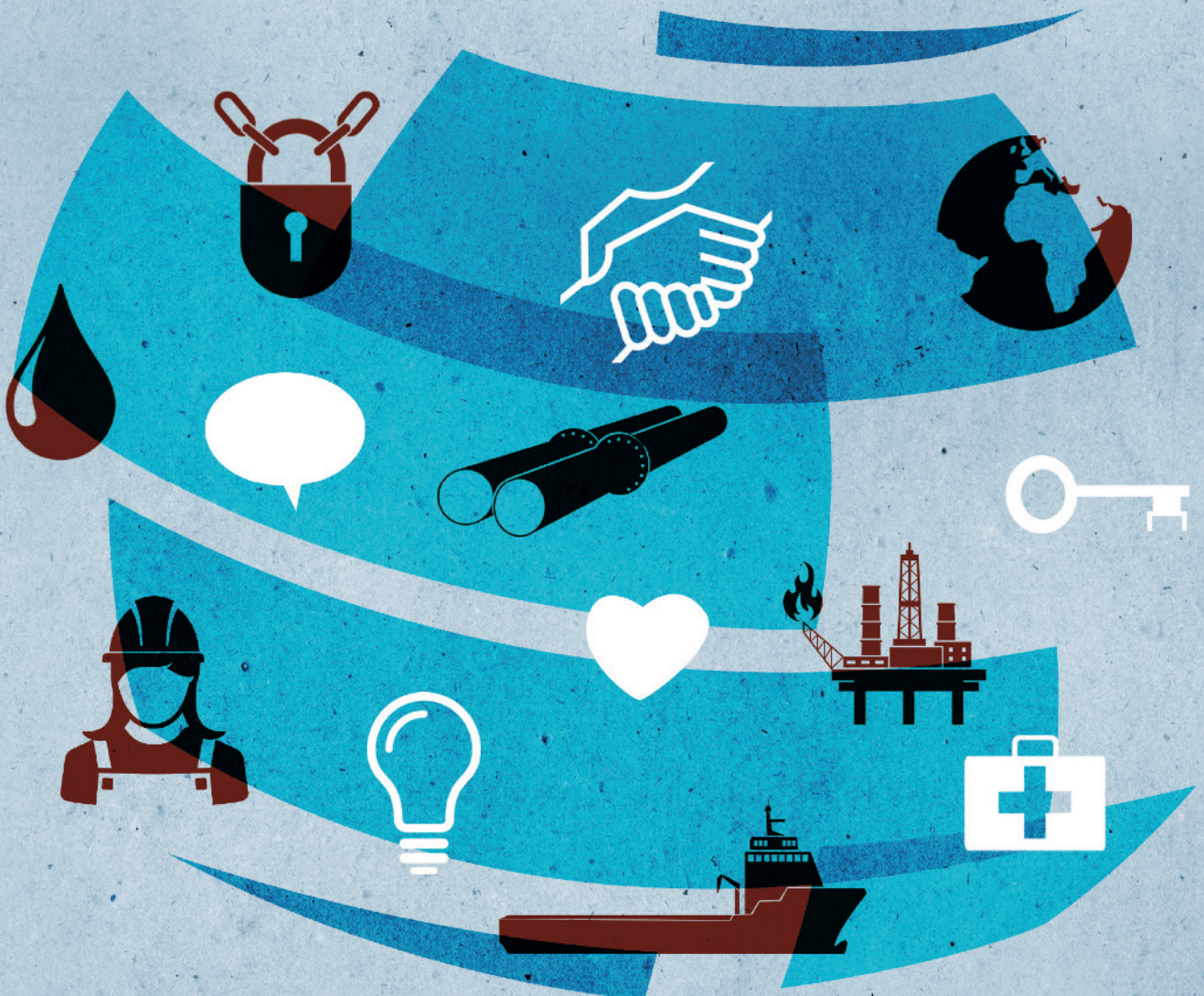




Norwegian Ministry  
of Labour and Social Affairs

Meld. St. 12 (2017–2018) Report to the Storting (white paper)

# Health, safety and environment in the petroleum industry



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## Abbreviations

AMU	Working Environment Committee
AOC	Air Operator Certificate
AORF	Arctic Offshore Regulators Forum
BaSEC	Barents Sea Exploration Collaboration
CEN	The European Committee for Standardization
DFU	Defined hazard and accident situations
ECHA	European Chemicals Agency
EPPR	Emergency prevention, preparedness and response
HSE	Health, safety and the environment
ICT	Information and communication technology
IOGP	The International Association of Oil & Gas Producers
IRF	International Regulators Forum
ISO	The International Organization for Standardization
Kg/s	Kilograms per second
KonKraft	Konkuransekraft – norsk sokkel i endring <Competition – a changing Norwegian shelf>
NORSOK	The Competitive Position of the Norwegian Shelf
NSOAF	North Sea Offshore Authorities Forum
PIO	Plan for Installation and Operation
Ppm	Parts per million
PDO	Plan for Development and Operation
RNNP-AU	Risk level in the petroleum activity – acute pollution
RNNP	Risk level in Norwegian petroleum activity
Sm <sup>3</sup>	Standard cubic metres
AOC	Acknowledgement of Compliance
APA	Awards in Predefined Areas
W2W	Walk to work



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*Recommendation from the Ministry of Labour and Social Affairs of 6 April 2018,  
approved by the Council of State on the same date.  
(Solberg Government)*



Figure 1.1



# 1 Introduction

The collective term “HSE”, as it is used in the petroleum activities, encompasses factors and considerations related to people, the environment and tangible assets. This report addresses topics linked to safety and working environment, but not pollution issues. A high level of safety and a good working environment naturally contribute to prevent emissions and discharges, and consequences for the environment. Therefore, the HSE work described in this report also contributes to protection of the external environment.

Chapters 2 and 3 of the report are descriptive chapters which provide an overview of the current HSE regime and the development that has taken place in the petroleum activities in recent years. Chapters 4 and 5 contain a review and discussion of development, challenges and follow-up of the risk scenario and the HSE regime in the Norwegian petroleum activities. Based on the review and assessments provided in Chapters 1–5, Chapter 6 presents an account of the Government’s main conclusions as regards ambitions and expectations for the further development and follow-up of health, safety and the environment in Norwegian petroleum activities.

## 1.1 The Government’s foundation

Petroleum activity is Norway’s largest industry, measured in value creation and revenue to the State. The industry has also maintained high performance and positive development over time when it comes to health, safety and the environment, although challenges remain. The major accident indicator was low in 2017, but development in the areas of psychosocial working environment and safety culture was negative, and there was an increase in serious personal injuries. Working conditions and how the work is organised have an impact on safety, working environment and health. The petroleum industry has the potential for major accidents, and several serious accidents and incidents have occurred in recent years. There were fatal accidents on Cosl Innovator in 2015 and Maersk Interceptor in 2017, and a

very serious situation occurred in October 2016 with loss of well control on the Songa Endurance drilling rig. This was a gas blowout that could have led to ignition and deaths under slightly altered circumstances. Incidents such as these remind us that safety vigilance can never be relaxed. Therefore, the HSE situation in the petroleum activity must constantly remain at the top of the agenda.

The HSE regime in the Norwegian petroleum activities is founded on cooperation and involvement, and also on accountability, respect and dialogue between the three parties; the authorities, the employees and the employers. This is a system that has proven to be both effective and constructive, and it has certainly contributed to the prevailing high level of safety. The three parties have different roles in following up HSE work. The safety authorities supervise the industry’s follow-up of safety and working environment. This follow-up is based on accountability and a climate of openness, trust and respect between the parties.

The petroleum activity is characterised by change over time, both in terms of activity level, profitability and the player landscape. The Petroleum Safety Authority is tasked with following up the industry, to ensure that the industry continues the further development of high safety levels along with implementing efficiency measures. Many have expressed concern that this development in the industry may have put pressure on the cooperation among the parties, and that more decisive supervision from the authorities is needed. This applies in all phases of the petroleum activity, from licence awards and production to cessation and disposal.

The perception of status and challenges on the part of the authorities and parties is an important starting point for the discussion of the HSE situation and HSE development. Therefore, in 2016, as a key part of the work on this report to the Storting, the Minister of Labour and Social Affairs invited the affected parties and authorities to participate in a work group to discuss status, challenges and development as regards health, work-

ing environment and safety in the petroleum activities. The assessments made by this work group formed part of the basis for this report, as well as an important foundation for the industry's further, continuous improvement work.

## 1.2 The Government's assessments and conclusions

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The Government's assessments and conclusions in Chapter 6 are based on the reviews and discussions in Chapters 1–5.

The Government's ambition is that the Norwegian petroleum activities shall be world leaders when it comes to HSE. This ambition is a clear signal that the petroleum industry cannot take a high safety level for granted, but must work to ensure continuous improvement. To ensure a sustainable future for the Norwegian petroleum activity, the industry must reduce costs and streamline operations, while simultaneously maintaining and further developing a high HSE level. The activities must have a long-term perspective, with parallel focus on good HSE results, resource management and value creation.

The various enterprises are responsible for the HSE level in the petroleum activities. The authorities' follow-up comes in addition to, and is not a replacement of, the enterprise's own follow-up. The transition that the petroleum industry has undergone in recent years also shows that the industry itself has the decisive influence on the cost level in the petroleum activities. Both the responsibility for and the key to achieving continuous improvement of HSE results and efficient operations therefore lies with the industry itself. This responsibility also entails following up the duty of care, both the operator's follow-up of suppliers down through the chain, and the licensees' follow-up of the operator.

A basic assumption for the current HSE regime is that the parties in the industry facilitate cooperation and participation in the two and three-party arenas, and the Government expects the industry to assign high priority to participation and cooperation among the parties. The significance of the tripartite cooperation depends on this having an effect on the two-party cooperation and on the HSE work in the companies. Therefore, the organisations in the tripartite cooperation must take responsibility for following up to ensure that discussions, exchange of experience and lessons learned are communicated and followed up among their members.

There is broad-based agreement that the current HSE regime has been very significant in the positive development and the high level of safety in the Norwegian petroleum activities. The Government takes its basis in the established HSE regime, which will continue to be important, given the high risk potential and the rapid technological development in the industry. Good utilisation of the latitude in the regime presumes that the three parties have mutual trust and respect for each other's roles and responsibilities. The industry must emphasise the added value in the cooperation between the parties. The two-party and three-party cooperation is an important pillar in the regime, and must be reinforced and further developed. The Petroleum Safety Authority must be a strong and decisive supervisory body which must actively assess and highlight its use of policy instruments, and adapt this to the development in the industry. The development could indicate a need for the Petroleum Safety Authority to be more clear in how it uses its reactions and responses, and it must also verify that orders are followed up, as necessary.

Through their follow-up of the licensing system, the authorities jointly contribute to ensuring professional and competent players and a high safety level on the Norwegian shelf. Decisions regarding the HSE regulations can have an impact on efficient operations, and decisions concerning awards and transfers can also have significance for the safety level on the Norwegian shelf. The authorities must therefore ensure that we have professional and competent players on the Norwegian shelf. For this reason, the manner in which the Petroleum Safety Authority and the Ministry of Labour and Social Affairs utilise the criteria for award of production licences as regards HSE considerations should therefore be subject to regular review, to ensure that these factors are properly addressed. Important objectives behind the award criteria and how they are put into practice are to promote good resource management and a high level of safety.

Good expertise and capacity are preconditions for safe and prudent operations. During times of change, downsizing and cost cuts, the industry must ensure the availability of relevant and sufficient expertise, both through recruitment and through development of skills and competence.

Knowledge and new technology are developing rapidly in the petroleum activity. Technology development leads to increased safety and efficiency, but can also entail new challenges that the industry must handle. New technology that con-

tributes to increased efficiency and safety must be put to use. The industry must make sure that the companies prioritise this effort, and that continuous HSE improvement takes place, also during times of major change and efficiency demands.

Continuous knowledge development and good documentation regarding health, safety and the environment in the petroleum activities is necessary, not least as a consequence of the technological development. Further development and follow-up of RNNP is an important measure in this context.

A continued commitment to research and innovation within HSE in the petroleum sector is still needed. There is a need for basic and applied research that contributes to new expertise, technology and innovation so as to prevent major accidents and improve health, safety and the environment in the petroleum activities. Development of knowledge and technology must remain a high priority for the future in the industry, in the organisations and in the companies.



Figure 2.1

## 2 The HSE regime in the Norwegian petroleum industry

The petroleum activities are an industry that has the potential for major accidents. Therefore, the activities are subject to stringent requirements for control and safety. Permission to conduct petroleum activity is regulated in detail through a comprehensive licensing system. The licensing system ensures that only players with the resources and expertise to operate in accordance with the regulations are granted access to the Norwegian shelf. It follows from the Petroleum Act that the activity must take place in a manner that ensures that a high level of safety can be maintained and developed in line with the technological development. It is a key regulatory requirement that the players must further develop and improve the HSE level. The continuous improvement requirement is based e.g. on the expectation that new knowledge will constantly emerge as a consequence of technology development, knowledge production and experience all through the life-cycle of the activity.

The HSE regulations stipulate strict requirements for goal achievement, but also allow freedom as regards which solutions are selected. Responsibility for the safety level lies with the industry itself, and the authorities' supervisory follow-up focuses on how the enterprises systematically follow up their own activities. Such an arrangement, where choices and decisions on a detailed level are made by the companies themselves, and the authorities' supervision comes in addition to the companies' follow-up, facilitates innovation and flexibility in the development and selection of good solutions. To ensure that this latitude is exploited in the best possible way, the key players must have mutual trust and respect for each other. The Ministry of Labour and Social Affairs and the Petroleum Safety Authority have regulatory responsibility for safety, preparedness, working environment and security in all phases of the petroleum activity. The Ministry of Petroleum and Energy and the Norwegian Petroleum Directorate have regulatory responsibility for resource management. There is a clear division of roles and responsibility between the Ministry of Labour and Social Affairs and the Ministry of Petroleum and

Energy in the work to follow up the industry. Through the current licensing system, the authorities, with two different roles, contribute to ensuring that we have professional and competent players on the Norwegian shelf.

### 2.1 Regulations

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The Petroleum Act sets the framework and the overarching safety requirements for the Norwegian petroleum activities. The Working Environment Act is the statutory basis for the general working environment requirements. More detailed regulations are found in the working environment regulations and in the special HSE regulations for the petroleum activities. The overall regulations for health, safety and the environment in the petroleum activities on land and on the shelf have been drawn up in close cooperation between the authorities and the parties in the industry.

#### 2.1.1 The licensing system and the framework for the activity

The Norwegian petroleum activities are regulated through statutes and regulations which entail that all key activities in all phases of the petroleum activity require licences, consents and approvals from the authorities. The system helps to provide the authorities with good management and control over the petroleum activity, from exploration for petroleum deposits, through development and production to cessation of the activity.

Before licences can be awarded under the Petroleum Act, the Storting must open the area in question for petroleum activity. The Ministry of Petroleum and Energy conducts an impact assessment as a basis for the authorities' decision for whether or not petroleum activity should be established in the relevant area. Commercial and environmental effects of the petroleum activity, pollution hazards and the economic and social impact of the petroleum activity are key assessments in this process. The question of opening new areas must be submitted to local authorities and key

### Box 2.1 Prequalification

Prequalification is an advance assessment of players that want to carry out petroleum activity on the Norwegian shelf. The final assessment of the company takes place when the company joins a production licence, either through licensing rounds or transfer.

The objective of the prequalification system is to contribute to predictability for new companies that want to enter the Norwegian shelf, in that they undergo an advance assessment of whether the company is suitable for the Norwegian shelf. The safety authorities, led by the Petroleum Safety Authority and the Ministry of Labour and Social Affairs, provide their expert assessments to the Ministry of Petroleum and Energy. Applications for prequalification are decided by the Ministry of Petroleum and Energy.

### Box 2.2 The players

#### *Licensee:*

Physical or legal person, or several such persons, who hold a licence for exploration, production, transport or utilisation of petroleum.

#### *Operator:*

The party who, on behalf of all licensees, is responsible for daily management of the petroleum activity in a production licence.

#### *Contractor and supplier:*

Delivers goods and services within various areas, such as engineering of facilities, operation of mobile facilities, drilling, well service, maintenance and equipment.

special interest organisations that must be presumed to have particular interest in the matter. The comprehensive management plans for each individual sea area must facilitate value creation while also maintaining the environmental values in the sea areas. The comprehensive management plans are submitted as separate reports to the Storting.

Access to petroleum resources on the Norwegian shelf requires a production licence. A production licence grants exclusive rights to the licensees for surveys, exploration drilling and production of petroleum deposits within the area covered by the licence. The award of production licences is made based on a specific set of criteria that are rooted in the EU's licensing directive, including the applicant's geological and technological capacity and financial strength<sup>1</sup>. The authorities' experience with the applicants is a key element in the assessments. Emphasis is placed on awarding production licences to multiple licensees, so that they can share knowledge and follow up each other's responsibilities. There are special requirements that apply to the

composition of a production licence, with particular requirements for expertise and operational experience in connection with activity in the Barents Sea, in deep waters, or in fields with high pressure and/or high temperature. One of the licensees is designated to be the operator. The operator is responsible for daily management of the activity on behalf of the licensee group, and has the primary responsibility for ensuring that the activity takes place in a prudent manner, in accordance with the regulations. The other licensees have a duty to ensure that the operator complies with requirements, including requirements in the health, safety and environment legislation.

The Ministry of Petroleum and Energy is responsible for implementing licence awards. In this work, the Ministry of Petroleum and Energy procures expert safety assessments from the Ministry of Labour and Social Affairs. Production licences are awarded by the King in Council.

Ownership interests in production licences can be transferred between companies. Such transfers can alter the composition of the licensee group and require consent from the Ministry of Petroleum and Energy. This is also true for transfer of operatorship, and such applications for consent are submitted to the Ministry of Labour and Social Affairs for assessment.

<sup>1</sup> There are two equivalent types of licensing rounds on the Norwegian shelf: the numbered rounds and awards in pre-defined areas (APA). The numbered rounds comprise immature parts of the shelf, and are normally carried out every other year. APA comprises the mature parts of the shelf and are carried out every year.

### Box 2.3 PDO and PIO

PDOs deal with the development of a petroleum deposit, or multiple petroleum deposits together (development part), and the consequences the planned development measures will entail (impact assessment).

A PIO is a plan for construction, placement, operation and use of facilities for petroleum activity, including shipping facilities, pipelines, cooling facilities, facilities for generation and transmission of electricity and other facilities for transport or utilisation of petroleum.

If the licensees in a production licence agree to develop a petroleum deposit, they must submit a Plan for Development and Operation (PDO) to the authorities for approval. The plan must contain information on how the licensees will develop and operate the field. It may also be necessary to submit a Plan for Installation and Operation (PIO), see fact box 2.3. The Ministry of Petroleum and Energy coordinates the authorities' processing of PDOs/PIOs and submits the plan to the Ministry of Labour and Social Affairs to obtain an assessment of whether the proposed development solution is considered to be suitable as regards safeguarding requirements related to health, safety and working environment. Based on the application and input from applicable authorities, the Ministry of Petroleum and Energy approves the application, with conditions, if relevant. Developments that have a total cost in excess of NOK 20 billion, or that have significant principle or social aspects, are submitted to the Storting prior to approval.

Before the licensees can start production of petroleum, they must secure consent to use facilities or onshore facilities from parties such as the Petroleum Safety Authority. Consent from the Petroleum Safety Authority is also required for a number of other activities in all phases of the petroleum activity, e.g. for exploration drilling and use of production facilities beyond the assumed lifetime.

Well in advance (two to five years) before use of a petroleum facility finally ceases, the licensees must submit a cessation plan. The plan must include a proposal for continued production or shutdown of production and disposal of the facil-

ity. If the facility will not be used for further production, the assumption is that it must be removed. Among other things, the cessation plan shall describe HSE factors associated with the actual removal operation on the field, and the measures that are implemented to ensure sound and prudent health, safety and environment conditions. The Ministry of Petroleum and Energy coordinates the processing of the cessation plan, and obtains statements from affected ministries before the proposed disposal resolution is submitted for processing in the Government and the Storting, if relevant.

### 2.1.2 Prudent activity requirement

It follows from the Petroleum Act that the petroleum activity shall take place in a prudent manner. The licensee's organisation in Norway must have a structure and a size suitable to ensure that the licensee can make well-considered decisions regarding the activity at any given time. The Petroleum Act also stipulates that the petroleum activity shall take place in a manner that ensures that a high level of safety can be maintained and developed in line with the technological development, and that security measures to prevent deliberate attacks are initiated and maintained. The special HSE regulations for the petroleum activity also stipulate requirements for a high level of HSE, and that this level must be further developed.

The responsibility for following up the regulatory requirements is unequivocally placed with the industry. The players are obliged to establish the necessary management systems to ensure compliance with the regulations in all phases of the activity. This entails that the activity must be organised such that it is planned, executed and maintained in accordance with the authorities' requirements. Follow-up by the authorities must come in addition to, and not as a replacement of, the players' own follow-up.

In addition, the operator that manages daily operation of the activity on behalf of the licensees has a special obligation to ensure that all parties that perform work on its behalf comply with the regulations and conduct prudent activity (the duty of care). The operator's management system must state how this duty of care is safeguarded. This responsibility entails that the operator must verify that the contractual partners are competent and qualified, both prior to and during contract signing, and in connection with execution of the activity. The operator must

also follow up the contractual partners and verify that the facilities and equipment that are used and the work that is performed maintain a prudent standard. The other licensees must ensure that the operator fulfils its obligations. The licensees must follow up the operator in a systematic manner, and the licensees' management systems shall state how the duty of care is safeguarded.

### 2.1.3 Development of the HSE regime

The current HSE regime was developed on the basis of experience gained since the beginning of the Norwegian petroleum activity. Various incidents and investigations, as well as extensive dialogue with the parties, have been important in this development. In particular, the Alexander Kieland accident on 27 March 1980 in which 123 people lost their lives, led to comprehensive changes in both the regulations and the supervision scheme in Norway. From regulations with detailed specification of requirements for structures, technical equipment and operations, the authorities developed regulations largely based on functional requirements that emphasise the players' responsibility to set the criteria for, and follow up, their own activity. Supervision of the activity, which was initially characterised by extensive detailed verification on the part of the authorities, has gradually developed into a system that focuses on accountability for the players, and how the players systematically follow up their own activity. This type of approach on the part of the authorities is important in an industry characterised by a high level of expertise and very rapid technological development.

### 2.1.4 Function-based requirements and use of standards

The HSE regulations for the petroleum sector are mainly formulated as functional requirements. Functional requirements indicate which results must be achieved, without describing how. The objective of the function-based approach is e.g. to avoid detailed provisions and to focus on the player's responsibility to find solutions, and through this, to facilitate flexibility in the selection of methods, approaches and technology development. Nevertheless, the regulations are more prescriptive in certain areas. Prescriptive provisions are mainly used to govern areas where a specific solution is desirable,

or to eliminate any doubt regarding minimum requirements.

The guidelines to the HSE regulations refer e.g. to various industry standards as ways of fulfilling the regulatory requirements. The guidelines to the regulations are not legally binding, and the players can therefore choose other solutions. If the responsible player chooses to use the recommended solution, it can normally be assumed that the regulatory requirements have been satisfied. If other solutions are used, such as for example other standards or company-specific procedures, the player must be able to document that the selected solution fulfils the regulatory requirements. It is presumed that the regulations and the guidelines are viewed in context in order to achieve the best possible understanding of the desired level one seeks to achieve through the regulations.

Good interaction, dialogue and trust between the authorities and the companies are preconditions for ensuring that functional regulations can function in practice. This demands that the players fulfil their responsibility to develop good solutions.

The NORSOK<sup>2</sup> standards are developed in cooperation between the players in the petroleum activities, and are jointly owned by Norwegian Oil and Gas Association, the Federation of Norwegian Industries and the Norwegian Shipowners' Association. Roles and responsibilities are regulated through an owner and order agreement where Standards Norway manages the standards and conducts administration of the work on behalf of the owners. The petroleum industry has devoted significant resources to developing the NORSOK standards, and has contributed through participation in and management of international standardisation projects in, for example, CEN<sup>3</sup> and ISO<sup>4</sup>. The Petroleum Safety Authority participates actively in the standardisation work, and is a driving force in clarifying the role of the standards in the petroleum regulations. The standardisation work is financed through a collaboration between the industry and the authorities.

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<sup>2</sup> NORSOK: The Competitive Position of the Norwegian Shelf.

<sup>3</sup> CEN is the EU's official standardisation organisation that develops and maintains European standards and specifications.

<sup>4</sup> International Organization for Standardization (ISO) is an international standardisation organisation that issues standards within a number of areas.



## 2.2 The Petroleum Safety Authority's supervision

### 2.2.1 The Petroleum Safety Authority

The Petroleum Safety Authority (PSA) is a professionally independent supervision and administrative body that reports to the Ministry of Labour and Social Affairs. The PSA is responsible for safety, the working environment, preparedness and security in the petroleum activities on the shelf and at eight onshore facilities. The PSA's area of responsibility encompasses all phases of the activity, such as planning, engineering, construction, use and potential subsequent removal. The PSA also supervises the players' management systems and preventive work aimed at deliberate attacks, as well as incidents and conditions that can lead to acute pollution. Undesirable incidents are prevented in the same way, regardless of whether they can lead to injury to people, acute pollution and/or loss of financial assets. Therefore, the safety work and accident prevention protect a number of different assets.

The supervision includes all activities that provide the PSA with a basis for assessing whether, and following up to ensure that, the companies conduct the activity in line with regulatory requirements. The most visible part of the supervision takes place on installations, onshore facilities or construction sites. However, the supervision also includes following up the industry in all phases of the activity, processing of applications and consents, data acquisition regarding accidents and incidents, investigations and processing of specific cases, as well as follow-up and possible use of formal sanctions. Each year, the PSA also conducts a number of activities targeting shared challenges in the industry. The primary purpose of such activities is to obtain a good basis of knowledge and an up-to-date risk picture of the safety and working environment challenges, to communicate new knowledge and to prepare audits of the respective players.

### 2.2.2 Audits at specific milestones

The Petroleum Safety Authority actively supervises the companies in connection with various milestones as regards safety and working environment, cf. Chapter 2.1. This follow-up creates predictability and lays the foundation for a trust-based relationship between the PSA and the industry.

In connection with prequalification applications, the PSA performs thorough assessments of

the applicant's HSE management system, HSE competence and HSE capacity. Prequalification forms the basis for the PSA's subsequent supervision of the enterprise, including assessments of applications for production licences, approval of development plans and applications for consent.

In its assessment of applications for production licences, the Petroleum Safety Authority evaluates the applications in relation to the award criteria within the HSE area.

After awarding production licences, the PSA evaluates the companies applications for consent to conduct exploration drilling. In order to secure consent, the operator must document that the planned drilling activities can be carried out in accordance with the regulations. As part of this application, the

### Box 2.4 Acknowledgement of Compliance (AoC)

All mobile facilities that are registered in a national ships' register and that are not operated by the operator must have an Acknowledgement of Compliance from the Petroleum Safety Authority in order to participate in petroleum activity on the Norwegian shelf. This arrangement was introduced, in part, based on the shipowners' desire for greater predictability.

The Acknowledgement of Compliance includes an assessment of the technical condition of the installation, as well as the applicant's organisation and management system. The PSA also undertakes its own verifications in connection with applications for acknowledgement of compliance.

The Acknowledgement of Compliance is not an approval, but a statement from the PSA that expresses the authorities' confidence that petroleum activity can be carried out with the facility within the framework of the regulations.

Knowledge of and compliance with the regulations has developed in a positive direction after the AoC system was established. Feedback from the industry confirms that the process of applying for an AoC leads to higher competence and better knowledge regarding the technical condition of the facility.

An AoC does not confer the right to initiate petroleum activity, but is part of the application for consent.

operator must e.g. submit analyses and assessments of health, safety and environment for the activities. The mobile installation that the operator chooses to carry out the exploration activity must also have an Acknowledgement of Compliance from the Petroleum Safety Authority (see fact box 2.4).

For an application for approval of a PDO or PIO, the PSA assesses whether the planned solutions satisfy the requirements in the HSE regulations, and whether the operator has systems in place to manage the activity in line with the regulations. The PSA also supervises the companies' systematic work to use new knowledge and technology, so the selected solutions yield the best possible results in a long-term perspective. The opportunity to exert influence is substantial in the planning phase. After the players have submitted the development plans, the possibility of major adjustments is limited, and more time-consuming. Therefore, audits of development projects are a prioritised activity for the PSA.

Before installations and facilities can be put to use, the operator must acquire a new consent from the Petroleum Safety Authority. Consent is also required e.g. for major modifications, manned sub-sea operations, use of production facilities beyond the presumed lifetime and removal of facilities. The consent scheme contributes to ensuring that the PSA is involved in key decisions in the activity. Issuance of a consent is not an approval, but an expression of the authorities' confidence that the operator can conduct the activity within the regulatory framework and in accordance with the information provided in the application for consent.

### 2.2.3 Supervision strategy and use of policy instruments

The Petroleum Safety Authority's supervision of the activity is system-oriented and risk-based. Sys-

tem-based supervision targets the relevant parts of the companies' management systems and any subsequent verifications. A risk-based supervision entails that the supervision targets players or facilities where the HSE conditions are the most challenging and critical, where there are factors that can result in increased risk of undesirable incidents or conditions, and where the Petroleum Safety Authority's efforts will have the greatest effect. Correspondingly, areas and topics with the highest risk of undesirable incidents or conditions are also prioritised, i.e. serious consequences and/or a high degree of uncertainty.

