Forskningsrådet

Prevention of major accidents, work-related illnesses and injuries to personnel in the petroleum industry

Strategy for the HSE initiative for 2012-2016 under the PETROMAKS programme

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1 Introduction

1.1 Summary

Report No. 29 (2010-2011) to the Storting on *Joint responsibility for a good and decent working life* by the Ministry of Labour emphasises that the continual development of new technology, knowledge and methods is needed to reach the objective of establishing the Norwegian petroleum industry as a world leader in health, safety and the work environment (HSE). To this end, an initiative has been designed under the Research Council of Norway's Large-scale Programme on Optimal Management of Norwegian Petroleum Resources (PETROMAKS) to address HSE matters in the petroleum industry.

Launched in 2002, the HSE initiative has now reached the conclusion of its second phase, as planned. The Ministry of Labour has expressed that there is a clear need to continue the HSE-related research initiative for the petroleum industry; the Research Council has thus drawn up this strategy document for the next five-year period beginning with 2012 in collaboration with an expert group comprising external specialists.

The objective of the HSE initiative for 2012-2016 under the PETROMAKS programme is:

> *To generate new knowledge and promote the development of new solutions that reduce risk by addressing key sectoral challenges in the petroleum industry. This requires close, multidisciplinary cooperation between research players and industry. Activities should focus particularly on the challenges related to the prevention of major accidents and work environment-related risk, including the prevention of work-related illnesses and injuries to personnel in the petroleum industry.*

Based on priorities of the authorities and industry players, the initiative will address solutions to the most relevant HSE issues facing the petroleum industry. HSE-related research should be targeted towards solutions that lead to new knowledge, methods and technology in the petroleum industry in order to meet the research needs in the following areas described in Report No. 29 (2010-2011) to the Storting:

- *Risk of major accidents*
- *Work environment-related risk*
- *Structural conditions in the petroleum industry*

Grant proposals will be assessed on the basis of their scientific merit, relevance in terms of research needs, and benefit relative to the industry and the research community in the short and the long term. The main body of the strategy document presents research topics and an overview of the most important challenges for Norway's current petroleum-related activities. Key industry challenges addressed include those stemming from changes in the various players on the Norwegian continental shelf, the internationalisation of the industry, new technology, new forms of operation, the ageing of installations and fields and extending their lifetimes, and more.

1.2 The strategy document

In light of the need for further publicly funded research and development targeting health, safety and the work environment (HSE) in the Norwegian petroleum sector, the Research Council of Norway took the initiative to draw up a strategy for R&D efforts for the period 2012-2016. This initiative is also in response to the challenges set out in Report No. 29 (2010-2011) to the Storting, which explicitly states that there is a need for continued R&D activities targeting petroleum-oriented HSE issues.

This strategy document is the result of the efforts of the PETROMAKS programme administration in collaboration with a broad-based group of experts. The expert group has considered relevant challenges and provided input on a number of topics believed to be of relevance within the framework of the initiative. The members of the expert group were:

Roy Erling Furre and Halvor Erikstein, Norwegian Union of Energy Workers (SAFE)
Bodil Sophia Krohn, Norwegian Oil Industry Association (OLF)
Ketil Karlsen, Industry–Energy
Berit Sørset, Federation of Norwegian Industries
Øyvind Lauridsen and Jorunn Tharaldsen, Petroleum Safety Authority Norway
Dordi Høivik, Statoil

Information obtained from a variety of sources, discussions, input and comments from relevant industry groups have been used in the process of drawing up this strategy document. A wide array of research groups from the university and university college sector as well as independent research institutes took part in a dialogue meeting. The document has been presented to the Safety Forum of the Petroleum Safety Authority Norway, and to the board of the OG21 initiative (Oil & Gas in the 21st Century). The Research Council's other strategies and related R&D programmes have also been consulted as part of the process.

