Barents 2020

Assessment of international standards for safe exploration, production and transportation of oil and gas in the Barents Sea

Harmonisation of Health, Safety, and Environmental Protection Standards for The Barents Sea

Final Report

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Terms and Definitions

The assessments made in this report focus on industry standards used by the oil and gas industry. Such standards are in this report categorised as follows:

- International standards, issued by ISO, ITU or IEC
- Regional standards, issued by e.g. CEN or CENELEC
- National standards, such as GOST-R or NS
- Industry and Association Standards, such as NORSOK, SNIP, API, OGP, DNV

The scope of work of this project does not include assessment of normative documents issued by National regulatory authorities, such as safety regulations issued by PSA in Norway or regulations issued by Russian authorities such as Rostechnadzor. However, reference is in some instances made to national regulations, without any assessment.

Abbreviations

In this report the following abbreviations are frequently referred to.
Further use of abbreviations will be explained when they occur, in the relevant report section.

ISO	International Organisation for Standardisation
ITU	United Nations agency for information and communication technologies
IEC	International Electrotechnical Commission
HVAC	Heating, Ventilation and Air-conditioning
HSE	Health Safety and Environment
MOU	Mobile Offshore Units
PPE	Personal protective equipment
NSR	Northern Sea Route
TC	Technical Committee for standardisation
EER	Escape, Evacuation, and Rescue
CEN	European Committee for Standardisation
CENELEC	European Committee for standardisation in electro technical area
API	American Petroleum Institute
EN	European standard issued by CEN
IMO	International Maritime Organisation
NS	Norwegian Standard
GOST-R	Russian national standard
OCIMF	Oil Companies International Marine Forum
OGP	International association of oil and gas producers
PSA	Petroleum Safety Authority of Norway
RN	Russian Norwegian groups of experts in this project
SOLAS	International convention regarding: Safety of life at sea
STCW	International Convention on Standards of Training, Certification and Watch-keeping for Seafarers.

Conclusive Summary

The purpose of this project is to recommend HSE standards for common Norwegian - Russian application in the Barents Sea, for **safeguarding people, environment and asset values** in connection with oil and gas activities, including sea transportation of oil and gas. The underlying assumption is that petroleum operations in the Barents Sea shall be at least as safe as those in the North Sea.

Phase 1 of the project lasted from October 2007 to October 2008. The results of phase 1 were documented in 5 “Position Papers”. The position papers provided the basis for further work in phase 2, lasting from November 2008 to March 2009, resulting in the **special topics prioritised for further study** in expert working groups in phase 3.

The selection of topics for further work was carried out in close cooperation between the Norwegian and Russian participating organisations. The process was constructive and quick, based on both Russian and Norwegian proposals. There was full agreement between the parties that the selected topics are among the most important issues which need to be addressed in relation to safeguarding oil and gas operations in the Barents Sea. Still, some proposed topics were left out, not because they are unimportant, but because they are addressed by other industry projects, and - because our resources were limited and needed to be prioritized.

The Barents 2020 project in phase 3 has focused on potential improvements which will help prevent incidents or accidents from occurring, e.g. to **reduce the probability** of incidents happening, **rather than to mitigate consequences** of incidents.

The seven selected topics from phase 2 which are addressed in this report are:

1	Recommend the basic list of internationally recognized standards for use in the Barents Sea
2	Recommend standards for design of stationary offshore units against ice loads in the Barents Sea
3	Recommend standards for Risk Management of major Hazards, such as Fires, Explosions and Blow-outs on offshore drilling, production and storage units in the Barents Sea.
4	Recommend standards for evacuation and rescue of people from ships and offshore units, including standards for rescue equipment
5	Recommend standards for working environment and safety related to human performance and decision making (Human factors) for operations in the Barents Sea
6	Recommend safe standards for loading, unloading and ship transportation of oil in the Barents Sea – to minimize risk of accidental oil spills
7	Recommend standards for operational emissions and discharges to air and water in the Barents Sea

This report provides the findings and recommendations from these seven expert groups.

Group 1, also called RN01 (Russian – Norwegian expert group number 1) summarizes recommendations from all working groups, and also include recommended recognised standards for topics which have not been studied in detail in this project.

Hence the list of standards from group 1 covers standards for most, if not all, aspects related to safeguarding personnel, environment, and asset values in connection with offshore operations in the Barents Sea. The list is attached to this report as Appendix 1.