High-risk groups have been an important focus area since 2007 as part of the PSA's risk-based supervision. High-risk groups are groups of personnel in the petroleum industry that face special challenges in their working environment; for example, employees who work within insulation, scaffolding and surface treatment, catering, as well as certain groups within drilling and well activity.

Audits of individual players are just one part of the Petroleum Safety Authority's overall supervision activities. Activities that are aimed at all or parts of the industry are also an important part of the supervision. Examples that can be mentioned here are audits of well control and hydrocarbon leaks. In these areas, a number of activities have been carried out aimed at all or parts of the industry, in addition to normal supervision tasks.

The Petroleum Safety Authority utilises different instruments in its supervision of the industry. The purpose of using policy instruments is primarily to influence the companies to initiate effective and long-term preventive measures or to handle acute hazard situations. Therefore, the most frequently used instruments are dialogue and interaction. The dialogue relates to how requirements are to be interpreted and complied with, as well as

Table 2.1 Overview of number of audits and verifications and the PSA's use of notifications of orders, orders, compulsory fines and halting of work

	2012	2013	2014	2015	2016	2017
Audits and verifications	223	125	172	200	196	189
No. notifications of order	6 <sup>1</sup>	12	3	1	7	11
Number of orders		9	3	1	7	9
No. of coercive fines and halting of work	0	0	0	0	0	1
Number of administrative fines <sup>2</sup>			0	0	0	0

<sup>1</sup> Number of notifications of order and orders were reported together for 2012.

<sup>2</sup> Administrative fines for violations were introduced as a policy instrument from 1 January 2014.

obtaining and exchanging knowledge and information. The PSA can send letters to the industry to provide information about audit experiences, research, etc. This can be used as an instrument to urge the industry to initiate activities or carry out HSE measures based on experience and new knowledge. The PSA can also utilise formal sanctions such as orders, when necessary. An order is considered to be a strong reaction from the PSA, and is an instrument that is rarely used. When special reasons so dictate, for example if hazard and accident situations should arise that threaten safety, the PSA can also use even stricter sanctions, such as halting the activity or imposing coercive fines to ensure that an order is carried out. In the event of serious and repeated breaches of the working environment regulations, the company can also be subject to administrative fines. So far, the PSA has not reported incidents to the police, but it does maintain close contact with the police, particularly in connection with serious incidents. It is not deemed necessary for the PSA to officially report incidents that the police are already investigating.

The Petroleum Safety Authority publishes all of its audit and investigation reports in an effort to achieve an open attitude and insight into the petroleum activities, and thus contribute to learning and improvement all across the industry. Therefore, all of the players in the activity, and the public sector in general, can obtain insight into how the companies comply with the regulations and how the supervisory authorities can monitor and follow this up.

Table 2.1 shows the number of audits and verifications carried out during the period 2012–2017. Variations in the number of audits and verifications conducted from one year to another are mainly due to variations in the scope and complexity of the individual audit and verification activities. The table also provides an overview of the PSA's use of formal policy instruments during the period from 2012 to 2017. As can be seen, there is little use of formal policy instruments in relation to the individual player. Reference is also made to Chapter 5.2 regarding the authorities' follow-up.

#### **2.2.4 Investigation – follow-up and lessons learned after incidents and accidents**

Investigation of undesirable incidents is an important part of the Petroleum Safety Authority's risk-based supervision activity. Such investigations come in addition to the investigations the

#### **Box 2.5 What is an investigation?**

An investigation is an in-depth look at the player's management system, organisation and practices within a specific work operation and/or a field. Investigations are an important part of the PSA's comprehensive risk-based follow-up of the petroleum activities. The results of investigations are an important supplement to other information the PSA acquires through the more routine follow-up of the activity, and from RNNP.

involved parties undertake on their own initiative. The objective is to clarify the causes, the course of events and actual and potential consequences, as well as to develop knowledge that can contribute to preventing similar incidents from recurring. The PSA itself builds up significant expertise and experience through investigations.

The number of investigations varies from year to year. The severity of the incident is the most important criteria for a decision to investigate. Learning potential is another important element in the assessment. In some situations, the resource situation in the PSA can also affect the selection of method and mandate for the investigation.

The following incident categories will normally qualify for implementing an investigation under the direction of the Petroleum Safety Authority:

- Major accident or near major accident
- Serious injury or fatality in connection with work accident
- Serious impairment or loss of safety functions and barriers that can endanger the integrity of the installation or the onshore facility
- Incidents which the police investigate and where the PSA assists the police

The industry players also carry out their own investigations and in-depth studies of incidents. Both the criteria and the process for investigation vary from player to player.

Consideration has been given to whether a permanent commission should be established for independent investigations of accidents and serious incidents in the petroleum sector. The Storting has considered the issue in connection with processing Storting reports on HSE in the

**Box 2.6 Follow-up after the Deepwater Horizon accident**

On 20 April 2010, there was a blowout, explosion and fire on board the mobile facility Deepwater Horizon on the Macondo field in the Gulf of Mexico. Eleven people lost their lives, several suffered serious injuries and the installation sank after two days. More than 4 million barrels of oil flowed uncontrollably from the well before the leak was finally stopped after 87 days.

After this accident, the Petroleum Safety Authority has devoted substantial resources towards reviewing investigation reports with the purpose of gaining lessons for Norwegian petroleum activities. This work was summarised in a main report in 2011 and a closing report in 2014. Follow-up of the accident has included the following:

- Updating drilling and well standards
- Development of capping equipment to enable shut-in of blowouts
- Development within barrier and risk management

The PSA has also worked with supervision authorities in other countries with regards to the follow-up, and has contributed with experience from the Norwegian supervision and regulatory system to the US' authorities investigation of the incident.

petroleum activities<sup>5</sup>. The Petroleum Safety Authority's investigations are an important part of the control and risk-based follow-up of the companies, and the agency's strong role in connection with investigations has been regarded as important. At the same time, there may be a need in some cases for a review by an independent investigation commission, of not just the course of events, but also the regulations and the roles of both the operators and the authorities. To facilitate effective initiation of such ad hoc commissions, what was then the Ministry of Labour made an agreement in 2010 with the

Accident Investigation Board in Norway regarding practical assistance if it becomes necessary to appoint an independent investigation commission in the petroleum sector. So far, this arrangement has not been used.

Through the established cooperation with other international HSE authorities, information is e.g. exchanged with the objective of sharing experience and learning. Follow-up of the Deepwater Horizon accident in the Gulf of Mexico in 2010 has contributed to learning across international borders, cf. Box 2.6.

**2.2.5 Cooperation with other national authorities**

The Petroleum Safety Authority is the coordinating agency for regulatory development and supervision of HSE in Norwegian petroleum activity. This coordination system was established in 1985 and further refined in connection with the establishment of the Petroleum Safety Authority in 2004. The system was then expanded to also include onshore facilities subject to the PSA's jurisdiction.

*The coordination system* comprises authorities with an independent supervision responsibility for the petroleum activity, and applies to fields of responsibility that require cooperation on the part of the authorities, including regulatory development, follow-up of incidents and coordination of the supervision. The coordination system shall contribute to ensure comprehensive and coordinated supervision by the authorities, but does not intervene in the formal roles and responsibilities of the various authorities.

The coordination system has been discussed in a number of previous Storting reports. Storting Report 29 (2010–2011) *Joint responsibility for good and decent working life*, pointed out that there is still a potential for improving HSE cooperation between the authorities. The Petroleum Safety Authority's experience is that the cooperation between the agencies largely functions well, and in accordance with the cooperation agreements.

*The assistance system* entails cooperation with other agencies that do not have independent authority in planning and carrying out supervision, but that do have special expertise in relevant fields.

The PSA has also entered into cooperation agreements with parties including the Norwegian Petroleum Directorate and the Police and prosecuting authorities.

<sup>5</sup> Storting Report No. 7 (2001–2002) *On health, safety and the environment in the petroleum sector* and Storting Report No. 12 (2005–2006) *On health, safety and the environment in the petroleum sector*

**Box 2.7 Coordination and assistance system**

*The offshore coordination system includes:*

- Petroleum Safety Authority
- Norwegian Environment Agency
- Norwegian Board of Health
- Norwegian Radiation Protection Authority

*The onshore facility coordination system includes:*

- Petroleum Safety Authority
- Norwegian Environment Agency
- Norwegian Board of Health
- Norwegian Radiation Protection Authority
- Norwegian Communications Authority
- Norwegian Coastal Administration
- Norwegian Industrial Safety and Security Organisation

*The assistance system includes:*

- Petroleum Safety Authority
- Norwegian Labour Inspection Authority
- Norwegian Directorate for Civil Protection
- Norwegian Coastal Administration
- Civil Aviation Authority
- Norwegian Meteorological Institute
- Norwegian Communications Authority
- Norwegian Labour and Welfare Service
- Norwegian Maritime Authority
- National Institute of Occupational Health
- Norwegian Board of Health

**2.2.6 International cooperation**

Treaties and agreements have been entered into with the authorities in a number of countries in order to facilitate comprehensive follow-up and exchange of experience across shelf borders, for example as regards to cross-border pipelines and transboundary reservoirs. Several cooperation arenas have also been established, such as North Sea Offshore Authorities Forum (NSOAF) and International Regulators Forum (IRF). The Petroleum Safety Authority also has extensive bilateral cooperation with the HSE authorities for example in the United Kingdom, the Netherlands and Denmark. On 24 April 2015, the Arctic Council

adopted a framework agreement on cooperation to prevent oil pollution from petroleum activity and maritime transport. The paramount objective of such cooperation is to improve safety on the various countries' continental shelves through exchanging information and promoting a common understanding of health, safety and environment issues. The Arctic Offshore Regulators Forum (AORF) was founded as a consequence of this framework agreement.

**2.3 Cooperation and participation**

Participation and cooperation among the parties are key preconditions and important arenas for the HSE regime in the petroleum industry. The regime presumes mutual trust and respect among the key players. This applies both to employee participation at the company level, as well as in the various arenas for tripartite cooperation.

Pursuant to the Working Environment Act, employees have both a right and an obligation to participate in ensuring a sound and prudent working environment, and employers are obliged to facilitate such participation. The statute also stipulates requirements for safety work and employee representation in working environment committees. Company legislation stipulates more detailed requirements for employee representation in company boards.

Furthermore, both formal and informal arenas exist for two-party cooperation between the employees and their organisations on the one side, and the employers and their organisations on the other side. The collective wage agreements are the foundation for this two-party cooperation.

In addition to the established two-party cooperation, there is also broad tripartite cooperation between the parties and the authorities in the petroleum industry, in a number of different arenas.

**2.3.1 Tripartite arenas***Safety Forum*

The Safety Forum was established in the autumn of 2000 and is made up of representatives from the authorities, employers and employees. The Petroleum Safety Authority heads the Safety Forum and has the primary task of promoting work on safety and working environment in the Norwegian petroleum activities through:

- Being a forum for discussing and following up relevant safety and working environment issues
- Facilitating good cooperation between the industry parties and the authorities
- Being a reference group for projects that have been initiated or planned by the parties or the authorities

Through the work in the Safety Forum, key issues can be identified in a joint effort, and the parties can discuss how the issues can be resolved. The Forum is also used actively to share knowledge across the industry, and to discuss strategy and priorities in the HSE work. Everything that takes place in the Safety Forum is documented and made easily accessible for others who do not participate directly in the Forum. This contributes to open and binding processes. Several important processes for continuous improvement of HSE in the petroleum activities over the years have their roots in the Safety Forum.

#### *Regulatory Forum*

The Regulatory Forum was established in 1986 and is also led by the Petroleum Safety Authority. In the Forum, the parties have an opportunity to follow the regulatory work on an ongoing basis, and to express opinions on important proposals. This leads to a greater degree of ownership and consensus as regards to final proposals for development of the regulations. The Forum also helps to clarify differences and similarities between the activity onshore and offshore.

The Regulatory Forum shall facilitate:

- Information, discussion, advice and possible feedback on the work to develop and maintain the regulations for petroleum activity
- Information and discussion on the practical implementation and use of the HSE regulations

#### *Working Together for Safety*

Working Together for Safety was established in 2001 as an arena for cooperation where the industry parties participate and the Petroleum Safety

Authority is an observer. Among other things, Working Together for Safety prepares training and information material in the form of safety films and specific recommendations for “best practice” for the industry.

#### *Sector board for petroleum industry standardisation*

The sector board for petroleum standardisation is appointed by Standards Norway’s board, and is a link between Standards Norway and the owners and users of the petroleum standards. Important tasks for the sector board include contributing to user-controlled, effective standardisation work in accordance with Standards Norway’s goals, general plans and strategy.

#### *Regulatory competence*

Regulatory competence is a training programme for the petroleum industry. Regulatory competence offers its courses through BI Norwegian Business School, which is responsible for organising the educational aspect. Regulatory competence is currently an active tripartite collaboration that has adjusted its training programmes in line with ongoing regulatory development. To date, more than 15 000 people have completed training under the direction of Regulatory Competence.

#### *Committee for helicopter safety on the Norwegian continental shelf*

Helicopter transport is not petroleum activity per se, but has a close link as part of the overall activity on the shelf. The Committee for helicopter safety on the Norwegian continental shelf works to enhance helicopter safety offshore. The Committee is led by the Norwegian Civil Aviation Authority and is composed of representatives from the authorities, the helicopter operators, the oil industry, Avinor, the trade unions and others who are involved in offshore flights. The Committee makes recommendations and gives statements to other players, for example through joint consultation comments to the authorities.





Figure 3.1



## 3 The petroleum industry

Chapter 3 provides an overview of the development within selected areas of the Norwegian petroleum industry in recent years.

### 3.1 Operations concepts

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There are several different operations concepts on the Norwegian shelf and new solutions are being developed. The current solutions vary from subsea wells and simple wellhead platforms to integrated drilling, production and living quarters facilities.

Many fields on the Norwegian shelf have access to infrastructure with available capacity that can be utilised in the development of new fields. This has resulted in some new fields being tied in to existing facilities.

There are several production facilities on the Norwegian shelf that are normally unmanned, and that are only staffed in connection with maintenance. Such facilities currently in operation on the shelf have helicopter decks. The first *simple facility without a helicopter deck* has now been installed on the Oseberg field through the Oseberg Vestflanken 2 development project, but has not yet started production. Special ships have been developed in recent years with gangways that can also be used to staff such facilities. Mobile gangway solutions that can be installed on various types of existing offshore vessels have also been developed. These types of solutions are often called “walk to work” (W2W). Simpler facilities without helicopter decks are an alternative for some future developments.

*Integrated operations* is a term that comprises everything from video conferences between offshore and onshore and suppliers’ monitoring of equipment, to moving control rooms onshore. Integrated operations have been applied on the Norwegian shelf for many years. Establishing higher quality data communication between facilities on the shelf and land has enabled closer cooperation between experts onshore and operations personnel on the shelf. This has resulted in tasks previously performed on the facilities being

moved onshore. For several new fields, the solutions facilitate control room functions onshore in addition to control rooms on the facilities. For some facilities, the objective is to be able to monitor and provide operations support from land, while for others, the plan is to control the installation from land in its entirety, with the option of taking over control offshore. There is constant evaluation of which tasks could be moved onshore in connection with streamlining processes. The industry’s goal is to achieve safer and more efficient operations. Integrated operations have resulted in better exchange of information in real-time and have been implemented throughout large parts of the shelf.

The term *multipurpose vessel* is used in reference to advanced ships that can be used for multiple purposes. The multipurpose vessels are often specially designed for a specific activity segment, for example diving activities, but can also be used for other activities, such as construction, repair and maintenance activity.

Multipurpose vessels are not a separate ship category, but a collective term used to refer to vessels that can perform various supply and support functions. Multipurpose vessels are discussed in more detail in Chapter 4.6.2.

### 3.2 The player landscape

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Today we have a wide range of players on the Norwegian shelf. The changes in the player landscape are inter alia the result of a long-term and deliberate policy to promote competition and efficiency on the Norwegian continental shelf. This policy has contributed to a number of discoveries and field developments.

The current number of companies is somewhat less than just a few years ago. This is largely due to the restructuring that has taken place in the industry in recent years. The changes among the operating companies are largely related to mergers and acquisitions, and have e.g. led to more robust companies on the shelf. Medium-sized companies with an active

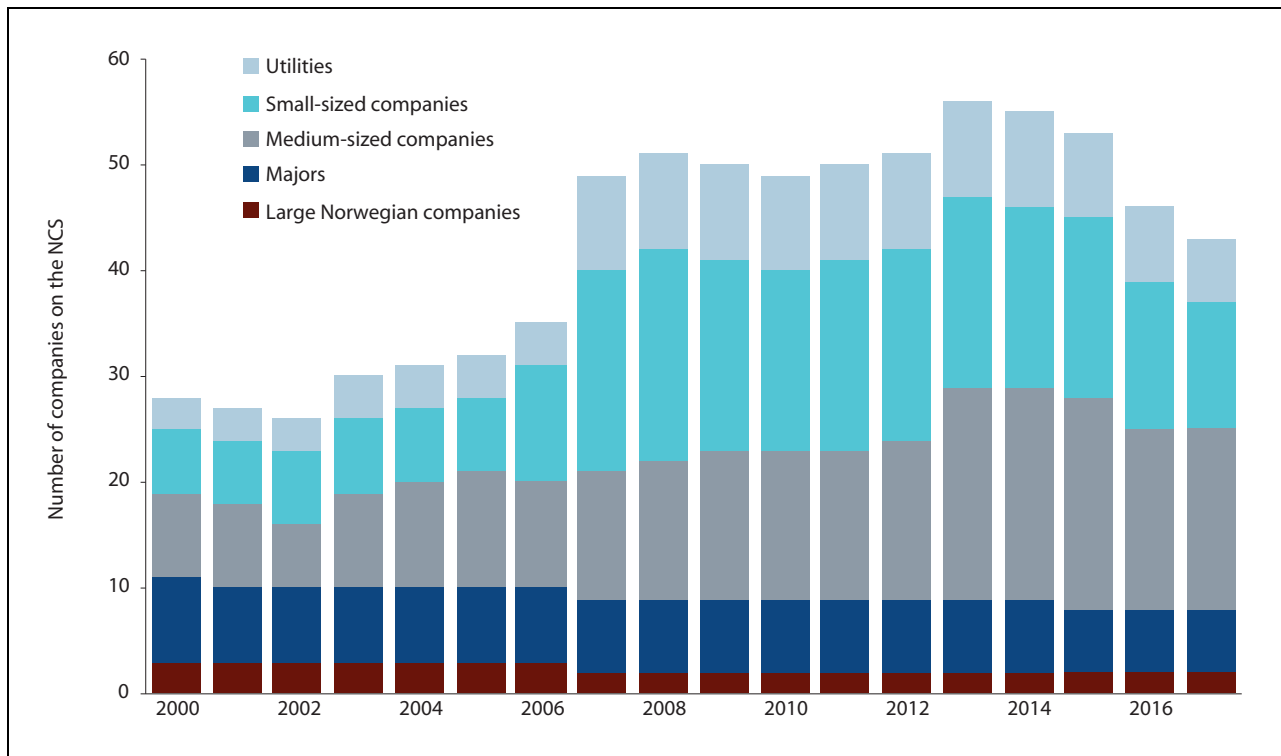


Figure 3.2 Number of players on the Norwegian shelf, distributed by size, 2000–2017

Source: [www.norskpetroleum.no](http://www.norskpetroleum.no)

commitment on the Norwegian shelf have, in particular, emerged stronger from this restructuring process, in part due to the opportunities that have opened up when some of the largest international oil companies have sold out of certain older fields.

One recent development is closer cooperation between the oil companies and the oil service companies in several of the new developments. Smaller companies are joining forces more often to lease drilling facilities, and hire in dedicated companies that handle planning and operational support on behalf of these companies.

Storting Report 29 (2010–2011) *Joint responsibility for good and decent working life*, pointed out the challenges associated with changes in the player landscape, including the fact that new players had weaker competence and capacity, and less financial strength as compared with the major oil companies with long traditions on the Norwegian shelf. This was one of the reasons that the existing Ministry of Labour in 2012 appointed an expert group to review the supervision strategy and HSE regulations in the petroleum activities, cf. Chapter 5. One of the conclusions of the expert group's report was that there is a need for a guide and facilitator function for

the HSE regime and the regulations in relation to new licensees. This has been followed up with the establishment of an HSE Forum under the direction of Norwegian Oil and Gas association, with objectives including transfer of experience and lessons for new licensees and smaller companies on the Norwegian shelf.

While the player landscape has become more diverse in the new millennium, Statoil is still clearly the largest player on the Norwegian shelf. The company is the operator for about 70 per cent of the Norwegian oil and gas production. However, Statoil is now responsible for a considerably smaller percentage of new field developments than was the case previously. Due to its position, Statoil is important for the level of HSE in the industry, and has great significance for the overall activity on the shelf.

### 3.3 Activity level

The petroleum industry is a cyclical industry. After a period of decline, there are now signs that the activity level is on the rise. The players in the industry have worked together to streamline operations, optimise development plans and reduce costs.

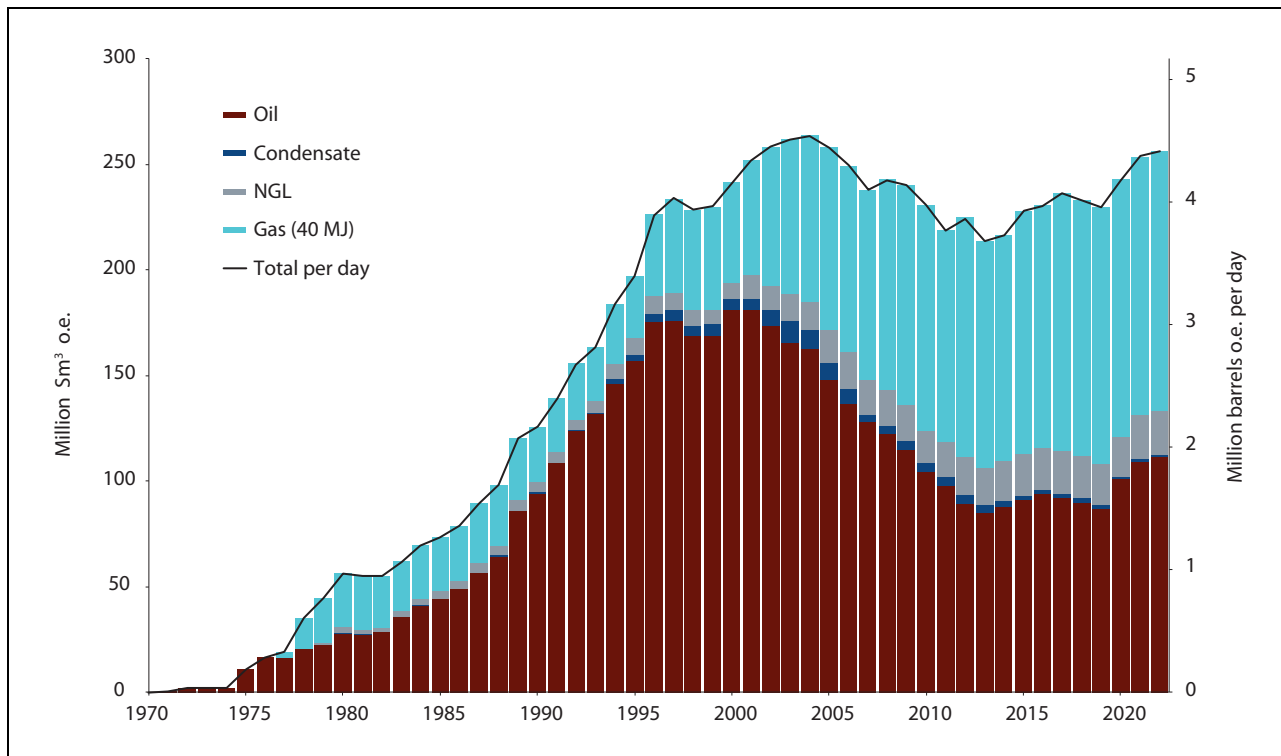


Figure 3.3 Historical and expected production of oil and gas in Norway, 1970–2022

Source: [www.norskpetroleum.no](http://www.norskpetroleum.no)

### 3.3.1 Production and reserves

Total petroleum production in 2017 was 236.4 million standard cubic metres of oil equivalents (Sm<sup>3</sup> o.e). Oil production in 2017 was somewhat lower than in 2016, but more gas was sold than ever before (122.0 billion Sm<sup>3</sup> gas). A moderate increase in petroleum production on the Norwegian shelf is expected for the next five years, mainly due to new fields coming on stream.

Over time, the number of producing fields on the Norwegian shelf has grown. Older fields are still producing, while new fields have been added. Nevertheless, total production has not increased because the production from the new fields has not been greater than the decline as a result of draining the resources in existing fields.

The resource accounts for 2017 indicate that 45 per cent of the total petroleum resources on the Norwegian shelf were produced by the end of 2017. Of the remaining resources, it is estimated that approx. 50 per cent are located in existing fields, ten per cent in discoveries not approved for development, while nearly 40 per cent have not yet been discovered. Nearly half of the remaining resources on the Norwegian shelf are expected to be situated in the North Sea. About one-third are expected to lie in the Barents Sea, while the

remainder are located in the Norwegian Sea. The situation is different for the estimated undiscovered resources. About two-thirds of these resources are located in the Barents Sea, while the rest are distributed between the Norwegian Sea and the North Sea.

### 3.3.2 Investments and exploration

The level of investment on the Norwegian shelf is high, but lower than the peak years 2012–2015. Development projects such as Johan Sverdrup have been important for development players in the industry after the decline in oil prices. Ten plans for development and operation (PDOs) were submitted in 2017 and submission of more development plans is also expected in 2018. Major investments are also being made in operating fields, in pipelines and onshore facilities. Over the longer term, the activity will depend on making new discoveries, developing existing discoveries and implementing improved recovery projects on existing fields.

Exploration activity has been stable over the last two years, despite lower oil prices. In 2017, 17 exploration wells were drilled in the Barents Sea, five in the Norwegian Sea and 12 in the North Sea. It is expected that the number of exploration

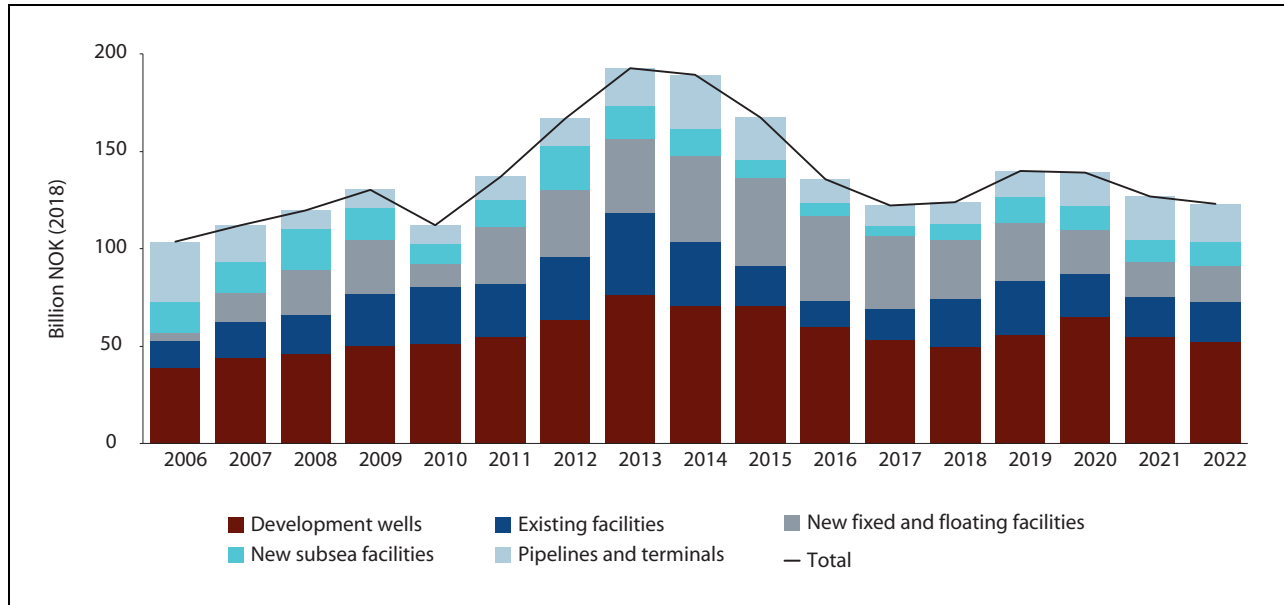


Figure 3.4 Investments on the Norwegian shelf distributed by main categories. Historical figures for 2006–2016 and forecast for 2017–2022

Source: www.norskpetroleum.no

wells in 2018 will be at about the same level as in 2017. Exploration activity on the Norwegian shelf is relatively high in a historical perspective.

### 3.3.3 Mobile facilities

After 2013, there has been a reduction in the activity with mobile facilities on the Norwegian shelf. Figure 3.5 shows the development in number of

days where mobile facilities have been in operation on the Norwegian shelf since 2000. The activity in 2017 was the lowest recorded since 2004. A gradual increase in activity is expected in 2018 and forward.

Of the 65 mobile facilities with an Acknowledgement of Compliance (AoC), 26 were active on the Norwegian shelf as of January 2018.