1.3 HSE in the petroleum sector (2007–2011)

During the 2007-2011 period, the objective of the HSE initiative under the PETROMAKS programme was to generate new knowledge and promote the development of new solutions related to relationships between HSE risk and people, organisations and technology in the petroleum industry. This also included a focus on increasing understanding of cultural factors that have an impact on risk trends and risk management in man-technology-organisation (MTO) interaction.

The initiative places priority on generating knowledge and methods that could help to reduce risk and improve the resilience of the petroleum sector. The initiative seeks to promote a better interface between this research and risk-related research in other areas, and highlight HSE challenges and contexts that are not necessarily given media attention or particular focus from the industry or the authorities.

According to the PETROMAKS work programme, the previous phase of the HSE initiative sought to:

- provide a foundation for integrating HSE into the industry's planning, decision-making and implementation processes, based on an overall understanding of the concept of HSE;
- contribute to strengthening the HSE culture of all petroleum industry players;
- challenge existing myths and established perceptions of reality;
- help the industry to see the value of investing in a good working environment, resilient solutions and HSE efforts.

The initiative proposed a thematically-based division of research topics from a man-technology-organisation (MTO) perspective:

- Man: Chemical health risk, organisational change, exclusion, risk understanding, working hours and new work procedures
- Organisation: organisational culture, power constellations, organisational restructuring, risk understanding, risk management, risk indicators, risk communication and risk-based design
- Technology: Integrated operations, extending lifetime, risk related to modification situations, and tools for risk modelling and visualisation
- Culture: as a basis and framework for activities and development; understanding and integration within a system context.

The external evaluation of the HSE initiative conducted in 2010 determined that its practical value has above all been the competence-building accomplished through the projects. This research has helped to improve the working environment and HSE culture at some of the participating companies. The external evaluation also points out that parts of the research have yielded new insight into the risk and causes of health problems among offshore employees. Nevertheless there is still a need for more cooperation between the research community and the industry.

Increased focus is needed on issues relating to implementation and translation of R&D into practical solutions, as well as on perspectives relating to the relationship between new/factual knowledge and the willingness/ability to apply this knowledge. In this regard, the evaluation also stresses the need to address the structural changes and overall development that have taken place in the industry.

2 Objectives of the HSE initiative

It is a stated objective of the Norwegian Government that Norway is to assume a leading role in HSE activities in the petroleum industry. To achieve this, Norway must succeed in developing its oil and gas resources in a long-term perspective that safeguards the safety of employees, economic value, and the environment.

During the 2007-2011 period, the objective of the HSE initiative under the PETROMAKS programme was to generate new knowledge and promote the development of new solutions related to relationships between HSE risk and people, organisations and technology in the petroleum industry. This also included a focus on increasing understanding of cultural factors that have an impact on risk trends and risk management in man-technology-organisation (MTO) interaction. The 2012-2016 period will be a continuation of the previous activity phase, but with the additional aim of achieving closer links to the petroleum industry. Thus the objective of the HSE-initiative for 2012-2016 is:

> *To generate new knowledge and promote the development of new solutions that reduce risk by addressing key sectoral challenges in the petroleum industry. This requires close, multidisciplinary cooperation between research players and industry. Activities should focus particularly on the challenges related to the prevention of major accidents and work environment-related risk, including the prevention of work-related illnesses and injuries to personnel in the petroleum industry.*

It is important that research activities are cross-disciplinary and that there is a good interface between development of knowledge and methods here and research in other areas and fields. This may help to highlight new HSE challenges and contexts that are not necessarily given widespread media attention or particular focus from industry or the authorities. HSE-related research should be targeted towards solutions that lead to new knowledge and methods for reducing risk and increasing resilience within the petroleum industry. By providing the opportunity to pose questions about existing practice and thinking while at the same time strengthening cooperation between players in research and industry, the initiative can help to bring Norway closer to its objective of becoming an international leader in HSE.

3 Research topics

This chapter describes the research topics prioritised in the strategy. Each topic should be considered in context with the other topics.

