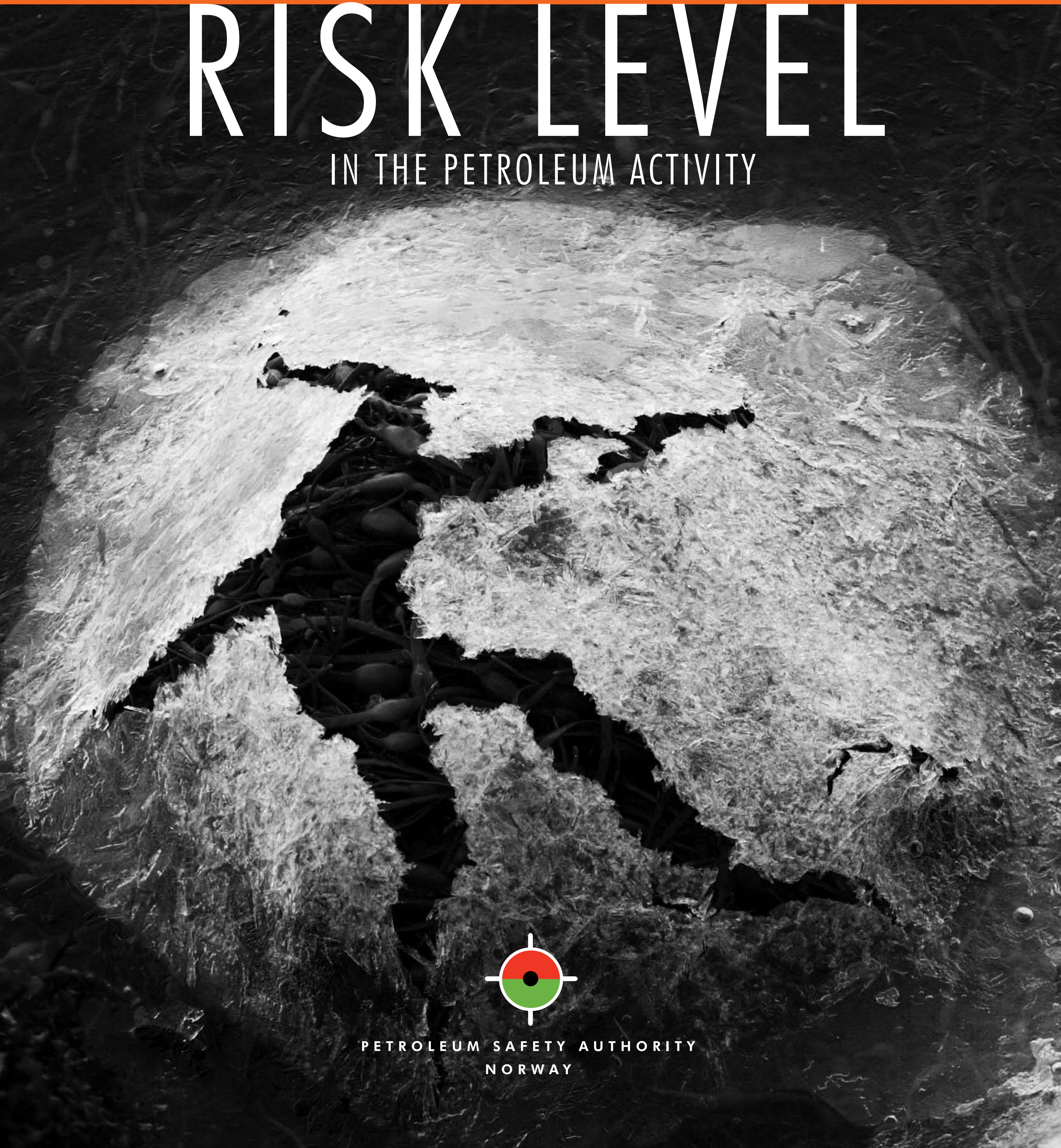
SUMMARY REPORT 2009 - NORWEGIAN CONTINENTAL SHELF

TRENDS IN RISK LEVEL

IN THE PETROLEUM ACTIVITY



PETROLEUM SAFETY AUTHORITY
NORWAY

Foreword

Trends in risk levels in the petroleum industry are not only a matter of concern to everyone involved in the industry but are also of interest to the public at large. It was therefore a logical and important step to establish a structure for measuring the effect of the collective HES work in the industry. This year's report is the tenth in the series.

As a tool, RNNP has undergone substantial development since the initial years 1999/2000 (the first report was issued in 2001). This development has taken place in the context of collaboration between the partners in the industry and consensus that the chosen approach is sensible and rational with a view to establishing a basis for a common understanding of the level of HES and its trends in an industrial perspective. This activity has come to assume an important role in the industry since it contributes to a unified understanding of risk levels.

The petroleum industry has a high level of competence in the field of HES. We have sought to draw on this competence by making the process an open one and inviting key resource persons from operating companies, shipping companies, the Civil Aviation Authority, helicopter operators, consultancy firms, research and teaching institutions to contribute.

Objectivity and credibility are key words if opinions on safety and the working environment are to carry any weight. This is conditional on all the parties concurring that the methodology offers a logical approach and that the results create value. Their joint ownership of processes and results is therefore important. To promote continuing active ownership of the process, a reference group representing the partners in the industry was constituted in 2009 with the mandate of contributing to the further development of the work.

There are many people, both in and outside the industry, who have contributed to the project. It would take too long to list them all but I should like to mention in particular the positive response we have met with in all our contacts with the parties concerned in connection with the implementation and continuing development of the work.

Øyvind Tuntland
Director for Professional Competence
Petroleum Safety Authority

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1. Purpose and limitations

1.1 Purpose

The project ”Trends in Risk Levels – Norwegian Continental Shelf” was launched in year 2000. The Norwegian petroleum industry has gradually gone from a development phase encompassing many major fields to one in which operation of facilities dominates. Among factors marking the industry today are problems associated with older installations, exploration and development in environmentally sensitive areas and the development of smaller and economically less viable fields. The future development of petroleum activities must be pursued in a perspective of continuing improvements in health, environment and safety (HES). Measuring the effect of all safety work in these activities is therefore an important contribution. Changes are also taking place in relation to participation, with increasing numbers of new players making their entry on the Norwegian Continental Shelf.

The industry has traditionally used selected indicators to illustrate safety trends in petroleum activities. An indicator based on the frequency of occupational accidents resulting in lost working time has been particularly widely applied. These indicators give only a partial picture of the overall safety situation. The preference in recent years has been for a range of indicators to be used to measure trends in certain key HES factors.

The Petroleum Safety Authority wishes to form a nuanced picture of trends in risk level based on information from different sides of the activities, with a view to measuring the effects of safety work in the industry as a whole.

1.2 Objectives

The Petroleum Safety Authority wishes to illustrate the level of risk on the basis of complementary information and data from more than one side of the activities, making it possible to measure the overall effect of all safety work, as this report does. The aim of the work is to:

- Measure the impact of HES-related measures in the petroleum industry.
- Help to identify areas which are critical for HES and in which priority must be given to identifying causes in order to prevent unplanned events and accidents.
- Improve understanding of the possible causes of accidents and their relative significance in the context of risk, among other reasons to create a reliable decision-making platform for the industry and authorities in planning preventive safety and emergency preparedness measures.

The work will also help to identify potential areas for making regulatory changes and for research and development.

1.3 Important limitations

The work focuses on risk to personnel and covers major accidents, occupational accidents and working environment factors. Both qualitative and quantitative indicators are used.

The activity is limited to factors which fall under the PSA’s area of authority in regard to safety and the working environment, and all helicopter transport of personnel, in cooperation with the Civil Aviation Authority Norway and helicopter operators on the Norwegian Continental Shelf. The survey covers the following areas:

- All production installations and mobile units on the Norwegian Continental Shelf, including subsea installations
- Transport of personnel by helicopter between helicopter terminal and installation (point of departure to point of landing).
- The use of vessels inside the safety zone around the installations.

Eight specified land facilities have been included from 1.1.2006. Data acquisition started from that date and separate annual reports have been published since 2007 containing results and analyses for land facilities.

2. Conclusions

We endeavour in this work to measure trends in risk level in relation to safety and the working environment through applying a range of relevant indicators. Analysis is based on the triangulation principle i.e. using different measurement tools to measure the same phenomenon, in this case trends in risk level.

Our primary focus is on trends. Taken by themselves, it is to be expected that some indicators, particularly within a limited topic field, will show sometimes substantial variation from year to year. Accordingly, and especially in view of the government's goal that the Norwegian petroleum industry should be a world leader in HES, the industry should direct its efforts towards achieving positive long-term trends.

Ideally, it should be possible to arrive at a synthesised conclusion based on information from all measurements. In practice this often proves complicated, partly because the indicators reflect HES factors on sometimes widely-divergent levels. In this survey we concentrate primarily on risk indicators relating to:

- Major accidents, including helicopter-related accidents
- Barriers, particularly those relating to major accidents and falling objects
- Serious injury to personnel
- Perceived risk
- HES culture
- Occupational illness and injury
    - Chemical work environment
    - Noise-related injury
    - The physical work environment
- Qualitative information relevant to the above

In 2010 a comprehensive questionnaire survey was conducted. This is the fifth time a survey of this kind has been carried out on the continental shelf. The first survey had a limited scope. Although the questionnaire itself is being continually developed, the core features of the survey remain the same. This provides unique data material for what are sometimes highly detailed studies. The results from the questionnaire survey presented in this report are the major findings.

The response percentage is put at approximately 30, calculated on the basis of the number of work hours reported in the period in which the survey was conducted. In 2007 the response percentage was also about 30. The 2003 and 2005 surveys had a response percentage of approximately 50. Against that figure, this year's response percentage is relatively low. The number of responses (7165) is nevertheless sufficient to permit statistical analyses, including at group level.

On the basis of index values, the tendency is for the safety climate to be reported at the same level as for the previous year. The index for negatively formulated statements about the HES climate shows a significant improvement, a result that also applies to the HES index for the positive statements although the improvement here is weaker. A slight improvement is also seen from 2008 in relation to assessments of a number of work environment indices: the respondents report less physical exposure and ergonomic strain than was the case in the previous measurement.

Almost one-third of those who have completed the questionnaire state that they had sickness absence last year. A relatively high proportion of those stating that they have been involved in an occupational accident also state that the incident was not reported. In relation to health complaints, muscular and skeletal complaints dominate. These refer to pains in the neck, shoulders, arms, back, knees and hips. Second come health complaints relating to hearing/tinnitus and skin complaints.

Assessment of personal work capacity – both physical and mental – is the same as in the last three questionnaire surveys. Work environment factors covering cognitive requirements (attention and concentration), control and social support (from managers and colleagues) are largely reported as identical with those in the two previous surveys.

Perception of risk associated with different accident scenarios increased in the period from 2005 to 2008 but shows a decrease in this latest measurement. The reduction was significant for eight of 13 risk indicators. However, the perceived risk of collision with vessel/drifting object shows an increase compared with 2008.

In 2010 a qualitative survey was conducted to investigate certain aspects related to general conditions and their bearing on HES. Informants from oil companies, contractors and sub-suppliers were interviewed about the following factors:

- The consequences of the economic recession for contractors and sub-suppliers
- The consequences of the merger between Statoil and Hydro for contractors and sub-suppliers
- Framework conditions for groups with frequent change of workplace (nomads)

The number of informants in the survey is limited and no conclusions can therefore be drawn that apply to the petroleum industry as a whole.

The survey revealed no dramatic HES effects in the companies covered as a result of the economic recession. Some of the informants pointed to factual and possible consequences, for example that the requirements for HES investments/measures have become more stringent. There is an increased tendency to put work out to tender, possibly resulting in less long-term security for the customer/-supplier relationship. The recession may also lead to more ready availability of qualified personnel, more stable manning and fewer nomads. It is important to ensure that investments in relationship building and knowledge sharing are not lost in the search for short-term savings and that HES work is not seen as a dispensable item if competition between bidders becomes stiffer.

No informants from contractor or supplier companies stated that the Statoil-Hydro merger had had a serious negative impact on their HES work. Contractors on land facilities had noticed fewer consequences of the reorganisation process than those on the offshore installations. A number of informants expressed concern that Statoil's marketing strength might push prices down to a level where they could no longer maintain their HES work. However, no one could point to any concrete instances where this had actually happened.

The term "nomads" covers various groups of personnel with widely-divergent framework conditions. It appears paradoxical that contractor personnel with nomad status are more exposed to risk in relation to accidents and work environment factors because of their work tasks than operator company personnel with a fixed workplace, while at the same time systematic HES work functions less well for nomads and nomads have less opportunity to influence their own HES situation.

In recent years the industry has focused much of its attention on reducing the number of hydrocarbon leaks. Clear reduction targets have been set on several occasions: first, a maximum of 20 leaks greater than 0.1 kg/sec in 2005, next maximum 10 leaks in 2008 and thereafter a 10% reduction each year. The first target was met in 2005 and in 2007 10 leaks of this type were registered. In 2008 and 2009 there was again an increase: 14 in 2008 and 15 in 2009. In 2009 it was particularly leaks in the category 1-10 kg/s where this increase occurred. A comparison of leak frequency per operator continues to show that there are relatively substantial differences between operators. In addition, a comparison of leak frequency on the Norwegian and British Continental Shelf shows that there is potential for reduction on the Norwegian Continental Shelf. In other words, the 2008 and 2009 targets have not been met and the trend is seen to point in the opposite direction. It is clearly a challenge to maintain a positive trend in relation to leak frequency. Directed, and not least continuous, effort is required to reverse the trend.

The indicator for well control events also points to a generally positive trend in recent years, but this too shows an increase in frequency in 2009, for both exploration and production drilling. Weighed against the potential contribution from this type of event in relation to loss of life, the level in 2009 is at the average for the entire period.

The number of vessels on collision course still points to a positive trend. The level in 2009 is significantly lower than the mean value in the period 2001–2008.

The other indicators reflecting incidents with major accident potential show a stable level with no or minor changes.

The total indicator reflecting potential for loss of life if registered incidents develop into events is a product of frequency (probability) and potential consequence. A risk factor based on history is not an expression of real risk but can be used to evaluate trends in parameters that contribute to risk. A positive development in an underlying trend for this type of indicator therefore gives an indication that a greater degree of control is being gained over factors contributing to risk.

The total indicator, for both production installations and mobile units, points to a positive trend in recent years. Compared with the average for the period 2001-2008 the reduction is statistically significant. Since individual events with large potential influence the indicator to a relatively noticeable degree from year to year, the evaluation is based on a 3-year rolling average.

Helicopter-related risk accounts for a major part of the total risk to which offshore personnel are exposed. The helicopter indicators used in this work have been modified in 2009/2010 in order to better reflect real risk associated with the events covered in the survey.

The last major accident entailing fatalities on the Norwegian Continental Shelf occurred in September 1997 in connection with the helicopter accident off Brønnøysund. In 2009 there were several serious helicopter accidents in the petroleum industry worldwide, as noted in the RNNP summary report for 2008. These events show in all clarity the importance of maintaining a sharp focus on helicopter safety.

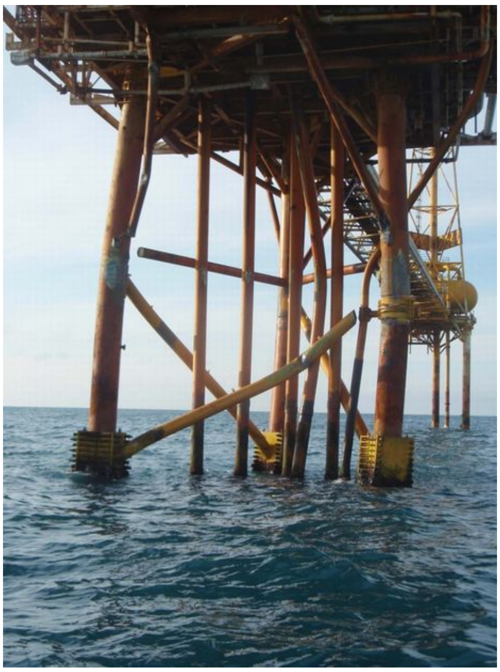
Changes have been made in two of the three helicopter indicators used for helicopter-related risk over a number of years, but the activity indicators have continued in use without modification. There have been contacts with SINTEF and its HSS3 (Helicopter Safety Study 3) project in connection with indicator revision.

