SUMMARY REPORT 2012 - NORWEGIAN CONTINENTAL SHELF

TRENDS IN RISK LEVEL

IN THE PETROLEUM ACTIVITY

PETROLEUM SAFETY AUTHORITY
NORWAY

Preface

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 an instrument to measure the impact 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 taken on 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 spills to sea was published in 2010. The report is based on RNNP data combined with data from the Norwegian Oil and Gas Association's Environmental Web database. Due to the data collection period in Environmental Web, the RNNP report regarding acute spills 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 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. 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, 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, 25 April 2013

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1. Objective and limitations

1.1 Purpose

The "Trends in risk level on the Norwegian 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 ageing 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 shelf. In addition, the industry's current activity level is very high. The development in petroleum activities must take place in a perspective where the HSE conditions are constantly improving. 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 incidents has been particularly popular. 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 factors.

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

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 in order to prevent undesirable incidents and accidents.
- Increase insight into 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, occupational accidents and working environment factors. Both qualitative and quantitative indicators are used. No qualitative survey was undertaken by RNNP in 2012.

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 shelf. The following areas are included:

- All production and mobile facilities on the Norwegian 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.

Onshore facilities in the PSA's administrative area are included as of 1 January 2006. Data collection started from this date, and separate reports have been published since then. Results and analyses for onshore facilities and results from these facilities are not included in this summary report. Since 2010, a separate report has been published with focus on acute spills to sea from offshore petroleum activities. This year's report concerning acute spills is expected during the autumn of 2013.

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, risk level trends.

Trends are the main focus. It must be expected that 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, one should arrive at a comprehensive conclusion on the basis of information from all the measurement instruments used. In practice, this is complicated, e.g. because the indicators reflect HSE conditions at levels that may be significantly different. This report particularly examines risk indicators associated with:

- Major accidents, including helicopter related accidents
- Selected barriers associated with major accidents
- Serious injuries to personnel
- Risk factors in the working environment
    - Chemical working environment
    - Noise related injury
    - Ergonomics
- Qualitative assessments for selected areas.

No qualitative survey was undertaken as part of RNNP in 2012. We experience that the qualitative surveys we carried out in 2011 and 2012, concerning causes associated with hydrocarbon leaks and well control incidents, respectively, have sparked considerable involvement in the industry. This has been costly in terms of resources for the PSA, and has contributed to the decision to not carry out this type of study in 2012.

In recent years, the industry has focused heavily on reducing the number of hydrocarbon leaks. Specific reduction targets have been established several times, first a maximum of 20 leaks greater than 0.1 kg/s in 2005, then a maximum of 10 leaks in 2008, followed by further annual reduction. The first target was reached in 2005, and 10 leaks of this type were registered in 2007. During the period from 2008 to 2010, there was an increase in the number of leaks. In 2011, it was observed a reduction that continued in 2012, with a total of 6 leaks greater than 0.1 kg/s – the lowest level ever recorded. Nevertheless, two of the leaks were greater than 10 kg/s, which contributes to substantial risk; the third highest on record related to hydrocarbon leaks during the period 1996-2012.

The number of well control incidents showed a small increase in 2012 (16), compared with 2011 (13). Fifteen of these incidents were in the lowest risk category, whereas one incident was in the second lowest category. If one normalises the well control incidents by the number of drilled wells, it can be seen that the increase in 2012 was related to exploration drilling.

In 2012, there were no leaks from risers within the safety zones of manned facilities.

Incidents associated with structures and maritime systems show an increase from three incidents in 2010 to 12 in 2012, of which eight are associated with mobile facilities. Six of the incidents are associated with mooring systems, two incidents related to DP systems, three incidents related to stability and one related to cracks. As regards mobile facilities,

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[1] Data collected through RNNP is used along with data from the Environmental Web database to assess acute discharges to sea. The results will be presented in a separate report to be published in the autumn.

these incidents are the greatest contributor to the overall risk indicator for 2012, contributing more than 90%.

The number of ships on collision course has shown a substantial reduction and the level in 2012 is significantly lower than the average during the period 2005 to 2011. The effect of controlled sea areas around the facilities, monitored by dedicated traffic centres, must be viewed as an evident cause for this reduction. In 2012, there was one collision between a facility and field-related vessel (supply vessel).

Other indicators reflecting near misses with major accident potential show a stable level with relatively minor changes in 2012.

The total indicator which reflects the potential for loss of life if registered near-miss incidents develop into actual incidents, is a product of the frequency (probability) and potential consequences. A historical risk indicator does not express risk, but may be used to assess trends in the parameters contributing to risk. A positive development in an underlying trend for this type of indicator therefore provides an indication that we are achieving better control of the contributors to risk.

Over the last 5-6 years, the total indicator, both for production facilities and mobile facilities, has levelled out at a level which is below the previous period. In 2012, an increase for both production facilities and mobile facilities is observed. The increase in the total indicator for mobile facilities in 2012 is significant, compared with the average during the period from 2005 to 2011. Since individual incidents with significant potential have a relatively major impact on the indicator from year to year, the assessment is based on a 3-year rolling average. In an overall perspective, this type of indicator should display a continuous positive trend in order to be in line with the objective of being a world leader within HSE. This trend was broken between 2010 and 2012, but the increase in the overall indicator that includes all types of facilities is not statistically significant.

Helicopter risk constitutes a large share of the overall risk exposure to which employees on the continental shelf are exposed. The risk indicators used in this work were significantly reworked in 2009/2010 to better capture the actual risk associated with the incidents included in the study. Among other things, an expert group has been established under the auspices of RNNP to assess the risk associated with the most serious incidents. The expert group consists of personnel with pilot, technical, ATM and risk expertise.

The indicator reflecting the most serious incidents, and which is assessed by the expert group, shows a positive development from 2011 to 2012. No incidents have been recorded over the last four years with ”little remaining safety margin”. For 2012, there is one incident in the indicator with ”medium remaining safety margin” related to the helicopter type EC225LP (Super Puma), and this concerned a technical issue with the brakes during parking on a helicopter deck.

Barrier indicators are an example of leading indicators. The indicators show that there are somewhat significant level differences between the facilities, not only in 2012, but also 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. Taking into account the industry's recent focus on major accident prevention, one would expect it to be possible to achieve greater improvements in this area than what the data from recent years shows.

Maintenance management data has been collected for four years. The figures from 2009 to 2012 show that several players are having difficulties fulfilling regulatory requirements for maintenance management. Mobile facilities face the greatest challenges.

The challenges are associated with tagging and classification of equipment, backlogs of preventive maintenance and outstanding corrective maintenance, including HSE-critical maintenance.

Serious injuries to personnel have shown a positive development in recent years. The injury frequency is now 0.51 serious injuries per million working hours for the entire shelf. This is significantly lower than the average for the preceding ten-year period. There was a significant reduction for production facilities in 2012, compared with the previous ten-year period. In 2012, the injury frequency for contractor employees (on production facilities) increased marginally, compared with 2011. One can see a very positive development for operator employees on production facilities in 2012, and the injury frequency is below the expected value based on the previous years. The injury frequency on mobile facilities shows a reduction in 2012 compared with 2011, but is still higher than the level in 2009 and 2010.

The noise indicator shows slight improvement in six of eleven position categories compared to 2011 and five of the position categories now have a weak positive trend over the last three years. The average noise indicator for the shelf activity in 2012 is 89.1, compared with 89.3 in 2011.

The noise indicator for the position categories machine engineer and surface treatment personnel are considerably higher than for other groups and for this group, the noise indicator including ear protection is relatively high.

The industry project for noise reduction in the petroleum activities that was started in 2011 is expected to contribute toward improvement in the noise indicator over time. It is unlikely that this work has had a measurable effect in the present reporting period.

The indicator for the chemical spectrum's hazard profile shows that there is still considerable variation between facilities with regard to the number of chemicals in use. To a certain degree, the variation reflects the type of facility and activities on the facility. Permanent installations generally have a higher number of chemicals in circulation than mobile facilities.

The indicator that describes risk associated with chemical exposure for position categories shows that short-term assessments for mechanics and process operators are highest for permanent installations, and mechanics' and shaker operators' short-term assessments were the highest for mobile facilities.

The ergonomics indicator shows that surface treatment personnel, as in previous years, have the highest red score for the overall assessment of duties. For roughnecks, mechanics and scaffolders, lifting and carrying, as well as working positions, comprise the greatest ergonomic risks. Compared with the figures from 2010 and 2011, this is an increase in the red score for these three groups. For surface treatment personnel, handheld tools, repetitive tasks and working positions constitute the greatest risks. For roughnecks and scaffolders, the risk factors working position and repetitive tasks have seen a slight decline in the red score.

Part 2: Execution and scope

3. Execution

The work in 2012 is a continuation of previous years' activities, carried out in 2000–2011, see NPD (2001), NPD (2002), NPD (2003), PSA (2004), PSA (2005), PSA (2006), PSA (2007), PSA (2008), PSA (2009), PSA (2010), PSA (2011) and PSA (2012). (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 work on analysing and evaluating data related to defined hazard and accident situations has been continued, both on the facilities and for helicopter transport.
- Considerable amounts of empirical data have been collected for barriers against major accidents, which have been analysed correspondingly as during the period 2003-2011. Greater emphasis has been placed on nuances in the data for well barriers and BOP data.
- Indicators for noise, chemical working environment and ergonomics have been continued.
- Data from onshore facilities have been analysed and presented in a separate report.
- Acute spills to sea and potential spills to sea are undergoing analysis, and will be presented in a separate report.

3.1 Executing the work

The work on this year's report started in the autumn of 2012. The following players have been involved:

• Petroleum Safety Authority Norway:	Responsible for execution and further development of the work
• Operating companies and shipowners:	Contribute data and information about activities on the facilities, as well as in the work on adapting the model for onshore facilities, which have 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:	Contribute data and information about helicopter transport activities
• HSE discipline group: (selected specialists)	Evaluate the procedure, input data, viewpoints on the development, evaluate trends, propose conclusions
• Safety Forum: (multipartite)	Comment on the procedure, results and recommend further work.
• Advisory group: (multipartite)	Multipartite RNNP advisory group that advises the Petroleum Safety Authority regarding further development of the work.

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

- Terje Dammen, Jorunn Seljelid, Grethe Lillehammer, Bjørnar Heide, Aud Børsting, Inger Krohn Halseth, Rolf Johan Bye, Reidun Værnes, Trond Stillaug Johansen, Anders Karlsen, Øystein Skogvang, Marie Horn Saltnes, Cecilie Å. Nyrønning, Kai Roger Jensen, Reidun Værnes and Astrid Lovise Westvik, Safetec
- The PSA's work 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 to the work on indicators for helicopter risk:

- Erik Hamremoen, Norwegian Oil and Gas Association, represented by LFE
- Egil Bjelland, Dag Vidar Jensen, Trond Arild Nilsen, Inge Antonsen, CHC Helikopter Service
- Per Skalleberg, Kjetil Heradstveit, Arne Martin Gilberg, Tormod Veiby, Caspar Smith, Bristow Norway AS
- Finn Mikkelsen, Blueway Offshore Norge AS

Several additional people have also contributed to the execution.

3.2 Use of risk indicators

Data has been collected 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 discharges of hydrocarbons, fires (i.e. process leaks, well incidents/shallow gas, riser leaks, other fires)
- Structural events (i.e. structural damage, collisions, risk of collision)
- Test data associated with the performance of barriers against major accidents on the facilities, including data concerning well status and maintenance management
- Accidents and incidents in helicopter transport
- Work accidents
- Noise, chemical working environment and ergonomics
- Diving accidents
- Other hazard and accident situations with consequences of a lesser extent or significance for preparedness.

The term major accident is used several places in the reports. There are no unambiguous definitions of the term, but the following are often used, and coincide with the definition used as a basis in this report:

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

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

Data collection for the DFUs related to major accidents is founded in part on existing databases in the Petroleum Safety Authority (CODAM, DDRS, etc.), but also to a significant degree on data collection carried out in cooperation with the operating companies and shipowners. All incident data has been quality-assured by e.g. checking it against the incident register and other databases in the Petroleum Safety Authority.

Table 1 shows an overview of the 19 DFUs, and which data sources have been used. The industry has used the same data registration categories through the Synergy (or simililar) database.

3.3 Developments in the activity level

Figure 1 and Figure 2 show the development over the period from 1996 to 2012 for production and exploration activities, of the parameters used for normalisation against the activity level (all figures are relative in relation to the year 2000, which has been set at 1.0). Appendix A to the main report (PSA, 2013a) presents the basic data in detail. Errors in the data basis in previous reports have been corrected.

Table 1 Overview of DFUs and data sources

DFU no.	*DFU description*	*Data sources*
1	Non-ignited hydrocarbon leak	Data collection*
2	Ignited hydrocarbon leak	Data collection*
3	Well incident/loss of well control	DDRS/CDRS + incident reports (PSA)
4	Fire/explosion in other areas, combustible fluid	Data collection*
5	Ship on collision course	Data collection*
6	Drifting object	Data collection*
7	Collision with field-related vessel/facility/shuttle tanker	CODAM (PSA)
8	Damage to platform structure/stability/anchoring/positioning error	CODAM (PSA) + the industry
9	Leak from subsea production facility/pipeline/riser/wellstream pipeline/loading buoy/loading hose	CODAM (PSA)
10	Damage to subsea production equipment/pipeline systems/diving equipment caused by fishing appliances	CODAM (PSA)
11	Evacuation (precautionary/emergency evacuation)	Data collection*
12	Helicopter crash/emergency landing on/near facility	Data collection*
13	Man over board	Data collection*
14	Personnel injury	PIP (PSA)
15	Work-related illness	Data collection*
16	Full loss of power	Data collection*
18	Diving accident	DSYS (PSA)
19	H_2S emission	Data collection*
21	Falling object	Data collection*

* Data collection is carried out in cooperation with the operating companies

The number of working hours on production facilities has peaked in 2012. On mobile facilities, the variations from year to year are greater than for production facilities, but the number of working hours in 2012 is the highest during the period here as well. A presentation of DFUs or risk can sometimes be different if absolute or "normalised" values are stated, depending on the normalisation parameter. Normalised values are primarily presented here.