1. Introduction

The industry's need for **HSE industry standards** to take into account the additional challenges due to arctic conditions, i.e. low temperatures, ice, icing, long distances, darkness, etc. have become apparent in connection with proposed oil and gas development projects in the Barents Sea, and the increased maritime tanker traffic from the Barents sea along the Norwegian coast due to petroleum developments in the High North.

The international oil and gas industry applies recognised technical standards which are used worldwide. The accumulated experience of the industry over many years and from all parts of the world is included in these standards through systematic updating and issuance of new revisions. These standards therefore represent best international practice in order to achieve an acceptable level of safety for the oil and gas industry, including offshore activities.

However, the updating of standards is a time consuming process, since it requires consensus from many parties, and the improvements may come late for actual industry needs.

In new situations, such as for offshore projects in the Arctic, existing regulations and technical standards have normally not been prepared or updated to address arctic conditions. In order to achieve an acceptable level of safety against new or expanded HSE challenges due to arctic challenges, existing technical standards must be supplemented by:

- Definition of societal and company safety objectives;
- Suitable and sufficient risk assessment from concept to execution and operations;
- Survey and acquisition of site specific environmental data and loads;
- Definition of additional or modified functional requirements.

The standards are general and can apply to many geographical areas and project development options. These generally applicable standards may require the need to establish project specific requirements and design criteria by input of:

- Site-specific environmental data regarding temperatures, waves, winds, etc.;
- Field-specific data regarding reservoir composition, pressure, temperature, etc.;
- Safety criteria for the project as basis for selection of safety factors etc.; and
- Additional requirements of regulations for the specific area.

In this context, recognised international technical standards can be used in cold climate areas, but with significantly increased reliance on project specific functional requirements by individual operators and down the supply chain.

With regard to maritime transportation and marine operations the Classification Societies today have complete sets of rules and notations for ships. For Arctic areas, harmonized rules are under discussion in the International Association for Class Societies (IACS).

In addition to Class Rules, there are international and national requirements that have to be fulfilled. When entering ice covered Russian ports, the vessel should have an Ice Certificate and when entering the Northern Sea Route (NSR) special rules and requirements will come in addition. National authorities will typically have local requirements.

Russia is today the most experienced nation with respect to ship operation in ice and low temperatures. In addition to the basic rules there are several guidelines covering practical operations.

This project gives recommendations on how existing standards may be applied for oil and gas operations in the Barents Sea.

2. Russian – Norwegian Cooperation Project

2.1 Description of the Project

This project was partly funded through the Norwegian Government's Barents 2020 program and partly by Russian and Norwegian Industry.

The project took as a basic assumption that protection of the environment and the resources in the Barents Sea is a shared responsibility between Norway and Russia. This project has therefore aimed at creating a dialogue between relevant Norwegian and Russian parties regarding safety of petroleum related activities in the Barents Sea. The aim was to arrive at common acceptable standards for safeguarding people, environment and asset values in the oil and gas industry in the Barents Sea, including transportation of oil and gas at sea.

Development of offshore oil and gas fields in the Barents Sea represents major financial and technical undertakings which require international cooperation and risk sharing between several partners. A common set of internationally recognised safety standards adapted to Barents Sea conditions, which all parties can agree to, was and is, seen as a prerequisite for such projects to be developed.

The objectives of this Barents 2020 project can be summarized as follows:

Through identification of areas for harmonisation of HSE standards for use in Norwegian and Russian parts of the Barents Sea, the project aimed to contribute to

- an acceptable and uniform safety level in the oil and gas activity in the Barents Sea
- a predictable HSE framework for oil and gas companies and contractors independent of nationality
- an improved basis for cooperation for all involved parties in the future

Further, the project aimed to identify areas where there is a need to

- update existing key industry standards to take into account the additional challenges related to arctic conditions, and
- contribute to creating a dialogue, and share knowledge, between relevant Norwegian and Russian parties.

The project has evaluated HSE and engineering standards for all petroleum related activities in the Barents Sea, including sea transportation of oil and gas by tankers and maritime supply and support services. The project has addressed exploration, construction, installation and production phases of offshore field developments. Standards considered cover all kinds of offshore installations, e.g. fixed, floating, hull-shaped, as well as ships for transportation of oil and gas.

The result of the work after completion of phase 3 working groups is contained in this report, providing:

- Common agreed references to recognised international standards which may be used in the Barents Sea;
- Harmonised comments to standards and practices which need to be revised due to Barents Sea challenges;
- Proposals for revisions and amendments to key industry standards;
- Suggestions for any amendments to national and international regulations to allow for the application of industry standards proposed by the working groups; and
- Identification of research and development needs in areas where current knowledge is insufficient.

