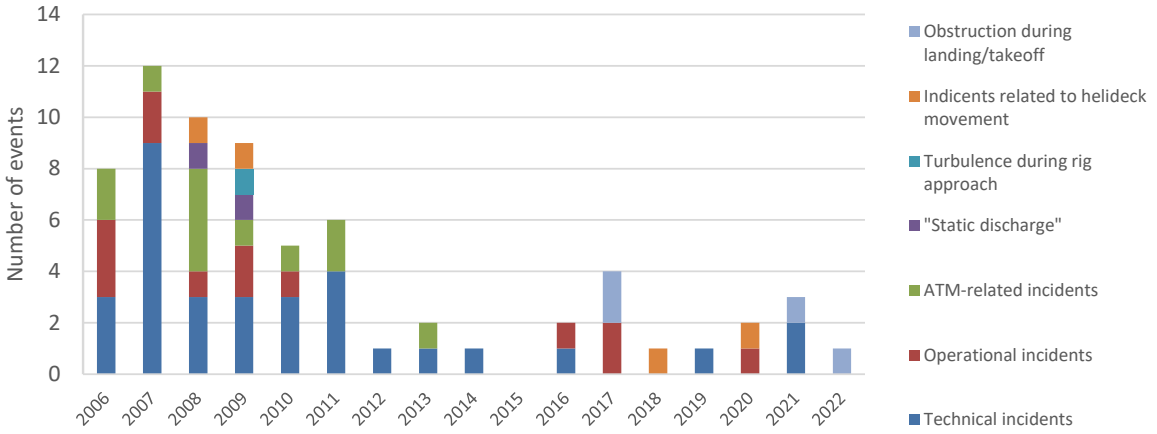

Figure 5-2 Incident indicator 1 per year by causal categories, not normalised, 2006–2022

In the expert group's assessment of incidents for 2022, there was one incident with one remaining barrier included in incident indicator 1. The one incident involved a possible close pass of a jack-up rig under sail on approach to the airport. Visibility was low and it is uncertain how close the pass was and whether the rig was higher than the approach minima.

6. Status and trends – indicators for major accidents on facilities

The indicators for major accident risk from previous years have been continued, with a primary emphasis on indicators for incidents and near-misses with the potential for causing a major accident (DSHA 1-10). The indicators for DSHA 12, helicopter incidents, are presented separately in chapter 5. Barriers against major accidents are presented in chapter 7.

There have been no major accidents, per the definition used in the report, on facilities on the NCS since 1990. The serious incident on COSL Innovator in 2015 where a wave stove in windows in an accommodation section, injuring four and killing one person, is categorised as a structural incident and is the first major accident DSHA to have caused a fatality in the period 2005-2022. The last time there were any fatalities in connection with one of these major accident DSHAs was in 1985, with a shallow gas blowout on the *West Vanguard* mobile facility. Added to this are the Norne and Turøy helicopter accidents in 1997 and 2016.

6.1 DSHAs associated with major accident risk

Figure 6-1 shows the trend in the number of reported DSHAs in the period 2005-2022. It is important to emphasise that this figure does not take account of the potential of near-misses in respect of loss of life. There was a rising trend in the number of incidents during the period 1996-2000, which has been discussed in previous years' reports and is therefore omitted from the figure. After an apparent peak in the number of incidents in 2005, there is a gradual reduction in the number of incidents with major accident potential. The number of reported incidents in 2022 is the lowest recorded in the period.

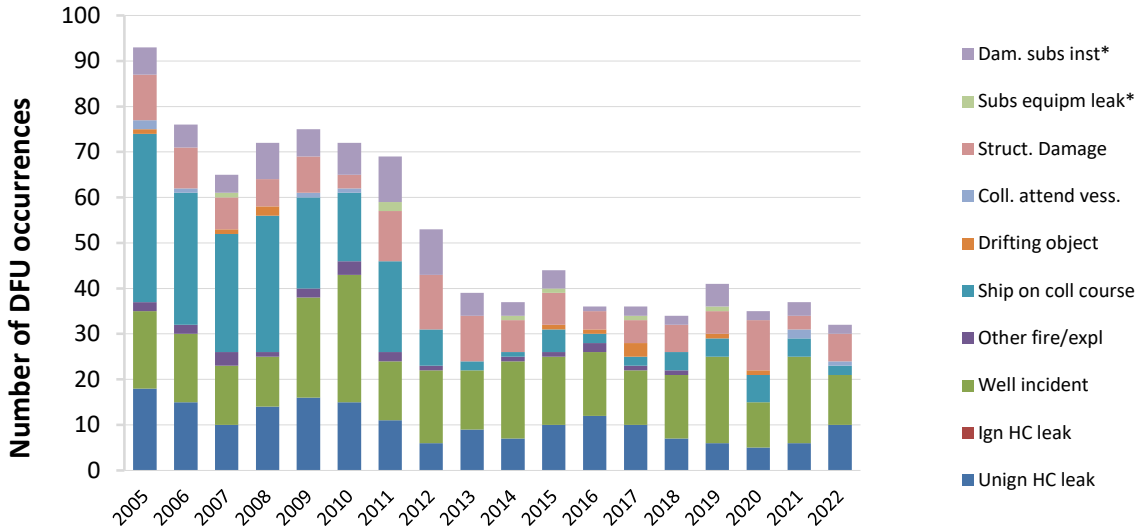

Figure 6-1 Reported DSHAs (1-10) by categories.
****Within the safety zone***

In Figure 6-1, the number of incidents is presented without normalisation relative to exposure data. Figure 6-2 shows the same overview, but now normalised against number of working hours. The level for 2022 is in the hatched area, indicating a stable level compared to the average in the previous ten-year period.

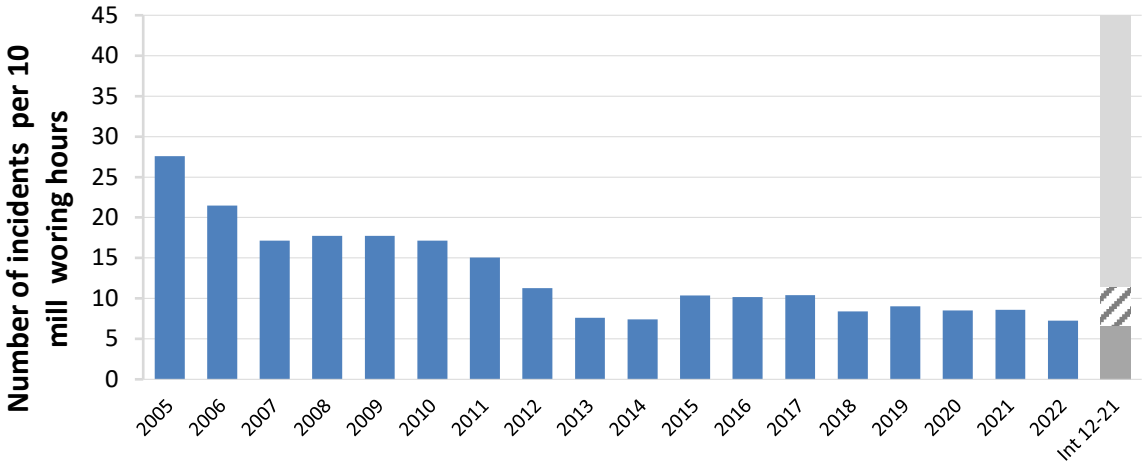

Figure 6-2 Total number of DSHA 1-10 incidents normalised against working hours

6.2 Risk indicators for major accidents

6.2.1 Hydrocarbon leak in the process area

Figure 6-3 shows the number of hydrocarbon leaks greater than 0.1 kg/s in the period 2005-2022. 10 hydrocarbons leaks were recorded in 2022, eight in the category 0.1-1 kg/s and two in the category 1-10 kg/s.

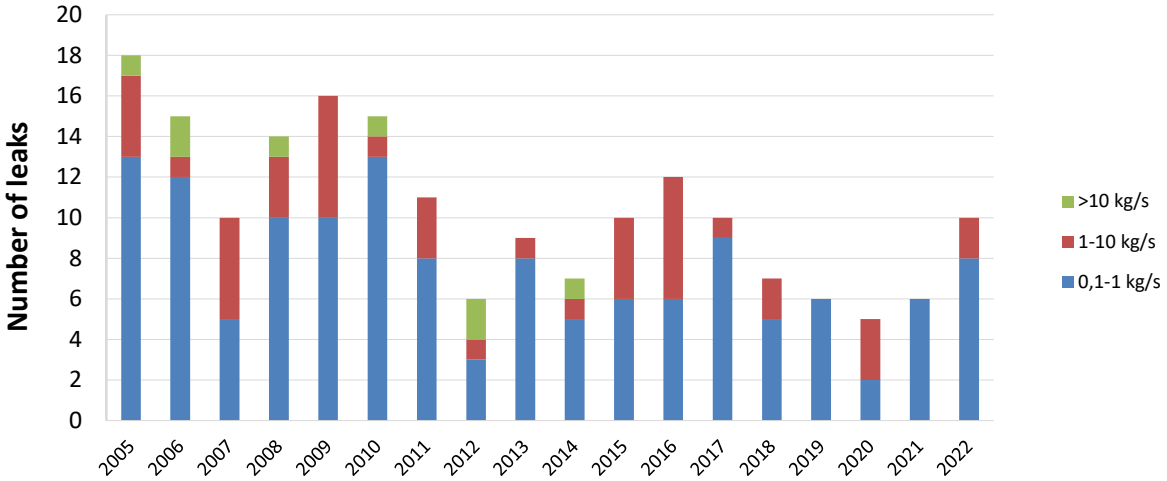

Figure 6-3 Number of hydrocarbon leaks exceeding 0.1 kg/s, 2005-2022

Figure 6-4 shows the number of leaks when these are weighted according to the risk potential they are assessed as having. In simple terms, one can say that the risk contribution of each leak is roughly proportional to the leak rate expressed in kg/s. The risk contribution rose slightly from 2021 to 2022.

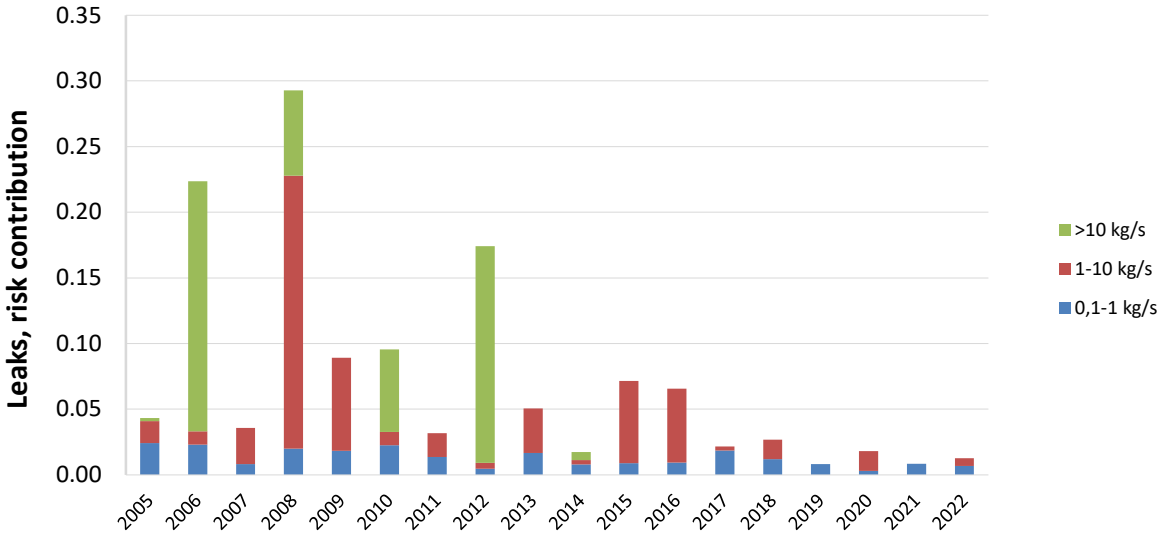

Figure 6-4 Number of hydrocarbon leaks exceeding 0.1 kg/s, 2005-2022, weighted according to risk potential

Figure 6-5 shows the trend in leaks exceeding 0.1 kg/s, normalised against working hours for production facilities. The figure shows that the number of leaks per million working hours in 2022 is within the prediction range. The change is therefore not statistically significant relative to the average for the period 2012-2021. The number of leaks has been normalised both against working hours and the number of facility years in the main report.

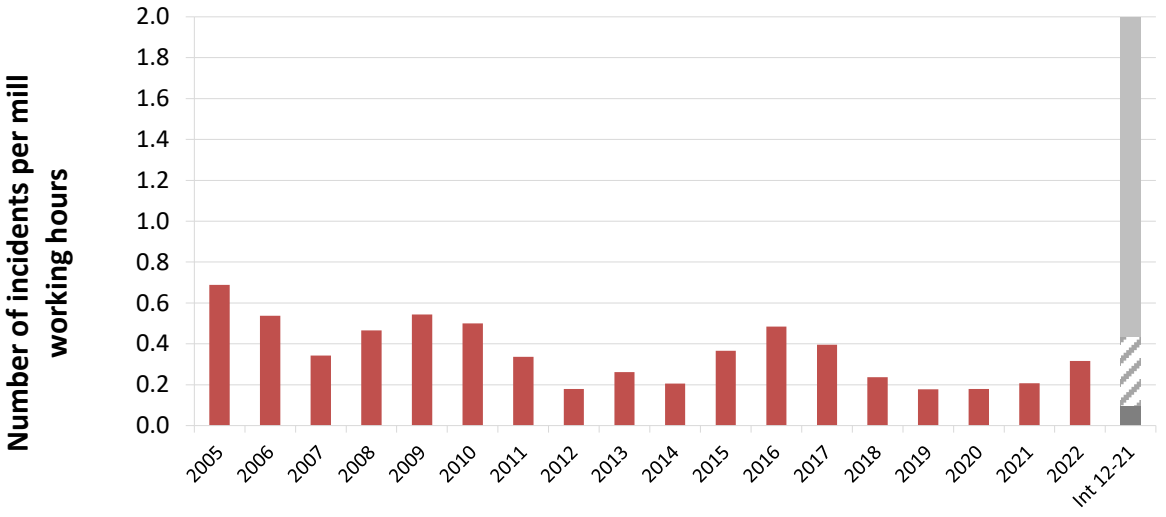

Figure 6-5 Trend, leaks, normalised against working hours

6.2.2 Loss of well control, blowout potential, well integrity

Figure 6-6 shows well control incidents broken down by exploration drilling and production drilling, normalised per 100 drilled wells.

There were 11 well control incidents in 2022, eight in production drilling and three in exploration drilling. All of these were in the lowest risk category. Figure 6-6 shows the share of well control incidents per 100 wells drilled. The number in 2022 is somewhat lower than in 2021. In general, the number of well control incidents per drilled well has been higher for exploration drilling, and with greater annual variation, than for production drilling. 2016 and 2017 stood out with zero incidents in exploration drilling, while, in 2018-2022, well control incidents in exploration drilling are seen to dominate again.

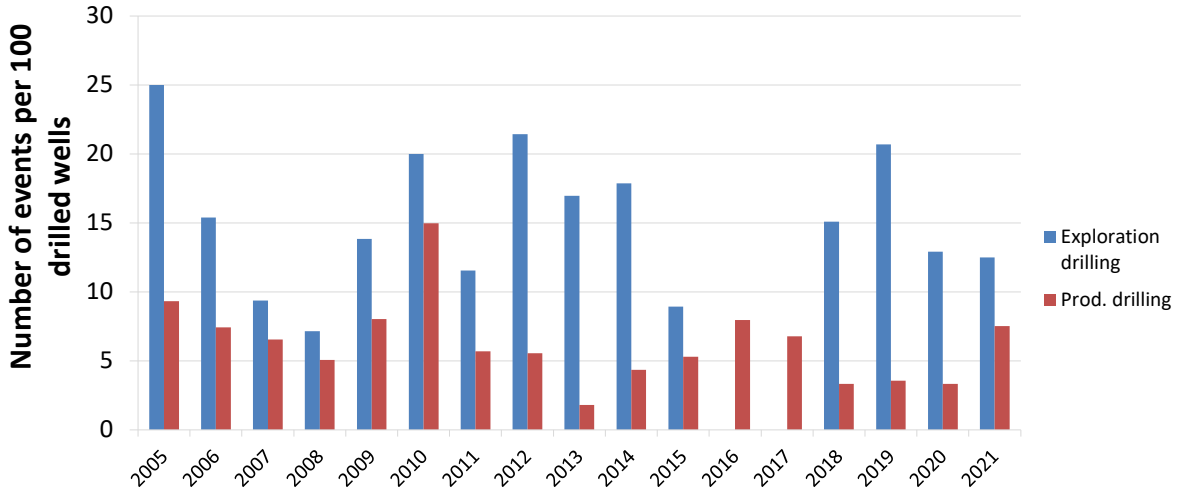

Figure 6-6 Well incidents per 100 wells drilled, for exploration and production drilling

Figure 6-7 shows the trend in weighted risk of loss of life normalised against working hours for exploration and production drilling combined. The figure shows that in 2017-2022 there was a relatively low risk associated with well control incidents on the NCS. The peaks we see in the figure are often associated with serious individual incidents that are weighted very highly compared to other incidents.