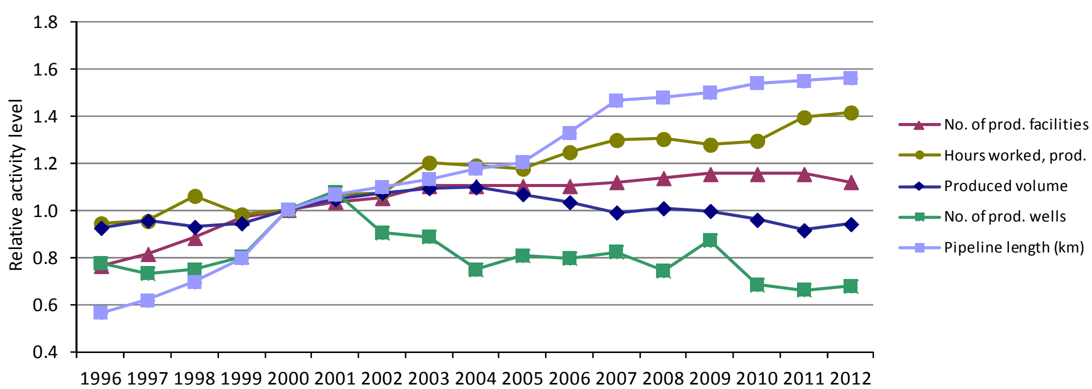

Figure 1 Development in activity level, production

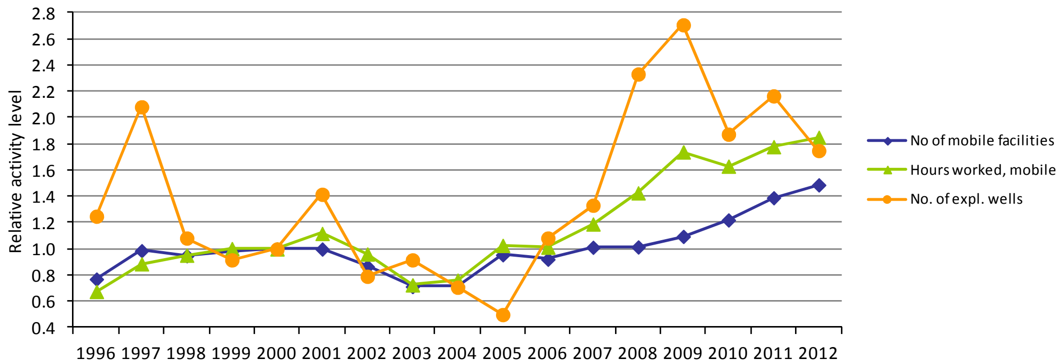

Figure 2 Development in activity level, exploration activities

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

3.4 Documentation

Analyses, assessments and results are documented as follows:

- Summary report – the Norwegian shelf for the year 2012 (Norwegian and English version)
- Main report – the Norwegian shelf for the year 2012
- Report for onshore facilities for the year 2012
- Report for acute spills to sea for the Norwegian shelf 2012, to be published in the autumn of 2013

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

4. Scope

The method for statistical analyses has been continued from previous years, with only minor changes.

Part 3: Results from 2012

5. Status and trends – DFU12, helicopter incidents

The cooperation with the Civil Aviation Authority and helicopter operators has been continued in 2012. Air traffic data collected from involved helicopter operators includes the incident type, risk class, severity, type of flight, phase, helicopter type and information about departure and approach. The main report (PSA, 2012a) contains additional information about the scope, constraints and definitions. The last major accident to result in fatalities on the Norwegian shelf was in September 1997 in connection with the helicopter accident outside Brønnøysund.

In 2012, there were two emergency landings on the sea in the UK sector, and one controlled emergency landing on a facility in the Norwegian sector. All of these occurred with the EC225 Super Puma helicopter type. The Civil Aviation Authority has, with support from the helicopter companies and oil companies, introduced restrictions on the use of this helicopter type and, at the time this is written, it is not used for transport service or shuttling.

Changes were made in 2009 for two of the three incident indicators that have been used for many years, and two new incident indicators were added, whereas the activity indicators have been continued without changes. The activity indicators express how the exposure to helicopter risk is developing, and are thus a more leading indicator. The indicators are explained in detail in the main report. The new indicators show interesting trends, in spite of the somewhat limited amount of data so far, and thus greater uncertainty.

5.1 Activity indicators

Figure 3 shows activity indicator 1 (transport service) and activity indicator 2 (shuttling) in the number of flight hours and number of person flight hours per year during the period 1999-2012. 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 period as a whole, but with a marked increase in person flight hours in 2012.

TRANSPORT SERVICE SHUTTLING

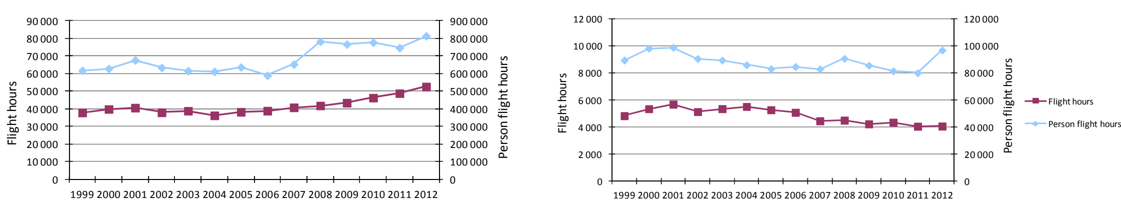

Figure 3 Volume of transport service and shuttling, person flight hours and flight hours, 1999-2012

Activity indicator 1, the transport service volume per year, must be seen in the context of the activity level on the Norwegian continental shelf. The number of working hours on production facilities has been slowly rising, whereas the number of working hours on mobile facilities has varied somewhat, but with a general increase after 2003. In principle, there is a constant need for transport per working hour, which should indicate an increase in both flight hours and person flight hours. This is offset by better utilisation of the helicopters, and the new helicopters ability to take off with the maximum number of passengers under virtually all weather conditions.

On several facilities, shuttling is part of everyday life. Most shuttling takes place on the Ekofisk field. To a certain degree, shuttling now takes place with larger helicopters than before. This can, to a certain degree, explain the general decline in the number of flight hours. The increase in the volume of person flight hours in 2012 can be viewed in the context of carrying out a major maintenance program which has necessitated more shuttling between the facilities. In 2012, the number of flight hours in reported shuttling is nearly equal to that of 2011, whereas the number of person flight hours has increased considerably (approx. 20.9%), compared with 2011.

5.2 Incident indicators

5.2.1 Incident indicator 1 – serious near-misses

Figure 4 shows the number of incidents included in Incident indicator 1. Since 2009 (as well as for 2006, 2007 and 2008), the most serious near-misses reported by the companies are 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, in order to classify the incidents on a finer scale, based on the following categories:

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

Incident indicator 1 includes the events with little or medium remaining margin against fatal accidents for passengers, i.e. no or one remaining barrier. In 2006 and 2007, there was one incident each year without remaining barriers, whereas there were two such incidents in 2008. There were no incidents without remaining barriers against fatal accidents during the years from 2009 to 2012. As previously, incidents in the parked phase are not included.

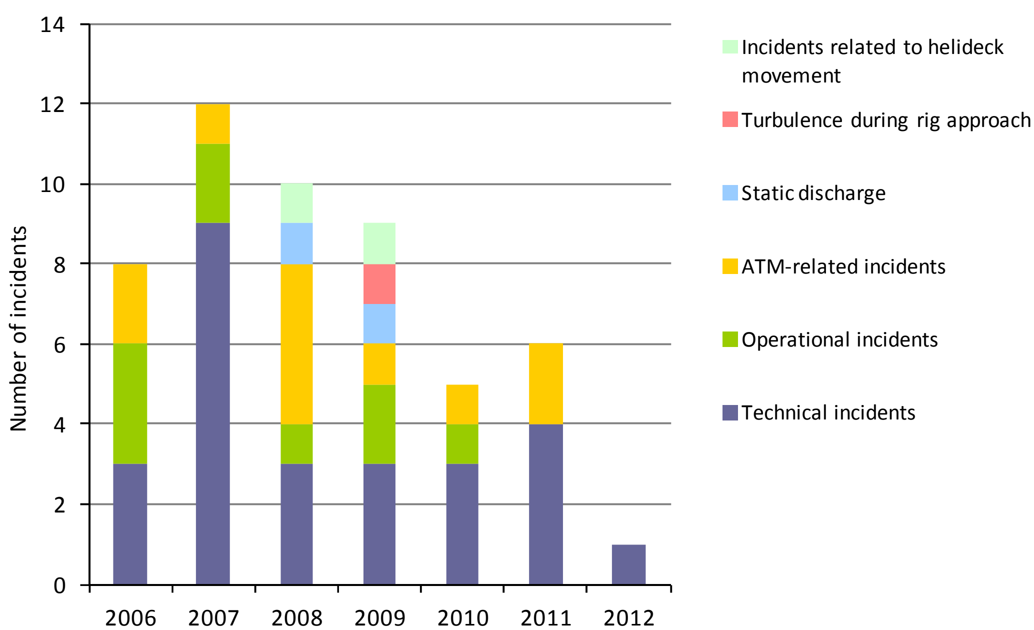

Figure 4 Incident indicator 1, incidents with little or medium remaining safety margin, 2006–2012

Six of the twelve incidents in 2007 were associated with the S-92, which is one of the newest helicopters on the Norwegian shelf. As regards traffic, S-92 contributes about 60–65% of flight time, whereas different generations of the Super Puma primarily make up the remainder. The number of incidents linked to the S-92 was three in 2008, four in 2009, three in 2010 and two in 2011. Of a total of 18 incidents with the S-92 during the period 2007–2011, 11 had technical causes, the others had e.g. operational causes, as well as strong turbulence from structures on the facility. The EC-225, which is also a new Super Puma helicopter, has only had four incidents during the period, with technical causes, including the incident in 2012.

5.2.2 Incident indicators linked to causal categories

As of 2009, Incident indicator 3 has been replaced by three incident indicators based on causal categories, with the following content:

- Incident indicator 3:
  Helideck conditions:
  - Incorrect information about position of helideck
  - Incorrect/lacking information
  - Equipment failure
  - Turbulence
  - Obstacles in approach/departure sectors or on deck
  - People in restricted sector
  - Breach of procedures
- Incident indicator 4:
  ATM aspects (air traffic management)
- Incident indicator 5:
  Collision with bird.

All degrees of severity beyond ”no impact on safety” are included in these indicators. The data for 2008-2012 is presented in Figure 5–Figure 7. There was a strong reduction for helideck conditions in 2010, compared with 2009. The number of incidents in 2012 is fairly close to the number in 2010, but it was somewhat higher in 2011. The majority of incidents can be related to floating facilities in 2012. There may appear to be a clear improvement on follow-up of procedures and routines on fixed facilities, which most likely reflects the industry's focus on such aspects. On the other hand, ATM incidents have increased in 2009, 2010 and 2011, whereas the indicator shows a sharp reduction in 2012. This is presumed to be partly linked to ongoing projects to increase ATM availability on the Norwegian shelf.

Based on these causal indicators, the main report (PSA, 2013a) has indicated areas and aspects where improvements should be prioritised. The following new improvement proposals have been identified:

- The operators using the new helicopter companies on the NCS are recommended to follow up closely in order to ensure that the activity takes place in a safe and prudent manner.
- The operating companies are recommended to ensure that the players work in a goal-oriented and coordinated manner to secure the phase-out of M-ADS, coordinated with the phase-in of A-DSB in order to avoid a period with reduced monitoring in the area in question.

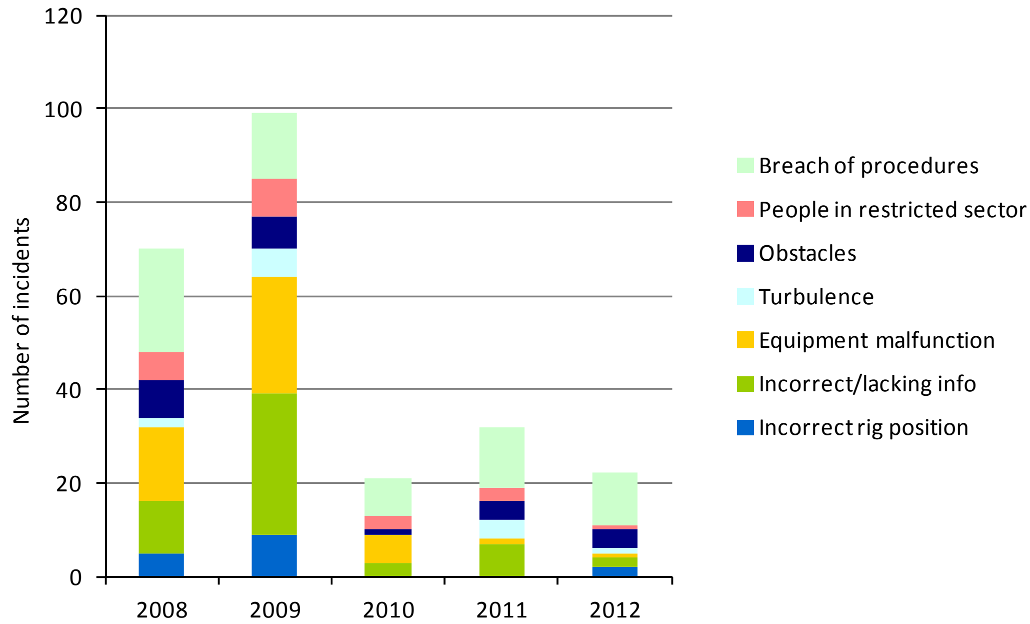

Figure 5 Helideck conditions, 2008–2012

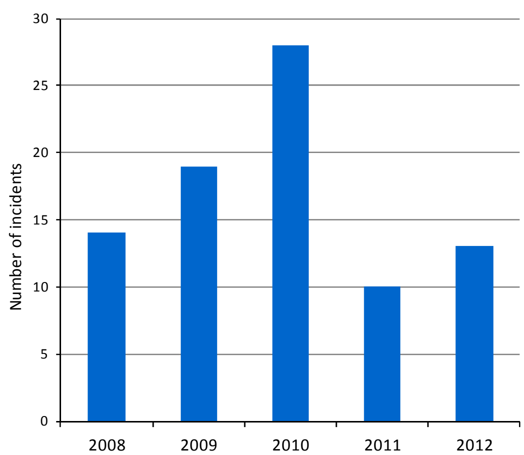

Figure 6 ATM aspects, 2008–2012

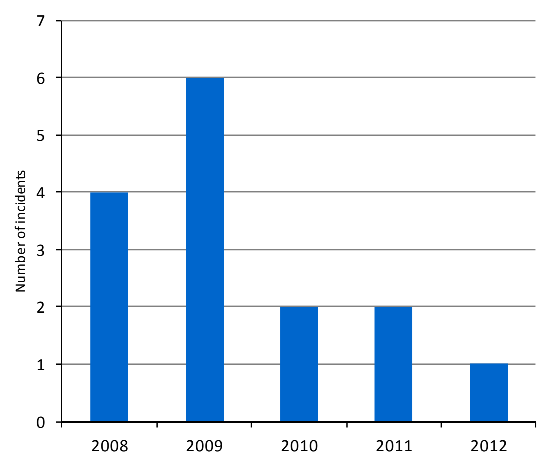

Figure 7 Collisions with birds, 2008–2012

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

The indicators for major accident risk from previous years have been continued, with primary emphasis on indicators for incidents and near-misses with the potential of causing a major accident. Indicators for major accident risk involving helicopters are discussed in Chapter 5, and barriers against major accidents in Chapter 7.