3.1 Risk of major accidents

The Deepwater Horizon disaster of April 2010 in the Macondo field, Gulf of Mexico, serves to remind the Norwegian petroleum industry of how imperative it is to conduct R&D activities targeting the prevention of major accidents. Research is critical for generating new knowledge, methods and technology that can help to reduce the risk of major accidents.

From a major-accident perspective, the elevated number of hydrocarbon discharges and oil well control incidents from 2008 to 2010 is cause for concern, as stated in a 2010 report (*Trends in Risk Level in the Petroleum Industry*) by the Petroleum Safety Authority Norway.

3.1.1 Barriers

There is a need to develop a more integrated and standardised approach to barrier control in the petroleum industry; the industry needs to give high priority to efforts targeting this.

In addition to the industry's own activities, public funding of R&D aimed at improving barrier control will be required. Key areas will include identifying organisational and operational barrier elements and establishing performance criteria for them, as well as communicating relevant information about the risk picture and the role of various barriers to the functions/personnel (from management to involved/performing personnel). Research on barriers and barrier control is not only of interest from an operational perspective, but also earlier, in the planning and design phase of installations – and research within this area should reflect this.

There is a need to continue developing solutions for monitoring barrier elements, including technology and visualisation tools that facilitate real-time monitoring of well barrier status. Good man-machine interfaces and work processes can be developed along with tools that improve real-time risk monitoring and the decision-making processes for drilling and well operations. In this area there are synergies with other thematic priority areas of the PETROMAKS programme.

3.1.2 Relationship between working environment and risk of major accidents

There has been little research on the working environment's impact on the risk of major accidents. Fast-paced, physically demanding workdays, for example, can pose a safety risk, so methods, approaches and instruments should be developed for measuring and monitoring working environment stress in order to implement preventive measures.

There are various prospects for studying stress levels and other aspects of working conditions that will lead to greater insights in this area. Relevant topics may include how the effects of tiredness/fatigue due to shift schedules, for instance, can affect critical decisions in irregular situations.

Research on the effects of stress in critical situations requiring reliable decision-making may help to identify new aspects relating to the risk of major accidents. Fatigue combined with stress can lead to breakdowns in communication, decision-making ability and cooperation. Research addressing this type of problem may help to optimise control in order to prevent or manage situations with the potential to trigger a major accident.

3.1.3 Technical and organisational conditions that affect the risk of major accidents

Assessments of the risk of major accidents must also take into account external framework conditions as well as technological, structural and organisational changes taking place within the sector. As the range of contractors and sub-contractors expands and becomes more complex, it becomes more necessary to incorporate the array of industry players into the risk picture for major accidents. Insufficient control of simultaneous activities, unclear distribution of responsibility, and the lack or inadequacy of procedures and routines can all disturb the coordination of activities needed between players.

New operational concepts, often classified as integrated operations (IO), have gradually emerged over the past few decades in the petroleum industry. There is reason to believe that such optimisation processes will have an impact on fundamental risk factors relating to system complexity and degree of interlinkage, and will thus have a major impact on risk levels. Cooperation between offshore and land-based activities is expected to increase by means of technology for remotely controlled systems and virtual interaction. The implementation of such technology entails modification of work processes – which will also affect the risk picture due to the addition of new risk contributors. Both empirical and theoretical research are needed to shed light on how IO-related changes in MTO can affect HSE conditions. Multi-disciplinary projects that integrate social science as well as physical science approaches are needed.

HSE issues must be addressed by improving forms of cooperation and by developing technology. IO presents opportunities to refine control principles and methods/tools for HSE management and thus the potential to achieve HSE gains beyond those immediately following the implementation of IO. But with the opportunities come challenges, which tie into other topics under the PETROMAKS programme. R&D targeted towards operations systems should include a particular focus on resilience and the development of solutions to prevent major accidents.

There is also a need to develop models, processes and tools that enhance the ability of involved personnel to recognise situations that could potentially lead to major accidents and blowouts. It will also be important to develop models, processes and tools that maximise the ability to deal with other potentially dangerous situations. Under the strategy it is possible to give priority to research activities on systems that facilitate early warning and strengthen the decision-making basis in emergency situations and during drilling and well operations. These activities should employ an integrated perspective.