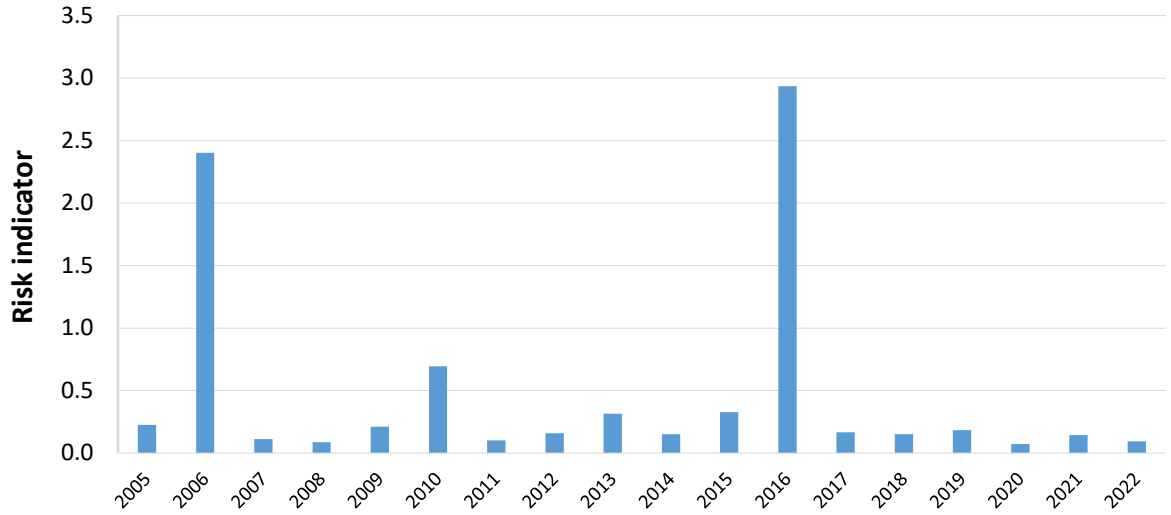

Figure 6-7 Risk indicators for well-control incidents in exploration and production drilling, 2005-2022

Offshore Norge (the Norwegian Oil and Gas Association) has continued the work on well integrity issues through the Well Integrity Forum (WIF), a working group of the Drilling Managers Forum. This is a joint project for the operators on the NCS with operational production wells.

Offshore Norge Recommended Guidelines 117 for well integrity also discuss recommendations covering training, documents for transferring wells between different departments in the companies, including well barrier drawings and criteria for categorising wells.

Table 6.1 shows the criteria for categorising wells with respect to well integrity in accordance with Guidelines 117.

Table 6.1 Criteria for categorisation of wells with respect to well integrity

Category	Principle
Red	Failure of one barrier and the secondary is degraded/uncontrolled, or leak to the surface.
Orange	Failure of one barrier and the secondary is intact, or single failure that may cause leak at the surface.
Yellow	One barrier degraded, the secondary intact.
Green	Well undamaged – no or minimal non-conformity.

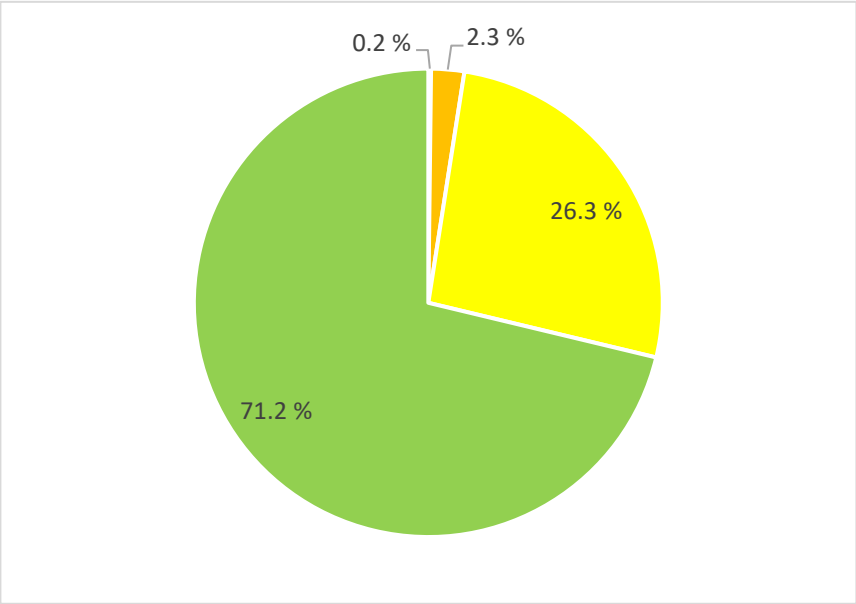

Figure 6-8 Well categories

The mapping in Figure 6-8 shows an overview of well categorisation by percentage share of a total of 2,146 wells.

The categorisation shows that around 29% of the wells included in the mapping have degrees of weakness of integrity. Wells in the red and orange categories have reduced quality in respect of the two-barrier requirement. Four wells (0.2%) were recorded in the red category and 49 wells (2.3%) in the orange category. There are three temporarily plugged wells and one production well included in the red category. In the orange category, all types of well are found . Wells in the yellow category have reduced quality in respect of the requirement for two barriers, but the companies have compensated for this through various measures such that they are deemed to comply with the two-barrier requirement. There are 564 wells (26.3%) in the yellow category.

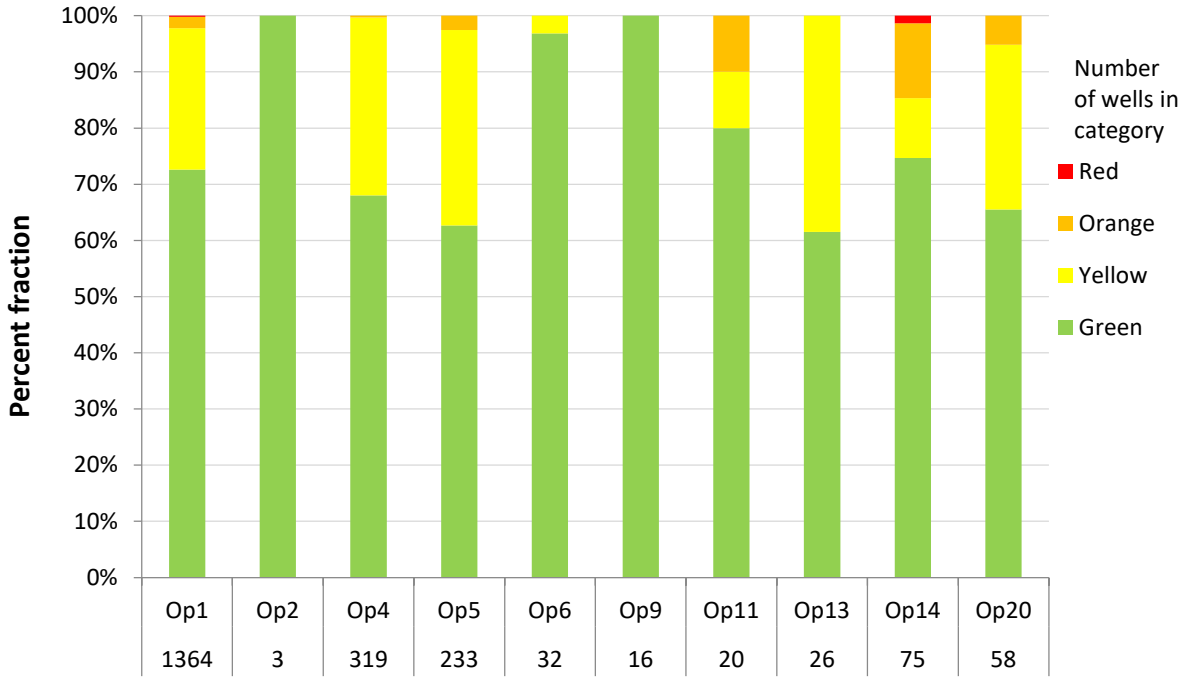

Figure 6-9 Well categorisation, by operator, 2022[1]

Figure 6-9 shows the 10 operators and wells in the integrity categories red, orange, yellow and green. There are two operators with wells in the red category (operator 1 and operator 14). Six out of ten operators have more than 70% of their wells in the green category. Two of them report all their wells in the green category.

6.2.3 Leak/damage to risers, pipelines and subsea facilities

In 2022, no serious leaks from risers were reported. Nor were any serious leaks from pipelines within the safety zones of surface facilities reported in 2022. Four minor hydrocarbon leaks were reported outside the safety zone.

As in previous years, there are still some leaks of chemicals such as hydraulic/barrier/control fluid and the like. Five such leaks have been reported.

[1] The number of wells included for each operator is stated under Op1, Op2, etc.

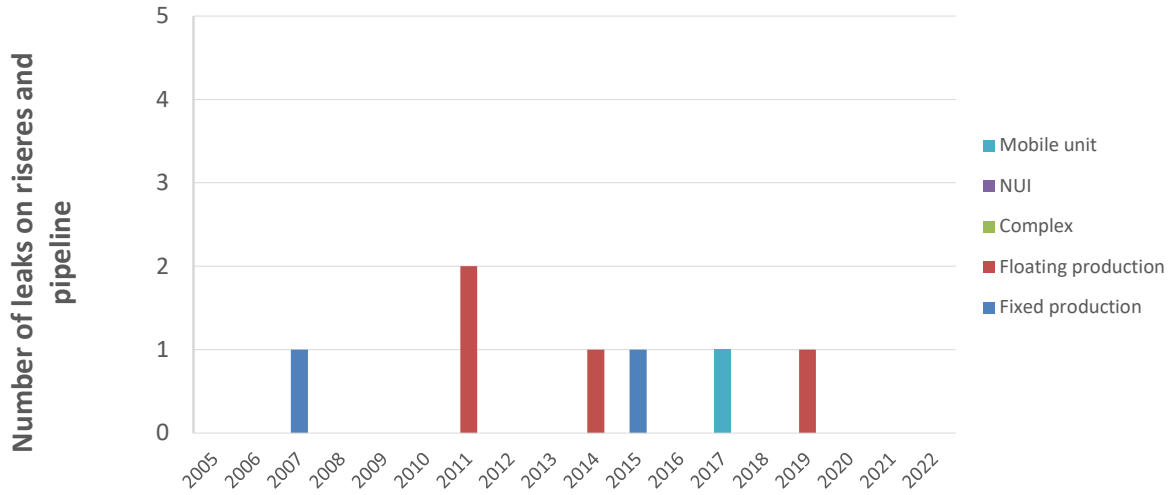

Figure 6-10 Number of leaks from risers & pipelines within the safety zone, 2005-2022

In 2022, two instances of serious damage to flexible risers were reported. Flexible risers have been and remain an important contributor to risk. We have followed up this topic over a number of years and in 2021 it was the subject of several of our supervisory activities, which led to certain updates to previous years. Figure 6-11 shows the number of incidents of serious damage to risers and pipelines in the period 2005-2022. Updated information has emerged from several previous years, which means that the figure is not comparable with figures in previous reports.

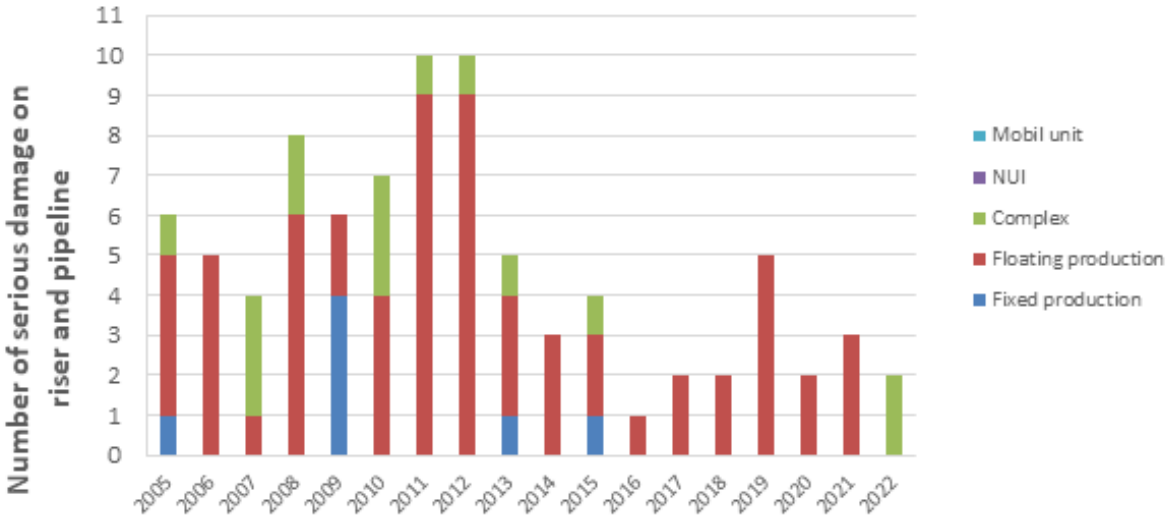

Figure 6-11 Number of major damage incidents to risers & pipelines within the safety zone, 2005-2022

6.2.4 Ships on collision course, structural damage

Since 2010, only a handful of production facilities have not been monitored from a traffic centre, and a few more mobile units. Some changes have therefore been made in relation to normalisation (previously monitoring days and now installation year) and weighting for DSHA 5. For more details, see the methodology report (PSA, 2023c).

The number of instances of ships on collision courses has declined substantially in recent years. In 2022, a total of two ships on collision courses were recorded.

As regards collisions between vessels associated with the petroleum activities and facilities on the NCS, there was an elevated level in 1999 and 2000 (15 incidents each year). Equinor in particular has worked hard to reduce such incidents, and in recent years, the number has been around zero to three per year; there was one collision in 2022.

Major accidents associated with structures and maritime systems are rare. Even though there have been several very serious incidents in Norway, there are too few to gauge trends. Accordingly, incidents and damage of lesser severity have been selected as measures of changes in risk. It is also assumed that there is a connection between the number of minor incidents and the most serious; see the methodology report.

The current regulations set requirements for flotels and production facilities in terms of withstanding the loss of two anchor lines without serious consequences. Loss of more than one anchor line happens from time to time. Mobile drilling facilities are required to withstand the loss of one anchor line without undesirable consequences.

Structural damage and incidents that have been included in RNNP are primarily classified as fatigue damage, and some are storm damage. As regards cracks, only continuous structural cracks are included. No clear correlation has been established between the age of the facility and the number of cracks. Figure 6-12 shows the number of reported incidents and damage events to structures and maritime systems which conform to the criteria for DSHA 8 from 2005-2022. In total, six incidents are included for 2022. This is 3 more than in 2021.

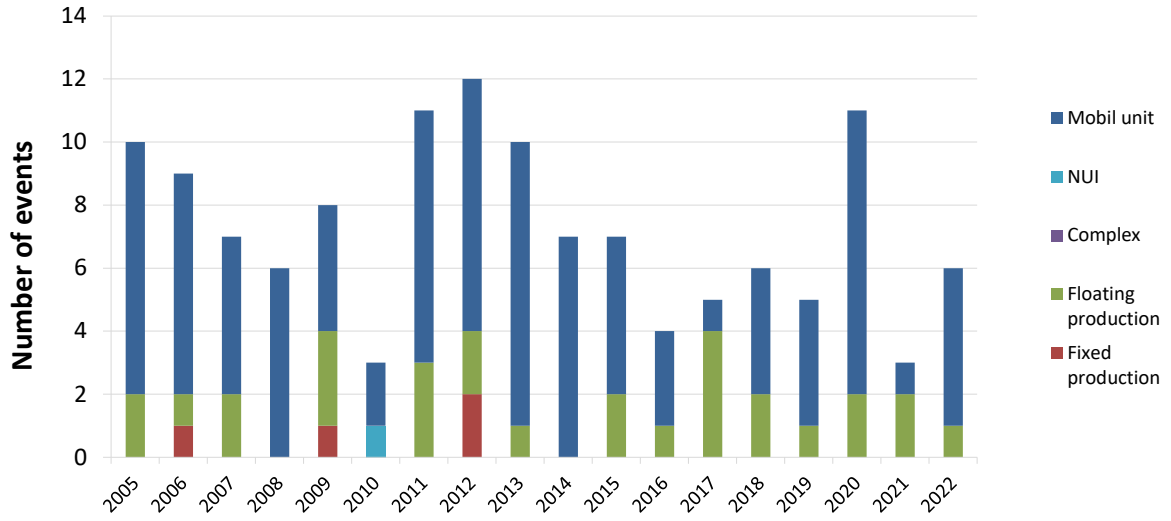

Figure 6-12 Number of reported incidents and damage events to structures and maritime systems which conform to the criteria for DSHA 8

6.3 Total indicator for major accidents

The total indicator is a calculated indicator based on incident frequency and the potential of the incidents to cause loss of life if they develop into serious incidents. It is emphasised that this indicator is only a supplement to the individual indicators, and expresses the development in risk factors related to major accidents. In other words, the indicator expresses the effects of risk management.

The total indicator weights the contributions from the observations of the individual near-misses according to the potential for loss of life, and will therefore vary considerably, based on the potential of the individual incidents. The weightings were changed in 2020 to better reflect current knowledge. For more details, see the methodology report (PSA, 2023c). The weightings are still fixed for different types of incidents and facility types. The largest incidents are assessed individually, in order to determine a realistic weighting based on

the relevant conditions at the facility and the incident. In 2022, there were no especially serious incidents.

There are large annual variations in this indicator, mainly caused by especially serious incidents. The large variations are reduced when viewing the three-year rolling average, which clarifies the long-term trend. Working hours are used for normalising against activity level. The level of the normalised value was set at 100 in the year 2005, which also applies to the value for the three-year rolling average.