According to our definition, there have been no major accidents on facilities on the Norwegian shelf after 1990. None of the DFUs that indicate major accident risk on facilities have resulted in fatalities during this period. The last time there were any fatalities in connection with one of these major accident DFUs was in 1985, with a shallow gas blowout on the "West Vanguard" mobile facility, see also page 10 in connection with the helicopter accident outside Brønnøysund in 1997. Neither have there been any ignited hydrocarbon leaks from process systems since 1992, apart from the occasional minor leak which is not considered to have the potential for resulting in major accidents.

The most important individual indicators for production and mobile facilities will be discussed in subchapter 6.2. The other DFUs are discussed in the main report. The indicator for total risk is discussed in subchapter 6.3.

6.1 DFUs associated with major accident risk

Figure 8 shows the development in the number of reported DFUs during the period 2003–2012. It is important to emphasise that these DFUs have very different contributions to risk. The clearly rising trend during the period 1996-2000 has been discussed in previous years' reports and has therefore been omitted from the figure. After 2002, there was a reduction in the number of incidents until 2007. After 2007, we observe minor variations around a stable level of about 70 incidents per year. In 2012, the number of incidents was the lowest it has been over the last 10 years.

There has been a decline in the number of incidents involving hydrocarbon systems during the period 2002–2007, from wells, process systems and pipelines/risers. In 2002, there were 72 incidents in these categories, whereas in 2007, there were 25 and in 2008, there were 26. 2009 and 2010 also saw considerable increases, to 41 and 43 incidents, respectively. For 2011, incidents involving hydrocarbons were reduced to 26 and in 2012 they have declined to 22 incidents. This is principally due to fewer process leaks and well incidents, which have declined by nearly one-half compared with 2010.

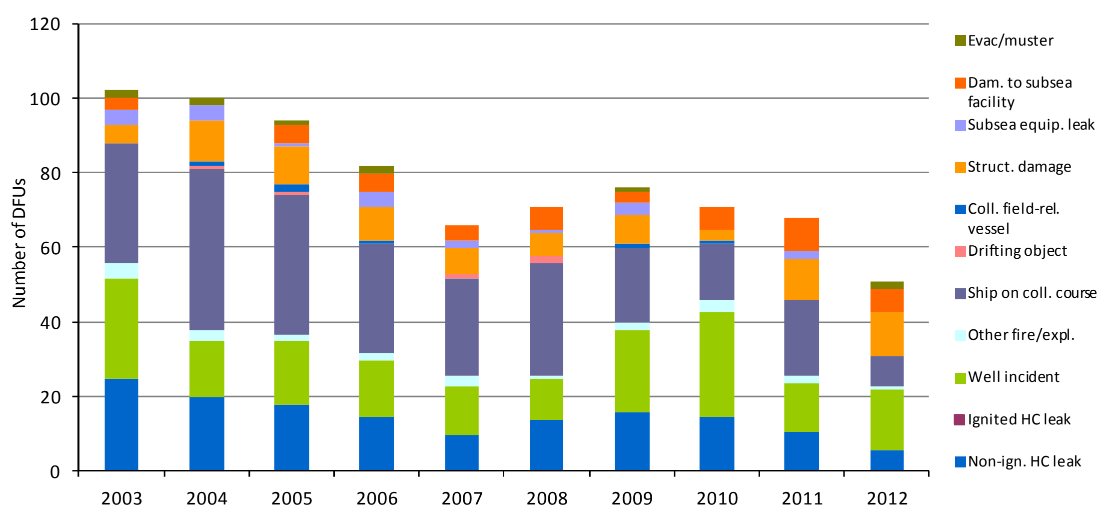

Figure 8 Reported DFUs (1-11) distributed among categories

6.2 Risk indicators for major accidents

6.2.1 Hydrocarbon leak in the process area

Figure 9 shows the overall number of leaks greater than 0.1 kg/s during the period 2001–2012. Up until 1999, there was a declining development, followed by substantial variation from year to year. There has been a marked decline from 2002 to 2007, but the number of leaks greater than 1 kg/s did not decline to the same degree. In 2012, two leaks were registered with a rate exceeding 10 kg/s. One leak was registered in the 1-10 kg/s category in 2012, which is thus a reduction from 2011. Three leaks were registered in the 0.1-1 kg/s category. Giving a total of six leaks exceeding 0.1 kg/s in 2012. Taking into account the entire period from 1996 to 2012, there have never been registered fewer leaks per year than in 2012.

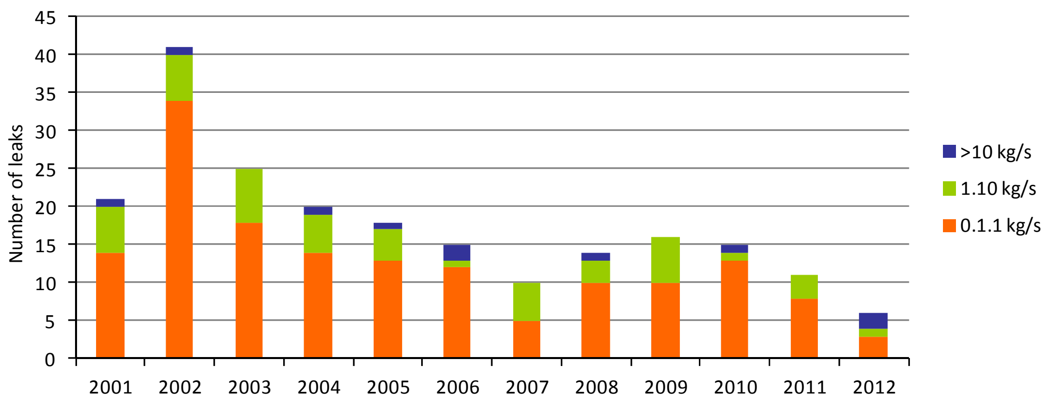

Figure 9 Number of hydrocarbon leaks exceeding 0.1 kg/s, 2001-2012

Figure 10 shows the number of leaks when they are weighted according to the risk contribution they are considered to have. Somewhat simplified, one could say that the risk contribution from each leak is approximately proportional to the leak rate expressed in kg/s. Therefore, the leaks exceeding 10 kg/s have a significant contribution, even though there are no more than one or two incidents per year. The weighting of these largest leaks is usually assessed manually based on the specific circumstances, whereas the others are weighted based on a formula. Figure 10 shows that the risk contribution in 2012 is the third highest that has been registered during the period 1996-2012, and that this is a substantial increase compared with 2011.

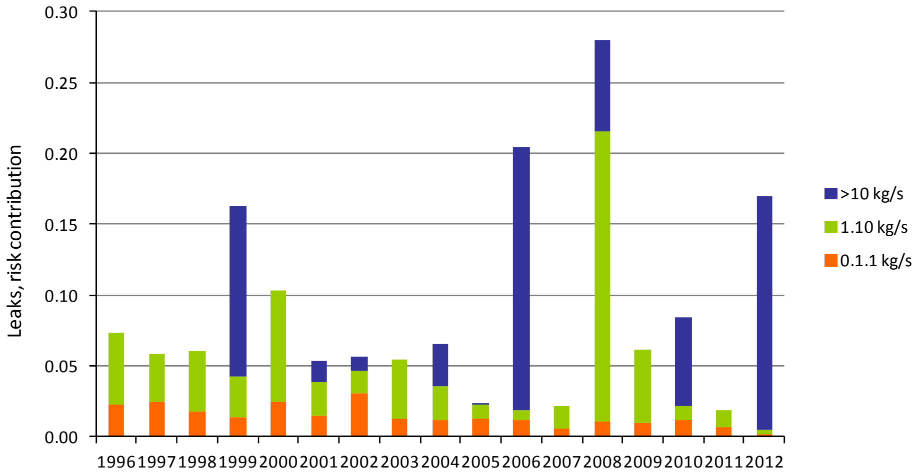

Figure 10 Number of hydrocarbon leaks exceeding 0.1 kg/s, 1996-2012, weighted according to risk potential

Figure 11 shows the trend in leaks exceeding 0.1 kg/s, normalised against facility years, for all manned production facilities. The figure illustrates the technique used throughout to assess the statistical significance (validity) of trends. Figure 11 shows that the reduction in the number of leaks per facility year is statistically significant in 2012, compared with the average for the period 2003–2011. This is indicated by the height of the column for 2012 falling below the middle grey shaded area in the column on the far right in the figure ("Int 03–11", see also subchapter 2.3.5 in the pilot project report). The number of leaks has been normalised both against working hours and against the number of facilities in the main report.

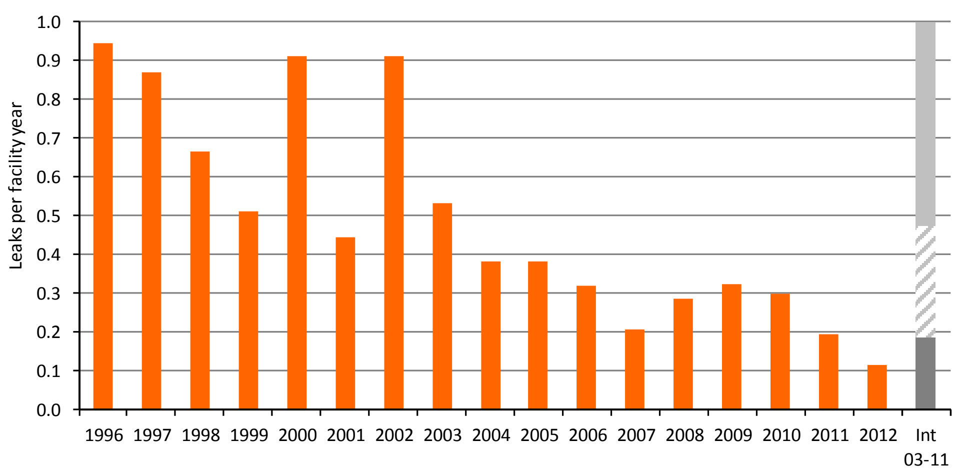

Figure 11 Trend, leaks, normalised against facility years, manned production facilities

There are considerable variations between operators as regards the frequency of leaks exceeding 0.1 kg/s. These variations have been nearly constant over many years, which show that there is still a clear potential for improvement. This is also underscored by Figure 12, which shows the average leak frequency per facility year for the operating companies on the Norwegian shelf. The figure shows data from the last five years. The same companies still have the highest frequencies, but the difference between them and some of the other companies is not as significant as before.

When the average leak frequency is charted for each individual facility, the four facilities with the highest average frequency during the period 2008–2012 – all with the same operating company – together account for more than 25% of the number of leaks on the Norwegian shelf during this period. Two of the five facilities with the highest average frequency have been among the top five in equivalent overviews in RNNP reports as of 2005.

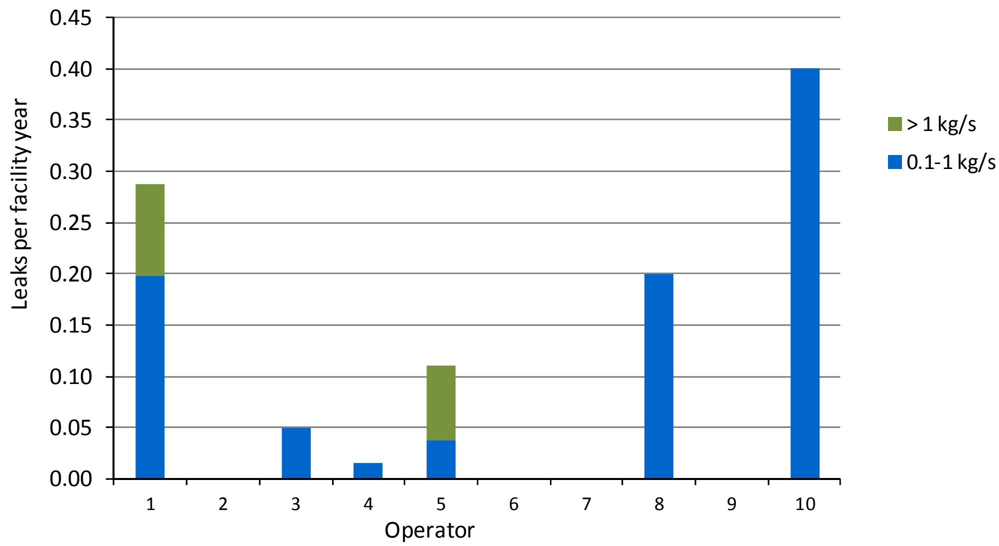

Figure 12 Average leak frequency per facility year, 2008–2012

It has been undertaken a systematic comparison for gas, condensate and oil leaks on the UK and Norwegian shelves for the areas north of Sleipner (59°N), where the facilities on both shelves are of somewhat similar scope and complexity. It must be pointed out that the reporting period for the UK shelf runs until 31 March each year. The most recent available period is 1 April 2011 – 31 March 2012 (called "2011"), which has been compared with 2011 on the Norwegian shelf.

Figure 13 shows a comparison between the Norwegian and UK shelves, including gas/two-phase leaks and oil leaks, normalised against facility year, for the two countries' shelves north of 59°N. The figure applies for the period 2000-2011. The data for oil leaks included in the figure is restricted to process equipment. As mentioned in previous years' reports, some oil leaks that are not associated with process equipment have been omitted from the figure.