The indicators used in this work show no clear trends in association with changes in risk level but the new indicators are expected to give a better picture of trends in time.

The industry is now turning its attention to pro-active (leading) indicators, i.e. indicators that can provide information about robustness in relation to capacity for withstanding potential events. Our barrier indicators are examples of these. The barrier indicators show that there is substantial variation between the different installations, some having relatively poor results for certain barrier systems. On the whole, the average result for all installations is approximately as anticipated but we must remember that the value of these indicators lies primarily on individual installation level. In 2009 the barrier indicators were reinforced with a set of indicators reflecting maintenance and management systems for maintenance.

In 2009 there was a fatal accident on the Norwegian Continental Shelf: on Oseberg B on 7th May 2009, during dismantling of a scaffold. However, as for the major accident indicators, the indicator for serious injury to personnel has otherwise pointed to a positive trend in recent years. Injury frequency is now 0.77 serious cases per million manhours for the Norwegian Continental Shelf as a whole. This is significantly lower than the average for the preceding ten-year period. For production installations, a slight increase is observable in 2009 (to 0.87) in relation to 2008. An increase is particularly observable in the contractor personnel group. Injury frequency on mobile units shows a marked reduction in 2009 (to 0.55) compared with previous years. In actual terms, the level for 2009 is close to two-thirds lower than in the two preceding years.

The indicator for noise exposure also shows no improvement in 2009. For the personnel categories in the survey most job categories have a noise exposure level in excess of the 83 dBA stipulated in the Platform Regulations.



(source: ConocoPhillips)

(source: ConocoPhillips)

(The pictures show damage to Ekofisk 2/4–W load-bearing structure and Big Orange XVIII after the collision on 8th June 2009. See the description of this collision on page 19.)

Part 2: Implementation and scope

3. Implementation

The work done in 2009 is a continuation of previous years' activities, performed in 2000–2008, see NPD (2001), NPD (2002), NPD (2003), PSA (2004), PSA (2005), PSA (2006), PSA (2007), PSA (2008) and PSA (2009). (Complete references are given in the main project report on www.psa.no/rnnp). This year we have applied the same general principles and expanded reporting with special emphasis on the following elements:

- The qualitative study consists of a questionnaire survey and a qualitative analysis of the importance of framework conditions for HES.
- The work of analysing and evaluating data relating to defined situations of hazard and accident has been continued, both for installations and for helicopter transport. With regard to helicopter transport a number of new indicators have been developed, reportable from and including 2009.
- A substantial quantity of experience data has been acquired for barriers against major accidents and analysed as in the period 2003-2008. There is a new indicator for maintenance while the indicator for well integrity has been followed up from 2008.
- Indicators for noise exposure have been followed up as before while some slight changes have been introduced in the indicators for chemical work environment.
- Data from land facilities have been analysed and presented in a separate report.

3.1 Implementation of the work

Work on this year's report began in summer 2009 and involved the following participants:

- The Petroleum Safety Authority:
  Responsible for implementation and follow-up of the work
- Operator companies and shipping companies:
  Contribute data and information about activities on the installations and in the work of adapting the model to land installations, which have been included since 1.1.2006
- Civil Aviation Authority Norway:
  Responsible for the reporting of public data on helicopter activities and quality assurance of data, analyses and conclusions
- Helicopter operators:
  Provide data and information on activities in the helicopter transport sector
- HES expert group: (selected specialists)
  Evaluate methods, databases, views on development, evaluate trends, propose conclusions
- The Safety Forum (representing unions, employers and authorities):
  Comment on methods, procedures and results and make recommendations for further work.
- Advisory group (representing unions, employers and authorities):
  The group was established medio 2009 to advise the Petroleum Safety Authority on follow-up of the work.

The Petroleum Safety Authority has had support from the following external experts with responsibility for specific aspects of the work:

- Jan Erik Vinnem, Preventor
- Odd J. Tveit
- Jorunn Seljelid, Beate Riise Wagnild, Grethe Lillehammer, Bjørnar Heide, Jon Andreas Hestad, Peter Ellevseth, Eva Kvam and Aud Børsting, Safetec
- Ragnar Rosness, Ulla Forseth and Irene Wærø, SINTEF
- Jorunn Tharaldsen, Brita Gjerstad, Leif Jarle Gressgård, Kari Anne Holte, Kari Kjestveit and Randi Underhaug, IRIS

The PSA working group is composed of: Einar Ravnås, Øyvind Lauridsen, Mette Vintermyr, Arne Kvitrud, Trond Sundby, Irene B. Dahle, Hilde Nilsen, Inger Danielsen, Elisabeth Lootz, Siri Wiig, Hilde Heber, Ola Kolnes, Anne Mette Eide, Sigvart Zachariassen and Torleif Husebø.

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

- Eirik Svare, Civil Aviation Authority Norway
- Øyvind Solberg, CHC Helicopter Service
- Inge Løland, Per Skalleberg, Bristow Norway

Various other people have contributed to the implementation of the work, for example in connection with the questionnaire survey and elucidation of framework conditions.

3.2 Use of risk indicators

Data have been collected for situations of hazard and risk associated with major accidents, occupational accidents and working environment factors, specifically:

- Defined situations of hazard and accident, with the following main categories:
    - Uncontrolled release 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 relating to the performance of barriers against major accidents on the installations, including well status data
- Accidents and events in helicopter transport activities
- Occupational accidents
- Noise and chemical work environment
- Diver accidents
- Other DFUs 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 applied in this report:

- Major accident is an accident (i.e. entails a loss) in which at least 5 persons may be exposed.
- Major accident is an accident caused by failure of one or more of the system's integral safety and preparedness barriers.

In the light of the definition of major accident in the Seveso II directive, the definition used here is closer to that of a 'large accident'.

Data acquisition for the DFUs relating to major accidents is based partly on the existing Petroleum Safety Authority databases (CODAM, DDRS, etc.) but also to a considerable extent on data acquired in cooperation with the operator companies 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.

Table 1 List of DFUs and data sources

DFU	*DFU description*	*Data sources*
1	Non-ignited hydrocarbon leaks	Data acquisition*
2	Ignited hydrocarbon leaks	Data acquisition*
3	Well kicks/loss of well control	DDRS/CDRS (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	Injury to personnel	PIP (PSA)
15	Occupational illness	Data acquisition*
16	Total power failure	Data acquisition*
18	Diving accident	DSYS (PSA)
19	H_2S emission	Data acquisition*
21	Falling object	Data acquisition*

* Data acquired with the cooperation of operator companies

3.3 Trends in activity level

Figure 1 and Figure 2 show trends over the period 1996-2009 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 put at 1.0). Appendix A of the Main Report (PSA, 2010a) presents the base data in detail. Errors in the database in previous reports have been corrected.

Changes in activity level in relation to the individual parameters are dissimilar, the number of manhours on production installations having increased by 30 % over 10 years. On mobile units the variations from year to year are even greater, and in 2009 the number of exploration wells was at the highest level ever. The presentation of DFUs or risk may therefore differ according to whether we use absolute or "normalised" values, depending on normalisation parameters. Normalised values have been presented in the main.

A corresponding activity overview for helicopter transport is shown in Subsection 6.1.

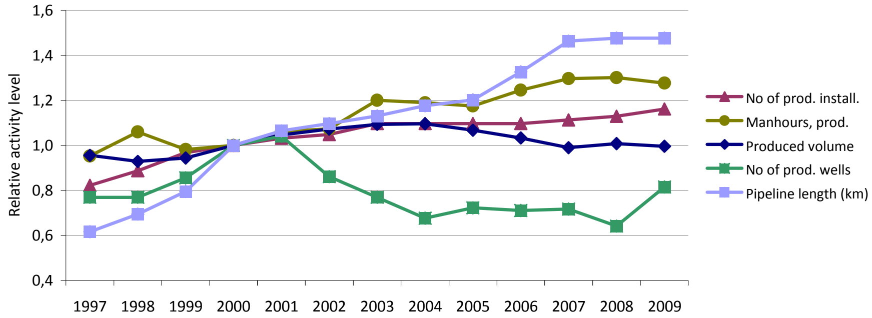


Figure 1 Trends in activity level, production

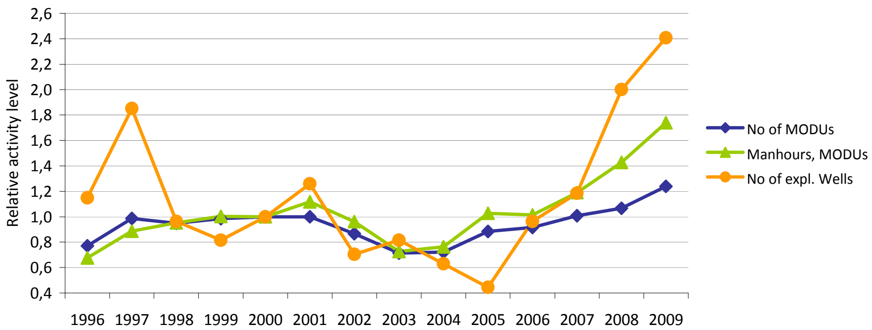


Figure 2 Trends in activity level, exploration

3.4 Documentation

The analyses, evaluations and results are documented as follows:

- Summary Report – Norwegian Continental Shelf for 2009 (Norwegian and English versions)
- Project Report – Norwegian Continental Shelf for 2009
- Land Facilities Report for 2009

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

4. Scope

The qualitative study takes the form of a questionnaire survey which is repeated every second year. In 2009/2010 a study was also made of the importance of framework conditions for HES work in Norwegian petroleum activities, based on interviews with informants from oil companies, contractors and sub-suppliers.

The methods used for statistical analysis in previous years have been continued, with only slight changes. There are new indicators for maintenance management, developed in cooperation with the industry. The work on serious injury related to occupational accidents has also been continued as before.

Noise indicators remain unchanged from the last few years while slight changes have been introduced in 2009 for chemical work environment indicators, see Section 10. Work has also commenced on the development of indicators for ergonomic factors.

Part 3: Results from 2009

5. Questionnaire survey

This part of the report presents the results from a questionnaire survey conducted among personnel working in the Norwegian offshore industry in the period 4 January to 14 February 2010. The overall aim of this survey was to measure employees' experience of the HES situation in the Norwegian petroleum industry. This is the fifth time that data have been collected using this questionnaire, first used in December 2001 and subsequently repeated every second year. A corresponding study has been performed for the second time for land facilities and the results from this are presented in the main report for land facilities (PSA, 2010b).

7165 forms were returned, a slightly higher number than in the preceding questionnaire survey, when 6529 forms were returned. Based on the number of manhours on the installations in the fourth quarter of 2009, the response percentage is put at approximately 30%. A 30% response rate is relatively low, but the number of responses is nevertheless sufficiently high to allow of statistical analysis and for the data material to be split into different groupings. By way of comparison, it can be noted that in the national living standard surveys conducted by Statistics Norway every third year, 176 randomly selected persons represent the entire petroleum industry. The preconditions are that the respondents comprise a representative sample of personnel working offshore. We can verify if the data are systematically skewed or not in relation to determined, measurable criteria. In practice this means that we check to see if certain groups are over- or under-represented. This is done by comparing the results with known demographic factors and with previous surveys. For most demographic variables there is good representativity. As in previous years, however, there is some overweight of responses from personnel in managerial positions.

5.1 HES factors, general comments

On the basis of index values, the safety climate tends to be reported as generally similar to that in the preceding year. The index for negatively-formulated statements about the HES climate shows a significant improvement, a finding that also applies to the HES index for the positively-worded statements although in this latter case the improvement is weaker. A slight improvement from 2008 is also observable in relation to evaluations of a number of work environment indices: respondents report slightly less physical exposure and fewer ergonomic problems than was the case in the previous measurement.

About a third of those who have completed the questionnaire state that they have had personal sickness absence in the last year. The percentage reporting cases of injury has remained more or less constant since measurement began in 2005. In respect to reporting of injuries, a relatively large percentage of those who state that they been involved in an occupational accident have not reported the injury to their line manager or the nurse (22%).

Respondents' assessment of personal work capacity – both physical and mental – is the same as in the last three questionnaire surveys. Work environment factors including cognitive requirements (attention and concentration), supervision and support (from managers and colleagues) are also reported as mainly the same as in the two preceding surveys.

In 2010 half of all employees report that they have suffered from pain in the neck/shoulders/arms, two out of five offshore employees report that they have experienced back pain in the last three months, 25% have some hearing problems and 5% have serious hearing complaints. In addition, 21% experience occasional skin problems and 6% suffer more frequently or seriously from skin complaints. For all these health complaints, apart from back pain, the findings point to a decrease in the percentage of respondents reporting quite frequent or very frequent/serious problems.

The perception of risk associated with various accident scenarios increased from 2005 to 2008 but shows a decrease in this latest measurement. The reduction was significant for eight of our 13 risk scenario indicators. On the other hand, the perceived risk of collision with vessel/drifting object shows an increase compared with 2008.

5.2 Improvement potential

Although this year's survey points to positive trends in a number of areas, there is still potential for improvement. For the negatively-formulated statements about the

HES climate, we wish to highlight six statements with relatively low average values despite the fact that some of them show a marked improvement from the previous measurement. The first two statements in particular are on a low level (average value less than 3 on a scale where 5 is best), and all of these are ranked here according to the lowest values:

- ”There are different procedures and practices for the same situations on different installations, and this represents a threat to safety”
- ”Deficient maintenance has resulted in poorer safety” (improvement)
- ”Reports of accidents or hazardous situations are often “air-brushed’” (improvement)
- ”Greater interaction between the platform and land organisation through the use of IT systems has resulted in less safe operations” (unchanged)
- ”Hazardous situations arise because not everyone speaks the same language” (significant improvement)
- ”In practice, regard to production comes before regard to HES” (significant improvement)

Among the positively-formulated statements about the HES climate, there is also potential for improvement. The first three statements below have average values higher than 2 (on a scale where 1 is the most positive value), and of these the first is close to a value of 3. The statements are ranked with the poorest values first:

- ”I think it is easy to find one’s way around the management documents (requirements and procedures)” (improvement)
- ”Manning levels are sufficient for HES to be maintained properly” (deterioration)
- ”I feel I am sufficiently rested when I am at work” (improvement)
- ”I have been informed about the risk involved in the chemicals I work with” (significant improvement)
- ”Comments and contributions from the safety delegates are taken seriously” (unchanged)
- ”I have received sufficient training in work environment matters” (significant improvement)
- ”Information about unplanned events is used effectively to prevent recurrences” (significant improvement)

Replying to the new questions relating to the physical work environment, many respondents give relatively high scores to the statement that ergonomic problems can lead eventually to strain injuries (repetitive movements, heavy lifts, hands at/above shoulder height and hunkering/kneeling). Some respondents also report that much of their work is sedentary. The physical environment is reflected in the health complaints reported. Pains in the neck, shoulders, arms, back, knees and hips get a high score, together with headaches, hearing impairment, skin complaints and tinnitus. If we look at the complaints respondents associate most with their work situation, we find impaired hearing, tinnitus and pain in the neck/-shoulder/arm and knees/hips.

Some respondents report that they seldom or never get any feedback from their line manager on the work they have performed. There are also those who think they have so many tasks that it is difficult to concentrate on all of them. Significantly more respondents than in the 2008 survey report the need to maintain a high work tempo. There is room here for improvement, since positive feedback from team leaders can encourage a keen working spirit and sense of achievement in a hectic work situation instead of stress. In the light of the reported health complaints, almost 30% of those who report suffering from emotional/mental health problems state that these are due entirely or in part to their work situation.

6. Status and trends – DFU12, helicopter events

Cooperation with Civil Aviation Authority Norway and helicopter operators continued in 2010, with some changes. For example, there is a new helicopter operator, Blueway Offshore Norge AS. Aviation data collected from the relevant helicopter operators cover event type, risk class, degree of severity, type of flight, phase, helicopter type and information about points of departure and arrival. The Main Report (PSA, 2010a) contains further details of scope, limitations and definitions. The last major accident involving fatalities on the Norwegian Continental Shelf was in September 1997 in connection with the helicopter accident off Brønnøysund. In 2009 there were a number of serious helicopter accidents in the petroleum industry at large, as discussed in the RNNP Summary Report for 2008. Helicopter-related risk accounts for a major proportion of the total risk an offshore worker is exposed to. The events in 2009 show in all clarity the importance of maintaining a sharp focus on helicopter safety.