Figure 6-13 shows the total indicator for production and mobile facilities. It is apparent that the value in 2022 is similar to that in 2021. The underlying trend, illustrated using a 3-year rolling average, shows a positive trend over time with a levelling off in recent years.

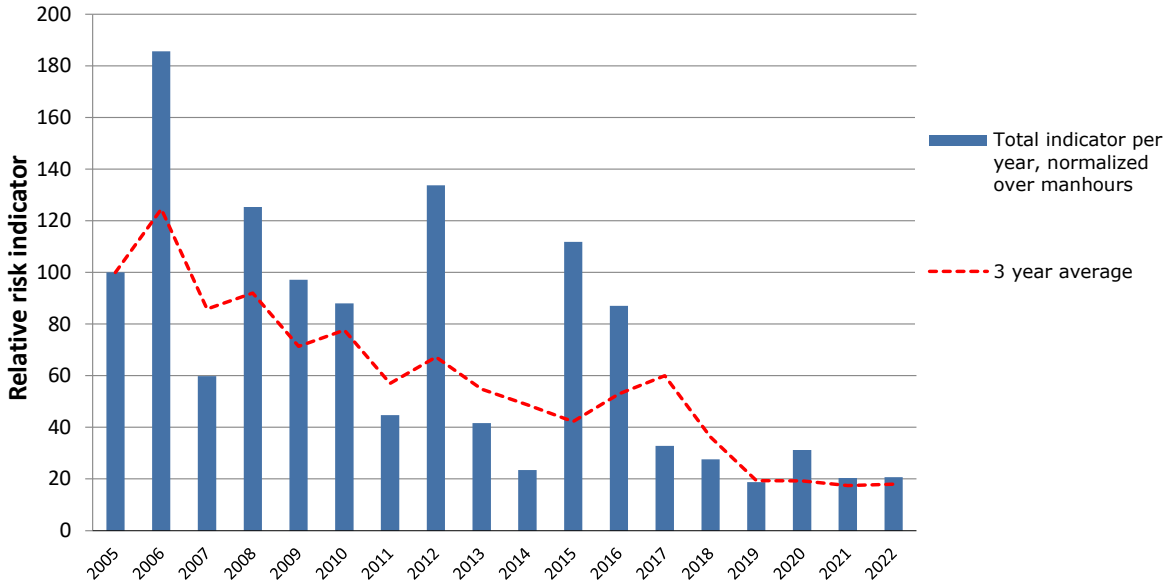

Figure 6-13 Total indicator for major accidents per year, normalised against working hours (Reference value is 100 in the year 2005, both for total indicator and three-year rolling)

The trend can be interpreted to mean that, in the period, the participants have achieved better management of factors that affect major accident risk. This can also be taken as an indication that factors that affect future risk must be kept in sharp focus and under active and continuous management.

Figure 6-14 and Figure 6-15 show the total indicator for production facilities and mobile facilities respectively.

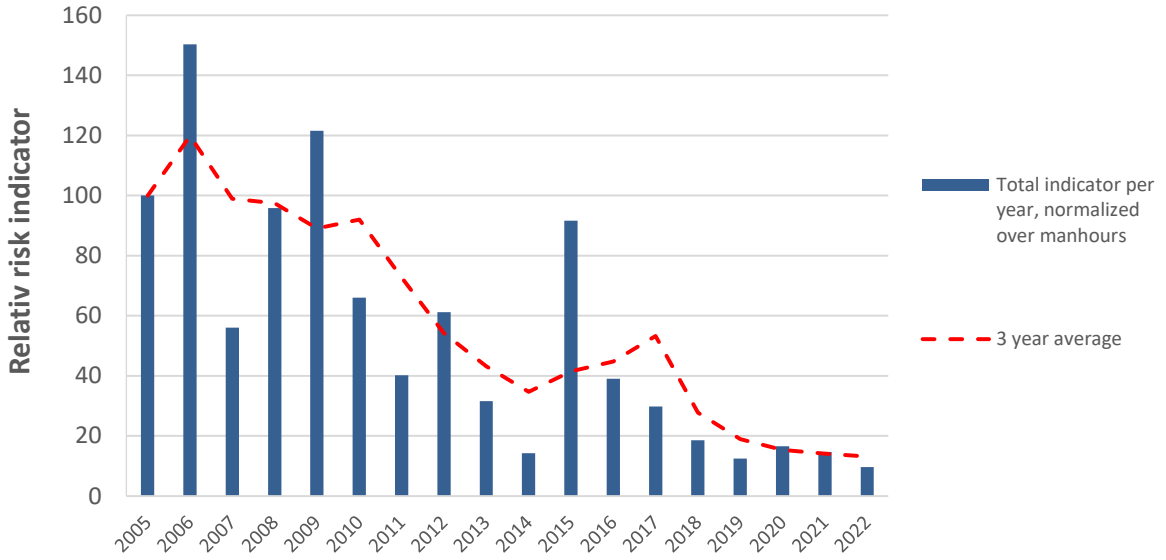

Figure 6-14 Total indicator, major accidents, production facilities, normalised against working hours, compared to three-year rolling average (Reference value is 100 in the year 2005, both for total indicator and three-year rolling)

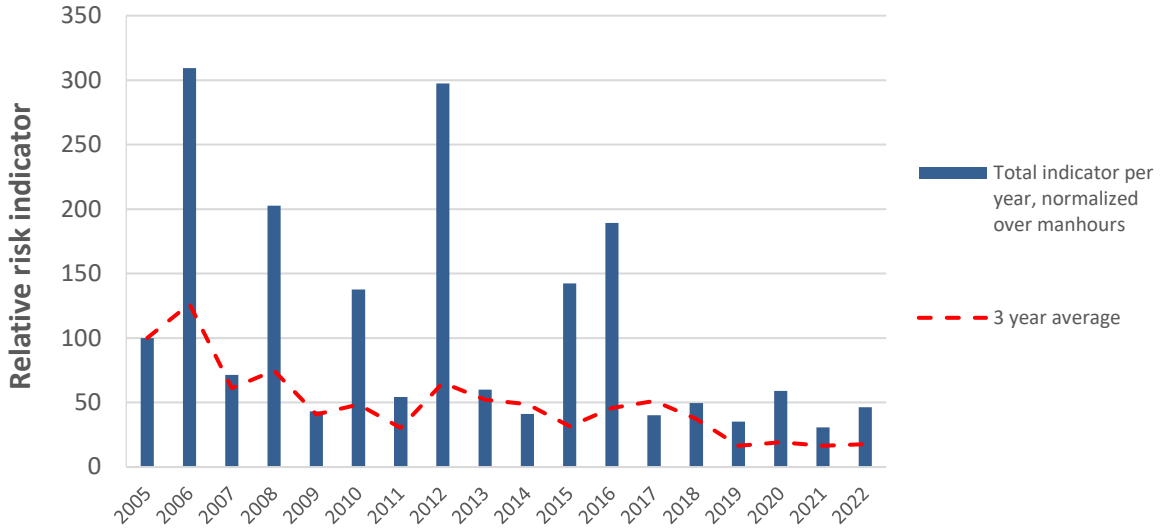

Figure 6-15 Total indicator, major accidents, mobile facilities, normalised against working hours, compared to three-year rolling average (Reference value is 100 in the year 2005, both for total indicator and three-year rolling)

7. Status and trends – barriers against major accidents

Reporting and analysis of data concerning barriers has been continued from preceding years without significant adjustments. As previously, the companies report test data from routine periodic testing of selected barrier elements.

7.1 Barriers in the production and process facilities

There is primary emphasis on barriers relating to leaks from the production and process facilities, including the following barrier functions:

- Integrity of hydrocarbon production and process facilities (covered to a considerable degree by the DSHAs)
- Prevent ignition
- Reduce clouds/emissions
- Prevent escalation
- Prevent any fatalities

The different barriers consist of several interacting barrier elements. For example, a leak must be detected before isolation of ignition sources and emergency shutdown (ESD) is implemented.

Figure 7-1 shows the proportion of failures for selected barrier elements associated with production and processing. The test data are based on reports from all production operators on the NCS. In addition, the associated industry norm for each barrier element is shown. Mean percentage failures for 2021 are above the industry norms for riser ESDV closure test and leak test, DHSV and BDV.

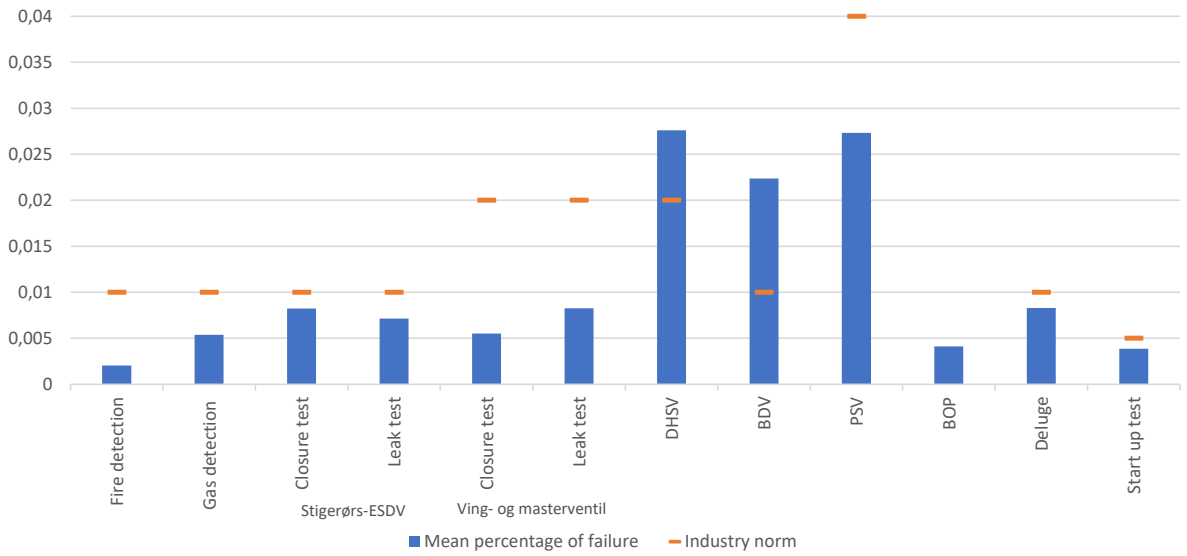

Figure 7-1 Mean percentage of failures for selected barrier elements in 2022

The main report shows both the "mean percentage of failures", i.e. the percentage of failures for each facility individually, averaged for all facilities, and the "overall percentage of failures", i.e. the sum of all failures on all reporting facilities, divided by the sum of all tests for all reporting facilities. All facilities make the same contribution to the mean percentage of failures, regardless of how many tests they have.

The data show considerable variations in average levels for each of the operating companies, and for several of the barrier elements. The variations are even greater when looking at each individual facility, as has been done for all barrier elements in the main report. Figure 7-2 shows an example of such a comparison for gas detection (all types of gas detectors). Each individual facility is assigned a letter code, and the figure shows the percentage of failures in 2021, the average percentage of failures during the period 2005-

2021, as well as the total number of tests carried out in 2021 (as text on the X axis, along with the facility code).

The industry norm for gas detection is 0.01. Figure 7-2 shows that 13 facilities are above the norm for percentage failures in 2022, while 12 are above the norm in relation to the average for the period 2005-2022.

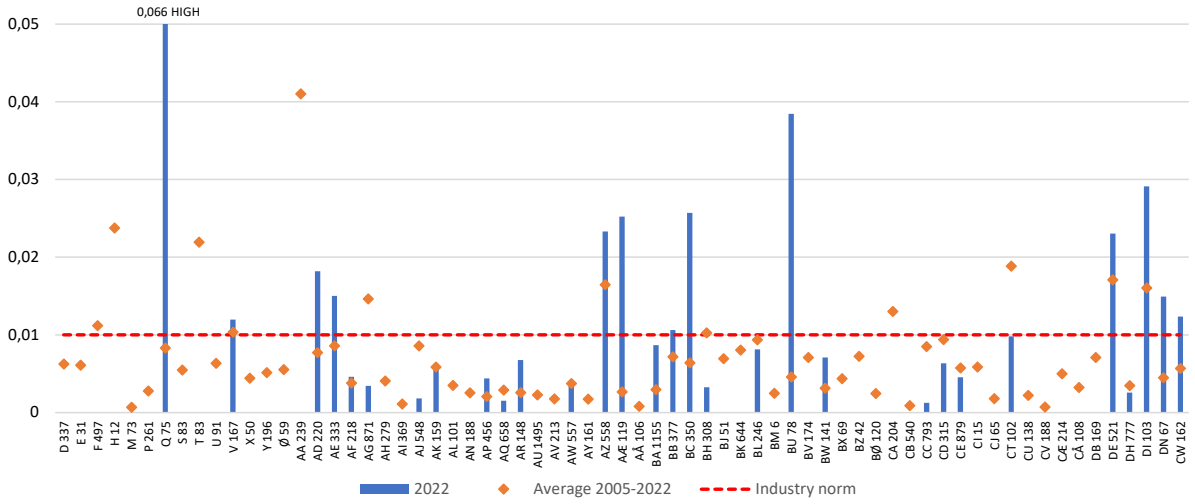

Figure 7-2 Percentage of gas detection failures

For production facilities, barrier data have now been collected for 20 years for most of the barriers, and the results show that there are large differences in level between the facilities. Figure 7-3 and Figure 7-4 compare the mean proportions of failures in three-year rolling averages from 2011 to 2022.

Figure 7-3 shows that fire detection, gas detection and start tests of fire pumps are consistently low and below the respective industry norms for mean proportions of failures in three-year rolling averages. Riser ESDV closure tests show a fall from the start of the period up to 2015, but a rising trend from 2015 to 2021 before reducing in 2022. Riser ESDV leak tests have the same trend, with declines up to 2018 and then a sharp increase every year until 2021 before falling off again in 2022. All years are well above the industry norm of 0.01 for both riser ESDV closure and leak tests. BDV shows a downward trend from 2012 to 2015, but is stable around 0.02, which is well above the industry norm of 0.01. Deluge fluctuates around the industry norm of 0.01. It was above the industry norm in the period 2013-2015, below it in the period 2016-2018, and above it in the period 2019-2021. In 2022, deluge is again within the industry norm of 0.01.

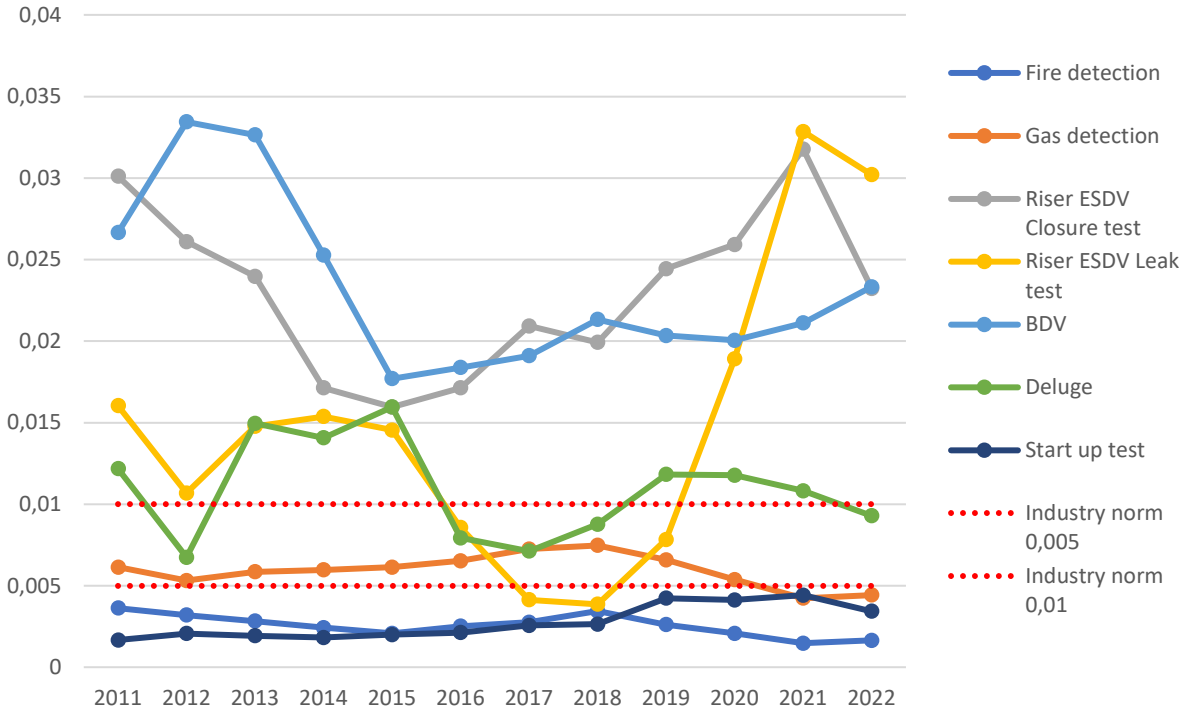

Figure 7-3 Mean percentage failures as a three-year rolling average

Figure 7-4 shows that DHSV has a rising trend from 2012 to 2017 and then a weakly declining trend up to 2022 for mean percentage failures on a three-year rolling average. DHSV has been above the industry norm of 0.02 since 2013. Other barriers remain stably below applicable industry norms. The wing and master valve closure test has had a relatively flat trend throughout the period 2011-2022. The wing and master valve leak test had an upward trend in the period 2012-2019, but has shown a downward trend in the period 2020-2022. PSV has a relatively flat trend in the period 2011-2019. From 2020 to 2022, PSV has an upward trend, but is still well below the industry norm of 0.04.