3.1.4 Major accidents and management

There is a need for R&D activity targeted towards management's role in dealing with the risk of major accidents in the industry. Available tools are primarily oriented towards identifying and documenting organisational weak points, but do not concentrate on the dynamic and response-related aspects of organisations in the interface with technology and people.

Little is known about whether investors influence the decisions taken by the company management and whether this in any way affects the frameworks for safety and risk levels of the activities. More knowledge is needed about the impact of economic incentives on decisions and risk. Thus there may be a need for research that examines whether the petroleum industry actors, companies and investors themselves see economic incentives as affecting decision-making and risk. Risk management and cultural aspects will be key topics in this research.

3.1.5 Risk management and analytical tools

Report No. 29 (2010-2011) to the Storting identifies a need to further develop principles and methods for risk analysis in order to deal with challenges relating to the risk of major accidents. There is a particular need for analysing, assessing and understanding the risk associated with major and minor changes in the industry that affect the risk picture. Many examples point to the need to reassess the way the industry currently manages the risk of major accidents. Thus, R&D projects that seek to improve tools by identifying strengths and weaknesses of the industry's current practices, methods and tools are encouraged.

3.1.6 Risk indicators

Many of the risk indicators currently used in the petroleum industry are not necessarily good indicators of the risk of major accidents. Furthermore, both in Norway and internationally there is a stated need to establish proactive risk indicators of major accidents that include technical, organisational and human components. Such indicators are important for implementing solutions that provide the best possible decision-making support in various situations in order to keep undesirable incidents from escalating and thus prevent accidents.

3.1.7 Learning from successful operations

Accidents, particularly major ones, are naturally the focus of a great deal of attention. Often in the wake of such accidents, causal relationships already identified in previous incidents are revealed. Attention is then focused on the industry's inability to learn from previous mistakes. There is a need to better understand which conditions were critical or contributing factors where accidents have *not* occurred. The starting point for R&D in this area could be to study experience gained from a representative sample of successful operations (in Norway and internationally), such as deep-sea drilling of wells and/or drilling of high-pressure, high-temperature (HPHT) wells.

3.2 Working environment, work-related illnesses and injuries in the petroleum industry

Risk in the working environment plays a role in health-related and economic impacts on society, companies and individuals. Exposure to chemicals, noise and vibration, heavy physical labour and psychosocial factors are examples of risk contributors for illness, injury and exclusion from working life.

A good working environment is not only important in itself, but is also critical to maintaining a low risk of major accidents. In order to gain greater insight into the current status of the working environment, health, and work-related illnesses and injuries in the petroleum industry, the HSE strategy for 2012-2016 places priority on the following research topics:

3.2.1 Working hours

Report No. 29 (2010-2011) to the Storting identifies a need for continued funding for research on risk relating to shift schedules in the petroleum industry. It is important to stress here that several issues relevant to the petroleum industry, such as the health impacts of the special work shift schedules, also have great transfer value to other industries.

3.2.2 Baromedicine

In the 1990s it was anticipated that the use of human divers would be partially phased out in favour of remotely operated underwater vehicles (ROVs). That trend, however, is changing; divers can perform many jobs far more efficiently than ROVs, and diving continues to be an important part of the petroleum industry. Diving in deeper waters than has been common in Norway in recent years is now under consideration.

In light of what has been learned in recent years, it is important to invest in research that ensures that diving can be performed responsibly and without negative health impacts on divers. Further research to generate new knowledge about diving in deeper waters is needed. There is also a need for broad-based baromedical research, which applies to basic research in health science as well as to more operational and user-oriented research on HSE aspects of diving activities.

More knowledge is also needed about the causes of injury when the body's ability to adapt is exceeded, and why different people react differently to the same environmental conditions. Health problems arise that are related to, for example, decompression issues and hyperbaric welding. It may be of future interest to link these to problems with extreme cold and its effects on the central nervous system.