Changes have been made in two of the three event indicators used for several years, while the activity indicators have continued unchanged. The changes are explained below. Activity indicators provide information on trends in exposure to helicopter risk and are accordingly more pro-active indicators. Indicators are explained in detail in the Main Report. SINTEF and its HSS3 (Helicopter Safety Study 3) project have been contacted in connection with the work of revising the indicators. SINTEF's proposal for leading indicators in RNNP is seen as being complicated to acquire data for, at least in the short term.

The indicators used in this work point to no clear trends with respect to trends in risk level, but the new indicators are expected in time to better reflect trends. It is also important to note that it is difficult for this type of indicator to pick up short-term changes in event frequency.

6.1 Activity indicators

Figure 3 shows activity indicator 1 (crew change traffic) and activity indicator 2 (shuttle traffic) in number of flight hours and number of person flight hours a year in the period 1999-2009. For crew change traffic there has been a clear increase in volume over the last two to three years. The volume of shuttle traffic increased up to 2001, followed by a certain reduction in person flight hours and flight hours.

Activity indicator 1, volume of crew change traffic per year, must be seen in the context of activity level on the Norwegian Continental Shelf. In 2009 activity level (manhours) on the Norwegian Continental Shelf increased by 4 %, while the number of flight hours increased by approximately 3.9 %, and person flight hours increased by 6.4 %. The larger increase in person flight hours compared with flight hours can be explained by better utilisation of helicopters and the fact that the new helicopters are capable of taking off with maximum passenger load under virtually all weather conditions.

Shuttle traffic is operated to some extent with larger helicopters than in the past. This may partly explain the decrease in the number of flight hours.

6.2 Event indicators

6.2.1 Event indicator 1 – serious incidents

Figure 4 shows the number of events covered by a new event indicator 1. Since there is a new definition of the content of this indicator, there are no data for previous years.

Event indicator 1 was formerly based on data reported by the helicopter operators, with no major adjustments. Over the years we saw that there were substantial differences in companies' classification practice, and that the classes used in the risk matrices were coarse. From 2009 the most serious incidents reported by the companies have been scrutinised by an expert group composed of operative and technical personnel from the helicopter operators, from the oil companies and personnel from the PSA project group, with a view to classifying events on a finer scale, based on the following categories:

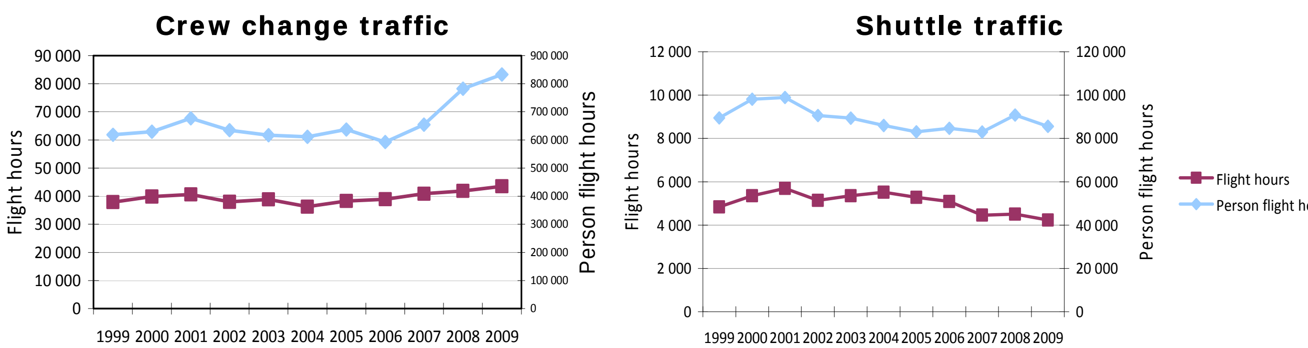


Figure 3 Volume of crew change traffic and shuttle traffic, person flight hours and flight hours, 1999-2009

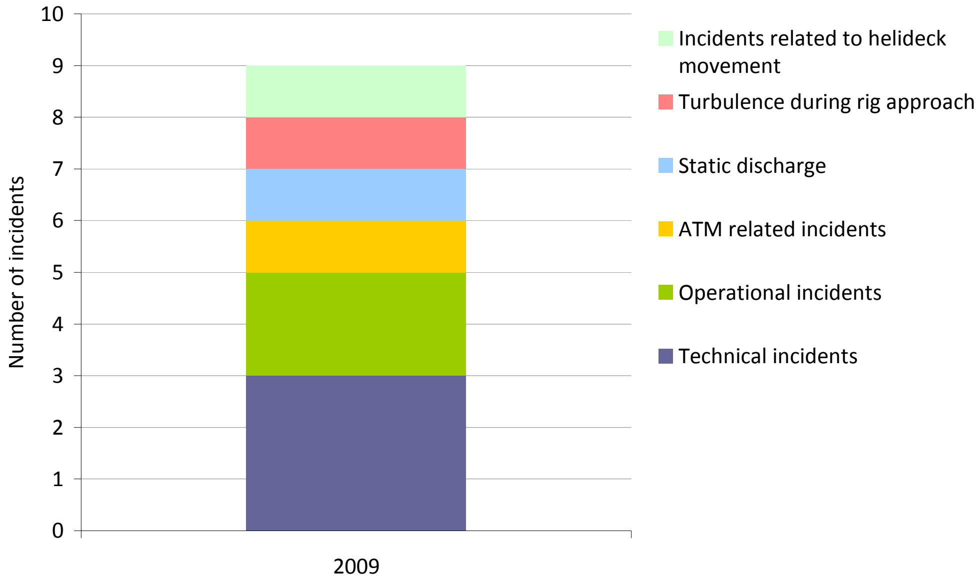


Figure 4 Event indicator 1, events with small or medium remaining safety margin, 2009

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

Event indicator 1 covers those events with small or medium remaining margin against fatal accident for passengers, i.e. no or one remaining barrier. In 2009 there were no events without remaining barriers, while in the case of nine events there was only one remaining barrier against fatal accident. As before, events in the parked phase have not been taken into account.

Four of the nine events are associated with the S-92, one of the newest helicopters on the Norwegian Continental Shelf. In terms of traffic, the S-92 accounts for approximately 60–70 % of flight hours, while different generations of the Super Puma mainly account for the rest. With the new indicator there is therefore no reason to claim that the S-92 is overrepresented in relation to serious incidents. Of the four events associated with the S-92 there was only one which had technical causes, the others arising from e.g. operational causes and strong turbulence from structures on the installation.

6.2.2 Event indicators in relation to cause categories

From 2009, event indicator 3 has been replaced by event indicators based on cause categories, with the following content:

- Helideck factors
  - o Erroneous information about the position of the helideck
  - o Erroneous/missing information
  - o Equipment fault
  - o Turbulence
  - o Obstacles in the landing/take-off sector or on deck
  - o Persons in the restricted sector
  - o Failure to follow procedures
- Flight control (ATM) aspects
- Collision with birds.

All degrees of severity beyond ”no safety-related consequences” are covered by these indicators. Data are presented in Figure 5–7 for both 2008 and 2009. For 2008 some events may not have been included but not so many that there is no clear increase up to 2009. This increase to 2009 is particularly clear in regard to erroneous and missing information while there are fewer cases of breach of procedures.

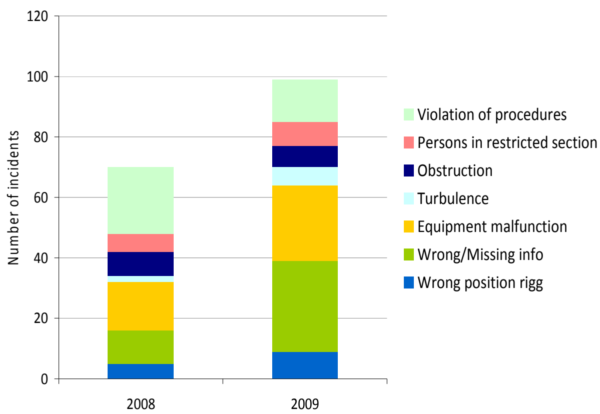


Figure 5 Helideck factors, 2008–09

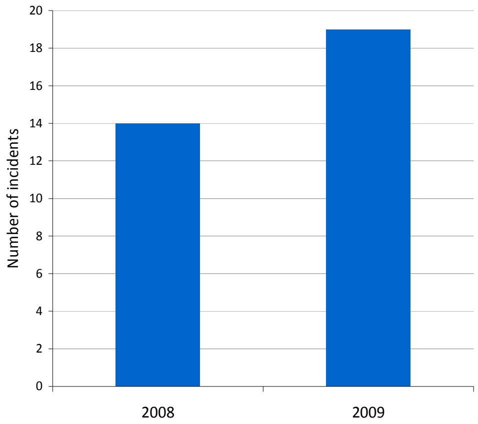


Figure 6 Flight control aspects, 2008–09

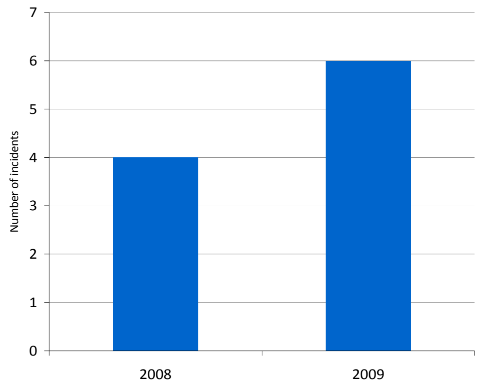


Figure 7 Collision with birds, 2008–09

On the basis of these cause-related indicators a number of areas and factors are mentioned in the Main Report (PSA, 2010a) where an effort should be made to effect improvement.

7. Status and trends – indicators for major accidents on installations

Indicators for major accident risk have been continued from previous years, with emphasis on indicators for events and incidents with major accident potential. Indicators for major accident risk associated with helicopters are discussed in Section 6.

There have been no major accidents, by our definition, on installations on the Norwegian Continental Shelf after 1990. None of the DFUs for major accident risk on installations have entailed fatalities in the period. The last time there were fatalities in association with one of these major accident DFUs was in 1985, with the shallow gas blowout on the rig "West Vanguard"; see also page 11 in connection with the helicopter accident off Brønnøysund. In addition, there have been no cases of ignited hydrocarbon leaks from process systems since 1992, apart from the occasional minor leak with no potential for major accident.

The most important individual indicators for production and mobile units are discussed in this section, while the other DFUs are discussed in the Main Report. The indicator for total risk is discussed in Subsection 7.3.

7.1 DFUs related to major accident risk

Figure 8 shows the trend in the number of reported DFUs in the period 1996-2008. It is important to emphasise that these DFUs vary widely in their contribution to risk.

The average level after 2000 is higher than the average for the period 1996-99. The level after 2002 shows a stable decrease and in 2007 was on a par with the level for the period 1996-99. The number of incidents increased by 10 % in 2008 but is still below the level for 2000-06. In particular, DFU5 (vessel on collision course) has been under-reported in previous years, in our view.

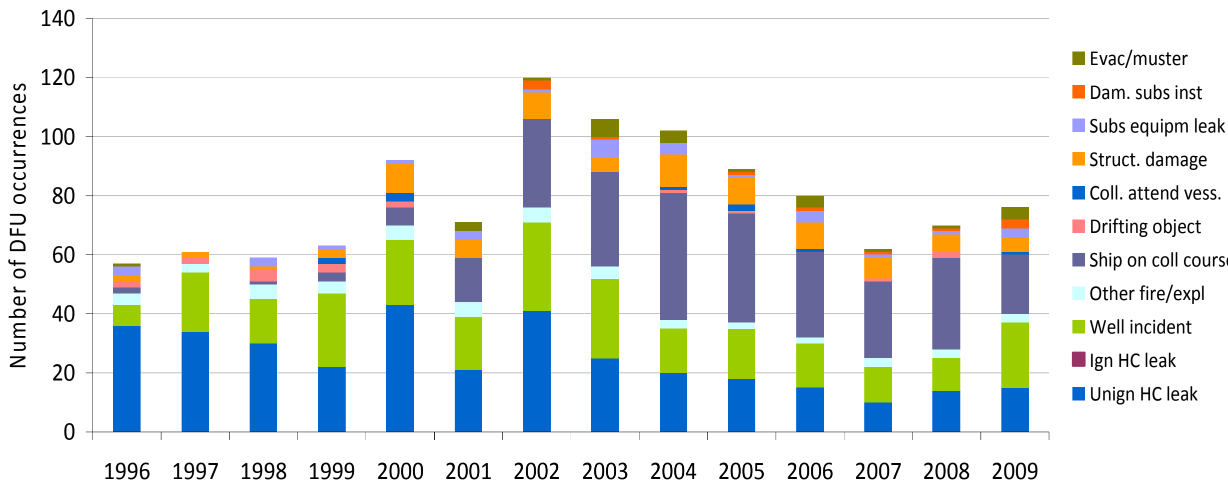


Figure 8 Reported DFUs (1-11) by category

This applies to a lesser extent to the DFUs relating to hydrocarbon leaks and loss of well control. Figure 8 shows that these are dominant in number up to 2003, but the percentage falls to below 50 % from and including 2004. The increase in DFU5 (vessel on collision course) Figure 8 in is not a reliable indication of trends in risk level (see the discussion in Subsection 7.2.4).

7.2 Risk indicators for major accidents

7.2.1 Hydrocarbon leaks in the process area

Figure 9 shows the total number of leaks exceeding 0.1 kg/s in the period 1996–2008. Up to 1999 there was a falling trend, succeeded by a period of wide variation from year to year. There was a substantial drop after 2002 but the number of leaks > 1 kg/s did not decrease to the same extent in the period 2003-05. In 2006 the number of leaks > 1 kg/s also shows a decrease but two of the leaks were in excess of 10 kg/s. In 2009 there were no leaks exceeding 10 kg/s but the number of leaks in excess of 1 kg/s is the highest since 2003, six leaks. Hydrocarbon leaks are still classified by leak rate in coarse classes as shown in Figure 9, while a finer grading is shown in the Main Report.

OLF's target for 2009 was maximum nine leaks exceeding 0.1 kg/s. The number of leaks in 2009 (15) is substantially above this target. The reduction observed in the period 2002–07 seems to have come to a halt, possibly even partly reversed. One company had practically doubled its number of leaks since 2007.

Figure 10 shows the number of leaks when weighted in relation to the contribution to risk they are reckoned to give. In simplified terms, the risk contribution from each leak is approximately proportional to the leak rate given in kg/s. Leaks exceeding 10 kg/s therefore make the biggest contribution even though there are no more than one or two such events a year. In most cases the weighting for these largest leaks is calculated manually from an assessment of the specific circumstances while the others are weighted following a formula. In 2009 there were no leaks requiring special calculation on the basis of their circumstances.