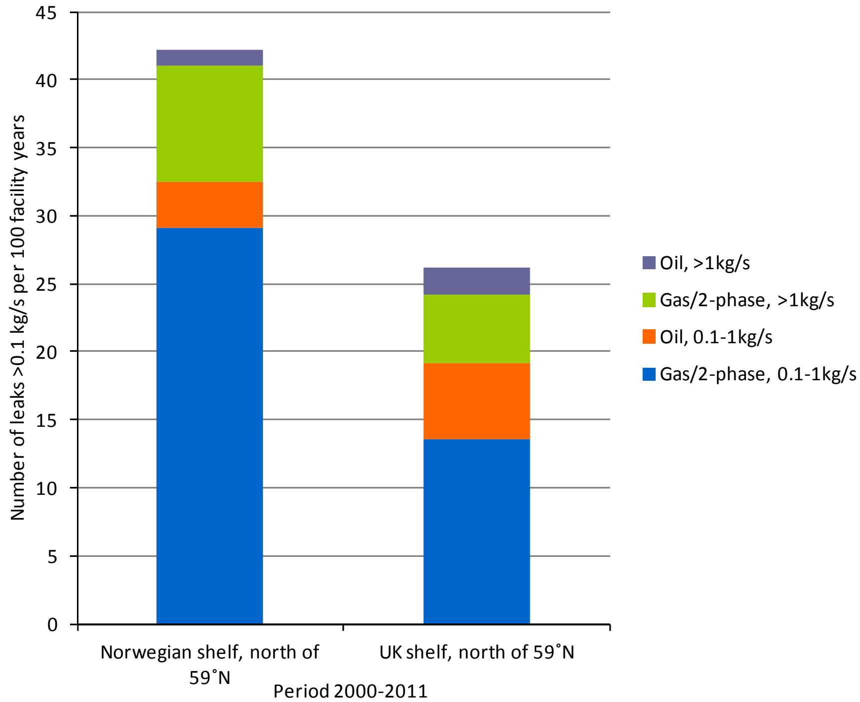

Figure 13 Comparison of gas/two-phase and oil leaks on the Norwegian and UK shelves north of 59°N per 100 facility years, average 2000-2011

The number of leaks on the Norwegian shelf has declined substantially in recent years, so the chosen period has a certain significance. For example, the data indicate the following observations as regards average leak frequency per facility year for all leaks exceeding 0.1 kg/s:

- The 2000–2011 period: Norwegian shelf 61% higher than the UK shelf
- The 2007–2011 period: Norwegian shelf 19% higher than the UK shelf.

No ignited hydrocarbon leaks (exceeding 0.1 kg/s) have been registered on the Norwegian shelf since 1992. The number of hydrocarbon leaks exceeding 0.1 kg/s since 1992 is approx. 450. It has been proven that the number of ignited leaks is significantly lower than on the UK shelf, where about 1.5% of the gas and two-phase leaks since 1992 have been ignited.

6.2.2 Loss of well control, blowout potential, well integrity

Figure 14 shows the occurrence of well incidents and shallow gas incidents distributed among 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.

As regards exploration drilling, there have been substantial variations throughout the period, perhaps around a stable average on par with 1996. There was a considerable reduction during the period 2005–2008 and significant variation during the period 2009-2012, with an increase in 2012 compared with 2011. Production drilling saw a continuously rising trend until 2003, with minor variations. During the period from 2004 to 2008, there was a decline, followed by an increase in 2009 and 2010. A reduction can be observed in 2011 and 2012. Most well incidents are in the regular category, i.e. incidents with minor potential.

EXPLORATION DRILLING

DEVELOPMENT DRILLING

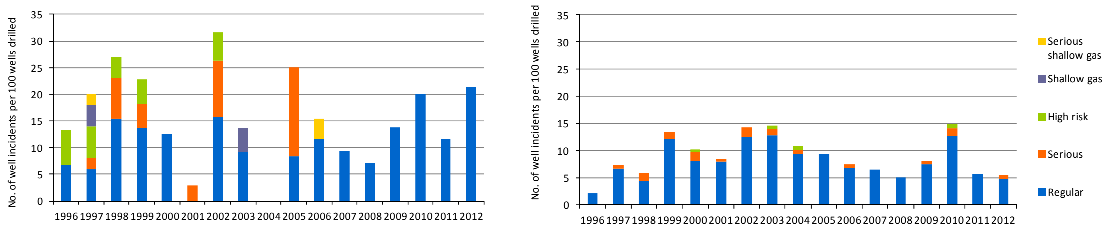

Figure 14 Well incidents according to severity per 100 wells drilled, for exploration and production drilling

Figure 15 shows an overview of all well control incidents (for exploration and production wells) in relation to the areas on the Norwegian shelf where the well control incidents have taken place. The area divisions correspond to the same divisions used on the Norwegian Petroleum Directorate's shelf map.

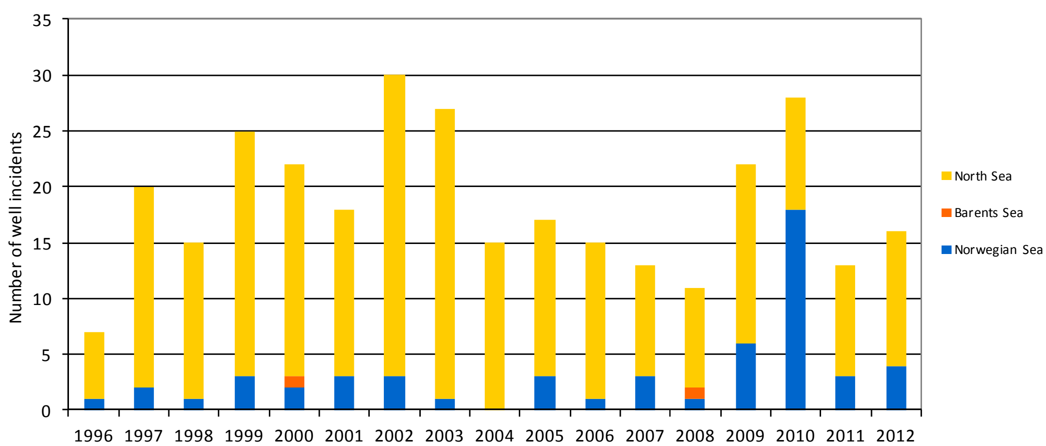

Figure 15 Distribution of well control incidents by areas, 1996-2012

The Well Integrity Forum (WIF) established a pilot project for performance indicators (KPIs) for well integrity in 2007. A total of 11 operating companies have reviewed all their "active" wells on the Norwegian shelf, a total of 1802 wells, with the exception of exploration wells and permanently plugged wells. This was first reported in accordance with WIF's list of well categories in 2008, based on current 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 leaks
Orange; one barrier failed and the other is intact, or a single failure could cause a leak to surroundings
Yellow; one barrier leaks within the acceptance criteria or the barrier has been degraded, the other is intact
Green; intact well, no or insignificant integrity aspects.

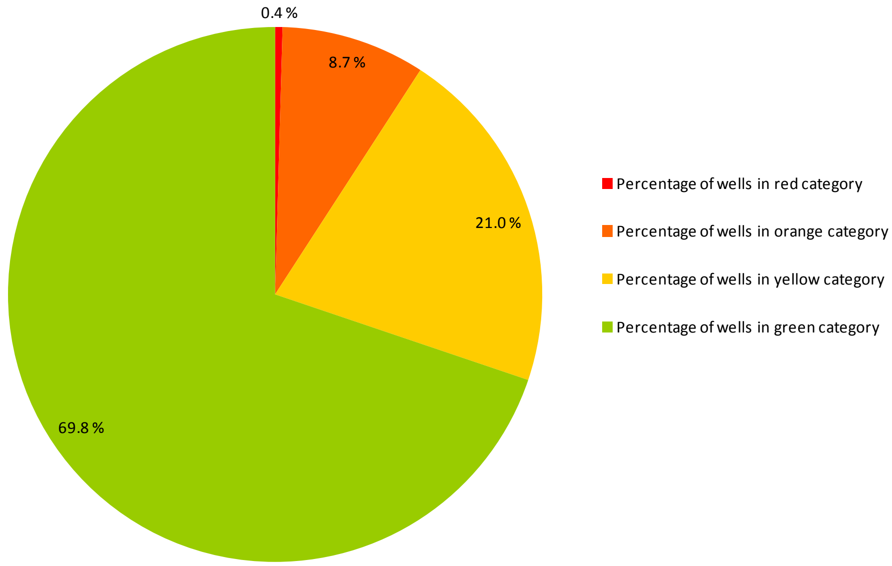

Figure 16 Well categories – red, orange, yellow and green, 2012

The mapping shows an overview of well categories distributed according to the percentage of the total selection of 1802 wells.

The results show that 9.2% of the wells have reduced quality compared with the requirement for two barriers (red + orange category). 21% of the wells are in the yellow category. This includes wells with reduced quality compared with the requirement for two barriers, but the companies have compensated for this through various measures such that they are deemed to comply with the requirement for two barriers. The rest of the wells, i.e. 70%, are in the green category. These are deemed to be in full compliance with the requirement for two barriers.

There has been an increase in the percentage of wells in the top three categories from 24 % to 30 % (90 more wells than in 2009). The development in the different categories is shown in Figure 17.

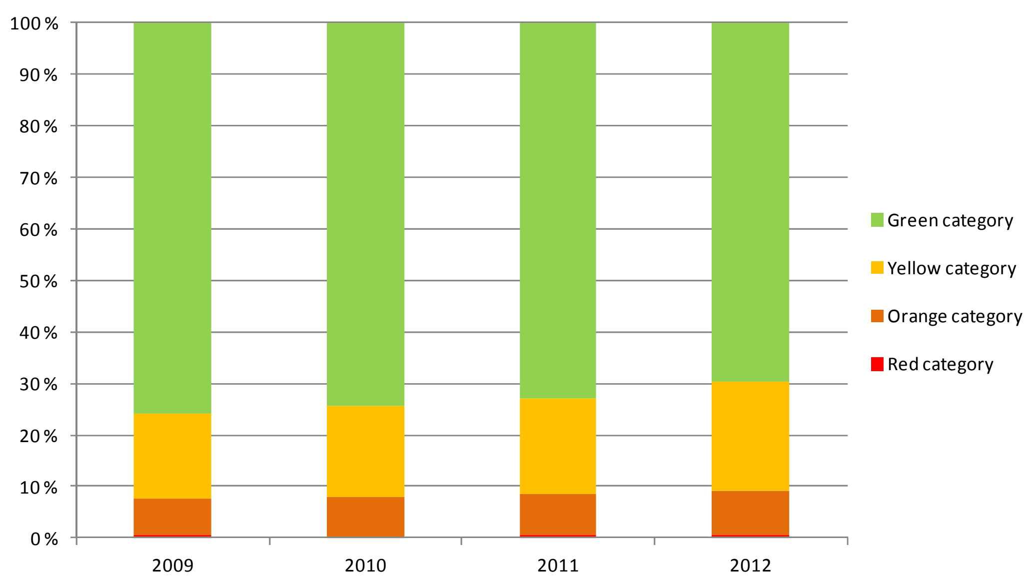

Figure 17 Development in well categories, 2009-2012

6.2.3 Leak/damage to risers, pipelines and subsea facilities

No leaks from risers to manned facilities were reported in 2012. Neither were any leaks from pipelines reported in 2012. In the previous year, two leaks were reported from flexible risers to manned facilities.

In 2012, six incidents were reported involving serious damage to risers and pipelines within the safety zone. The data for previous years has also been updated based on new information. It is added 21 incidents that are deemed to be serious from the year 2000 to 2011. This means that the data and overviews have been adjusted correspondingly. These incidents are also primarily associated with flexible pipelines and risers.

Serious damage is also included in the calculation of the overall indicator, but with lower weight than for leaks. Figure 18 shows an overview of the most serious incidents involving damage during the period 1996-2012.

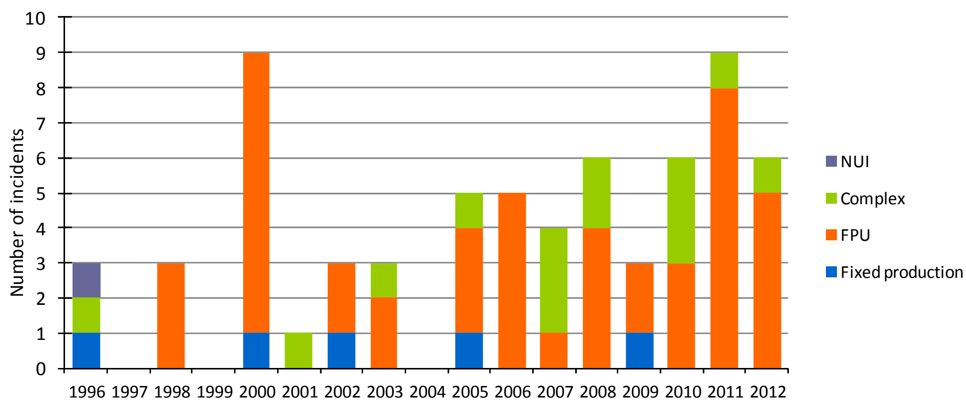

Figure 18 Number of incidents involving serious damage to risers & pipelines within the safety zone, 1996-2012

6.2.4 Ships on collision course, structural damage

There are only a handful of production facilities and somewhat more mobile facilities where the facility itself or the standby vessel are responsible for monitoring passing ships on a potential collision course. The others are monitored from the traffic centres at Ekofisk and Sandsli.

The indicator for ship on collision course, DFU5, is the number of ships reported on a potential collision course normalised according to the number of facilities monitored from the traffic centre at Sandsli, expressed as the total number of monitoring days for all facilities monitored by Statoil Marine at Sandsli. The number of ships registered on a collision course has declined substantially in recent years.

As regards collisions between vessels associated with the petroleum activities and facilities on the Norwegian shelf, there was an elevated level in 1999 and 2000 (15 incidents each year). Statoil in particular has worked hard to reduce such incidents, and in recent years, this figure has been around two to three per year.