3.2.3 Chemical working environments

The petroleum industry's recently completed four-year project *Kjemikalieprosjektet* (Chemical working in the oil and gas industry) helped to generate, collect and disseminate new and updated knowledge on chemical working environments in the oil and gas industry. The project identified knowledge gaps and areas in which further research on chemical working environments is needed, e.g. skin exposure/injuries and the health impacts of exposure to oils, particularly with regard to the nervous system, the cardiovascular system and reproductive toxicology.

The petroleum industry uses a variety of chemical substances; more knowledge about the health risks associated with different types of chemicals is needed. It is important to examine chemical exposure in connection with various maintenance tasks such as surface treatment and welding, as well as exposure to chemicals during the work processes associated with daily operations. There is a need to know more about the health impacts of chemicals used in cold environments, and for research on long-term effects of the use of nanomaterials. Few epidemiological studies from the petroleum industry address the relationship between actual exposure and health impacts. Research should also give greater consideration to cumulative exposure in order to gain a better understanding of combined effects.

The exposure pattern in the petroleum industry is characterised by long work shifts during a period of two consecutive weeks, whereas administrative norms for contaminants in the work atmosphere are based on eight hours' exposure and a five-day workweek. There is thus a need for research that can provide better support for the establishment of administrative norms for deviating exposure patterns.

3.2.4 Cancer

Epidemiological studies relating to the incidence of cancer in offshore employees are still lacking. These should be linked to causal relationships and specific forms of exposure that apply to offshore employees. There is some knowledge about the incidence of cancer, but little research has centred on causal relationships based on employees' tasks.

3.2.5 Problems with cold and lighting conditions

There may be a need for more knowledge about physical and psychological health impacts that can stem from exposure to extreme temperatures and unique seasons, particularly within the context of shift work schedules. As the industry expands increasingly northward, a future need may arise for more detailed studies on the use of chemicals under extremely cold conditions.

The same applies to technological innovation in connection with diverse equipment, specialised work clothes, protective equipment, etc., for use in Arctic areas and the Barents Sea.

Another research topic is the organisation of work and potentially new work shift schemes for employees in the Arctic, relative to seasons. Further research needs involve technology development in combination with medical innovation related to telemedicine, the Arctic region and the Barents Sea.

Another consideration is that extreme temperatures, permafrost, icing, and other season-dependent factors such as light and darkness may necessitate new ergonomic designs.

3.2.6 Musculoskeletal disorders

The incidence of musculoskeletal disorders in the general population is high. These are also a common problem among petroleum industry employees, but the causes have not been examined in detail. Physical activities of offshore work should be studied in terms of sickness absence and employee health complaints.

Ergonomic conditions are most likely highly significant. As the Norwegian petroleum industry enters an era of more intensive maintenance, it is important that research on ergonomic design also addresses working methods and technology in terms of maintenance and the phasing out of older installations.

There are also new challenges relating to employees' increased use of information and communications technology. With automation and the development of more complex operator support functions, more knowledge is needed about optimising cognitive and ergonomic conditions within new technological and organisational environments.

3.2.7 Noise

Many groups of petroleum industry employees are exposed to high noise levels; noise-related hearing impairment is widespread. These conditions are well documented in the statistics on work-related injuries compiled for the Petroleum Safety Authority Norway. At existing installations, preventive measures often combine personal protective equipment with limits on exposure time. Uncertainty factors involving personal protective equipment should be researched further and efforts to strengthen barriers against serious, lasting noise-related hearing impairment should be continued.

The use of various types of hand-held tools is a major contributing factor to noise exposure and the risk of noise damage. This applies in particular to certain employee groups in the contractor segment. A number of industry players are involved in the value chain for hand-held tools. A strategy to reduce noise must be based on a solid understanding of the players' interests and the relationships between them, as well as applicable national and international regulations and standards.

R&D activity aimed at analysing performance and cost/benefit aspects for a representative sample of specific noise-reduction measures may help to form a basis for improved, more targeted reduction of the risk of hearing impairment.

