SUMMARY REPORT 2011 - NORWEGIAN CONTINENTAL SHELF

TRENDS IN RISK LEVEL

IN THE PETROLEUM ACTIVITY

PETROLEUM SAFETY AUTHORITY NORWAY

Introduction

Trends in the risk level in the petroleum industry concern all parties involved in the industry, as well as the general public. It was therefore natural and important to establish a structure for measuring the effect of the industry's overall HSE work.

RNNP as a tool has developed considerably from its inception in 1999/2000 (first report published in 2001). The development has taken place in a multipartite collaboration, where there has been agreement regarding the prudence and rationality of the selected course of development as regards forming the basis for a shared perception of the HSE level and its development in an industry perspective. The work has been awarded an important position in the industry in that it contributes toward forming a shared understanding of the risk level. The first RNNP report related to acute discharges to sea was published in 2010. The report is based on RNNP data combined with data from OLF's Environmental Web database. Due to the data acquistion period in Environmental Web, the RNNP report regarding acute discharges will be published this autumn.

The petroleum industry has considerable HSE expertise. We have attempted to utilise this expertise by facilitating open processes and inviting contributions from key personnel from both operating companies, the Civil Aviation Authority, helicopter operators, consultancies, research and teaching.

Objectivity and credibility are key factors for any qualified statement regarding safety and the working environment. We therefore depend on the parties' shared understanding of the sensibility of the applied method and that the results create value. The parties' ownership of the process and the results is therefore important. So as to further facilitate active ownership of the process, a multipartite reference group was established in 2009 to assist in the development.

Many people have contributed to the execution of the project, both internally and externally. It would take too long to list all the contributors, but I particularly want to mention the positive attitude we have encountered in our contact with the parties in connection with execution and further development of the work.

Stavanger, 24 April 2012

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CONTENTS

Overview of tables

Overview of figures

Part 1: Objective and conclusions

1. Objective and limitations

1.1 Purpose

The "Trends in risk level - Norwegian Continental Shelf" project started in the year 2000. The Norwegian petroleum activities have gradually evolved from a development phase with many large fields, to a phase dominated by operation of petroleum facilities. Today, the petroleum activities are characterised by e.g. issues related to aging facilities, exploration and development in environmentally sensitive areas, as well as development of smaller and financially weaker fields. The player landscape is also changing, as more and more new players are participating in activities on the Norwegian Continental Shelf. The development in petroleum activities must take place in a perspective where the HSE conditions are improved. It is therefore important to measure the impact of the industry's overall safety work.

The industry has traditionally used a selection of indicators to illustrate safety development in the petroleum activities. The use of an indicator based on the frequency of lost time events has been particularly widespread. Such indicators only cover a small part of the overall safety picture. There has been a development in recent years where multiple indicators are used to measure trends in a few key HSE matters.

The Petroleum Safety Authority Norway wants to create a differentiated picture of trends in risk level based on information from several sides of the industry, so that we can measure the impact of the industry's overall safety work.

1.2 Objective

The objective of the work is to:

- Measure the impact of the industry's HSE work.
- Contribute to identify areas that are critical for HSE and where the effort to identify causes must be prioritised to prevent undesirable events and accidents.
- Increase insight in potential causes of accidents and their relative significance for the risk profile, e.g. to provide a better basis for decisions 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

At the core of the work is personnel risk, which includes major accidents, work accidents and working environment factors. Both qualitative and quantitative indicators have been used. A qualitative analysis of well control events, causes and measures has been carried out for this report.

The work is limited to matters included in the PSA's area of authority as regards safety and the working environment. All helicopter passenger transport is also included, in cooperation with the Civil Aviation Authority Norway and the helicopter operators on the Norwegian Continental Shelf. The following areas have been included:

- All production and mobile facilities on the Norwegian Continental Shelf, including subsea facilities
- Passenger transport by helicopter from departure/arrival from helicopter terminals to landing/departure at the facilities
- Use of vessels within the safety zone around the facilities.

Eight specific onshore facilities have been included since 1 January 2006. Data acquisition started from this date, and separate reports have been published over the last five years with results and analyses for onshore facilities. The results from these facilities are not included in this summary report. A separate report focusing on acute discharges to sea from the offshore petroleum activities was published for the first time in 2010.

2. Conclusions

In this work, the PSA seeks to measure trends in the risk level as regards safety, the working environment and the external environment[1], by using several indicators that are relevant in this regard. The basis for the assessment is the triangulation principle, i.e. using multiple measuring instruments to measure the same phenomenon; in this case, trends in risk level.

Trends in risks are the main focus. Some indicators, particularly within a limited area, will display somewhat significant annual variations. The petroleum industry should therefore focus on positive development of long-term trends, particularly in light of the Government's goal for the Norwegian petroleum industry to be world leading within HSE.

Ideally, we should arrive at a comprehensive conclusion on the basis of information from all the measurement instruments used. In practice, this often proves complicated, partly because the indicators reflect HSE conditions at somewhat significantly different levels. This report particularly examines risk indicators associated with:

- Major accidents, including helicopter-relatec accidents
- Barriers, particularly those relating to major accidents
- Serious injuries to personnel
- Risk factors in the working environment
    - Chemical working environment
    - Noise related hearing impairment
    - Ergonomics
- Qualitative assessments for selected areas.

A questionnaire survey was carried out among employees in the Norwegian offshore petroleum industry during the period from 17 October until 27 November 2011. This is the sixth time data have been acquired using this questionnaire. The questionnaire has been changed somewhat, but the core of the survey remains the same. The results from the questionnaire survey presented in this report are principal findings.

8066 forms were returned, which amounts to an estimated response rate of approx. 32%. This is somewhat higher than for the previous questionnaire survey and is deemed sufficient to perform statistical analyses, including at the group level.

Based on the index values, the trend is that the safety climate is largely reported to be the same as previous years. However, there has been a negative development in several variables related to physical aspects of the work situation; e.g. exposure to noise, vibrations and deficient lighting, as well as several ergonomic factors. We observed an improvement in these factors from 2007 to 2009, but the results have now returned to 2007 levels.

In recent years, the industry has focused heavily on reducing the number of hydrocarbon leaks. Specific reduction targets have been established several times. There was an increase in the number of leaks from 2008 to 2010, but it is registered a positive development in 2011, with a reduction to 11 leaks. The indicator related to well control events has had a continuously positive development during the period leading up to 2008. There was an increase during the period 2008–2010, from 11 in 2008 to 28 in 2010. The 2011 indicator is substantially reduced compared with 2010. It is still too early to say whether the positive development related to hydrocarbon leaks and well control events in 2011 will continue, however it is obviouse that the industry has achieved

[1]Data acquired through RNNP is used along with data from the Environmental Web database to assess acute spills to sea. The results are presented in a separate report that is published in the autumn.

positive results within high-focus areas, and that we shall maintain focus in this area in the years to come.

A qualitative study was carried out in 2011 with a background in the negative trend during the period 2008-2010 associated with reported well control events on the Norwegian Continental Shelf, as well as experience following the Deepwater Horizon accident in the Gulf of Mexico. The negative development in 2010 has reminded the petroleum industry of the risk potential associated with well control events. An overview study has therefore been carried out to increase insight into (1) important human, technical and organisational causes of well control events on the Norwegian Continental Shelf, (2) which measures have been proposed/implemented, (3) whether there is good concordance between identified causes and proposed measures and (4) how the petroleum industry can continue its work to reduce the number of well control events.

There was a considerabely high number of events resulting in damage to risers and pipelines within the safety zone in 2011. In addition, there were two leaks from risers on manned facilities. This is the largest contribution to the total risk indicator in 2011 for production facilities.

A total of 11 structural damage events were registered in 2011, of which three are associated with anchor lines and four to cracks in main loadbearing structures (fatigue). None of the events are categorised as serious. As regards mobile facilities, these events are the largest contributor to the total risk indicator for 2011, nearly 60%.

The number of events involving vessels on collision course continues to show a positive trend. The level in 2011 is significantly below the mean value during the period 2002–2010, even with a few more events in 2011 compared with 2010. The effect of controlled areas around the facilities from dedicated traffic centres must be counted as an explanation.

Over the course of the last ten years, there have been 27 collisions between facilities and visiting vessels on the Norwegian Continental Shelf. There was a reduction in the number of collisions during the period 1998-2001, but the number of serious events during the period 2004-2011 has increased somewhat.

The other indicators reflecting incidents with major accident potential show a stable level, with relatively minor changes in 2011.

The total indicator, which reflects the potential for loss of life if registered events develop into actual events, is a product of the frequency (probability) and potential consequences. A historical risk indicator is not a expression of risk, but can be used to evaluate trends in the parameters that contribute to risk. A positive development in an underlying trend for this type of indicator therefore provides an indication that we achieve better control of the contributors to risk.

Since 2007, the total indicator for both production facilities and mobile facilities has levelled out to a level which is below the previous period. An important goal in a continuous risk reduction process is to demonstrate a continuous reduction in this indicator. Since individual events with great potential have a relatively significant effect on the indicator from year to year, the assessment is based on a three-year rolling average.

Helicopter-related risk constitutes a large share of the overall risk exposure to which offhore personnel are exposed. The helicopter indicators used in this work were significantly modified in 2009/2010 in order to better illustrate the actual risk associated with the events included in the survey. The steps taken include the establishment of an expert group under the RNNP umbrella to assess the risk associated with the most serious events. The expert group consists of personnel with aviation (pilot), technical and risk expertise.

The last major accident to result in fatalities on the Norwegian Continental Shelf occured in September 1997 in connection with the helicopter accident outside Brønnøysund. In 2009 there were also several serious helicopter accidents in the global petroleum activities.

The indicator reflecting the most serious helicopter events, and which is assessed by the expert group, shows a weak negative development from 2010 to 2011. However, no events have been recorded over the last three years with ”little remaining safety margin”. Four of the events in the 2011 indicator with ”medium remaining safety margin” are related to engine failure on the helicopter. The number of events related to ATM (air traffic management), particularly in relation to lack of radio coverage, shows an increasing trend over the last four years.

Barrier indicators are an example of leading indicators. The indicators show that there are somewhat significant differences between the facilities, not only in 2011, but also in average over the last ten years. Several facilities have relatively poor results for certain barrier systems. The average level for some indicators also exceeds the expected level. In other words, the industry has a clear potential for improvement as regards some of the barriers.

Data related to maintenance management has been acquired for three years. Data acquisition must normally take place over several years to have sufficiently stable set of data. The figures from 2009 to 2011 show that several participants have challenges associated with establishing an expected level of maintenance management, in light of the regulations.

The challenges are related to both classification of equipment and the degree of outstanding work in relation to both preventive and corrective maintenance, including HSE-critical maintenance.

Serious injuries to personal have shown a positive development in recent years. The injury frequency is now 0.6 serious personal injuries per million working hours for the entire Continental Shelf. This is significantly lower than the average for the preceding ten-year period. There has been a positive trend since 2009 for production facilities. The injury frequency on production facilities in 2011 is at the lowest level so far. Even with the increased number of total working hours, the number of serious accidents has declined from 23 serious personal injuries in 2010 to 17 in 2011. There has been a considerable decline within the drilling and well operations group in 2011. The injury frequency on mobile facilities in 2011 shows an increase in the frequency for serious personal injuries from 0.4 in 2010 to 0.7 in 2011. The injury frequency is just below the average for the ten previous years. There were nine serious personal injuries in 2011 on mobile facilities, compared with five in 2010. In 2011, the serious personal injury frequency for drilling and well operations on production facilities is about one-third of the corresponding function on mobile facilities. The opposite was true in 2010.

In 2011, one person was confirmed missing from the Visund platform. The person did not report for work, and a search was started immediately. The search was terminated without finding the missing person.

The noise exposure indicator shows improvement in 2011 and several of the position categories have a positive trend over the last 2-3 years. However, data from the study indicates that most of the position categories are exposed to noise exceeding the limit value of 83 dBA. If we consider the use of hearing protection, we see that noise exposure for most position categories is within the requirement. The situation is not satisfactory, as hearing protection has clear limitations as a preventive measure. There is considerable variety as regards the degree to which binding action plans have been established. There is a positive trend for production facilities, but significant decline for mobile facilities.

Indicators for ergonomics have been reported for the third time this year. The indicator was changed in 2010, so the figures from 2009 and 2010 have not been comparable, which means that this is the first time it is possible to compare figures from one year to the next, from 2010 to 2011. The reporting quality for 2011 was not as good as for 2010.

The ergonomic risk indicator shows a continued high risk for scaffolding, surface treatment personnel and roughnecks, closely followed by mechanics. Compared with 2010, we see an increase in risk for scaffolding and roughnecks. The working posture shows the most negative development of the following factors: working posture, monotony, lifting and handheld tools.

Part 2: Implementation and scope

3. Implementation

The work in 2011 is a continuation of previous years' activities, carried out in 2000–2010, see NPD (2001), NPD (2002), NPD (2003), PSA (2004), PSA (2005), PSA (2006), PSA (2007), PSA (2008), PSA (2009), PSA (2010) and PSA (2011). (Complete references are provided in the main report, as well as www.ptil.no/rnnp). This year we have continued the general principles and have further developed the reporting with special emphasis on:

- The social analysis consists of an analysis of causes and follow-up of measures for well control events.
- The work on analysing and evaluating data related to defined hazard and accident situations has been continued, both for the facilities and for helicopter transport.
- Considerable amounts of experience data have been acquired for barriers against major accidents, which have been analysed correspondingly as during the period 2003-2010. More emphasis has been put on nuances in data for well barriers and BOP data.
- Indicators for noise, chemical working environment and ergonomics have been continued.
- Data from onshore facilities has been analysed and presented in a separate report.
- Cases of acute discharges to sea and potential discharges to sea have been analysed and presented in a separate report.

3.1 Implementation of the work

Work started on this year's report during the summer of 2011. The following participants have been involved:

• The Petroleum Safety Authority Norway:	Responsible for implementation and follow-up of the work
• Operating companies and shipping companies:	Contribute data and information about activities on the facilities, as well as in the work on adapting the model for onshore facilities, which has been included as of 1 January 2006
• The Civil Aviation Authority Norway:	Responsible for reporting public data regarding helicopter activities and quality assurance of data, analyses and conclusions
• Helicopter operators:	Provide data and information regarding activities in helicopter transport
• HSE expert group: (selected specialists)	Evaluate methods, basic data, viewpoints on the development, evaluate trends, propose conclusions
• Safety Forum: (representing unions, employers and authorities)	Comment on methods, results and provide recommendations for further work.
• Advisory group: (representing unions, employers and authorities)	Joint RNNP advisory group providing advice to the Petroleum Safety Authority on following up the work.

The following external experts have assisted the Petroleum Safety Authority on specific assignments:

- Terje Dammen, Jorunn Seljelid, Beate Riise Wagnild, Grethe Lillehammer, Bjørnar Heide, Aud Børsting, Rolf Johan Bye, Sverre Kvalheim, Trond Stillaug Johansen and Øystein Skogvang, Safetec

- Ranveig Tinmannsvik, Stein Hauge, Eivind Okstad, Inge I Carlsen SINTEF Petroleum Research/Technology and Society
- Kari Kjestveit, Elisabeth Kiær, Leif Jarle Gressgård, Randi Austnes-Underhaug, Stian Brosvik Bayer and Brita Gjerstad, IRIS

The PSA's working group consists of: Einar Ravnås, Øyvind Lauridsen, Mette Vintermyr, Arne Kvitrud, Trond Sundby, Jorunn Elise Tharaldsen, Hilde Nilsen, Inger Danielsen, Elisabeth Lootz, Sigvart Zachariassen, Brit Gullesen, Anne Mette Eide, Hans Spilde, Semsudin Leto and Torleif Husebø.

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

- Erik Hamremoen, OLF, represented by LFE
- Egil Bjelland, Dag Vidar Jensen, CHC Helicopter Service
- Per Skalleberg, Arne Martin Gilberg, Tormod Veiby, Bristow Norway AS
- Finn Mikkelsen, Blueway Offshore Norge AS

Numerous others have also contributed to the implementation of the project.

3.2 Use of risk indicators

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

- Defined hazard and accident situations, with the following main categories:
  - Uncontrolled discharge of hydrocarbons, fires (i.e. process leaks, well events/shallow gas, riser leaks, other fires)
  - Structural events (i.e. structural damage, collisions, threat of collision)
- Experience data related to the performance of barriers against major accidents on the facilities, including data regarding well status and maintenance management
- Accidents and events in helicopter transport activities
- Occupaional accidents
- Noise, chemical working environment and ergonomics
- Diving accidents
- Other hazard and accident situations with minor consequences or significance for emergency preparedness.

The term major accident is used at various points in these reports. There is no universally agreed definition of the term but the following definitions are often used and coincide with the definition used in this report:

- A major accident is an accident (i.e. entails a loss) in which at least five persons may be exposed.
- A major accident is an accident caused by failure of one or more of the system’s integral safety and preparedness barriers.

In light of the definition of major accidents in the Seveso II directive, the definition used here is closer to that of a ‘big accident’.

Data acquisition for the DFUs relating to major accidents is based partly on established Petroleum Safety Authority databases (CODAM, DDRS, etc.) but also includes considerable amounts of data acquired in cooperation with the operators and shipping companies. All event data have been quality-assured by e.g. checking them against the event register and other Petroleum Safety Authority databases.