These recommendations will be submitted to national regulatory bodies for their consideration. Proposals for updating and revision of industry standards due to arctic challenges will be submitted to the bodies responsible for updating of the standards in question, e.g. International Standardisation Organisation (ISO), International Maritime Organisation (IMO), etc.

2.2 Cooperation Partners

Norwegian Cooperation Partners
The process of involving Norwegian stakeholders involved the following main milestones and activities

- Launch meeting 8.01.08 with 70 participants from Norwegian industry, relevant authorities, scientific institutions and NGOs. In this meeting stakeholders were asked to record their interests for participation in the work. Interested organisations were invited to take part in subsequent workshops.
- Preparation of Norwegian industry position papers involving interested parties through workshops and hearings commenting on draft position papers sent out electronically.
- Presentation of final position papers, updated with comments from hearings and workshops, 6.10.08 with 44 participants from Norwegian industry and authorities, including representatives from offshore workers' organisations.
- Several meetings with various Norwegian ministries have taken place in order to inform about progress and direction of the project
- Cooperation agreement has been established with Standard Norge
- Special contact is maintained with PSA.

In July 2008, 11 Norwegian companies were invited to participate as sponsors in phase 3, and as per December 2008, the following seven Norwegian companies were confirmed sponsors:

- Statoil
- ENI Norge
- Acergy
- MossMaritime
- Transocean Norway
- Schlumberger /Western Geco
- DNV

Russian Cooperation Partners
With assistance from the Norwegian Embassy in Moscow the project during February and March 2008 met with relevant Russian ministries, e.g. Ministry of Energy, Ministry of Transportation, Rosteknadzor and Rostekregulirovanie, and quickly identified (were advised) the Russian partners with which we should work in this project. It was

- TC 23 "Equipment and Technologies of oil and gas production and processing": Technical committee 23, which is responsible for modernisation of standards for the oil and gas industry in Russia, including standards for the offshore industry in the Barents Sea, and
- TC 318 "Morflot": Technical Committee for Maritime safety, including standards for transportation of oil and gas by tankers in the Barents Sea.

The cooperation with Russian stakeholders took place as follows:

- Meetings with individual member companies in the said committees to explain the Barents 2020 project and discuss cooperation (all agreed to cooperate)
- Launch meeting for project cooperation in Gazprom/ VNIIGAZ premises 11.3.2008 with more than 70 participants from industry and authorities.
- Signing of protocols with committee chairmen of TC 23 and TC 318,
- Sharing of Norwegian position papers with our Russian partners: the project had the position papers translated into Russian to ease communication, and these were submitted to the Russian side for their review and comments
- Several additional meetings took place to ensure a broad input and support for the project cooperation. Hence meetings were conducted with, Russian Register of Shipping, CNIIMF (Central National Institute for Maritime Research), Sovcomflot, Murmansk Shipping, and Petroleum Advisory Forum in Moscow (the society for International Oil and gasCompanies working in Russia.
- Continuous cooperation throughout the project has been maintained with the main project partner OAO Gazprom, which assisted in establishing TC 23 (chairman of TC 23 is Mrs. Rusakova, member of Gazprom's Management Committee and Head of Gazprom's Department for Strategic Development).

The sponsors have approved the selected work group topics, and provided experts to the working groups. This report is the result of the work performed in 2008 – 2009.

2.3 Steering Committee

In accordance with the agreements between the sponsors and DNV as project manager, it was required that the work should be controlled by a Russian – Norwegian Steering Committee. This was also a requirement from the main Norwegian sponsor, the Norwegian Ministry of Foreign affairs.

The following steering committee was therefore established in February 2009, with the following composition

Gazprom	*member*
Lukoil	*member*
Rostekregulirovanie	*member*
Rostechnadzor	*member*
Statoil	*member*
Standard Norge	*member*
DNV	*member*
DNV	*Chairperson*

The meetings in the steering committee were chaired by Mrs Elisabeth Harstad, responsible for the Barents 2020 project in DNV.

The DNV project manager attended as secretary and prepares minutes of meeting.

This final report must be presented to the Steering Committee for approval, and approved before it can be distributed for general use.

The Steering Committee has met 27.01. 2009, 01.07.2009, 16.12.2009 and will meet again 11.03.2010 to consider the recommendations of this report.

2.4 Project Management

DNV acted as project manager on the Norwegian side and worked in close cooperation with the Russian coordinators through Gazprom and VNIIGAZ.

The project manager and the expert group coordinators responsible for preparing this report have been DNV personnel.

The DNV offices in Moscow and St Petersburg have also, together with the Russian side, been involved in arranging expert workshops and conferences.