There was one collision incident in 2012. On 11 March, the Siddis Skipper supply vessel crashed into starboard column 1 on the COSLPioneer drilling facility during loading to the vessel. Due to the weather conditions, the Siddis Skipper was unable to maintain its position. Scraped paint was proven in an area of about 50x50 cm on column 1.

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

The current regulations set requirements for flotels and production facilities as regards withstanding the loss of two anchor lines without serious consequences. Loss of more than one anchor line happens from time to time. This may have significant consequences, but rarely has consequences as severe as what happened on the *Ocean Vanguard* in 2004. Mobile drilling installations are only required to withstand the loss of one anchor line without undesirable consequences.

Structural damage and incidents that have been included in RNNP are primarily classified as fatigue damage, but some are storm damage. As regards cracks, it is only included continuous structural cracks. There is no clear connection between the age of the facility and the number of cracks. The number of DFU8 incidents during the period 1996-2012 is shown in Figure 19.

A total of 12 incidents involving structural damage were registered in 2012, of which six were associated with anchor lines, two DP incidents, three incidents involving water penetrating the hull and one incident involving cracks in the main load-bearing structure (fatigue). Three of the incidents in 2012 are categorised as serious. As regards mobile facilities, these incidents are the greatest contributor to the overall risk indicator for 2012, with a contribution of more than 90%.

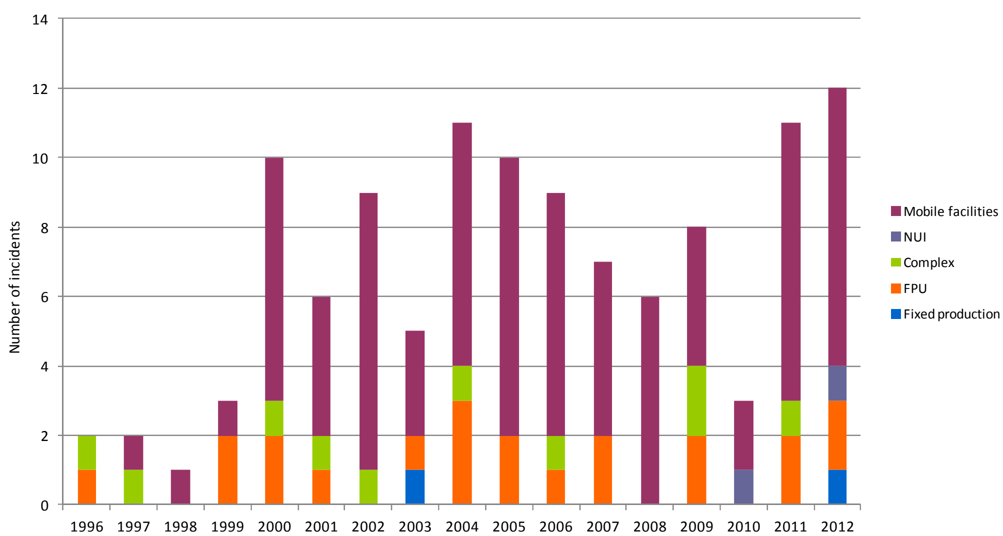

Figure 19 Number of serious incidents and incidents involving damage to structures and maritime systems which conform with the criteria for DFU8

6.3 Total indicator for major accidents

The total indicator applies to major accident risk on facilities, whereas risk associated with helicopter transport was discussed in Chapter 5. The calculation model assigns the DFUs a weight based on the probability of a fatal accident. It is emphasised that this indicator is only a supplement to the individual indicators, and expresses the development in risk factors related to major accidents.

The total indicator weights the contributions from the 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 the observations of the individual DFUs. Figure 20 shows the indicator for production facilities with annual values, in addition to a three-year rolling average. The large variations from year to year smooth's out when one considers the three-year rolling average, thus clarifying the long-term trend. Working hours have been used as a common parameter for normalisation against the activity level. The level of the normalised value was set at 100 in the year 2000, which also applies to the value for the three-year rolling average.

Looking at the three-year average, the main impression is a relatively constant level until 2006. Since 2007, the level has been somewhat constant at a lower level and slightly declining. Individual incidents with substantial risk potential may result in significant variations, and have an impact over three years, due to the average, as the figure clearly shows for 2004 (Snorre A blowout) and 2010 (well incident on Gullfaks C). There were several serious incidents in 2012, including two large hydrocarbon leaks.

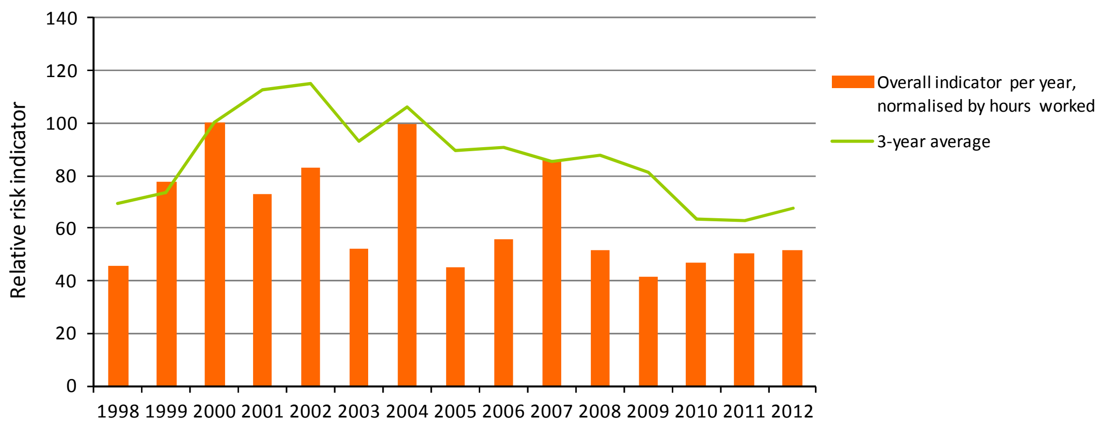

Figure 20   Total indicator, production facilities, normalised against working hours, annual values and three-year rolling average

Figure 21 shows the development of the total indicator for mobile facilities, with annual values and three-year rolling average. The values in 2009, 2010 and 2011 are the lowest three-year averages in the entire period. A significant increase can be seen in 2012, primarily due to structure-related incidents.

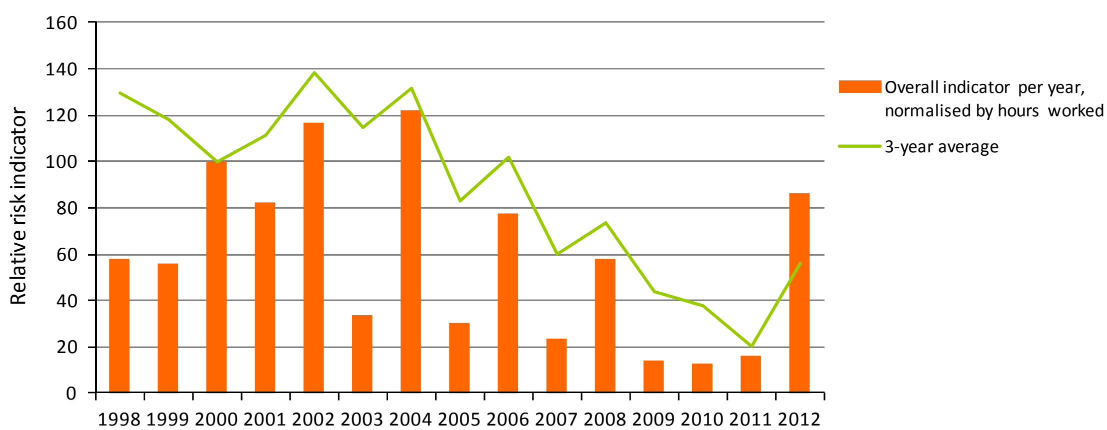

Figure 21   Total indicator, mobile facilities, normalised against working hours, annual values and three-year rolling average

7. Status and trends – barriers against major accidents

Reporting and analysis of barrier data has been continued without significant adjustments from previous years. As before, the companies report test data from periodic testing of selected barrier elements.

7.1 Barriers in the production and process facilities

The main emphasis is on barriers related to leaks from the production and process facilities, which includes the following barrier functions:

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

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

Figure 22 shows the percentage of failures for the barrier elements associated with production and process, for which test data has been collected. The test data are based on reports from all production operators on the Norwegian shelf.

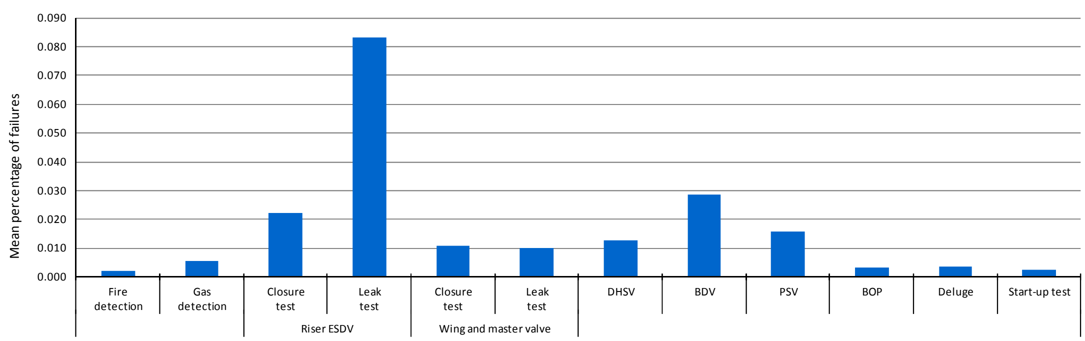

Figure 22 Mean percentage of failures for selected barrier elements, 2012

The main report shows the difference between the mean percentage of failures (Figure 22), i.e. the percentage of failures for each facility individually, averaged for all facilities, and the ”overall percentage of failures”, i.e. the sum of all failures on all reporting facilities, divided by the sum of all tests for all reporting facilities. All facilities have the same contribution to the mean percentage of failures, regardless of how many tests they have.

The data shows considerable variations in average levels for each of the operating companies, and for several of the barrier elements. The variations are even greater when one looks at each individual facility, as has been done for all barrier elements in the main report. Figure 23 shows an example of such a comparison for testing emergency shutdown valves (ESDVs) on risers and flowlines. Each individual facility is assigned a letter code, and the figure shows the percentage of failures in 2012, the average percentage of failures during the period 2007–2012, as well as the total number of tests carried out in 2012 (as text on the X axis, along with the facility code). The figure shows that, with a few exceptions, few failures were registered on the ESDV closure test in 2012.

The industry standard for the ESDV closure test is 0.01, and the figure shows that several facilities exceed the industry standard, eight for the percentage of failures in 2012 and 18 for the average value.

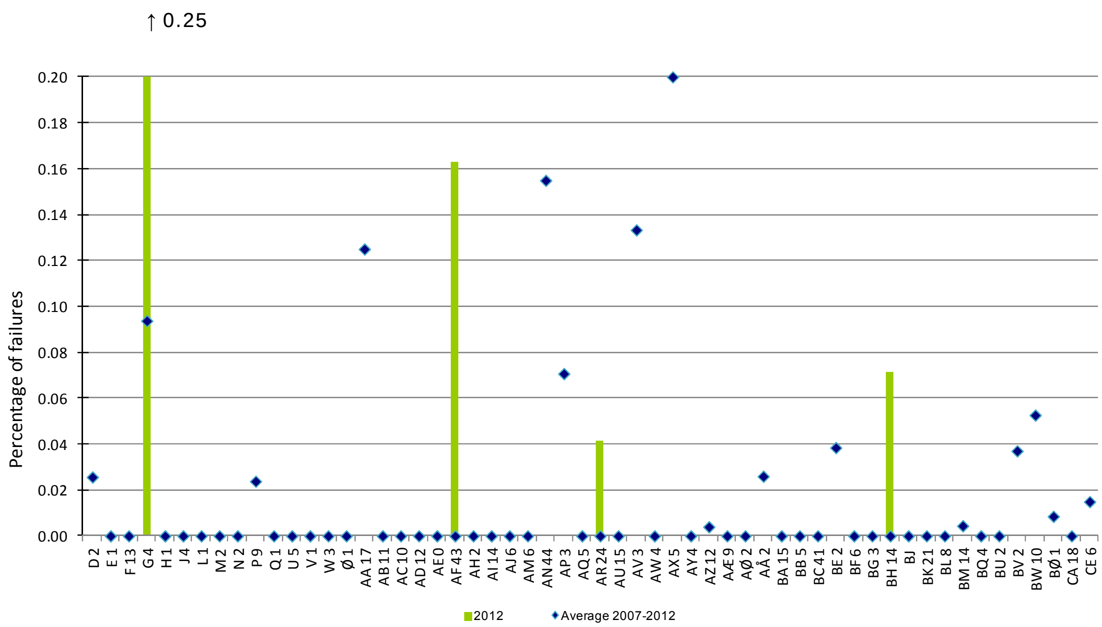

Figure 23 Percentage of failures for riser ESD valves (closure test)

As regards production facilities, it has now been collected barrier data for over 10 years for most barriers. Overall, many facilities performed below or far below the industry standard for several of the barrier elements, both in 2012 and on average for the entire period. Taking into account the industry's recent focus on major accident prevention, one would expect it to be possible to achieve greater improvements in this area than what the data from recent years shows.

Table 2 shows how many facilities have carried out tests for each barrier element, the total number of tests, the average number of tests for the facilities that have carried out tests, the overall percentage of failures and the mean percentage of failures for 2012 and for the period 2002–2012. This can then be compared with availability requirements for safety-critical systems. Figures in bold indicate that the percentage of failures exceeds the industry standard.

The table shows that, overall, most barrier elements are below or about on par with the industry standard for availability. However, this does not apply for riser ESDVs and bleed-down valves (BDVs), where the overall percentage of failures is far above the industry standard for 2012, as well as for the period 2002-2012. In other words, the industry has a clear potential for improvement as regards some of these barriers.