Table 1 shows an overview of the 19 DFUs, and the data sources used. The industry has applied the same categories for data registration through the Synergi database.

3.3 Trends in activity level

Figure 1 and Figure 2 show trends over the period 1996-2010 for production and exploration activities, of those parameters used for normalisation against activity level (all figures are relative to the status in year 2000, which is set at 1.0). Appendix A of the Main Report (PSA, 2012a) presents the basic data in detail. Errors in the basic data in previous reports have been corrected.

Table 1 List of DFUs and data sources

DFU no.	*DFU description*	*Data sources*
1	Non-ignited hydrocarbon leaks	Data acquisition*
2	Ignited hydrocarbon leaks	Data acquisition*
3	Well events/loss of well control	DDRS/CDRS + event reports (PSA)
4	Fire/explosion in other areas, flammable liquids	Data acquisition*
5	Vessel on collision course	Data acquisition*
6	Drifting object	Data acquisition*
7	Collision with field-related vessel/installation/shuttle tanker	CODAM (PSA)
8	Structural damage to platform/stability/anchoring/positioning failure	CODAM (PSA) + industry
9	Leaking from subsea production systems/pipelines/risers/flowlines/loading buoys/loading hoses	CODAM (PSA)
10	Damage to subsea production equipment/pipeline systems/diving equipment caused by fishing gear	CODAM (PSA)
11	Evacuation (precautionary/emergency evacuation)	Data acquisition*
12	Helicopter crash/emergency landing on/near installation	Data acquisition*
13	Man overboard	Data acquisition*
14	Personal injury	PIP (PSA)
15	Occupational illness	Data acquisition*
16	Total power failure	Data acquisition*
18	Diving accident	DSYS (PSA)
19	H_2S emissions	Data acquisition*
21	Falling object	Data acquisition*

* Data acquired with the cooperation of operating companies

We can see that, while the number of working hours on production facilities has peaked in 2011, the number of production wells has reached the lowest during the period. On mobile facilities the variations from year to year are greater than for production facilities, but the number of working hours in 2011 has peaked here as well during the period. A presentation of DFUs or risk may sometimes be different if absolute or ”normalised” values are stated, depending on the normalisation parameter. The presented values are principally normalised.

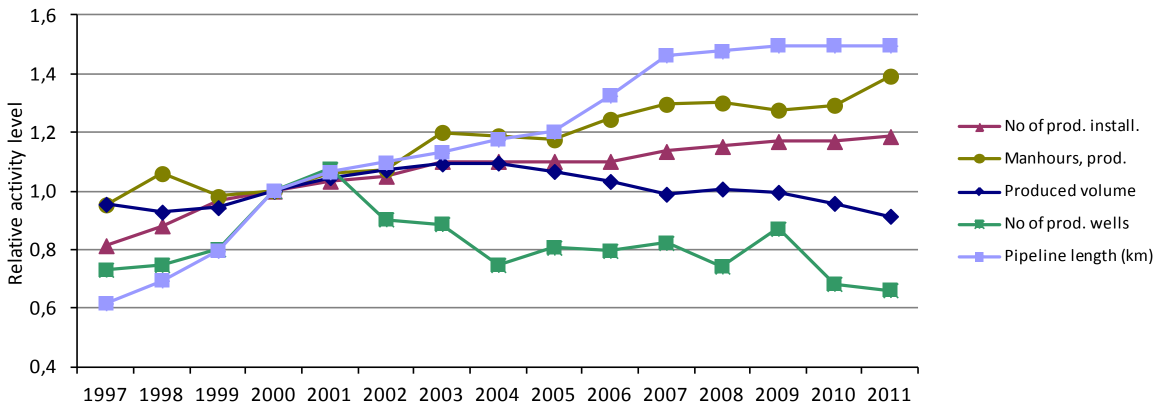

Figure 1 Trends in activity level, production

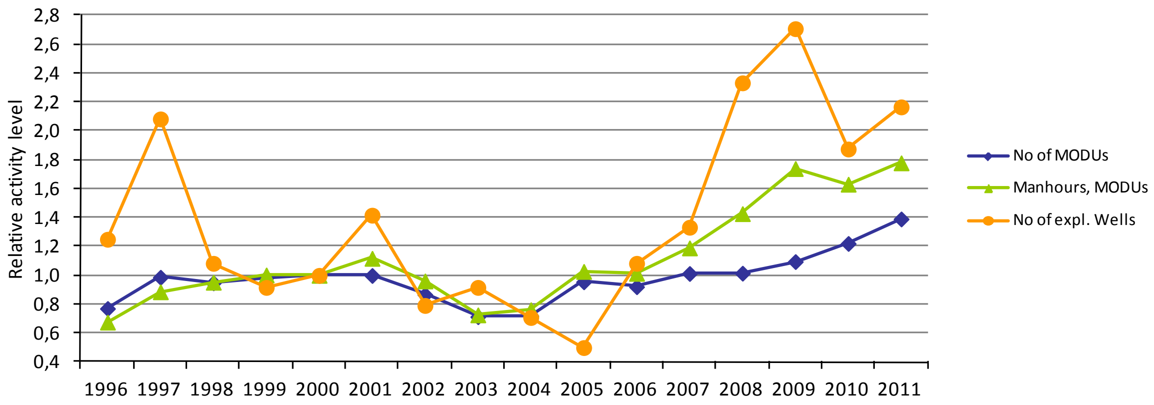

Figure 2 Trends in activity level, exploration

A corresponding activity overview for helicopter transport is shown in Subsection 7.1.

3.4 Documentation

The analyses, evaluations and results are documented as follows:

- Summary Report – Norwegian Continental Shelf for 2011 (Norwegian and English versions)
- Main Report – Norwegian Continental Shelf for 2011
- Onshore Facilities Report for 2011
- Acute Discharges to Sea Report – Norwegian Continental Shelf for 2011, to be published in the autumn of 2012

These reports can be downloaded free of charge from the Petroleum Safety Authority's website (www.ptil.no/rnnp).

4. Scope

The social analysis consists of the questionnaire survey which is repeated every other year and a study of causes of and measures to avoid well control events.

The statistical analysis method applied in previous years has been continued, with only minor changes.

Part 3: Results from 2011

5. Questionnaire survey

This part of the report presents the results from a questionnaire survey carried out among employees in the Norwegian offshore petroleum industry during the period from 17 October to 27 November 2011. The paramount objective of the questionnaire survey is to measure the employees' perception of the HSE situation in the Norwegian petroleum industry. This is the sixth time data have been acquired using this questionnaire, after the first mapping was carried out in December 2001. It was subsequently repeated every other year. A corresponding survey has been carried out for the third time for onshore facilities, and its results are presented in the Onshore Facilities Report.

8066 forms were returned, which is somewhat higher than for the previous questionnaire survey, where 7165 forms were returned. Based on the number of working hours on the facilities in 2011, the response rate is estimated at approx. 32%. A response rate of 32% is relatively low. However, the number of responses is sufficient to perform statistical analyses and split the data material into different groups. For comparison we can mention that the entire petroleum industry is represented by less than 200 randomly selected persons in the national Survey of Level of Living conducted by Statistics Norway every three years. The assumption is that those who have replied constitute a representative selection of the people working on the Continental Shelf. We can check whether the data are systematically skewed or not in relation to certain, measurable criteria. In practice, this means checking whether certain groups are over or under-represented. This is checked by comparing the results with known demographic factors and with previous surveys. Most demographic variables are sufficiently representative. However, there is a certain predominance of responses from people in management positions. This has also been the case in previous years.

5.1 In general regarding HSE-related aspects

Based on the index values, the trend is that the safety climate is largely reported to be the same as last survey. The indices for negatively and positively formulated statements about the HSE climate both show significant improvement since the previous measurement. There is, however, a negative development for multiple variables concerning physical aspects of the work situation; e.g. exposure to noise, vibrations and deficient lighting, as well as several ergonomic factors. We saw improvement in these factors from 2007 to 2009, but now they have returned to the 2007 level.

The percentage of persons stating that they have been subject to a personal injury over the last year on the facility is 4.4%. This has been nearly constant since 2005. As regards reporting of injuries, 90% of those stating they have been exposed to a work accident say it was reported to the closest supervisor or nurse.

The assessment of one's own work capacity – both physically and mentally – has been the same in the last questionnaire surveys. Working environment aspects, which includes cognitive requirements (attention and concentration), control and social support (from supervisors and colleagues) are mainly reported to be the same as during the two previous surveys.

In 2011, 60% of all employees stated that they have experienced pain in their neck/shoulder/arm, and approx. half stated that they have experienced back pain in the last three months. 30% have experienced some hearing loss and 7% have experienced significant hearing loss. Furthermore, 21% have experienced some skin ailments and 6% have experienced significant skin ailments. In general, there has been an increase in the percentage reporting health issues compared with the previous measurement. Looking at which issues the respondents most often connect with their work situation, these are tinnitus, hearing loss, neck/shoulder/arm pain, knees/hips, skin ailments and mental issues.

Perception of the risk associated with various accident scenarios increased from 2005 to 2007, but showed a decline in 2009. There is a further reduction in this most recent survey. The reduction was significant for ten of 13 evaluated accident scenarios. However, the perceived risk of sabotage/terror and faults in IT systems was increasing compared with 2009.

5.2 Potential for improvement

Even though this year's survey shows positive development in some areas, there is still potential for improvement. As regards the negatively formulated statements regarding the HSE climate, six statements with relatively low average values can be emphasised, even though some of them have improved compared with the previous survey.

- ”There are different procedures and routines for the same aspects on different facilities, and this amounts to a safety risk” (improvement).
- ”Deficient maintenance has led to poorer safety” (improvement).
- "Hazardous situations occur because not everyone speaks the same language” (decline).
- ”Reports on accidents or hazardous situations are often ’doctored’” (unchanged).
- ”Increased collaboration between offshore and onshore through use of IT systems has resulted in less safe operations” (unchanged).
- ”In practice, production concerns trump HSE concerns” (improvement).

There is also potential for improvement among positively formulated statements regarding the HSE climate. The following statements have the greatest potential for improvement, and they are ranked according to statements with the poorest values first:

- ”I find it easy to navigate governing documents (requirements and procedures)” (improvement).
- ”Manning is sufficient to safeguard HSE in a sound manner” (improvement).
- ”I feel sufficiently rested when I'm at work” (improvement).
- “It is easy to notify the occupational health service about health issues and ailments that may be work-related” (decline).
- ”Input from the safety delegates is taken seriously” (unchanged).
- ”I have been informed about the risk inherent in the chemicals I work with” (improvement).
- “I always know who to report to in the organisation” (unchanged).

As for the survey in 2009, the questions related to physical working environment indicate that many are reporting relatively high on ergonomic strain which may cause strain injuries over time (repetitive movements, heavy lifts, hands at/above shoulder height and squatting/kneeling). Some people also report considerable amounts of sedentary work. The physical working environment is reflected in the reported ailments. Neck, shoulder, arm, back, knee and hip pain score high, along with headaches, hearing loss, skin ailments and tinnitus, and a considerable amount of the health issues are also stated as work-related.

Some experience that they rarely or never receive feedback from their closest supervisor on performed work. At the same time, many also believe that they have so many work tasks that it is difficult to concentrate about each individual task (even though there is considerable improvement in this area, compared with the last survey). From 2007 to 2009 there was an increase in the percentage reporting the necessity of a high work pace at work, and this is unchanged in 2011. There is room for improvement here, as positive feedback from supervisors can contribute to characterising a hectic work situation by drive and accomplishment rather than a sense of stress.

6. Causal factors and measures associated with well control events in Norwegian petroleum activities

The negative development during the period 2008-2010 associated with reported well control events on the Norwegian Continental Shelf, as well as experience following the Deepwater Horizon accident in the Gulf of Mexico in 2010, have reminded the petroleum industry of the risk potential associated with well control events. The PSA has therefore commissioned an overview study to gain increased insight in key human, technical and organisational causes of well control events[2] on the Norwegian Continental Shelf, which measures have been proposed/implemented, whether the identified causes correspond well with the measures, as well as how the petroleum industry can continue its work to reduce the number of well control events. Other topics that have been discussed include the companies' implementation and application of risk assessments in the establishment of barriers. The study is based on an review of investigation reports (2003-2010) and event reports, technical literature and documents received from the industry, assessments from 12 operating companies' and drilling contractors' experts in the area, as well as interviews with 33 people who are involved in planning and execution of drilling operations.

Based on the results in this study, we have summarised four key challenges facing the industry in relation to further reducing the number of well control events:

Stronger focus on technical measures to improve safety

In light of the fact that a large percentage of the triggering causes described in the investigation reports can be related to technology, the amount of proposed technical measures appears to be low. Due to the limited focus on developing technical measures in the industry, it is prudent to emphasise the importance of making standards such as NORSOK D-001 and D-010 more aggressive as regards stipulating requirements that contribute to continuous improvement. It is mentioned in the interviews that there is need a for increased focus on better technical solutions associated with e.g. systems for detecting well kicks, presentation of safety-critical information for the driller and drilling fluid logger, design of the drilling cabin and systems/technology for pore pressure predictions.

After the Deepwater Horizon accident, many have asked how the drilling personnel could ignore all the signals that a blowout was developing. It may be tempting to ask: *Provided that all these signals were available and unambiguous, why do we not have a system that automatically shuts in the well? Is it a lack of technology, and/or the fear of an unnecessary shutdown that prevents such solutions from being considered and potentially introduced?*

Increased focus on planning, barrier management and more tailored risk assessments

There is need for alternative methods for performing risk assessments which are simpler to execute and communicate in the operational environment. It is particularly important to have a methodology for risk assessment of changes that occur during the drilling operations. There is also a need for examining the actual risk analysis process, e.g. as regards involving the correct technical expertise from the operator, drilling contractor and drilling service companies in assessing uncertainty in the analyses. Furthermore, it is important to illustrate *all* barriers with associated barrier elements during drilling, set performance requirements for them, and ensure that the requirements are followed up during operation. It is important to emphasise technical barrier elements other than the BOP and mud column, as well as develop a joint understanding of how the industry should define "operational and organisational barrier elements".

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[2] In RNNP, a "well control incident" is defined as the following: Well control incident refers to inflix of formation fluid in the well, where pressure builds up with a closed BOP, following a positive flow check. The kill method is determined and implemented. Note that the definition is limited to events that occur in the well's construction or completion phase, and does not comprise events in the operational phase.

More focus on major accident risk – more investigation of events

During the period 2003 – 2010, a total of 146 well control events were reported on the Norwegian Continental Shelf, of which only about ten events have been investigated. The percentage of investigated well control events is far below e.g. crane and lifting accidents and hydrocarbon leaks in the process area. Since the major accident potential inherent in well control events is indisputable, this disparity is striking. Considering that incident reports and investigation reports emphasise the causes of well control events differently, it is of utmost importance that more events are investigated. This will provide the necessary insight in causal mechanisms, complex connections and framework conditions that contribute to such events, which in turn is a precondition for efficient measures and experience transfer in the industry. Increased efforts directed toward barrier management, more investigations of well control events and operational risk assessments, will be instruments to ensure understanding of major accident risk in connection with well control events.

Create framework conditions for good collaboration in the operator-supplier hierarchy

Framework conditions are conditions that affect the practical opportunities an organisation, organisational unit, group or individual have to keep major accident risk and working environment risk under control (Rosness et al 2011). Better framework conditions is about the best possible facilitation for individuals, groups, organisational units and companies facing demanding and safety critical tasks. Particular attention should be given to the following: 1) Planning complex wells, 2) Risk assessment and quality assurance when operative plans must be changed on short notice, 3) Detection and interpretation of early signs of a risk of losing well control and 4) Safe handling of downtime situations. The following are examples of key framework conditions:

- Allocating sufficient time and resources for planning complex wells, as well as for risk assessment and quality assurance in the event of changes in operative plans
- Develop good stoppage criteria for when a drilling operation must be interrupted
- Develop a notification culture – avoid unreasonable interference in decisions to interrupt an operation
- Develop systems for presenting the well's condition to the driller and drilling fluid logger
- Develop KPIs that are directed more toward major accident risk.

7. Status and trends – DFU12, helicopter events

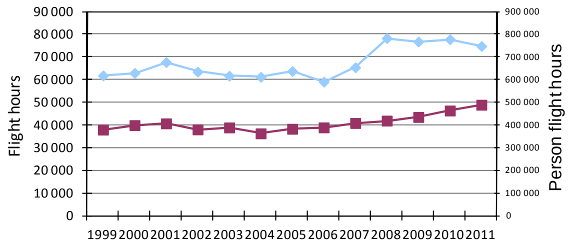
The collaboration with the Civil Aviation Authority and helicopter operators was continued in 2011. Aviation data acquired from involved helicopter operators comprises event type, risk class, severity, flight type, phase, helicopter type and information regarding departure and arrival. The main report (PSA, 2012a) contains further details of scope, limitations and definitions. The last major accident that led to fatalities on the Norwegian Continental Shelf was in September 1997 in connection with the helicopter accident on the Norne field outside Brønnøysund.

In 2009, changes were made to two of the three event indicators that have been used for several years, and two new event indicators were added, while the activity indicators were continued without changes. The changes to the event indicators are continued in 2011. The activity indicators indicate how exposure to helicopter risk develops, and is thus a more leading indicator. The indicators are explained in detail in the main report. The new indicators show interesting trends, even through the data scope is somewhat limited, thus containing greater uncertainty.