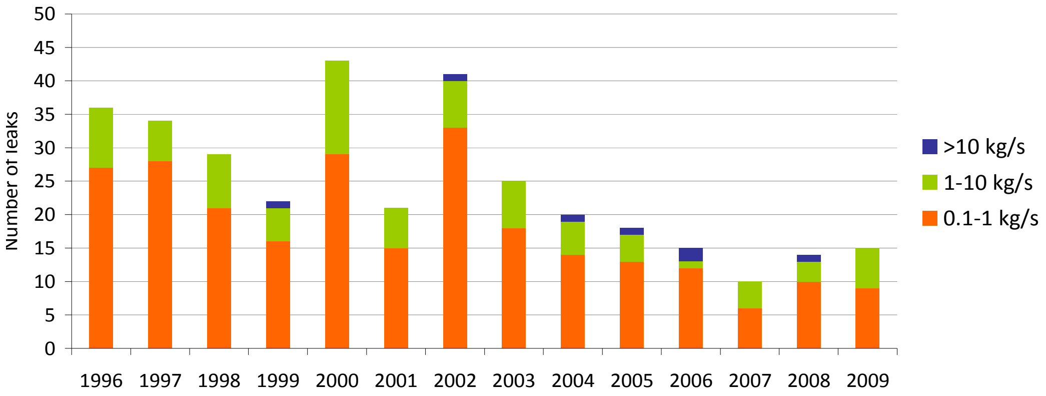


Figure 9 Number of hydrocarbon leaks exceeding 0.1 kg/s, 1996-2009

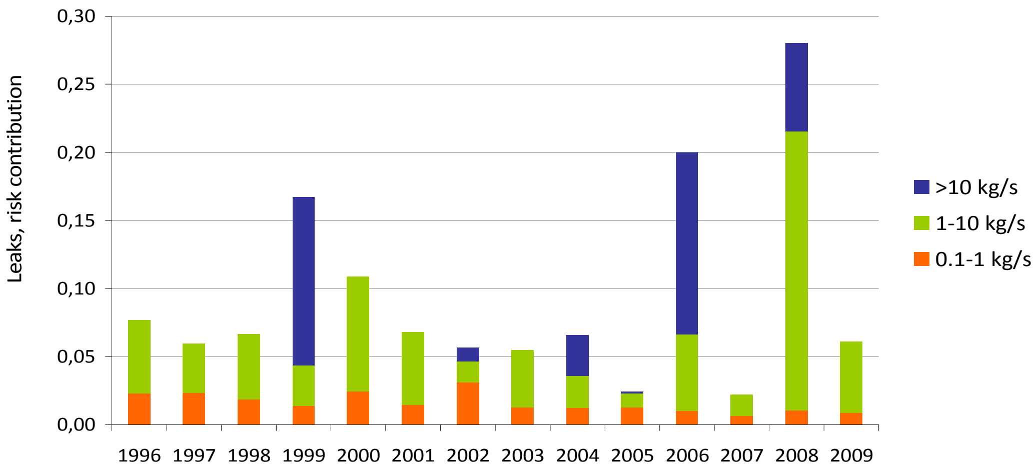


Figure 10 Number of hydrocarbon leaks exceeding 0.1 kg/s, 1996-2009, weighted by risk potential

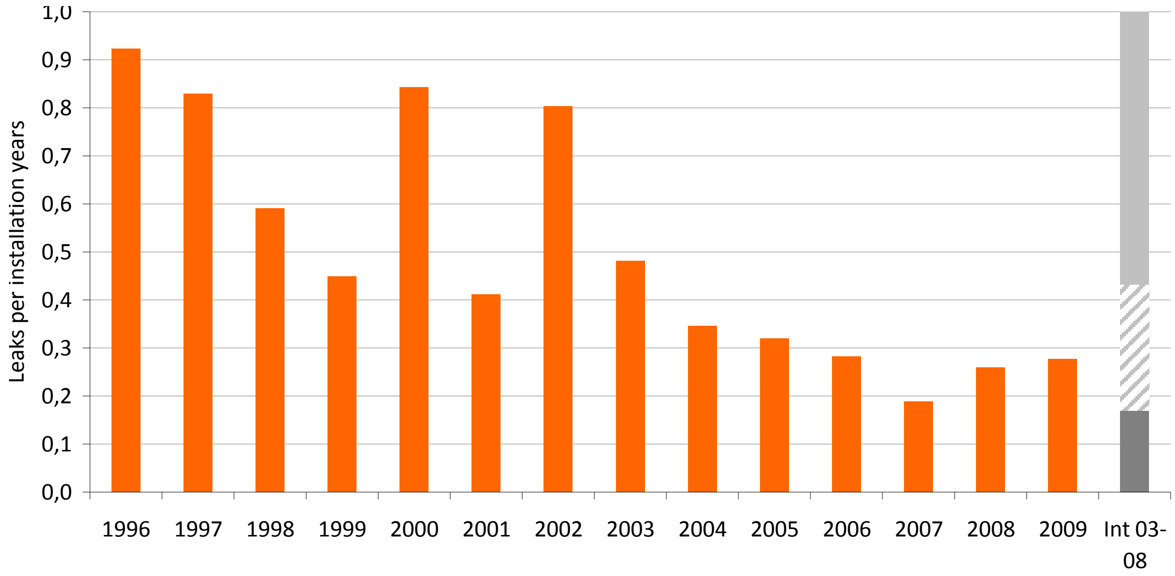


Figure 11 Trend, leaks, normalised against installation year, manned production installations

Figure 11 shows the trend for leaks exceeding 0.1 kg/s, normalised against installation year, for all types of production installation. The figure illustrates the technique universally applied to analyse the statistical significance (robustness) of trends in RNNP. Figure 11 shows that the number of leaks per installation year in 2009 is on a par with the average for the period 2003-08. Leaks are discussed in the Main Report, normalised against both manhours and number of installations.

The frequency of hydrocarbon leaks over 0.1 kg/s shows considerable variation between operators, evidence that there is still clear potential for improvement. This is further substantiated by Figure 12 which shows average leak frequency per installation year for operator companies on the Norwegian Continental Shelf. In previous years this figure has been presented for the entire period 1996 to the present day. If the period is limited to the last five years, the same companies are seen in the main to have the highest frequencies.

A systematic comparison has been made for gas, condensate and oil leaks on the UK and Norwegian Continental Shelf in the areas north of Sleipner (59 °N), where the installations on both sectors are of generally corresponding scope and complexity. It should be noted that the UK Health and Safety Executive reporting period runs to 31st March each year. The last period for which data are available is 1.4.2008–31.3.2009 (which is compared with 2008 on the Norwegian Shelf).

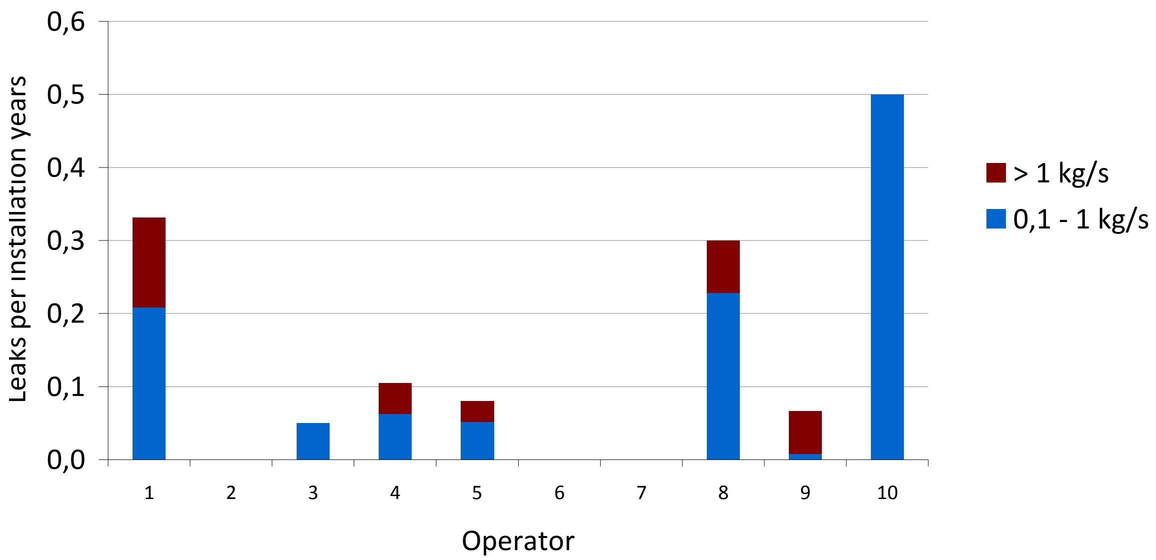


Figure 12 Average leak frequency, per installation year, 2005-09

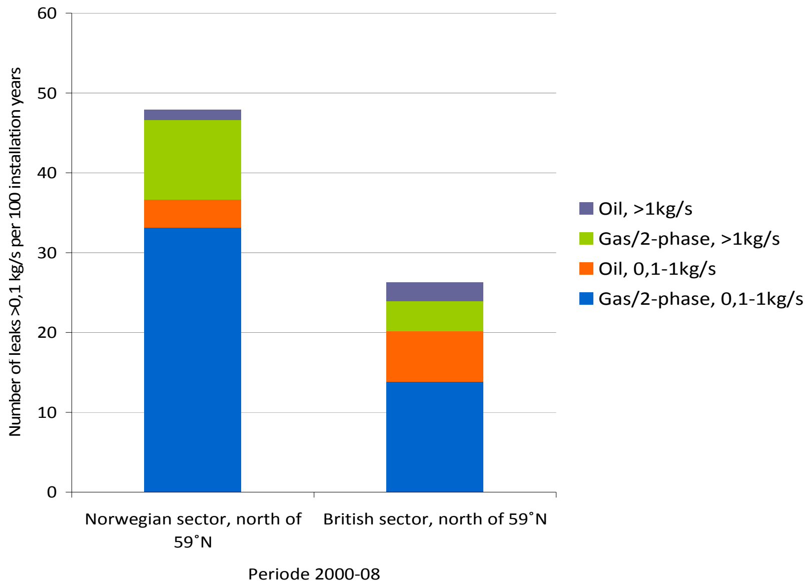


Figure 13 Comparison of gas/two-phase and oil leaks on the Norwegian and the UK Continental Shelf per 100 installation years, average 2000-08

Figure 13 shows a comparison between the Norwegian and the UK Continental Shelf, in which both gas/two-phase leaks and oil leaks are included, normalised against installation year, for the two national shelves north of 59°N. The figure applies to the period 2000-08. The data included in the figure are limited to process facilities in which oil leaks have occurred.. In this period there was approximately one leak per year in shafts in connection with storage cells, on the northern sector of the UK Shelf, and one leak every third year in connection with tank operations on production ships or storage tankers. No corresponding leaks occurred in this period on Norwegian production installations but in 2008 there was a major oil and gas leak in the shaft on Statfjord A on the Norwegian Continental Shelf. These leaks have not been included in the figure.

The number of leaks on the Norwegian Continental Shelf has been substantially lower in recent years, meaning that the period under consideration has a certain significance. For example, the following observations can be made from the data:

- For all leaks exceeding 0.1 kg/s the average leak frequency per installation year on the Norwegian Continental Shelf compared to that on the UK Shelf is:
    - o 86 % higher in the period 2000-08
    - o 21 % higher in the period 2006-08.

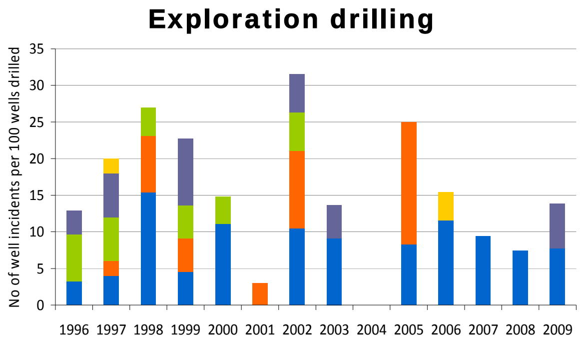
On the Norwegian Continental Shelf no cases of ignited hydrocarbon leaks (> 0.1 kg/s) have been registered since 1992. The number of hydrocarbon leaks > 0.1 kg/s since 1992 is probably minimum 400. It has been shown that the percentage of ignited leaks is significantly lower than on the UK Continental Shelf, where approximately 1.5 % of gas and two-phase leaks since 1992 have been ignited.

7.2.2 Loss of well control, blowout potential, well integrity

Figure 14 shows the incidence of well incidents and shallow gas events distributed by exploration drilling and production drilling, normalised per 100 drilled wells. Both exploration drilling and production drilling are shown collectively and with a common scale, for purposes of comparison.

For exploration drilling there have been large variations throughout the period, perhaps around a stable average on a par with the level in 1996.

The number halved from 2006 to 2008, while in 2009 the level is once more almost on a par with that from 2006. A relatively large number of exploration wells have been drilled in recent years (see Figure 2) and the number of manhours in this sector is also high. Limited competence may be a contributory factor. Production drilling showed a rising trend up to 2003, with minor variations. In the period 2004–08 there was a fall but frequency in 2009 has returned to the 2006 level, including for production drilling. With one exception all well incidents in 2009 fall into the category “regular” i.e. events with minor potential. There were also five shallow



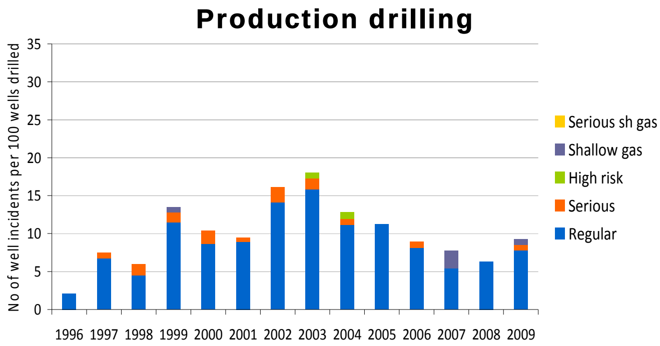


Figure 14 Well incidents according to degree of severity per 100 wells drilled, for exploration and production drilling

gas events in 2009, four in connection with exploration drilling, a record high figure in any single year.

The Well Integrity Forum (WIF) initiated a pilot project in 2008 aimed at defining measurement parameters (KPI) for well integrity. Operator companies have reviewed all their "active" wells on the Norwegian Continental Shelf, a total of 1712 wells, with the exception of exploration wells and permanently plugged wells. Results were first reported in 2008 based on WIF's list of well categories, using the existing definitions and subgroups per category. WIF has adopted the following system for well classification:

Red: one barrier failed and the other degraded/unverified or with external leak

Orange: one barrier failed and the other intact, or a single fault which may cause leaking into the external environment

Yellow: one barrier leaking within acceptance criteria or the barrier is degraded, and the other is intact

Green: intact well, with no or insignificant integrity factors.

The survey covers a total of 1712 wells and eight operator companies; BP, ConocoPhillips, Exxon Mobil, Norske Shell, Statoil, Marathon, Talisman and Total (in random order). The figure shows well categories by percentage of the total number of wells, 1712.

The results show that 8 % (11 % in 2008) of the wells have reduced quality in relation to the requirements for two barriers (red + orange category). 16 % (13 % in 2008) of the wells are in the yellow category. There are also wells with reduced quality in relation to the requirement for two barriers but the companies have implemented various compensatory measures to meet the two-barrier requirement. The remaining wells, i.e. 76 % (as in 2008), fall into the green category. These are reckoned to have met the requirement for two barriers in full.

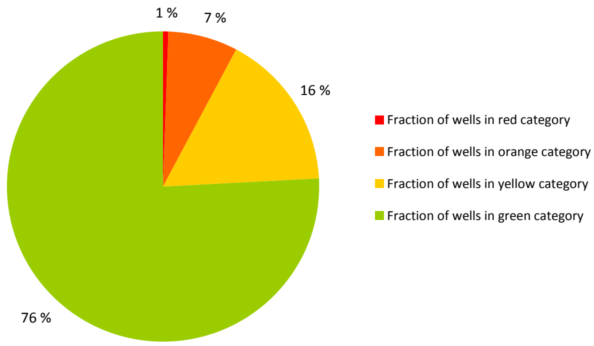


Figure 15 Well classification – category red, orange, yellow and green, 2009

However, none of the reported conditions in category red or orange are of a nature requiring corrective measures beyond those already implemented by the companies themselves.

7.2.3 Leaks from / damage to risers, pipelines and subsea installations

In 2009 no cases were reported of leaks from risers or pipelines inside the safety zone of manned installations. This continues the trend from the four preceding years. In the last five years there has been an average of three serious cases of damage per year to risers and pipelines inside the safety zone. In 2009 there were three reported incidences of serious damage to risers and pipelines inside the safety zone:

1. Damage to the skirt on a 2" gas lift line (FPSO)
2. Damage due to wear and tear to the skirt on a 12" flexible production riser (GBS)
3. Damage to the static section of an 18" gas export riser (FPU)

Damage in all these cases is to flexible risers. This confirms previous trends indicating that the fault rate (number of faults per year during operation) is higher for flexible risers than for rigid risers.

In addition to the instances of serious damage mentioned above, there have been several cases of less serious damage to risers and pipelines inside the safety zone which have either been repaired or are being monitored.

There were a few instances of minor leaks from pipelines and subsea installations outside the safety zone in 2009. Because of their location, these leaks presented little risk to personnel but had potential for substantial environmental consequences.

Cases of serious damage are also included in calculating the total indicator but with a lower weight than leaks. In 2009 there were three such cases of damage. Figure 16 shows an overview of the most serious cases of damage in the period 1996–2009.