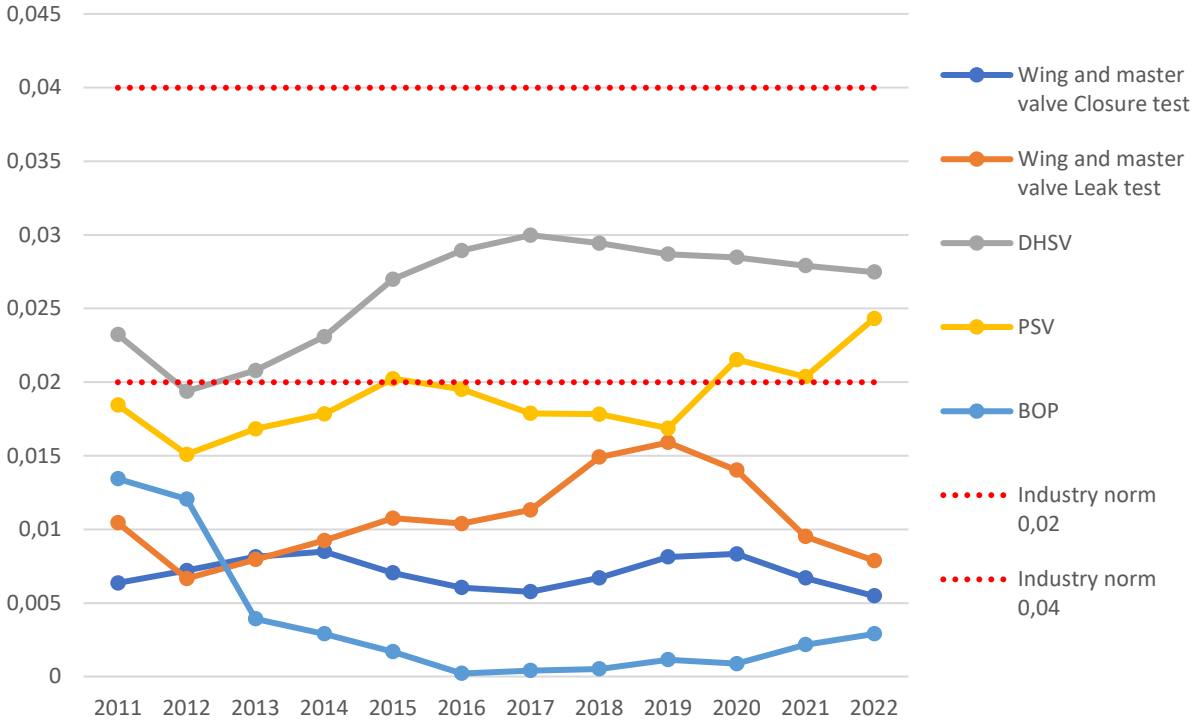

Figure 7-4 Mean percentage failures as a three-year rolling average

Table 7.1 shows how many facilities have carried out tests for each barrier element, the average number of tests for those facilities that have carried out tests, the number of facilities that have a proportion of failures above the industry norm in 2022, and the average for the period 2005-2022 above the industry norm. Mean percentage failures for 2022 and for the period 2005-2022 are also included. These can then be compared to the industry's availability requirements for safety-critical systems. Figures in bold indicate that the percentage of failures exceeds the industry norm.

Table 7.1 General calculations and comparison with industry norms for barrier elements

Barrier elements	*Facilities conducting tests in 2022*	*Average no of tests for facilities testing in 2022*	*Facilities with failures above industry norm in 2022 (average 2005-2022 in brackets)*[2]*	*Mean percentage failures in 2022*	*Mean percentage fa 2005-2022*	*Industry norm for availability*
Fire detection	80	407	3 (6)	0.002	0.003	0.010
Gas detection	80	243	13 (20)	0.005	0.007	0.010
Shutdown:						
· Riser ESDV	72	22	9(7)	**0.020**	**0.020**	0.010
Closure test	72	15	4 (4)	**0.008**	**0.021**	0.010
Leak test	71	7	5 (5)	**0.007**	**0.017**	0.010
· Wing and master valve	85	204	10(25)	0.007	0.007	0.020
Closure test	84	95	8 (14)	0.005	0.007	0.020
Leak test	85	109	8 (10)	0.008	0.011	0.020
· DHSV	84	77	24 (24)	**0.030**	**0.025**	0.020
BDV	76	53	26 (18)	**0.020**	**0.021**	0.010
PSV	76	62	21 (26)	0.030	0.023	0.040
Isolation with BOP	22	114	3(3)	0.004	0.011	-
Active fire protection:						
· Deluge valve	79	23	11 (10)	0.008	**0.011**	0.010
· Start up test	68	74	13 (13)	0.004	0.003	0.005

7.2 Barriers associated with maritime systems

In 2022, data were collected for the following maritime barriers on mobile facilities:

- Watertight doors
- Valves in the ballast system
- Deck height (air gap) for jack-up facilities
- GM and KG margin values for floaters. The KG margin values have been collected as of 2015.

Data collection was carried out for both production and mobile facilities. There are considerable variations in the number of tests per facility, from daily tests to twice per year.

7.3 Maintenance management

Defective or deficient maintenance has often proved to be a contributory cause of major accidents. The major accident potential means that safety work in general and the maintenance of safety-critical equipment in particular have been given a strong emphasis in the petroleum industry.

One aim of such maintenance management is to identify critical functions, and ensure that safety-critical barriers work when required.

The individual participant is responsible for regulatory compliance and ensuring systematic HSE efforts, so as to reduce the risk of unwanted incidents and major accidents.

[2] For *closure tests* and *leak tests* for riser ESDVs and wing and master valves, the average is from 2007, for PSVs and BDVs, the average is from 2005.

7.3.1 The management of maintenance of fixed facilities

The main report shows more graphs of participants' maintenance management figures than are reproduced here.

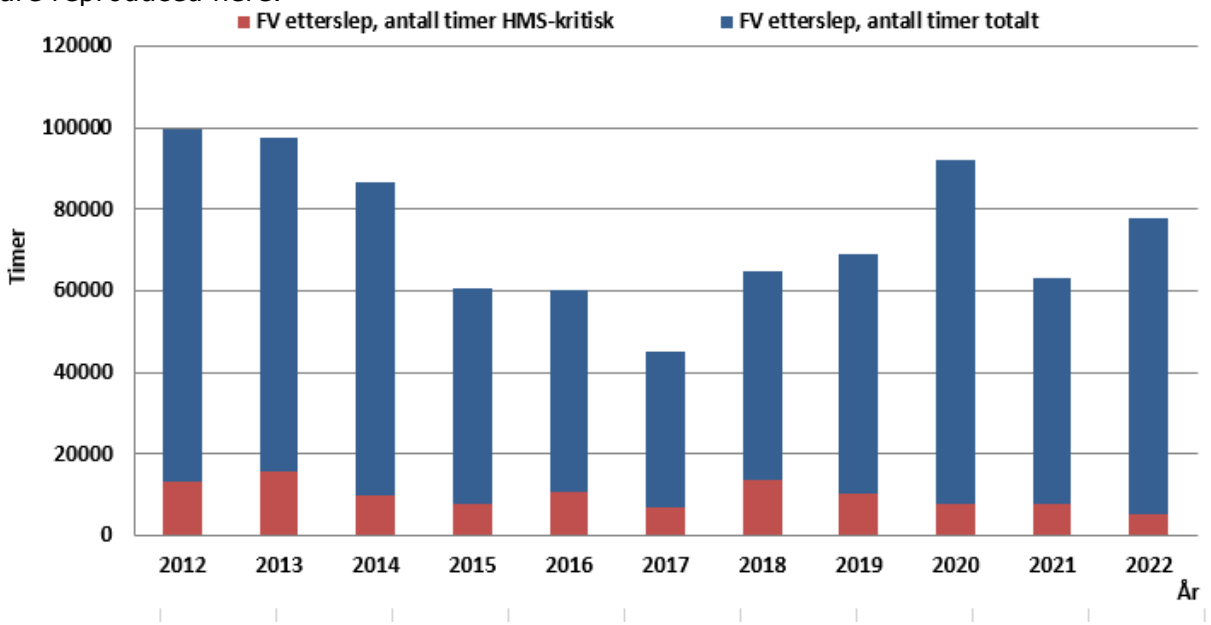

Figure 7-5 Total backlog in PM per year in the period 2012-2022 for the fixed facilities

Figure 7-5 shows the *total backlog in preventive maintenance* in the period 2012-2021 (sum of monthly averages). The backlog in HSE-critical preventive maintenance has fallen somewhat in recent years.

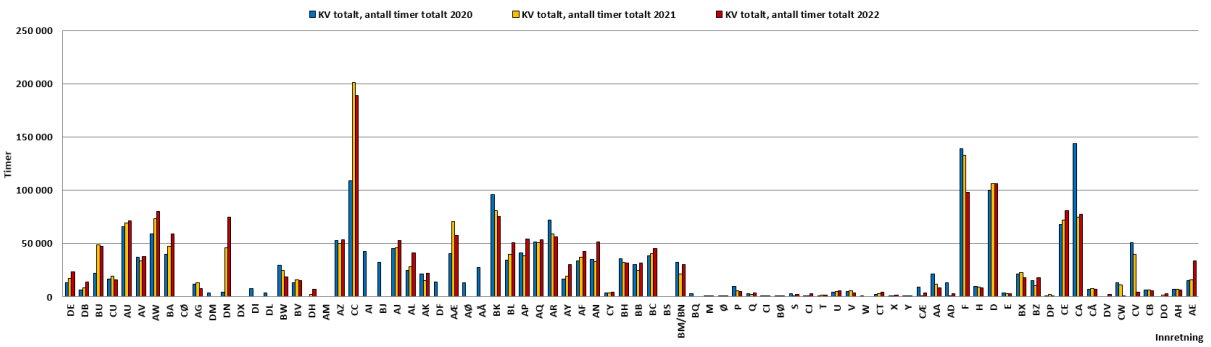

Figure 7-6 Total CM at 31.12.2022 for the fixed facilities. Two facilities have not provided data. The figure also shows data for 2020 and 2021

Figure 7-6 shows that some facilities have a high total number of hours of corrective maintenance not performed as at 31.12.2022. Some facilities have increased the number of hours, but most facilities have stable figures.

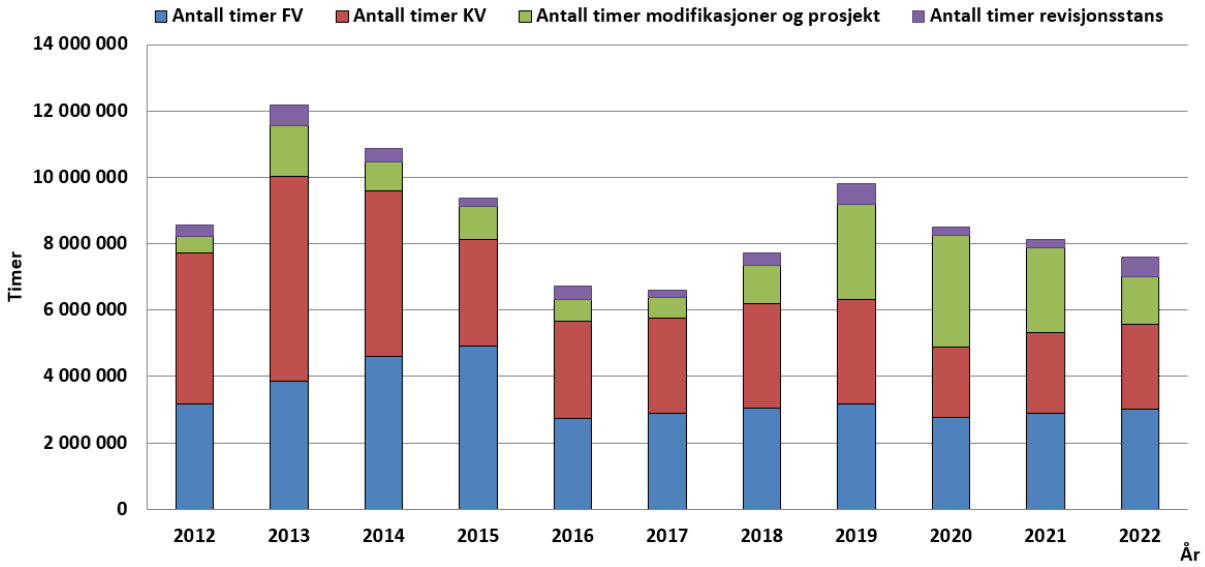

Figure 7-7 Total number of hours for performed maintenance, modifications and planned shutdowns for the fixed facilities in the period 2012-2022

Figure 7-7 shows the total number of hours for *performed maintenance, modifications and planned shutdowns* for the fixed facilities in the period 2012-2022. Figure 7-7 is especially intended to show the *distribution* of the activities. It is apparent that the hours worked for the activities as a whole have decreased somewhat in 2022 compared to the previous year, but that the number of hours for modifications and projects has fallen compared to recent years.

We note that:

- some of the facilities have not classified some of the tagged equipment
- there are large variations in the proportion of HSE-critical equipment, with some facilities having a low proportion of such equipment. The participants use virtually the same classification method
- there are few hours of backlog in preventive maintenance, but a number of facilities have not performed HSE-critical preventive maintenance in accordance with their own deadlines
- the total backlog in preventive maintenance in 2022 is higher than that reported in 2021. The backlog in HSE-critical preventive maintenance has fallen in recent years
- some facilities have a high total number of hours of corrective maintenance not performed at 31.12.2022. Some facilities have increased the number of hours, but most facilities have stable figures
- one participant has seen a significant increase in the number of hours of corrective maintenance that have been identified, but not performed, in recent years
- there is overall a considerable number of hours of corrective maintenance not performed as at 31.12.2022. The extent in 2022 is at the same level as in 2020 and 2021
- there was a considerable fall in the number of hours of total outstanding corrective maintenance in 2022 compared with recent years. The total outstanding HSE-critical corrective maintenance also shows a decline in 2022 and is the lowest reported since 2016
- the hours for preventive and corrective maintenance carried out in 2022 are approximately the same as the year before, but that the number of hours for modifications and projects has decreased somewhat compared to recent years
- there is a large variation in the percentage distribution by participant of performed preventive and corrective maintenance
- some operators have a significant number of hours of corrective maintenance not performed on 31.12 of the last three years compared to the corrective maintenance performed in the same period

These observations must be seen in the context of the regulatory requirements, notably that

- plant, systems and equipment must be tagged and classified so as to facilitate safe operation and prudent maintenance, including maintaining the performance of the barriers
- the activity level on the facility must take account of the status of maintenance performance. Status in this context includes the backlog of preventive maintenance and the outstanding corrective maintenance
- the significance of unperformed maintenance must be assessed both individually and in combination. The assessment is crucial for determining the extent to which unperformed maintenance entails increased risk
- backlogs in the HSE-critical preventive maintenance may contribute to increased uncertainty with regard to technical condition, and hence increased risk
- corrective maintenance of HSE-critical equipment should not exceed the defined deadlines, since the HSE-critical equipment is intended to inhibit or restrict the defined situations of hazard and accident

7.3.2 The management of maintenance of mobile facilities

Figure 7-8 provides an overview of tagged and classified equipment as of 31.12.2022. The figure shows that there is large variation in the degree of tagging and classification of the facilities' systems and equipment

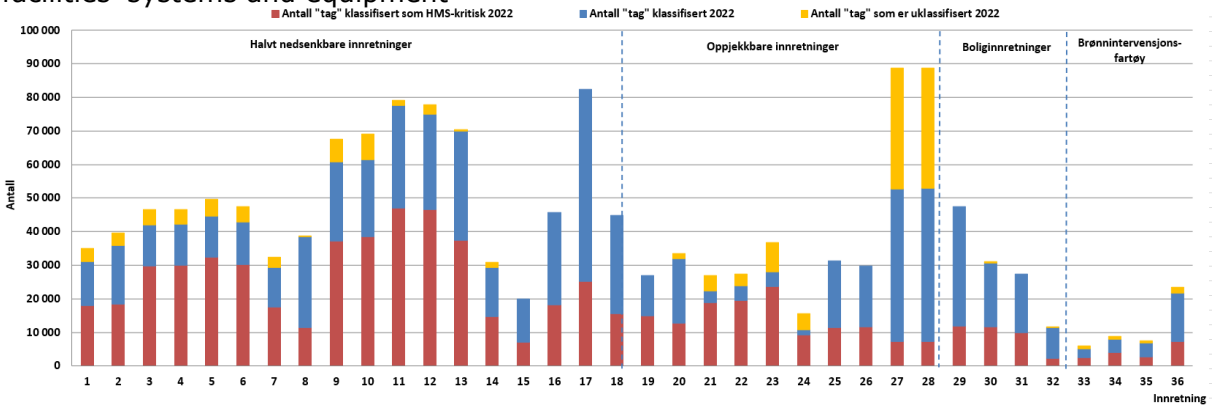

Figure 7-8 Tagged and classified equipment for mobile facilities at 31.12.2022.

Figure 7-9 shows the *backlog in preventive maintenance* in 2022.