7.1 Activity indicators

Figure 3 shows activity indicator 1 (crew change traffic) and activity indicator 2 (shuttle traffic) in the number of flight hours and number of passenger flight hours per year in the time period 1999-2011. There has been an increase in recent years for the transport service. There is a weak reduction in the volume of shuttle traffic for the entire period overall.

Crew change traffic



Shuttle traffic

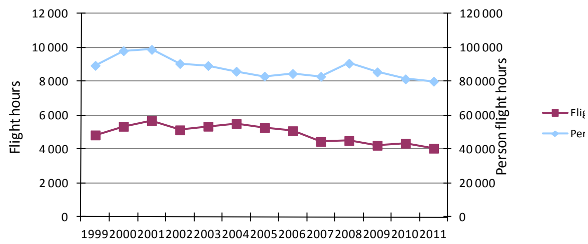


Figure 3 Volume crew change traffic and shuttle traffic, passenger flight hours and flight hours, 1999-2011

Activity indicator 1, volume crew change traffic service per year must be seen in context with the activity level on the Norwegian continental shelf. The number of working hours on production facilities increased slightly, whereas the number of working hours on mobile facilities has varied significantly, but with an increase after 2003. There is generally a constant need for transport per man-hour, which should result in an increase in both flight hours and passenger flight hours. Better utilisation of the helicopters, and the new helicopters' ability to take off with the maximum number of passengers during most weather conditions pull this in the opposite direction.

Shuttling is a normal part of the day on a number of facilities. The Ekofisk field has the most shuttle traffic. Shuttle traffic is, to a certain extent, carried out with larger helicopters than before. This could partially explain the decline in the number of flight hours. In 2011, the number of flight hours reported in shuttle traffic is somewhat lower than in 2010 (approx. 6.7%) and the number of passenger flight hours decreases (approx. 1.7%) compared with 2009.

7.2 Event indicators

7.2.1 Event indicator 1 – serious incidents

Figure 4 shows the number of events included under Event indicator 1. From 2009 (as well as for 2006, 2007 and 2008) the most serious incidents that the companies reported are therefore reviewed by an expert group consisting of operative and technical personnel from the helicopter operators, from the oil companies, and from the PSA's project group, to classify the events in more detail, based on the following categories:

- Small remaining safety margin against fatal accident: *No remaining barriers*
- Medium remaining safety margin against fatal accident: *One remaining barrier*
- Substantial remaining safety margin against fatal accident: *Two (or more) remaining barriers*.

Event indicator 1 includes the events that have a minor or medium remaining margin against a fatal accident for passengers, i.e. no or one remaining barriers. In 2006 and 2007, there was one event each year without remaining barriers, whereas there were two such events in 2008. There were no events without remaining barriers against fatal accidents in 2009 through 2011. As before, events during the parked phase are not included.

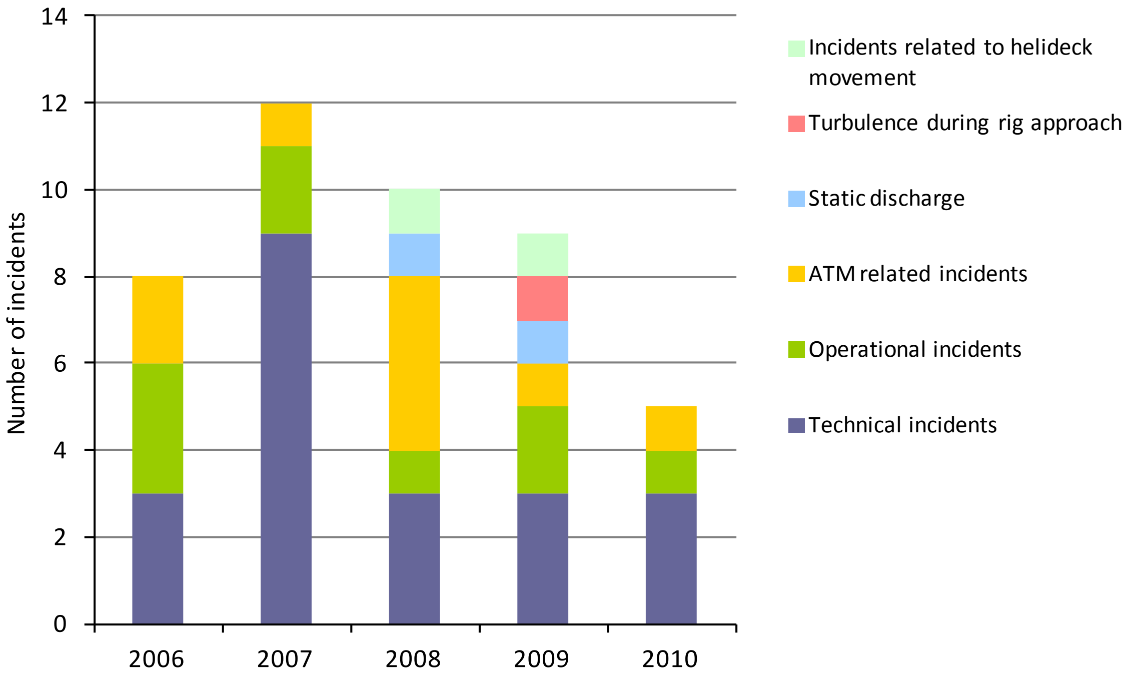


Figure 4 Event indicator 1, events with a small or medium remaining safety margin, 2006–11

Six of 12 events in 2007 were connected to the S-92, which is one of the newest helicopters on the Norwegian Continental Shelf. As regards traffic, S-92 accounts for approx. 60–65% of flight time, whereas various generations of Super Puma primarily account for the remainder. The number of events in connection with S-92 was three in 2008, four in 2009, three in 2010 and two in 2011. Out of a total of 18 events with S-92 in the period 2007–2011, 11 had technical causes, the others e.g. had operational causes, as well as severe turbulence from structures on the facility. EC-225, which is also a new Super Puma helicopter, only had three events in the period, with technical causes, but two of them took place in 2011.

7.2.2 Event indicators related to cause categories

Event indicator 3 is from 2009 and replaced three event indicators based on cause categories, containing the following:

- Event indicator 3:
  - Helideck conditions:
    - Incorrect information regarding position of helideck
    - Incorrect/deficient information
    - Equipment fault
    - Turbulence
    - Obstacles in landing/departure sector or on deck
    - Personnel in restricted sector
    - Breach of procedures
- Event indicator 4:
  - ATM aspects (air traffic management)
- Event indicator 5:
  - Collision with birds.

All degrees of severity beyond ”no safety-related impact” are included in these indicators. Data is presented in Figure 5 – Figure 7 for 2008–2011. For 2008, a few events could be missing, but not enough to entail a clear increase to 2009. In 2010, there was a strong reduction for helideck events, but this increases in 2011 again. The predominant percentage of events is related to floating facilities in 2011. There appears to be a clear improvement on follow-up of procedures and routines on fixed installations, which most likely reflects the industry's focus on such conditions. On the other hand, ATM events increased in 2009, 2010 and 2011.

Based on these cause-related indicators, the main report (PSA, 2012a) indicates areas and conditions where improvements should be achieved. The following improvement suggestions have been identified:

- It is recommended to reduce exposure time where two engines are needed to an absolute minimum.
- The helicopter operators should ensure that the mobile drilling rigs follow the Helideck Manual, or equivalent guidelines. Furthermore, the Committee for Helicopter Safety on the Norwegian Continental Shelf should consider whether there are other measures that could be considered to improve the safety on helicopter decks on these facilities.

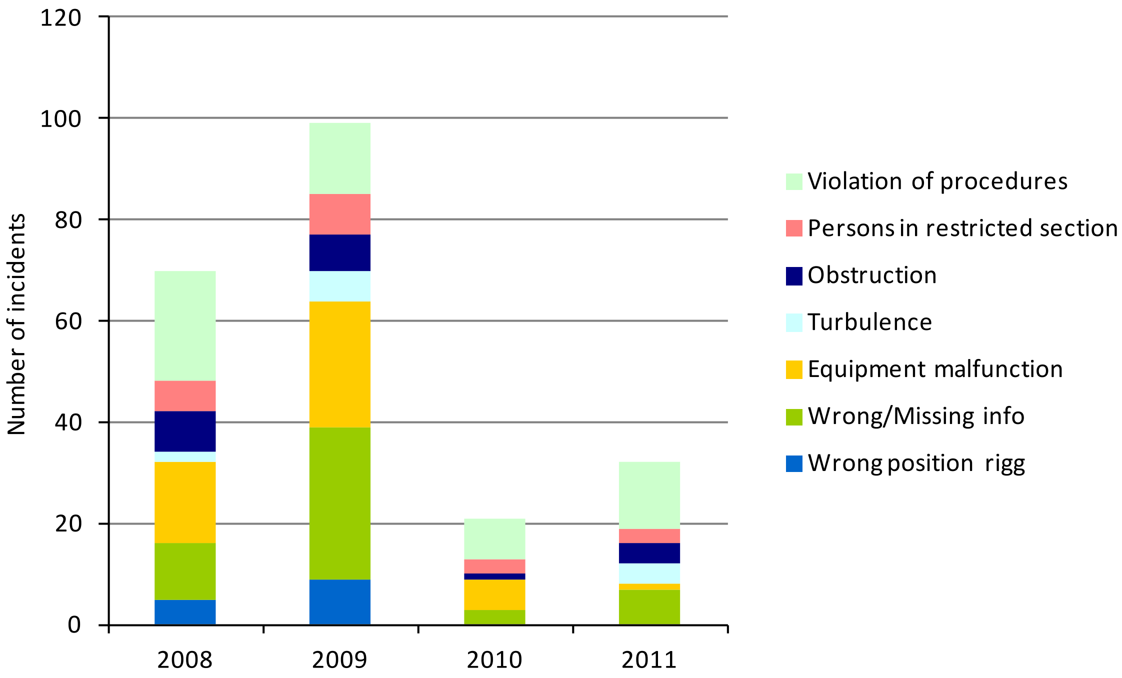


Figure 5 Helideck conditions, 2008–11

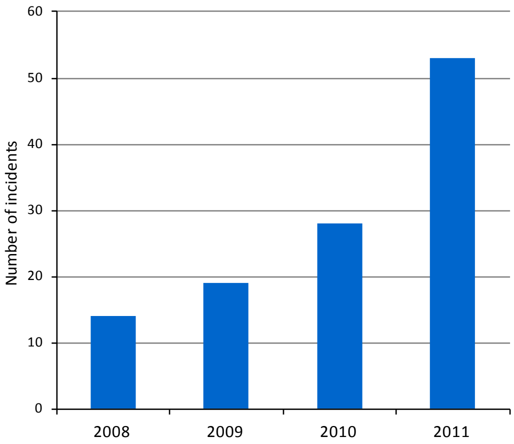


Figure 6 ATM (Flight control) aspects, 2008–11

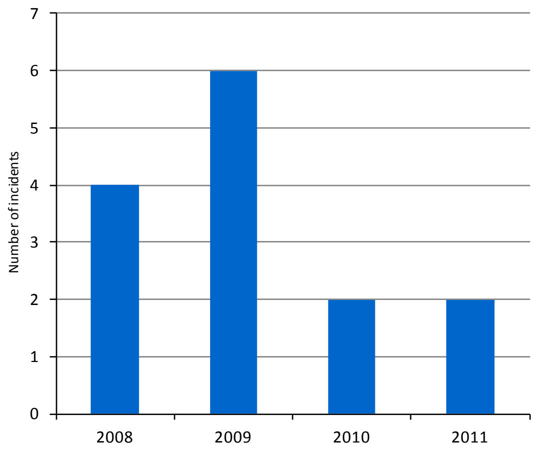


Figure 7 Collisions with birds, 2008–11

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

Indicators for major accident risk from previous years are continued, with the main emphasis on indicators for events and incidents with potential to result in a major accident. Indicators for major accident risk associated with helicopters are discussed in section 7, and barriers against major accidents in chapter 9.

There have been no major accidents, according to our definition, on facilities on the Norwegian Continental Shelf after 1990. None of the DFUs that indicate major accident risk on facilities have resulted in fatalities during the period. The last time there were fatalities in connection with one of these major accident's DFUs was in 1985, with the shallow gas blowout on the mobile facility ”West Vanguard”, see also page 15 in connection with the helicopter accident outside Brønnøysund in 1997. Nor have there been any ignited hydrocarbon leaks from the process systems since 1992, with the exception of occasional minor leaks that are not considered to have the potential of resulting in major accidents.

The most important individual indicators for production facilities and mobile units are discussed in Subsection 8.2. The other DFUs are discussed in the main report. The indicator for overall risk is discussed in sub-chapter 8.3.

8.1 DFUs associated with major accident risk

Figure 8 show the development in the number of reported DFUs during the period 1996–2011. It is important to emphasise that these DFUs have very different contributions to risk.

The clear increasing trend in the period 1996-2000 has been discussed in previous years' reports. From and including 2000, the number of events has been substantially higher than in the period 1996–1999, with some variations. After 2002, there has been a reduction in the number of events up to 2007. No further reductions have been identified after 2007, and there have been only minor variations around a stable level of about 70 events per year.

There has been a decline in the number of events involving hydrocarbon systems during the period from 2002–2007; from wells, process systems and pipelines/risers. In these categories, there were 72 events in 2002, while there were 25 events in 2007 and 26 events in 2008. These are the lowest levels ever reported in this work. Significant increases were once again registered in 2009 and 2010; 41 and 43 events, respectively. For 2011, the number of events involving hydrocarbons has been reduced to 26. This is mainly due to fewer well events, which have been halved compared with 2010.

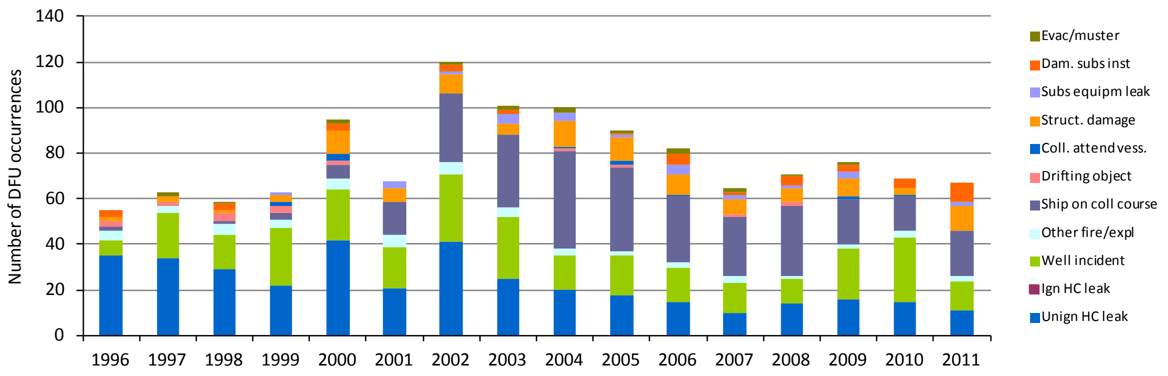


Figure 8 Reported DFUs (1-11) distributed by categories

8.2 Risk indicators for major accidents

8.2.1 Leakage of hydrocarbons in the process area

Figure 9 shows the total number of leaks greater than 0.1 kg/s in the period 1996–2011. Up to 1999, the trend was clearly declining. Subsequently, there has been significant year-to-year variation. There was a definite downward trend from 2002 to 2007, but the number of leaks greater than 1 kg/s did not decline to the same degree. Three leaks were registered in the 1-10 kg/s category in 2011, which is up slightly from 2010. Eight leaks were registered in the 0.1-1 kg/s category. A total of 11 leaks greater than 0.1 kg/s were registered in 2011. When considering the entire 1996-2011 interval, fewer leaks were only reported in 2007.

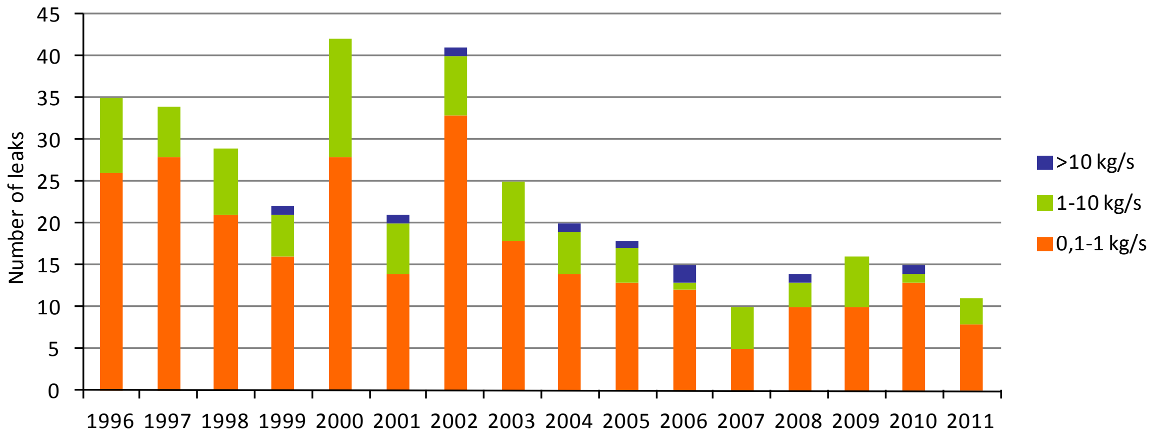


Figure 9 Number of hydrocarbon leaks greater than 0.1 kg/s, 1996-2011

Figure 10 shows the number of leaks when these are weighted in relation to their assessed contribution to risk. Put in simpler terms, we could say that the risk contribution from each leak is approximately proportional with the leak rate expressed in kg/s. Therefore, leaks greater than 10 kg/s account for the greatest contribution, even though there are not more than one or two events per year. The weighting of these largest leaks is usually assessed manually based on the specific circumstances, whereas the other leaks are weighted according to a formula. Figur 10 shows that the contribution to risk in 2011 is the lowest ever recorded in the period 1996-2011, and that it is a substantial reduction compared with 2010.