In addition to the above points, it may be of interest to research differences in exposure conditions between employees' leisure time and working hours in order to better understand causal factors.

3.3 Structural conditions in the petroleum industry

The Norwegian petroleum industry has undergone continual change and development. In the ten years since the HSE research initiative for the petroleum industry was launched, many changes have taken place in the industry players involved and the HSE regulatory regime. Installations have aged, while new operational concepts have emerged and been implemented. In addition, the industry has made significant new discoveries and expressed ambitions to increase activities in areas nearer to the coastline and in Arctic and sub-Arctic areas.

A number of investigations following incidents and accidents share the general conclusion that contractors and sub-contractors were involved, and that a lack of coordination between operators and contractors was an underlying cause. Unclear distribution of responsibility, inadequate control of parallel activities and a lack of harmonisation of procedures and routines are typical problems that are dependent on coordination between the various players and the manner in which this is specified contractually. There is also reason to expect that increased interaction between offshore and land-based operations, the implementation of new technology relying substantially on remote control and virtual interaction, and subsequent changes in work processes will alter the risk picture for many actors and add new risk contributors.

Some companies, whether operators or contractors, have weak employee participation mechanisms. In the interfaces between operators and contractors, there can be a lack of mechanisms for safeguarding the right of employees further out in the contractual chains to participate in decisions, particularly nomadic employees who travel from installation to installation and temporary personnel, often foreign employees, hired by contractors. One trend in the industry is that the rising number of new, smaller operating companies is increasing the dependency on consultancy companies for ensuring necessary competence in core activities such as the planning of drilling and well operations.

The transition to tail-end production and late-phase projects poses challenges in terms of organisational structures and solutions that evolve. In the petroleum industry there are often several contractual levels and multiple interfaces, both vertical and horizontal. Many parties deal with agencies that hire out personnel. The trend for recovery solutions on the Norwegian continental shelf is towards a larger number of small fields with subsea facilities. The industry players are also facing modification projects, rig upgrades, smaller IOR projects and decommissioning projects that will entail a great deal of work for the contractors and likely generate even more complexity in the interaction between players.

There is a need for new perspectives and models and more empirical data in relation to the HSE culture of the Norwegian petroleum industry. Cultural challenges such as responsibility, trust and risk-taking must be addressed, and culture must be viewed as a key component of the structural conditions within the petroleum industry.

3.3.1 Impact of structural conditions on risk in the petroleum industry

Partite cooperation and facilitation of employee participation comprise the cornerstones of Norwegian working life and are deeply entrenched in the petroleum industry. Processes and projects for central tri-partite arenas in the petroleum industry contribute to knowledge-sharing and professionalisation of the parties and their cooperation. The industry's changing array of players and shifts in the balance of power are challenging the Norwegian model of partite cooperation centrally and locally.

An overall description of the situation can be achieved by studying the mechanisms of partite cooperation at different levels (tri-partite, between companies within a contractual chain, and between the safety delegates and labour unions – at various social, industrial and company levels). Research of interest may involve examining which conditions need to be in place for well-functioning cooperation, and studying good examples of best practice.

There is a need for more knowledge about how power constellations affect the risk of major accidents and risk in working environments within the petroleum industry. Power constellations play a significant role in interactions between the various actors in the petroleum industry such as the authorities, licensees, operators, contractors and sub-contractors, and the parties in central and local partite cooperation. Power structures are influenced by and have impacts on company structure and national and cross-national management of risk in all phases of the industry as well as the culture of safety.

3.3.2 National and international regulatory regime

HSE regulations for the petroleum industry have been refined over the last few decades. This has been brought about as a result of the increasing focus on the application of functional requirements, an overarching objective to have an integrated regulatory framework, and the decision to extend the regulations to encompass land-based operations as well.