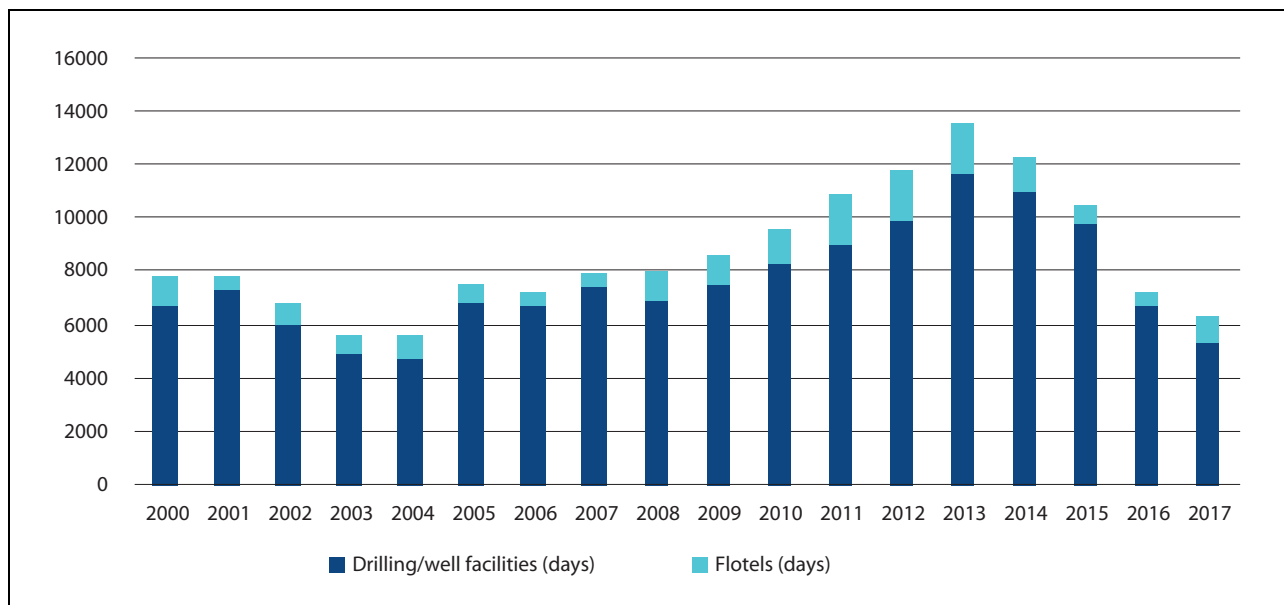


Figure 3.5 Development in rig days on the Norwegian shelf

Source: RNNP 2017

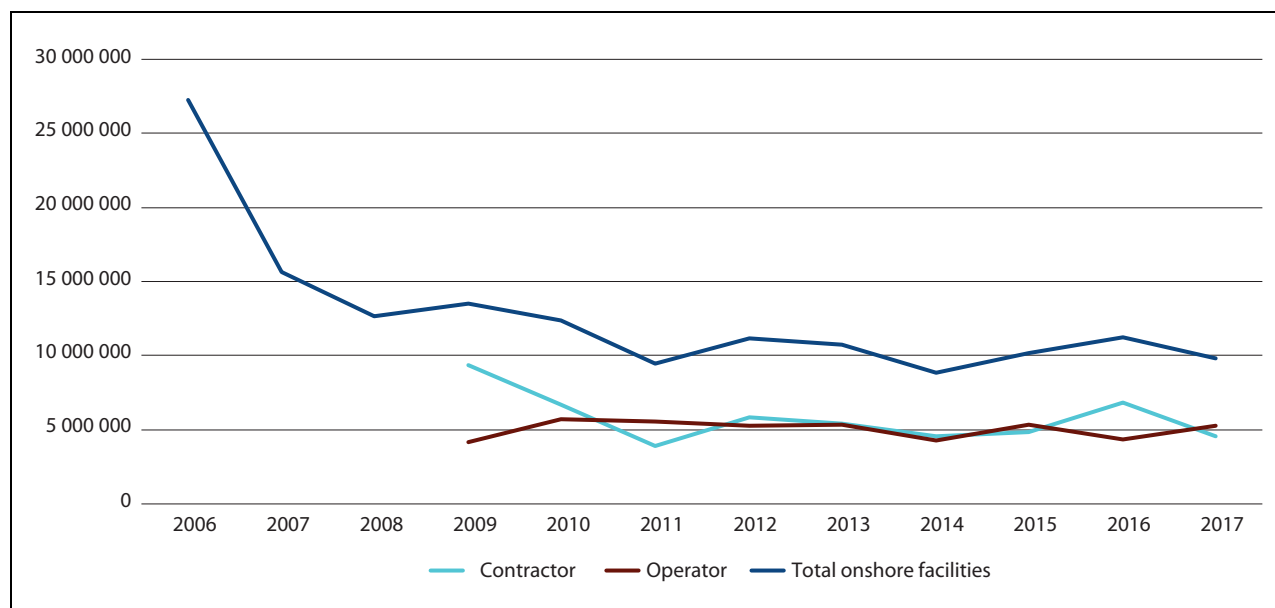


Figure 3.6 Development in hours worked distributed between operator and contractor employees in onshore facilities

Source: RNNP 2017

### 3.3.4 Onshore facilities

There are eight onshore facilities for landing and/or processing of oil or gas in Norway. The refineries, which mainly produce gasoline and diesel, were subject to significant changes in the market after the financial crisis in 2009, when surplus capacity and pressure on margins for refinery products entailed a need to adjust the activity. The other onshore facilities are also affected by both changes in oil price and by the market for gas products.

Figure 3.6 shows the development in hours worked distributed between operator and contractor employees in the onshore facilities.

### 3.3.5 Supplier industry

The supplier industry is Norway's second largest measured in turnover (after the sale of oil and gas) and consists of more than 1100 companies throughout the entire value chain: from seismic, engineering, drilling rig equipment, shipyard industry, advanced offshore supply and service vessels, as well as subsea technology. During the period from 2002–2013, the Norwegian supplier industry underwent a period of strong growth,

averaging 14 per cent per year. Sales in the supplier industry amounted to NOK 481 billion in 2015. In 2016, sales in the Norwegian-based supplier industry amounted to NOK 378 billion, of which 35 per cent in international markets<sup>1</sup>. Lower oil prices and a weaker market both internationally and in Norway has created a need for readjustment in the supplier industry.

### 3.3.6 Employment in the industry

In 2013, 232 100 employees in Norway could be linked to the petroleum industry, either as employees in the industry itself, or associated with suppliers or subcontractors to the industry. As a consequence of reduced investments in the petroleum industry, new estimates indicate that the number of employees associated with the industry was reduced to 183 800 in 2016, a decline of nearly 50 000 employees<sup>2</sup>.

<sup>1</sup> Report (2017). *International turnover from Norwegian oil service companies*. Report from Rystad Energy to the Ministry of Petroleum and Energy – 31 October 2017

<sup>2</sup> Statistics Norway, published 18 January 2017: <https://www.ssb.no/nasjonalregnskap-og-konjunkturer/artikler-og-publikasjoner/faerre-sysselsatte-knyttet-til-petroleums-naeringen>

**3.3.7 Permanent, temporary employee or contract hire**

The RNNP survey (cf. Chapter 4.2.1) maps whether employees offshore and at the onshore facilities have permanent or temporary employment, and whether they are contracted in to the company they work for. The mapping of contract hires offshore did not start until 2017. The results

show that the percentage of temporary employees and contract hires is considerably higher in contractor companies than in operating companies. Figure 3.7 shows the percentage of temporary employees and contract hires in contractor companies. Figure 3.8 shows the percentage of temporary employees and contract hires in operating companies.

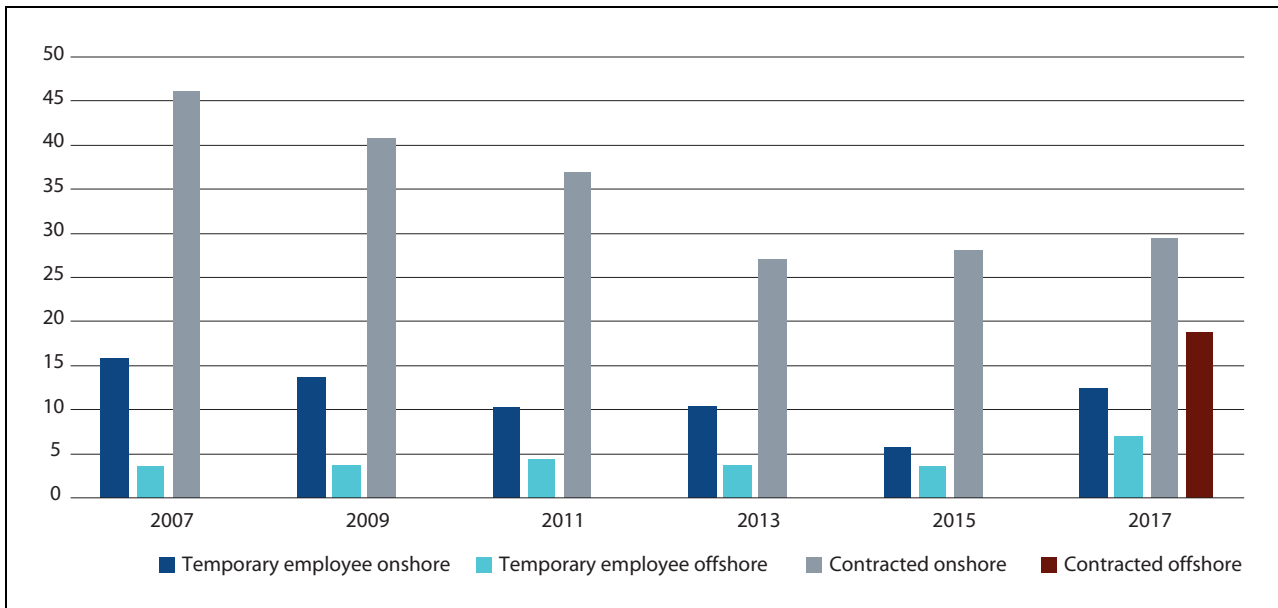


Figure 3.7 Percentage temporary employees and contract hires in contractor companies

Source: RNNP survey 2017

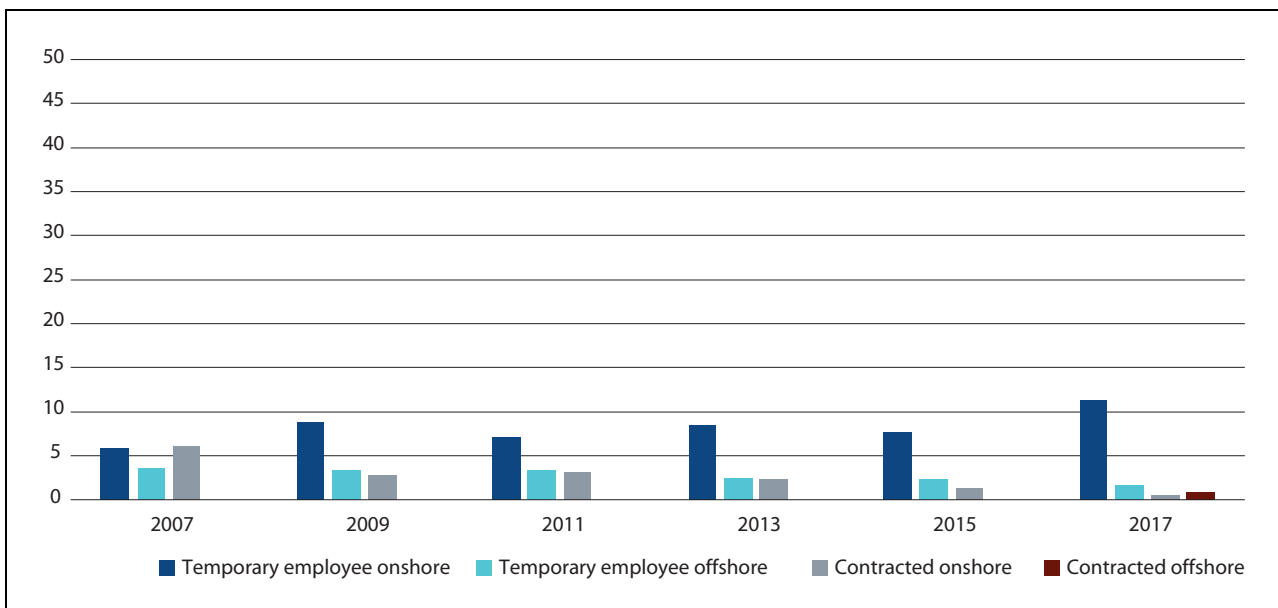


Figure 3.8 Percentage temporary employees and contract hires in operating companies

Source: RNNP survey 2017

**3.3.8 Hours worked on mobile facilities and production facilities**

Figure 3.9 shows the development in number of hours worked on production facilities, distributed between operator employees and contractor

employees, as well as the development in number of hours worked on mobile facilities. As can be seen from the figure, there has been a marked decline in the hours worked for contractor employees on production facilities and employees on mobile facilities in the period after 2014.

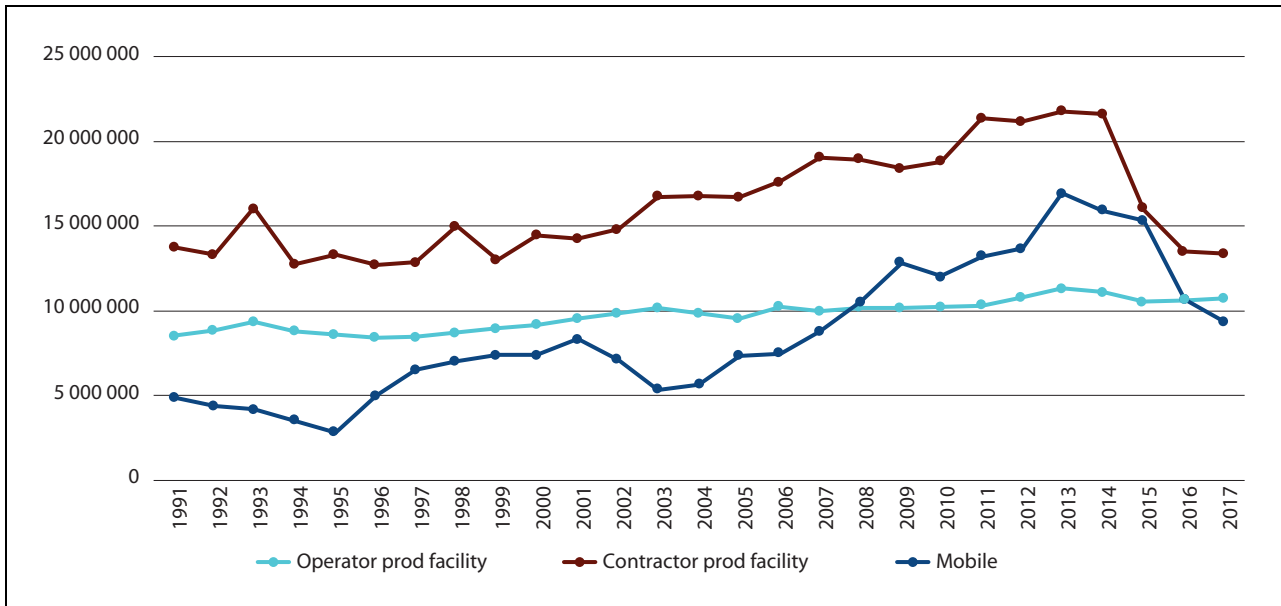


Figure 3.9 Development in hours worked distributed between mobile facilities and operator and contractor employees on production facilities

Source: RNNP 2017



Figure 4.1



## 4 Risk, development and follow-up

The petroleum industry is an industry with the potential for major accidents. Investigations from Norway and abroad show that major accidents often have a complex and complicated course of events, and that organisational factors can be strong contributors to the accidents.

In addition to the risk of major accidents, the petroleum activity on the shelf also faces challenges when it comes to working environment. The physical working environment is characterised by sometimes difficult weather conditions, shift systems, chemical exposure, noise and ergonomics challenges. The work is organised in complex operator-supplier chains, there is extensive cooperation between offshore and onshore, and many groups of employees rotate between different facilities, and between work onshore and offshore.

This chapter discusses risk, development and follow-up as regards major accidents and working environment in the petroleum activities. There is a link between safety and working environment. A good working environment is important in its own right, and is also important in maintaining low risk of major accidents. Chapter 4.6 also includes a more detailed discussion of risk, development and follow-up in a number of key areas.

### 4.1 Risk concept in the petroleum activity

The Norwegian petroleum industry has long experience with safety and risk work. Identifying, understanding and managing risk is crucial in the work to prevent accidents, and the industry must have a common understanding of what risk actually is. Traditional risk reasoning often defines risk mathematically as the product of the likelihood that an incident will occur and the consequence of the incident: Risk = likelihood x consequence. However, this approach to risk is not sufficient to manage and handle risk.

The PETROMAKS2 research programme, cf. Chapter 4.2.4, has supported a project aimed at developing new principles and methods for risk management<sup>1</sup>. Cooperating parties have come

from both the authorities and business and industry. A number of serious incidents in the petroleum activities have shown that it is precisely this understanding of risk that has failed, and the project's research has contributed a new approach towards understanding these incidents. Risk assessments can be based on preconditions and assumptions that may be incorrect, or based on insufficient knowledge. The project has helped to clarify what risk is, and how risk should best be described in order to understand the connection between uncertainty, knowledge and the unexpected. Based on the need for "new" ideas regarding risk, the Petroleum Safety Authority defines risk as "the consequences of the activity, with associated uncertainty"<sup>2</sup>. The clarification does not entail any new regulatory requirements.

Uncertainty is about the lack of information, lack of understanding or lack of knowledge. The type of uncertainty, whether large or small, whether it can be reduced or eliminated, are important aspects. Uncertainty and the strength of knowledge must, to a greater extent, be taken into consideration in the risk assessments, and the results from risk analyses must be relevant and useful for those who will use them in decision processes.

The risk concept is connected to consequences of the activity, not just to consequences of a specific activity or incident on the specific facility. Therefore, risk relates not just to the concrete activity then and there, but is linked to how the activity is planned, where it takes place and under what framework conditions.

Risk must be understood and managed in all phases of the petroleum activity.

### 4.2 Basic data

When risk is assessed, it is important to look at the big picture, and base the assessments on mul-

<sup>1</sup> Aven, Terje (2017). *The Illusion of Risk Control – What Does it Take to Live With Uncertainty?*

<sup>2</sup> Guidelines to Section 11 of the Framework Regulations.

multiple sources, such as basic data, input from the industry and experience from audits. There are a number of sources which, overall, provide a basis for describing and assessing the HSE situation and risk development in the petroleum activity. The most important sources of the information provided in the Storting report are:

- Risk level in the petroleum activity (RNNP)
- Audit experiences, including investigations performed by the Petroleum Safety Authority
- Whistleblowing and notes of concern
- Research results and special studies

#### 4.2.1 Risk level in Norwegian petroleum activity (RNNP)

The project entitled Risk level in Norwegian petroleum activity (RNNP) monitors risk development in the petroleum activity and is organised in a cooperation with the companies, the authorities, the trade associations, the unions and relevant research communities. The development in the petroleum industry is monitored with the aid of a number of indicators for safety and working environment. A report is prepared each year showing trends in the risk scenario over time, and this is intended to provide a joint understanding of the risk scenario. The foundation for the RNNP work is the cooperation among the parties through the Safety Forum, which also functions as reference group and main recipient of the results. In the work on RNNP, an advisory group has been established with representatives from the industry parties, which contributes to quality-assuring the RNNP results. A professional group has also been set up with national experts in safety and working environment disciplines, which contributes to method development and quality assuring data and information. RNNP contains information about major accidents, work accidents and other relevant safety and working environment factors on the shelf and on land. RNNP also shows the development as regards acute discharges and emissions.

The ultimate objective of RNNP is to monitor the risk level and measure the effects of the safety and working environment work over time. Measuring such effects is challenging because there are many factors that have an impact on this development. The measurement in RNNP does not cover all aspects of safety and working environment, and therefore provides a simplified picture of a complex reality.

RNNP is based on qualitative and quantitative historical data obtained from multiple sources.

Historical data provides an image of the development up to the present, but not how the development will progress in the future. A qualitative survey could, for example, have the goal of discussing and summarising new research on a topic, or analysing investigation reports for a specific period. The quantitative data, which is used in the more traditional indicators, is mainly obtained from the industry itself.

The questionnaire survey in RNNP is conducted every second year, and includes all employees that work on the Norwegian shelf and at the onshore facilities. The questionnaire mainly maps the employees' perception of the physical and psychosocial working environment, HSE climate and perceived risk, as well as the employee's perception of own health, illness and injuries. There have been discussions among the parties as to whether the response to the survey is too low (30–50 per cent). Despite a somewhat low response rate, the survey is deemed to be representative, in part because the distribution of responses agrees with other information about the population, such as reported number of hours from operating companies, shipping companies and onshore facilities in total for the period, divided between the respective work areas. Nevertheless, measures should be considered to increase the response percentage and ensure the quality of the questionnaire survey. The Petroleum Safety Authority cooperates with the National Institute of Occupational Health (STAMI) to develop a more effective and user-friendly processing and reporting of the questionnaire data from the RNNP survey. The objective is to improve the quality of the reporting and contribute to increased use of results in the industry, more user-friendly communication, and more active use of the results for improvement work.

The results from RNNP make up a key part of the Petroleum Safety Authority's basis for carrying out risk-based supervision, further development of the regulations, competence building and advice to the Ministry and the industry. The multipartite work group concluded in the fall of 2017 that RNNP constitutes the most important foundation for a unified industry understanding of and communication surrounding the risk level in the petroleum industry, and that the parties in the industry must continue to support the work and further development of RNNP<sup>3</sup>. The Ministry's

<sup>3</sup> *Health, safety and working environment in the petroleum activities*. Report from multipartite work group, 29 September 2017

experience is that there have been discussions among the parties regarding the understanding and application of RNNP. RNNP is a very important basis for the industry's further priorities and formulation of policy as regards health, safety and the working environment, and a high degree of legitimacy must be ensured for the RNNP results. Consideration should therefore be given to how the RNNP work can be organised and reinforced to ensure a balanced and precise use of results and analyses.

A correct picture of current risk is important for the industry's follow-up work. In addition to the historical data from RNNP, there is a need for supplemental information about current risk to ensure a better and more unified understanding of trends and challenges. Development and updating of a current risk scenario must be done in cooperation with the parties in the industry, the Safety Forum and the academic community. The objective is to achieve better understanding for change and development based on current information regarding incidents, audits, changes, notes of concern, etc.

#### **4.2.2 Experience from audits and investigations**

The risk scenario that emerges through RNNP is supplemented by the Petroleum Safety Authority's experience from audits, internal and external investigations, reports and notes of concern, and follow-up of incidents. These can contribute to a description of the risk scenario, and can indicate potential trends.

#### **4.2.3 Reports and notes of concern**

Issues related to whistleblowing concerning reproachable circumstances in working life have been on the agenda in recent years. The Working Environment Act's rules regarding whistleblowing cover cases where employees report circumstances in the workplace that are or may be in violation of legislation, the company's guidelines, or general understanding of what is responsible or ethically acceptable. In January 2016, the Ministry of Labour and Social Affairs appointed an official committee to undertake a comprehensive review of the whistleblowing rules in the Working Environment Act, and to consider whether there was a need to propose further statutory amendments and/or other measures. The committee published its report on 15 March 2018 in

NOU <Official Norwegian Report> 2018: 6 *Whistleblowing – values and protection*. The Whistleblowing Committee's point of departure was that it is positive and profitable for society that reproachable conditions are revealed through whistleblowing. With this basis, they have a number of proposals to clarify the regulations and ensure sufficient protection for the whistleblowers. The report will be submitted for consultation before any decision is made as to how the Whistleblower Committee's proposals will be followed up. In addition, a project has been carried out under the direction of the Norwegian Labour Inspection Authority to improve interaction between relevant authorities as regards whistleblowing. The project has proposed a number of measures to reinforce the authorities' competence and coordination, so that whistleblowers in Norwegian working life can report reproachable conditions without the risk of reprisals.

The Petroleum Safety Authority conducts supervision to ensure that the companies have established whistleblowing routines and in connection with potential violations of the Working Environment Act linked to whistleblowing cases, for example in connection with bullying or harassment.

The Petroleum Safety Authority has received a growing number of notifications and notes of concern in recent years. During the period from 2011 to 2017, there was a total of 150 notes of concern, cf. Table 4.1. In the period 2011 to 2014, about half of the notes of concern came from the safety delegate service or trade unions. For the years 2016 and 2017, several notes of concern came from the employees. If we compare the period from 2015 to 2017 with the period from 2011 to 2014, there appears to be a development in the direction of more notes of concern regarding lack of accordance between tasks and resources, weak/lacking employee involvement, pressure on working hours schemes, lack of a reporting culture and challenges in the areas of training/competence. These types of notes of concern account for more than 80 per cent of the notes of concern regarding psychosocial and organisational working environment. One common feature is that most of these notes of concern are linked to change and efficiency processes. The Petroleum Safety Authority has received more notes of concern within technical safety from 2015 to 2017 than previously. In this area, there are no specific issues that stand out.

Table 4.1 Distribution of notes of concern by topic

	2011	2012	2013	2014	2015	2016	2017	Total
Preparedness	4%	6%	8%	0%	5%	3%	0%	3%
Physical working environment	13%	6%	8%	8%	0%	13%	3%	7%
Organisational working environment	43%	78%	38%	50%	70%	47%	47%	53%
Psychosocial working environment	13%	0%	0%	0%	5%	6%	3%	5%
Technical safety	22%	11%	38%	33%	15%	19%	41%	25%
Other	4%	0%	8%	8%	5%	13%	6%	7%
Total	100% (23)	100% (18)	100% (13)	100% (12)	100% (20)	100% (32)	100% (32)	100% (150)

Source: The Petroleum Safety Authority

#### 4.2.4 Research results and special reports

Since 2002, the Ministry of Labour and Social Affairs' sector responsibility for research on health, safety and working environment in the petroleum activities has mainly been organised as part of the major petroleum research programmes in the Research Council – now PETROMAKS2. The HSE research in PETROMAKS is also followed up by a dedicated reference group with connections to the parties in the industry. In 2016, the Research Council of Norway's R&D efforts in health, safety and working environment were continued and made synchronous with the rest of the PETROMAKS2 programme, and have also been converted into a continuous commitment with three-year programme plans. This research and development has resulted in new technology and knowledge about safety and working environment and more general aspects such as safety culture and regulatory regimes.

The report refers to various projects conducted under the direction of the PETROMAKS programme. The discussions in the report also refer to special investigations, such as the report from a technical expert group which, in 2013, assessed how the supervisory authorities' follow-up is adapted to current and future challenges<sup>4</sup> and an investigation project under the direction of Safetec linked to new operational solutions in the petroleum sector<sup>5</sup>. A report from the multipartite

<sup>4</sup> *Supervision strategy and HSE regulations in Norwegian petroleum activities*. Expert group report to the Ministry of Labour, 27 August 2013

<sup>5</sup> *Study of new forms of operation in the petroleum industry*. Report from Safetec to the Ministry of Labour and Social Affairs, 8 February 2018

work group that reviewed HSE status and development in Norwegian petroleum activities was submitted in September 2017, and also forms an important basis for the work on the Storting report<sup>6</sup>.

#### 4.3 Development in HSE status in the industry

Over time, the HSE level in the petroleum activity has shown positive development, and the authorities and the parties agree that the safety level in the industry in Norway is high. The attention paid to safety is higher in the sector than in many other industries. From 2000, there has largely been a stable and positive development if one looks at most indicators for major accidents. This indicates that the industry has gotten better at managing factors that impact risk.