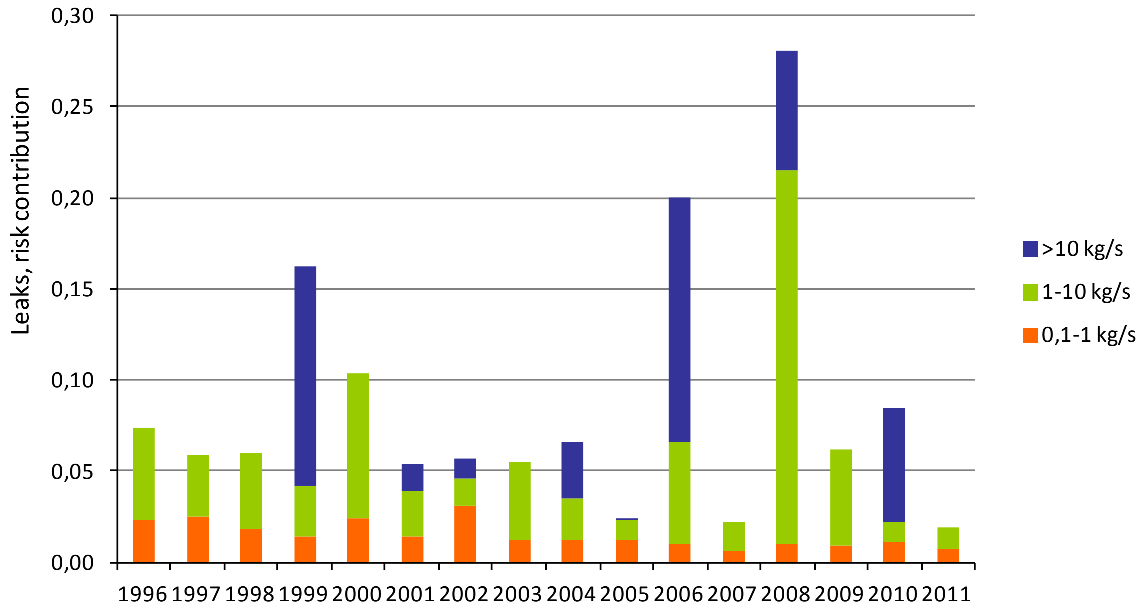


Figure 10 Number of hydrocarbon leaks greater than 0.1 kg/s, 1996-2011, weighted by risk potential

Figure 11 shows the trend of leaks greater than 0.1 kg/s, normalised by facility year, for all manned production facilities. The figure illustrates the technique used throughout to assess the statistical significance (robustness) of trends. Figur 11 shows that the reduction in the number of leaks per facility year is not statistically significant in year 2011 as compared with the average for the period 2003–2010. This is illustrated in that the height of the bar for 2011 falls within the middle grey-shaded field in the bar at the far right of the figure ("Int 03–10", see also sub-chapter 2.3.5 in the pilot project report). Leaks are discussed in the Main Report, normalised against both manhours and number of installations.

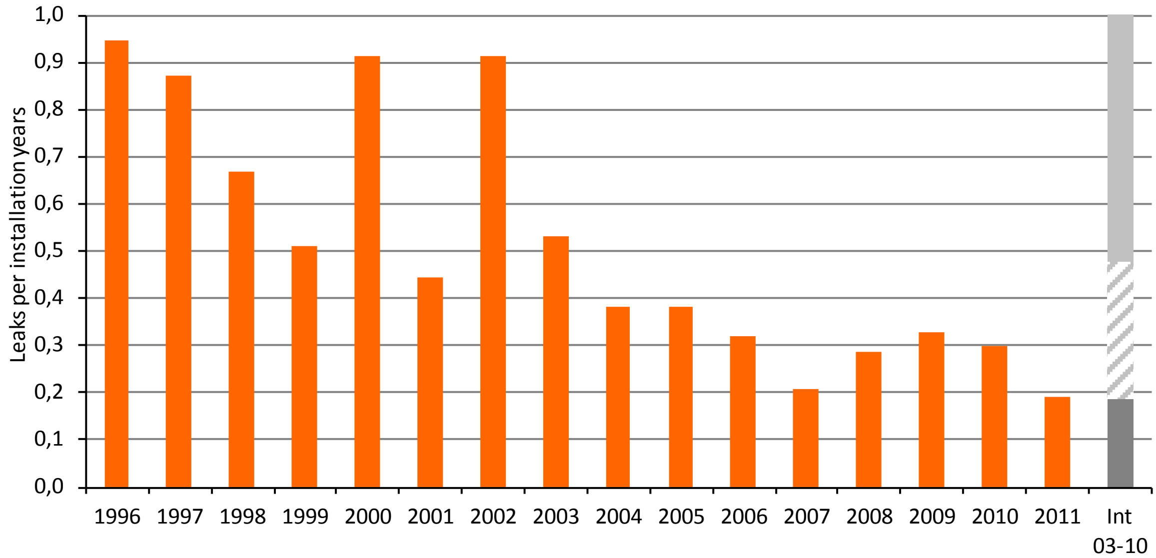


Figure 11 Trends, leaks, normalised against facility year, manned production facilities

There is substantial variation between operators as regards frequency of leaks greater than 0.1 kg/s. These differences have remained nearly constant for many years, which illustrates that there is still a clear potential for improvement. This is also underlined by Figure 12 which shows the average leak frequency per facility year for the operating companies on the Norwegian Continental Shelf. The figure shows data from the last five years. The same companies continue to have the highest frequencies, but they are no longer much higher than any of the other companies.

When the average leak frequency is presented for each individual facility, the five facilities with the highest average frequencies during the period 2006–2011 – all with the same operating company – make up more than 25% of the number of leaks on the Norwegian Continental Shelf in the period. Three of the five facilities with the highest average frequency were also among the top five in corresponding overviews in RNNP reports as of 2005.

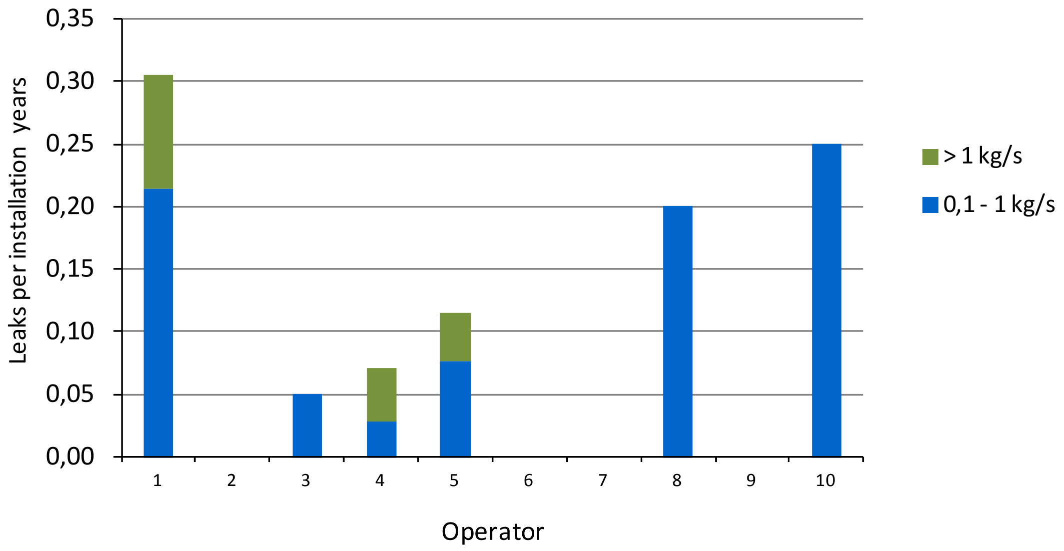


Figure 12 Average leak frequency per facility year, 2007–2011

A systematic comparison has been performed for gas, condensate and oil leaks on UK and Norwegian Continetal Shelf for the areas north of Sleipner (59 °N), where the facilities on both shelves have a nearly comparable scope and complexity. We want to point out that the HSE reporting period runs until 31st March every year. The last available period is 1st April 2010–31st March 2011 (labelled "2010"), which is compared with 2010 on the Norwegian Continental Shelf.

Figure 13 shows a comparison between the Norwegian and UK Continental Shelf, which includes both gas/two-phase leaks and oil leaks, and which is normalised against the facility year, for the two countries' shelves north of 59°N. The figure applies to the period 2000-2010. Data for oil leaks included in the figure are limited to process equipment. As mentioned in previous years' reports, some oil leaks which are not related to process equipment have been excluded from the figure.

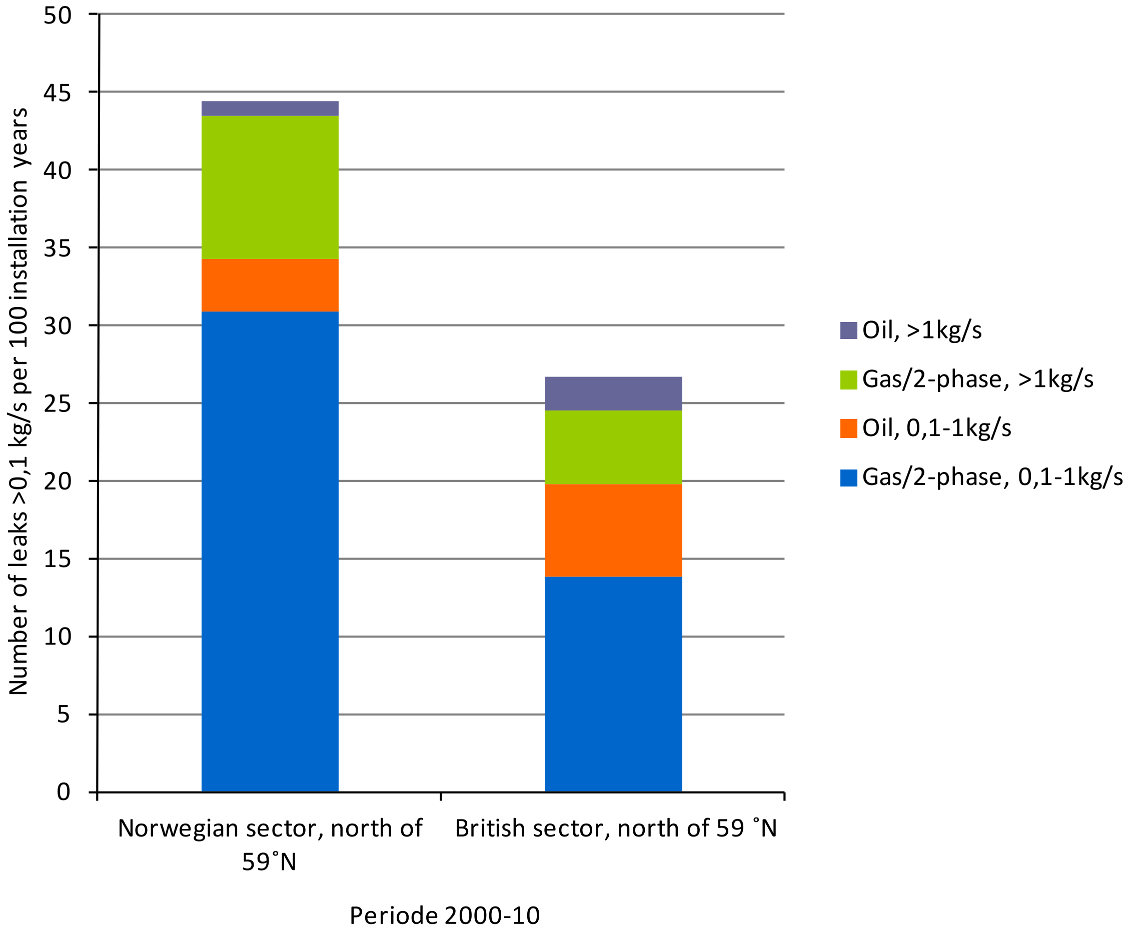


Figure 13 Comparison of gas/two-phase and oil leaks on the Norwegian and UK Continenal Shelf north of 59°N per 100 facility years, average 2000-2009

The number of leaks on the Norwegian Continental Shelf has been considerably in recent years, which means that the period considered has a certain importance. For example, the data show the following observations as regards the average leak frequency per facility year for all leaks exceeding 0.1 kg/s:

- 2000–2010 period: Norwegian Continental Shelf 66% higher than the UK Continental Shelf
- 2006–10 period: Norwegian Continental Shelf 24% higher than the UK Continental Shelf.

No ignited hydrocarbon leaks (> 0.1 kg/s) have been registered on the Norwegian Continental Shelf since 1992. The number of hydrocarbon leaks > 0.1 kg/s since 1992 is most likely about 450. It has been proven that the number of ignited leaks is significantly lower on the UK Continental Shelf, where approx. 1% of the gas and two-phase leaks since 1992 have been ignited.

8.2.2 Loss of well control, blowout potential, well integrity

Figure 14 shows the occurrence of well events and shallow gas events distributed between exploration drilling and production drilling, normalised per 100 drilled wells. Both exploration drilling and production drilling are shown together and on the same scale, for comparison.

There have been considerable variations for exploration drilling throughout the period, perhaps around a stable average on a par with 1996. There was a substantial reduction during the period 2005–2008 and a substantial increase in 2009 and 2010, but the number has declined again in 2011. Production drilling had a continuously increasing trend toward 2003, with minor variations. During the period from 2004 to 2008, there was a decline and an increase in 2009 and 2010. There was a reduction in 2011. Most well events are in the regular category, i.e. events with minor potential. In 2011 there were three events with shallow gas, all associated with exploration drilling.

EXPLORATION DRILLING PRODUCTION DRILLING

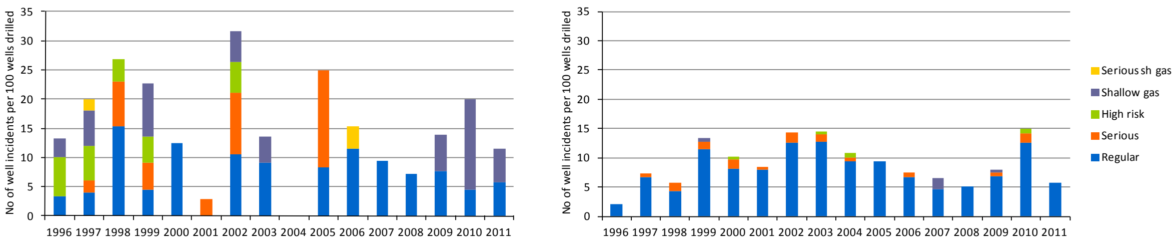


Figure 14 Well events according to degree of severity per 100 wells drilled, for exploration and production drilling

Figure 15 shows an overview of all well control events (for exploration and production wells) in relation to which areas on the Norwegian Continental Shelf where the well control events have occurred. The area division corresponds to the same division as given in the Norwegian Petroleum Directorate shelf map.

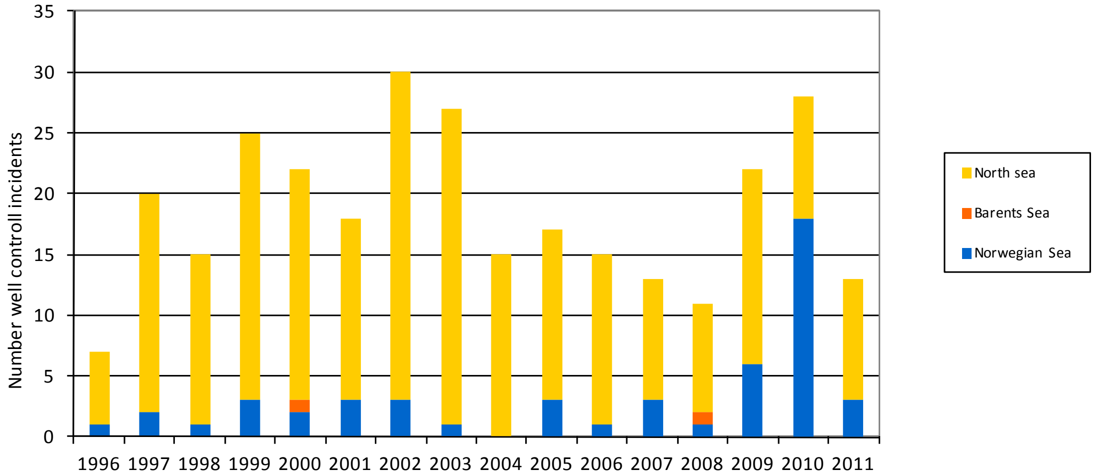


Figure 15 Distribution of well control events by area, 1996-2011

The Well Integrity Forum (WIF) established a pilot project for Key Performance Indicators (KPIs) for well integrity in 2007. A total of 11 operating companies have reviewed all their ”active” wells on the Norwegian Continental Shelf, a total of 1757 wells, with the exception of exploration wells and permanently plugged wells. This was reported for the first time in 2008 according to WIF's list of well categories, with a basis in applicable definitions and subgroups per category. WIF uses the following well categories;

Red;	one barrier failed and the other is degraded/not verified or with external leak
Orange;	one barrier failed and the other is intact, or one individual fault may cause a leak to the surroundings
Yellow;	one barrier is leaking within the acceptance criteria or the barrier is degraded, the other is intact
Green;	intact well, no or insignificant integrity aspects.