7.2.4 Vessel on collision course, structural damage

There are only four production installations and a few more mobile units where the installation itself or the standby vessel is responsible for monitoring passing traffic. In all other cases monitoring is from the traffic centres at Ekofisk and Sandsli. It would be an improvement, especially for production installations, if all traffic was monitored from traffic centres, as all experience indicates that the quality of monitoring is better than that the individual installation or standby vessel can achieve.

In phase 5 a new indicator was introduced for DFU5, in which the number of vessels reported on possible collision course was normalised in relation to the number of installations monitored from the traffic centre at Sandsli. The new indicator points to a decrease since 2002. In 2008 a slight modification was made following a suggestion from Statoil Marin. The new indicator is expressed as the relative percentage between the number of observed vessels on collision course and the total number of monitoring days for all installations monitored by Statoil Marin at Sandsli.

In regard to collisions between vessels associated with petroleum activities and installations on the Norwegian Continental Shelf, the level in 1999 and 2000 was high (15 events a year) and Statoil in particular has made a great effort to reduce the number of such events, latterly about two to three a year. One of two collisions of this nature were among the most serious events in 2009, based on their potential for damage to the installations.

Big Orange XVIII (3424 dead weight tonnes) collided with Ekofisk 2/4-W. On 8th June 2009 the vessel was en route to the 2/4-X-installation on the Ekofisk field to perform well stimulation. The autopilot had not been deactivated prior to the vessel's entering the safety zone and since the autopilot was still active during the approach the planned change of course failed to take place as expected. The vessel managed to avoid colliding with Ekofisk 2/4-X and Ekofisk 2/4-C, and passed under the bridge between these installations. It also avoided colliding with the jack-up quarters platform COSLRigmar, but ultimately collided with the unmanned water injection facility Ekofisk 2/4-W.

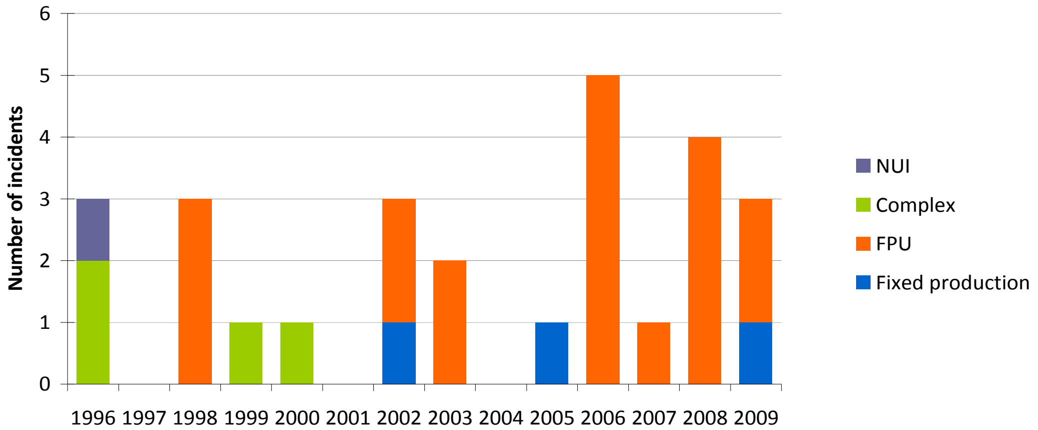


Figure 16 Number of cases of "major" damage to risers and pipelines inside the safety zone, 1996-2009

At the time of impact Big Orange XVIII had a speed of 9.3 knots. The vessel's size and speed produced a collision energy much higher than that some of the vulnerable installations are dimensioned to withstand. No personnel suffered physical injury; however, there was significant material damage, both to the facility and the vessel.

Big Orange XVIII had equipment from the roof of the bridge torn off and the bow of the vessel was compressed by about two metres.

Ekofisk 2/4-W was pushed partly out of position because several legs came loose from the main load-bearing structure. In addition, a water injection riser was extensively bent and several wellheads were displaced. The bridge connecting Ekofisk 2/4-W and bridge support BS01 were also pushed far out of position. Extensive damage was discovered to some of the legs under the surface. Production from Ekofisk 2/4-A had to be shut down and the bridges to Ekofisk 2/4-W removed. When all remaining wells have been plugged, Ekofisk 2/4-W will be removed. Removal operations are planned to take place in 2010. PSA's investigation report is available on www.psa.no.

If we compare the size of the vessels which have collided with installations, we can see from Figure 17 that the average size of vessels is now substantially larger, having increased by about 100 tonnes a year since the 1980s. Collision energy increases proportionately with the size of the vessels, meaning that the average vessel travelling at the same speed is capable of causing much more damage than would have been the case 20 years ago.

Current rules and regulations prescribe requirements for flotels and production installations to withstand the loss of two anchor lines without serious consequences. The loss of more than one anchor line occurs from time to time and can have large consequences but seldom as large as in the event involving Ocean Vanguard in 2004. Drilling rigs are only required to withstand the loss of one anchor line without unplanned consequences. Up to 2006 there were more than two events on average per year, but in 2006 there were six such events. In 2009 there was one corresponding event, the lowest incidence since 2003.

Structural damage and events included in RNNP are mainly classified as fatigue damage but some cases are storm damage. In relation to cracks, only penetrating cracks through the entire thickness of the structure are taken into account. In the wake of the Alexander Kielland catastrophe, structural cracks are taken very seriously in Norway. Cracks are generally the result of errors in design, choice of materials and manufacture. However, some of the installations have been in use for a longer period of time than previously assumed in the analyses. Connections can be shown on mobile units between the degree of cracking and changes in displacement of mobile units since the facility was new. Many other factors play an undoubted role. There is no clear relation between the age of the installation and the number of cracks. Storm damage refers mainly to cases of damage to the deck area but there may also be cracking on the hull. In most cases the damage was caused by waves and in one case by wind.

In 2009 two events were reported of holes in the hull. Both were in the vicinity of fairleads and are probably due to anchor handling. Cases of damage remain at a fairly stable level of one to three severe cases a year, with no particular trends.

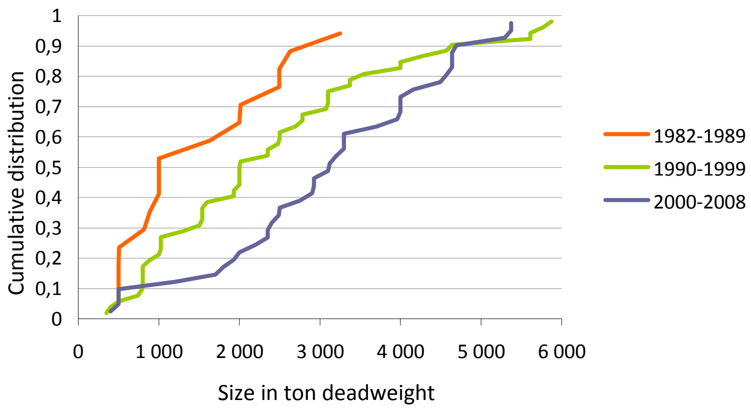


Figure 17 Cumulative distribution of size of vessels (excluding tankers) in DWT involved in collisions, 1982–2009

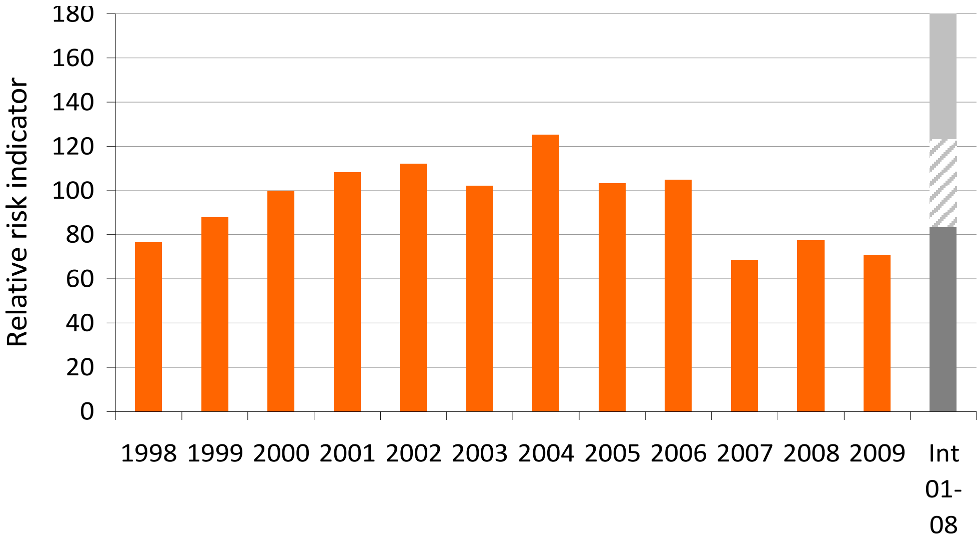


Figure 18 Total indicator, production installations, normalised against manhours, 3-year rolling averages

7.3 Total indicator for major accidents

The total indicator applies to major accident risk on the installation, while the risk relating to helicopter transport was discussed in Section 6. The model gives the DFUs a weighting based on the probability of fatalities. We would emphasise that this indicator is only a supplement to the individual indicators and that it is an expression of trends in risk level relating to major accidents.

The total indicator weights contributions from observations of the individual DFUs in relation to their potential for loss of life (see the Pilot Project Report), and will therefore vary to a substantial degree from observations of the individual DFUs. Figure 18 shows the indicator with 3-year rolling averages. This helps to avoid large jumps from year to year and thus make the long-term trend clearer.

Manhours are used as the common parameter for normalisation against activity level. The level is put at 100 in year 2000 (i.e. the average for 1998–2000). Figure 18 shows the trend of the total indicator for all production installations.

The main impression given by the figure is that of a relatively stable level for the period, with a possible reduction over the last five years. Individual events with substantial risk potential can result in greater variation, even when three-year averages are applied. The leak in the utility shaft on Statfjord A in May 2008 is among events making a large contribution.

Figure 19 shows the indicator for major accident risk for floating production units.

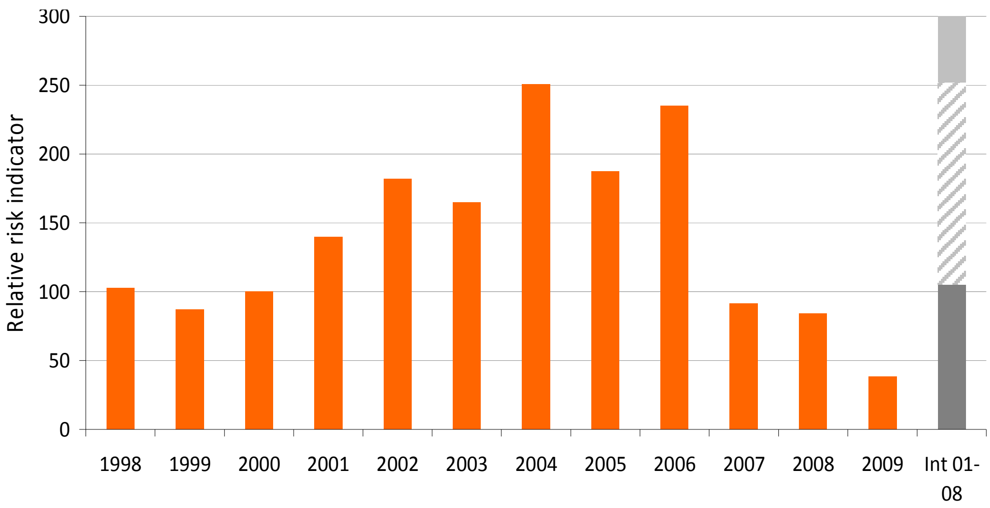


Figure 19 Total indicator, floating production units only, normalised against number of installations, 3-year rolling averages

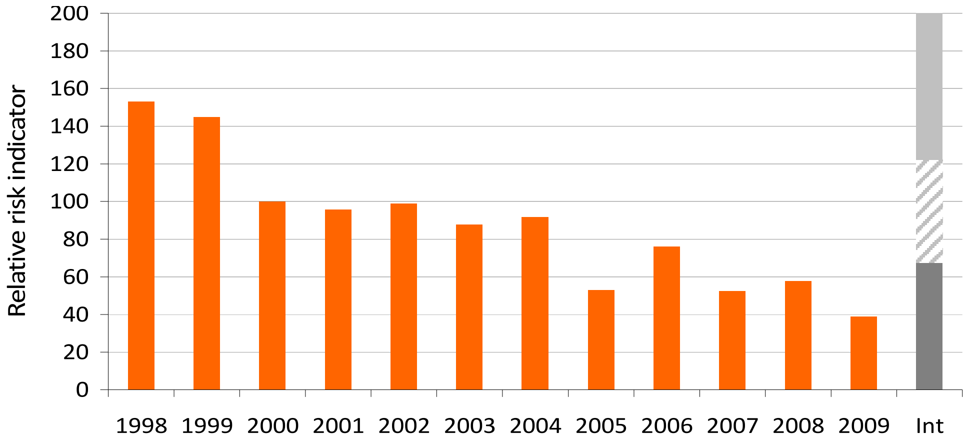


Figure 20 Total indicator, mobile units, normalised against manhours, 3-year rolling averages

Figure 20 shows the trend for the total indicator for mobile units, with 3-year rolling averages. There is an overall falling trend over the entire period.

As already noted, it was especially the gas blowout on Snorre A that made a large contribution in 2004, together with the gas leak on Visund in 2006. Both events affect the value for 2006 (average for the period 2004-06) but are out of the picture from 2009. The corresponding figure for production installations shows a stable level for the whole period, with no reduction in the last few years.

The figure shows only the total value for the indicator. The values for mobile units are substantially influenced by well events and shallow gas blowouts in the period 2000-2002 and, to an even greater extent, by structural damage. During the last five years it was only in 2008 that there were any incidents in the most serious category.

8. Status and trends—barriers against major accidents

The reporting and analysis of barrier data have been continued, including the well status indicator, but with the addition of indicators for maintenance management. As before, companies report test data from periodic testing of selected barrier elements.

8.1 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:

- maintain the 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 consist of various coordinated barrier systems (or elements). For example, a leak must be detected before any isolation of ignition sources and emergency shutdown routines (ESD) are effectuated.

Figure 21 shows the relative fraction of failures for those barrier elements for which test data have been acquired. These test data are based on reports from all production operators on the Norwegian Continental Shelf.

The fraction of failures is on a par with the industry's availability requirements for new installations, but the highest values in the figure are above this level. Overall, there is no uniform picture, the most characteristic feature being a constant level with minor variations. The exception concerns data from muster drills, where the total number of drills and the proportion meeting efficiency requirements remain more or less unchanged from year to year.

The Main Report shows the difference between the mean fraction of failures, i.e. the fraction of failures for each installation separately and then the mean for all installations and the "total fraction of failures", i.e. the sum of all failures on all installations reporting data divided by the sum of all tests for all installations 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.

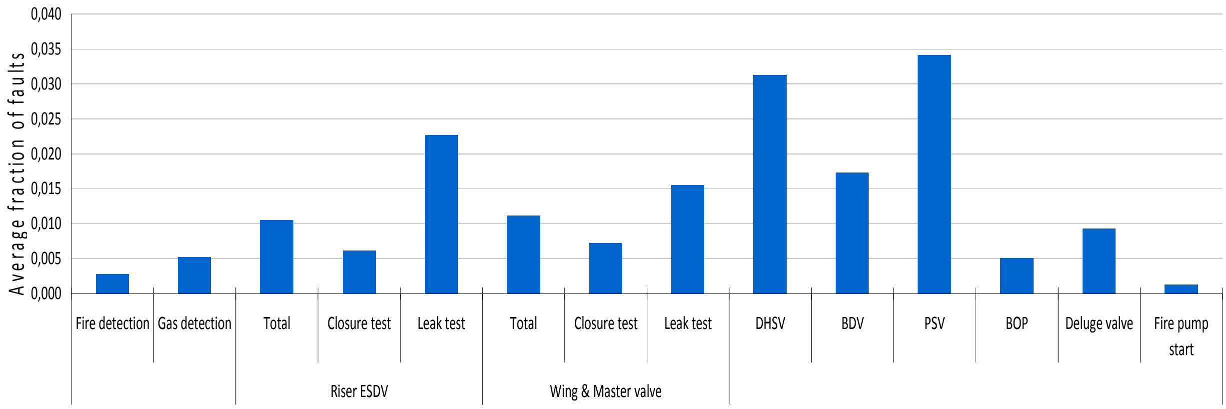


Figure 21 Mean fraction of failures for selected barrier elements, 2009

The total fraction of failures for well isolation with DHSV is 0.0312 for 2009. For the period 2002-2009 the total failure fraction is 0.0218. The mean fraction of failures is 0.0282 for 2009 and average 0.0219 for the period 2002-2009. This is rather higher than the availability requirements used in the industry, for example in Statoil's own guidelines which stipulate a level of 0.02. There has also been a persistent increase in the fraction of failures in the period, in DHSV testing. On the other hand these tests been subject to close scrutiny since they it is the first valve test that is to be reported, and this may have contributed to the increase in failure fraction.