In recent years, the petroleum industry has gone through a challenging period, with comprehensive changes and adjustments. The major accident indicator that reflects both the number of serious incidents and the potential of these incidents as regards loss of life was at a low level in 2013 and 2014, but was higher in 2015 and 2016. In 2017, the major accident indicator returned to the same level as in 2013 and 2014. The working environment standard in the petroleum activities has mainly exhibited positive development, but the industry still faces a number of challenges as regards working environ-

<sup>6</sup> *Health, safety and working environment in the petroleum activities*. Report from multipartite work group, 29 September 2017

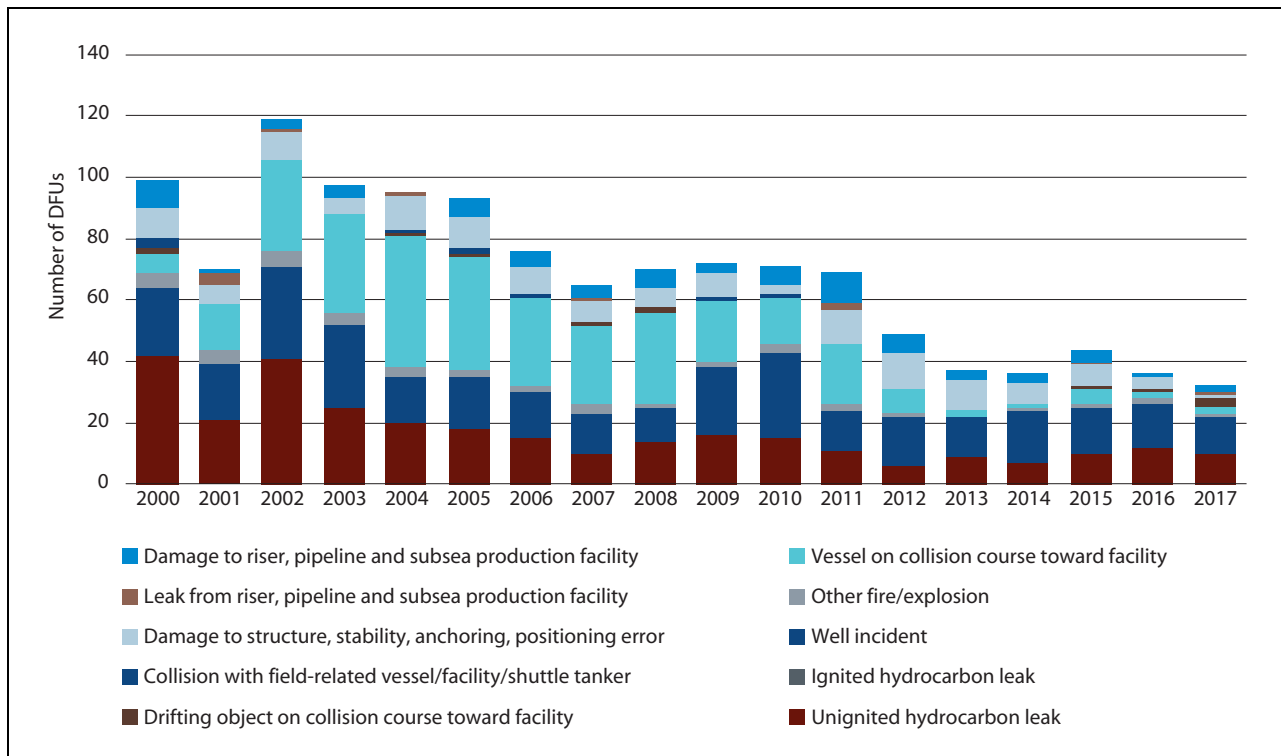


Figure 4.2 Overview of development in incidents with major accident potential

Source: RNNP 2017

ment. The questionnaire survey in connection with RNNP 2015 and 2017 reveals challenges as regards psychosocial working environment, safety climate and reporting culture, and there was an increase in serious personal injuries in 2017. Over the last ten years, there have been four fatal accidents in the Norwegian petroleum industry. Supervision experience indicates pressure on the cooperation between the parties in the companies. Working conditions and organisation of the work is significant for safety, working environment and health. Systematic work to reduce the scope of work-related health injuries is important to ensure continued good long-term development of the working environment in the petroleum industry.

Helicopter transport accounts for a relatively large part of the overall risk scenario for work on the shelf. The helicopter accident at Turøy in April 2014 in which 13 people died illustrates the importance of systematic risk management work, also in connection with transport of personnel.

#### 4.4 Major accident risk

The design of offshore facilities and onshore facilities, the selection of robust technical solutions,

maintaining good technical condition and effective barriers are elements that will reduce the likelihood of incidents with major accident potential, as well as prevent incidents from developing into major accidents. A major accident entails loss of multiple lives, serious damage to the environment or loss of significant financial assets, and can take place both on offshore facilities and onshore facilities and in connection with transport to and from the facility.

RNNP has eleven different indicators for defined hazard and accident situations (DFUs) linked to major accidents on the shelf. As regards to the shelf, Chapters 4.4.2–4.4.6 provide an overview of the total indicator for major accidents and results for the DFUs with the greatest contributions to the total indicator.

Figure 4.2 gives an overview of the number of reported incidents with major accident potential in the period 2000 to 2017. As the figure illustrates, there has been a gradual decline in the number of incidents after a peak in 2002.

##### 4.4.1 Total indicator

The RNNP report states a total indicator for major accidents on facilities. The total indicator does not express the risk level explicitly, but is

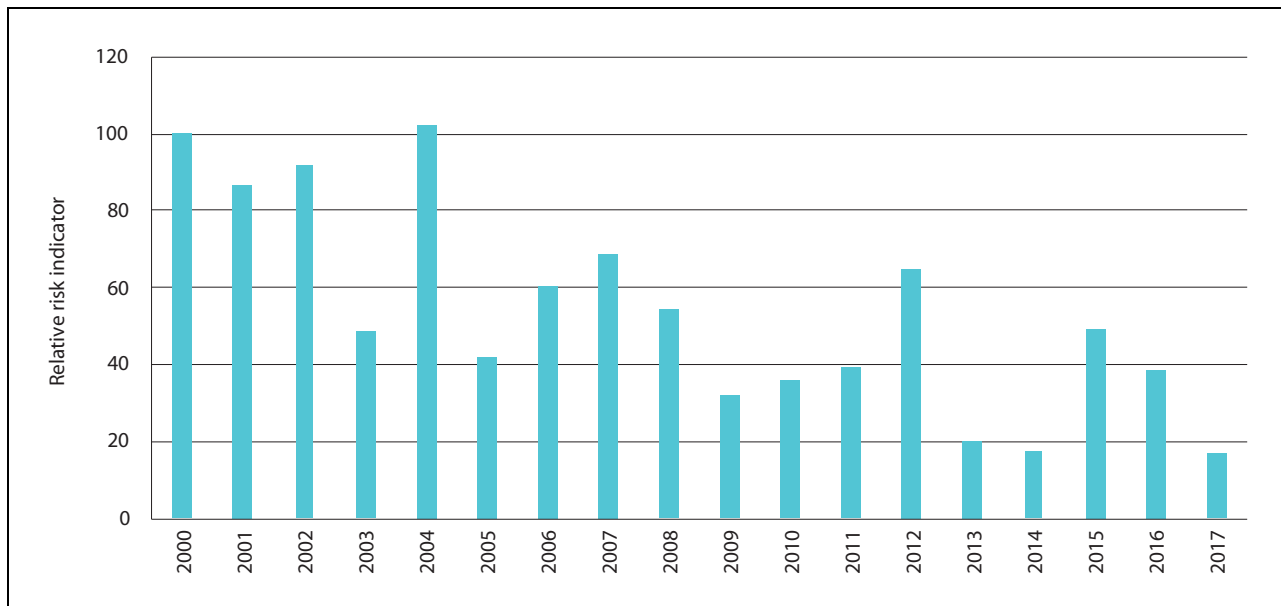


Figure 4.3 Total indicator for major accidents on the Norwegian shelf for 2000–2017, normalised for hours worked

Source: RNNP 2017

an indicator based on incidents that have occurred and near-miss incidents, assessed in relation to a weighted incident potential. A positive development of this indicator shows that the industry has achieved better control over factors that result in future risk. Incidents associated with helicopter transport are reported separately and are not part of the total indicator, cf. Chapter 4.6.9.

The weighting factors used in the total indicator reflect the potential of the incidents to result in loss of life if the incident develops into a major accident. Near-miss incidents and incidents that can lead to major accidents have different potentials. For example, a minor fire has a lower major accident potential than a large fire. It follows from this that the total indicator is sensitive to incidents with a significant potential. It is therefore important to place greatest emphasis on a potential underlying trend over time when assessing the indicator. Figure 4.3 reveals substantial annual variations, but there has been a consistent positive development of the total indicator from 2002, if one looks at average numbers. The relatively high numbers in 2015 and 2016 are mainly due to a few serious individual incidents.

#### 4.4.2 Hydrocarbon leaks

Hydrocarbon leaks have great significance for major accident risk in the petroleum industry. All hydrocarbon leaks that may have major accident potential are recorded in RNNP. In the 2000–2017 period there has been a clear decline in the number of such hydrocarbon leaks, see Figure 4.4.

Several projects and studies have been conducted since 2003 with the goal of uncovering the causes and reducing the number of hydrocarbon leaks, both by the industry parties and in an RNNP context. The largest single cause of hydrocarbon leaks is manual intervention in hydrocarbon-bearing systems.

A cooperative effort has been established in the industry to reduce the number of hydrocarbon leaks. The hydrocarbon leak project is e.g. developing best practice documents and manuals that can be used for prevention of hydrocarbon leaks, cf. Box 4.1.

In addition to measures to prevent occurrence of hydrocarbon leaks, considerable resources are devoted to preventing leaks from developing into major fires or explosions. This requires effective barrier functions that detect leaks, prevent ignition and explosion and limit the consequences of a potential fire or explosion. Particular emphasis is placed on maintaining good control over potential

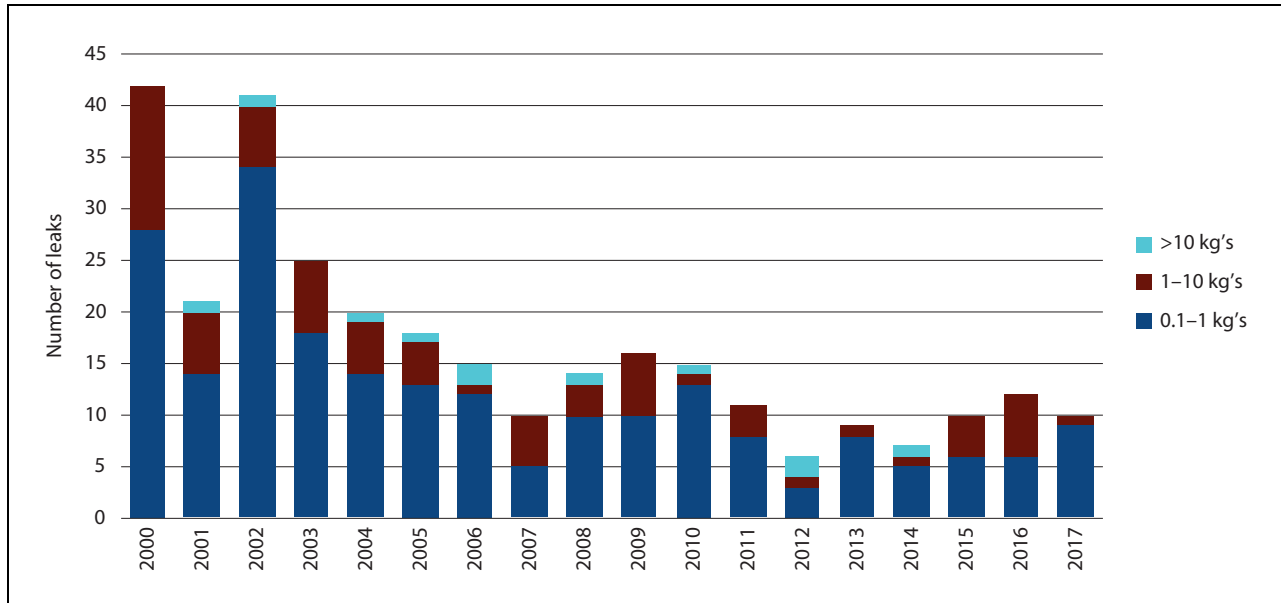


Figure 4.4 Number of leaks, all facilities on the Norwegian shelf

Source: RNNP 2017

#### Box 4.1 The hydrocarbon leak project

Hydrocarbon leaks have a major accident potential. At the turn of the millennium, there was a negative development in the number of hydrocarbon leaks on the Norwegian shelf. In response to pressure from the authorities, the industry therefore established a project in 2003 with the objective of reducing the number of hydrocarbon leaks. There were definite improvements in the first five years, until the number of hydrocarbon leaks started to rise again in 2008.

In the spring of 2011, the industry initiated a new project aimed at reducing the number of hydrocarbon leaks: “Project hydrocarbon leaks”.

The industry established yet another new project in 2017: “Revitalisation: Reduction of HC leaks on the Norwegian shelf”. The project is headed by the Norwegian Oil and Gas association. The companies participate actively in this work, and the trade unions and the Petroleum Safety Authority are also participating. The goal of the project is to contribute to a continuous reduction in the number of hydrocarbon leaks with major accident potential, with an ultimate vision of zero hydrocarbon leaks with major accident potential on the Norwegian shelf.

ignition sources. None of the leaks with major accident potential (i.e. more than 0.1 kg/s) reported in RNNP in the period 1996–2017, have ignited.

#### 4.4.3 Well control and well integrity

Loss of well control is a major accident risk in every drilling and well activity. Reducing well incidents and greater attention to well integrity are key factors in reducing the risk of major accidents on the shelf. Both the industry and the Petroleum Safety Authority carefully monitor development in well control incidents and well integrity.

In total, there has been a decline in the number of well control incidents in 2017 compared with the three previous years. In general, the number of well control incidents per drilled well has been higher for exploration drilling than for production drilling. Therefore, the last two years with zero incidents in exploration drilling stand out, cf. Figure 4.5.

The well incidents are classified in three levels according to severity (low, medium and high). Since 2001, there have been four incidents classified with high severity. The last of these was the well incident on the Songa Endurance drilling rig on the Troll field in 2016. This was a gas blowout that could have led to ignition and fatalities under slightly different circumstances.

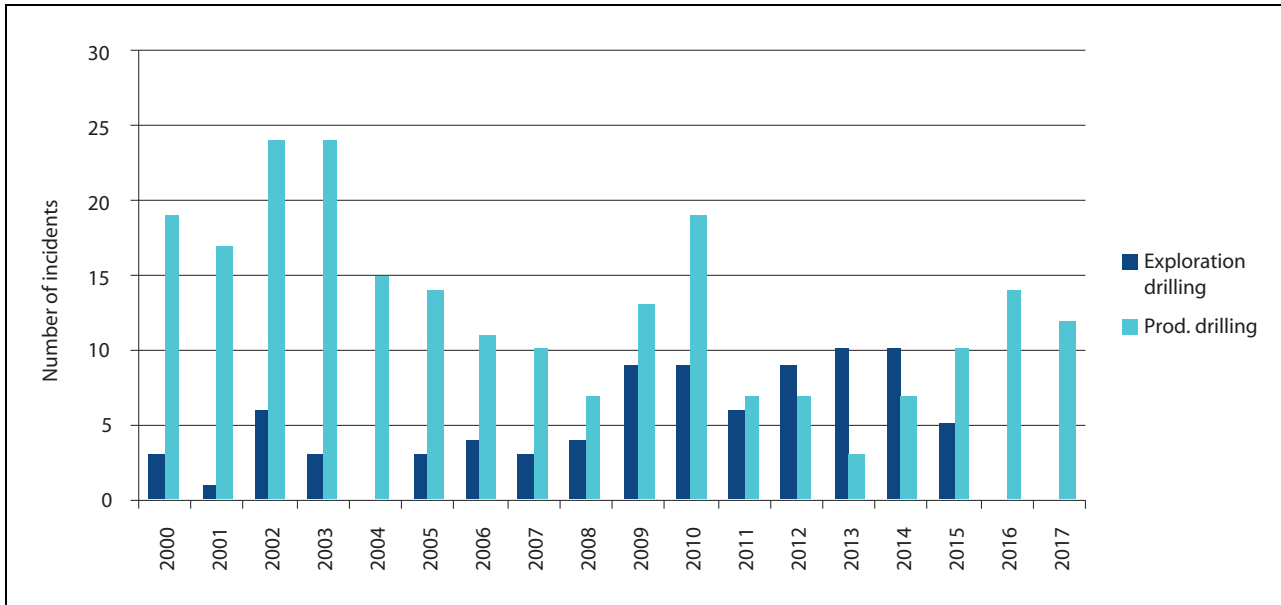


Figure 4.5 Number of well control incidents in exploration and production drilling, 2000–2017

Source: RNNP 2017

**4.4.4 Leaks from risers, pipelines and subsea production facilities**

Leaks from risers, pipelines and subsea facilities have a substantial potential for major accidents. This is due, in part, to high pressure and the large volume of hydrocarbons. Leaks can come up under the facility, thus entailing a danger of ignition.

The indicator covers risers, pipelines and subsea facilities within the safety zone, as well as other leaks that pose a hazard for the facility.

Twelve such serious leaks have been reported during the period 2001–2017.

**4.4.5 Structural damage and maritime incidents**

*Structural damage*

Major accidents associated with structural damage are rare. Most structural damage is caused by fatigue damage (cracks) or storm damage. The

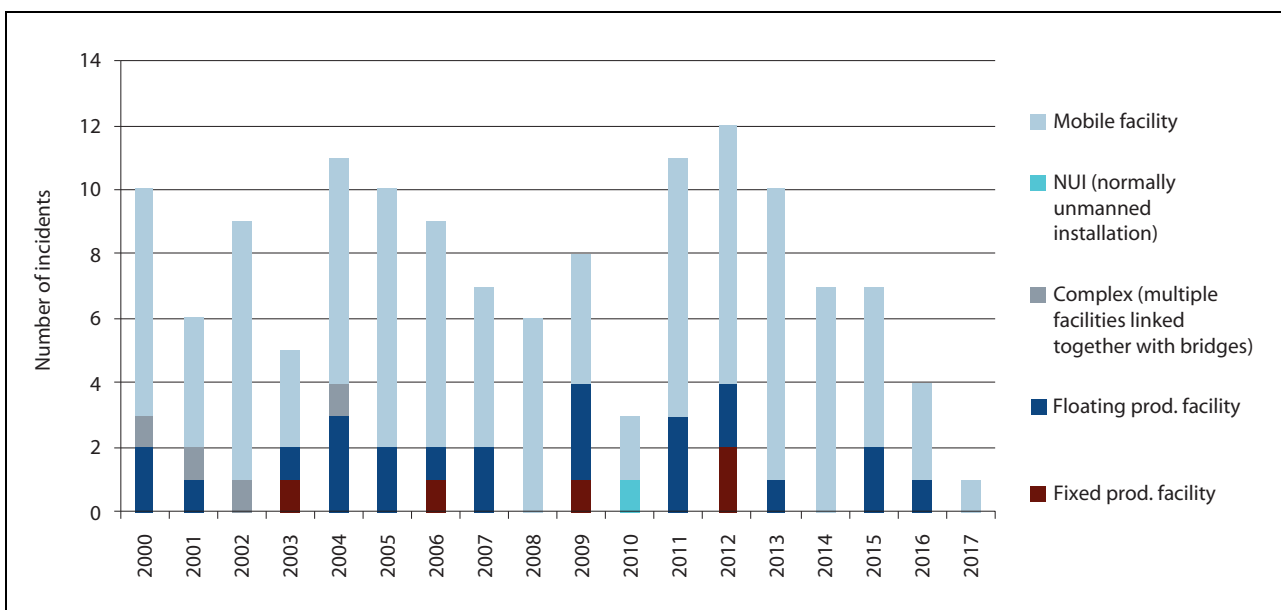


Figure 4.6 Number of reported incidents and damage to structures and maritime systems

Source: RNNP 2017



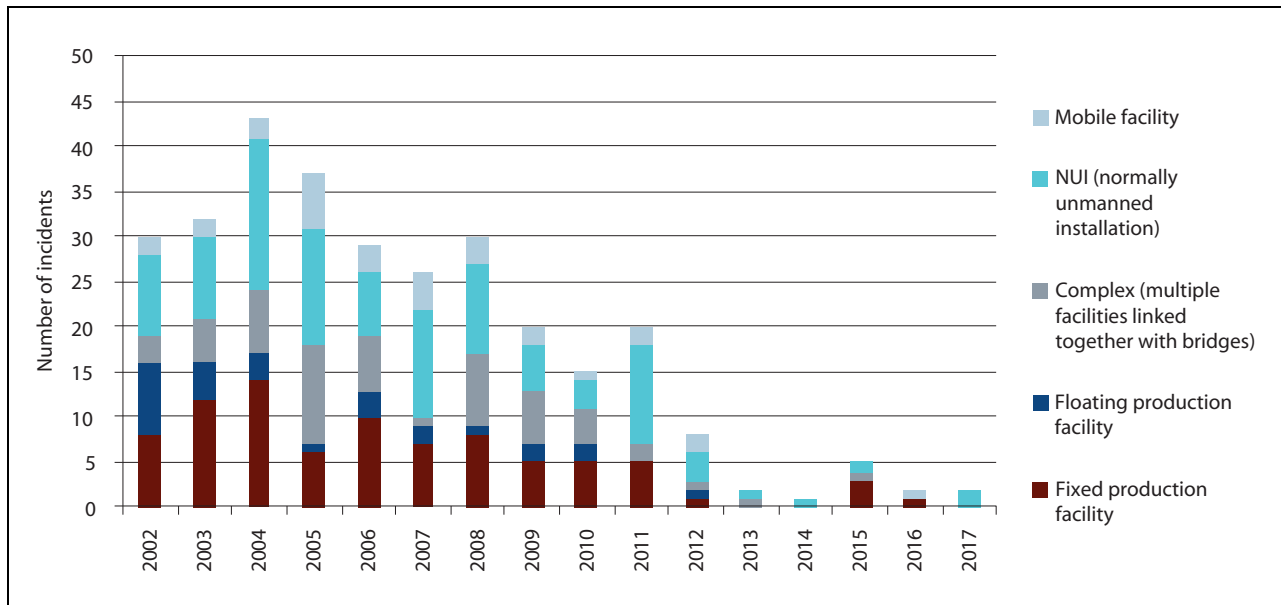


Figure 4.7 Number of ships on collision course, 2000–2017

Source: RNNP 2017

fatality on the mobile facility COSL Innovator in 2015 was caused by a wave that struck the living quarters on the facility. Most of the reported structural damage relates to damage to mobile facilities.

#### Mooring systems

Mobile facilities are held in place either with the help of dynamic positioning systems or through mooring on the seabed. If the systems fail, this can lead to serious consequences. As regards drilling or production facilities, the connection to the equipment on the seabed can be destroyed or damaged. This can lead to loss of well control and the danger of a blowout. Loss of position also entails danger of collision with other facilities. A few years ago, there was an increase in incidents linked to mooring systems. Based on an initiative from the Petroleum Safety Authority and measures implemented in the industry, this trend has been reversed and such incidents have been rare in recent years.

#### Ships and drifting objects on collision course

There have been serious collisions between ships and facilities after the year 2000, although there has been a decline in the number of such incidents. The number of ships on collision course has also declined in the period, cf. Figure 4.7. This development is due, in part, to better monitoring of ship traffic.

#### 4.4.6 Acute discharges

RNNP-acute discharges are limited to the offshore petroleum activities, and cover all acute discharges and near-miss incidents<sup>7</sup> in the period 2001–2016.

#### Acute crude oil spills

There has been a positive development in the number of acute oil spills in the period 2001–2016, cf. Figure 4.8. This is mainly due to a decline in minor crude oil spills. The annual discharge volume from such incidents is subject to significant variation through the period.

#### Acute spills from subsea facilities

Subsea technology is used extensively, and there is a large and growing number of subsea facilities in the petroleum activities on the Norwegian shelf. Figure 4.9 shows the number of acute spills from subsea facilities since 2006.

Over a number of years, the industry has developed technologies aimed at rapid detection of leaks from the seabed. Experience from the Petroleum Safety Authority's supervision, as well as reported acute oil spills from subsea facilities show that it takes time to discover such leaks, and

<sup>7</sup> Incidents with major accident potential that could have led to accidental discharges if more barriers had failed.

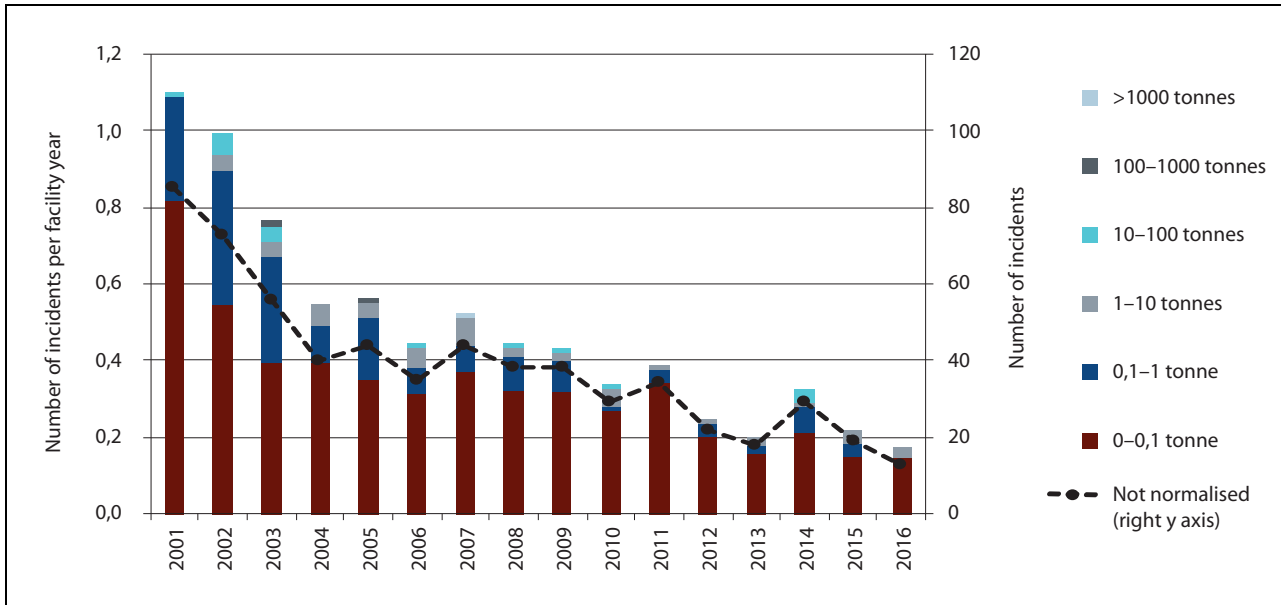


Figure 4.8 Acute crude oil spills 2001–2016

Source: RNNP-AU 2016

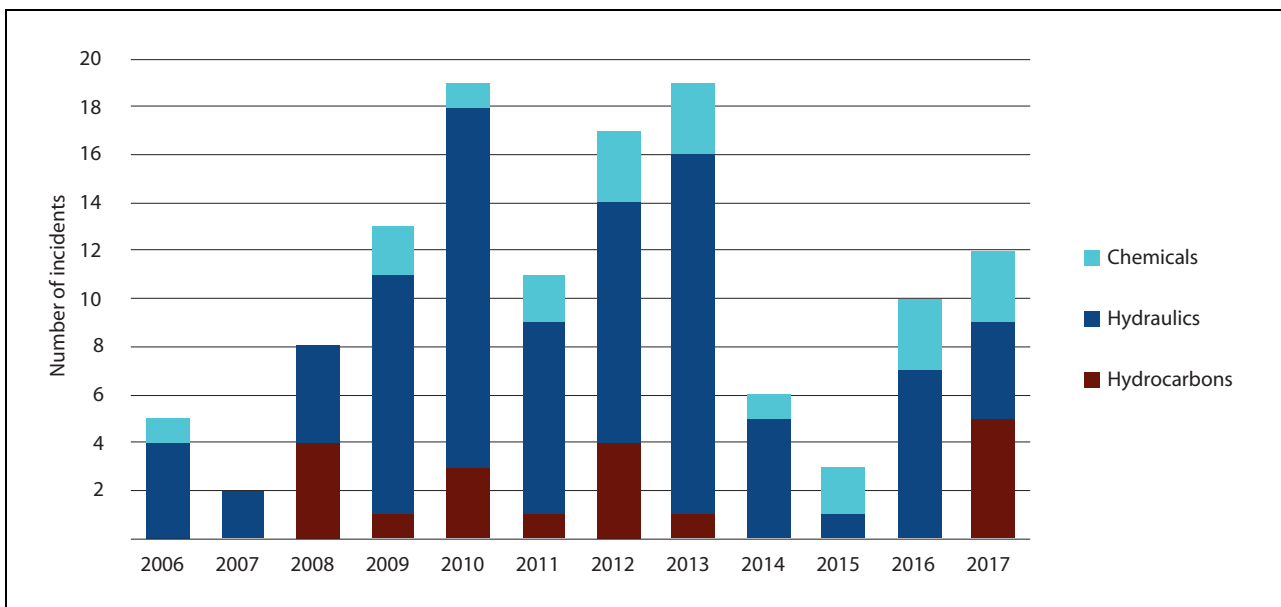


Figure 4.9 Acute spills from subsea facilities

Source: RNNP-AU 2016

that they are primarily discovered by visual observation on the sea surface. The companies must prioritise prevention and early detection of acute pollution from subsea facilities.

#### 4.4.7 Barrier management

Effective barriers are important in reducing the likelihood of incidents, and reducing their consequences. Monitoring the companies' barrier man-

agement is thus a key indicator in RNNP and for follow-up in supervision. Barrier management entails systematic and continuous assurance that necessary barriers are in place to protect against errors, hazard and accident situations<sup>8</sup>. This applies to both technical, operational and organi-

<sup>8</sup> The barriers are to detect beginning incidents, prevent development of a course of events and limit damage, cf. Section 5 of the Management Regulations.

sational barriers. Experience from audits reveals a positive development in systems and methodology for barrier management, particularly as regards the technical barriers.

A number of supervision activities have been conducted in recent years targeting barriers related to well integrity, well control, hydrocarbon leaks, integrity of structures and marine systems. Several activities have been initiated which, overall, have contributed to new and improved knowledge about the role and function of the barriers in preventing major accidents. The industry has taken the initiative of further developing internal company documents in accordance with regulatory requirements and more detailed requirements in the Petroleum Safety Authority's memorandum on barrier management, and the regulations have evolved based on experience from audits. It is important that the players in the industry utilise solid technical and organisational solutions that reduce the risk of error or accidents, and that barrier management is established and maintained in all phases of the activity, also in the time ahead and under altered framework conditions.