Table 2 General calculations and comparison with industry standards for barrier elements

Barrier elements	Number of facilities where tests were conducted in 2012	Average, number of tests, for facilities where tests were conducted in 2012	Number of facilities with percentage of failures in 2012 (and average 2002-2012) exceeding industry standards	Mean percentage of failures in 2012	Mean percentage of failures 2002-2012	Industry standard for availability (Statoil)
Fire detection	70	801	2 (8)	0.0020	0.0029	0.01
Gas detection	70	390	10 (18)	0.0052	0.0071	0.01
Shutdown:						
· Riser ESDV	61	21	10, 4 (16, 13)*[2]	**0.021**	**0.014**	0.01
· Wing and master (Xmas tree)	55	287	6, 6 (3, 7)*2	0.005	0.008	0.02
· DHSV	57	155	14 (19)	0.015	**0.021**	0.02
Bleed-down valve, BDV)	56	65	21 (42)	**0.020**	**0.023**	0.005
Pressure safety valve (PSV)	70	171	9 (14)	0.021	0.032	0.04
Isolation with BOP	29	122		0.007	0.008	*[3]
Active fireproofing:						
· Deluge valve	68	30	3 (19)	0.005	0.009	0.01
· Start-up test	59	141	6 (9)	0.002	0.003	0.005

7.2 Barriers associated with maritime systems

In 2012, data was collected for the following maritime barriers on mobile facilities:

- Watertight doors
- Valves in the ballast system
- Deck height (air gap) for jack-up facilities
- GM values for floaters at year-end.

Data collection was carried out for both floating production and mobile facilities. There are considerable variations in the number of tests per facility, from daily tests to twice per year. Approx. 26 000 tests of watertight doors and approx. 109 000 tests of ballast valves were carried out in 2012.

The failure frequencies for these systems in 2012 were 0.0046 for tests on watertight doors and 0.0003 for tests on ballast valves. These failure frequencies are at approximately the same level as for production facilities.

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[2] As regards riser ESDVs and wing and master valves, the figures concern the *closure test* and *leak test*, respectively.
[3] There is no comparable requirement for this barrier, as an availability requirement is not considered to be appropriate. Statoil's internal guidelines recommend following up failures in this barrier using trend analysis.

7.3 Indicators for maintenance management

In 2006, the PSA started the project *Maintenance as a policy instrument in order to prevent major accidents; maintenance status and associated challenges*. The goal was e.g. to update the status of maintenance management in the petroleum activities with a view to the significance of maintenance in preventing major accidents. The project showed that the status as regards classification of systems and equipment had not improved, compared with what emerged in Report No. 7 to the Storting (2001-2002). The PSA's audits during the period 2006–2009 uncovered several nonconformities in relation to regulatory requirements with all companies subject to audits. The recurring nonconformities were:

- Deficient classification of systems and equipment,
- Deficient use of classification,
- Deficient control of outstanding maintenance,
- Deficient documentation,
- Deficient expertise,
- Lacking evaluation of maintenance efficiency.

The maintenance management indicators focus on the *decision basis for maintenance management*, which means tagging systems and equipment on the facilities, classification of what has been tagged, and the percentage of what has been classified as critical as regards health, safety and the environment ("HSE-critical"). This also includes the *status of performed maintenance*, which means the number of hours spent on preventive and corrective maintenance, the preventive maintenance backlog, and outstanding corrective maintenance; also as regards HSE-critical equipment and systems. The reporting classes are as follows in the introductory phases:

Decision basis for maintenance management:

- Total number of tagged equipment
- Number of classified "tags"
- Number of "tags" classified as HSE-critical

Status of performed maintenance:

- PM backlog, total number of hours
- PM backlog, number of HSE-critical hours
- Outstanding CM, total number of hours
- Outstanding CM, number of HSE-critical hours

The main report shows all the indicators; only two are shown here. Figure 24 shows the size of the preventive maintenance backlog for production facilities, whereas Figure 25 shows the size of the preventive maintenance backlog for mobile facilities.

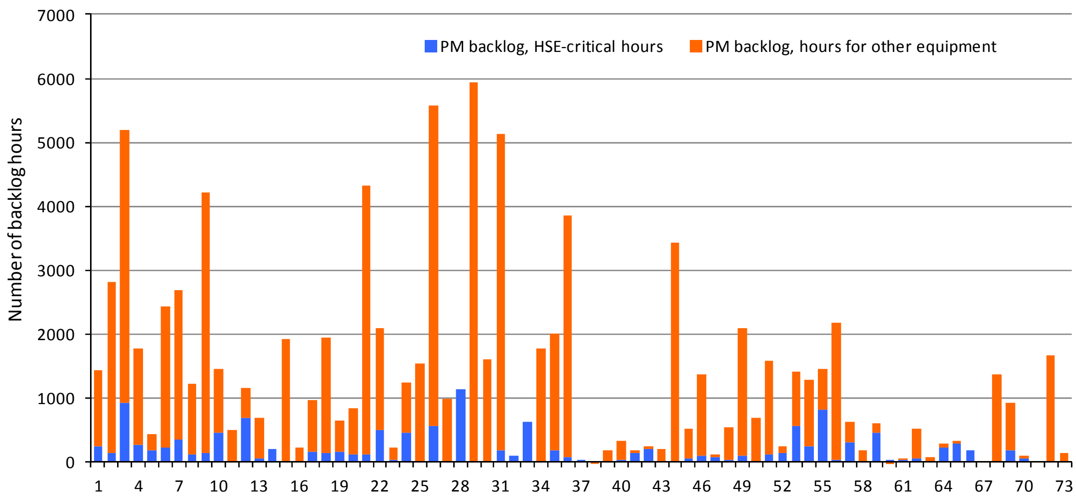

Figure 24 Overview of preventive maintenance backlog, production facilities

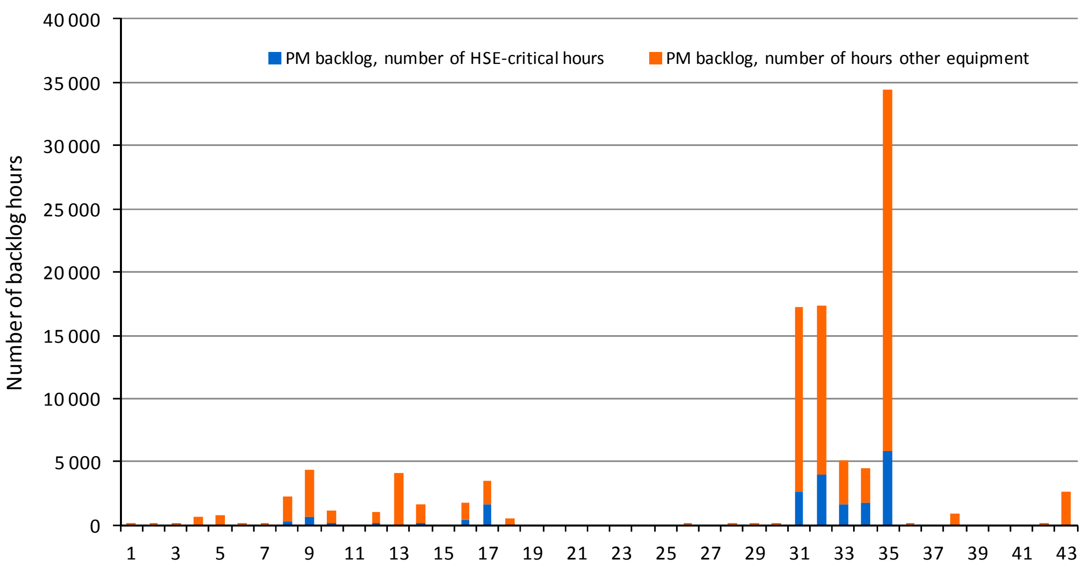

Figure 25 Overview of preventive maintenance backlog, mobile facilities

There is a somewhat significant backlog of planned maintenance, also for HSE-critical systems and equipment. Maintenance backlogs introduce risk contributions. It is therefore important to carefully control backlogs and the risk this represents.

As regards tagging and classification of equipment, the figures from 2012 show that more production facilities have tagged systems and equipment than in 2011. Mobile facilities still have low figures for tagging and classification. For some facilities, the level of classification is so low that it can be difficult to establish a risk-based decision basis for maintenance purposes.

8. Status and trends – work accidents involving fatalities and serious personnel injuries

For 2012, the PSA registered 336 personnel injuries on facilities in the petroleum activities on the Norwegian shelf that fulfil the criteria fatality, absence into the next shift or medical treatment. In 2011, 335 personnel injuries were reported. There were no fatal accidents in the PSA's area of authority on the shelf in 2012.

In addition to this, 39 injuries were classified as off-work injuries and 51 as first aid injuries in 2012. For comparison, in 2011, there were 65 off-work injuries and 105 first aid injuries. First aid injuries and off-work injuries are not included in figures or tables.

In recent years, there has been a clear reduction in the number of reported injuries on NAV (Norwegian Labour and Welfare Administration) forms. In 2012, a total of 36 % 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. The injuries not reported on NAV forms also include serious injuries.

On production facilities there was a clear, steady decline during the period from 2002 to 2004, from 18.2 to 11.3 injuries per million working hours in 2004. From 2004 to 2008, the overall injury frequency was generally unchanged, around 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 continued from 2009 to 2010. In 2011 and 2012, the injury frequency was 7.8 per million working hours.

On the mobile facilities, in the same way as for production facilities, there has been a positive development over the last ten years; from 2002, the frequency steadily declined from 15.8 to 11.1 in 2006. I 2007, there was an increase in injury frequency, but since 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. Last year saw positive development again, and the injury frequency in 2012 was 6.6 injuries per million working hours. In 2012, there were 90 injuries on mobile facilities, compared with 93 in 2011.

8.1 Serious personnel injuries, production facilities

Figure 26 shows the frequency of serious personnel injuries on production facilities per million working hours. The frequency exhibited a downward trend from 2002 to 2004. Starting in 2005, there was a positive trend until 2008, when the positive development reversed. In 2009, there was a temporary decline, followed by a positive trend in recent years, and in 2012, the injury frequency on production facilities reached its lowest level ever. In recent years, there has been a reduction in the injury frequency on production facilities of 0.11 injuries per million working hours. The injury frequency has declined from 0.55 in 2011 to 0.44 in 2012. As regards production facilities, there was a significant reduction in both 2011 and 2012, compared with the previous ten-year period.

There were 14 serious injuries on production facilities in 2012, compared with 17 in 2011. The number of working hours has increased by 0.5 million hours, from 31.18 million in 2011 to 31.65 million in 2012.

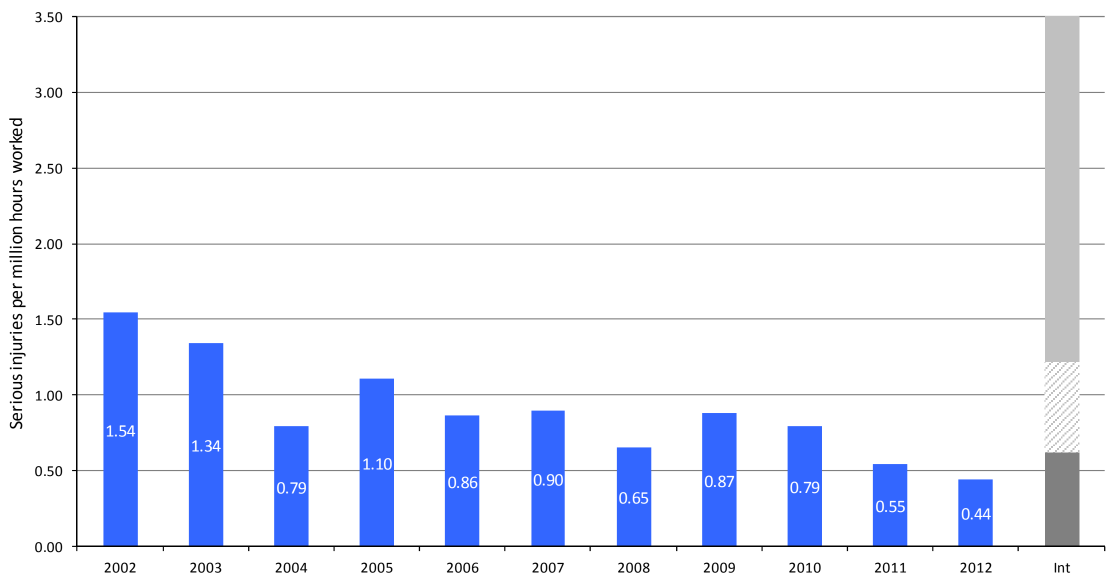

Figure 26 Serious personnel injuries on production facilities in relation to working hours

8.2 Serious personnel injuries, mobile facilities

Figure 27 shows the frequency of serious personnel injuries per million working hours on mobile facilities. Over the long term, there has been a clear decline in recent years from the peak in 2002. The development during the period from 2002 to 2006 was characterised by minor changes in injury frequency, whereas in 2007, there was a more marked reduction. In 2008, there was another decline in the frequency, but the subsequent two years are characterised by a very positive development, and in 2010, the frequency was the lowest level ever recorded. I 2012, there was a reduction in the frequency of serious personnel injuries of 0.2 injuries per million working hours, from 0.83 in 2011 to 0.66 in 2012. The injury frequency is within the expected value, based on the previous ten years.

The number of hours reported for mobile facilities in 2012 had increased by 0.5 million, from 13.2 to 13.7 million. The number of serious personnel injuries in 2012 was 9, compared with 11 in 2011.