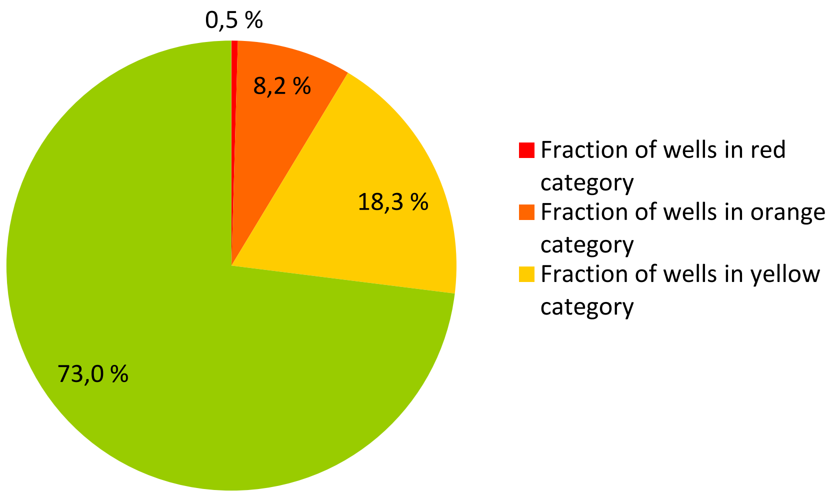


Figure 16 Well categorisation – categories red, orange, yellow and green, 2011

The mapping shows an overview of well categorisation distributed by the percentage of the total selection of 1757 wells.

The results show that 8.7% (7.9% in 2010) of the wells have reduced quality in relation to the requirement for two barriers (red + orange categories). 18.3% (17.8% in 2010) of the wells are in the yellow category. This includes wells with reduced quality in relation to the requirement for two barriers, but the companies have, through various measures, compensated the condition in such a manner that they are considered to safeguard the requirement for two barriers. The remaining wells, i.e. 73% (74% in 2010), are in the green category. These are considered to fully safeguard the requirement for two barriers.

There has been an increase in the percentage of wells in the top three categories from 24 to 27% (62 more wells than in 2009). However, none of the reported conditions in categories red or orange are of such a nature that the need for measures is considered, beyond the measures implemented by the companies them selves.

8.2.3 Leakage/damage to risers, pipelines and subsea facilities
In 2011, two leaks were reported from risers on manned facilities. Both leaks occurred from flexible risers within the safety zone near the facility. No pipeline leaks were reported in 2011. There have been no leaks in the previouse five years.

In 2011, eight serious cases of damage to risers and pipelines were reported within the safety zone. All damages are on flexible risers. This confirms trends as the fault ratio (number of faults per year in operation) has been higher for flexible risers than for rigid risers.

In 2011, eight of ten damage instances and both leaks were associated with a special type of design for flexible risers, so-called triple-layer PVDF/Coflon. A new fault mode was discovered associated with this type of design. About 60 flexible risers of this type have been installed on the Norwegian Continental Shelf. Multiple risers have been removed from operation and work is ongoing to phase out these types of risers.

Cases of serious damage are also included in the calculation of the total indicator, but with a lower weight than leaks. Figur 17 shows an overview of the most serious damages in the period 1996-2011.

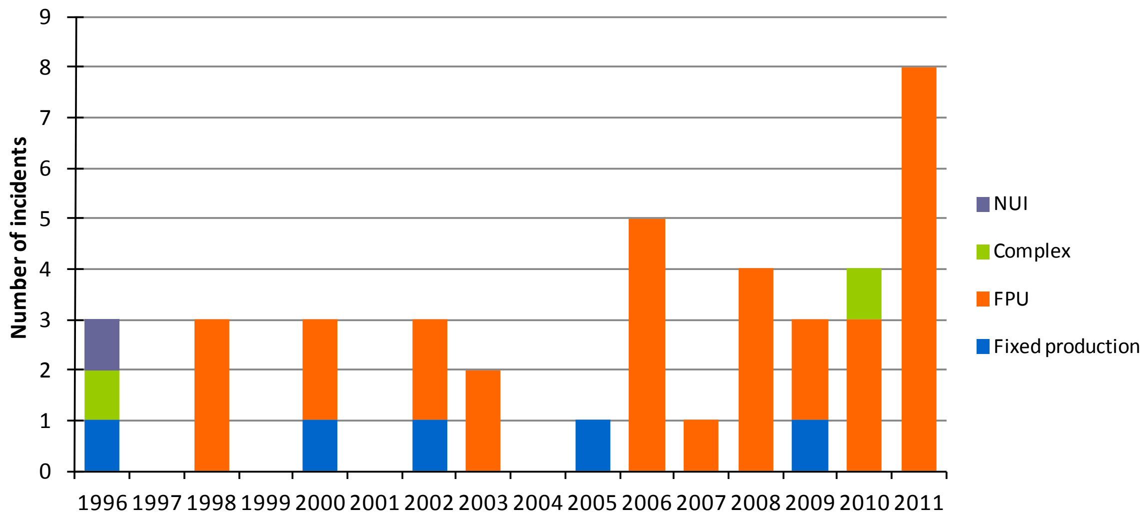


Figure 17 Number of cases of serious damage to risers & pipelines within the safety zone, 1996-2011

8.2.4 Ship on collision course, structural damage

There are only a handful of production facilities and a few more mobile units where the facility itself or standby vessel is responsible for monitoring of passing vessels on a potential collision course. The remainder are monitored from the Ekofisk and Sandsli traffic centres.

For ten years there has been an indicator for DFU5 where the number of vessels reported on a possible collision course was normalised in relation to the number of facilities that are monitored from the traffic centre at Sandsli, expressed as a total of number of monitoring days for all installations that are monitored by Statoil Marine at Sandsli. The number of vessels registered on a collision course has declined substantially in recent years.

For collisions between vessels that are associated with petroleum activities and facilities on the Norwegian Continental Shelf, there was a high level in 1999 and 2000 (15 events each year). In particular, Statoil has carried out considerable work to reduce such events, and the level has been around two to three a year.

There were two events in 2011. The supply vessel Rem Fortune collided with Ekofisk J during loading and offloading on 23 January 2011. The vessel lost its position and collided with one of the platform legs. One lifeboat was damaged and destroyed, a scaffolding below deck was struck and fell in the sea, and antennas on the vessel were damaged. During loading from Eldfisk 2/7-A on 30 July 2011, the supply vessel Normand Mjolne manoeuvred in towards Eldfisk A at 0.3 m/s. When the ship was positioning itself below the crane, it came too close to the facility so the stern was pushed against the facility and struck the north-eastern leg before it vent clear of the facility. As mentioned in previous years, the average size of vessels has increased substantially.

Major accidents related to structures and maritime systems are rare. Even though there have been multiple very serious events in Norway, there are too few to be able to measure trends. We have therefore selected events and injuries with a minor degree of severity to measure changes in risk. It is also assumed that there is a correlation between the number of minor events and the most serious, see the method report.

The current regulations set requirements for flotels and production facilities to withstand the loss of two anchor lines without serious consequences. Loss of more than one anchor line happens occasionally. This can have major consequences, but rarely has consequences as great as on *Ocean Vanguard* in 2004. Mobile drilling units are required to withstand the loss of one anchor line without undesirable consequences.

Structural damage and events included in RNNP are mainly classified as fatigue damage, but some of this is storm damage. Only structural cracks have been included. There is no clear correlation between the age of the facility and the number of cracks.

In 2011, a total of 10 cases of structural damage were recorded, of which four are associated with anchor lines and four with cracks in main loadbearing structures (fatigue). There have not been any events in the most serious category in the last three years. For mobile facilities, these events are the greatest contributor to the total risk indicator for 2011, constituting nearly 60%.

8.3 Total indicator for major accidents

The total indicator applies to major accident risk on facilities, while risk associated with helicopter transport was discussed in Section 7. The calculation model assigns the DFUs a weight based on the probability of fatalities. We want to emphasis that this indicator is only an addition to the individual indicators, and is an expression of trends in risk-affecting factors related to major accidents.

The total indicator weights the contributions from observations of the individual DFUs according to the potential for loss of life (see the Pilot project report), and will therefore vary considerably based on observations of the individual DFUs. Figur 18 shows the indicator with annual values, as well as a three-year rolling averages. The great leaps from year to year disappear when we consider the three-year rolling average, thus elucidating the long-term trend. Manhours are used as a common parameter for normalising against the activity level. The level for normalised value is set at 100 in the year 2000.

Looking at the three-year average, the main impression is a fairly constant level up to 2006. Since 2007, the level has been somewhat constant at a lower level and slowly declining. Individual events with substantial risk potential may result in significant variations, and have an impact over three years, due to the average, as is clearly shown by the figure for 2004 (Snorre A blowout) and 2010 (well event on Gullfaks C). None of the events in 2011 have been assigned a particular weight.

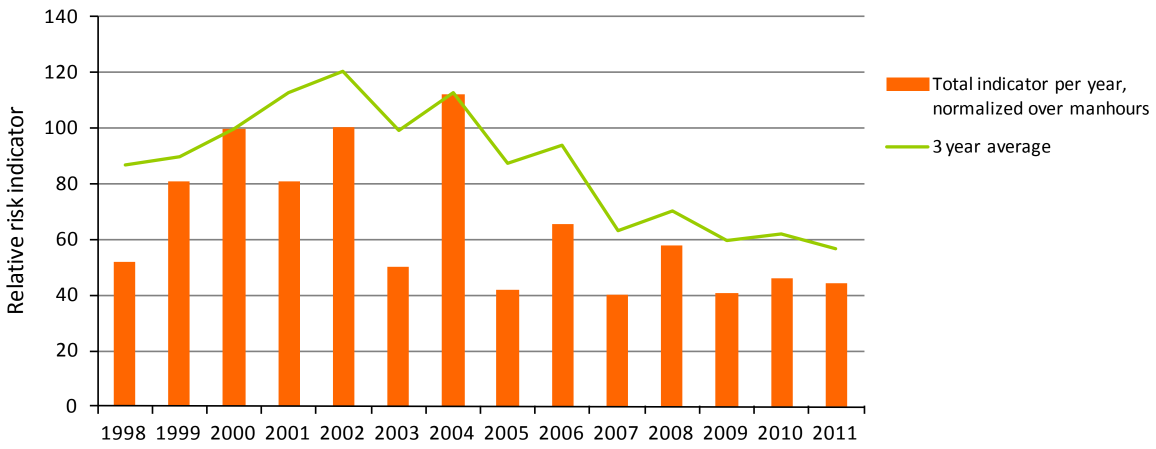


Figure 18 Total indicator, production facilities, normalised against manhours, annual values and three-year rolling average

Figure 19 shows the trend of the total indicator for mobile units, with annual values and the three-year rolling average. The values in 2009, 2010 and 2011 are the lowest three-year average values in the entire period. There has been a general declining trend throughout the period, considering the three-year average.

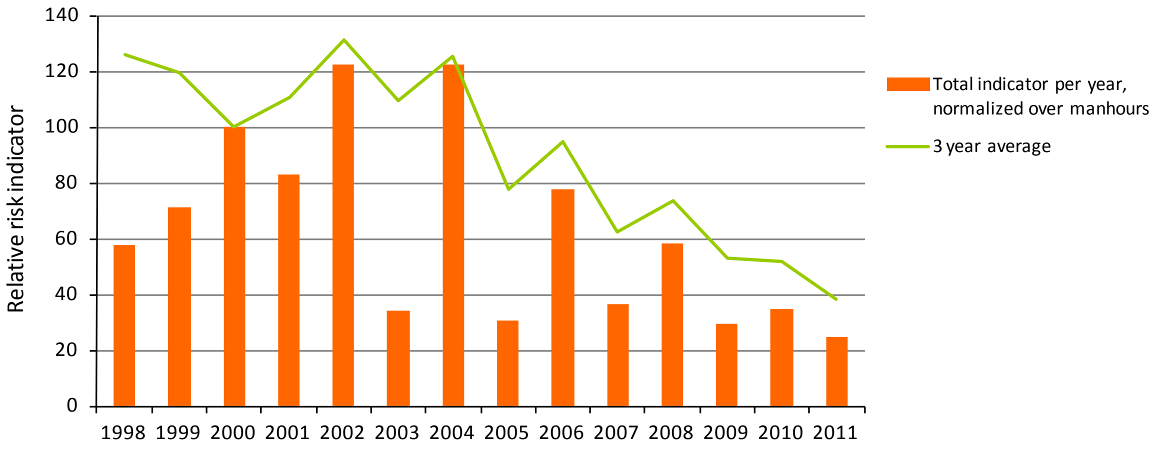


Figure 19 Total indicator, mobile facilities, normalised against manhours, annual values and three-year rolling average

9. Status and trends – barriers against major accidents

The reporting and analysis of barrier data have been continued, with no significant changes from preceding years. As before, companies report test data from periodic testing of selected barrier elements.

9.1 Barriers in production and process facilities

The main focus is on barriers relating to leaks in production and process facilities, where the following barrier functions are included:

- Integrity of hydrocarbon production and process facilities (covered to a large extent by the DFUs)
- Prevent ignition
- Reduce cloud/spill
- Prevent escalation
- Prevent fatalities

The different barriers comprise a number of coordinated barrier systems (or elements). For example, a leak must be detected before any isolation of ignition sources and emergency shutdown routines (NAS/ESD) are effectuated.

Figure 20 shows the relative fraction of failures for those barrier elements relating to production and process, for which test data have been acquired. These test data are based on reports from all production operators on the Norwegian Continental Shelf.

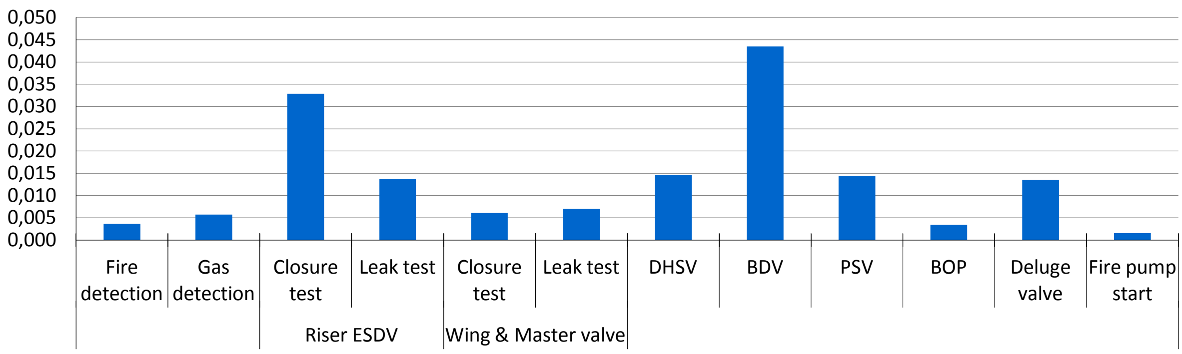


Figure 20 Mean fraction of failures for selected barrier elements, 2011

The Main Report shows the difference between the mean fraction of failures (Figur 20), i.e. the fraction of failures for each facility separately and then the mean for all facilities, and the "total fraction of failures", i.e. the sum of all failures on all facilities reporting data, divided by the sum of all tests for all facilities reporting data. The mean fraction of failures gives all installations the same contribution to the average, regardless of whether they have many tests or few.

The data show significant variations in mean levels for each of the operating companies, and for several barrier elements. The variations are even greater when we examine each individual facility, which has been done for all barrier elements in the Main Report. Figur 21 shows an example of such a comparison for testing emergency shutdown valves (ESDV) on risers and flowlines. Each individual facility has been assigned a letter code, and the figure shows the number of failures in 2011, the average number of failures during the period 2007–2011, as well as the total number of tests performed in 2011 (as text on the X axis, along with the facility code). The figure shows that, with a few exceptions, very few failures have been recorded on ESDV closing tests in 2011. We want to mention that facility L carried out one test, and this test failed, thus resulting in a failure fraction of 1.0 in 2011. Facility BV has carried out three tests with one failure. The fraction of failure for both these facilities is significantly affected by the low number of tests, while facility BA has carried out 17 tests, and the fraction of failure is still more than double the average for this facility. BQ also has significantly high fraction of failure.

The industry requirement for an ESDV closing test is 0.01, and the figure shows that several facilities exceed the industry requirement, eight for the fraction of failure in 2011 and 19 for the mean value.