RNNP collects data on certain selected barrier elements to prevent and limit the consequence of incidents with major accident potential. Data reveals significant variation at the facility level, while positive development has been noted on a general industry level in recent years. Barrier elements that have historically shown weak results, are showing improvement.

#### 4.4.8 Maintenance management and technical condition

Deficient and lacking maintenance can be a contributing cause of accidents and undesirable incidents in the petroleum activities. The objective of maintenance management includes identifying safety-critical functions and ensuring that these functions (including barriers) work when they are needed. Installations, facilities and equipment must therefore be maintained in all phases of their lifetime. Great emphasis is placed on maintenance to maintain technical condition in the safety work in general, and in maintenance of safety-critical equipment in particular.

Corrosion is, in general, a known challenge in the petroleum industry, particularly under insulation and in locations that are difficult to access. *Corrosion under insulation* has proven to be the cause of several incidents with major accident potential in recent years. The corrosion can occur both on black steel and stainless steel, and can

develop rapidly due to moisture, high temperatures on the actual process equipment and pipe systems and in connection with sea air. Corrosion under insulation can be difficult to detect, since the corrosion is covered up by the insulation material. Corrosion challenges are expected to increase as installations, facilities and pipelines age. The multipartite work group in 2017 stated that the industry must follow up corrosion challenges and devote attention to these issues in the time ahead. New competence and technological development is needed in relation to corrosion and maintenance issues.

#### 4.4.9 Onshore facilities

There are eight onshore facilities for landing and/or processing of oil and gas in Norway. Figure 4.10 shows the development in number of incidents with major accident potential at the onshore facilities. As can be seen from the figure, there is no clear trend for the period, but there has been a positive development in recent years. No separate overall indicator is prepared for major accidents at the onshore facilities.

Corrosion under insulation is a challenge for a number of facilities, cf. Chapter 4.4.8. The older facilities have comprehensive maintenance programmes to monitor this, but other facilities are also at risk.

A cooperation arena has been established in which the heads of the eight facilities meet regularly to exchange experience (L-8). This has contributed to good dialogue among all facilities. Results and data from RNNP are discussed for all facilities, under the direction of L-8.

### 4.5 Working conditions, work-related health ailments and work injuries

Working conditions and organisation of the work has an impact on safety, working environment and the incidence and progression of a number of health ailments and illnesses. It is well-documented that there are causal links between working environment exposure and reduced health and work involvement on the part of employees<sup>9</sup>. The working environment standard in the Norwegian petroleum activities has largely experienced positive development in the period 2011–2017.

<sup>9</sup> National surveys of working environment and health (2015). *Fact book on working environment and health 2015 – status and trends*

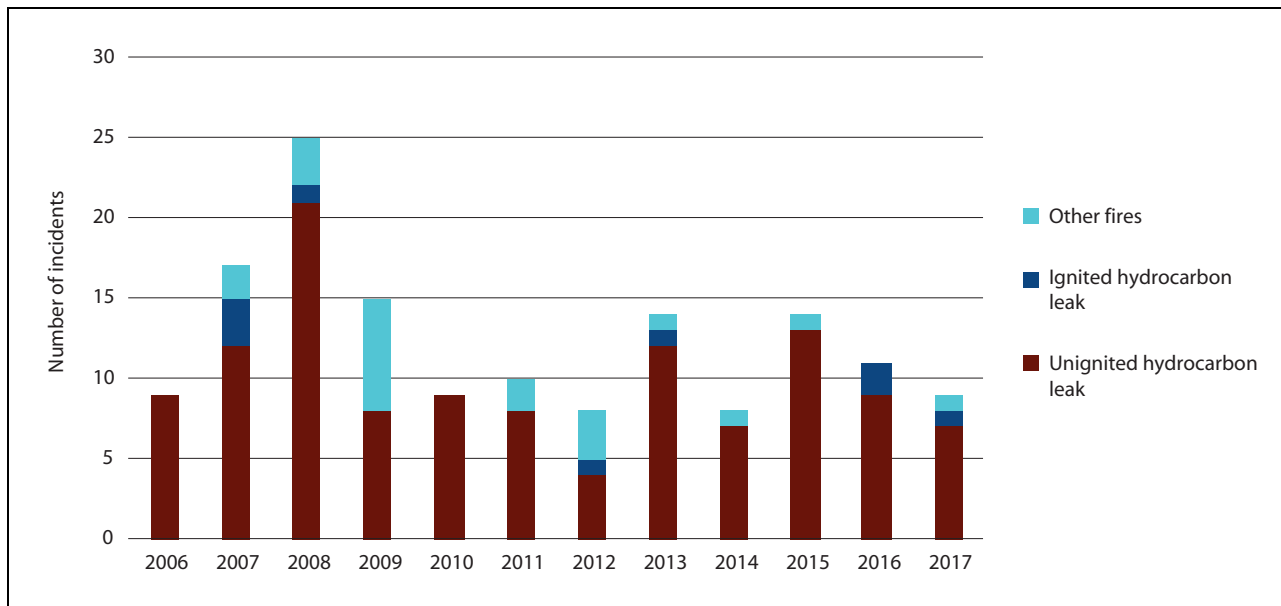


Figure 4.10 Incidents with major accident potential

Source: RNNP Onshore facilities 2017

Nevertheless, the petroleum activities are an industry with a number of working environment challenges.

The technical working environment standard in connection with design and construction has largely had a positive development. However, the questionnaire survey in connection with RNNP in 2015 and 2017 reveals challenges as regards psychosocial working environment, safety climate and reporting culture, particularly for employees on the shelf. These results must be viewed in context with extensive downsizing and readjustment in the activities on the shelf in this period. It is important that the industry and the parties address these challenges and continue their long-term prevention work in the fields of working environment, health and safety.

Systematic work to reduce the scope of work-related health injuries, in part through increased knowledge about the risk conditions, is important to ensure continued good long-term development of the working environment in the petroleum industry.

#### 4.5.1 Personal injuries and fatalities

Work accidents that entail serious personal injuries or fatalities are an important indicator for the risk level in the industry. In the period 2006 to 2013 there was a general positive development as regards serious personal injuries. There have been four fatal accidents in the Norwegian petro-

leum activities over the last ten years, in 2007, 2009, 2015 and 2017<sup>10</sup>. There was also a tragic helicopter accident in April 2016 where 13 people lost their lives, cf. Chapter 4.6.9.

In 2017, 204 reportable personal injuries were recorded on the Norwegian shelf. Of these, 27 were classified as serious. The frequency of serious personal injuries was 0.8 per million working hours in 2017. This is the highest frequency since 2008. The increase in serious personal injuries from 2016 to 2017 relates to both production facilities and mobile facilities. The total injury frequency applies to both production facilities and mobile installations. The total injury frequency for onshore facilities is 0.6 serious personal injuries per million hours worked. The percentage of people who state in the RNNP questionnaire survey that they have been exposed to an occupational accident involving personal injury has also risen both offshore and on land from 2015 to 2017.

#### 4.5.2 Chemical working environment

In connection with work in the petroleum industry, many occupational groups will come in contact with chemicals, either through inhaling dust and gases, or through skin contact. Health risk resulting from the use of a chemical substance depends both on the substance's toxicity and the

<sup>10</sup> 2007: Saipem 7000, 2009: Oseberg B, 2015: COSL Innovator, 2017: Mærsk Interceptor.

degree of exposure, i.e. how the substance is used.

Chemical health risk in the petroleum activities is primarily found in connection with activities such as drilling of wells and processing of hydrocarbon streams. The companies have reported on serious exposure situations for selected groups of positions. Within drilling, exposure to oil vapour and oil fog presents a challenge, while benzene exposure is the greatest challenge for operations and maintenance personnel. Equipment and pipe systems are opened in connection with maintenance of process facilities, and personnel may be exposed to hydrocarbons and benzene. Chemical exposure also occurs in connection with work such as catering services, mechanical maintenance and repair work, workshop activities and laboratory work, etc. In connection with surface treatment there can be periods of high exposure to dust, solvents and allergenic chemicals. The need for surface treatment grows along with the increasing age of installations and facilities.

Chemical working environment is monitored in the petroleum industry, for example through following the development in the number of chemicals that are used, the number of chemicals with the highest hazard category, and the companies' management of chemical exposure risk. For offshore facilities, both the total number of chemicals and the number in the highest hazard category have increased in the period 2004–2015, particularly within maintenance. The same trend is evident on onshore facilities, but is less clear. At the same time, it is noted that the companies have a high level of awareness as regards chemical management, and most have their own processes for risk assessment and approval of new chemicals.

Through the RNNP questionnaire survey, we can see self-reported exposure to chemicals either through skin contact or inhalation, as well as ailments that can be linked to such exposure. Up to 2013, there was a moderate but definite positive development in the direction of better working environment and a lesser degree of ailments due to inhalation of and skin contact with chemicals. The results from the survey in 2015 and 2017 indicate an increase in perceived exposure, but a stable level for ailments.

Physicians have a reporting obligation to the Petroleum Safety Authority when it is assumed that the illness is due to the working environment. The doctor-reported work-related illnesses that can be linked to chemical exposure are primarily skin diseases, airway illnesses and tumours. The number of reported cases of work-related skin ail-

ments has declined in the last 20 years. Most of the reports regarding skin ailments have been linked to drilling activity and contact with drilling mud, and the clear reduction in the number of reported skin diseases indicates a substantial improvement of the working environment in this area. The numbers are substantially lower for the other two diagnosis groups, so that it is more difficult to talk about trends.

In recent years, the health hazard linked to benzene exposure has received increased attention in the industry. New research knowledge has emerged indicating that benzene can have a carcinogenic effect through lower exposure levels than the current limit value of one ppm<sup>11</sup>, and that the substance is linked to more forms of cancer in blood and lymphatic organs than previously assumed. The European Chemical Agency (ECHA) has proposed lowering the limit value for benzene to one-tenth of the current value. Among male workers employed on the Norwegian shelf during the period 1965–1998, for the period 1999–2011, links were found between benzene exposure and several forms of cancer in the blood and lymphatic organs<sup>12</sup>. These effects are related to the exposure levels for benzene in the industry prior to 1999. In a recently published analysis, the same researchers have found a connection between exposure to crude oil or benzene and skin cancer<sup>13</sup>. The research shows that oil workers that have been exposed to crude oil and benzene for ten years or more, have up to seven times higher risk for skin cancer on their hands and underarms compared with persons who have never been exposed. The Petroleum Safety Authority's supervision activity and the companies' own mapping activity in recent years have identified multiple sources of benzene exposure, e.g. through cold venting and certain types of maintenance work, and there is a need to conduct further mapping to better understand the exposure scenario and risk.

While there is great variation, it is the experience of the Petroleum Safety Authority that the companies' systematic work on chemical working environment is improved after implementation of

<sup>11</sup> Talbott et al. (2011). *Risk of leukemia as a result of community exposure to gasoline vapors: a follow up study*. Environ Res

<sup>12</sup> Stenehjem et al. (2015). *Benzene exposure and risk of lymphohematopoietic cancers in 25 000 offshore oil industry workers*. Br J Cancer

<sup>13</sup> Stenehjem et al. (2017). *Aromatic Hydrocarbons and Risk of Skin Cancer by Anatomical Site in 25 000 Male Offshore Petroleum Workers*. Am J Ind Med

**Box 4.2 The chemical project**

The chemical project was an extensive tripartite cooperation that took place in the period 2007–2011. The project was started based on a growing understanding that knowledge and practice in the area was not good enough. The objective of the project was to provide a comprehensive picture of current and earlier exposure, describe and close knowledge gaps and contribute to the industry doing a better job of handling risk surrounding chemicals in the working environment in the oil and gas sector. The project was a collaboration between Norwegian Oil and Gas association, the Federation of Norwegian Industries, the Norwegian Shipowners' Association, LO <the Norwegian Confederation of Trade Unions> and SAFE <the Norwegian Union of Energy Workers>. The Petroleum Safety Authority and the Norwegian Labour Inspection Authority participated as observers. The project has promoted independent research and development projects, and many Norwegian and international research environments were involved.

the chemical project (see Fact Box 4.2). This applies both to the scope and quality of measurements and risk assessments and operational practice, where chemical use is linked more strongly to formal processes for work permits and safe job performance.

**4.5.3 Physical working environment**

Noise, vibration and cold are examples of physical risk factors in the working environment in the petroleum sector.

There is a lot of heavy machinery and rotating equipment gathered in small spaces and a dense grid of pipes and valves on facilities on the shelf. These are significant sources of noise and vibration. Noise and vibration are connected, but in the petroleum sector, noise is often the most critical factor. In addition, in line with increasing age, the facilities are exposed to corrosion and an increasing need for surface maintenances, which entails use of hand-held tools that yield high noise levels.

The picture differs in the petroleum sector on land, here there is more room to separate noise sources, build more noise insulation and have

**Box 4.3 The noise project**

In 2011, the industry established a three-year noise project called "HØR – Støy i petroleum-sindustrien" <LISTEN – Noise in the petroleum industry>. The background was the Petroleum Safety Authority's follow-up of noise exposure in the industry where e.g. figures from RNNP showed a worsening and high numbers for work-related noise injuries. The project was a collaboration between Norwegian Oil and Gas association, the Federation of Norwegian Industries, KIS (Corrosion, insulation and scaffolding contractors' association), SAFE, LO, Industri Energi, the Norwegian United Federation of Trade Unions and the Norwegian Organisation of Managers and Executives. The Petroleum Safety Authority and the Norwegian Labour Inspection Authority participated as observers. The project has helped to collect, create and spread knowledge about noise and effective noise reduction measures, and was divided into 6 sub-projects: area noise, self-produced noise, barrier control, helicopter noise, vulnerability factors and vibrations. The project has developed databases for noise and vibration data, calculation tools, methods and recommendations that can also be used by land-based industry.

more units so that repair and maintenance can take place on shut down and protected equipment.

RNNP's noise indicator has provided much valuable information about noise exposure. Even though the companies work actively on noise reduction, and new technical measures are constantly reported, there are still many groups that face high noise exposure. For late-phase facilities, it has proven difficult to implement major noise reduction measures. The RNNP questionnaire survey contains several questions covering both noise exposure and ailments that can be linked to noise. Overall, noise is the working environment factor that most employees report exposure to.

New technology and new ways of designing facilities have contributed to reducing noise on newer facilities. Use of the NORSOK S002 industry standard, which deals with working environment design, has proven to yield good results within the area of noise. Over time, the industry has also developed a set of tools and a protective

regime against noise, which includes use of advanced hearing protection and limits on length of stay. The petroleum industry has cooperated to follow-up and reduce problems linked to noise exposure, cf. e.g. the noise project discussed in Box 4.3.

#### 4.5.4 Ergonomic risk factors

Ergonomic risk factors refers to factors that can contribute to developing work-related musculoskeletal ailments. Work-related musculoskeletal ailments often have complex causes, where physical/mechanical, organisational and psychosocial factors play a role. In the petroleum sector, physical strain is also particularly prominent in operation and maintenance of offshore facilities. There is a lot of equipment in a limited area, which means challenges in relation to access and material handling. There is also a lot of walking on hard surfaces with substantial friction, as well as walking in staircases over multiple stories. Catering personnel face challenges related to uniform strain, while lifting and carrying are risk factors for scaffolding and drill floor personnel. On assignment from the Petroleum Safety Authority, IRIS conducted an analysis in 2016 of work-related musculoskeletal ailments based on the RNNP questionnaire survey 2011–2015<sup>14</sup>. An increase in self-reporting of all work-related musculoskeletal ailments was reported, and particularly an increase in reporting of ailments in the neck, shoulders and arms. The analysis also revealed a higher percentage of job-related neck ailments for those who had experienced a downsizing or reorganisation process. The results apply both for offshore and onshore employees. Up to 2016, the companies have reported data to an RNNP indicator where different ergonomic factors on installations and facilities are assessed. The data show that drill floor workers have work tasks with most strain, followed by surface workers and mechanics.

Workplace design and ergonomic facilitation are generally good in the petroleum industry, particularly on newer facilities and installations. However, there is still a need and an opportunity for targeted improvements of the working environment to reduce work-related musculoskeletal ailments, particularly among certain groups at risk.

<sup>14</sup> Kari Anne Holte og Kathrine Skoland (2016). *Risk indicators for self-reported musculoskeletal ailments – offshore and onshore facilities. Analyses of RNNP questionnaire surveys 2011, 2013 and 2015*. IRIS

#### 4.5.5 Organisational and psychosocial working environment

Organisational factors comprise structural and formal conditions at a workplace, such as responsibility, size of units and groups, working hours, shift schemes, formal communication channels and changes in the organisation. How the work is organised, the content of the work and interaction between employees and leaders has an impact on many types of psychological and social factors in the working environment. Psychosocial and organisational factors affect the employees' physical and mental health. Studies also show that changes in such factors affect the employees' understanding of their situation and their ability to master unexpected situations, and also has significance for major accident risk<sup>15</sup>.

RNNP measures psychosocial working environment using four factors: job requirements, control (autonomy, tempo), managerial support and colleague support. For employees offshore, the results from 2013 show a positive level, while in 2015 and 2017 there are reports of higher job requirements, lower control and lower manager support. Support from colleagues, however, shows positive results and is at the same level as in 2015 and 2017. Onshore, employees experience higher job requirements in 2017 compared with 2015, while there is no change in other psychosocial questions.

#### *Reorganisation and downsizing*

A study was conducted in RNNP in 2016 to take a closer look at potential consequences of reorganisation and downsizing processes as regards psychosocial working environment, safety climate and health in the petroleum activities. It has been reported that downsizing processes can trigger stress reactions in the employees due to increased work volume, job uncertainty and reduced autonomy. Research on health consequences in con-

<sup>15</sup> Sneddon, A., Mearns, K., & Flin, R. (2013). *Stress, fatigue, situation awareness and safety in offshore drilling crews*. Safety Science

Mearns, K., Flin, R., Gordon, R., & Fleming, M. (2001). *Human and organisational factors in offshore safety*. APA PsykNet

Goldenhar, L.M., Williams, L.J., & Swanson, N.G. (2003). *Modelling relationships between job stressors and injury and near-miss outcomes for construction labourers*. APA PsykNet

Zwetsloot, G. I. J. M., Drupsteen, L., & de Vroome, E. M. M. (2014). *Safety, reliability and worker satisfaction during organisational change*. Journal of Loss Prevention in the Process Industries

nection with downsizing processes shows that the involved parties have an increased risk of developing psychological ailments. Several studies report that long-term absence due to illness among the remaining employees rises, while short-term absence due to illness appears to decline<sup>16</sup>. The RNNP study showed that employees that have experienced reorganisation and downsizing report a higher risk of injuries, absence due to illness, health ailments and a poorer safety climate and psychosocial working environment compared with employees who do not report such change processes. The analyses indicated that the higher risk of job injuries among those affected by downsizing or reorganisation in the industry, viewed together, can be linked to weaker results on safety climate and psychosocial working environment.

In the RNNP questionnaire survey in the period 2013–2017, there is a substantial increase in the percentage of shelf employees who report reorganisation of moderate or great significance (from 32 per cent in 2013 to 56 per cent in 2017) and downsizing or terminations in the past year (from 19 per cent in 2013 to 69 per cent in 2017). The percentage reporting that the organisation has reduced staffing in the past year has fallen from 2015 to 2017 by four per cent. The percentage of shelf employees who experience significant uncertainty linked to both current and future job opportunities has increased from seven per cent to 24 per cent in the same period. Employees on mobile facilities report a higher degree of job uncertainty and downsizing than employees on production facilities.

For the onshore facilities, RNNP shows that approx. 40 per cent report reorganisation in 2015 and 2017. The percentage reporting downsizing is reduced from 71 per cent in 2015 to 47 per cent in 2017. Perceived job uncertainty is lower at the onshore facilities than on the shelf, but has increased in the same period from 11 per cent to 16 per cent.

In periods of change and reorganisation, it is particularly important that the companies direct focus at preventive factors in the working environment. There is a lot of knowledge-based and documented research showing that participation and facilitating predictability and the perception of control for employees are important preventive

factors that can contribute to a good working environment.

#### *HSE climate*

The results for HSE climate in the period 2013–2017 reveal a decline in some areas. For offshore employees, this relates particularly to issues related to management's prioritisation of HSE. For example, certain questions regarding maintenance and whether production considerations take precedence over HSE, show a negative development over a longer time period – both for employees offshore and onshore. The results also show that employees who have been exposed to downsizing or reorganisation score more negatively on these statements than do others.

An increasing number state in the RNNP questionnaire survey that they experience pressure not to report personal injuries or other incidents that can “ruin the statistics”. In 2015, there were 20 per cent who said that they agreed with the statement, in whole or in part, while 26 per cent stated this in 2017. Similarly, there has been an increase from 28 per cent in 2015 to 36 per cent in 2017 for those who say they agree, in whole or in part, that reports on accidents or hazardous situations are “often doctored”. These results comprise petroleum activity both onshore and offshore.

#### **4.5.6 Shift work and night work**

Petroleum activity takes place 24-7, and is characterised by shift work, night work and long working weeks. Intensive work periods are often followed by free periods. At onshore petroleum facilities, 31 per cent report that they work in a shift system, 96 per cent of these work continuous shifts with night work. The onshore facilities have less intensive work periods than on the shelf. The percentage that have night work in the offshore petroleum activities has varied in recent years. The percentage on production facilities was 40 per cent in 2017, while the percentage on mobile facilities was 77 per cent.

Workers on the shelf work long shifts where the average work session is twelve hours. Many switch between night and day during the course of a 14-day period (so-called “swing shift”)<sup>17</sup>.

Shift work increases the risk of a number of health problems and illnesses. In recent years,

<sup>16</sup> RNNP 2016, Chapter 8: Changed risk conditions. The study consisted of a review of literature and analyses of data from the 2015 RNNP questionnaire survey, and was conducted by STAMI/NOA.

<sup>17</sup> RNNP 2017



several studies have shown negative health effects of “quick returns“ (in other words, eleven hours or less between two shifts)<sup>18</sup>.

Among workers on the shelf, 16 per cent report having worked 15 hours or more overtime during the course of the last offshore period. Moreover, 15 per cent state that they have worked more than 16 hours during the course of a day on one or more occasions during the past year, and 15 per cent report that they were awakened during their free time to perform a work task during their last offshore period<sup>19</sup>.

Working hours that include night or late evenings or long work shifts can contribute to sleep disturbances, circadian rhythm disturbances and reduced cognitive function, and these are factors that can increase the risk of occupational accidents. Long work shifts in excess of eight hours increase the risk of accidents, while work shifts of more than twelve hours double the risk<sup>20</sup>. The risk of incidents is particularly linked to night work, and the risk appears to increase with the number of subsequent shifts.

Breaks with the opportunity to sleep can contribute somewhat to restoring cognitive functions. Disturbances in circadian rhythm affect many functions, including the regulation of nearly all hormone systems. The transition between day work and night work, as well as being called out during the sleep period, entails a disturbance in circadian rhythm. The possibility to influence working hours is linked to better future health and later retirement, and adapted working hours planning can change the health risk associated with shift work<sup>21</sup>.

## 4.6 Special topics

### 4.6.1 Development in the petroleum activities

The petroleum industry is a cyclical sector which undergoes change and streamlining processes over time. The changes are extensive and include, for example, downsizing, technological development, reduced investment, reduced activity and changes in how work is organised. The pace of this change can be quite high, at least during periods – such as after the oil price decline in 2014, and several change processes may take place simultaneously. This makes the change processes complex, and it can be challenging to conduct comprehensive assessments of the HSE consequences that may result from the changes.

The business opportunities on the Norwegian shelf change over time. The discoveries made today in the most familiar parts of the Norwegian shelf are consistently smaller than was the case in the 1970s and 1980s. At the same time, a lot of infrastructure has been established over the last 50 years which has available capacity that can be exploited in the event of new discoveries. This infrastructure makes profitable development possible for many smaller fields as they can be developed with subsea facilities or simple remote-controlled platforms that can be tied in to existing fields. Several Norwegian fields have been developed with subsea facilities connected to production and storage vessels. A common feature of many such operational solutions also appears to be that they use advanced vessels as a base for conducting e.g. structural and maintenance activity.

Knowledge and new technology are thus rapidly developing in the petroleum activities. Technological development contributes to a higher level of HSE and efficiency in the petroleum activities, but can also entail new challenges that the industry must manage.

As stated in the Norwegian Parliament (the Storting) on 23 May 2017<sup>22</sup>, the Ministry announced a research and study project in 2017 to map use and practices surrounding multipurpose vessels. The announcement also included an assessment of how the development in Nor-

<sup>18</sup> Vedaa Ø et al (2016). *Short rest between shift intervals increases the risk of sick leave: a prospective registry study*. BMJ Journals

<sup>19</sup> RNNP 2017

<sup>20</sup> Dembe, A. E., J. B. Erickson, R. G. Delbos and S. M. Banks (2005). *The impact of overtime and long work hours on occupational injuries and illnesses: new evidence from the United States*. PubMed

Dong, X. (2005). *Long workhours, work scheduling and work-related injuries among construction workers in the United States*. PubMed

Weaver, M. D., P. D. Patterson, A. Fabio, C. G. Moore, M. S. Freiberg and T. J. Songer (2015). *An observational study of shift length, crew familiarity, and occupational injury and illness in emergency medical services workers*. PubMed

<sup>21</sup> STAMI-report, Vol. 15, No. 1 (2014). *Working hours and health. Update of systematic study of literature*

<sup>22</sup> Processing the recommendation from the Standing Committee on Labour and Social Affairs regarding the Representative proposal to make the Working Environment Act applicable for petroleum-related activities from vessels on the Norwegian shelf (Recommendation 298 S (2016–2017), cf. Document 8:61 S (2016–2017)).

wegian petroleum activity is expected to unfold, and which solutions may be used in the years to come with regard to new technology, new operational solutions, integrated operations, simpler facilities, etc. The study assignment was awarded to Safetec. Safetec's report was published on 8 February 2018, and will e.g. be included in the basis for discussing the multipartite work that has been initiated to arrive at a more unified understanding of the realities as regards the use of multipurpose vessels on the Norwegian shelf, cf. Chapter 4.6.2<sup>23</sup>.

In its report, Safetec asserts, among other things, that the oil industry will largely follow the development in the rest of the economy. Based on an expected weak positive development in oil and gas prices, and assuming that development and use of new technology will lower costs, Safetec believes that there will be a moderate positive development in the financial framework conditions on the Norwegian shelf in the period up to 2030. Safetec expects a high and rising rate of development up to 2022/2023.

The KonKraft<sup>24</sup> project "Competitiveness – changing tide on the Norwegian continental shelf"<sup>25</sup> primarily targets measures and recommendations connected to how to ensure an efficient, sustainable and more environmentally-friendly industry, but also touches to some extent on HSE factors and risk. Emphasis is also placed on the need to update regulations and standards to ensure the fastest possible adjustment of the relationship between regulations and new technological solutions, particularly within digitalisation. The report also underlines the need for knowledge, development, testing and implementation of new technology, and the need for a plan to step up the DEMO 2000 and Petromaks2 research efforts. While the Konkraft project does not really address HSE directly, the recommendations include a number of proposals that will have consequences for regulating and influencing various HSE aspects in the petro-

leum activities. The measures are also marked by a desire to turn the industry in the direction of changes in how work is organised and development of new operations and business models. A greater degree of digitalisation, technological development and cooperation are the most crucial assumptions for realising the recommendations in the project.

How the industry will develop in the years to come, and how fast this will occur, with new operating concepts and solutions, etc. is of great significance for assessing how the industry should be followed up in the future.

#### 4.6.2 Multipurpose vessels

The Working Environment Act applies to "[...] activities associated with exploration for and exploitation of natural resources in the seabed or its substrata, Norwegian inland waters, Norwegian sea territory and the Norwegian part of the continental shelf", cf. Section 1-3 of the Working Environment Act. The more precise scope for application of the Working Environment Act on the shelf follows from limitations stipulated in regulations to the Act, particularly the Regulations relating to health, safety and the environment in the petroleum activities and at certain onshore facilities (the Framework Regulations). This means that the Working Environment Act applies to all facilities, fixed and mobile, that have direct control over wells. Flotels (living quarters installations) and manned diving operations are also covered, regardless of whether the operation takes place from a petroleum facility or a ship. Supply and standby vessels for the petroleum activities are not covered by the Working Environment Act. However, the Ministry of Labour and Social Affairs has the regulatory authority to stipulate that the statute shall apply for "vessels that perform construction, pipelaying or maintenance activities in the petroleum activities". This power has never been exercised.

There has been a great deal of attention in recent years surrounding the use of so-called multipurpose vessels on the Norwegian shelf. The Ministry has received descriptions of a situation where an increasing part of the work on the shelf is carried out from advanced ships, and to a lesser degree from traditional petroleum facilities. In this context, it has also been asserted that the employees on such vessels work in a space not regulated by statute, and that which supervisory authority is responsible for this activity is unclear. Moreover, several employee organisa-

<sup>23</sup> Report (2018). *Study of new operating forms in the petroleum industry*. Report from Safetec to the Ministry of Labour and Social Affairs, 8 February 2018

<sup>24</sup> KonKraft is a cooperation arena for Norwegian Oil and Gas, Federation of Norwegian Industries, Norwegian Shipowners' Association and Norwegian Confederation of Trade Unions (LO), with the LO unions Norwegian United Federation of Trade Unions and Industri Energi. KonKraft shall be a supplier of premises for national strategies for the petroleum sector, and work to maintain the competitive standing of the Norwegian shelf.