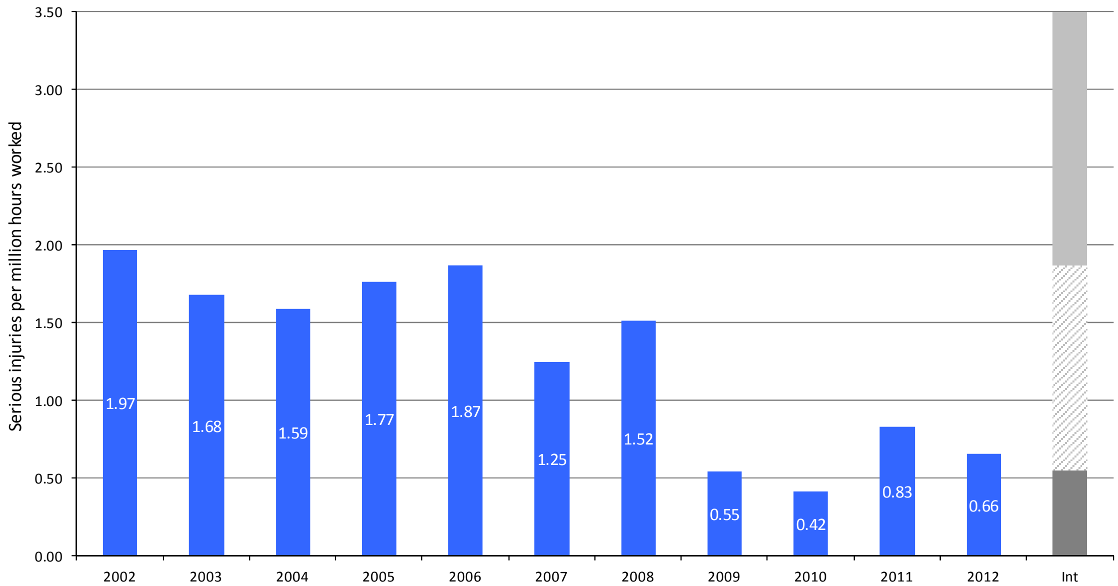

Figure 27 Serious personnel injuries per million working hours, mobile facilities

8.3 Comparison of accident statistics between the UK and Norwegian shelves

Every six months, the PSA and the Health and Safety Executive (HSE) produce a joint report comparing offshore personnel injury statistics. The classification criteria were initially virtually identical, but more detailed reviews revealed that the classification practice was somewhat different nevertheless. In order to improve the basis for comparison, the PSA, in dialogue with the UK authorities, has classified serious injuries according to joint criteria and such that they include equivalent areas of activity.

A calculation of the average injury frequency for fatalities and serious injuries for the period from 2007 up to the 1st half of 2012 shows that there have been 0.65 injuries per million working hours on the Norwegian shelf and 0.73 on the UK shelf. The difference is not significant.

The average frequency for fatalities on UK shelf is 0.97 per 100 million working hours, compared with 0.89 on the Norwegian shelf. This difference is also not significant. On the UK shelf, there were three fatalities during the mentioned period, compared with two on the Norwegian shelf.

9. Risk indicators - noise, chemical working environment and ergonomics

The emphasis of these indicators is on expressing risk factors as early as possible in the causal chain that lead to an occupational injury or illness, and furthermore that they are attractive for use in the companies' improvement work.

As regards noise and chemical working environment, with a few exceptions, data has been registered from all offshore and onshore facilities. As regards noise, the data set is characterised by a shared 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 to change. As regards the chemical working environment, changes and adaptations have been made in order for the indicators to best reflect the actual risk factors. The indicator was unchanged for 2012.

Indicators for ergonomic factors have been reported for 2009 to 2012. The indicator for 2009 was changed in 2010, so the figures for 2009 and 2010 were not comparable. It is possible to compare the figures from 2010 to 2012.

The indicators are based on a standardised data set and will only capture parts of a complex risk profile. The indicators can therefore not replace the companies' duty to carry out exposure and risk assessments as a basis for implementing risk-reducing measures.

9.1 Noise exposure harmful to hearing

Data has been reported from 81 facilities, 45 fixed production facilities and 36 mobile ones. Among the production facilities, 18 facilities are ”new” and 27 are ”older”. New facilities means facilities with a Plan for Development and Operation (PDO) approved after 1 August 1995, when more stringent and detailed noise requirements (the SAM Regulations) were introduced.

The noise exposure indicator covers eleven predefined position categories. The collected data represents a total of about 7500 employees on the shelf.

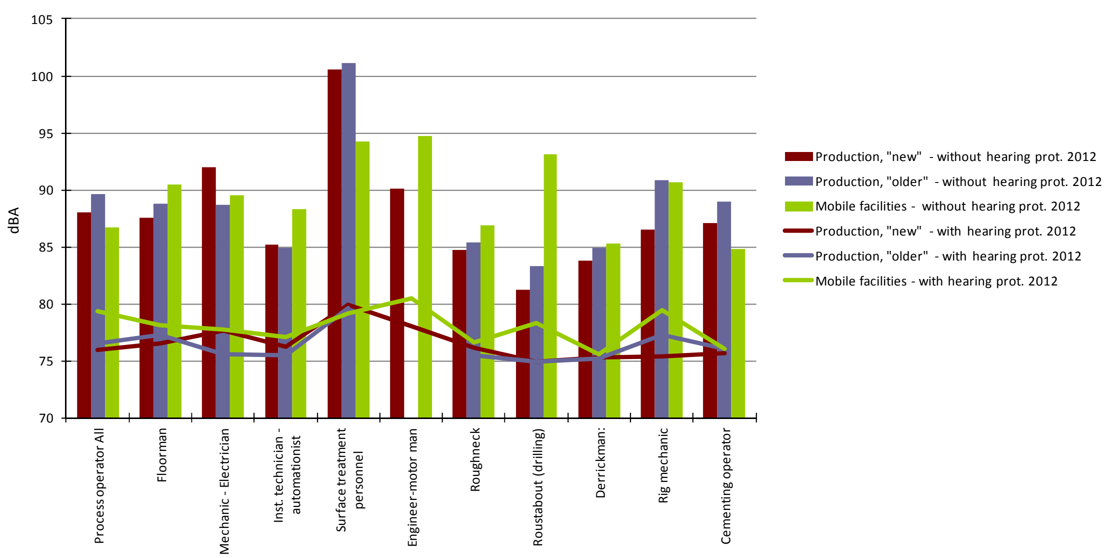

Figure 28 Average noise exposure for position categories and facility type, 2012

The noise indicator shows improvement in six of eleven position categories from 2011 and five of the position categories have a weak positive trend over the last three years. Looking at the average value of the noise indicator for the entire shelf activity, it has changed from 90.2 in 2010 and 89.3 in 2011, to 89.1 in 2012. This is primarily due to the fact that the figures for manning in certain position categories have been increased.

At the facility level, there are also some annual variations that cannot be attributed to improvement, but rather the activity level and types of activity. The average noise indicator for the facilities is significantly affected by how many surface treatment personnel have worked on board the facility. Viewed as a whole, the development in the noise indicator per position category provides the best assessment basis for changes.

The noise indicator for the position categories engineer and surface treatment personnel are considerably higher than for other groups and for this group, the noise indicator including ear protection is relatively high.

For most position categories, the noise indicator is lower on "new" facilities than on "older" ones. Eight facilities have reported that technical measures had been implemented which, overall, had resulted in reduced noise exposure by 1 dB, five facilities reported a reduction of 3 dB, four facilities reported a reduction of 5 dB and one facility reported a reduction of 5 dB for certain position categories. This is an improvement compared with the previous year, but nevertheless represents an overall level of measures yielding only a minor reduction in exposure.

The reporting confirms that several companies have formalised and implemented plans for working hours restrictions. Of 81 facilities, five have not introduced such plans for any position categories. This applies especially for mobile facilities. As in previous years, there is still a potential for improvement within this area for mobile facilities. Even though it may be difficult to verify that this type of measure is effective, there are examples to indicate that they work. Such plans may have operational disadvantages and may inherently be a driver for more robust technical measures.

In spite of the indicator pointing in the direction of high exposure, several of the facilities still do not have action plans for risk reduction, see Figure 29. The picture has developed in a more positive direction, compared with 2010, for "new" and "older" production facilities. The indicator for mobile facilities has developed in a negative direction.

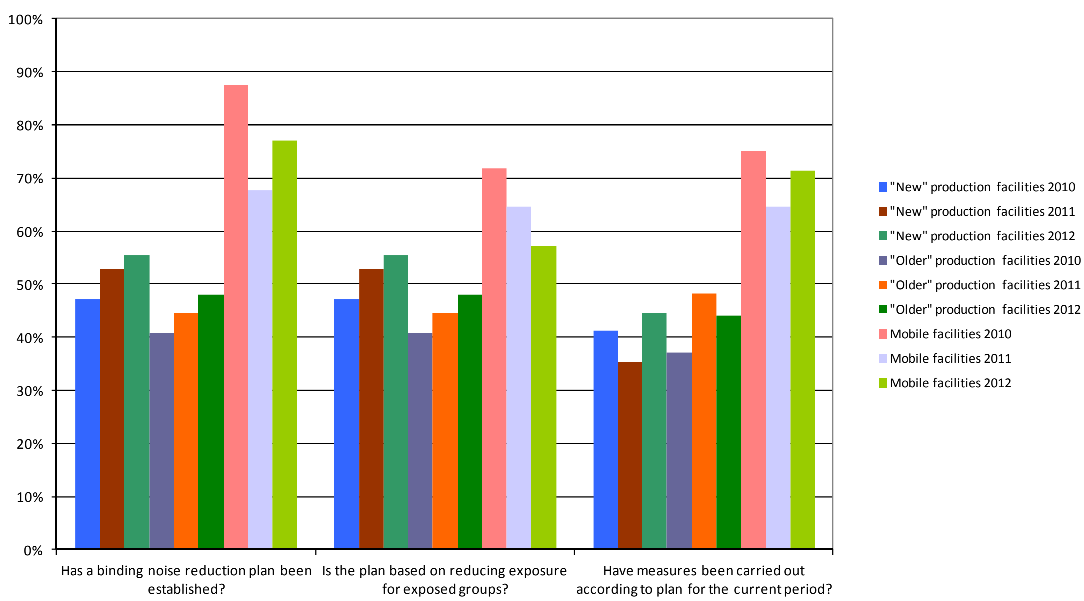

Figure 29 Plans for risk-reducing measures

For 2012, 646 (710 in 2011) instances of reduced hearing and 173 (126 in 2011) instances of tinnitus were reported to the Petroleum Safety Authority Norway. Viewed as a whole, it seems to be clear that large groups of employees in the offshore petroleum activities are exposed to high noise levels and that the risk of developing noise-induced hearing loss is significant. The PSA's experience through contact with the industry, administrative processing and audits, indicates that the potential for noise-reducing measures is significant. The industry project for noise reduction in the petroleum activities that was started in 2011 is expected to contribute toward improvement in the noise indicator over time. It is unlikely that this work has had a measurable effect in the present reporting period.

9.2 Chemical working environment

The indicator for the chemical working environment consists of two elements. One is the number of chemicals in use, distributed among health hazard categories (the chemical spectrum's risk profile), as well as actual exposure to defined position categories where we attempt to capture exposure with the highest risk. Supplementary information that provides an indication of the companies' risk management for chemical exposure has also been reported. The establishment of binding plans and follow-up of these are key in this context.

For 2012, data has been reported from a total of 75 facilities, 40 fixed production facilities and 35 mobile ones. The data for 2012 shows that there is considerable variation between companies as regards the number of chemicals in use (Figure 30 and Figure 31).

As regards fixed facilities, there has been a negative development for chemicals with high risk potential. During the period from 2004 to 2012, the number of chemicals with high risk potential has increased by around 31%.

A total of 482 substitutions with health risk benefits were registered in 2012. This is an improvement compared with 2011, when a total of 205 substitutions with health risk benefits were registered. The majority of substitutions in 2012 were carried out on 3 of 40 fixed facilities, with a total of 190 substitutions. As regards mobile facilities, the 2012 reporting shows that several facilities have contributed substitutions, and there were a total of 292 substitutions in 2012.

The indicator for actual chemical exposure shows an improvement in six position categories in what is considered to be the highest chemical exposure, compared with the previous year.

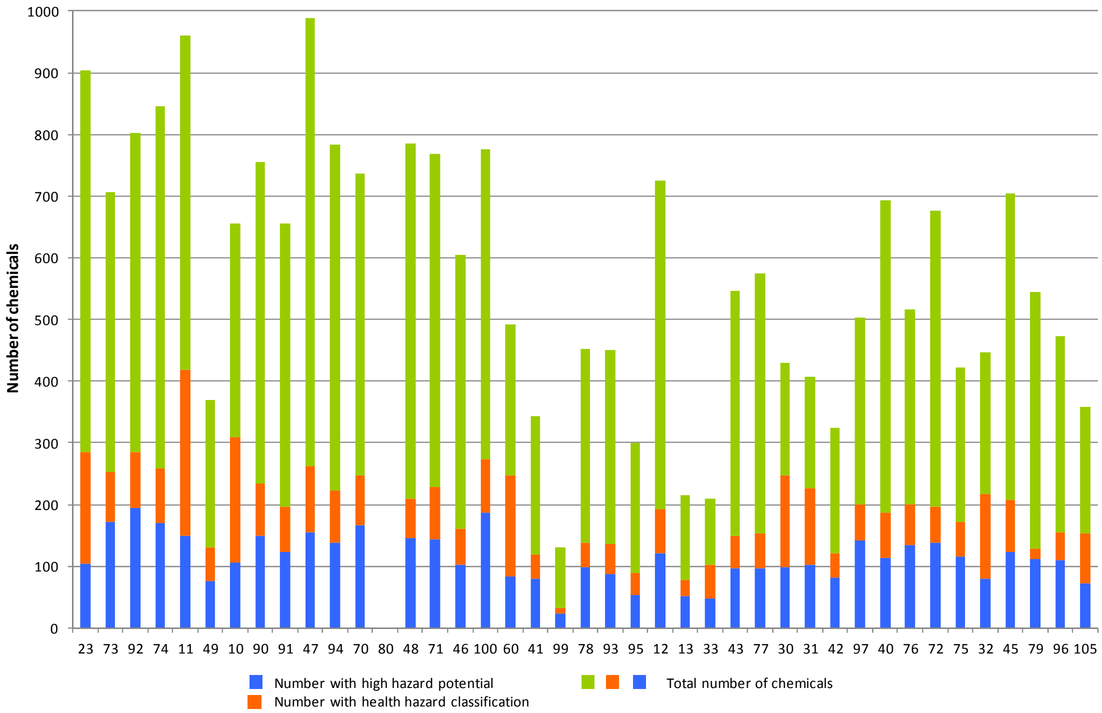

Figure 30 Indicator for the chemical spectrum's risk profile – production facilities

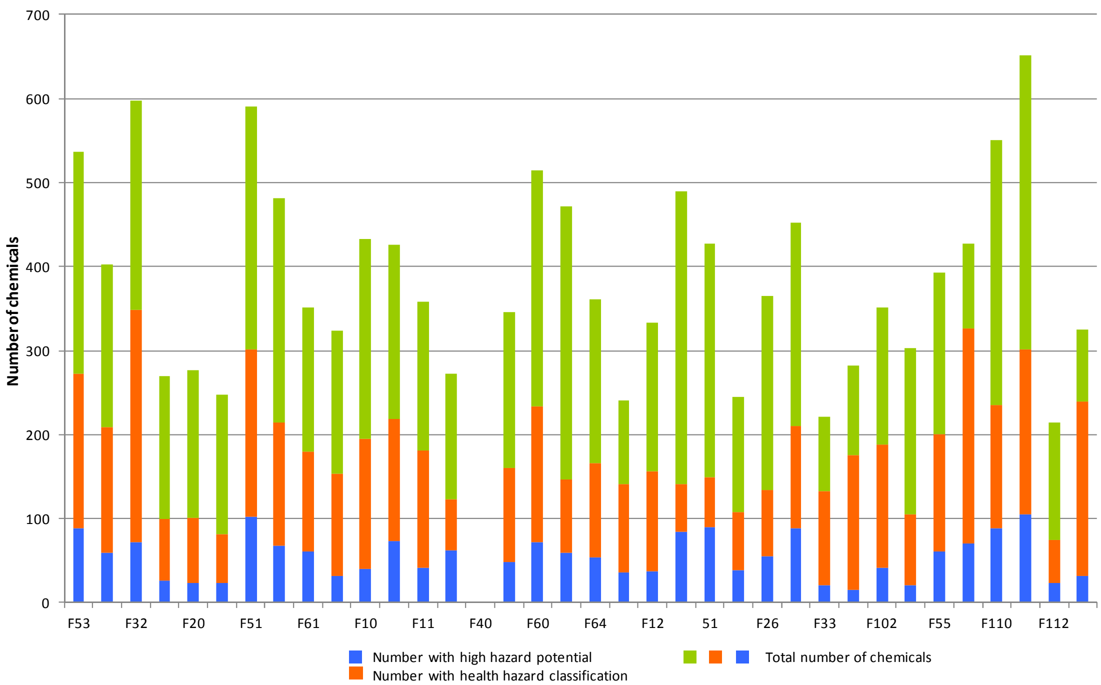

Figure 31 Indicator for the chemical spectrum's risk profile – mobile facilities

In 2012, 34 new cases of occupational skin diseases mainly caused by chemical exposure were reported, compared with 26 cases in 2011.