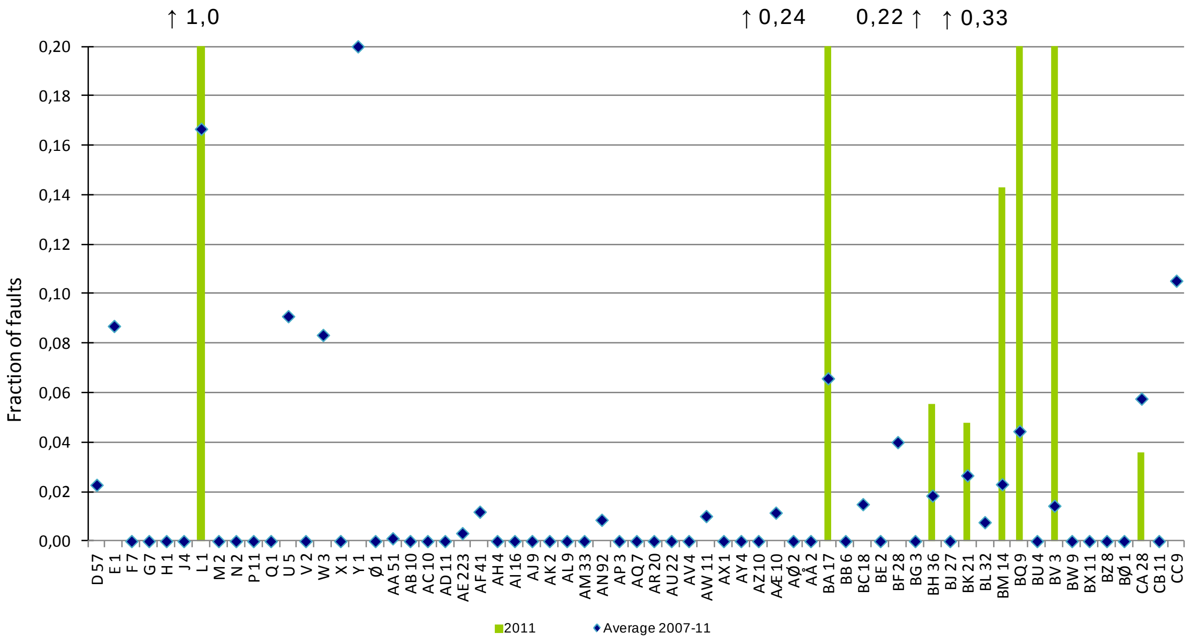


Figure 21 Fault ratio for ESD valves on risers (closing test)

Barrier data for production facilities has now been acquired for 10 years for most barriers. Overall, many individual facilities as well as several barrier elements have performed below or considerably below industry requirements, both in 2011 and on average throughout the period. With the industry's current focus on preventing major accidents, one would expect it to be possible to achieve more improvements in this area than what is indicated by the data from recent years.

Tabell 2 shows how many facilities have performed tests for each barrier element, the total number of tests, the average number of tests for the facilities which have performed tests, the total fraction of failureand the mean fraction of failurefor 2011 and for the period 2002–2011. This can then be compared with availability requirements for safety-critical systems. Bold figures signify that the fraction of failure exceeds the industry requirement.

The table shows that, overall, most barrier elements are below or nearly satisfy the industry requirement as regards availability. However, this does not apply to the riser ESDV and pressure relief valve (BDV), where the total fraction of failuresubstantially exceeds the industry requirement for 2011, as well as for the period 2002-2011. In other words, the industry has a clear potential for improvement for these barriers.

Table 2 Overall calculations and comparison with industry requirements for barrier elements

Barrier elements	Number of facilities where tests have been performed in 2011	Average, number of tests, for facilities where tests have been performed in 2011	Number of facilities with a 2011 fraction of failure(and average 2002-2011) exceeding industry requirements	Mean fraction of failurein 2011	Mean fraction of failure2002-2011	Industry requirements for availability (Statoil)
Fire detection	69	768	6 (10)	0.004	0.005	0.01
Gas detection	69	409	10 (20)	0.006	0.009	0.01
Shutdown:						
· Riser ESDV	63	25	8, 7 (19, 14)*[3]	**0.023**	**0.021**	0.01
· Wing and masts (X-mas tree)	56	274	7, 8 (3, 7)*3	0.007	0.011	0.02
· DHSV	56	147	17 (20)	0.015	**0.021**	0.02
Pressure relief valve (BDV)	57	73	22 (42)	**0.044**	**0.022**	0.005
Safety valve (PSV)	68	212	7 (17)	0.014	0.029	0.04
Isolation with BOP	30	93		0.003	0.025	*[4]
Active fire prevention:						
· Deluge valve	67	36	13 (20)	**0.014**	**0.011**	0.01
· Start-up test	54	134	7 (9)	0,002	0.004	0.005

9.2 Barriers related to maritime systems

Data have been acquired in 2011 for the following maritime barriers on mobile facilities:

- Watertight doors
- Ballast system valves
- Deck height (airgap) for jack-up facilities
- GM values for floaters at the end of the year.

Data acquisition has been carried out for both floating production and mobile facilities. There are significant variations in the number of tests per facility, from daily tests to twice per year. The increase is due to high failure frequencies on the newest facilities. In 2011, approx. 20 000 tests have been performed on watertight doors, as well as approx. 260 000 tests of ballast valves. The failure frequencies for these systems in 2011 are approximately on a par with those for production facilities. There is no clear connection between the number of failures and number of tests, but the ones that tested the least had the highest failure frequencies (number of failures/number of tests on the entire facility), and likely the greatest system downtime.

There has been a steady increase in recent years in the number of failures in ballast valves. There are greater annual variations for watertight doors, but the trend is increasing here as well. We have examined the relationship between age and failure frequencies, and it turns out that there are more faults on younger facilities.

[3]For the riser ESDV and wing and master valve the figures apply to the *closing test* and *leakage test*, respectively.
[4]There are no requirements to compare this barrier with.

Data for the metacentre height (GM) for floating production facilities has been acquired since 2010, while such data have been requested for mobile facilities since 2008. GM is the distance from the metacentre (M) to the facility's centre of gravity (G). A high positive value indicates good intact stability. The facility is stable when the metacentre height is positive and it is unstable if it is negative. This value will mainly express weight changes on the facility, but also whether changes have been made in updrift volumes. The average metacentre height on 31 December 2011 was 3.25m for mobile facilities and 3.3m for floating production facilities.

9.3 Indicators for maintenance management

In 2006, the PSA started the project Maintenance as an instrument to prevent major accidents; maintenance status and challenges in this context. The goal was, among other things, to update the status of maintenance management in the petroleum activities as regards the significance maintenance has for prevention of major accidents. The project showed that the status, as regards consideration for classification of systems and equipment, had not improved in relation to what was stated in Storting Report. no. 7 (2001-2002). The PSA's audits during the period 2006–2009 identified a number of nonconformities in relation to the regulatory requirements in all companies that were subject to audits. The general nonconformities are:

- deficient classification of systems and equipment,
- deficient use of classification,
- deficient inspection with outstanding maintenance,
- deficient documentation,
- deficient expertise,
- deficient evaluation of maintenance efficiency.

The indicators for maintenance management focus on *the decision basis for maintenance management*, i.e. labelling (”tagging”) systems and equipment on the facilities, classification of what is labelled, and what percentage of this is classified critical as regards consideration for health, safety and the environment (”HSE critical”). In addition, the *status of performed maintenance*is included, i.e. the hours spent on preventive and corrective maintenance, lag for preventive maintenance, and outstanding corrective maintenance; also with consideration for HSE-critical equipment and systems. The reporting classes in the introductory phases are as follows:

Decision basis for maintenance management:

- Number labelled ("tagged") equipment in total
- Number of "tags" classified
- Number of "tags" classified as HSE-critical

Status of performed maintenance:

- PM lag, number of total hours
- PM lag, number of hours HSE-critical
- Corrective maintenance outstanding, number of total hours
- Corrective maintenance outstanding, number of hours HSE-critical

The main report shows all indicators, this only shows two of these. Figur 22 shows the degree of lag for preventive maintenance for production facilities, whereas Figur 23 shows the degree of lag for mobile facilities.

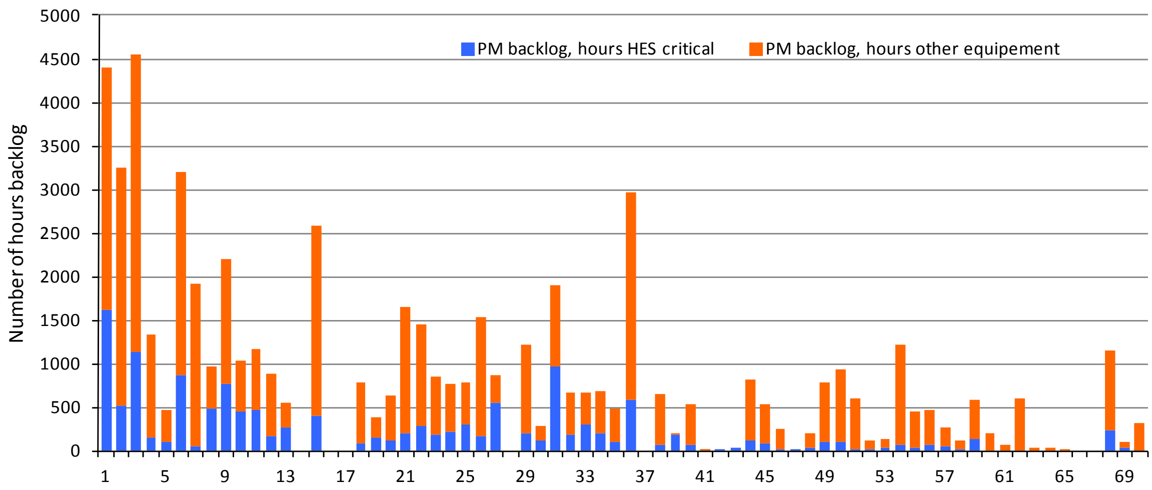


Figure 22 Overview of lag in preventive maintenance, production facilities

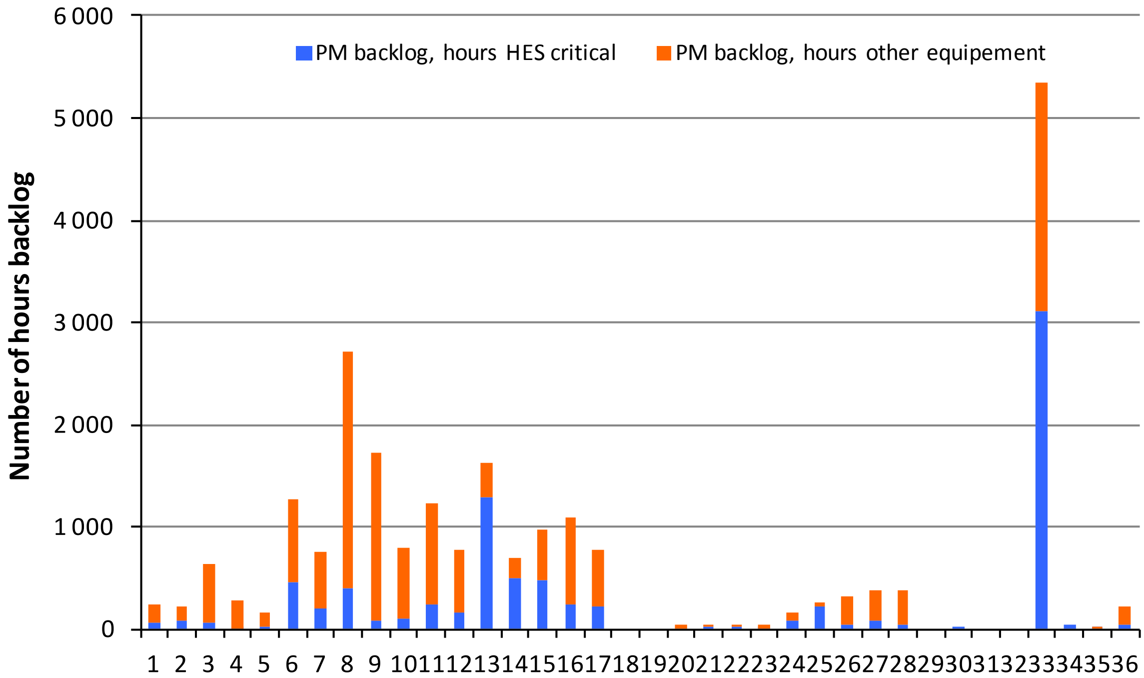


Figure 23 Overview of lag in preventive maintenance, mobile facilities

There is also much planned maintenance that has not been carried out, also for HSE-critical systems and equipment. Lag in maintenance introduces risk contributors. It is thus important to carry out stringent inspections of the lag and the risk it represents.

As regards labelling and classification of equipment, the figures from 2011 show that more production facilities have labelled systems and equipment than in 2010. Mobile facilities still have low figures for labelling and classification. For some installations, the classification level is so low that it could be difficult to establish a risk-based decision basis for maintenance purposes.

10. Status and trends – work accidents with fatalities and serious personal injuries

In 2011, the PSA registered 330 personal injuries on facilities in petroleum activities on the Norwegian Continental Shelf that fall under the criteria of fatality, missing the next shift or medical treatment. In 2010, 288 personal injuries were reported. There were no fatal accidents within the PSA's area of authority on the Continental Shelf in 2011. One person is confirmed missing on the Visund platform. The person did not report for work, and a search was started immediately. The search was terminated without finding the missing person.

In addition, 63 injuries were reported classified as off-duty injuries and 104 first aid injuries in 2011. For comparison, there were 56 recreational injuries and 105 first aid injuries in 2010. First aid injuries and off duty injuries are not included in figures and tables.

In recent years, there has been a clear reduction in the number of injuries reported on NAV (Norwegian Labour and Welfare Administration) forms. In 2011, a total of 24% of the injuries were not reported to the PSA on NAV forms, but were registered based on information received in connection with quality assurance of data. In total, the number of injuries increased in 2011.

In the period 2001-2004, there was a clear reduction from 23.1 to 11.3 injuries per million working hours on production From 2004 to 2008, the overall injury frequency has generally remained unchanged at about 11 injuries per million working hours. In 2009, there was a significant decline from 11 to 8.6 injuries per million working hours. This positive development continueed from 2009 to 2010. In 2011, the injury frequency is 7.6 per million working hours, which is a small increase of 0.1 from 2010.

There has been a positive development in the last ten years on mobile facilities, the same as for production facilities. From 2001 the frequency steadily declined from 22.5. to 11.1 in 2006. In 2007, there was an increase in the injury frequency, but from 2008 there has been a positive development and 2010 has the lowest registered frequency in the entire period. However, in 2011, the frequency increased again from 5.8 in 2010 to 7.0 per million working hours in 2011. In 2011 there were 92 personal injuries on mobile facilities compared with 70 in 2010. There is an increase in reported injuries for mobile facilities, the same as for production facilities.

10.1 Serious personal injuries, production facilities

Figure 24 shows the frequency of serious personal injuries on production facilities per million working hours. The frequency has had a downward trend from 2001 up to 2004. From 2005, there was a positive trend until 2008, when the positive development turned. In 2009, there was a temporary decline, but in recent years we can see a positive trend, and in 2011 the injury frequency on production facilities is at its lowest level. There has been a reduction in the injury frequency on production facilities in the last year equalling 0.25 injuries per million working hours. The injury frequency has declined from 0.79 in 2010 to 0.55 in 2011. For production facilities, this was a significant reduction in 2011 compared with the last decade.

There were 17 serious personal injuries on production facilities in 2011 compared with 23 in 2010. The number of working hours has increased by 2.2 million hours from 28.96 million in 2010 to 31.18 million in 2011.

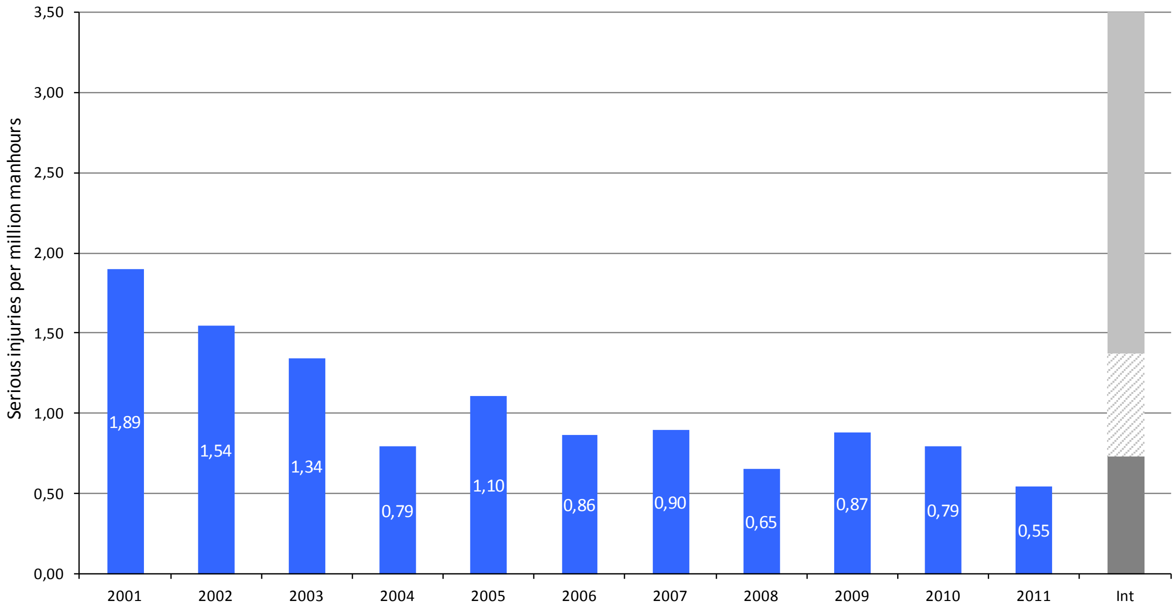


Figure 24 Serious personal injuries on production facilities related to working hours

10.2 Serious personal injuries, mobile facilities

Figure 25 shows the frequency of serious personal injuries per million working hours on mobile facilities. There has been a pronounced decline in recent years from the peak in 2001. From 2002 to 2006, there were minor changes to the injury frequency, whereas there was a reduction in 2007. In 2008, there was another decline in the frequency, while in 2009 and 2010 there was a very positive development with the lowest level ever in 2010. In 2011, there was an increase in the frequency for serious personal injuries totalling 0.3 injuries per million working hours from 0.42 in 2010 to 0.68 in 2011. The injury frequency in 2011 is sigificantly lower compared with the average for the previous ten years.