<sup>25</sup> Report (2018). *Competitiveness – changing tide on the Norwegian continental shelf*, 16 January 2018

tions have stated that the described development must entail that the Working Environment Act is given application to also cover multipurpose vessels.

With this basis, among other things, the Ministry of Labour and Social Affairs asked the Petroleum Safety Authority for a factual and legal description of the situation surrounding the use of multipurpose vessels on the Norwegian shelf. The PSA's report was complete in September 2016, and confirms that vessel activity on the shelf has exhibited a growing trend in recent years, primarily due to new developments in the form of subsea solutions. However, based on the available information, the Petroleum Safety Authority could not see that an increasing portion of production or drilling and well work is actually transferred from traditional petroleum facilities to vessels. As regards the legal situation, it is the assessment of the Petroleum Safety Authority that *“there is no lack of clarity as regards which regulatory regime or supervisory regime applies for the vessels and the employees on board, although it is somewhat complicated.”* The Petroleum Safety Authority thus shows that the vessels are not operating in a space not regulated by statute. The working conditions for the employees on board are governed by the shipping legislation in the country where the ship is registered (“the flag state principle”). These regulations are based on international conventions which the respective flag states must implement. Supervision of the working conditions on vessels belongs, generally speaking, under the flag state, but the Petroleum Safety Authority has the authority to conduct supervision of the vessel activity, to the extent it falls under the Petroleum Act.

In March 2017, a representative proposal was made in the Storting (Doc 8: 61 S (2016–2017) to the effect that “[...] *the Working Environment Act shall apply in full for petroleum-related activities (including e.g. construction, pipelaying, maintenance and removal) which take place from vessels on the Norwegian shelf.*”

In response, the Minister of Labour and Social Affairs pointed out that parts of the proposal were unclear, and that the consequences of this had not been sufficiently studied. At the same time, the Minister stated that the Government would welcome multipartite work with a view towards arriving at a more unified understanding of reality among the parties. Therefore, the parties in the industry were invited to take part in such an effort in May 2017.

#### **Box 4.4 The term “multipurpose vessels”**

“Multipurpose vessels“ is not a legal term, but a generic term referring to advanced vessels that may be specially designed for a specific activity segment, but which can also be used for other activity, such as construction, repair and maintenance activities.

This could include, for example:

- Diving vessels (construction, repair, maintenance, etc.)
- Construction vessels (construction, repair, maintenance, hook-up of seabed structures, etc.)
- Well stimulation vessels (that do not directly control the wellstream)
- Pipelaying vessels
- “Walk to Work“ vessels (for possible accommodation function and gangway transfer of personnel to simpler facilities)

Safetec's report will be one of several elements to consider as a basis for the work group's discussions going forward. In its report, Safetec assumes among other things that the use of vessels in operations on the Norwegian shelf has increased in the period from 2010 to 2016. According to Safetec, the main cause of this increase is that more and more developments on the Norwegian shelf have been implemented as subsea developments, where both construction and maintenance are largely performed from vessels. Safetec expects continued growth in vessel use toward 2030.

Based on its findings, Safetec's assessment is that supervision of working environment factors on the vessels should be reinforced.

The multipartite work group will continue its discussions, inter alia with a point of departure in Safetec's report. The social partners have initially been asked to provide their input as regards the report in May of this year. The work group's efforts will culminate in a report that is expected to be available during the autumn of 2018.

#### **4.6.3 Petroleum activities in the High North**

We have had petroleum activity off the coast of Northern Norway for nearly 40 years, and considerable experience and knowledge has been acquired both in the industry and on the part of the authorities. In June 2013, the Storting

### Box 4.5 The High North – facts

*1979:*

The first exploration well on the Norwegian shelf was drilled in 1966. In 1979, the Storting allowed exploration drilling north of 62 degrees latitude, in other words, in the Norwegian Sea and the Barents Sea.

*1981:*

The first exploration well in the Barents Sea was drilled in 1980. The first discovery, 7122/8-1 Askeladd, was made in 1981 and was subsequently incorporated in the Snøhvit field.

*2 fields*

Two fields have started production in the Barents Sea, Snøhvit and Goliat.

*Barents Sea*

So far, 186 wells have been drilled in the Norwegian sector of the Barents Sea, 145 of these are exploration wells.

*Snøhvit*

Snøhvit was proven in 1984. The field came on stream in 2007 with Statoil as operator. A pipe-

line runs from Snøhvit in to the onshore facility on Melkøya near Hammerfest, where the gas is processed and cooled to LNG (Liquefied natural gas) before it is transported onward by ship. The distance from the Snøhvit field to Melkøya is 160 kilometres.

*Goliat*

The Goliat oil field is located about 50 kilometres south-east of the Snøhvit field and approx. 60 kilometres from the coast of Finnmark. Goliat was proven in 2000. The field started production in 2016 with Eni Norge as operator.

*Johan Castberg*

Johan Castberg was proven in 2011. Castberg is situated about 240 kilometres north of Hammerfest and 200 kilometres south of Bjørnøya. Planned production start-up is in 2022.

*Plans:*

As of today, there are plans to develop three new fields in the Barents Sea: Johan Castberg, Alta/Gohta and Wisting.

resolved to open the south-eastern Barents Sea for petroleum activity. This is the Norwegian part of the previously disputed area between the Norwegian and Russian continental shelves.

There is increasing petroleum activity in the northern areas on the Norwegian shelf. The conditions in the Barents Sea vary from south to north and from west to east. Temperatures drop towards the north and east, while wind and waves decrease in intensity. When planning activity in the Barents Sea, it is important to take location-specific conditions into consideration due to the variations over a relatively large geographical area. Significant knowledge and experience have been collected from when the first exploration well was drilled in 1980 and up the most active year so far, 2017.

The players and the authorities in the industry have devoted considerable resources towards mapping and developing knowledge about uncertainty and risk factors in order to reduce the risk of major accidents in the Barents Sea. This work is aimed at contributing to prevent incidents and accidents. The need for and scope of this work received particular attention in connection with the opening of the south-eastern Barents Sea, cf. Report No. 36 to the Storting (2012–2013) *New opportunities for Northern Norway – opening of the south-eastern Barents Sea for petroleum activity* and Report No. 41 to the Storting (2012–2013) *Supplementary report to Report No. 36 to the Storting (2012–2013) New opportunities for Northern Norway – opening of the south-eastern Barents Sea for petroleum activity*.

#### Box 4.6 The High North Project

The initiative “HSE challenges in the High North” was started by Norwegian Oil and Gas in 2010 and concluded in 2014. The employer organisations, the employee organisations, the Petroleum Safety Authority and the Norwegian Petroleum Directorate participated in this work.

The objective of the project was to increase knowledge about HSE challenges in the northern areas, and to establish a joint understanding of these issues.

Extensive searches of literature were conducted and a number of working seminars were held on topics related to HSE challenges in the High North:

- climatic conditions and communication
- health and working environment
- helicopter logistics and helicopter preparedness
- risk management and design
- preparedness
- logistics and ice management

There has been a high level of interest and involvement in the High North Project, and the knowledge and expertise that has been developed is shared with the parties and other stakeholders.

Some examples of projects and measures that have been initiated:

- Developing standards for Arctic operations
- Cooperation arena for operators with exploration activity “Barents Sea Exploration Collaboration” (BaSEC)<sup>26</sup>
- The Petroleum Safety Authority is conducting a number of R&D projects during the period 2015 to 2019

Experience gained from the Petroleum Safety Authority’s supervision activity so far indicates that the activity in the northern areas is prudent, with technical adaptations (winterisation) and operational measures such as stay restrictions, special clothing, etc., so that the risk of hypother-

mia and physical frostbite can be managed. Low temperatures with wind and precipitation have an impact on the design and outfitting of the facilities, and also affects the working environment on board. Work in a cold climate can e.g. affect mental processes such as alertness – and judgement.

The Petroleum Safety Authority is also involved in cooperation with the authorities in the other Arctic countries through the Arctic Offshore Regulators Forum (AORF) and through bilateral agreements with these countries. The Petroleum Safety Authority contributes to the Arctic Council, particularly in the “Emergency Prevention, Preparedness and Response” (EPPR) work group. The PSA’s activities and cooperation contribute to the exchange of experience among the parties in the industry on both the national and international level, as well as to raise the level of knowledge among the social partners concerning HSE challenges in cold climates and how the activities can be operated prudently in the north. Experience and knowledge from the follow-up activity is used in the Petroleum Safety Authority’s monitoring of the operators’ planning and execution of operations in the Barents Sea. This also entails audits on the facilities, in exploration activity and operations.

#### 4.6.4 Organisational changes

Most companies in the petroleum industry have established change and improvement programmes to increase productivity and to adapt to a lower income and cost level. Such change and improvement programmes are not new in the petroleum industry. However, in recent years there has been a more rapid development in the direction of increased use of operations and maintenance models that combine standardisation with simplification, and more flexible ways of utilising personnel. Organisational changes include, for example, lower basic staffing and establishment of central staff units that can meet fluctuating needs for local personnel or expert personnel, more campaign and activity management, movement of tasks from offshore to central support units on land and assigning more tasks to fewer groups of staff. The changes affect the entire operator and supplier chain, as well as offshore and onshore organisations, and affect many disciplines and groups of employees.

The efficiency and change processes started on the onshore facilities around 2008, i.e. considerably earlier than offshore. Most of the onshore

<sup>26</sup> The cooperation arena was established by the industry in 2015 to promote cooperation between the operating companies with activities in the Barents Sea.

facilities are now in a phase of continuous work on streamlining and cost cuts. Offshore, the biggest changes were first implemented in the operating companies. This, in turn, has led to efficiency programmes for the contractors and the suppliers.

A greater degree of rotation and more mobile employees can entail a need for expertise development and increased facilitation to avoid negative consequences for HSE. At the same time, rotation of personnel can be an effective way to achieve transfer of experience and learning. It can be challenging to understand the significance of complex change processes for HSE, cf. Chapter 4.5.5. Potential challenges depend on how the work is organised and carried out. Good risk and change management, along with well-functioning cooperation among the social partners, is therefore important. Sufficient education and training of employees must be ensured, and the operator must provide predictability for contractors through good planning. The Petroleum Safety Authority follows up how the companies manage and assess the risk associated with downsizing and change processes. Challenges linked to adjustment processes and efficiency are also followed up in the Safety Forum.

#### 4.6.5 Digitalisation

There is a rapid development within digitalisation that will affect the petroleum activities going forward. Digitalisation entails e.g. further development of integrated operations, remote control, automation, robot technology, artificial intelligence and exploitation of the opportunities that lie in analysis of large volumes of data. Among other things, this development can contribute to more efficient work processes, replace manual work, yield better analyses and contribute to better decisions. This could have clear positive effects for HSE, in part as a consequence of reduced exposure, and contribute to greater competitiveness. At the same time, this development can bring challenges, for example in relation to understanding the situation, securing information and incorrect actions. The industry must therefore actively follow up changes in the risk scenario as a consequence of digitalisation.

Both the industry and the Petroleum Safety Authority work to obtain an overview of HSE opportunities and challenges linked to digitalisation, and how these challenges can be managed. The Safety Forum also follows up this work.

#### 4.6.6 ICT vulnerability and security

Increasing use of digital technologies makes the petroleum industry more vulnerable as a consequence of vulnerabilities in ICT systems and advanced digital threats. Both human error and equipment faults can lead to disruptions in operational regularity and financial loss. Cyber-attacks are also growing in scope, becoming more sophisticated and more difficult to ward off. The changes in the risk scenario demand that the players maintain continuous vigilance and improve their ICT security and ability to handle unwanted digital incidents. The Petroleum Safety Authority has also reinforced its resources for supervision of ICT security. The need to boost supervision of the petroleum activities' ICT security and vulnerability was pointed out by the Lysne Committee, NOU 2015: 13 – *Digital vulnerabilities – Secure society* and Report No. 38 to the Storting (2016–2017) *Cyber security – A joint responsibility*.

The hostage action in In Amenas in 2013 and changes in the threat landscape have also led to greater focus and measures to improve security in the petroleum sector. The Petroleum Safety Authority has prioritised follow-up of security and preparedness linked to deliberate attacks and terrorism in the industry. The audit activity has included security and ICT security throughout the entire logistics chain. In 2017, the Petroleum Safety Authority conducted audits of supply bases, helicopter transport and offshore facilities.

Like the HSE regulations, the security requirements are formulated as functional requirements. This means that, normally, no specific requirements are stipulated for security measures. Overall, the authorities believe that there has been improvement in the security work in the petroleum industry in recent years, but that developments require even stronger follow-up in the industry.

#### 4.6.7 Preparedness

Preparedness is an important element in monitoring security in the petroleum sector. Preparedness entails continuous work to be as prepared as possible to handle various hazard and accident situations that may arise. The main objective of preparedness is to prevent or limit the consequences of accidents and near-misses. Many different players are involved in the preparedness work, and clear roles and lines of responsibility are important. It is also important to have clear notification routines for hazard and accident situations. Good

communication and good cooperation among the players are also important preconditions. There are rigorous requirements for expertise and drills, and in some cases there are also requirements regarding physical and mental fitness for the personnel who are part of the emergency preparedness organisation. Emergency preparedness systems and competence are further developed through annual drills in cooperation between the industry and the authorities.

In the petroleum activities, the operator is responsible for maintaining effective preparedness and for handling any hazard and accident situations that may arise. It follows from the Petroleum Act that licensees or others that participate in the petroleum activities must, at all times, maintain effective preparedness with a view towards responding to hazard and accident situations.

Quality, and the ability to improve, both as regards organisation, technology and personnel at all levels of the organisation, are important factors in the preparedness work. The need for preparedness measures will vary based on an assessment of risk, including geography, climate, etc. The most important preparedness work is done by the players themselves, and encompasses measures of technical, operational and/or organisational character.

Pursuant to the Civil Protection Act, the onshore facilities are also subject to supervision from the Norwegian Industrial Safety and Security Organisation (NSO) and preparedness measures must be designed pursuant to the regulations relating to industrial safety. Several of the onshore facilities also participate in various forms of preparedness cooperation.

The Petroleum Safety Authority supervises the operators' preparedness work. In the event of incidents, the Petroleum Safety Authority will continuously assess the measures the operator plans and implements, and will contribute factual information, situational understanding and impact assessments.

The Petroleum Safety Authority has established an emergency preparedness duty scheme which ensures that the agency is notified regarding hazards and accident situations, and can in turn alert other involved authorities pursuant to established agreements and notification procedures. This may include the Ministry of Labour and Social Affairs, the Norwegian Petroleum Directorate, the Norwegian Coastal Administration, the Norwegian Environment Agency, the Norwegian Maritime Authority and the relevant police district. The Petroleum Safety Authority

also notifies other nations regarding incidents that may have an impact on their petroleum activity. During the period 2015 to 2018, notification was provided for around 500–600 hazard and accident situations per year.

If required by the situation, the Petroleum Safety Authority can decide that other parties must make necessary emergency response resources available at the licensee's expense, or implement other measures at the licensee's expense to obtain necessary additional resources. Such interventions will only be relevant in the event of hazard and accident situations that can entail loss of human life or personal injuries, pollution or significant material damage.

The Petroleum Safety Authority can also establish temporary exclusion or hazard areas, if this is deemed necessary to prevent or limit certain serious harmful effects. Such areas have been established for example in connection with gas leaks to prevent vessels from coming in contact with easily ignitable gas.

#### *The authorities' responsibility and roles in connection with non-deliberate incidents on the Norwegian continental shelf*

In December 2015, a serious near-miss occurred when the unmanned Eide Barge 33 broke loose in the North Sea and drifted toward the platforms on the Valhall field. The incident showed that several of the involved players had room for improvement in their handling of notification and coordination. After the incident, measures have been implemented to improve dialogue and how information is shared between the various authorities.

In the wake of this incident, cooperation was initiated between the affected ministries under the direction of the Ministry of Justice and Public Security. The Ministry of Justice and Public Security has a coordinating role in the public security area when the issues involve multiple sectors. A report will be prepared on the roles and responsibilities of various Norwegian authorities in connection with non-deliberate incidents on the Norwegian continental shelf. This could be floating objects or other situations that pose a hazard for life, health, the environment, security or significant financial assets in the petroleum activities. The report will describe the ministries' and the agencies' areas of responsibility, and can function as a reference for similar incidents. The objective is to improve the Norwegian authorities' knowledge of each other's roles, the expertise of the various players, and which means and instru-

ments they have available in the event of similar incidents on the continental shelf. These elements are important in a robust crisis management system that is based on good cooperation and dialogue between the affected players, in line with the cooperative principle. The report will also refer to the players' lines of communication during extraordinary incidents, and identify potential areas for improvement. The Ministry of Justice and Public Security aims to finish the report in the spring of 2018.

#### 4.6.8 Diving

The HSE regulations apply to diving as for other activities in the petroleum industry. Since 1985, there has been a consent scheme for all manned underwater operations. The purpose of the consent scheme is that the operator shall document to the authorities that diving operations are carried out in line with the regulations. The Petroleum Safety Authority obtains assessments from the Norwegian Board of Health Supervision in connection with processing the application for consent.

In 2017, 15 568 staff-hours were reported in connection with saturation diving on the Norwegian shelf. The figures entail a reduction of about 65 per cent compared with diving activities in 2016, and is the lowest activity level since 2002. No injuries or hazardous situations were reported in connection with saturation diving in 2017. There have been few cases of decompression sickness after 1991, when the authorities introduced a joint framework for decompression tables for saturation diving. The last fatal accident in connection with saturation diving on the Norwegian shelf took place in 1987.

For surface-supplied diving on the Norwegian shelf, 406 staff-hours in water and no undesirable incidents were reported in 2017. The activity level for surface-supplied diving is generally low and has remained low over the past 20 years.

##### *Follow-up of the North Sea diver case*

Former divers have sued the Norwegian state in multiple rounds and demanded compensation for injuries as a result of diving in the North Sea during the period 1965–1990. The case received a final political conclusion in the Storting's decision of 16 June 2014, which concerned the processing of Proposition to the Storting No. 88 S (2013–2014) *Changes in the 2014 national budget under the Ministry of Labour and Social Affairs relating*

*to follow-up of former North Sea divers.* In line with the Storting's decision, a settlement was agreed upon between the State and divers. The settlement e.g. entailed that the divers were offered an additional 25 G (basic amount) in compensation in return for a commitment that they would not pursue the case before the courts. The compensation scheme for the pioneer divers was concluded in 2015, and the Pioneer Diver Board was phased out during the same year. Through these schemes, the State has made compensatory payments to 270 divers and their survivors. Only two former divers did not accept the offer from the State.

The settlement also entailed that a work group comprised of the authorities and parties would be appointed to more closely examine the divers' current working conditions. Furthermore, it was concluded that Stiftelsen Kontakttelefonen for pionerdykkere (Dykkerkontakten) <diver helpline> would be continued. It was also pointed out in the proposition that there should be more research environments that could shed light on issues related to diving.

##### *Working conditions for divers*

The agreement to more closely assess the divers' current working conditions was followed up through the establishment of a multipartite work group under Safety Forum. The work group has found that it would be appropriate to include diving personnel in the RNNP survey, which relates to questions concerning working environment and perceived safety. With this measure, diving personnel will be included in RNNP from 2018 on par with other personnel in the petroleum activities. The Ministry believes that this is a good measure that could provide useful information about the divers' working conditions. This knowledge would e.g. be important in the continuous work to prevent injuries and accidents.

##### *Dykkerkontakten*

Dykkerkontakten was established in 2003 to help former North Sea divers in a difficult situation. The foundation runs a 24/7 helpline, among other things. The foundation has three employees and has also accumulated relevant competence within debt counselling and other counselling in order to assist divers. Dykkerkontakten also contributes seminars, discussion groups and information online. Dykkerkontakten has a good reputation and has provided excellent medical, psychological, social and legal support to the divers for many



years. However, the need for Dykkerkontakten's services is apparently diminishing, and the work is entering a final phase. The Ministry therefore expects that Dykkerkontakten will eventually be phased out and that potential further follow-up needs will be met in the ordinary health and welfare system.

#### *Diving-related research*

The risk of delayed injuries in connection with diving has been highlighted in several contexts. For example, through PETROMAKS and PETROMAKS2, the Research Council of Norway has supported research where emphasis has been placed on HSE in diving activities on the shelf, and references results which indicate that biochemical factors are affected by diving<sup>27 28</sup>. This research is e.g. significant for procedures that can increase the safety of saturation diving. As a step in the continuous safety work, the National Institute of Occupational Health (STAMI), on behalf of the Ministry, has conducted a mapping and review of the knowledge regarding health effects of occupational diving. Both national and international studies have been assessed in connection with the work. In its report from 2017<sup>29</sup>, STAMI concludes that no certain serious health injuries have been proven from saturation diving or surface-supplied diving in the petroleum activities under normal circumstances, i.e. when the diving is carried out with a sufficient safety margin against known harmful exposure. Based on the knowledge review, STAMI's assessment is that there is no documented occurrence of serious chronic health injuries related to diving to depths deeper than 180 metres, which is in practice the limit in the Norwegian petroleum activities today. This presumes that the divers have a certification which takes into account the special conditions that apply for such dives, good work organisation, good quality control regimes and good working environment conditions. It is also important that thorough health examinations of the divers are carried out both before and after the exposure, in line with applicable regulations. STAMI also references its study

from 2010, which e.g. concluded that, compared to health monitoring of employees on land, divers appear to be safeguarded well<sup>30</sup>. In the report, STAMI points out that the current scheme with assessments before and after dives and health checks every three years, indicates that the divers are protected well with regard to health monitoring. Annual certificate verifications (or every two years) come in addition as an added safety factor.

STAMI otherwise believes there is a need for additional studies of saturation diving and potential health effects, with particular emphasis on psychological effects and effects on the central nervous system, as well as cardiovascular effects. The review will form an important basis for the authorities' further follow-up within the area, and in the work on preventing injuries and illness as a result of occupational diving. As regards the need for additional research, the Ministry has signalled through the letter of award to the Research Council of Norway in 2018, that the Ministry expects research related to occupational diving, among other things.

#### **4.6.9 Helicopter safety**

Helicopter transportation is not in and of itself a part of the petroleum activities, but is closely related as a part of the total offshore activities. Helicopter risk constitutes a significant portion of the total risk exposure for employees on the shelf.

Helicopter operations on the shelf take place in challenging circumstances. The flights are over vast open sea areas to landing sites on fixed or floating installations that can be challenging to use. There are often no emergency landing sites apart from the actual sea surface. This entails some very significant demands, firstly as regards the aircraft's reliability, equipment, procedures and flight crew training, but also for rescue equipment and for example evacuation training for passengers. In addition to these challenges, the climatic conditions in Norwegian coastal and sea areas, with frequent inclement weather and icing during winter, make the operation even more challenging.

Despite the high inherent risk of the helicopter operations, the safety development for helicopter operations in the Norwegian petroleum activities has had a clear positive trend since 1990. However, an EC225 helicopter crashed in April 2016 on the way from Gullfaks to Flesland, and 13 people died. The accident is being investigated by

<sup>27</sup> Fismen, L., Eide, T., Hjelde, A. et al. (2013). *Hyperoxia but not ambient pressure decreases tetrahydrobiopterin level without affecting the enzymatic capability of nitric oxide synthase in human endothelial cells*. *Arbeitsphysiologie*

<sup>28</sup> Fismen, L. (2013). *Nitric oxide synthesis and biochemical defense factors in saturation diving*

<sup>29</sup> STAMI Report Vol. 18, No. 4 (2017). *Knowledge status regarding diving in sheltered waters and in the offshore activities*

<sup>30</sup> STAMI Report Vol, No. 1 (2010). *Assessment of need for medical follow-up of divers in the petroleum activities*

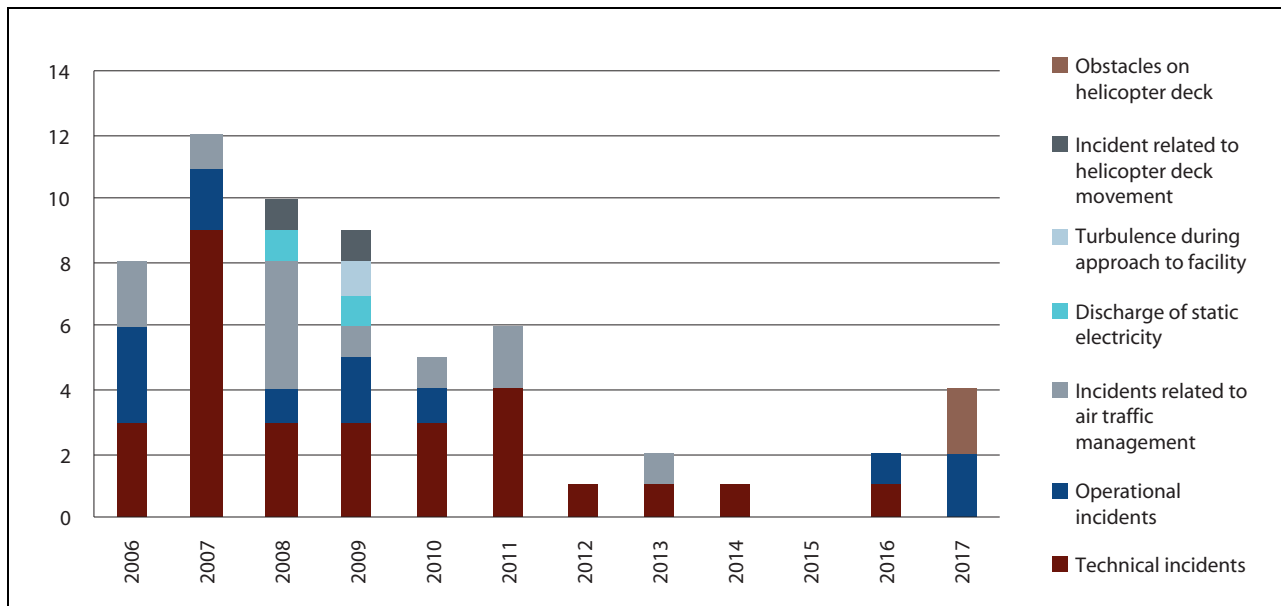


Figure 4.11 Incidents with a small or medium remaining safety margin

Source: RNNP 2017

the Accident Investigation Board Norway. A preliminary report has been published. The direct cause of the accident appears to be a fatigue crack in a gear in the main gearbox.

Figure 4.11 shows the number of incidents with a small or medium remaining safety margin, i.e. that there is no or one remaining barrier, respectively, against a fatal accident.

The Norwegian Civil Aviation Authority supervises helicopter operations in the petroleum activities on the Norwegian shelf. In order to be allowed to conduct such helicopter operations in Norway, the helicopter company must be established in Norway and be certified with a licence and Air Operator Certificate (AOC) issued by the Civil Aviation Authority. The Civil Aviation Authority supervises all helicopter operators that conduct offshore operations in the Norwegian area, as the audit responsibility falls to the state that issued the AOC certification<sup>31</sup>.

Over several decades, the helicopter companies, operators on the shelf and the employee organisations, together with the Norwegian authorities, have developed a good safety culture that contributes to the high safety level in helicopter operations on the Norwegian shelf, cf. Chapter 2.3.1. A tripartite HSE forum has also been estab-

lished for the aviation industry. Participants include representatives from the employer side (Confederation of Norwegian Enterprise – NHO), employee side (Parat, Norwegian Confederation of Trade Unions (LO), Norsk Kabinforening, Norsk Flygerforbund) and representatives from the Civil Aviation Authority.

The oil price drop in 2014 led to cutbacks to reduce the costs associated with helicopter transport. Staff cuts and a reduction in the number of helicopters in the helicopter companies have required more efficient utilisation of helicopters and crews. One outcome of this is that flight crews often perform more flights per day than before. The increased exposure time for helicopter noise and vibrations can lead to challenges with regard to the crew's working environment. This situation is being closely monitored by the Civil Aviation Authority.

Increasing oil and gas activities in the northern part of the Norwegian Sea and in the Barents Sea will entail an increased need for transport of personnel by helicopter to and from the relevant areas. The challenges in the north include a long winter season with darkness, and weather conditions characterised by fog, precipitation as snow, icing and polar low pressure. This is also a challenging weather forecasting area with few observations and vast geographical distances. Increased helicopter activity in these areas will therefore require close follow-up by players and the supervision authority.

<sup>31</sup> Unlike offshore helicopter operations, there is no requirement to have an AOC issued by Norwegian aviation authorities for onshore helicopter operations in order to be allowed to conduct helicopter operations in Norway.

**Box 4.7 Regulations for helicopter operations**

Helicopter operations on the Norwegian shelf are governed by the Regulations relating to aviation operations, which contains the ordinary operating and safety provisions for aviation operations, including helicopters. The Regulation implements EU Regulation 965/2012. Additional Norwegian rules have also been stipulated in various regulations. In addition, Norwegian Oil and Gas developed the industry standard *NOG066 Recommended guidelines for flights to/from petroleum facilities*, which contains numerous additional requirements beyond the authorities' minimum requirements regarding helicopter safety. These requirements can be consid-

ered a summary of experiences from 50 years of helicopter flights on the Norwegian shelf and is an important contribution to the helicopter safety on the Norwegian shelf.

The EU has adopted joint European additional rules for offshore helicopter operations (HOFO regulations). These rules will replace the additional national requirements. Norway's standpoint is that the joint European additional rules for offshore helicopter operations are not comprised by the EEA Agreement. The HOFO regulations have therefore not been implemented in Norwegian law.