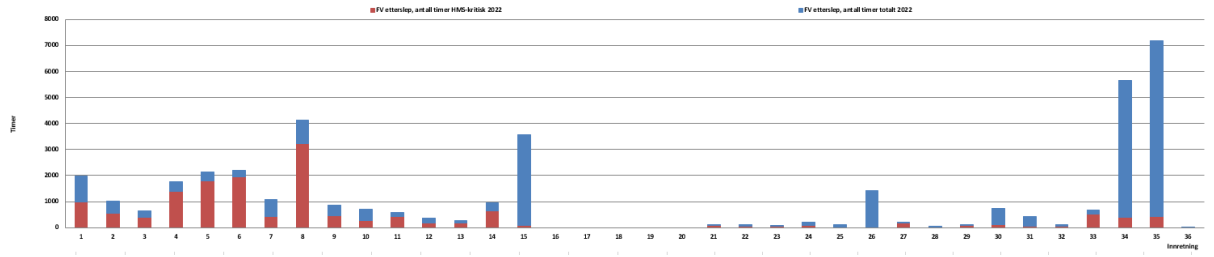

Figure 7-9 Backlog in PM for mobile facilities in 2022

There are variations in the backlog of preventive maintenance for mobile facilities. This corresponds to what we have seen in recent years. Several facilities have not performed HSE-critical preventive maintenance in accordance with defined deadlines. This may

contribute to increased uncertainty with regard to technical condition, and hence increased risk.

Maintenance is of great importance for maintaining critical functions and ensuring that HSE-critical equipment functions when required.

Figure 7-10 shows the *outstanding corrective maintenance* in 2022.

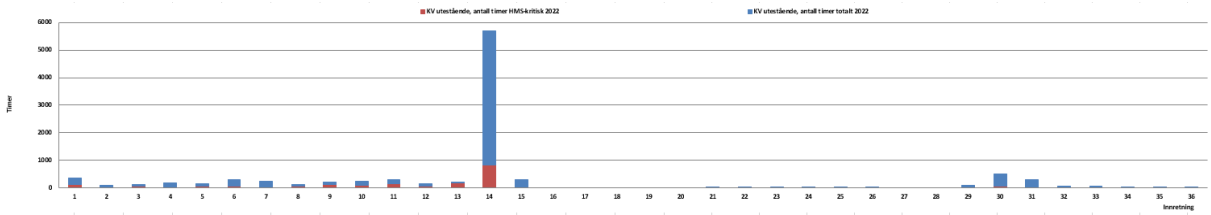

Figure 7-10 Outstanding CM for mobile facilities in 2022

There are variations in the outstanding corrective maintenance for mobile facilities. This corresponds to what we have seen in recent years. The hour total is however relatively low. Several facilities have not performed HSE-critical corrective maintenance in accordance with their own deadlines.

Maintenance of this type of equipment should not exceed the defined deadlines since HSE-critical equipment is intended to inhibit or restrict the defined situations of hazard and accident.

On several occasions, we have emphasised the importance of participants assessing the significance of outstanding corrective maintenance, both as individual items and collectively. The assessment is crucial for determining the extent to which outstanding maintenance entails increased risk.

We note that:

- there is large variation in the degree of tagging and classification of the facilities' systems and equipment
- newer facilities generally have a higher quantity of tagged and classified equipment than older ones
- there is a lot of variation in the proportion of HSE-critical equipment. Some facilities have a low proportion
- there are variations in the backlog of preventive maintenance for mobile facilities. This corresponds to what we have seen in recent years
- several facilities have not performed HSE-critical preventive maintenance in accordance with defined deadlines
- there are variations in the outstanding corrective maintenance for mobile facilities. This corresponds to what we have seen in recent years. The hour total is however relatively low
- several facilities have not performed HSE-critical corrective maintenance in accordance with their own deadlines
- there is a large variation in the percentage distribution by participant of performed preventive and corrective maintenance

These observations must be seen in the context of the regulatory requirements, notably that

- plant, systems and equipment must be tagged and classified so as to facilitate safe operation and prudent maintenance, including maintaining the performance of the barriers
- the activity level on the facility must take account of the status of maintenance performance. Status in this context includes the backlog of preventive maintenance and the outstanding corrective maintenance

- the significance of unperformed maintenance must be assessed both individually and in combination. The assessment is crucial for determining the extent to which unperformed maintenance entails increased risk
- backlogs in the HSE-critical preventive maintenance may contribute to increased uncertainty with regard to technical condition, and hence increased risk
- corrective maintenance of HSE-critical equipment should not exceed the defined deadlines, since the HSE-critical equipment is intended to inhibit or restrict the defined situations of hazard and accident

8. Work accidents involving fatalities and serious personal injuries

There were no fatalities within the Petroleum Safety Authority Norway's area of authority on the NCS in 2022. For 2022, the PSA registered 229 personal injuries on facilities in the petroleum activities on the NCS that fulfil the criteria of fatality, absence into the next shift or medical treatment. In 2021, 178 personal injuries were reported.

In addition, 19 injuries classified as off-work injuries and 15 first aid injuries were reported in 2022. For comparison, in 2021 there were 21 off-work injuries and 15 first aid injuries. First aid injuries and off-work injuries are not included in figures or tables.

In recent years, we have seen a reduction in the number of injuries reported on the NAV (Norwegian Labour and Welfare Administration) forms, and this trend continued in 2022. 36% of the injuries were not reported to us on NAV forms in 2022. These injuries are therefore recorded on the basis of information received in connection with the quality assurance of the data. The injuries not reported on NAV forms include five classified as serious. The injuries concern both contractors' and operators' employees.

There were 176 personal injuries on production facilities in 2022 against 142 in 2021. In the long term, there has been a positive trend in the injury rate since 2012 when the overall rate was 7.5 injuries per million working hours. In 2022, there were 5.6 injuries per million working hours. This is an increase in the injury level from 2021, which was the year in the period with the lowest injury level. The rise was of 0.7 injuries per million working hours. This increase is not significant.

In 2022, there were 53 personal injuries on mobile facilities, compared with 36 in 2021. In 2021, we recorded the lowest level of injury in the entire period. The total injury rate rose from 2.5 in 2021 to 4.2 injuries per million working hours in 2022. In the long term, mobile facilities, like production facilities, have seen a positive trend. The injury rate has fallen from 6.8 in 2012 to 4.2 in 2022.

8.1.1 Serious personal injuries

Serious personal injuries are defined in the guidelines to the Management Regulations Section 31, which definition is used as the basis for classifying serious personal injuries.

Figure 8-1 shows the rate of serious personal injuries on production facilities and mobile facilities combined. In 2022, a total of 21 serious personal injuries were reported, against 27 in 2021.

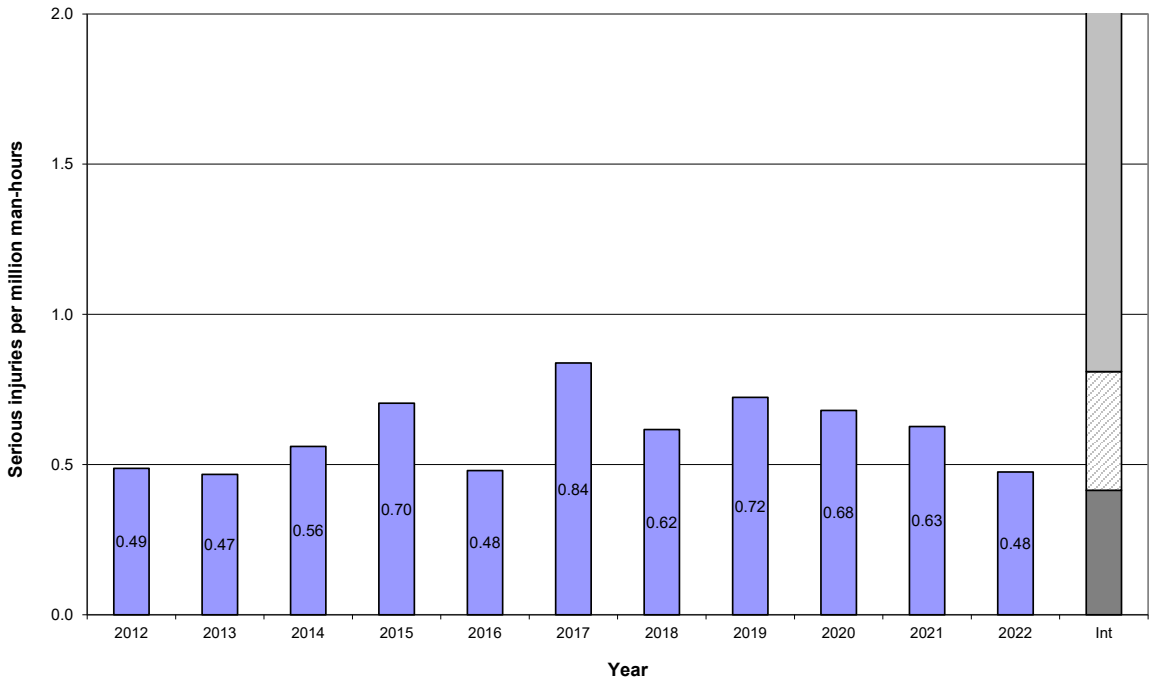

Figure 8-1 Serious personal injuries per million working hours – NCS

In the first part of the 11-year period, there was a upward trend in the personal injury rate on the NCS. From 2015, the trend was more varied, with the rate of serious injuries per million working hours varying from 0.5 in 2016 to 0.8 in 2017. In the latter part of the period, from 2019 to 2022, we see a downward trend. In 2022, the rate of serious personal injuries per million working hours is 0.5, and is within the expectation range based on the ten preceding years.

The activity level on the NCS last year rose by 1.1 million from 43.07 to 44.14 million working hours.

8.1.2 Serious personal injuries on production facilities

Figure 8-2 shows the rate of serious personal injuries on production facilities per million working hours.

With the exception of 2015, the injury level in the first part of the 11-year period was lower than in the latter part of the period. From 2018 to 2020 we see a slight increase, but from 2021 the trend reverses and in 2022 the frequency is at approximately the same level as in the first part of the period. The rate of serious personal injuries per million working hours fell from 0.7 in 2021 to 0.4 in 2022. The rate in 2022 is within the expected level based on the ten preceding years.

On production facilities, there were 14 serious injuries in 2022 compared with 19 in 2021. The number of working hours increased by 2.7 million in 2022, from 28.9 million in 2021 to 31.6 million in 2022.

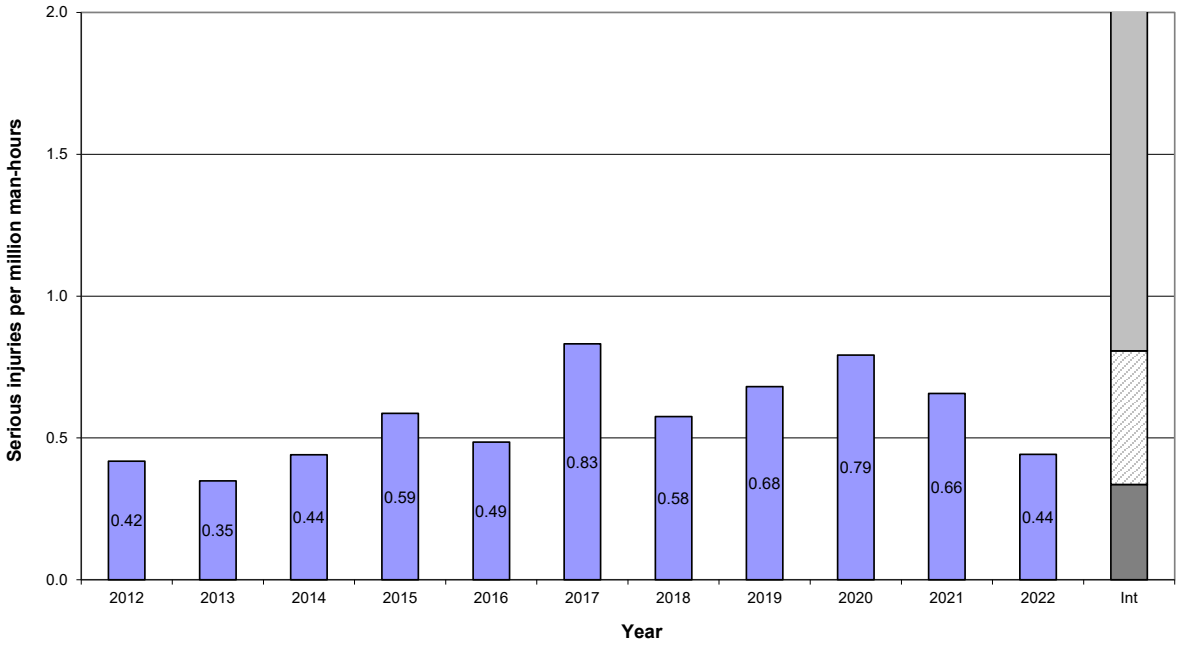

Figure 8-2 Serious personal injuries on production facilities per million working hours

8.1.1 Serious personal injuries on mobile facilities

Figure 8-3 shows the rate of serious personal injuries per million working hours on mobile facilities.

We see a levelling off of the frequency level in 2021 and 2022, where, in both years, the injury level is 0.6 serious personal injuries per million hours worked. The injury rate is therefore within the range of expected values based on the preceding ten years. In the period 2012 to 2021, the years 2016 and 2020 are distinctly positive; otherwise the level at the end of the period has varied.

The number of hours reported for the mobile facilities in 2022 is 12.5 million. We see a significant reduction of 1.6 million relative to 2020 when we recorded 14.1 million hours (-11.6%). The number of serious injuries is seven in 2022 compared with eight in 2021.

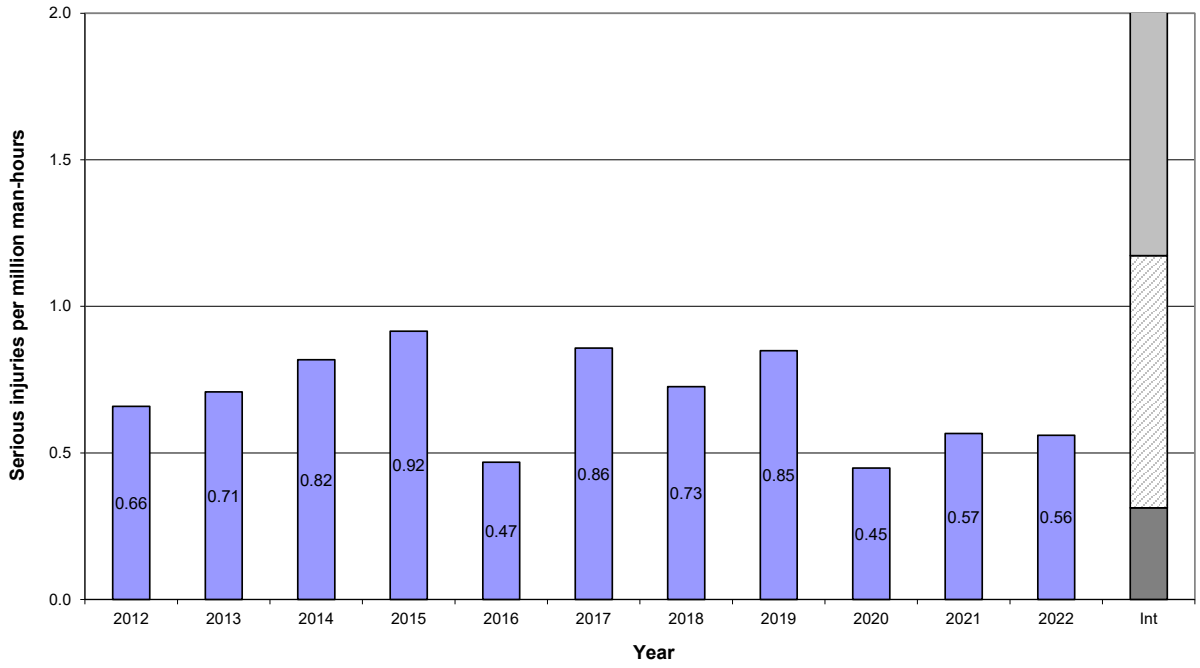

Figure 8-3 Serious personal injuries per million working hours, mobile facilities

9. Qualitative study – causes of and measures related to well-control incidents in the Norwegian petroleum industry

Well-control incidents are included in the assessment of the major accident potential on the NCS. This study is a continuation of a similar study conducted under RNNP 2011, which was based on a negative trend in the number of reported well-control incidents in 2010. Results and main challenges have subsequently been communicated to the industry and followed up through various types of activities by the PSA. Despite these efforts, however, the desired reduction in the risk contribution from well-control incidents on the NCS has not been achieved. The purpose of this study was therefore to analyse and gain a better insight into causal factors and possible measures related to well-control incidents on the NCS after 2011.