9.3 Ergonomics

Indicators for ergonomic factors have been reported since 2009. The reporting for 2009 was a pilot, and changes made in 2010 entailed that the figures for 2009 could not be compared with later years' results. In 2012, a few changes were made to the questions regarding risk management, which means that some of the results here cannot be compared with previous years.

The indicators have been developed in cooperation with specialist environments in the companies and STAMI. The status overview "Work as a cause of musculoskeletal disorders" was prepared by STAMI in 2008 on assignment from the Norwegian Labour Inspection Authority and the PSA, and has been used as a basis in developing the indicators. The previous regulations relating to heavy and repetitive work with guidelines (amended on 1 January 2013) states the assessment criteria that shall form the basis for reporting. The use of ergonomic specialist personnel has been emphasised by the PSA.

Data has been reported from 50 production facilities and 30 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 over the short or long term.

The strains must be studied in more detail. Aspects such as the duration, tempo and frequency of the strain are particularly important. The combination of the strains may have an amplified impact. In the green area, there is a minor risk of repetitive strain injuries for most employees.

The quality of this year's reporting is better than last year. This may be linked to the fact that the PSA, prior to sending out forms for 2012, held a seminar focusing on the RNNP ergonomics indicator, results from 2011 and filling in the form for 2012. However, this year, as before, we have experienced deficient completion of the form for overall risk of each of the factors working position, repetition, lifting and carrying, as well as handheld tools. Many have also not adequately followed the predefined work tasks. Several have also neglected to fill in data for risk management. In some cases, deficient forms were returned to the senders with requests for specific improvements. The forms returned after such revisions were usually completed satisfactorily.

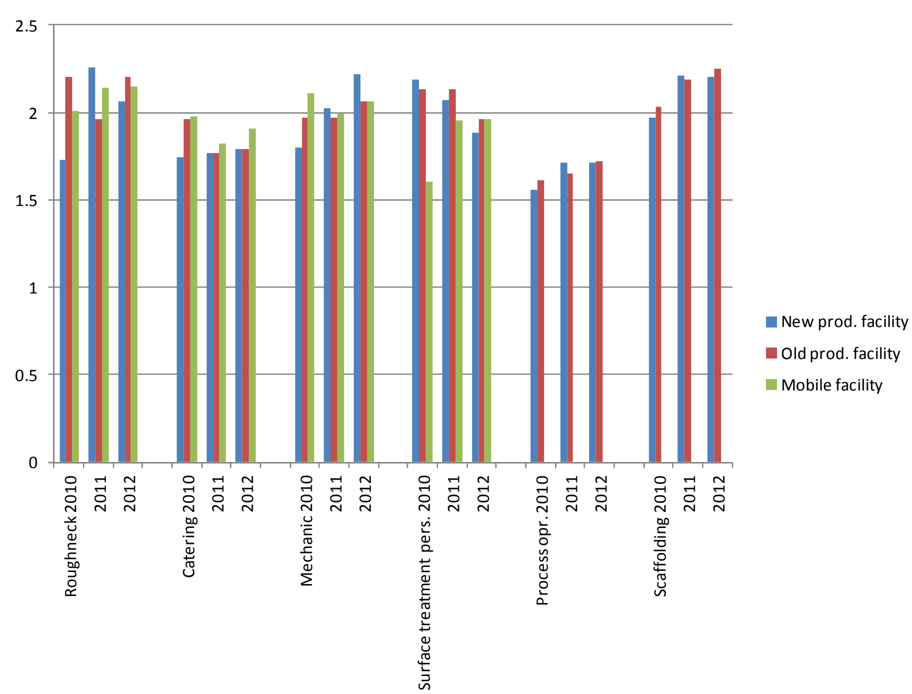

Figure 32 Average risk score for all work tasks distributed among employee groups on production and mobile facilities

The values on the vertical axis represent the risk assessment in the following manner: green = 1; yellow = 2; red = 3

Overall, the results are fairly similar to those from 2011. The reporting shows that roughnecks, mechanics and scaffolders have the highest risk scores in 2012. As regards mechanics, we see a weak increase on new production facilities. Catering maintains a relatively stable risk score, compared with 2011. I 2010, the tendency was that roughnecks, catering and mechanics had higher scores on old facilities than on new ones. We see that this tendency has changed. In 2012, only catering scores higher on mobile facilities than on production facilities.

Some of the questions were changed in 2012, and the question regarding to what extent ergonomic specialist expertise has been used in the process with this year's reporting, is new. This means that not all answers from 2012 can be compared with 2010 and 2011. There has been considerable variation in the response rate on these questions, but a clear improvement from year to year. As regards questions as to whether ergonomic specialist expertise has been involved, the response rate has been low, especially for mobile facilities, where approx. 25 % do not respond to questions as to whether ergonomic specialist expertise has been used in the process of filling in RNNP forms.

On production facilities, surface treatment personnel stand out as the employee group with the best reporting as regards most questions concerning risk management. Reports indicate that, between 85 and 90% of catering assistants are subject to established binding plans, implemented measures and that they have involved the users in this work. Roughnecks are the lowest at 55-59 %. However, catering is only at 60 % as regards involvement of ergonomics specialist expertise, both as regards work on plans and measures, as well as in the RNNP work. The system of formalised working hours restrictions as a measure to decrease ergonomic risk is used the least frequently by roughnecks, only 39 %.

On mobile facilities, catering stands out as the employee group that reports the best as regards risk management. More than 80% report that they have established binding plans for implementing measures to improve ergonomic risk, that measures have been implemented according to plan and that prioritisation and implementation of measures has taken place in cooperation with users. There is considerable variation in the reporting on these questions among the other employee groups. As regards surface treatment personnel, all reporting states that they have formalised working hours restrictions, but they score the lowest on binding plans and measures implemented according to plan.

User involvement is reported to exceed 70 % for all employee groups. Ergonomics specialist expertise is used to a varying degree in the work on plans and measures, between 52 % (roughnecks) to 83 % (surface treatment personnel). However, ergonomics specialist expertise is used to a greater extent in the work on RNNP reporting.

The following work tasks for facilities on the shelf are considered to have the highest risk in 2012 (the figures represent the average risk score):

- Needle scaling: 2.71
- Handling "chicksan": 2.65
- Setting/pulling/lifting manual "slips": 2.52
- Setting/pulling/lifting manual "slips": 2.45
- Water jetting/pressure washing: 2.44
- Rigging: 2.44
- Needle scaling: 2.43
- Erecting/taking down scaffolding: 2.42

10. Other indicators

10.1 DFU21 Falling objects

During the period 2002–2012, an average of 220 incidents related to falling objects was reported to RNNP each year. The level of annually reported incidents has been fairly steady during the period 2002–2009, but the level for 2010-2012 is a bit lower, with 162 incidents in 2012. There have been two fatalities and 97 injuries related to falling objects since 2002.

An analysis has been carried out in order to categorise the incidents according to initiating causes. The assessment primarily focuses on the 2006–2012 period. The categorisation has taken place according to the model of categories developed in the BORA project, see the main report. This method was originally developed to classify hydrocarbon leaks, but has been generalised and adapted for use on incidents with falling objects.

Figure 33 shows the distribution of incidents in main categories of work processes. The causes are distributed differently across the various work processes. Causal categories F and B dominate the crane-related incidents; External circumstances and Human activity introducing latent risk. Incidents with falling objects associated with crane-related work processes are also particularly interesting, as the incidents are concentrated in the two highest energy classes.

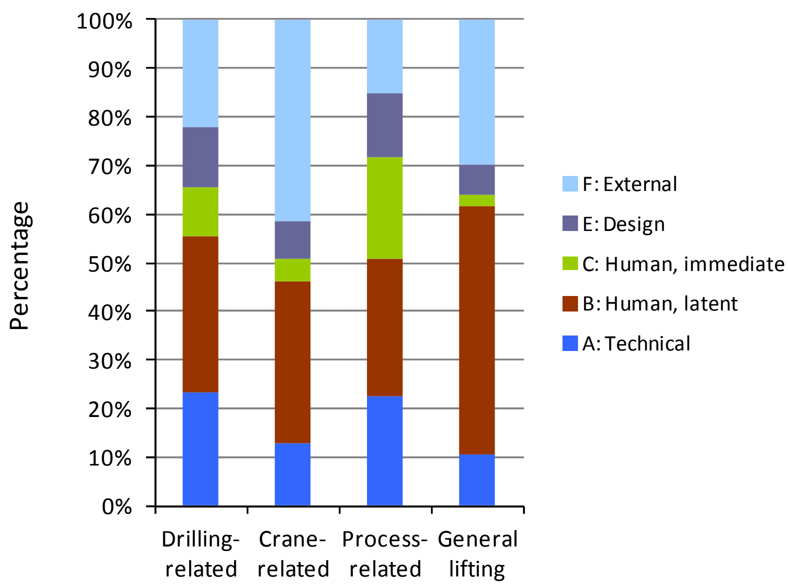

Figure 33 Triggering causes distributed by main categories of work processes, 2002-2012

Figure 34 presents a detailed overview of causes of falling objects in connection with the work processes loading and offloading operations (from vessels) and lifts that take place internally on a facility. The data for these work processes includes incidents as far back as 2002. The F3 category – influence from crash/hooking, accounts for a relatively large share of the incidents in the main category crane-related work processes. A large share of these incidents can be found within lifts that take place internally on the facility. A more comprehensive analysis can be found in the main report.

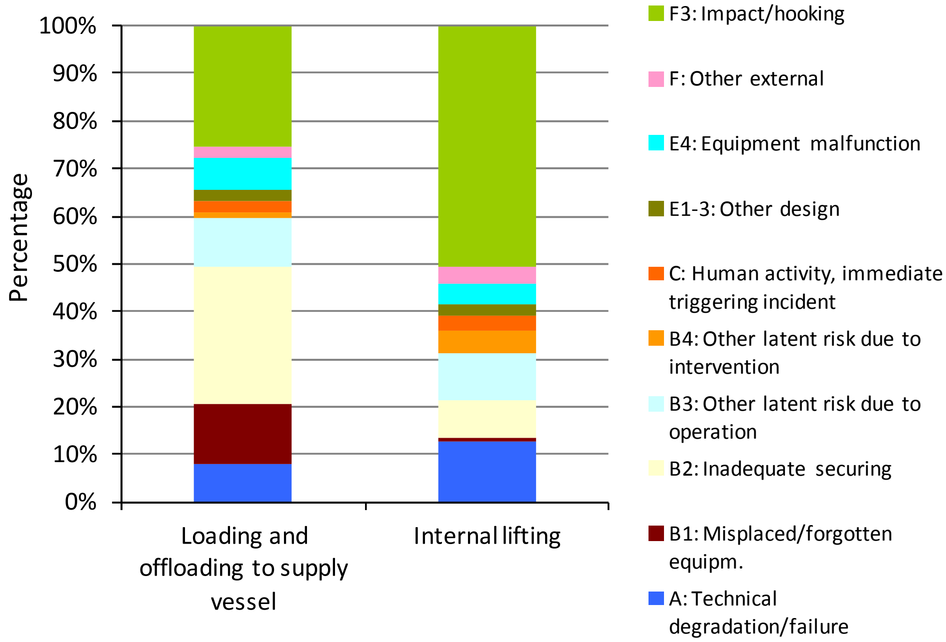

Figure 34 Triggering causes distributed by detailed categories of work processes, 2002-2012

10.2 Other DFUs

The main report presents data for incidents that have been reported to the Petroleum Safety Authority Norway, as well as for other DFUs without major accident potential, such as DFU10, 11, 13, 16 and 19, see Table 1.

11. Definitions and abbreviations

11.1 Definitions

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

11.2 Abbreviations

For a detailed list of abbreviations, see PSA, 2013a. Developments in the risk level on the Norwegian shelf, Main report, 25 April 2013. 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
CM	Corrective maintenance
NPD	Norwegian Petroleum Directorate
PSA	Petroleum Safety Authority
STAMI	National Institute of Occupational Health
WIF	Well Integrity Forum

12. References

Detailed reference lists can be found in the main reports:

PSA, 2013a. Developments in the risk level on the Norwegian shelf, Main report, 25 April 2013

PSA, 2013b. Developments in the risk level – onshore facilities in the Norwegian petroleum activities, 25 April 2013