Installations which have consistently shown many failures in testing of multiple barrier elements have been analysed to enable comparison with the number of leaks exceeding 0.1 kg/s on the same facilities. A corresponding analysis was performed in 2007 and 2008 and the results are consistent, as in the last three years (see also the Main Report for 2010, PSA, 2010a).

Figure 22 shows the total fraction of failures per barrier element for the eight operators reporting test data in 2008. The figure shows that there is substantial variation in the fraction of failures per barrier element between the different operators. (The variation noted is due to various factors, which are discussed in the Main Report):

- *Difference in test interval*. The total fraction of failures is calculated as X/N where X is the number of failures and N the number of tests. If the failure rate, i.e. the number of failures per time unit, is assumed to be constant, it is reasonable to assume that the proportion of total fraction of failures will diminish if test frequency increases. Differences in test interval have been observed, although the impact of this has not been analysed in detail.

- *Difference in the number of installations for which operators are responsible.* Fewer installations and components result in greater variation.

- *Difference in the number of tests.* Variation is normally largest in the case of barrier elements with relatively few tests.

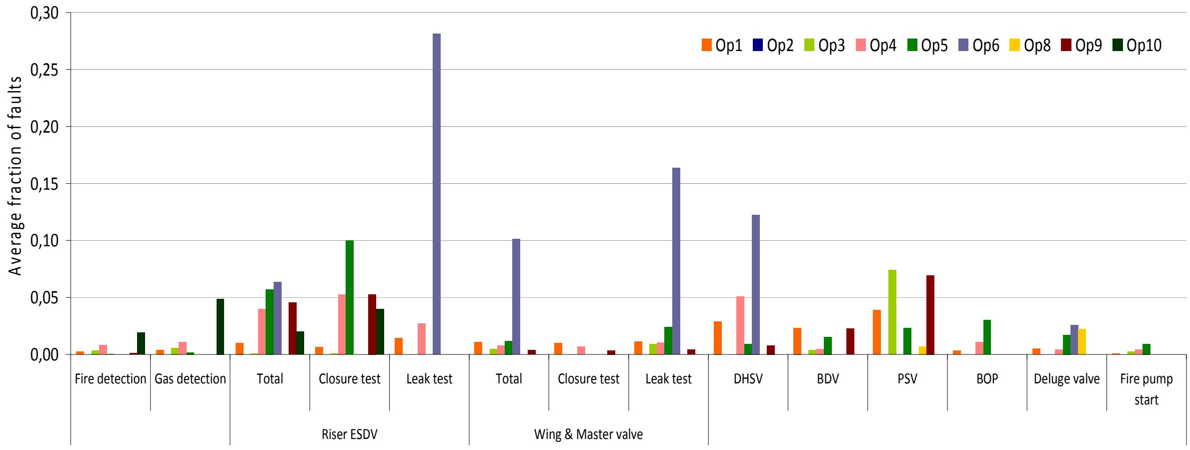


Figure 22 Total fraction of failures presented per barrier element for operators 1–10

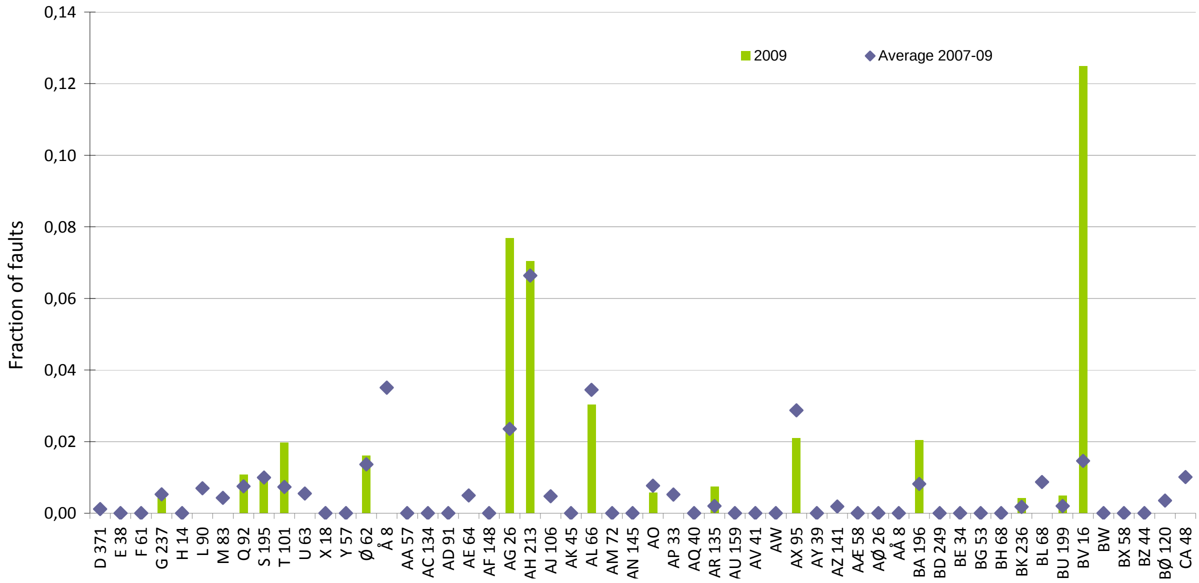


Figure 23 Fraction of failures for closing tests of wing and master valves

The failure criteria for ESDV (generally the acceptable internal leak rate) can vary between installations and between companies, since criteria are determined on the basis of risk calculation. Acceptable internal leak rate for wellhead wing and master valves is given by API and is thus common for all installations and companies.

Figure 22 shows average values for each of the operator companies and large variations are evident for several of the barrier elements. Even greater variations can be seen if we look at the individual installations, as has been done for all barrier elements in the Main Report. Figure 23 shows an example of this comparison for closing tests of wing and master valves. Each installation is given a letter code and the figure shows the fraction of failures in 2009, the average fraction of failures in the period 2007-09 and the total number of tests performed in 2009. Most installations have an average of below 0.02, but one installation has an average fraction of failures close to 0.05. Three installations have a high fraction of failures in 2009, with more than 10 % failures of the number of tests.

8.2 Barriers relating to marine systems

In 2009 there was data acquisition for barrier elements relating to marine systems, for:

- Watertight doors
- Ballast system valves
- Anchoring system
  - o The number of situations where a brake has been knocked out
  - o The number of situations where the second brake has also failed
- Time without acceptable signals from three reference systems or fewer than two reference systems following different principles (applies only to mobile units)
- Metacentre height for mobile units.

No data have been reported for situations in which brakes were taken out of function.

Data were collected for both floating production units and mobile units. With respect to production units, the fraction of failures in 2006 in relation to tests of watertight doors and ballast system valves corresponded to 1.5-2 % while for 2007 and 2008 the fraction fell to under 0.5 %. The value for 2009 is approximately 1%. For mobile units the number of tests and number of failures vary from installation to installation. Average values are partly lower than for floating production units with respect to watertight doors and ballast system valves.

A new element from 2008 is that there has been a request for metacentre height data (GM). This is the distance from the metacentre (M) to the centre of gravity (G) on the installation. A high positive value indicates good intact stability. The installation is stable when the metacentre height is positive and unstable with negative values. This value will generally indicate weight changes on the installations but will also show if there are changes in buoyancy volumes. Both average and minimum metacentre heights as on 31.12.2008 show a slight increase from 2008 to 2009.

8.3 Indicators for maintenance management

In 2006 PSA launched the project *Maintenance as a means of preventing major accidents: maintenance status and associated challenges.* One of the project's aims was to update the status of maintenance management in petroleum activities with a view to determining the importance of maintenance in the prevention of major accidents. The project showed that classification of systems and equipment had not improved in relation to the status indicated in Storting White Paper No. 7 (2001-2002). Audits conducted by PSA in 2006, 2007 and 2008 revealed a number of non-conformities in all companies audited. Much the same status was revealed in the 2009 audit. The most recurrent non-conformities are:

- deficient classification of systems and equipment,
- inadequate use of classification,
- inadequate overview of outstanding maintenance,
- lacking/deficient documentation,
- lacking/deficient competence
- deficient evaluation of maintenance efficiency.

As a result of these findings, we wished to survey the status of maintenance management over a period of time, for both production installations and mobile units on the Norwegian Continental Shelf. Our particular area of focus is *the decision basis for maintenance management* i.e. tagging of systems and equipment on the installations, classification of the tagged elements and how much of the classified material is critical in relation to health, safety and the environment ("HES critical"). We also wished to establish an overview of *the status of maintenance already performed*, i.e. the hours spent on preventive and corrective maintenance, backlogs in preventive maintenance and outstanding corrective maintenance, also with a view to HES critical systems and equipment. The reporting categories are the following:

Decision basis for maintenance management:

- The total number of tagged equipment items*
- The number of classified tags*
- The number of tags classified as HES critical*
- The last classification performed

Status of performed maintenance:

- Number of hours preventive maintenance
- Number of hours corrective maintenance
- Number of hours modifications and projects
- Number of hours overhaul shutdown
- Preventive maintenance backlog, number of hours in total*
- Preventive maintenance backlog, number of hours, HES critical*
- corrective maintenance outstanding, number of hours in total*
- corrective maintenance outstanding, number of hours, HES critical*

The items marked with an asterisk are those focused on in the pilot phase. The Main Report covers all indicators while only two are shown here.

Figure 24 shows a substantial backlog in preventive maintenance for production installations, while Figure 25 shows a substantial backlog for mobile units.

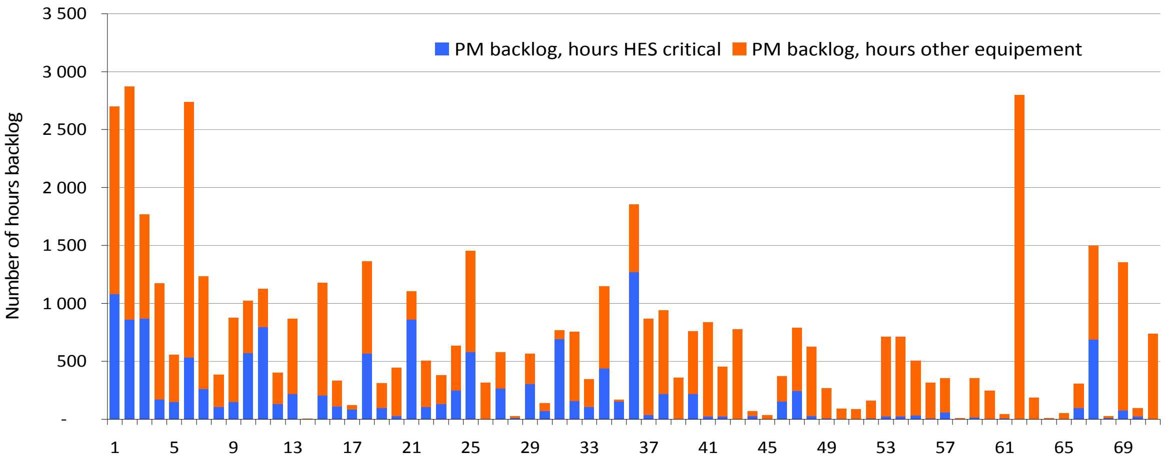


Figure 24 Overview of backlog in preventive maintenance, production installations

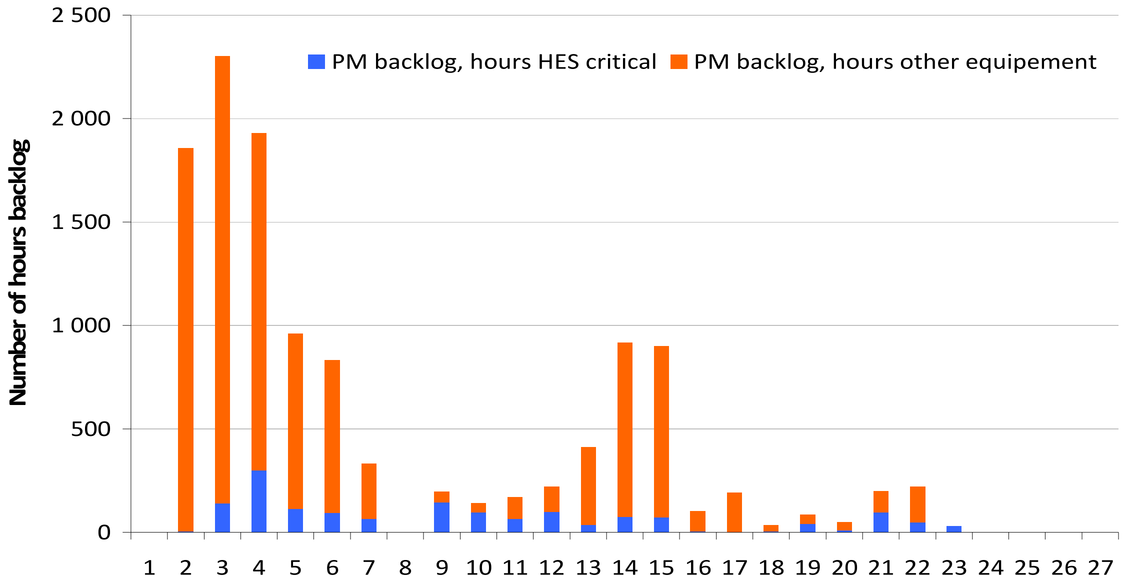


Figure 25 Overview of backlog in preventive maintenance, mobile units

There are therefore many planned maintenance jobs not yet performed, including those HES critical for systems and equipment. This maintenance backlog introduces contributory risk factors. It is therefore important to exercise strict control over this backlog and the risk it represents.

9. Status and trends – occupational accidents resulting in fatalities and serious injury

For 2009 PSA has registered 329 cases of injury to personnel on petroleum-related installations on the Norwegian Continental Shelf that come under the criteria of death, absence continuing over into the next shift or medical treatment. In 2008, 414 cases of injury were reported. In 2009 there was one fatal accident within the PSA' s area of authority on the Norwegian Continental Shelf, on Oseberg B, 7th May 2009, during dismantling of scaffolding. A further 64 cases of injury were reported, classified as injuries incurred during leisure-time activities and 144 injuries requiring first aid treatment in 2009. In 2008, by comparison, there were 60 cases of leisure-time injuries and 174 first aid cases. First aid cases and leisure-time injuries are not included in figures and tables here.

In the period 1990 to2000 there were only slight changes in total injury frequency for production installations. From 2000 to 2004 a clear decline is seen, with a reduction from 26.4 to 11.3 occurrences of injury per million manhours in 2004. From 2004 to 2008 the total injury frequency has remained generally unchanged at around 11 cases of injury per million manhours. In 2009 we observe a significant fall from 11 to 8.5 cases of injury per million manhours. In 2009, 244 cases of injury on production installations were reported.

Similarly, on mobile units there were slight changes in the period 1990 to 2000. A steady decrease in frequency is then observed, from 33.7 in 2000 to 11.1 in 2006. In 2007 there was once more a rise in injury rate. In 2008 frequency again showed a positive trend and for 2009 this positive trend has continued, with a reduction of 2.3 cases of injury per million manhours to 6.6 cases per million manhours in 2009. This is a significant fall. The frequency for mobile units is clearly below that for production installations. In 2009 there were 85 cases of injury on mobile units against 94 in 2008.

9.1 Serious injuries, production installations

Figure 26 shows the frequency of serious injuries on production installations per million manhours. There is a falling trend in frequency from 2000 to 2008. In recent years there has been a positive trend in the frequency of serious injuries for production installations, but from 2008 to 2009 there was again an increase in frequency from 0.65 in 2008 to 0.87 in 2009. The frequency figure in 2009 lies within the anticipated value based on the preceding ten years. On production installations 25 cases of serious injury occurred in 2009 as against 19 in 2008. The number of manhours is reduced from 29.1 million in 2008 to 28.6 million in 2009.