The greatest challenge in drilling and well operations is loss of well control, which can ultimately lead to a blowout of hydrocarbons. Planning and execution of drilling and well operations include the following areas: i) Prevention of well-control incidents, ii) Intervention in/management of well-control incidents and iii) Response to well-control incidents in the event of escalation and/or spills. This study focuses on the first two areas and is based on the following data:

- Interview with 58 people with roles linked to well-control risk
- Review of 113 audit reports and 38 investigations related to well control
- Review of other in-depth studies and documents following well-control incidents, including 121 well-control incidents from Offshore Norway's database and 172 well-control incidents internationally with associated causal analyses from IOGP's database
- Reports following investigation of the Deepwater Horizon accident
- Results from the last RNNP questionnaire survey

The main results identify a number of factors that may have resulted in changes and a higher degree of complexity in the drilling processes: e.g. more complex wellbores, challenging subsurface conditions, more advanced well targets, organisational and technological changes, etc. Such factors are discussed in the report and form the basis for the following four main challenges and improvement areas:

1) The need for better well-control competence and improvements in well-control training; more closely linked to conditions on the NCS,
2) the need for better processes for learning and experience transfer after incidents
3) the need to further develop processes to manage overall risk associated with drilling and well operations, particularly for handling uncertainty in pore pressure and knowledge of subsurface conditions during drilling, and
4) the need for more attention to change management, especially in connection with reorganisation.

The PSA will communicate the results and challenges from the study and follow up how the industry is establishing measures to satisfactorily meet the challenges. The results will also be seen in the context of the PSA's focus on investigation and learning following serious incidents.

10. Other indicators

10.1 DSHA 20 Crane and lifting operations

DSHA 20 crane and lifting operations includes incidents involving lifting equipment and its use which led to, or could have led to, personal injury or harm to equipment or the environment. It includes incidents both involving and not involving dropped objects. DSHA 20 was created and presented for the first time in the 2015 report. The time series now consists of data for the period 2013-2022. The analysis looks at both the ten years combined and a comparison between the years, as appropriate.

The most important findings, which are also shown in the figures below, are:

Fixed facilities

- The absolute number of reported incidents for fixed facilities in 2022 is at roughly the same level as in 2021. Normalised against working hours, there was a small fall, after the period 2018-2021 had shown a slightly upward trend (see Figure 10-1).
- There is an increase in the number of personal injuries for fixed facilities in 2022 compared with 2021 (see Figure 10-2).
- In 2022, there is an increase from 2021 in incidents related to lifting by offshore cranes (both absolute and normalised). The number of incidents related to lifting in the drilling module and other lifting activities has decreased somewhat since 2021. See Figure 10-3, Figure 10-4, Figure 10-6 and Figure 10-7.
- Looking at incidents without personal injury, but with the potential for injury, in 2022 there was a significant increase in the number of incidents with one person exposed, compared to 2021 and 2020, and the level was higher than in all previous years. At the same time, there has been an increase in the number of incidents with two or more people exposed compared to 2021 (see Figure 10-5).

Mobile facilities

- The number of reported incidents for mobile facilities increased steadily from 2017 to 2020 (both normalised and absolute). In 2021, the absolute number of incidents was at the same level as in 2020 before declining slightly again in 2022. Normalised, there was a slight reduction in both 2021 and 2022 (see Figure 10-1).
- Breaking incidents down by type of lifting activity, there was an increase in the period 2018-2020 especially in incidents relating to lifting in drilling modules, and the increase is in both the absolute and normalised numbers of incidents. The number of incidents in 2021 was the highest ever in the reporting period. In 2022, it fell back slightly again, although it is still at a high level. But normalised against both the number of wells drilled and working hours, there was an increase in the number of incidents related to lifting in the drilling module in 2022 (see Figure 10-6 and Figure 10-7).
- Looking at incidents without personal injury, but with the potential for injury, in 2022 there was a fall in the number of incidents with one person exposed compared to 2021. There was also a fall in incidents with more people exposed (see Figure 10-5).

Figure 10-1 Number of reported incidents for crane and lifting operations in the period 2013-2022 for fixed and mobile facilities – absolute numbers and numbers normalised against millions of working hours relating to drilling and well operations and to construction and maintenance, per type of facility

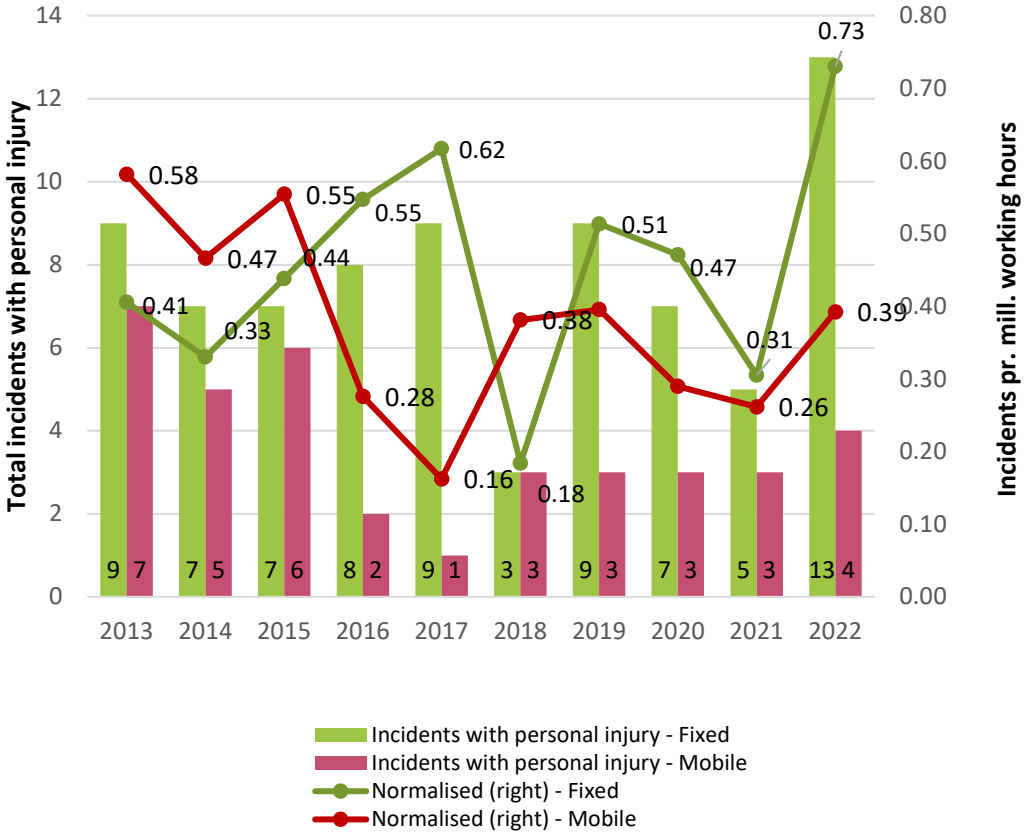

Figure 10-2 Number of incidents with personal injury for crane and lifting operations in the period 2013-2022 for fixed and mobile facilities - absolute numbers and numbers normalised against millions of working hours relating to drilling and well operations and to construction and maintenance, per type of facility

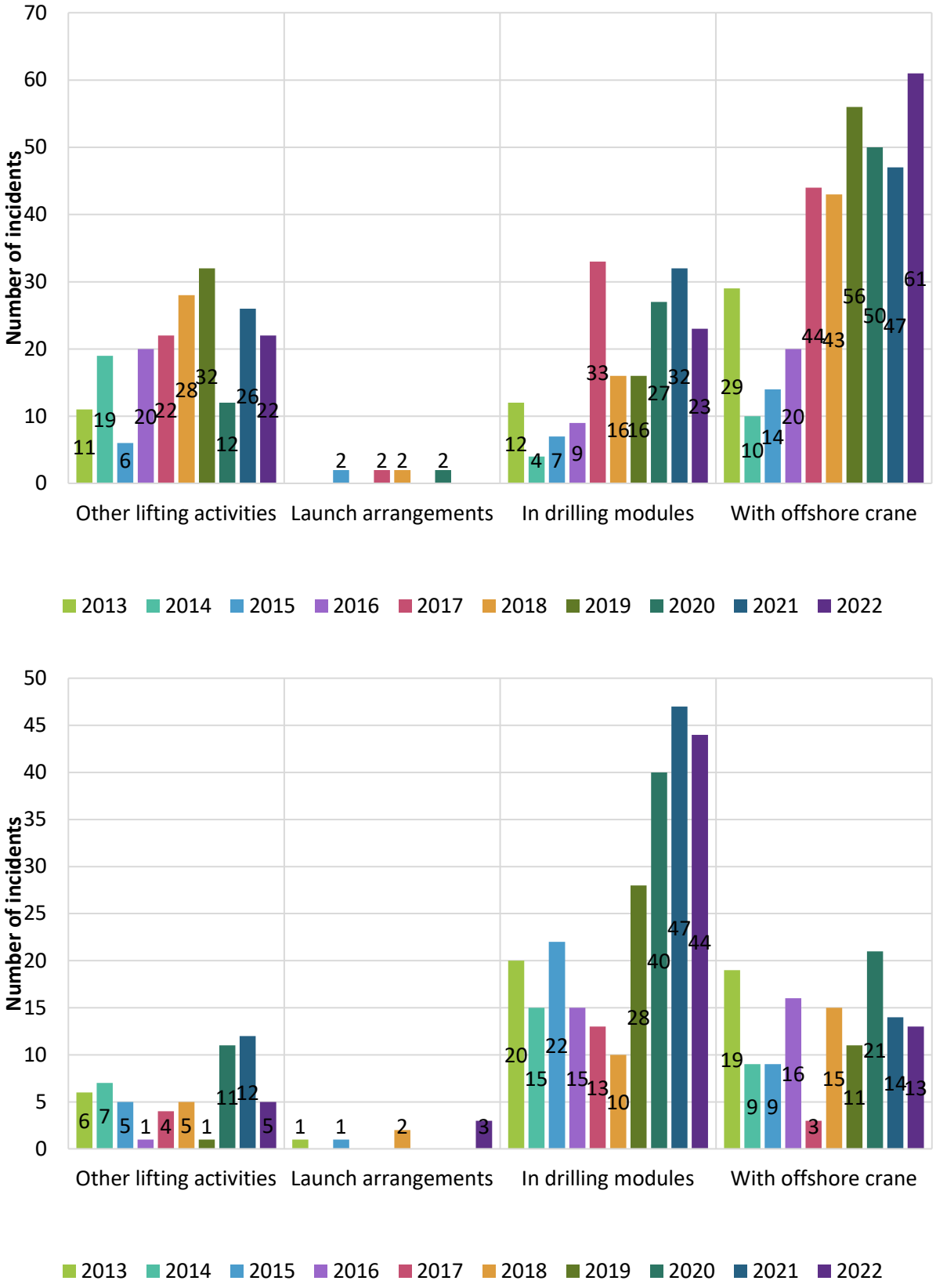

Figure 10-3 Number of incidents per year for the different types of lifting activities for the period 2013-2022, shown for fixed (top) and mobile (bottom) facilities.

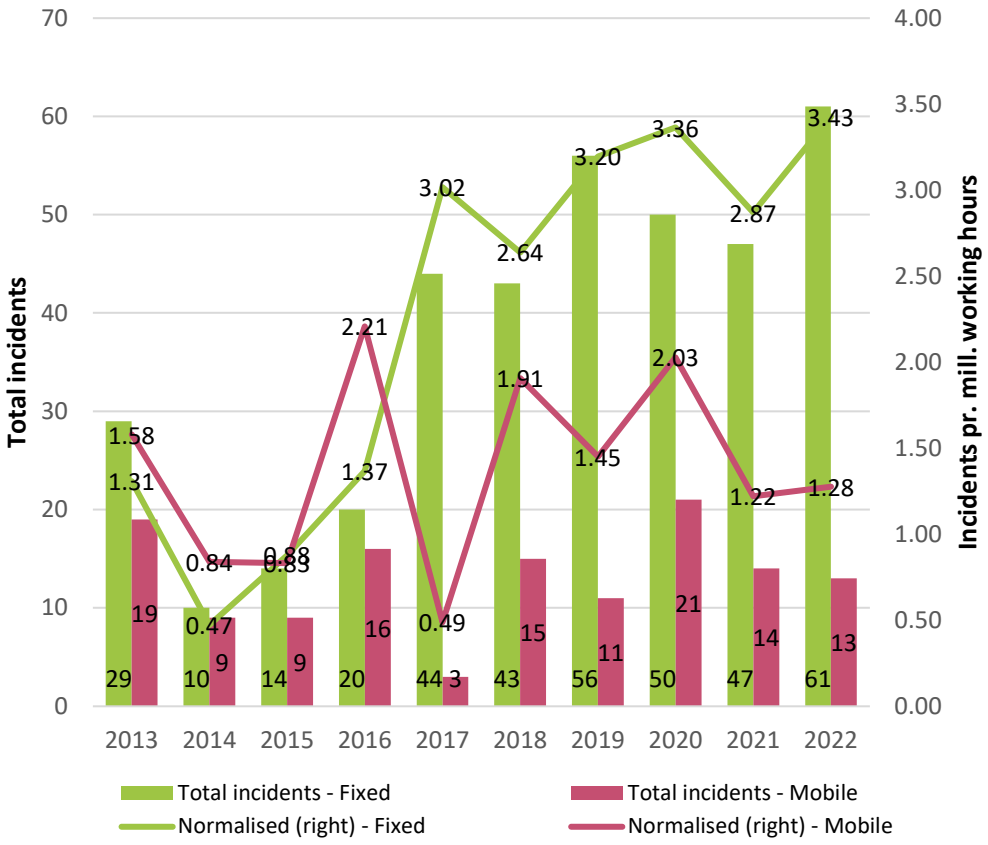

Figure 10-4 Number of reported incidents relating to lifting using offshore cranes for the period 2013-2022 shown for fixed and mobile facilities – absolute numbers and numbers normalised against millions of working hours relating to drilling and well operations and to construction and maintenance, per type of facility

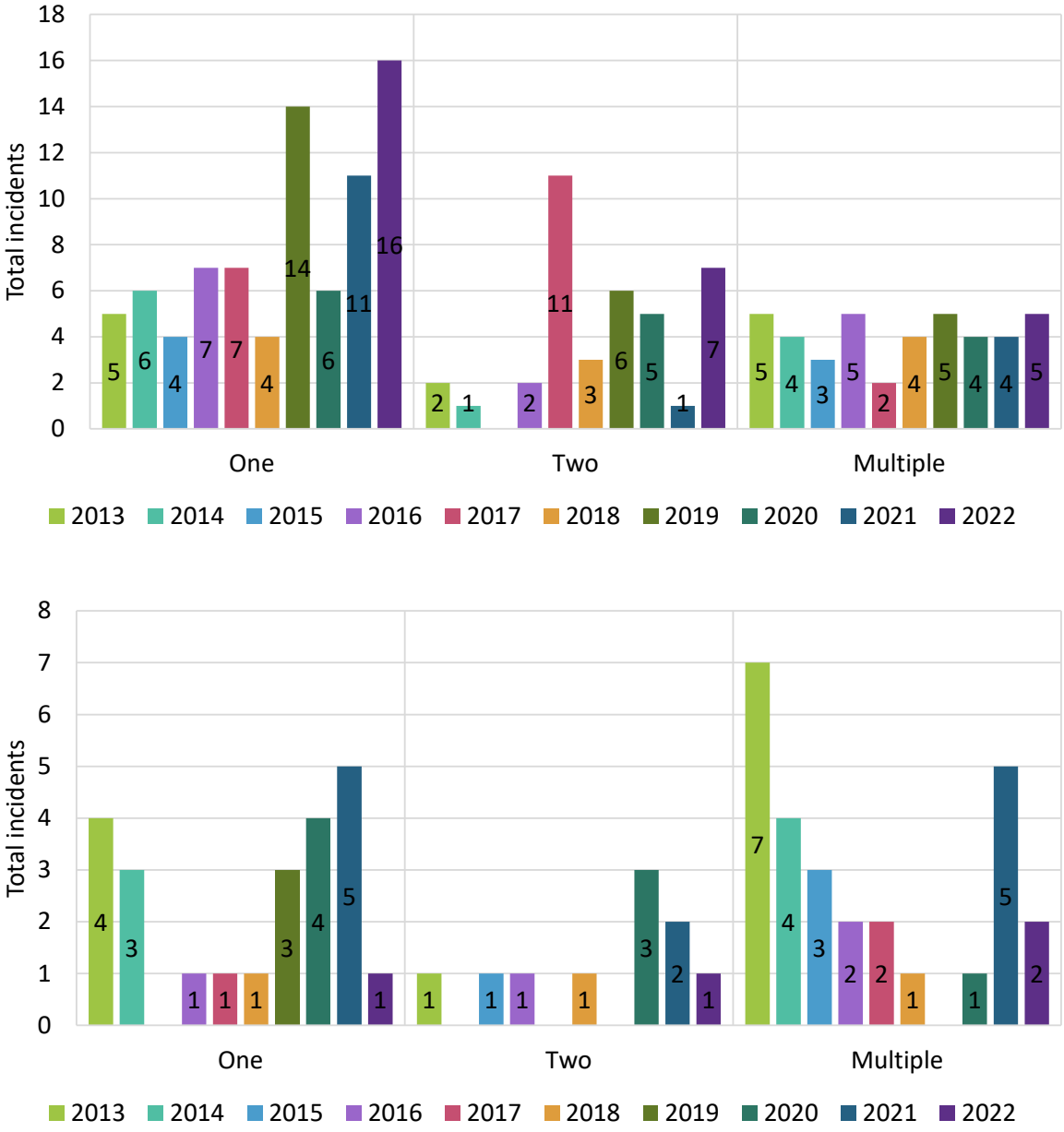

Figure 10-5 Number of incidents (without personal injury) with persons exposed to the incident, for fixed (top) and mobile(bottom) facilities, for the period 2013 to 2022.