There is an increased need for knowledge relating to how these trends affect HSE management and the ongoing efforts to improve it. At the same time it is important to view the development of the Norwegian regulatory framework from a wider theoretical and comparative standpoint, and assess it against international trends. In this context there may be a need for multi-disciplinary approaches based on historical, contextual, cultural, technological and legal perspectives. It is also considered valuable to clarify how national and international standards influence and overlap one another, and which trends and driving forces are working.

Such knowledge will be critical for understanding the actors' adaptation to and compliance with the regulatory framework, in order to correct undesired effects and to refine the principles of thought concerning the development of regulations. It is also valuable to facilitate a more thorough understanding of the interplay between laws and regulations and voluntary norm-setting and standardisation efforts, and how this influences the distribution of power and interactions between the authorities and the industry, as well as among the petroleum industry players.

3.3.3 Risk management and interaction in the interface between industry actors

Late-phase projects and recovery from mature fields may increase the pressure to choose MTO solutions that pose challenges to various HSE components. This issue will most likely arise during the final stages of an operational period and in the window of time between the decision to phase out an installation and its actual closure. Extended lifetimes often entail modifications of existing infrastructure and technology at older installations. In this context it will be useful to shed light on the impact of such changes on risks of major accidents and in the working environment. The industry needs more knowledge about how the choice of solution affects key HSE conditions, and how the players balance the relationship between financial considerations and ensuring that resilient solutions are implemented. This should be seen in context with points 3.1.5 and 3.1.6 above.

A number of investigations following incidents and accidents share the general conclusion that contractors and sub-contractors were involved, and that a lack of coordination between operators and contractors was an underlying cause.

Key questions include: How do different types of framework conditions affect the organisation and its ability to take action to ensure the prevention of major accidents and reduce risk in the working environment? How are authority and responsibility distributed among the various players involved? How is communication about risk issues carried out across interfaces?

Research will be needed to better understand how the industry deals with challenges related to partite cooperation and employee participation, and in particular how suppliers far down or on the outer edges of the operator/supplier chains have the chance to participate in decisions on key HSE issues.

Unclear distribution of responsibility, inadequate control of parallel activities and a lack of harmonisation of procedures and routines are typical problems that are dependent on coordination between the various players and the manner in which this is specified contractually. There is also reason to expect that increased interaction between offshore and land-based operations, the implementation of new technology featuring remote control and virtual interaction, and subsequent changes in work processes will alter the risk picture for many actors and add new risk contributors.

3.3.4 Groups exposed to risk

Inspections have revealed that certain groups of contractors generally have more risk factors in their working environments. Moreover, the control elements, which are intended to ensure full compliance in the working environment, are substantially weaker in the contractor groups compared to operator groups. The inspectors conclude that organisational framework conditions such as contractual terms, economic terms and work organisation can all affect the contractor's ability to reduce risk for its own employees. This means that these groups in general have poor working environments, which in turn can have an impact on work performance, error frequency and omissions during maintenance and modification work typically carried out by these groups. Herein lies the potential to trigger factors for various types of accidents, including major ones, once the systems are put into operation. Furthermore, little is known about whether communication-related aspects among these groups exposed to risk may raise the risk of undesirable events.

More attention should be focused on obtaining detailed knowledge about each and every working area associated with groups vulnerable to risk. One topic to examine is which health complaints are widespread in these risk-exposed jobs and groups, as well as links to the conditions under which their work is performed and the types of risk factors associated with these activities. This should be viewed in context with section 3.2 above.

4 Coordination with other related instruments under the PETROMAKS programme and other programmes at the Research Council

The initiative on health, safety and the work environment (HSE) in the petroleum sector shares an interface with several other technology and thematic areas under the PETROMAKS programme. While this applies in particular to research questions that primarily call for targeted technology development, there may also be significant overlap with R&D activities relating to systems for control, surveillance and monitoring, communication and decision support, as the main focus of the PETROMAKS programme in general is on technology development. Relevant activities may include, for example:

- Development of technical equipment and organisational solutions and methods that strengthen the basis for decision-making and facilitate early warning and intervention opportunities in emergency situations, particularly during drilling and well operations.