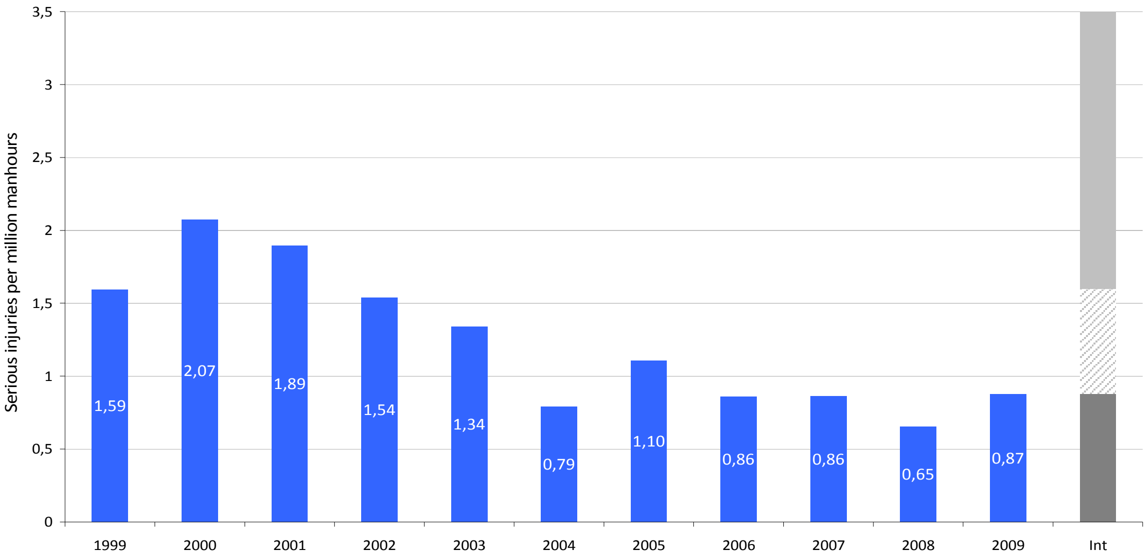


Figure 26 Serious injuries on production installations in relation to manhours

9.2 Serious injuries, mobile units

For 2009 the frequency of serious injuries is 0.55 per million manhours (see Figure 27) as against an average for the preceding ten years of 1.95. From 2002 to 2005 there were minor changes in injury frequency. In 2009 we observe a marked drop in the frequency of serious injury per million manhours. The level in 2009 is 39 % in relation to the frequency in 2008 while there has simultaneously been an increase in activity. The number of manhours reported for mobile units increased by 2.3 million, from 10.5 to 12.8 million. The number of cases of serious injury is seven in 2009 as against 15 in 2008.

9.3 Comparison of accident statistics between the UK and the Norwegian Continental Shelf

PSA and the UK Health and Safety Executive (HSE) produce a half-yearly joint report in which statistics of injuries to offshore personnel are compared. The classification is revised in dialogue with the British authorities so that the categories cover corresponding areas of activity.

The calculation of average injury frequency for fatalities and serious injuries for the period 2001 up to and including the first half of 2009 shows that there have been 0.95 cases of injury per million manhours on the Norwegian side and 1.01 on the British Continental Shelf. The difference is not significant. However, the difference in frequency of fatal accidents in the same period is larger. The average frequency of fatalities on the British Continental Shelf is 2.7 per 100 million manhours as against 1.5 on the Norwegian Continental Shelf, this difference not significant. On the British Continental Shelf there were 11 fatalities in the period as against four on the Norwegian Continental Shelf.

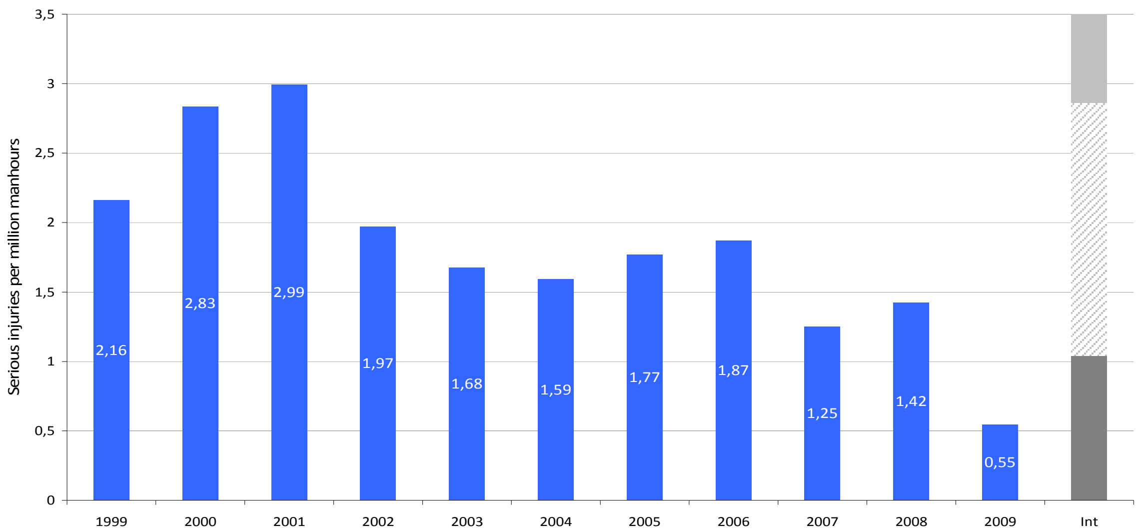


Figure 27 Serious injuries per million manhours, mobile units

10. Risk indicators – noise, chemical work environment and ergonomics

It has been stressed that indicators must express risk factors as early as possible in the causal chain leading to occupational injury or illness and that the indicators must lend themselves readily to use in companies' improvement work.

With few exceptions, data for noise and chemical work environment have been registered from all offshore installations and land facilities. In regard to noise, the data set shows that there is common understanding of reporting criteria and the indicator seems to give a realistic and consistent picture of the actual conditions. It also seems to be sensitive to change. Indicators for chemical work environment have been slightly modified to give better robustness

New this year is the reporting of data as a basis for a risk indicator for the development of muscular/skeletal complaints. Data have been reported from selected sources, a total of 38 installations.

Response from the companies has been generally positive. The work has created commitment and management attention around the topic of indicators, and the preconditions for prioritised risk reduction have been improved. An important aim in the establishment of indicators is that they should support good processes in the companies. There is a high level of activity in the branch directed towards the development and implementation of methods and tools for risk assessment and risk management in relation to work environment factors, and there are a number of good examples of major improvement projects in the industry. Indicators are based on a standardised data set and reflect only some aspects of a complex risk picture. Indicators cannot therefore be a substitute for companies' obligations to perform vulnerability and risk assessments as a platform for implementing risk-reducing measures.

10.1 Noise exposure harmful to hearing

The noise exposure indicator covers 11 predefined job categories. The total data reported represent 2572 offshore personnel, an increase from 2008 where 2400 were reported. The average noise indicator for the 2400 persons covered by the survey is 90.7, a slight increase from the 2008 level, which was 90.2 (90.4 in 2007). The split between different job categories and installation groups is shown in Figure 28 (further details in the Main Report, PSA, 2010a). The results point to an improvement on 34 out of a total of 73 installations, fewer than in 2008. The figures show a marked deterioration particularly for four new production installations, with an increase from 12.5 dBA to 15.8 dBA.

If we assume that the noise indicator reflects real exposure to noise, most job categories covered in this survey have a level of noise exposure exceeding 83 dBA, which is the maximum permitted under the Facilities Regulations, Section 22. However, if we take into account the use of hearing protection as reported by the companies, the majority of job categories are seen to have a level of noise exposure within the required limit.

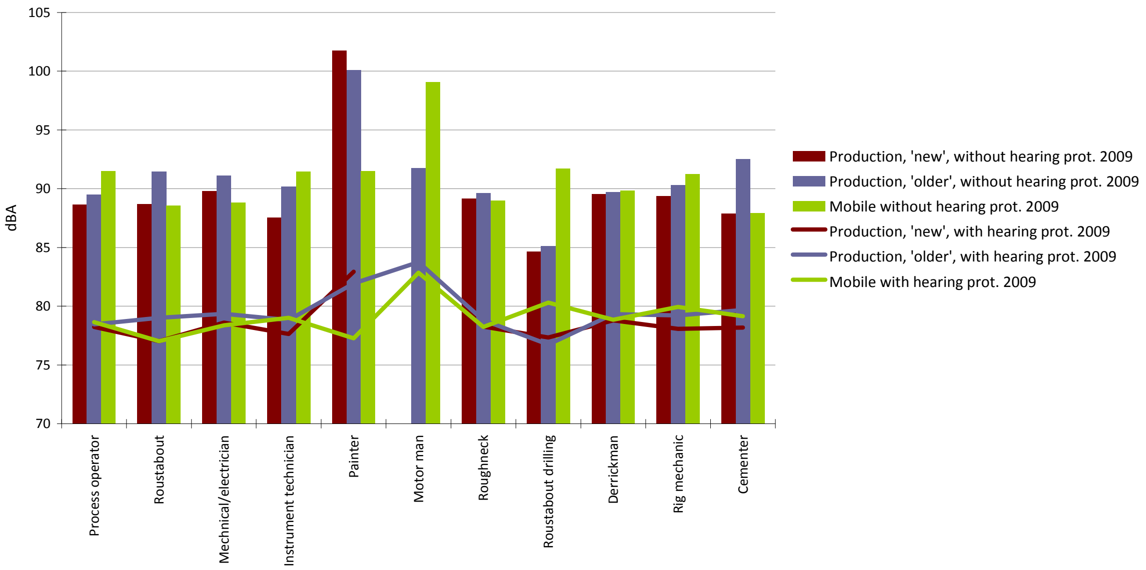


Figure 28 Average noise exposure by job category and installation type, 2009

Even if we apply a conservative estimate for the noise suppression effect of the hearing protection, this does not mean that the situation is satisfactory. Hearing protection has clear limitations as a preventive measure. Persistently high levels of reported hearing damage indicate that this is not an effective barrier. The average noise indicator with the use of hearing protection for the 2572 persons covered by the survey is 79, as against 79.2 in 2008.

The indicator also calculates uncertainty in the result and the 95 % percentile for indicator value, which typically lies 6-8 dB higher/lower than the average values shown in the Figures. This means that a relatively high number of personnel may have a much higher level of exposure than the average figures would suggest.

The noise indicator for the job category machinist is markedly higher than for other groups and for this category the noise indicator including hearing protection is also relatively high.

For most job categories the noise indicator is lower on "new" installations than on "older" ones. For mobile units, four out of 11 job categories have lower levels of noise exposure compared with those on new and older installations.

19 installations have reported that technical measures have been implemented which in total have led to reduced noise exposure by respectively 1 dB, 11 installations with a reduction of 3 dB, eight installations with a reduction of 5dB and two installations with a reduction of 8 dB for certain job categories, a result which is an improvement in relation to 2008.

Reporting of data confirms that some companies have formalised and implemented schemes for manhour limitations: of 71 installations there are 11 which have not introduced schemes of this kind for some job categories. This applies particularly to mobile units. As in previous years, there is still potential for improvement in this area on mobile units. Although it may be difficult to verify if this kind of measure is effective, there are examples showing that they may work. Schemes of this nature may have operational drawbacks and may in themselves serve to hasten the implementation of technical measures.

Although indicators point to high levels of exposure, there are still a number of installations which have not established plans for risk-reducing measures, cf. Figure 29. The pictures show a negative trend compared with that for 2008, for both new production installations and mobile units. The picture for older production installations has changed compared with that of preceding years, a slightly positive trend being observable. For mobile units, approximately 90 % have drawn up plans for risk-reducing measures. An improvement potential has been registered in relation to implementation of these plans, particularly in the case of new production installations and mobile units. Some new and exacerbated cases of hearing damage have been registered in the period 2009 for all installations.

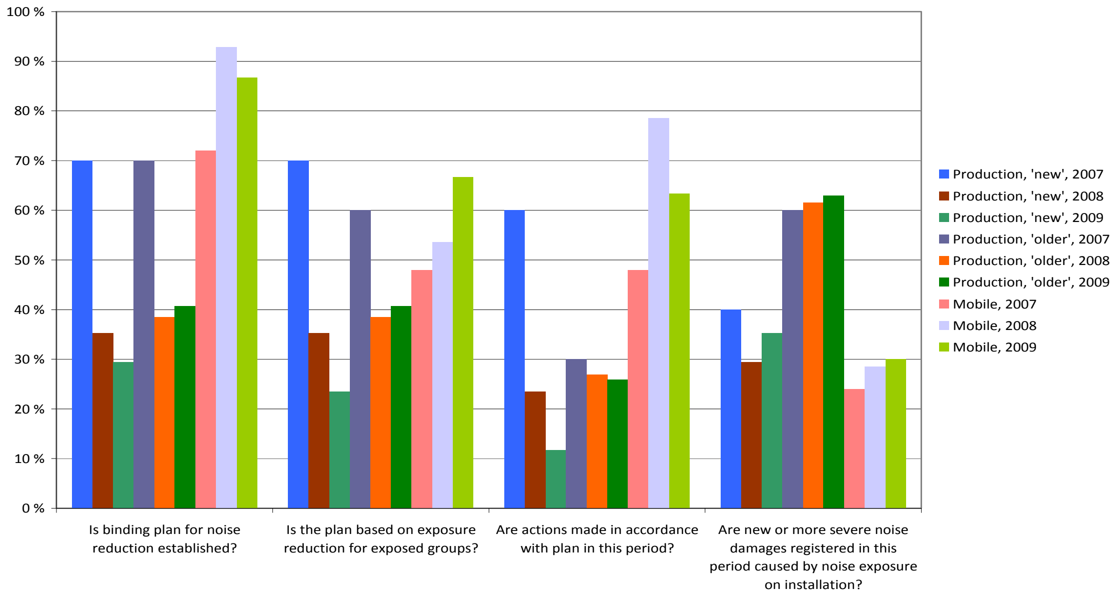


Figure 29 Plans for risk-reducing measures

For 2009, 397 cases of noise-related injury have been reported to the Petroleum Safety Authority. This represents a lower level than the figures registered for the last few years: in the last two years there were approximately 600 cases. PSA is aware that some companies have reviewed their noise data records in recent years and have probably reported some backlog from previous years. There has also been some uncertainty in relation to modified reporting criteria, which may have led to especially high figures in 2007 and -08.

All in all, it would seem to be clear that large groups of personnel in the offshore petroleum activities are exposed to high levels of noise and that the risk of developing noise-related hearing damage is not insignificant. PSA's experience through its contact with the industry, case handling and audits suggests that the potential for noise-reducing measures remains large.

10.2 Chemical work environment

The indicator for chemical work environment has two elements. One is the number of chemicals in use listed by categories of health hazard, the hazard profile of the chemical spectrum and substitution data. The second element relates to actual exposure for defined job categories, which seeks to identify exposure carrying the highest risk.

The indicator for the chemical spectrum's hazard profile shows the number of chemicals in circulation per installation and chemicals with a high and defined hazard potential. This indicator has limitations in that it does not take into account how the chemicals are actually used and the risk this use represents. It nevertheless tells us something about companies' ability to limit the presence and use of potentially hazardous chemicals. It is a recognised scientific argument that the probability of health-hazardous exposure increases with the number of harmful chemicals in use.

There was little change in the trend of this indicator in 2009. In the light of the industry's improvement potential and companies' sharp focus on the chemical work environment, this result is disappointing (see Figures 31 and 32).

Following comments and suggestions from the companies, the model from 2008 which uses a standardised and colour-coded risk matrix to illustrate actual exposure has been further developed and the reporting criteria have been tightened up. In the matrix, exposure data and health hazard information are used to show the level of risk for four defined job categories. It is the situations/operations the companies assess as posing the highest risk which have been reported. This does not give a valid basis for comparison for this indicator and it is therefore difficult to draw any conclusions. In the Main Report (PSA, 2010a) there is a more detailed description and analysis of results.