Figure 10-6 Number of incidents relating to lifting in the drilling module for the period 2013-2022 shown for fixed and mobile facilities – absolute numbers and numbers normalised against million working hours relating (exclusively) to drilling and well operations, per type of facility.

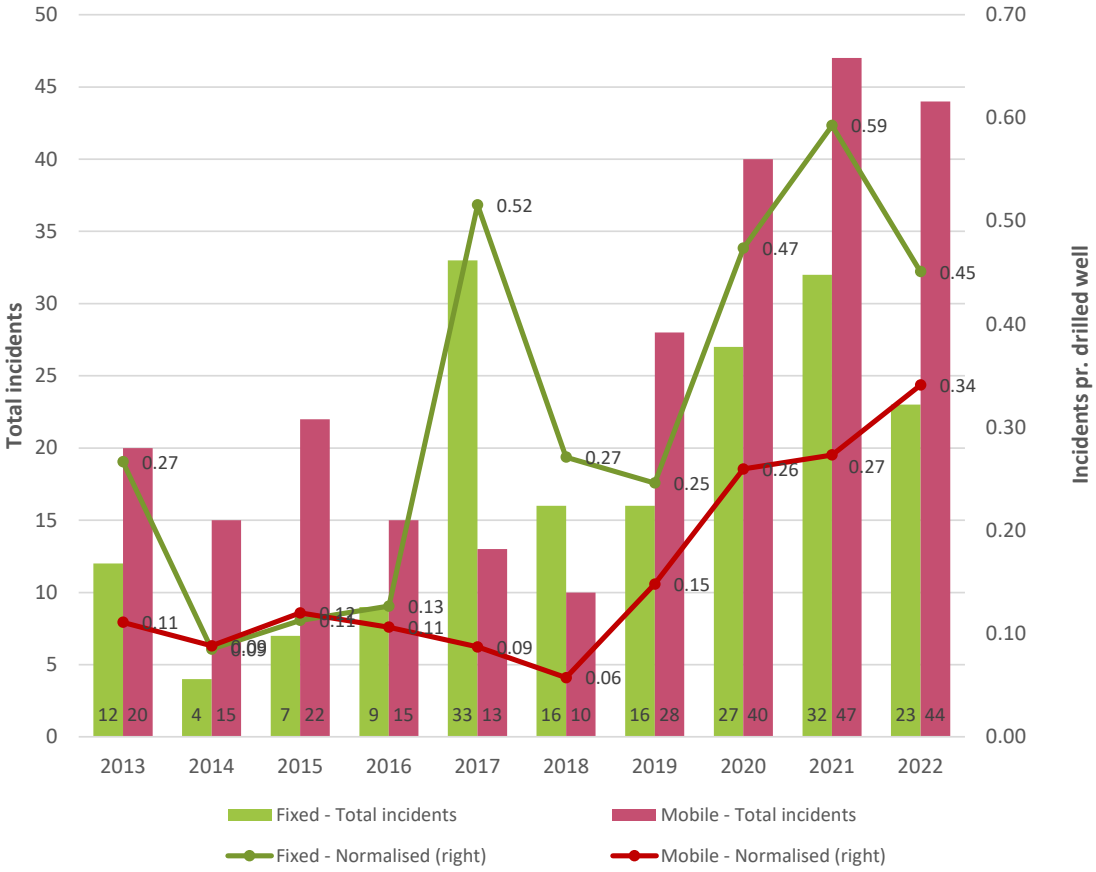

Figure 10-7 Number of incidents relating to lifting in the drilling module for the period 2013-2022 shown for fixed and mobile facilities – absolute numbers and numbers normalised against the number of drilled wells (exploration and production wells).

10.2 DSHA 21 Dropped objects

DSHA 21 Dropped objects comprises all incidents where an object falls within a facility's safety zone, either on deck or into the sea, with the potential for becoming an accident, and which does not involve crane and lifting equipment and the use thereof. Incidents linked to crane and lifting equipment and the use thereof are presented in DSHA 20.

As of the 2015 report, for offshore facilities, a new DSHA 20, Crane and lifting operations, was introduced which has caused changes in DSHA 21 Dropped objects. The time series now consists of data for the period 2013-2022. The analysis looks at both the ten years combined and a comparison between the years, as appropriate.

The most important findings, which are also shown in the figures below, are:

Fixed facilities

- The number of reported incidents for *fixed facilities* shows a slight increase from 2019 to 2021, and further in 2022. The normalised number of incidents (against the total number of hours worked) has gone in the other direction: a slight reduction in the entire period from 2019 to 2022 (see Figure 10-8).
- A significant decrease was observed in 2020 in the number of incidents that resulted in personal injuries, totalling five on fixed facilities in 2020 compared with eleven in 2019. In 2021 and 2022, the number was closer to the levels up to 2017, with a total of six incidents (see Figure 10-9).
- For drilling areas, there was a very significant increase in the number of incidents >40 J from 2018 to 2019; a threefold increase. This was lower in 2020 and 2021,

before another marked increase in 2022 (see Figure 10-10 for <40 J, and Figure 10-11 for >40 J).

- For incidents involving scaffolding, there was a strong reduction in the number of falling objects with energy <40 J and an increase of one falling object with energy >40 J from 2021 to 2022. Normalised against the number of hours worked on construction and maintenance, there was a marked reduction for falling objects with energy <40 J. However, for incidents >40 J, the total number of incidents increased from 2021 to 2022, while there was a decrease in the number of incidents normalised against hours of construction and maintenance worked (see Figure 10-12).
- For incidents without personal injury, but with the potential for injury, there is a negative trend in 2019, in that the proportion of incidents with exposed personnel (one, two and more persons) increased compared to 2018. This reversed with a sharp decline in 2020, and remained at the same level in 2021. In 2022, the number of incidents involving exposed personnel, but without personal injury, was the second highest in the observed period (2013-2022). The number of incidents with more than two people exposed was eight in 2022, compared to zero in 2021 (see Figure 10-13).
- The potential for injury, looking at the total number of incidents involving exposed personnel, rose in 2022 from 2021 (see Figure 10-13).

Mobile facilities

- In 2018, *mobile facilities* saw an increase in reported incidents after a number of years of a weak downward trend. In 2022, the number of incidents was at the same level as in 2021, slightly lower than in 2018, 2019 and 2020 in absolute number of incidents. The number of incidents normalised against working hours decreased significantly from 2019 to 2021, before a slight increase in 2022, as the total number of working hours on mobile facilities was lower in 2022 than in 2021. (see Figure 10-8).
- For drilling areas, there was the same absolute number of incidents involving energy <40 J, and an increase in the number of incidents involving energy >40 J in 2022 compared to 2021. The number of incidents normalised against hours worked decreased significantly from 2019 to 2021, but increased slightly for incidents with energy <40 J, and sharply for incidents with energy >40 J in 2022. See Figure 10-14 and Figure 10-15. The number of incidents normalised against the number of wells drilled also increased from 2021 to 2022 (see Figure 10-16 and Figure 10-17).

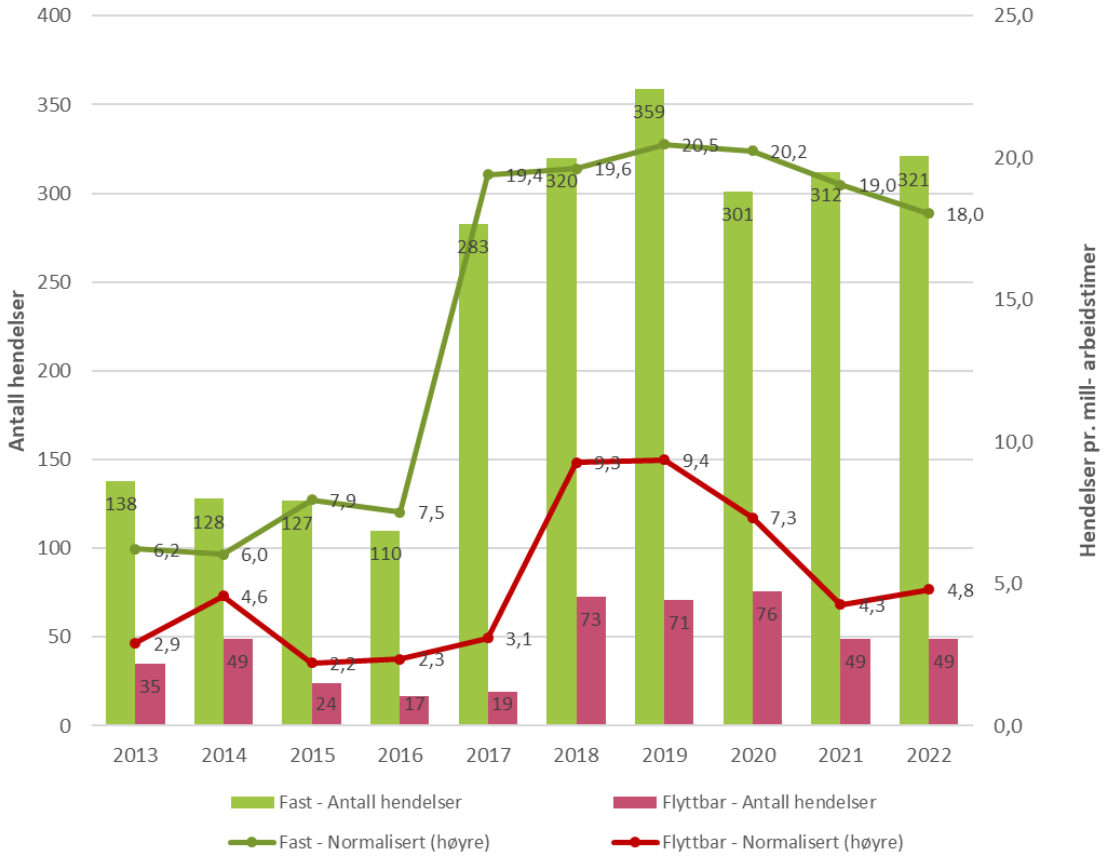

Figure 10-8 Number of incidents and incidents per million working hours classified as falling objects, by fixed and mobile facilities, in the period 2013-2022

Figure 10-9 Total number of falling object incidents causing personal injury, in the period 2013-2022. For fixed facilities, the number of incidents normalised against the total number of working hours is also shown.

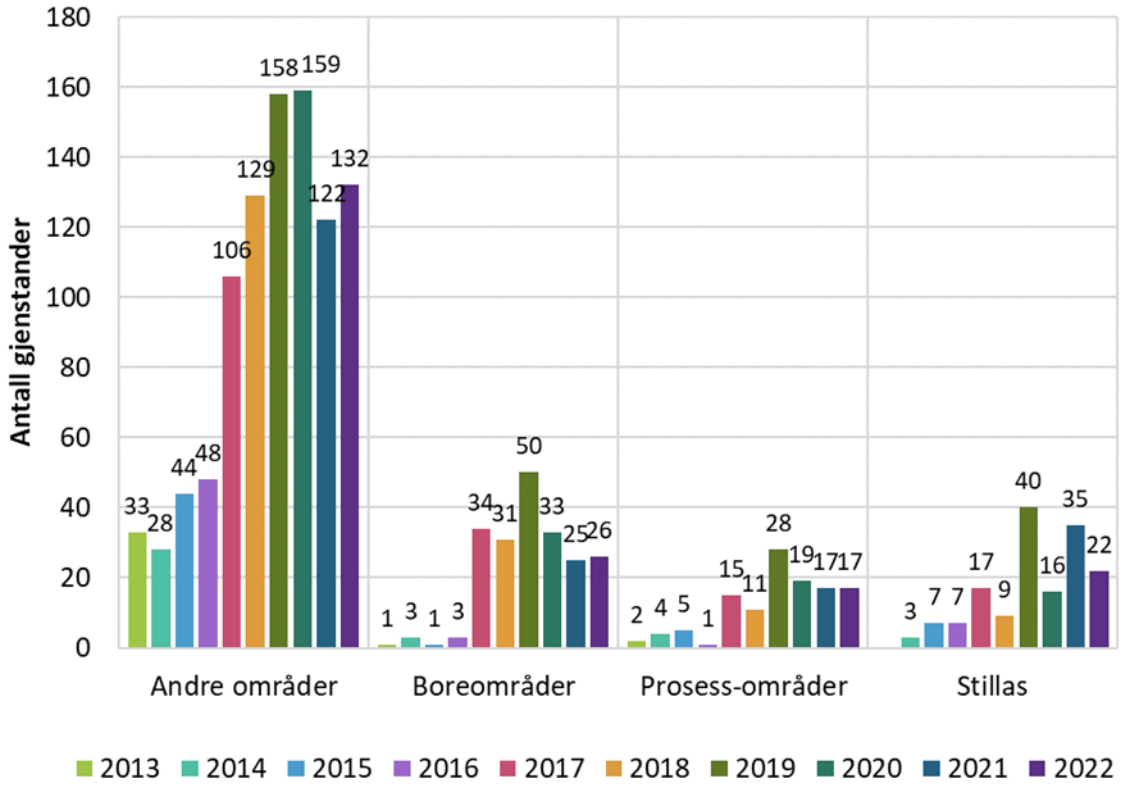

Figure 10-10 The total number of falling object incidents for <u>fixed</u> facilities, involving <u>energy <40 J</u> – by main categories of work processes (numbers of falling objects per year are given in the columns), for the period 2013-2022

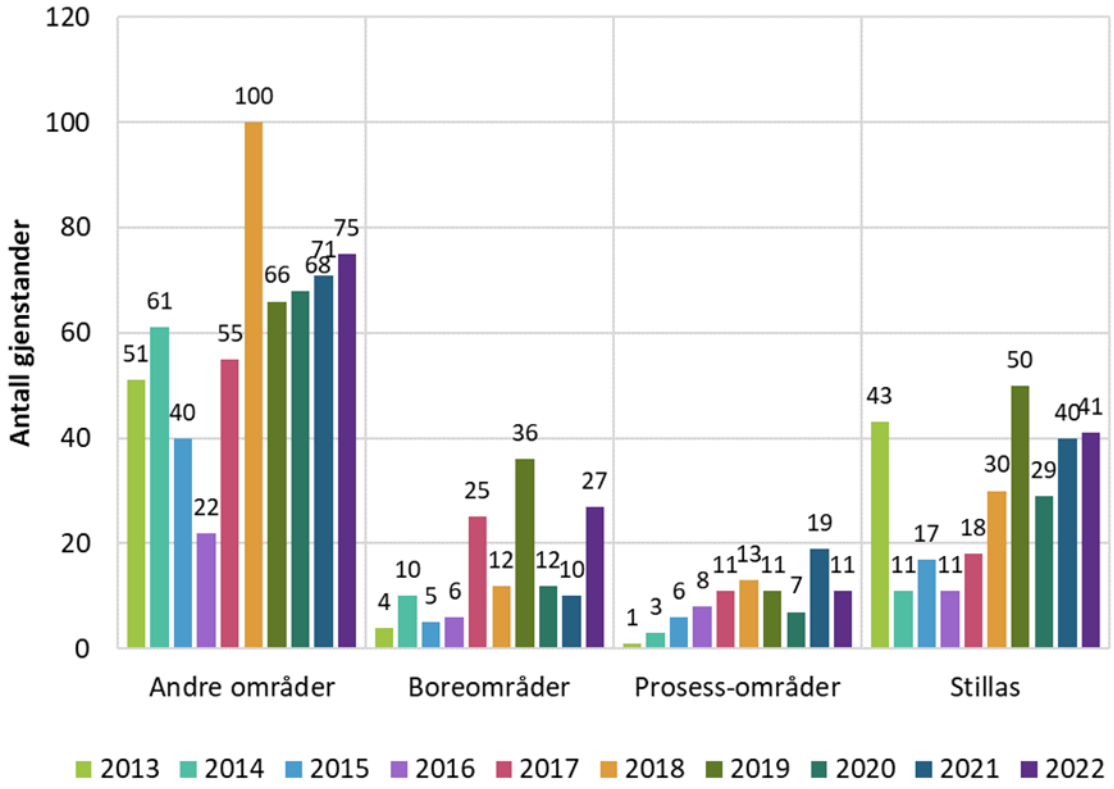

Figure 10-11 The total number of falling object incidents for <u>fixed</u> facilities, involving <u>energy >40 J</u> – by main categories of work processes (numbers of falling objects per year are given in the columns), for the period 2013-2022

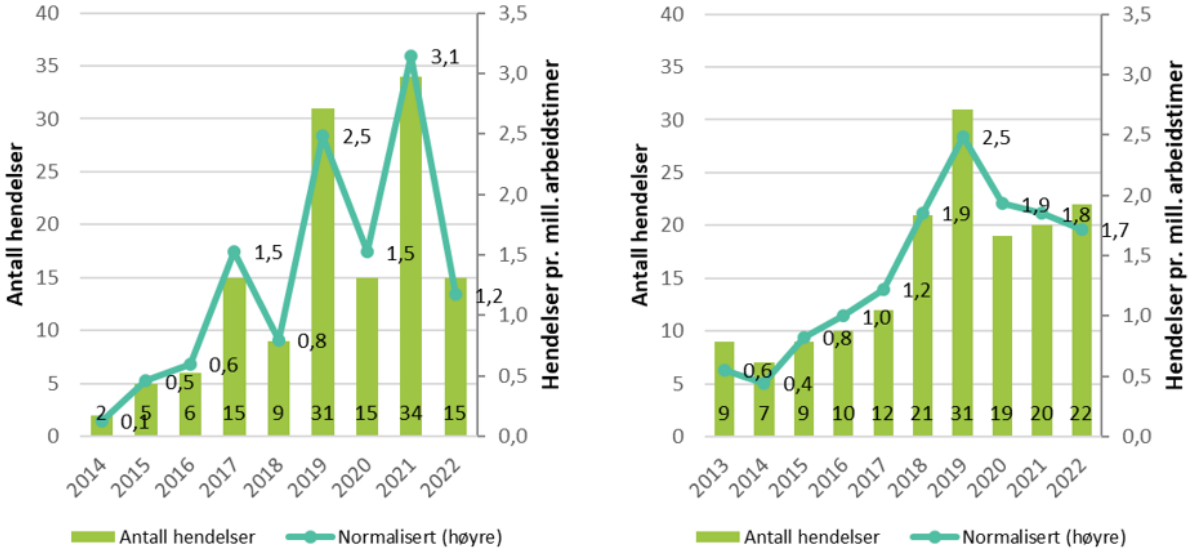

Figure 10-12 Number of incidents, <40 J on the left and >40 J on the right, on fixed facilities relating to erection/dismantling and use of scaffolding, as well as normalised against working hours for construction and maintenance, for the period 2013-2022