- Research on technical and organisational systems relating to the prevention of major accidents, including blowouts.

The HSE initiative also shares an interface with other research programmes at the Research Council. Of particular relevance here is the programme Sickness Absence, Work and Health (SYKEFRAVAER), whose overall objective is to create conditions that promote a satisfactory working environment and good working health, as well as a high level of participation in the labour market. The SYKEFRAVAER programme and the HSE initiative share an interface in research on the interaction between work, the working environment and working health and research on effective instruments for preventing and reducing sickness absence, disability and work-related illness.

The Research Programme on Welfare, Working Life and Migration (VAM) focuses on working life research and older employees' relationship to working life, but only touches on issues relating to the working environment, health and sickness absence. The Research Programme on Public Health (FOLKEHELSE) conducts general research on public health, while the Research Programme on Health and Care Services (HELSEOMSORG) deals with health and care policy, and the Research Programme on Environmental Exposures and Health Outcomes (MILPAAHEL) covers environmental exposures outside of working life.

Of interest here as well is the Norwegian RD&D CCS Programme (CLIMIT) at the Research Council, which is designed to accelerate the commercialisation of CCS. The HSE initiative also shares an interface with the large-scale programme Clean Energy for the Future (RENERGI), whose primary objective is to develop knowledge and solutions as a basis for ensuring environment-friendly, economically efficient and effective management of Norway's energy resources, a highly reliable energy supply and internationally competitive industrial development related to the energy sector. Closer cooperation with these programmes on HSE-related research in the future is being sought.

Below is a list of webpages for the programmes that share an interface with the PETROMAKS programme's HSE initiative:

www.forskningsradet.no/petrosam
www.forskningsradet.no/samrisk
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5 Target groups and instruments

5.1 Target groups

The target groups for the HSE initiative comprise players active in offshore petroleum activities and petroleum-related, land-based activities. These include:
- research groups;
- supplier companies;
- operators;
- the authorities.

When introducing the next phase of the HSE initiative, it will be necessary to implement targeted measures to reach more players within the target groups than those that took part in phase 2 of the initiative. Such an expansion would be advantageous, both in terms of enhancing knowledge building and dispersion and in terms of promoting greater interdisciplinarity within the projects. Suitable measures include thematically and geographically-based meetings prior to the first funding rounds for the initiative. On the user side, active effort will be made to encourage greater involvement on the part of the diverse array of petroleum companies represented on the Norwegian continental shelf, in addition to smaller companies affiliated with the supplier industry.

5.2 Instruments

As an integrated component of a larger R&D programme administered by the Research Council, the initiative on health, safety and the work environment (HSE) in the petroleum sector will primarily employ the Research Council's established funding instruments, including:

- *Knowledge-building Projects for Industry (KPN)*
- *Innovation Projects for the Industrial Sector (IPN)*
- *Researcher Projects*

It will also be important to make the most of the Research Council's function as a meeting place. This may be done under the auspices of the PETROMAKS programme and in connection with individual projects by funding special measures such as scientific arenas and networks and by creating links between technology projects under the PETROMAKS programme. The PETROMAKS programme board may also introduce strategic measures or give priority to a strategic focus in funding announcements if this will help to achieve programme objectives.

6 Organisation

The HSE initiative is part of the PETROMAKS programme under the Division for Energy, Resources and the Environment. The PETROMAKS programme board is the steering body for the initiative and approves funding announcements and grant allocations to new projects. The programme board is also responsible for any revisions to the strategy document for the HSE initiative. In addition, the programme board is responsible for ensuring that the programme achieves its stipulated objectives and is implemented as efficiently as possible within the framework approved by the division research board. The programme board reports to the division research board via the Director of the Department for Petroleum Research and the Executive Director of the division.

The Research Council programme administration is responsible for the day-to-day activities of the programme, and is responsible for implementing the programme board's decisions. There are plans to strengthen the role of the initiative's expert group so that this group can participate more actively, for example, by providing input for funding announcements. This in turn will boost user interest in the initiative.