**4.6.10 Late phase**

Facilities and associated infrastructure on the Norwegian shelf are normally designed and constructed with an estimated lifetime of approx. 15–30 years. About half of the fixed facilities are more than 20 years old, and the oldest facilities on the Norwegian shelf are now more than 40 years old. Figure 4.12 shows the age distribution of the operational fixed facilities on the Norwegian shelf, in number and percentage.

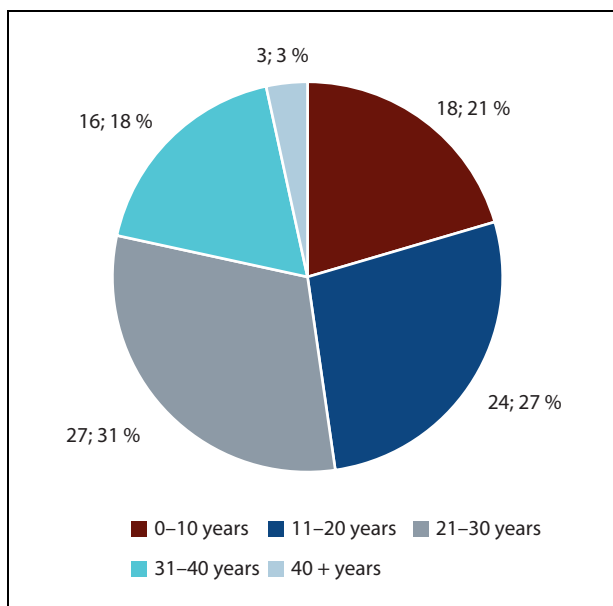


Figure 4.12 Age distribution of fixed facilities on the Norwegian shelf

Source: Petroleum Safety Authority

In order to use facilities beyond the original design lifetime, consent from the Petroleum Safety Authority and Norwegian Petroleum Directorate is required. The application for consent must be submitted one year before the planned lifetime expires. In the application, the operator must document that continued use of the facilities safeguards the requirements for prudent operations and the principles for risk reduction. As of 1 March 2017, 29 operational facilities on the Norwegian shelf have received consent for extended lifetime.

Use of facilities and infrastructure on the Norwegian shelf beyond the originally calculated lifetime requires attention on a number of factors. The operator must ensure that the safety level and technical integrity are maintained and safeguarded in an ageing facility. Changed use as the result of new or changed operational solutions, changed reservoir or drilling and well conditions and application of new technology, are all important elements that must be safeguarded.

On older facilities, the combination of new and old equipment and systems often poses a challenge. Modifications and changes can make it challenging to have an overview and understanding of the function of important safety barriers, and how they are correlated. The Petroleum Safety Authority has seen in recent years that certain incidents can be linked to deficient understanding of the interaction between old and new. Older equipment can also entail that the safety management is more operational, i.e. that there are less automatic processes to prevent and han-

dle potential incidents. For “tomorrow’s” barrier solutions it is therefore very important that the technical condition is good and that the personnel have good competence and understand the systems and equipment on the facility.

There is no basis for claiming that the general safety level on late-phase facilities is lower. Nor do figures from RNNP indicate that late-phase facilities stand out. In recent years, the industry has increased its understanding of ageing and late-phase problems and the Norwegian Oil and Gas association has issued guidelines concerning lifetime extensions, which were recently revised. However, the safety authority finds that the maintenance on late-phase facilities is characterised by being more corrective than preventative. This is a development that could weaken safety over time, and which the Petroleum Safety Authority is monitoring. In 2016–2017, the Petroleum Safety Authority e.g. cooperated with the authorities in the North Sea Offshore Authorities Forum (NSOAF) on a series of audit activities that particularly addressed issues that are relevant for late phase. The goal of the cooperation is to ensure exchange of experience and learning between the member countries in NSOAF.

#### 4.6.11 Well plugging

On the Norwegian shelf there are currently about 2000 active wells that produce petroleum, inject water or gas, or that are temporarily shut down. In addition, an estimated 100 to 150 new wells are drilled each year. Exploration wells have historically been plugged continuously, but there has been little plugging of production wells. Several fields are now approaching the end of their lifetimes and the total number of wells that will be plugged is increasing. Well plugging is therefore expected to constitute a significant portion of the activity level in the next 10 to 15 years.

Wells with deficient plugback can pose a risk to personnel, facilities and the environment. Leaks from such wells can cause a blowout, explosion, fire and pollution. It is therefore important that wells are plugged back in a manner that will prevent leaks from occurring in the future. To reduce the risk and prevent an accumulation of old wells, the authorities are concerned with ensuring the number of temporarily abandoned wells is as low as possible. The petroleum regulations stipulate that the wells that are not in use must be plugged back within a certain period.

One challenge is that older wells are not designed for being plugged and permanently

abandoned in a simple and cost-efficient manner. In addition, structural weaknesses or changes in the subsurface may have occurred during a well’s lifetime, which makes it more challenging to plug the wells. Experience from plugback projects, both in Norway and in other countries, has proven that this work can be challenging. In many cases, it has taken just as long to permanently plug a well as it originally took to drill the well.

Today, there is no one method or one tool that can be used to fulfil all regulatory requirements for permanent plugging of wells. Finding safe, good, efficient and reasonable ways to plug and abandon wells is important to prevent unnecessary costs on the shelf going forward. Work is therefore ongoing in the industry to develop new methods and tools that can increase the efficiency of well plugging work. The Petroleum Safety Authority is closely monitoring this development. Established State funding schemes, for example through PETROMAKS2, Demo 2000 and Innovation Norway, have been, and will continue to be important in this development work.

#### 4.6.12 Disposal

A number of facilities are expected to stop producing and be removed over the next ten-year period. Removal of facilities often entails multiple simultaneous activities, which places special requirements on comprehensive risk management of the activity.

In the removal phase, the Petroleum Safety Authority has supervisory responsibility until the facility, or parts of the facility, have been placed on board a vessel. From this date, the responsibility is transferred to the authorities in the country in which the vessel is registered. The Norwegian Labour Inspection Authority is the responsible authority for the onshore scrap yard. The Norwegian Environment Agency is the authority and has supervisory responsibility for elements related to the external environment.

The Petroleum Safety Authority’s experience is that the companies’ execution of removal activities has substantially improved from when the first facilities were removed until today. In close cooperation, operating companies and involved contractors have developed equipment, methods, competence and systems which support a high HSE level. The Petroleum Safety Authority also finds that there is a greater extent of facilitation for safe removal of facilities when new developments are engineered.



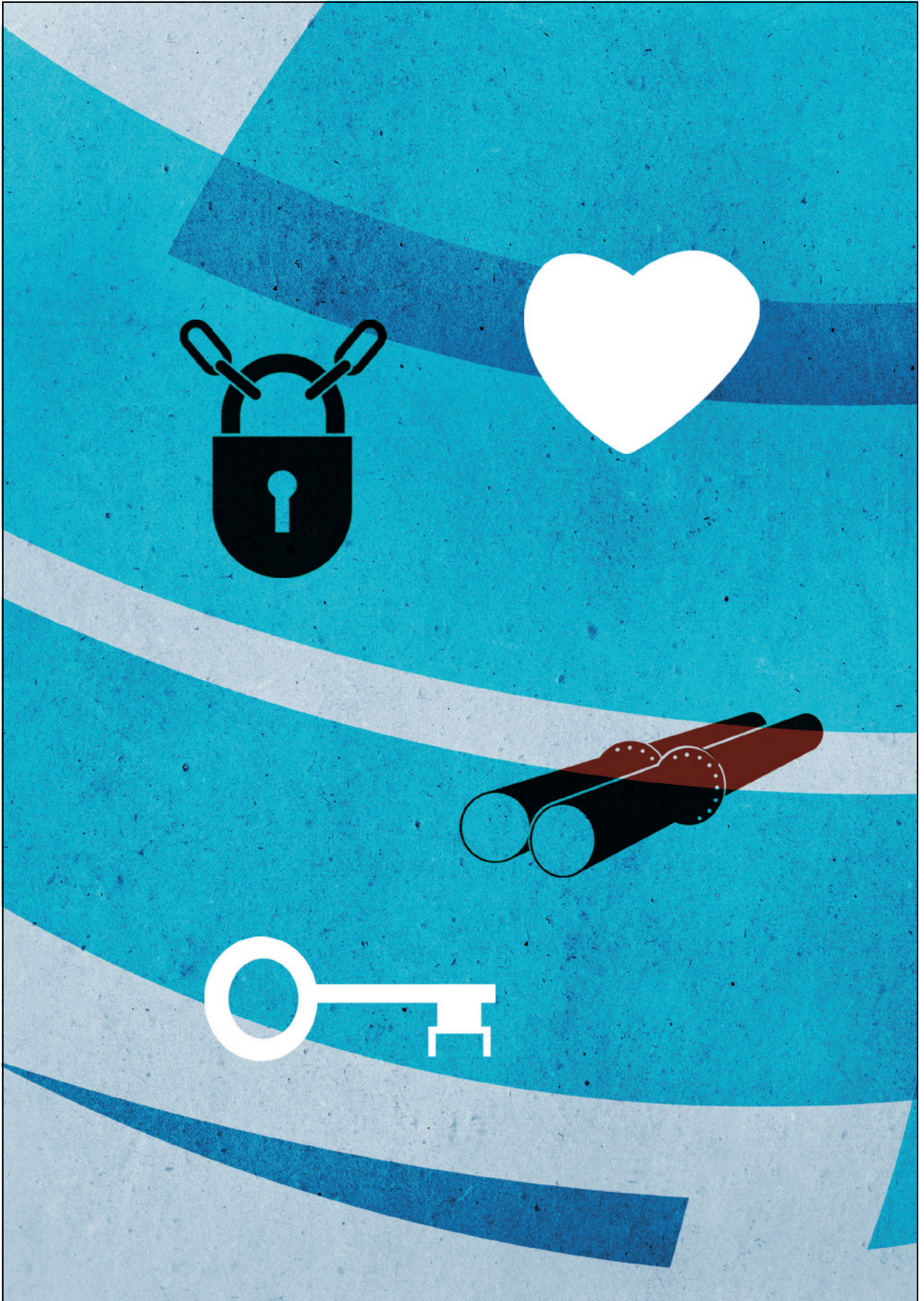


Figure 5.1

## 5 Follow-up of the HSE regime

Today's HSE regime was developed on the basis of experience gained since the beginning of the Norwegian petroleum activities, cf. Chapter 2.1.3. It is presumed that this regime, which emphasises a functional approach to the regulations and accountability of the industry in the safety work, has been an important foundation for a positive development and a high HSE level in the Norwegian petroleum activities.

Storting Report No. 29 (2010–2011) *Joint responsibility for a good and decent working life*, pointed out important challenges for the petroleum industry in the future. The Report e.g. pointed out that changes in activity level and the player landscape, with more small and international companies on the Norwegian shelf, could be significant for an active and well-functioning multipartite cooperation. The significance of tackling the challenges so that they do not lead to increased risk and damage to health, safety and the environment, was emphasised. This will require continuous awareness of the fact that authority follow-up and regulations must be designed such that new development trends and challenges are detected and handled in the optimal manner. The Ministry therefore signalled an exhaustive review and assessment of the HSE regime within the petroleum activities. This review was required to potentially confirm that the current scheme was expedient, or as a signal that major or minor changes were required. As follows from Chapter 4.2.4, a technical expert group was appointed in 2012 to review and assess the current HSE regime. In 2013, the expert group concluded that the Norwegian HSE regime for the petroleum activities predominantly works well, but that it has some important challenges. The group e.g. pointed out a need for clearer prioritisation and use of policy instruments on the part of the authorities and to consider a clear practice for cost-benefit assessments when introducing new regulations and administrative decisions. It was also pointed out that the authorities should improve the management of major accident risk through clearer and more detailed requirements for risk acceptance criteria and risk analyses.

In November 2016, the Ministry of Labour and Social Affairs also invited affected parties and authorities to join a work group for joint assessment and discussion of the HSE status and development in the Norwegian petroleum activities. The background for this was that the HSE development in 2015 and 2016 created a need to focus on the HSE situation in the petroleum activities. An important goal of the work group was to arrive at a representative and unified overview of the status of HSE in the petroleum activities. The group would also assess what would be required to maintain and improve the safety level, in parallel with efficient and commercial operations. The parties' and authorities' perception regarding the status, challenges and potential paths to further development and improvement would be included as a basis for this Storting Report on health, safety and environment in the petroleum industry. The work group's report was presented to the Ministry on 29 September 2017. The work group pointed out that the authorities and parties, through the years, have supported the current HSE regime, which emphasises function-based rules, holding the players accountable and risk-based and dialogue-based supervisory follow-up. The work group concludes that the regime for follow-up of health, safety and environment in the Norwegian petroleum activities generally functions well and should be continued. The HSE regime facilitates innovation and flexibility in development and the selection of good solutions. This flexibility is desirable as the industry is in rapid development and the companies need to use the technology that is best suited at any given time. This flexibility constitutes the *latitude* in the regime. The latitude allows the parties to challenge each other and the authorities with regard to interpretation and follow-up of framework and opportunities. At the same time, the latitude has limits. The work group pointed out that challenges and testing the limits of the latitude can lead to jeopardising the trust between the players and increased pressure on how the regime is organised.

The work group also agreed that continuous improvement of health, safety and working environment is a precondition and shared goal in the petroleum activities. To ensure efficient operation and continuous improvement, the industry and authorities must always reach for, learn from and utilise new knowledge and new technology. The parties in the work group also agreed on cooperation measures for improved follow-up in a number of areas.

Through PETROMAKS, the Research Council of Norway has funded a project which analysed the unique features of the Norwegian regulatory regime, and compared it with other safety regulations<sup>1</sup>. The research shows that the safety regulation in the Norwegian petroleum activities has developed in a different manner than corresponding safety regulations on land, largely due to the strong tripartite cooperation. The research shows that the tripartite cooperation is a strength, both with regard to legitimacy, democratisation and efficiency. The project shows that trust is important for a functional tripartite cooperation, but experience also shows that trust-based structures are vulnerable. In the comparative study of the regimes in Norway, the UK and USA, the project shows that there is an important divide as regards whether the regulations are based on prescriptive and detailed rules or on describing the purpose and functional requirements. Prescriptive regulations reduce the ambiguity and number of possible actions and is a good fit where conflicts of interest are “legalised”. Function-based regulations allow for multiple possible solutions when conflicts of interest occur. The preconditions for function-based regulations to work are a high tolerance for uncertainty, high degree of trust between players and a supervisory practice that can be more instructive and dialogue based.

## 5.1 Follow-up by the industry and companies

Like other parts of Norwegian working life, the companies themselves are responsible for the HSE level in the petroleum activities.

Active and continuous follow-up from the industry itself is required to establish, maintain and further develop a high HSE level. Managers at all levels have a special responsibility to contri-

bute to reducing the risk of major accidents and work-related illness and injury. The current HSE regime requires the industry and companies to be knowledgeable and able and willing to follow-up the expectations and framework that follow from the regime, including cooperation with the employee side, follow-up of the authorities’ supervision, as well as understanding and respect for the regulatory framework.

The HSE regulations impose an overarching responsibility on operating companies to ensure that regulatory requirements are met and that the other players in the activities are following up their duties. This is particularly important during a period characterised by major changes, and when there is uncertainty regarding how changes in work processes, staffing and organisation will affect health, safety and the environment going forward. The operator is responsible for daily operation of the petroleum activities, but does not have sole responsibility. The licensees must follow-up their duty of care and ensure the operator is running the activities responsibly and in compliance with applicable regulations.

Experience from the Petroleum Safety Authority’s audits in recent years shows that operating companies in the operations phase are generally actively following up to ensure that management systems have been established and function as intended, and that the HSE level is adequate. The Petroleum Safety Authority also believes that the companies largely do follow-up the duty of care, but that it can be more challenging to follow-up suppliers further down in the supply chain.

The petroleum industry has a tradition of sharing experience and facilitating learning after incidents, both nationally and internationally. Exchange of experience and learning is facilitated through established cooperation forums at the company level, in the tripartite cooperation and the authority level. This has among other things, contributed to changes in the regulatory regime and organisation of the authorities, further development of regulations, technological development and changes in the companies’ systems.

For many years the Norwegian Oil and Gas association, Norwegian Shipowners’ Association and Federation of Norwegian Industries have conducted joint projects to improve safety on the Norwegian shelf, cf. including the gas leak project, chemicals project and noise project mentioned in Chapter 4. Through these projects, the industry has taken responsibility in situations that have required better follow-up.

<sup>1</sup> Lindøe, P., Baram, M., & Renn, O. (Eds.) (2013). *Risk Governance of Offshore Oil and Gas Operations*



Prevention of *major accidents* has been, and remains, the most important task of the parties in the petroleum activities. Two of the most important focus areas for the industry will continue to be reduction of the number and severity of hydrocarbon leaks and well incidents. For this reason, the Norwegian Oil and Gas association has taken the initiative to revitalise the project “Reduction of hydrocarbon leaks on the Norwegian shelf” where the trade unions and the Petroleum Safety Authority are also participating. The project aims to contribute to increased learning and exchange of experience concerning the incidents, cf. Chapter 4.4.2. Information packages containing the most important lessons from the various incidents are being prepared as a part of this work. These information packages are used in connection with HSE training out on the facilities. Players in the industry are also cooperating on reducing the number of well control incidents. For example, a dedicated industry forum has been established that will work on preparing learning packages that will be distributed to all rigs, and which constitute the basic premise of the learning material that is used to learn from incidents experienced by other rigs and companies.

The *working environment standard* in the Norwegian petroleum activities has largely seen a positive development during the 2011–2017 period, but the industry still has several working environment challenges. RNNP shows a negative trend as regards psychosocial working environment and safety culture in 2017, and there was an increase in serious personal injuries. Working conditions and organisation of work have impact on safety, working environment and health. The multipartite work group emphasised that the industry must continue to work to improve the working environment, with particular emphasis on challenges such as shift work and rotation schemes, noise and vibrations, chemical health risk and ergonomic factors. The group also pointed out that, for many years, there has been a positive development in the industry with regard to incorporating working environment requirements at an early stage in the design phase of new facilities and installations. This is cost-effective risk reduction that is in line with the principles of good risk management.

The parties in the work group agreed that night work must be limited to what is necessary and responsible, and good risk assessments must be conducted in connection with planning and execution of night work. Issues related to night work are followed up in a collaboration between

the parties and authorities under the Regulatory Forum. The work group also pointed out that further work is required on developing good knowledge and documentation concerning working environment risk in the petroleum industry. The industry must work to achieve better mapping of exposure and risk, for example in connection with benzene, but also hazardous chemicals in general and other defined working environment factors for risk-exposed groups. The parties in the industry also agree that companies should register their own metering data in the national database EXPO<sup>2</sup>, and the industry associations will encourage the companies to use this database. Use of the EXPO database is highly significant for the development of broad and factual knowledge about chemical working environment in the industry. A collaboration has been established under the Safety Forum as a follow-up of the multipartite group’s recommendations. Through this project, the parties will further improve knowledge and documentation related to noise, vibrations and chemical exposure.

It is well documented that there is a causal link between working environment exposure and reduced health and job involvement in employees<sup>3</sup>. There is also increasing scientific documentation proving that a poor working environment is very costly to society and companies. At the same time, new research has shown that good working environment conditions have a positive impact on the companies’ results and productivity. And, provided that working environment measures have been means-tested and are knowledge-based, there is also increasing documentation that the cost-benefit effect of such measures is clearly positive. In an industry that needs to cut costs and streamline, there are thus good reasons for improving working environment conditions, beyond the purely safety-related. However, this is contingent upon developing the working environment based on real needs at each workplace, and that the measures being implemented are related to the execution and organisation of the actual work. It has been proven that this is important for the working environment measures to have an

<sup>2</sup> <https://stami.no/expo/>

<sup>3</sup> Karlson, Hagberg and Bergström (2015). *Production loss among employees perceiving work environment problems*. PubMed, SINTEF (2016). *Costs of work-related illnesses and injuries*, DGUV Report (2013). *Calculating the International Return on Prevention for companies: Costs and Benefits of Investments in Occupational Safety and Health* and STAMI (2015). *Fact book on working environment and health*

effect and this should therefore be a governing factor in the systematic working environment effort.

Joint projects have considerable significance for the HSE work in the petroleum sector. Work carried out in the collaboration arenas has helped challenge the parties, and led to a joint benefit for the HSE work. Surveys and research projects have led to increased insight and knowledge that is actively being used in the work. In recent years there has also been increased contact between the Petroleum Safety Authority Norway and the parties in the industry, which has resulted in elucidation and more focus on different aspects of the HSE work. At the same time, it is important that such joint projects are followed up in the individual companies, and that the effect of the projects is promoted. The multipartite work group pointed out that the parties should encourage assessments and agreements in the tripartite arenas to be followed up and to yield an effect in the HSE work and HSE level in the companies.

Due to the rapid technological development within the petroleum activities, continuous knowledge development is required when it comes to health, safety and the working environment. It is also important that new technology that could affect efficiency and safety is utilised by the companies.

The operators have made major contributions to research and study projects that are relevant for petroleum activity on the Norwegian shelf. The industry's investments in research peaked in 2013. After this, operators significantly reduced their investments. The operators have made more cuts in external R&D investments than internal R&D investments, and it is thus more challenging for the institute sector to provide necessary research funding from the operators than before. The Research Council of Norway is concerned about this development and is monitoring it in a close dialogue with the operators.

Knowledge and technology development are fundamental prerequisites for the continuous improvement work in the petroleum activities. The industry must therefore ensure that this is prioritised by the organisations and companies. The multipartite group recommended that the industry, authorities and relevant research communities, establish a work group that will examine to what extent HSE-relevant research has yielded results, and how new technology can be put to use. This is followed up in the Safety Forum.

## **5.2 Follow-up by the authorities**

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The authorities have different policy instruments for contributing to a high HSE level in the petroleum industry. This applies both with regard to ensuring serious players and cooperating on continuous improvement work in all phases of the activity.

### **5.2.1 Follow-up of the licensing system**

The HSE requirements are followed up through out all phases of the petroleum activity. The framework contributes to giving the authorities good management and control over the petroleum activities, from exploration for petroleum deposits, development and production to cessation of the activity, cf. Chapter 2.1.1. The Ministry of Petroleum and Energy is responsible for conducting licensing rounds and approval of development plans.

The safety authorities, represented by the Petroleum Safety Authority and the Ministry of Labour and Social Affairs, also give their expert assessments to the Ministry of Petroleum and Energy in connection with the applications. There is a clear division of responsibility and roles between the authorities in this work, and this division is fixed and continued. However, decisions concerning the HSE regulations can have an impact on efficient operations, and decisions concerning awards and transfers can have an impact on the safety level. The authorities must therefore ensure that we have serious and competent players on the Norwegian shelf.

The criteria for awarding production licences include requirements related to the composition of the production licences and special requirements related to expertise and operational experience for the activity in the Barents Sea, in deep sea areas, areas with high pressure and/or high temperature. These criteria were most recently made more stringent in 2011, as the result of experience after the blowout on Deepwater Horizon.

### **5.2.2 The Petroleum Safety Authority's supervision**

The most visible part of the Petroleum Safety Authority's supervisory follow-up is the continuous follow-up of the industry. The supervision covers a broad spectrum of activities from traditional control activities such as audits, meetings with the industry and investigation of incidents through all

phases of the petroleum activity. A description of the Petroleum Safety Authority's supervision strategy and method follows from Chapter 2.2.

The technical expert group that discussed supervision strategy and HSE regulations in the Norwegian petroleum activities in 2013, concluded that the Norwegian HSE regime is generally robust and should be continued. At the same time, it was pointed out that there is a need for clearer prioritisation and use of policy instruments and that the Petroleum Safety Authority should be more clear in exercising its role as a supervisory authority, in the application of the basis for supervision, dialogue-based audits and use of statutory and non-statutory instruments. The Petroleum Safety Authority has followed up this challenge through building and further developing its employees' knowledge and competence through broad-based technical training services. The expert group also pointed out a need to assess the regulations and the authorities' follow-up of major accident risk. The PSA implemented different measures based on this, such as regulatory clarifications, risk and barrier management projects and follow-up of the players in the industry. The supervisory authority and the industry have taken a number of initiatives within risk management, barrier management and management follow-up.

In 2017, the multipartite work group also agreed that a system and risk-based supervision model is a key part of the HSE regime, and should be continued. Furthermore, the group agreed on the necessity of strong and clear supervision, with necessary authority. The Petroleum Safety Authority's supervision strategy is generally based on dialogue and trust, and in order to have the necessary authority, the Petroleum Safety Authority must be competent, clear and consistent in exercising its role as a supervision and control authority vis-à-vis the industry and individual companies. There are different viewpoints regarding whether the Petroleum Safety Authority's trust-based strategy is fully appropriate given the current situation in the industry. The labour organisations in the work group expressed that, in light of individual cases, it can be questioned whether the PSA always has sufficient authority and uses its policy instruments in a satisfactory manner. This particularly applies in connection with repeated findings of undesirable factors and conditions.

In a broad sense, the supervision term can be understood as all activity and use of policy instruments that are implemented to follow-up the intention of and compliance with the regulations. It

thus includes all activities that give the Petroleum Safety Authority grounds for assessing whether the companies are taking responsibility for prudent operations, during all phases of the activity. In a long-term perspective, the Petroleum Safety Authority's ambition is to contribute to prevention and continuous improvement, to support the objective of world-leading HSE results in the petroleum activities.

The Petroleum Safety Authority rarely uses formal sanctions. If use of dialogue is considered to be equally efficient as formal sanctions, this is preferred. The purpose of the policy instruments, including sanctions, is to hold the players accountable and to ensure compliance with regulations. One advantage of cautious use of formal sanctions could be that the responsibility for follow-up is clearly placed with the companies themselves, and one maintains room to send more powerful signals when the PSA does not trust the players' own follow-up.

In every single case, the Petroleum Safety Authority must assess the use of policy instruments and sanctions with regard to the desired result and effect. The PSA must continuously adapt to changes in the industry and continuously assess its own supervision follow-up and use of sanctions. The supervision role is exercised and perceived differently in different contexts. The PSA must therefore be aware of and clear with regard to which signals and effect result from use of the different policy instruments. A dialogue-based follow-up promotes learning and emphasises the industry's responsibility, but can be perceived by the industry more as guidance and advice rather than authority supervision. Use of sanctions emphasises the role as a control and supervision agency. A development with changed framework conditions and more challenging situations could indicate that there is a need for the Petroleum Safety Authority to be more clear in its use of sanctions and to verify that orders are followed up, as necessary.

In recent years, the Petroleum Safety Authority has dedicated particular attention to assessment and use of policy instruments and sanctions in all phases of the petroleum activities. Most developments on the Norwegian shelf are carried out within the range of uncertainty for time and costs that is provided in the PDO. However, certain developments have experienced challenges with significant overruns, both as regards costs and implementation time. This could also be significant for quality and HSE in the engineering and construction. Based on this, the Petroleum

Safety Authority will review experiences from audits of safety and working environment in development projects in recent years, with the aim of summarising experiences, identifying potential deficiencies in project implementation and lessons learned, as well as propose measures for further development of its own supervision. This includes assessing appropriate use of audits and sanctions at an early phase of development projects.

The Petroleum Safety Authority shall therefore, in an active and visible manner, assess its use of policy instruments and how the entire spectrum of policy instruments is used in the authorities' follow-up of the companies. To ensure the Petroleum Safety Authority has legitimacy and authority in exercising the regulatory role, the agency must also ensure that it has the competence and capacity to assess future development trends, the implications this may have for supervision, use of policy instruments and potential needs for regulatory development.

### **5.2.3 Prioritised main topics for supervision**

Based on development trends in the industry over the last few years, the Petroleum Safety Authority launched the main topic "Reverse the trend – with the Petroleum Safety Authority initiating and the industry executing" in 2017. The background for the main topic was RNNP results, experience from supervision activities and incidents and information from different parties in the industry on risk, which indicated a negative trend in the HSE development in 2015 and 2016. The goal was to highlight a few key challenges and to contribute to getting the development on the right track. The three key challenges were *multipartite cooperation*, *robustness* and *standardisation*. The Petroleum Safety Authority conducted audits and carried out several other activities in its follow-up of the industry. There was a good dialogue and a high level of involvement regarding the topics in 2017.

Overall, "Reverse the trend" contributed to increased attention and knowledge regarding improvement measures in the industry in connection with multipartite cooperation, robustness and standardisation. The main topic also led to a debate and exchange of experience, and has put important topics on the agenda. Although the main topic for 2017 has been concluded, multipartite cooperation, robustness and standardisation will continue to be important topics for follow-up going forward.

In 2018, the Petroleum Safety Authority chose "Safety is a choice of value" as its main topic. With

this, the PSA is emphasising that safety is the pillar of the Norwegian petroleum activities. Without a safe industry, values are at stake. The industry is changing and constantly choosing new solutions, but protecting the life and health of people must still be the top priority. The Petroleum Safety Authority emphasises that the parties have a joint responsibility for strengthening and further developing the safety level that has been developed over many years. In order to succeed, the value of safety must be acknowledged in all decisions.