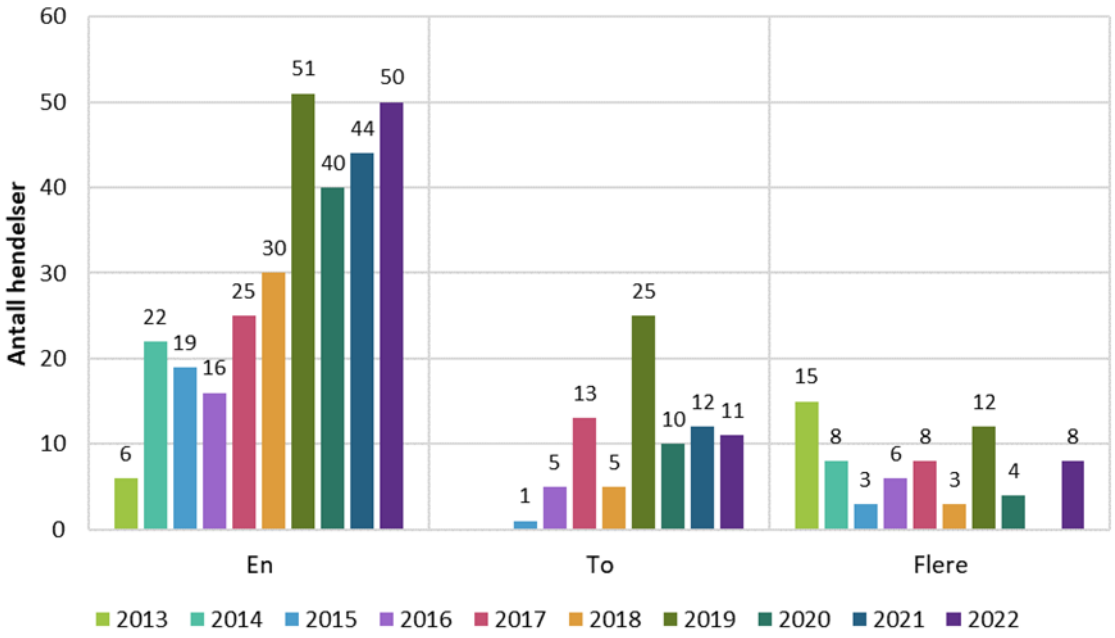

Figure 10-13 Absolute number of incidents (without personal injury) with persons exposed on fixed facilities, for the period 2013-2022

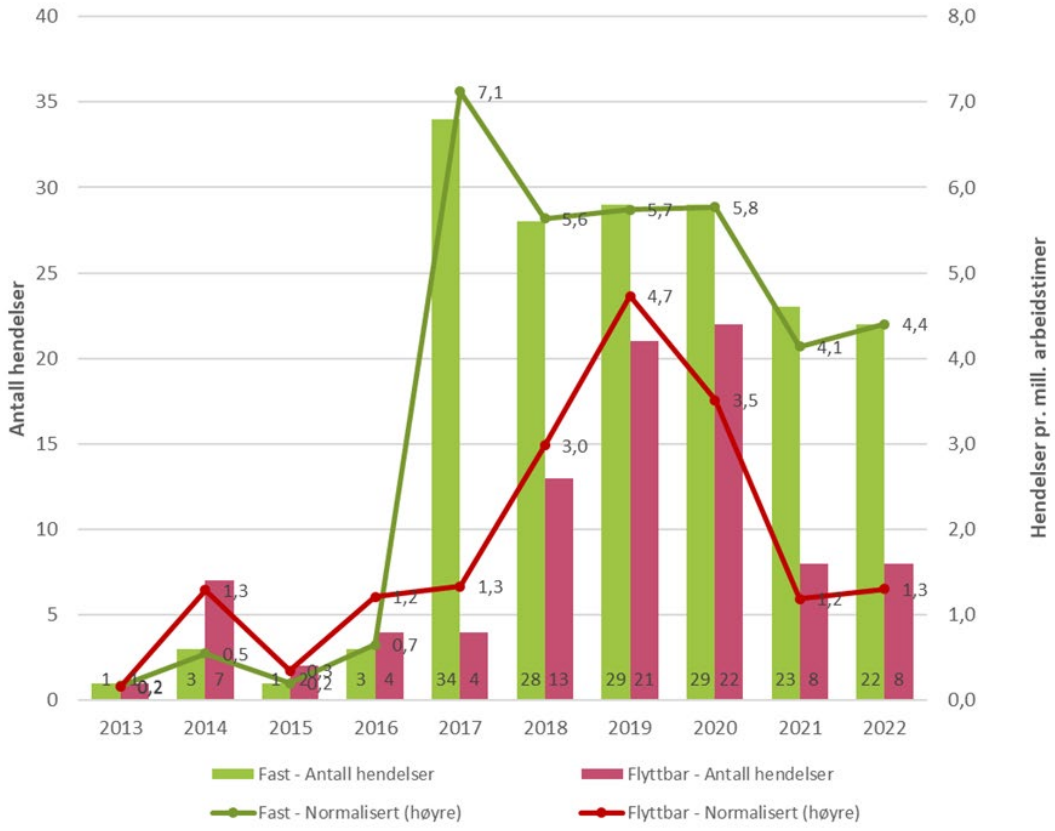

Figure 10-14 Number of incidents in drilling areas with <u>energy <40 J</u>, by fixed and mobile facilities, and normalised against drilling and well hours per year, for the period 2013-2022

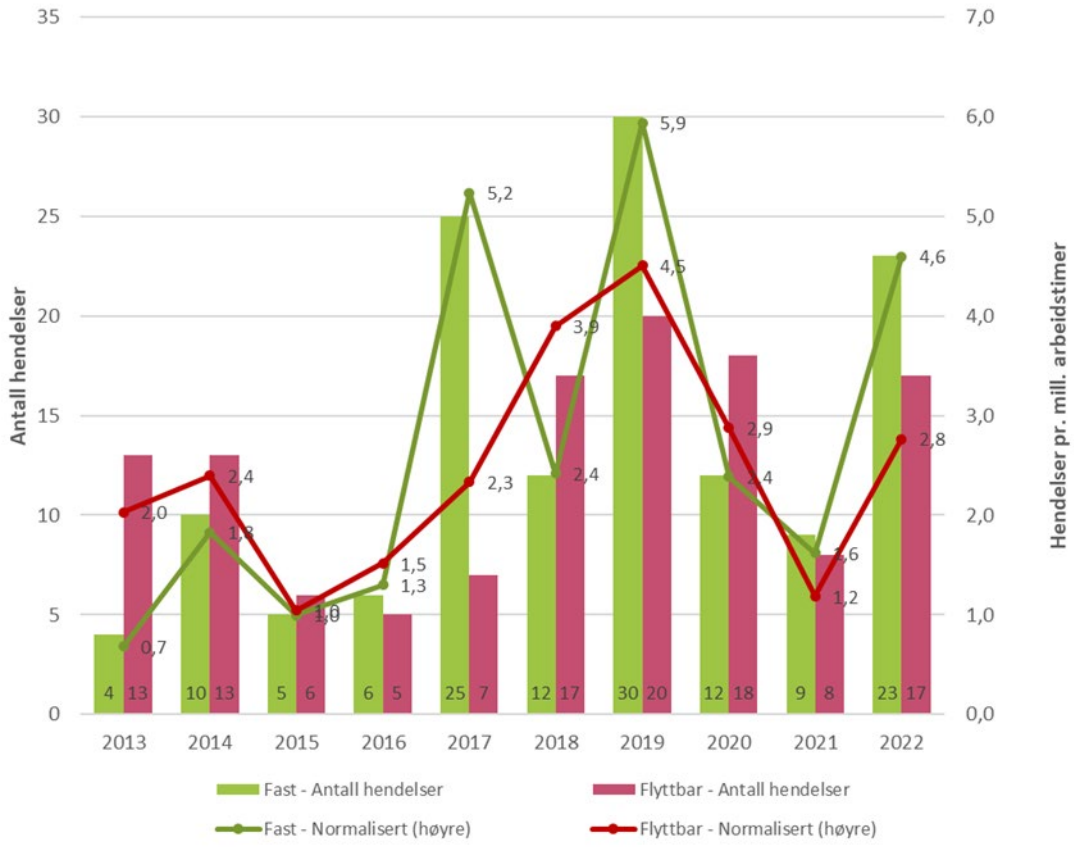

Figure 10-15 Number of incidents in drilling areas with energy >40 J, by fixed and mobile facilities, and normalised against drilling and well hours per year, for the period 2013-2022

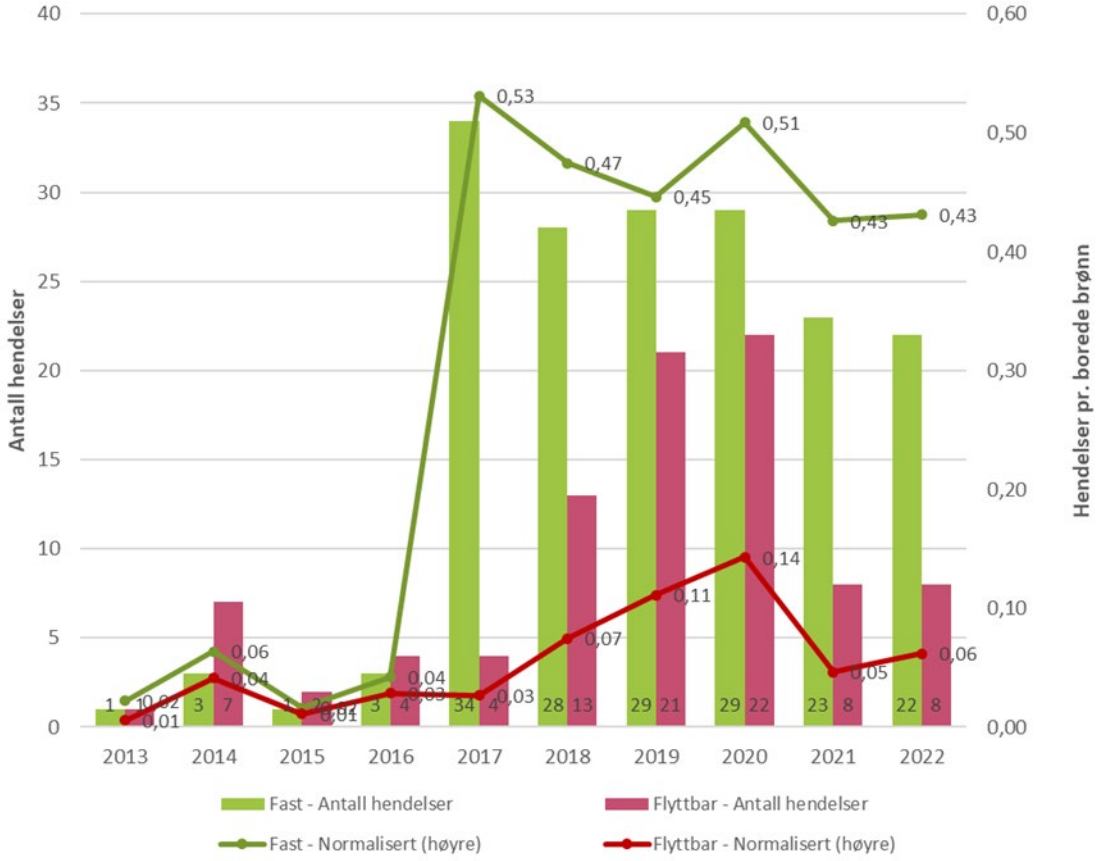

Figure 10-16 Number of incidents in drilling areas with energy <40 J, by fixed and mobile facilities, and normalised against number of drilled wells per year, for the period 2013-2022

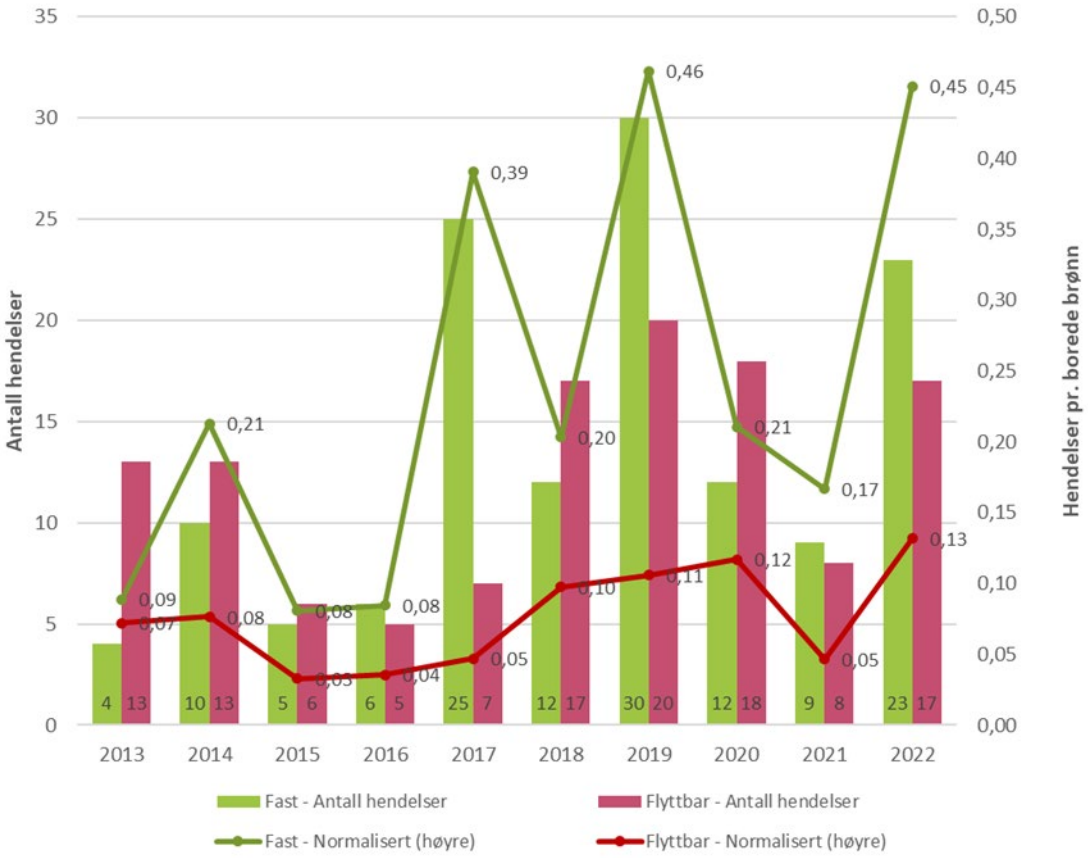

Figure 10-17 Number of incidents in drilling areas with energy >40 J, by fixed and mobile facilities, and normalised against number of drilled wells per year, for the period 2013-2022

10.3 Other DSHAs

The main report presents data for incidents that have been reported to the Petroleum Safety Authority Norway, as well as for other DSHAs without major accident potential, such as DSHA 11, 13, 16 and 19.

11. Definitions and abbreviations

11.1 Definitions

See sub-chapters 1.10.1 - 1.10.3, as well as 5.2, in the main report.

11.2 Abbreviations

For a detailed list of abbreviations, see PSA, 2023a.a The most important abbreviations in this report are:

CODAM	Database for damage to structures and subsea facilities
BDV	Blowdown valve
BOP	Blowout Preventer
BORA	Barrier and operational risk analysis
DDRS/CDRS	Database for drilling and well operations
DSHA	Defined situations of hazard and accident
DHSV	Downhole safety valve
DSYS	The PSA's database of personal injuries and hours of exposure during diving activities
ESDV	Emergency shutdown valve
PM	Preventive maintenance
GM	Metacentre height of floating facilities
HSE	Health, safety and environment
KG	The distance from the keel to the centre of gravity on floating facilities
KPI	Key Performance Indicator
CM	Corrective maintenance
PSA	Petroleum Safety Authority Norway
RNNP	Trend in risk level in the Norwegian petroleum activity
WIF	Well Integrity Forum

12. References

Detailed reference lists can be found in the main reports:

PSA, 2023a. Risk level in the petroleum activity – Norwegian Continental Shelf, Main report, 31.03.2023
PSA, 2023b. Risk level in the petroleum activity – onshore installations, 31.03.2023
PSA, 2023c. Risk level in the petroleum activity – Methodology report, 31.03.2023