The number of hours reported for the mobile facilities in 2011 increased by 1.2 million from 12.0 to 13.2 million. There were nine serious personal injuries in 2011, compared with five in 2010.

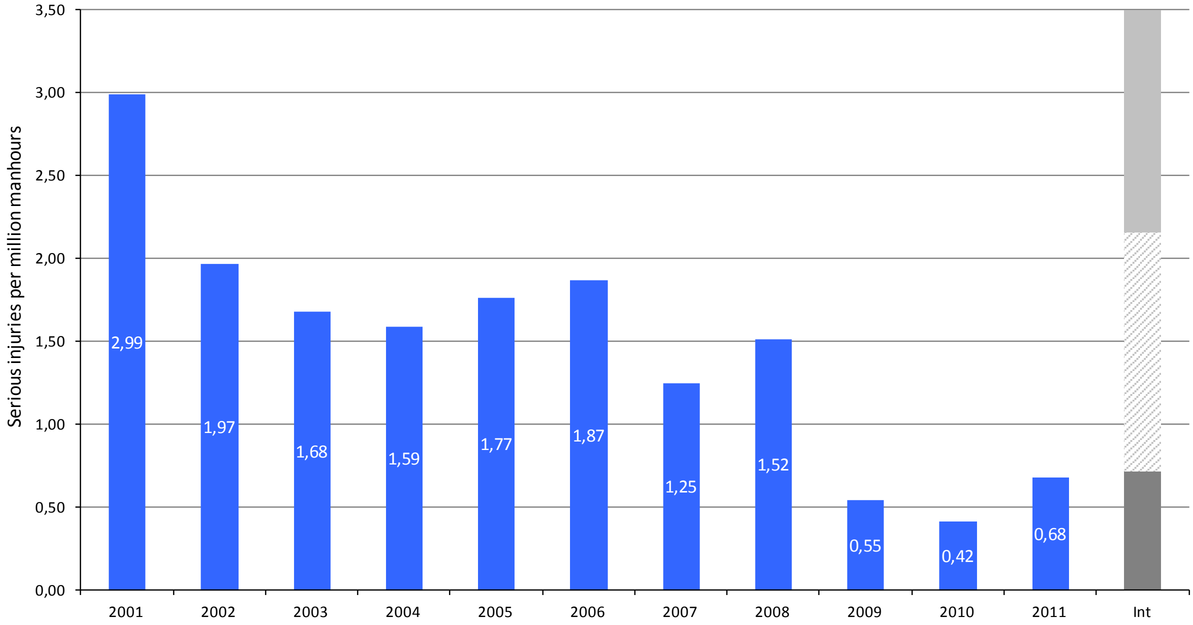


Figure 25 Serious personal injuries per million working hours, mobile facilities

10.3 Comparison of accident statistics between the UK and Norwegian Continental shelves

The PSA and the UK Health and Safety Executive (HSE) bi-annually produce a joint report comparing statistics on offshore personal injuries. The classification criteria were initially virtually equal, but upon closer examination, it emerged that the classification criteria were actually somewhat different. To improve the comparison basis, the PSA has, in dialogue with UK authorities, classified serious personal injuries according to joint criteria and so they cover corresponding activity areas.

The calculation of the average injury frequency for fatalities and serious personal injuries for the period from 2006 to and including the first six months of 2011 shows that there were 0.73 injuries per million working hours on the Norwegian side and 0.78 on the UK Continental Shelf. The difference is not significant. However, the difference in the frequency of fatal accidents in same period is greater. The average frequency for fatalities on the UK Continental Shelf is 1.32 per 100 million working hours compared with 0.93 on the Norwegian Continental Shelf. This difference is also not significant. On the UK Continental Shelf, four people died during the mentioned period compared with two on the Norwegian Continental Shelf.

11. Risk indicators – noise, chemical working environment and ergonomics

Emphasis has been placed on these indicators, in that they express risk factors as early as possible in the causality chain that leads to occupational injury or illness, and for them to be desirable for use in the company's improvement work.

As regards noise and chemical working environment, data have been recorded from all installations and onshore facilities with a few exceptions. As regards noise, the data set is characterised by a common understanding of the reporting criteria and the indicator appears to provide a realistic and consistent picture of the actual conditions. It also appears to have good sensitivity for changes. Changes and adaptions have been made for the chemical working environment so that indicators will reflect real risk factors as best possible. The indicator has not changed for 2011.

Indicators for ergonomic factors have been reported for 2009, 2010 and 2011. The indicator for 2009 was changed in 2010, so the figures for 2009 and 2010 were not comparable. This is the first time it is possible to compare figures from one year to another, from 2010 to 2011.

The indicators are based on a standardised data set and will only detect parts of a complicated risk picture. Indicators can therefore not replace the company's duty to carry out exposure and risk assessments as a basis for implementing risk-reducing measures.

11.1 Noise hazardous to hearing

Data have been reported from 78 facilities, 44 production facilities and 34 mobile facilities. Among the production facilities, 16 facilities are ”new” and 28 are ”old”. New facilities refers to facilities that have an approved plan for development and operation (PDO) after 1 August 1995. At this time, strict and detailed noise requirements were introduced (SAM Regulations).

The indicator for noise exposure covers 11 pre-defined position categories. In total, data representing approx. 7500 employees on the Continental Shelf has been reported.

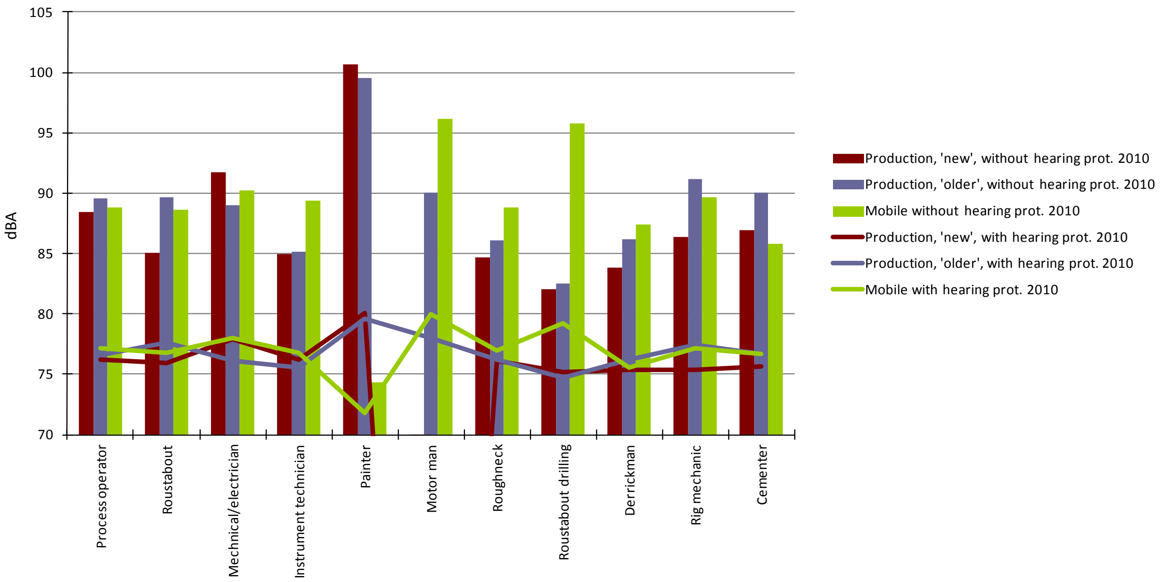


Figure 26 Average noise exposure for position categories and facility type, 2011

The results show an improvement in nine of ten position categories from 2010 and for several of the position categories there is a positive trend over 2-3 years. Looking at the average for the noise indicator for the entire Continental Shelf activity, it has changed from 90.2 in 2010 to 89.3 in 2011. This is partially due to the fact that the figures for manning in some position categories have been adjusted upwards and annual variations that cannot be attributed to improvement, but variations in activity level and activity types. The average noise indicator for the facilities is significantly impacted by how many surface treatment personnel have worked on board the facility. Overall, the development in noise indicator per job category provides the best assessment basis for change.

The noise indicator for the engineer and surface treatment group is significantly higher than for other groups, and the noise indicator including hearing protection is still relatively high for these groups.

For most job categories, the noise indicator is lower on ”new” facilities than ”old”. There are 14 facilities that have reported that technical measures have been implemented that have resulted in overall noise reductions of 1 dB, 12 facilities with a reduction of 3 dB and two facilities with a reduction of 5 dB, respectively, for some job categories. This is an improvement in relation to previous years, but still represents a level of implementation resulting in little exposure reduction.

The reporting confirms that multiple companies have formalised and implemented plans for working hours restrictions. Of 78 facilities, five facilities have not introduced such plans for any job categories. This particularly applies to mobile facilities. As in previous years, there is still a potential for improvement within this area on mobile facilities. Even though it can be difficult to verify that these types of measures are effective, there are examples indicating that they may work. Such plans could have operational disadvantages and could help initiate technical measures.

Despite the indicator pointing in the direction of high exposure, several facilities still do not have risk reduction measure plans, see Figur 27. The picture has developed in a more positive direction compared with 2010 for ”new” and ”old" production facilities. The indicator for mobile facilities has developed in a negative direction.

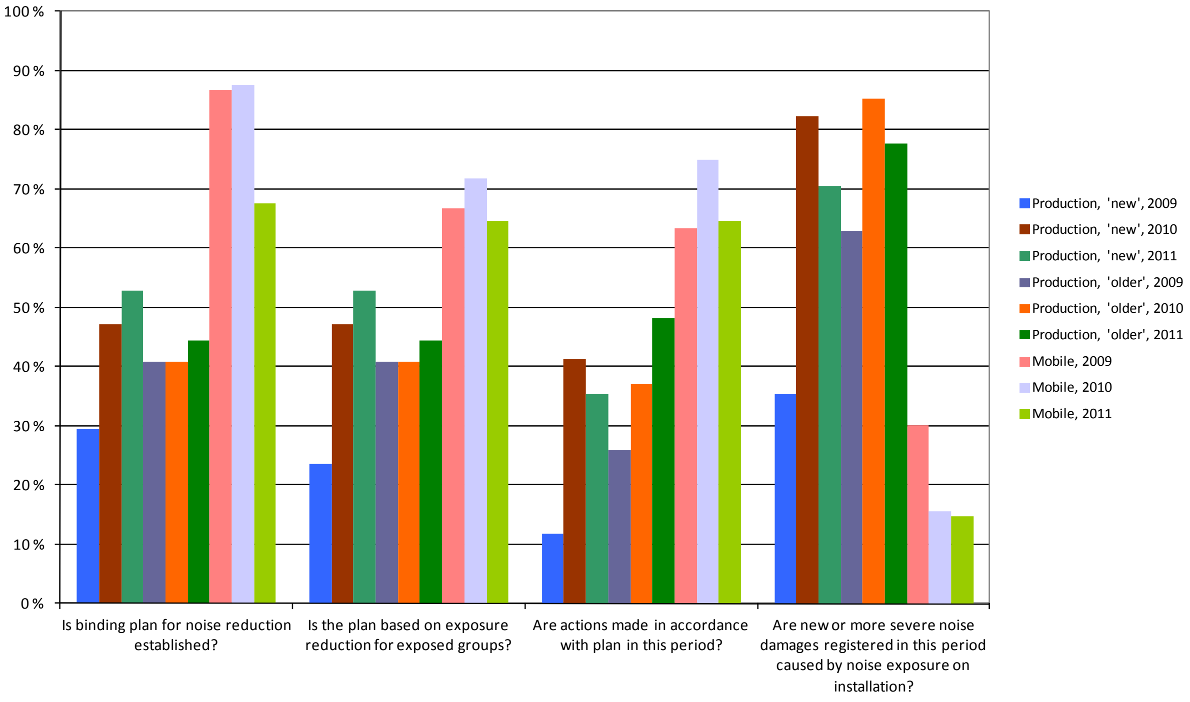


Figure 27 Plans for risk-reducing measures

In 2011, 710 noise-related injuries were reported to the PSA, compared with 605 in 2010. This is the highest number recorded. All in all, it seems clear that large employee groups in the offshore petroleum activities are exposed to high noise levels and that the risk of developing noise-related hearing injuries is not negligible. The PSA's experience through contacts with the industry, case processing and audits, indicates that the potential for noise-reducing measures is substantial. This is also part of the reason why actions were taken in 2011 for a major industry project for noise reduction in petroleum activities.

11.2 Chemical working environment

The indicator for the chemical working environment consists of two elements. One is the number of chemicals in use distributed by hazard category (chemical spectrum's risk profile), as well as data on substitution. The other element is associated with actual exposure for defined position groups where one attempts to detect the exposure with the highest risk. In addition, supplementary information has been reported which indicates the companies' management of chemical exposure risk. Establishing binding plans and follow-up of these is a key factor in this context.

The indicator for the chemical spectrum's risk profile provides a picture of the number of chemicals in use on each facility and how many of these have a high and defined risk potential. The indicator has limitations in that is does not take into consideration how the chemicals are actually used and the risk this represents. However, it does say something regarding the companies' ability to limit the occurrance and use of potentially dangerous chemicals. There is a recognised professional argument that the probability of hazardous exposure increases with the number of hazardous chemicals in use.

For 2011, data were reported from a total of 74 facilities, 41 fixed production facilities and 33 mobile. The data for 2011 shows that there are significant variations between the companies as regards the number of chemicals in use (Figur 28 and Figur 29).

There was a weak negative development for chemicals with a high risk potential for production facilities. The number of chemicals with a high risk potential has increased by around 27% in the period from 2004 to 2011. For mobile facilities, some of the same development has been observed.

The number of implemented substitutions with a health risk benefit is clearly lower this year in relation to last year. The majority of substitutions in 2011 were carried out on six of a total of 74 installations. This has been a stable picture. Only a handful of facilities contribute to the reduction each year, but these are different facilities from year to year. There is every indication that the work on substitution in many companies has not been systemised.

The indicator for actual chemical exposure shows little change in relation to previous years. It is worth noting that only half of the reported data for chemical exposure is based on implemented measurements of contamination in the work atmosphere (measurement data). This data represents the exposure situations the companies consider to be most hazardous and where recognised measurement standards are established for the relevant components. The shaker operator on production facilities is the position category where most measurements were reported, 62% of the assessments here are based on measurement data. Oil mist/oil vapour is, with one exception, considered to be the chemical agent constituting the greatest health risk for this position category.