### **5.2.4 Investigation of accidents and independent committee of inquiry**

When processing Storting Report No. 12 (2005–2006) *Health, safety and environment in the petroleum activities* it was concluded that it should be possible to establish ad-hoc committees of inquiry when an external investigation of the course of events, regulations and the operator's and authorities' role is needed for incidents in the petroleum activities. In 2010, the Ministry entered into an agreement with the Accident Investigation Board Norway relating to assistance in connection with potential inquiries, cf. Chapter 2.2.4. External committees of inquiry have not been implemented after this. The employee side in the industry has requested use of independent committees of inquiry in the petroleum activities. The Ministry finds that use of independent investigations will be important and useful when required, but still does not believe that it is expedient to establish a fixed independent committee of inquiry for the petroleum activities. Based on the current scheme, a committee of inquiry can be established both when necessary due to objectivity considerations and the general trust in the authorities and regime, and with regard to learning and improvement. An external, independent committee of inquiry will therefore be considered, for example when there is a need to assess the authorities' role and follow-up, and for particularly serious incidents.

### **5.2.5 Measures to reduce the cost level on the shelf**

In the Government's political platform in 2013 (the Sundvolden platform), the Government expressed a commitment to reduce the cost level on the Norwegian shelf. A review of potential measures to simplify the movement of mobile facilities between different countries' shelves in the North Sea was therefore initiated, as well as a

cooperation between the authorities to prepare a joint guideline for socioeconomic analysis for decisions in the petroleum activities.

#### 5.2.5.1 *Easier movement of mobile facilities between different countries' shelves*

On behalf of the Ministry of Labour and Social Affairs, the Petroleum Safety Authority prepared the report "*Movements of mobile facilities between continental shelves in the North Sea Basin*" in 2015. In the report, the Petroleum Safety Authority identified possible measures that can make it easier to move mobile facilities between the Norwegian and UK shelves and/or reduce costs and increase efficiency, without concluding whether it would be expedient to implement the measures.

On behalf of the Ministry, the Petroleum Safety Authority has continued working on selected measures that were identified in the report. Of these, measures that are not expected to have a negative impact on the HSE level were followed up. These measures include clarifying the regulations in certain areas, as well as certain changes in the supervisory follow-up and regulations for mobile facilities. Other assessed measures have either not been feasible, would not increase efficiency, or are expected to have a negative impact on the HSE level. The Government will not implement measures that are expected to have a negative impact on the HSE level in the petroleum activities.

#### 5.2.5.2 *Sector guideline for socioeconomic analysis*

When assessing State measures that are expected to yield significant benefit or cost effects, including significant budget-related effects for the State, an analysis must be carried out in accordance with the applicable circular letter for socioeconomic analyses.

To improve the quality of such analyses, the Ministry of Petroleum and Energy is in charge of a project that will prepare a joint sector guideline<sup>4</sup> for socioeconomic analysis for the petroleum sector. The sector guideline will cover decisions in the petroleum sector, regardless of which authority makes the decision. The Ministry of Petroleum

and Energy, Ministry of Climate and Environment, Ministry of Finance, Ministry of Labour and Social Affairs, Norwegian Petroleum Directorate, Norwegian Environment Agency, Petroleum Safety Authority and Norwegian Government Agency for Financial Management are participating in the work. The purpose of the sector guideline is to contribute to ensuring a sound decision basis prior to authority decisions. A good decision basis will yield better considerations for resource utilisation and HSE. The sector guideline will e.g. specify how to take into account major accident risk and emissions/discharges that could have a negative impact on environmental values that is hard to quantify. The work on the sector guideline is in the final phase.

### 5.3 Participation and multipartite cooperation

The two-party and three-party cooperation are major preconditions and important arenas for the HSE regime in the Norwegian petroleum activities. Good cooperation presumes sound and open communication and mutual recognition of roles and responsibilities. A good two-party cooperation in the enterprises is characterised by good processes, transparency and real participation in the relationship between the employer and employee sides. The formal basis and different arenas for multipartite cooperation and participation are discussed in Chapter 2.3.

Employee participation entails that the employees and their representatives are involved in the relevant processes so that their input and opinions can constitute a part of the decision basis, that they have the necessary knowledge and that they are allowed the time necessary to perform their tasks. Through employee participation, the employees' overall knowledge and experience is used to ensure matters are sufficiently elucidated before decisions are made regarding health, safety and environment, and that the employees are given the opportunity to influence on their own work situation.

Employees in the petroleum activities have important knowledge and experience that contributes to the foundation for good HSE work. Participation is therefore considered a precondition for responsible petroleum activities, and shall be carried out in the various phases of the activity. Audit experience shows that in companies with a good cooperation climate, where real employee participation works, the multipartite cooperation

<sup>4</sup> The circular letter for socioeconomic analyses allows for the preparation of sector guidelines that provide in-depth explanations and guidelines for sector-specific calculation preconditions.

contributes positively to the health, safety and environment work.

The companies shall facilitate real employee participation, and ensure that statutory schemes such as working environment committees and safety delegates are used well in preventive HSE work, and in connection with change and streamlining. The petroleum industry has undergone a challenging period with downsizing and reorganisation. This situation can also be challenging for the established multipartite cooperation. In connection with its main topic in 2017 “Reverse the trend”, the Petroleum Safety Authority pointed out that it has registered increased pressure on the multipartite cooperation, particularly in connection with streamlining the enterprises and downsizing. The multipartite cooperation was followed up through numerous activities in 2017, in audits, status meetings with the companies’ management, the Safety Forum, meetings with trade unions and forums for coordinating main safety delegates. The PSA has found that the multipartite cooperation has varying degrees of functionality in the companies. The perceived pressure on the two-party cooperation can be correlated with the fact that the industry is adapting to changed framework conditions. The development in management and organisation methods, which may entail that less emphasis is being placed on real participation and cooperation, could also affect the two-party cooperation. However, there are nuances between the parties in the industry concerning the perception of to what extent participation and cooperation in the petroleum activities have come under pressure. Audits of employee participation in change processes also show that several players are able to achieve good processes with broad involvement and that there is a good cooperation between management, the safety delegate service and employee representatives.

A study published by the Petroleum Safety Authority in 2016 showed that the employee side was not involved sufficiently and early enough in HSE-critical issues, that the safety delegates experienced challenges related to sufficient time, and weaknesses and deficiencies in training and expertise<sup>5</sup>. Most companies had formal systems and structures in place, but there was some variation with regard to how well this worked in practice. *IRIS* and *Fafo*, on behalf of the Petroleum Safety Authority and the Norwegian Labour Inspection Authority, carried out a research pro-

ject on employee participation in the petroleum activities and at major construction sites on land<sup>6</sup>. The project examined preconditions for and challenges with facilitation for employee participation at the company level and in contract chains. A general impression from interviews with some companies in the petroleum sector is that both the employer side and employee side are active and involved in the HSE work. The cooperation is often described as challenging, but constructive. The companies had many good intentions and experience with employee participation and multipartite cooperation. The companies devoted considerable time and resources to cooperation with the trade unions, and organisation of the safety delegate service and working environment committees.

Trust in the two-party cooperation is a foundation for the tripartite cooperation and a precondition for the Norwegian HSE regime. Around year 2000, there were signs that the parties in the industry lacked a joint point of departure and a joint perception of the risk level, and that sufficient emphasis was not being placed on multipartite cooperation and participation. Concrete steps were taken to improve the tripartite cooperation, e.g. through the establishment of the Safety Forum in 2001. RNNP was also established in 1999 to contribute to a unified understanding of the development in risk level among the employer side, employee side and authorities. After this, the Norwegian petroleum activities were considered a vanguard industry with regard to organisation and cooperation between the three parties.

The multipartite work group from 2017 agreed that the tripartite arenas in the petroleum activities generally work well and should be continued. Important topics and issues are put on the agenda and discussed between the three parties, and the discussions are characterised by a willingness to cooperate. In 2017, the Safety Forum was expanded with members from the Tekna (Norwegian Society of Chartered Technical and Scientific Professionals) and NITO (Norwegian Society of Engineers) employee organisations, and this is particularly relevant based on the rapid technological development and the challenges that this entails for the petroleum activities.

In the tripartite arenas, the parties are largely represented through their organisations, and the discussions take place at a general and principal

<sup>5</sup> Petroleum Safety Authority (2016). *New study on employee participation and multipartite cooperation*

<sup>6</sup> Melberg K., Solberg A., Bråten M., Andersen R. (2018). *Employee participation in the petroleum industry and at major construction sites*

level, cf. Chapter 2.3.1. The organisations cannot formally require their members to specifically follow-up discussions and agreements in the tripartite arenas, although the organisations' advice can have a major significance for the companies' prioritisations.

Joint initiatives and projects in prioritised areas have been implemented under the Safety Forum, cf. for example the discussion in Chapter 4 of the chemicals project, noise project and northern area effort. These are considered positive collaborative projects that have led to involvement and activity in the industry. At the same time, there are situations today where the tripartite cooperation is being challenged to a greater extent than before. There may be a need and potential for better utilisation of the tripartite arenas for reaching agreement on challenges and follow-up. The added value of the tripartite cooperation is contingent upon discussions in the tripartite arenas leading to cooperation on follow-up and measures.

The companies have undergone major changes over recent years and have gained considerable experience with employee participation when implementing challenging change processes. There are examples of both processes where the participation has worked well and processes with deficient participation. It is important that this experience is used for further learning. Based on a recommendation from the multipartite work group from 2017, a multipartite effort has been initiated under the Safety Forum to collect, discuss and compare experience with the aim of learning and further development of the multipartite cooperation. This group can e.g. discuss and define roles and responsibility in the two and three-party cooperation, and discuss various management systems.

#### 5.4 Learning, exchange of experience and prevention

The petroleum industry has extensive experience with sharing knowledge and experience and facilitating learning from incidents. Knowledge and experience are exchanged through established collaboration forums at the enterprise level, in the tripartite cooperation and at the authority level.

Challenges related to learning and the question of why lessons have not been learned, often come up in connection with investigation of incidents and accidents. Both direct triggers and underlying causes of accidents often have com-

monalities. In connection with investigation of major accidents, it is often found that information and knowledge in the organisations could have contributed to preventing the accident.

However, it is not just undesirable incidents that provide grounds for learning. There is also a lot to learn from why things go well. PETROMAKS2 has funded research that has contributed to increased knowledge about why accidents do not occur, and which preconditions must be present for a work operation to be characterised as a success<sup>7</sup>. Knowledge has been developed which could help the industry achieve more targeted learning from successful operations. This will in turn contribute to the industry being more proactive in the safety work, so that management systems and procedures and actual work practice can be adjusted *before* an undesirable incident or accident occurs.

Today, there are many meeting venues and arenas where HSE is being discussed and there is a vast scope of knowledge that can be shared. However, the knowledge needs to be systemised to a better extent in order to yield good learning after incidents. Through Safety Forum, the parties have appointed a multidisciplinary multipartite work group on this basis, which will assess how sharing of knowledge can be made more efficient and systematic in a long-term perspective.

#### 5.5 Organisation of regulations and use of standards

Expedient and up-to-date standards are important for a functioning regulatory regime. From approx. 2005 to 2014, there was a development towards more company-specific requirements in the industry. After 2015, however, there has been a clear development towards using joint standards. The Norwegian Oil and Gas association has also conducted a project with the aim of identifying company-specific requirements, pointing out their unfortunate consequences and proposing measures to move away from company-specific requirements and instead use joint and recognised industry standards. IOGP also has a major project to identify and coordinate company-specific requirements and, over time, promote them as joint industry standards (ISO).

Through the years, the standardisation work has had varying levels of involvement and impact.

<sup>7</sup> SINTEF (2016). *What do you do when you build safety? – Practitioners' guide to learning from successful operations*

Among other things, in 2013 this led to a considerable lag in updating standards that are referenced in the regulations. However, extraordinary measures in the standardisation work have contributed to rectifying this situation, so that the NORSOK standards today are largely updated<sup>8</sup>.

The NORSOK owners (the Norwegian Oil and Gas association, Federation of Norwegian Industries and Norwegian Shipowners' Association), agree on the following goals for petroleum standardisation:

- Ensure a prudent safety level
- Increase use of international standards
- Reduce use of special Norwegian requirements
- Reduce the need for internal company specifications
- Ensure standards represent cost-efficient solutions
- Contribute to strengthening competitiveness for the Norwegian continental shelf

The authorities also support these goals. The Petroleum Safety Authority wants to contribute to ensuring the industry has relevant standards that fulfil the need for detailed specifications, so that users can comply with functional requirements in the regulations. It is also important that standards are further developed, so that they help maintain a high HSE level and HSE development in line with the technological development.

The development in the industry in recent years with a generational shift, new players, etc. indicates that there is a need to promote knowledge concerning the function-based regulation. One of the multipartite work group's recommendations was therefore that the Petroleum Safety

Authority, in cooperation with the parties in the industry, takes the initiative to assess the established training that is offered in relation to the regulatory regime. The objective of the work will be to further develop the training that is offered and increase the competence regarding the regulatory regime in the industry. This work is anchored in the Regulatory Forum.

## 5.6 Knowledge development

The industry's prioritisations are crucial for the knowledge development in the petroleum activities. Investments in research and technology are mainly funded by the oil companies. In 2016, these investments totalled about NOK 3.2 billion for the sector overall. Development in recent years shows that investments in R&D increased until 2013 to a level just under NOK 4.2 billion, and then started declining. After 2013, however, the percentage of internal company research activity has increased. This indicates that the external research communities have experienced the greatest reductions. The Research Council of Norway is concerned about this development and is monitoring it in a close dialogue with the operators.

The Ministry of Labour and Social Affairs has overarching regulatory responsibility for research on safety and working environment in the petroleum activities. The publically funded research is generally organised as a part of the Research Council of Norway's major petroleum programme, PETROMAKS2. This effort has been continued and synchronised with the rest of the PETROMAKS2 programme, and has been converted into a continuous operation with three-year programme plans.

<sup>8</sup> Project NORSOK analysis (2016). *NORSOK owners' recommendations concerning resource efforts and prioritisations for further work on the NORSOK standards.*







Figure 6.1

## 6 The Government's conclusions

Based on the summary of facts and discussion in Chapters 1-5, the Government gives an account in Chapter 6 of ambitions and expectations for further development and follow-up of HSE in the petroleum activities.

### 6.1 Expectations regarding the HSE level

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The petroleum activities are Norway's largest industry measured by value creation and revenues for the State. At the same time, the petroleum activities are an industry with a potential for major accidents and with working environment challenges, which means that the HSE work and HSE standards must be subject to stringent requirements. Safety has an expiration date. The HSE situation in the petroleum activities must therefore always be a top priority. "Good enough" is not enough when it comes to the safety and working environment level in this industry. The Government's ambition is for the Norwegian petroleum activities to be a world leader within HSE. This ambition stands firm, and is a clear signal to the petroleum industry that it must work hard to continuously improve safety through all phases of activity. The vision of being a world leader, requires the industry to have a preventive and long-term approach to HSE. It presumes that the industry does not take a high safety level for granted, but works for constant improvement. A key requirement in the petroleum regulations is that the players continuously further develop and improve the level for health, safety and environment.

Over time, the HSE level in the petroleum activities has developed positively, and the authorities and parties in the industry agree that the safety level is high. In 2017, the major accident indicator was at a low level. However, the Norwegian petroleum activities have been characterised by changes, both in activity level, profitability and player landscape. There were multiple serious incidents and accidents in 2015 and 2016. In 2017, RNNP showed a negative development as regards

psychosocial working environment and safety culture, and there was an increase in the number of serious injuries. To ensure sustainable development in the Norwegian petroleum activities, it is still a necessity to further develop the safety level, implement streamlining measures and reduce the cost level. The activities must have a long-term perspective with a focus on a high HSE level, resource management and value creation. The industry must safeguard all these considerations. The Petroleum Safety Authority shall follow up to ensure that the industry continues to further develop a high safety level in connection with streamlining measures.

### 6.2 Follow-up of responsibility

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The companies are responsible for the HSE level in the petroleum activities. The authorities' follow-up comes in addition to, and not as a replacement for, the companies' own follow-up. The HSE regulations in the Norwegian petroleum activities stipulate stringent requirements for goal achievement, but allow freedom in choosing solutions. This gives the industry latitude that facilitates the development of new solutions for increased efficiency, and simultaneously a high HSE level. The adjustment that the petroleum industry has undergone in recent years shows that the industry itself also has considerable influence over the cost level in the petroleum activities. Both the responsibility for and key to continuous improvement of the HSE level and efficient operations therefore lie with the industry itself.

It is expected that the industry is capable of managing and adapting to changes in the petroleum activities while also taking responsibility for further developing and strengthening safety and the working environment. This responsibility also entails follow-up of the duty of care, both the operator's follow-up of suppliers down in the chain and the licensees' follow-up of the operator. The industry's efforts within this area should be strengthened going forward.

The current HSE regime is contingent upon the parties in the industry facilitating cooperation and participation in the two-party and three-party arenas, and participation and multipartite cooperation must be highly prioritised in the industry. It is positive that the cooperation in the tripartite arenas is perceived as constructive and well-functioning. It is also positive and important that the industry is jointly taking responsibility for establishing and following up important improvement projects to reduce accident risk and improve the working environment, for example the chemicals project, gas leak projects, etc. The significance of the tripartite cooperation, however, depends on this having an impact on the two-party cooperation and the HSE work in the companies. The organisations in the tripartite cooperation must therefore take responsibility for ensuring discussions, exchange of experience and learning are communicated to and followed up among their members.

### **6.3 Regime for follow-up of health, safety and the environment**

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The regime for follow-up of health, safety and the environment in the petroleum activities was developed and designed with regard to follow-up of a complex and high-tech industry undergoing constant development. Generally, the authorities and parties consider the current HSE regime to be robust and well-functioning and believe it should be continued. The HSE regime is considered to have been very significant for the positive development and high safety level in the petroleum activities today. The established HSE regime will continue to be important, given the high risk potential and rapid technological development in the industry. At the same time, good use of the latitude in the regime presumes that the three parties have mutual trust and respect for each other's roles and responsibilities. In recent years, it has been discussed whether the development, with changes in the player landscape, adjustments and streamlining requirements and pressure on the multipartite cooperation, could challenge the current HSE regime. Challenges and testing the limits for choosing solutions can lead to jeopardising the trust between the players and putting pressure on the HSE regime. The players in the industry must be aware of this.

The petroleum industry must emphasise the added value of the multipartite cooperation. This cooperation is an important pillar of the regime,

and must be strengthened and further developed. The Government is pleased that the parties in the industry are aware of their responsibility and have implemented cooperative measures to get on a better track as regards multipartite cooperation, regulatory understanding, follow-up of major accident risk and working environment challenges, among other things.

The Petroleum Safety Authority must be a strong and clear authority and must assess its use of policy instruments in an active and visible manner. This applies to all phases of the petroleum activity, from awards and production to cessation and disposal. The development could indicate that there is a need for the Petroleum Safety Authority to be clearer in its use of sanctions in certain cases, and to verify that nonconformities and orders are followed up when necessary.

Through follow-up of the licensing system, the authorities jointly contribute to a high safety level on the Norwegian shelf. Decisions concerning the HSE regulations can have an impact on efficient operations, and decisions relating to awards and transfers can impact the safety level on the Norwegian shelf. The authorities must therefore ensure we have serious and competent players on the Norwegian shelf. The Petroleum Safety Authority and Ministry of Labour and Social Affairs' practice of the award criteria as regards the HSE consideration should be reviewed at regular intervals, to ensure these considerations are safeguarded in a satisfactory manner. This way, experience from serious incidents and development trends in the industry can form a basis for potential adjustments of the award criteria and how they are practiced. Important purposes of the award criteria and how they are practiced include promoting good resource management and a high safety level.

### **6.4 Further development in the petroleum activities**

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The petroleum industry is constantly changing. After the oil price drop in 2014, major change and streamlining processes were implemented, and they are still ongoing. The change processes are rapid and complex, and it can be challenging to carry out comprehensive assessments of the HSE consequences that the changes might have. Good competence and capacity are preconditions for safe and prudent operations. The Government expects the industry, during times of change, adjustment and cuts, to ensure relevant

and sufficient competence, through both recruitment and competence development. Going forward, the petroleum industry must also be very aware of changes in work content and working environment in connection with adjustments, and work to ensure companies focus on prevention and follow-up of potential health effects of such changes.

Knowledge and new technology are continuously being developed in the petroleum activities and new concepts and operation methods are applied over time. Technology development is a requirement for increased safety and efficiency in the petroleum activities. Digitalisation is also a part of this picture. However, new technological and digital solutions can also bring new challenges. To make room for development and facilitate efficient operations, the requirement for continuous improvement must therefore be viewed in a longer perspective, and not in isolation in connection with individual cases. New technology that is significant for both efficiency and safety must be utilised. The industry must ensure that this is prioritised by the companies. The petroleum industry must ensure continuous improvement of the HSE level, also during times with major changes and streamlining requirements in the industry.

As follows from Chapter 4.6.2, a multipartite work group is working on issues concerning use of vessels on the shelf, and the overarching goal for this work is to arrive at a more unified perception of reality in the “multipurpose vessel issue”. In this connection, reference is also made to recommended decision no. 1101 (2016–2017), where the Storting asked the Government to assess possibilities for stipulating Norwegian wage and working conditions in Norwegian waters and on the Norwegian shelf. The assessment falls under the authority of the Minister of Trade and Industry, and will e.g. clarify the coastal state’s latitude in Norwegian waters and on the Norwegian shelf without conflicting with the flag state principle. It could be relevant to also consider this assessment in connection with the multipurpose vessel case. The Government will get back to the Storting concerning the matter in the appropriate manner when these processes have been finalised.

In their reports, both the Petroleum Safety Authority and Safetec paint a picture where an increasing share of the activity on the Norwegian continental shelf is being conducted from ships, see Chapter 4.6.2. A natural consequence of this development is that the safety authorities dedicate

more attention to this part of the petroleum activities. The Government will therefore intensify supervision efforts vis-à-vis vessel activity on the continental shelf, within the framework of the Petroleum Act.

## 6.5 Knowledge and documentation

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Continuous knowledge development and good documentation are necessary in connection with HSE in the petroleum activities, not least as a result of the technological development. Further development and follow-up of RNNP is an important measure in this context. Measures to increase the response rate and ensure the quality of RNNP’s questionnaire, as well as how the RNNP work can be organised and strengthened to ensure balanced and precise use of results and analyses, will be assessed further. The Ministry will follow this up in cooperation with the Petroleum Safety Authority and the industry.

In upcoming years, there will also be a need for investment in research and innovation within HSE in the petroleum sector. The need for more knowledge is supported by the Government’s long-term plan for research (Meld. St. 7 (2014–2015) Report to the Storting *Long-term plan for research and higher education 2015–2024*), where it emerges that the petroleum activities need new knowledge in order to maintain the high standards for health, safety and environment. Traditionally, research within HSE in the petroleum activities has been aimed at issues that have been important to the industry. It is also important to explore broader issues that may become relevant to the industry over the long-term. The Research Council of Norway has pointed out a need for increased knowledge, e.g. on the significance of change processes and changed framework conditions for working environment and major accident risk, as well as special challenges related to petroleum activity in the northern areas.

During times of major adjustments and changes in the industry, it is crucial to generate a knowledge basis that is as relevant as possible. The Government expects basic and applied research that contributes to new competence, technology and innovations to prevent major accidents and improve health, safety and environment in the petroleum activities. In the future, knowledge and technology development must be a high priority in the industry, organisations and companies.

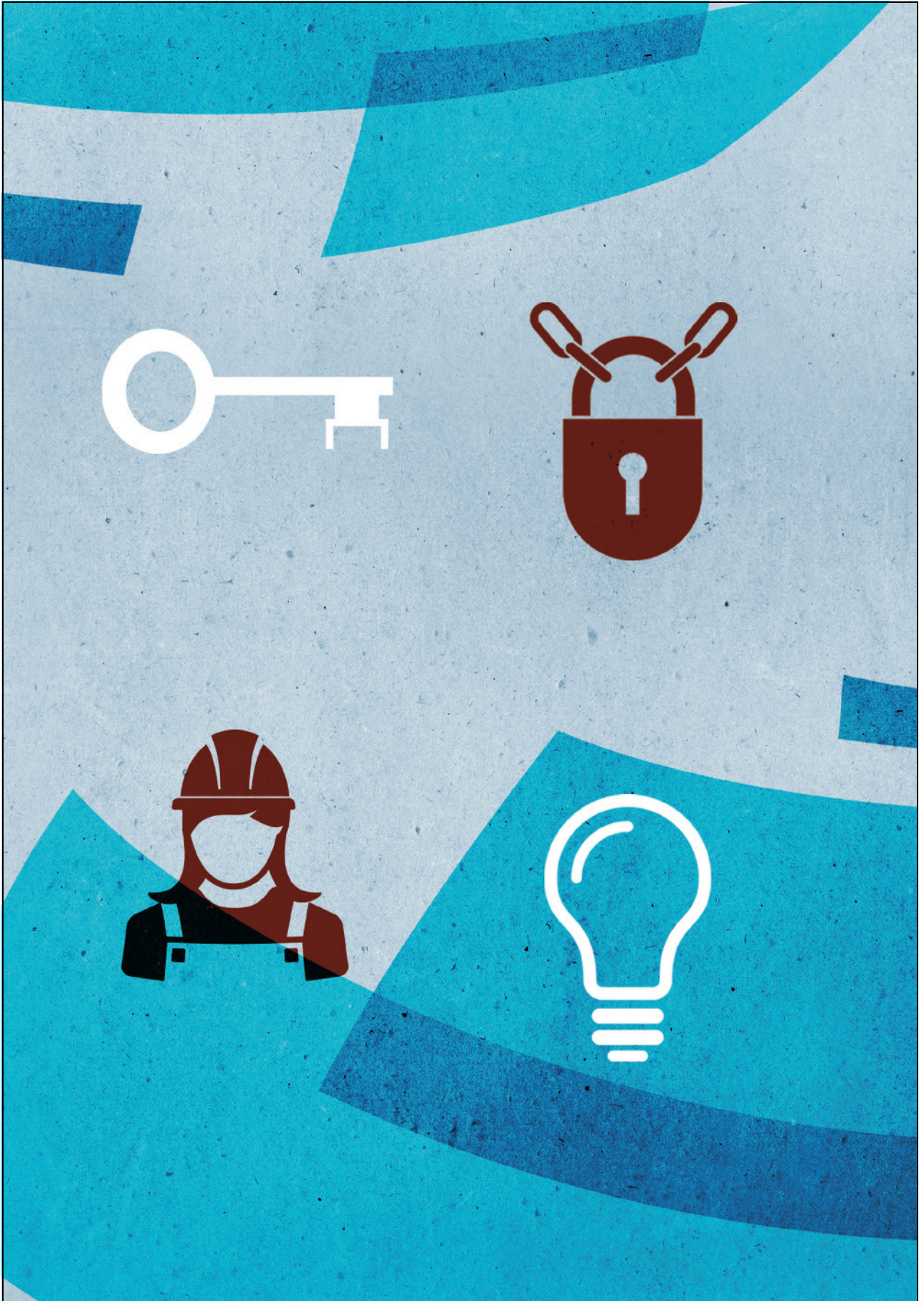


Figure 7.1

## 7 Financial and administrative consequences

A high HSE level in the petroleum activities is important both to society and the industry itself. In order to ensure a sustainable future for Norwegian petroleum activity, the industry must reduce costs and increase efficiency of operations, while also maintaining and further developing a high HSE level, ensuring sound resource management and safeguarding value creation.

In the Report, the Government emphasises the need for improved follow-up and cooperation from the industry within several areas. Most of these measures are generally proposed in joint arenas and under the direction of the parties themselves, and do not require regulatory amendments or special investments beyond work efforts by the parties. The goals are to contribute to improved cooperation between the parties and continuous improvement of the HSE level. Furthermore, the Government expects that knowledge and technology development is a high priority in the future for the industry, organisations and companies. The objective is to contribute to continuous improvement and development that supports the joint ambition of the Norwegian petroleum activities being a world leader within HSE. It is difficult to estimate the financial effects of such continuous, preventive measures and knowledge development, but the costs related to inadequate HSE work and major accidents can be very high. It is also well-documented that a poor working environment is very costly to society and the companies. Furthermore, it is presumed that good prevention can contribute to a higher level of HSE, and thus also to efficient operations and good socioeconomics. In this context, the measures will contribute to savings for both the industry and society at large. The instruction for official studies and reports applies for decisions and potential rule changes, which e.g. entails that cost and benefit effects must be elucidated and shown.

Good socioeconomic analyses provide the basis for optimal considerations with regard to resource utilisation and HSE. The ministries are in the final phase of working on a sector guideline for socioeconomic analysis for the petroleum sector, which also covers health, safety and the environment.

The Government also points out that there may be need for clearer follow-up on the part of the supervisory authority. Challenges in the industry can lead to a need for clearer use of sanctions and a greater extent of verification that non-conformities and orders are followed up. The Government is not proposing to change the current HSE regime or supervision strategy, but the Petroleum Safety Authority must actively and systematically consider efficient use of policy instruments, and must utilise the entire range of policy instruments if necessary. A good, neutral and unified factual basis is also important for the continued HSE work in the petroleum activities. The risk level in the petroleum activity (RNNP) project is an important foundation for the industry's further prioritisations and for design of policies within the area. RNNP should be further developed and strengthened to ensure the most balanced and precise use of results and analyses possible. Clearer supervision and a good knowledge and factual basis are generally followed up through the planning and prioritisation of resources within the current framework.

The Ministry of Labour and Social Affairs

r e c o m m e n d s :

Recommendation from the Ministry of Labour and Social Affairs of 6 April 2018 relating to Health, safety and environment in the petroleum industry, will be submitted to the Storting.

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