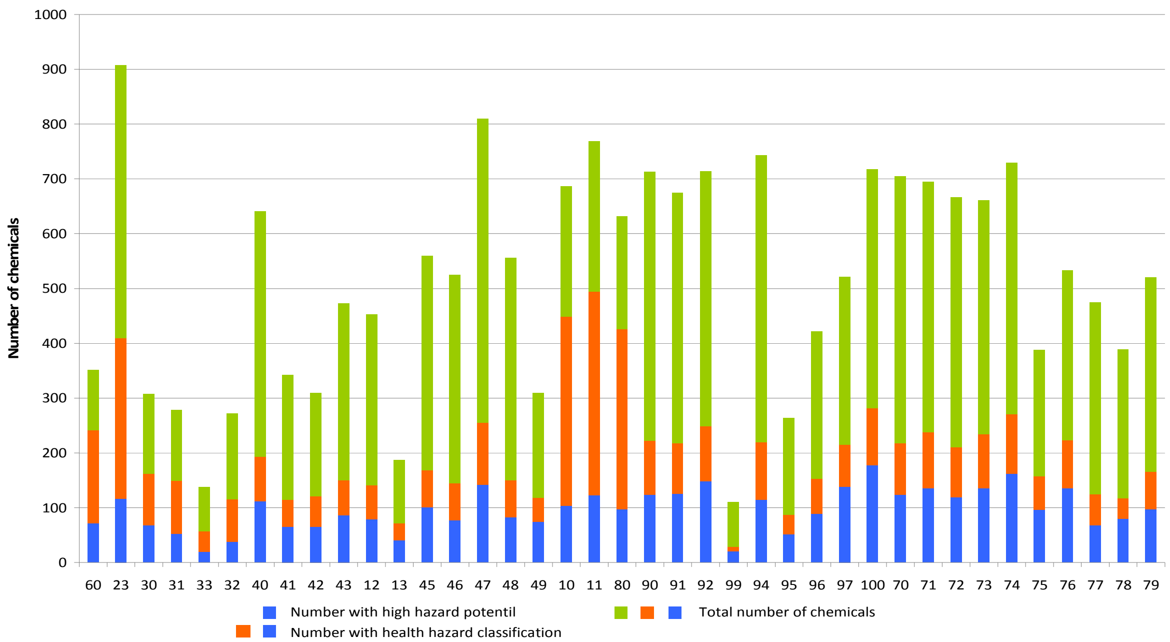


Figure 30 Indicator for the chemical spectrum's hazard profile – production installations

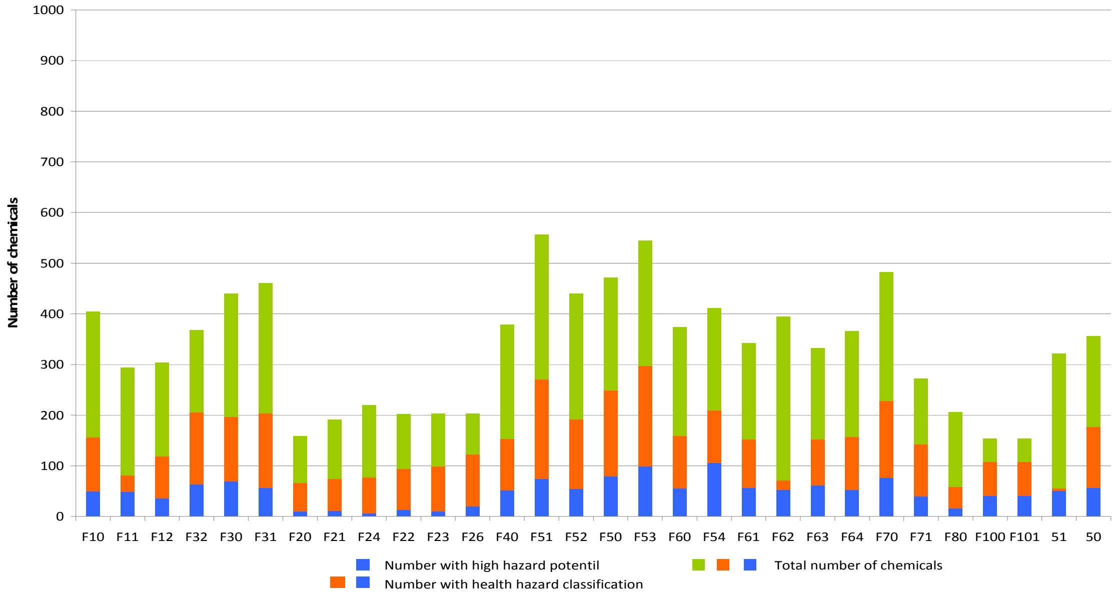


Figure 31 Indicator for the chemical spectrum's hazard profile - mobile units

For production installations there is a slight decrease in the total number of chemicals in relation to preceding years. For mobile units there is an increase in the total number of chemicals in relation to preceding years.

10.3 Indicator for ergonomic factors

Indicators for ergonomic risk factors are new in 2009. The companies have reported data for two work operations involving a high risk for some defined job categories of developing muscular/skeletal complaints. The work operations considered are of a type performed regularly and with a certain duration. Indicators have been developed in cooperation with the relevant disciplines in the companies and STAMI. In 2008 a status overview was drawn up "Work as the cause of muscular/skeletal complaints" by STAMI, on the order of the Norwegian Labour Inspection Authority and the PSA. The results of this work have been used in the development of indicators. The "Regulations relating to Heavy and Repetitive Work" and associated guidelines list the assessment criteria to be applied for reporting. The involvement of ergonomics experts in quality assurance of these assessments is a precondition emphasised by PSA.

Some interesting information about ergonomic risk factors has been obtained but on this occasion there is no basis for drawing far-reaching conclusions. Some further development of indicators is required before they are capable of giving a representative picture of risk for the job categories in question. In the Main Report (PSA, 2010a) the provisional results and analyses are presented.

11. Importance of framework condition for HES

The results from PSA' s work with HES in contracts, investigations and international research show that framework conditions are a key element in the prevention of major accident risk and risk associated with the work environment. Companies working in petroleum activities have also, in meetings with PSA, themselves mentioned key framework conditions, for example market fluctuations, contractual factors and work organisation through maintenance campaigns as important for HES work in the industry, in individual companies and the division of responsibility between companies. Against this background, PSA wished the importance of framework conditions for trends in risk level to be a topic for the qualitative part of RNNP in 2009.

The term "framework conditions" is taken to mean *factors influencing the practical possibilities open to an organisation, an organisational unit, group or individual for keeping the risk of major accident and risk associated with the work environment under control.*

This definition implies that framework conditions exercise an *indirect* influence on risk associated with the work environment and major accident risk, through their impact on scope of action, resources, incentives etc. for the participants mentioned above. In other words, it concerns factors over which the participants themselves cannot exercise effective and immediate control. These framework conditions may for example be created by the market, through decisions made previously in another organisation or at another organisational level. In some cases, however, the participants can work strategically to change the framework conditions under which they find themselves.

On the basis of this working definition, contractual factors, nomadic existence, knowledge and skills, incentive schemes and organisational change processes can for example be understood as framework conditions in the sense that these factors can influence participants' practical opportunities to exercise control over major accident risk and risk associated with the work environment. Contracts are an example of how individual framework conditions can impact on a number of other conditions – in this case factors governed by the contracts.

Framework conditions can have both a positive and negative impact on HES work. The study does not focus solely on identifying constraints and obstacles to participants' HES work. It is just as important to elucidate and systematise positive experience. The following issues have been given particular attention:

1. How has the economic recession influenced framework conditions for HES work in the contractor branch in petroleum activities?
2. How has the merger between Statoil and Hydro influenced framework conditions for HES work in contractor companies and sub-suppliers?
3. How do frequent changes of workplace (nomadic existence) influence the framework conditions for HES work?

The study has not revealed any dramatic HES effects resulting from the economic recess in the three enterprises covered. Close to half of the informants said they had not observed consequences of the financial crisis for their activities. However, given the method adopted in the study there is no basis for generalising this conclusion to apply to the Norwegian petroleum activities as a whole.

Some of the informants mentioned the following actual and possible effects of the recession:

- Calls to justify investment in HES work and measures have become more stringent. It can be more difficult, they say, to gain approval for measures that are not clearly necessary to satisfy the rules and regulations, and there are examples of how it can take longer to implement measures
- Cost-saving on travel expenses can mean that there is less opportunity to communicate face-to-face. E-mail and videoconferencing replace face-to-face meetings and, in some informants' view, this has a deleterious effect on relationship building and knowledge sharing
- It is becoming more usual to put work out to tender. This may lead to less long-term predictability in customer-supplier relations
- Costly technical measures may be replaced by cheaper forms of HES work (focus on behaviour)
- Some suppliers are experiencing price pressure. This may come from either more extensive use of tendering or direct contractual pressure on suppliers to cut costs
- Uncertain work situation in connection with downsizing and closures can lead to negative psychosocial consequences
- The recession can also bring benefits in the form of better access to qualified personnel, more stable manning, fewer nomads, less pressure on employees and better time to attend to HES.

The informants also expressed views on how participants in the petroleum activities can maintain HES during a recession. They stressed in particular the importance of long-term relations between customer and supplier for knowledge sharing, culture building and the willingness to invest in HES measures. A hypothetical plan was put forward for how operational leaders can function as ”continuity agents” in a supplier hierarchy and contribute to making HES work resistant to any negative effects of fluctuations in the economy. It will prove an important challenge to ensure that local investments in relationship building and knowledge sharing are not lost in the search for short-term savings. An additional challenge is to ensure that HES work does not become a dispensable item in a context of stiffer competition between contractors and sub-suppliers. Furthermore, it is a challenge to ensure that investments and measures of significance to HES in a long-term perspective continue to be given priority even in periods of economic recession.

No informants at contractor and sub-supplier level stated that the Statoil-Hydro merger had had any serious negative consequences for their HES work. Contractors on land facilities have observed fewer effects of the change process than offshore contractors and sub-suppliers:

- A number of informants expressed concern about the possibility of Statoil's marketing strength leading to so much price pressure on contractors and sub-suppliers that they were no longer able to maintain their HES work. On the other hand, no one could point to any concrete examples where this had actually happened
- Uncertainty was expressed about the possibility of the new operating model leading to increased use of maintenance campaigns, partly because this can drive more personnel into a nomadic existence and partly because it may affect the ability to handle critical situations
- The merger has taken up much time for Statoil's safety delegate organisation, which may have a deleterious effect on their cooperation with contractors' safety delegates
- The introduction of the management system "Work process oriented management" (APOS) is seen as a desired standardisation, but some contractors are concerned that Statoil's requirement for contractors to adapt to this system has put a heavy demand on resources.

The "nomad" category includes different groups of personnel with widely divergent framework conditions. New operating forms, such as the increased use of maintenance campaigns, can result in this group expanding. In principle, nomads can act as a some kind of HES agents influencing established HES work in a positive direction by bringing ideas to it from outside. Nomads' working conditions, on the other hand, can be an obstacle to their being properly integrated in the HES work in the workplace they come to, with the result that they may be left to themselves. It is also a challenge for the companies in which nomads are employed to relate to many different workplaces for each employee. One may also ask who is to be responsible for speaking on behalf of nomads in relation to major accident risk and risk associated with the work environment.

Contractor personnel with nomad status are more exposed to the risk of accident and work environment risks in connection with their tasks than operator personnel with a fixed workplace. Systematic HES work also functions less well for nomads and nomads have less opportunity to influence their own HES conditions. If new operational forms result in a higher proportion of nomads, it is doubtful if it will be possible to maintain or improve the current level of HES unless nomads' HES conditions (and the possibility to influence their own HES conditions) can be made on a par with conditions for permanently-based personnel. In this context it is necessary to deal with HES factors across the board and not limited to accident risk.

12. Other indicators

12.1 DFU21 Falling objects

216 "falling object" events have been reported to this work for 2009, about the same level as for 2008 (220) but with a greater reduction from the average for the period 2002-08, which was 250. PSA was notified of 188 events in 2009, as against an average of 110 notified events in the period 1997-2008. The long-term picture shows an increase in notified events and a slow decrease in the number of events reported to RNNP. There has been sharper focus on falling object risk over a number of years, while at the same time no lower limit has been set for what should be reported. The figures are not directly comparable and cannot be used to establish trends.

A falling object can result in injury to personnel, material damage, production shutdown or a combination of these. The number of injuries has varied between two and 18 cases a year, with an average of ten cases of injury a year. In 2009 there were seven cases of injury. Data have been reported for two indicators from and including year 2002:

- The frequency of falling objects for different work processes (drilling, crane operations, process operations and others)
- The frequency of falling objects for different energy classes (indicator to see the potential in a falling object to cause damage to equipment and structures or to injure personnel).

All reported events have been classified in relation to the work process in operation at the time of occurrence or which caused the event to occur. The main categories of work processes are:

- Drilling-related work processes
- Crane-related work processes
- Process-related work processes
- Other work processes

Figure 32 shows the percentage of the total number of events contributed by each work process. Since 2003 the category "other" has contributed with the highest number of events, followed by events involving drilling processes. After a sharp fall from 108 events in 2007 to 72 events in 2008, the level in 2009 remains almost unchanged, with 74 reported events.

The number of process-related events has fallen by 25% from eight events in 2008 to six events in 2009. The number of crane-related events has decreased by 10%, from 40 in 2008 to 36 in 2009.

It would appear that success has been achieved in reducing the number of events in association with concrete work processes whereas there are more undesired events involving falling objects in situations where there are no concrete work processes.

12.2 Other DFUs

The Main Report presents data for events reported to the Petroleum Safety Authority, and for the following remaining DFUs, which have no major accident potential:

- DFU10 Damage to subsea production facilities/pipeline systems/diving equipment caused by fishing gear
- DFU11 Evacuation (precautionary/emergency evacuation)
- DFU13 Man overboard
- DFU16 Total blackout
- DFU18 Diving accident
- DFU19 H2S release

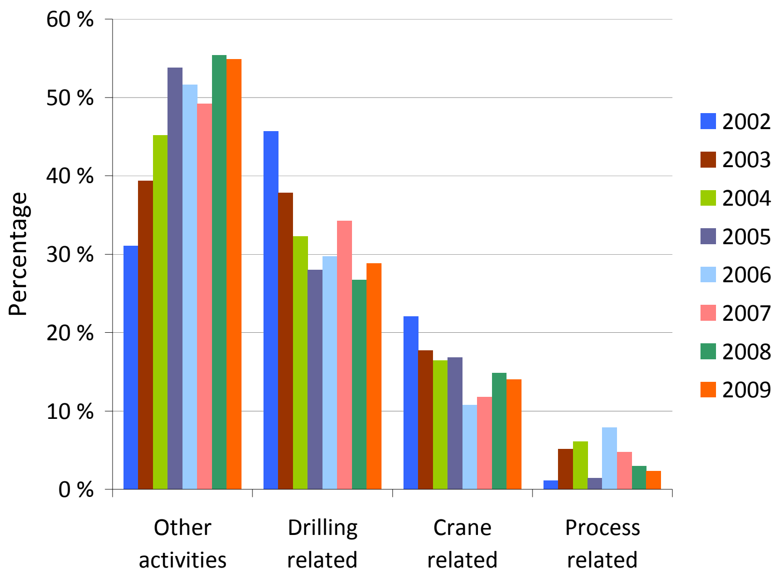


Figure 32 Percentage share of events by work process, 2002-09

13. Definitions and abbreviations

13.1 Definitions

See Subsections 1.9.1 - 1.9.3 and 6.2 i n the Main Report.

13.2 Abbreviations

For a detailed list of abbreviations, see PSA, 2010: Trends in Risk Level on the Norwegian Continental Shelf, Main Report, 22.4.2010. The most important abbreviations in this report are:

CODAM	Database for damage to structures and subsea installations
DDRS/-CDRS	Database for drilling and well operations
DFU	Defined situations of hazard and accident
FV	Preventive maintenance
GM	Metacentre height
HES	Health, environment and safety
KLIF	The Climate and Pollution Agency
KV	Corrective maintenance
MTO	Man, Technology and Organisation
NPD	The Norwegian Petroleum Directorate
PSA	The Petroleum Safety Authority
STAMI	The National Institute of Occupational Health

14. References

For a detailed reference list, see the Main Reports:

PSA, 2010a. Trends in Risk Levels on the Norwegian Continental Shelf, Main Report, PSA 09-01, 22.4.2010

PSA, 2010b. Trends in Risk Levels – Land Facilities in the Norwegian Petroleum Industry, PSA 09-04, 22.4.2010