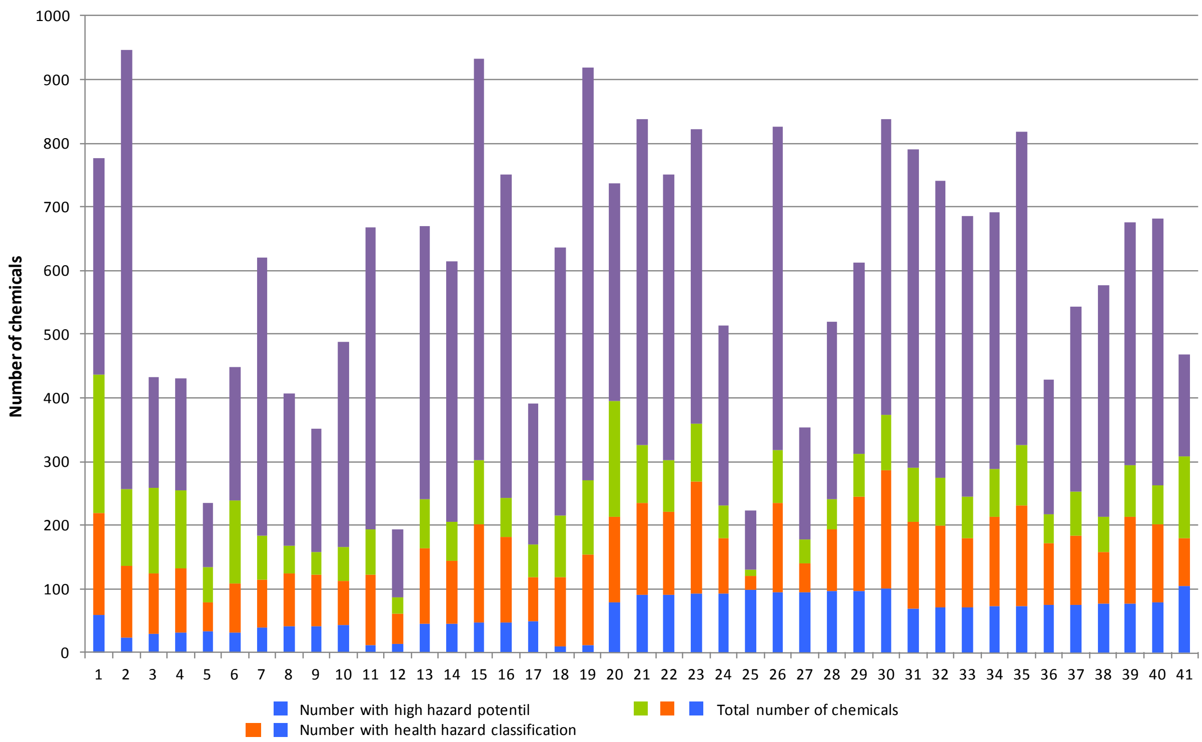


Figure 28 Indicator for the chemical spectrum's risk profile – production facilities

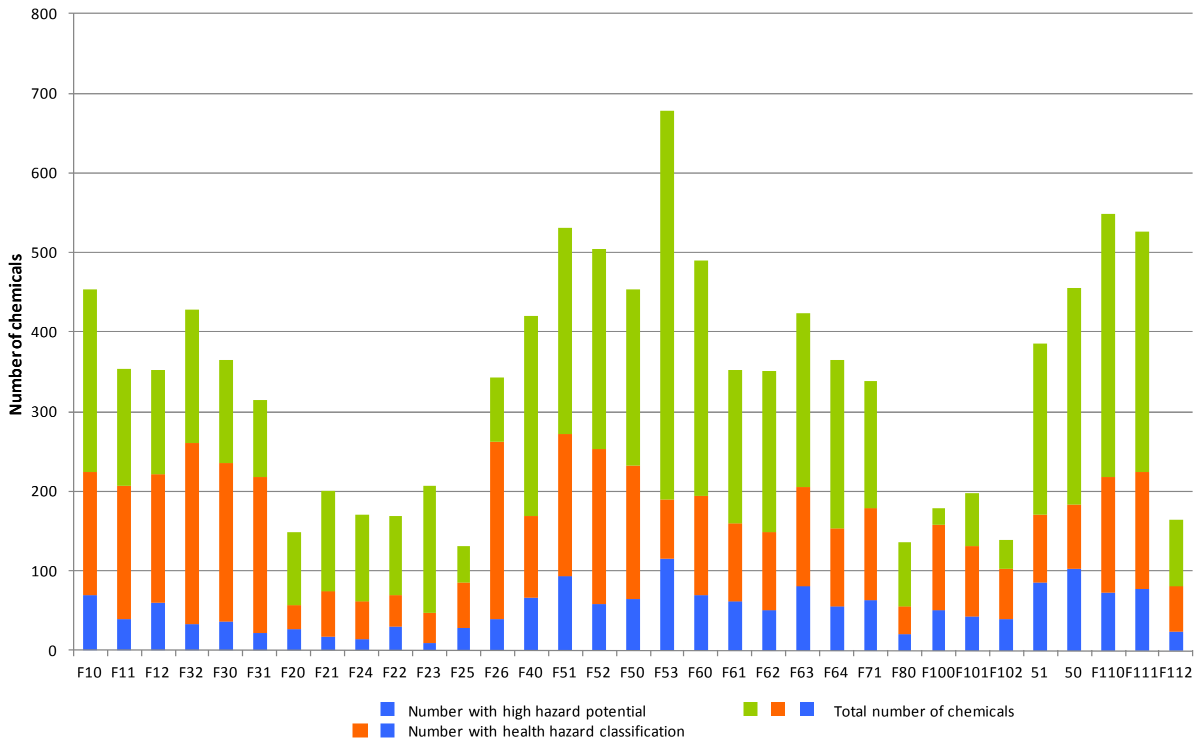


Figure 29 Indicator for the chemical spectrum's risk profile – mobile facilities

In 2011, 26 new cases of occupational skin disease were reported, which were mainly caused by chemical exposure, compared with 36 cases in 2010.

11.3 Ergonomics

Indicators for ergonomic factors were reported for 2009, 2010 and 2011. The indicator for 2009 was changed in 2010, so the figures for 2009 and 2010 have not been comparable. This means that this is first time it is possible to compare figures from one year to another, from 2010 to 2011.

The indicators were developed in cooperation with expert personnel in the companies and STAMI. In 2008, a status overview was prepared, ”Work causing musculoskeletal ailments” by STAMI, commissioned by the Norwegian Labour Inspection Authority and PSA, which was used as a basis in developing the indicators. The Regulations relating to heavy and repetitive work, and the guidelines thereto, provide the assessment criteria that must be used as a basis for reporting. Use of ergonomic expert personnel when quality assuring the assessments is emphasised by the PSA.

Data have been reported from 49 production facilities and 31 mobile facilities. In the *red* area, the probability of sustaining repetitive strain injuries is very high. In the *yellow* area, there is a certain risk of developing repetitive strain injuries in the short or long term. The strain must be assessed in more detail. Factors such as duration, pace and frequency of strains are particularly crucial. The combination of these strains could have an amplified significance. In the *green* area, there is little risk of repetitive strain injury for most employees. If there are special conditions, or if the employee still sustains repetitive strain injuries, a more detailed assessment should be carried out. The comment ”high score” indicates that the task has been considered red by many.

The quality of reporting this year is poorer than last year. In particular, this relates to inadequately filling out forms for overall risk of each of the following factors; working posture, monotony, lifting and handheld tools. This data were not used in the graphs. Also, many have not sufficiently followed the pre-defined work tasks.
Otherwise, it can be seen that some of the companies consider the same work tasks quite differently. There are examples of one company reporting almost exclusively green and yellow for all work tasks for all position categories, whereas another company reports generally a lot of red for the same work tasks. This can reflect actual differences in the work conditions, but it can also be due to different assessments of virtually conditions.

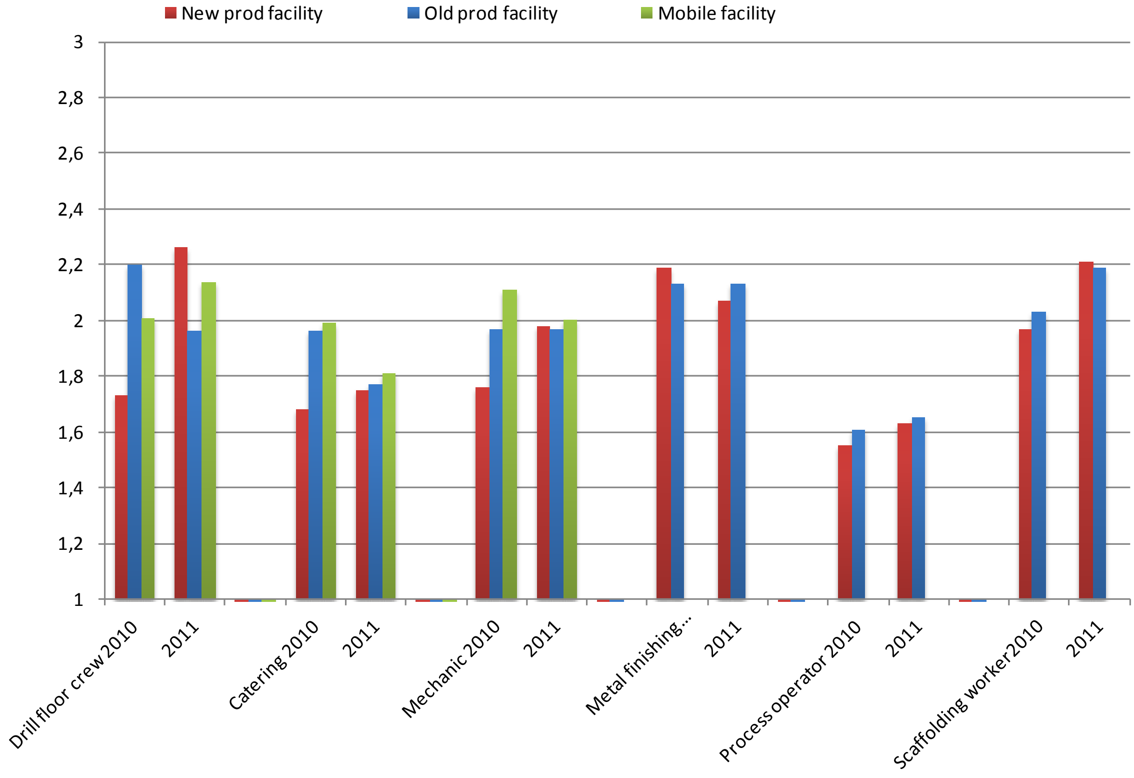


Figure 30 The average risk score for all work tasks distributed by employee groups on production and mobile facilities

On the vertical axes, the values represent the risk assessment in the following manner: green = 1 yellow = 2 red = 3

The selection for production facilities is not directly comparable with 2010 because data have been reported from more than twice as many facilities this year (49) as for 2010 (22).

In total, the results are very similar with 2010. In general, the highest risk is reported for scaffolding, surface treatment personnel and roughnecks, closely followed by mechanics. There is an increase from 2010 for scaffolding and roughnecks. The changes are minor for the other work groups.

A comparison between production facilities and mobile facilities showed a significantly higher score on mobile facilities for working postures for all work groups in 2010. Because of an increase here for production facilities and a decline for mobile facilities, this difference has stabilised. In 2010, the tendency was that roughnecks, catering personnel and mechanics had a higher score on old facilities than on new. We can see this tendency has changed. And the score for mobile facilities this year is quite similar to the score for production facilities. This could be due to the changed selection.

It might be somewhat surprising that catering has such a low score. A possible explanation could be that in recent years, systematic work has been carried out on the working conditions for this group on the Continental Shelf. Catering has a higher average score on the onshore facilities, 1.91 compared with 1.76 on the Continental Shelf. Figures from the questionnaire survey support this tendency. Here offshore catering reports better conditions both as regards physical working environment, psychosocial factors (requirements, review, support) and self-reported musculoskeletal ailments.

The following work tasks for facilities on the Continental Shelf are considered the highest risk:

- Use of vibrating handheld tools
- Nipling and running BOP/stack
- Work on pumps
- Carrying
- Building/tearing down scaffolding
- Sandblasting

12. Other indicators

12.1 DFU21 Falling objects

In the period 2002–2011, an average of 226 events related to falling objects have been reported to RNNP each year. The level of the annual number of reported events has been relatively stable in the period 2002–2007, but declined slightly in the last three years, to 149 events in 2011. There have been two fatalities and 92 personal injuries related to falling objects on the Norwegian Continental Shelf since 2002.

An analysis was carried out to categorise the events in relation to initiating causes. The period 2006–2011 has primarily been assessed. The categorisation was done according to model categories developed in the BORA project, see the main report. This method was originally developed for the purpose of categorising hydrocarbon leaks, but it has been generalised and adapted to use for events with falling objects.

Figure 31 shows the distribution of events in main categories of work processes. The distribution of causal factors is distributed differently in the various work processes. For crane-related events, cause categories F and B (External conditions and Human activity) are dominant and introduce latent risk. For internal lifting operations, cause category F *External conditions* is even more dominating (55%). A more detailed analysis of the causality distribution was therefore carried out internally under main category F. Events with falling objects connected to crane-related work processes are also particularly interesting as the events are concentrated in the two highest energy classes.

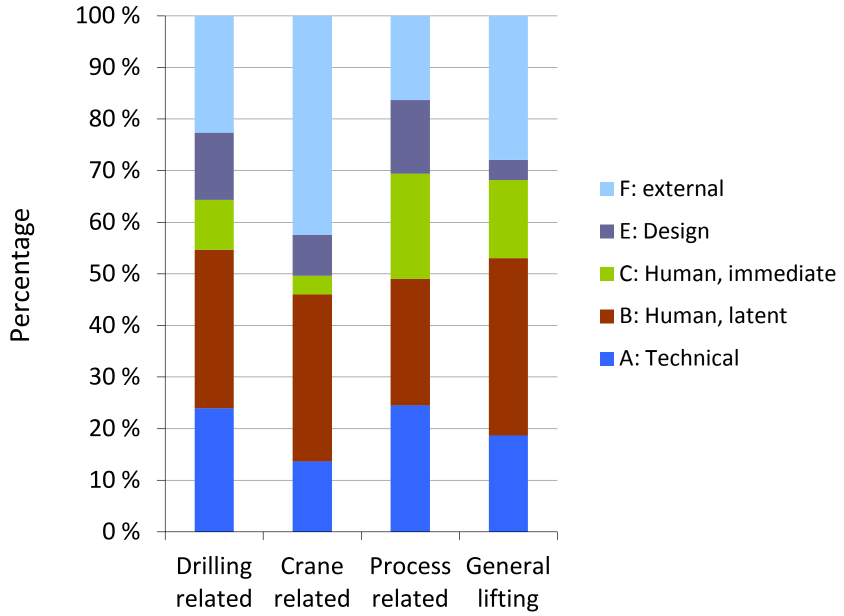


Figure 31 Triggering factors distributed by main categories of work processes, 2002-2011

In Figure 32 a detailed representation of causes of falling objects is presented in connection with the work process loading and offloading operations (from vessels) and lifting operations that take place internally on a facility. The data material for these work processes include registered events going back to 2002. Category F3 – effect from crash/catching constitutes a relatively large percentage of the events in the main category of crane-related work processes. A large percentage of these events can be found within lifting operations that take place internally on the facility. A more extensive analysis is presented in the main report.

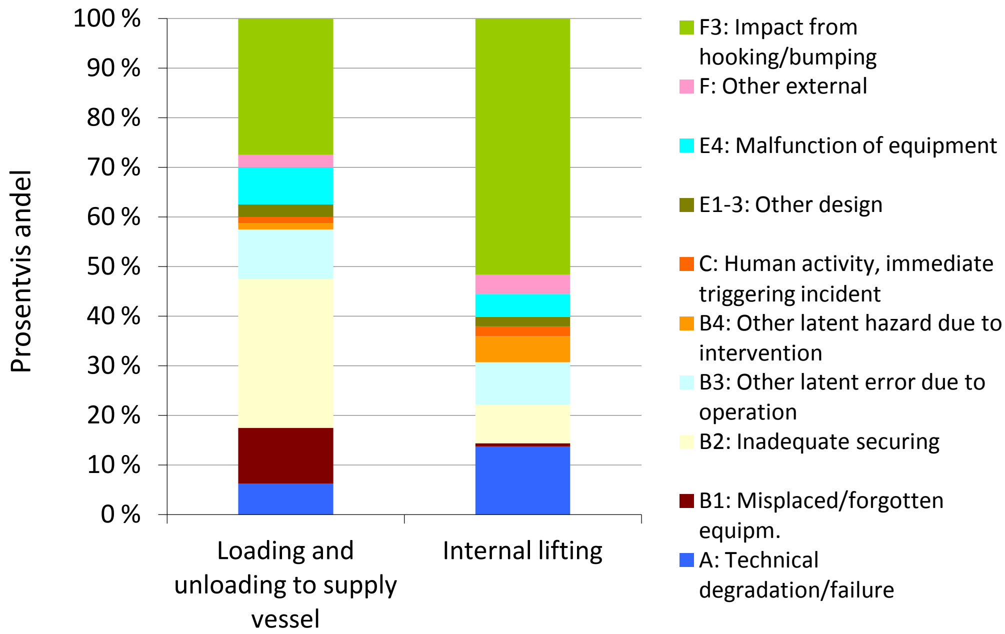


Figure 32 Triggering factors distributed by detailed work process categories, 2002-2011

12.2 Other DFUs

The main report presents event data that is reported to the PSA, as well as for other DFUs, that do not have a major accident potential DFU10; 11; 13; 16 and 19, see Tabell 1.

13. Definitions and abbreviations

13.1 Definitions

See sub-chapters 1.9.1 – 1.9.3, as well as 4.2 in the main report.

13.2 Abbreviations

For a detailed list of abbreviations, see PSA, 2012a. Development in the risk level for the Norwegian Continental Shelf, Main report, 24 April 2012. The most important abbreviations in this report are:

API	American Petroleum Institute
CODAM	Database for damage to structures and subsea facilities
DDRS/CDRS	Database for drilling and well operations
DFU	Defined hazard and accident situations
PM	Preventive maintenance
GM	Metacentric height
HSE	Health, safety and the environment
KPI	Key Performance Indicator
KV	Corrective maintenance
NPD	Norwegian Petroleum Directorate
PSA	Petroleum Safety Authority Norway
STAMI	National Institute of Occupational Health
WIF	Well Integrity Forum

14. References

For a detailed reference list, see the main reports:

PSA, 2012a. Development in the risk level for the Norwegian Continental Shelf, Main report, 24 April 2012

PSA, 2012b. Development in the risk level – onshore facilities in Norwegian petroleum activities, 24 April 2012