3. Work process

3.1 General identification of Hazards and Risks

The Barents Sea is not uniform with respect to hazards and risks related to oil and gas operations. The western part is in many ways comparable to the North Sea with respect to environmental conditions, while additional arctic challenges increase further east.

The additional arctic challenges are caused by low temperatures, ice, icing, darkness, remoteness and vulnerable environment.

Risk is defined as the product of the probability of an incident and the consequence of that incident. (Risk = Probability x Consequence)

It is reasonable to deduct that the consequences of accidents - in terms of loss of lives, environmental damage and/ or economical loss – may be more severe in the Arctic due to

- remoteness, huge distances, and lack of infrastructure which make emergency response more challenging
- darkness which makes response more difficult
- extreme temperatures and weather making response more challenging
- sea ice complicating rescue operations and oil spill response
- vulnerable marine and coastal environment
- potentially long down-time of operations after accidents, due to only seasonal access for repair
- high public attention to activities in the Barents Sea, low public tolerance for accidents, with potential for loss of reputation for all parties involved

If the consequences may be more severe in the Barents Sea, it means that the risk level also will be higher unless risk mitigating measures are made. The risk can be reduced by reducing the probability and/or mitigating the consequences of potential accidents.

However, some of the consequence driving factors, such as darkness, low temperatures, remoteness and vulnerable environment cannot easily be compensated for.

In order to maintain the same safety level (i.e. risk level) as in the North Sea, it is more effective to address and reduce the probability of incidents, to prevent accidents from happening.

Standards and operating procedures for installations and vessels are the main sources which define integrity and safety and the probability of incidents.

Standards and procedures for offshore operations in the Arctic must reflect the need to mitigate the increased risks, by reducing the probability of incidents. This project aims to contribute to amendments of standards to achieve this.

3.2 Position Papers

The results of phase 1 of the project were documented in five “position papers”, which were translated into Russian and shared with our Russian colleagues. The position papers created the basis for discussions which resulted in the special topics selected for further study in expert working groups. The position papers covered

- Ice and Metocean conditions in the Barents sea, reference /1/
- Environmental Baseline for the Barents Sea, reference /2/
- Safety Baseline, Offshore, reference /3/
- Baseline on HSE Standards, reference /4/
- Baseline Maritime Transport and Operations, reference /5/

A summary of the position papers are given in the following sections of this report.

3.2.1 Ice and Met Ocean Conditions in the Barents Sea

The following findings are taken from reference /1/. Several factors that may change the probability of certain action effects and loads and/or the consequences of accidents resulting from these effects have been identified:

- Sea ice, icebergs, icing and wind chill are new elements that may increase both frequency of accidents and the consequences thereof. Data on ice and iceberg are insufficient.
- Less reliable weather forecasts combined with small scale, very local atmospheric phenomena, such as polar lows, increase the probability of failing or disrupted operations

The lack of sufficient data on ice implies uncertainties in estimates of rare ice events in the Barents Sea.

Although available measured data and results from numerical models do not show worse metocean design criteria related to wind, waves and currents in the Barents Sea than further south on the Norwegian shelf (the North Sea, mid-Norway), less knowledge about the physical environment in the Barents Sea introduces larger uncertainties into the estimates of values with annual recurrences of 10^{-2} and 10^{-4}.

Climate change may alter this picture but degree and character are uncertain.

It will take several years until the data uncertainties for the Barents Sea have been reduced to the same level as in the North Sea.

Until more extensive databases have been established, design and operational planning must take the uncertainties into consideration.

3.2.2 Environmental issues for offshore activities

As regards Barents Sea "Vulnerability issues" (see reference /2/) it is quite clear that the main area of concern related to offshore petroleum activities is **the risk of oil spill**, and generally a large oil spill. Hence the main environmental *challenge* when moving into the area is related to this issue and improvements and standard harmonization/ development should primarily target this. However, as the petroleum activities may induce other threats or impacts on the environment than the threat of oil spill, other standards (including industry practices) may have to be reviewed in order to reduce the industry's impact if applied to the Barents Sea operations. Hence, also "normal" operational emissions and discharges to air and sea will be evaluated in the further work.

3.2.3 Safety Baseline Offshore

This report (reference /3/) presents the project's safety baseline with respect to offshore oil and gas activities, and the understanding of the safety challenges for oil and gas offshore activities in the Barents Sea.

The report does not aim to contain the complete set of offshore design and operational requirements for safe operations in arctic waters, but to highlight what is considered to be the main issues in the risk picture in the Barents Sea.

This study has identified several arctic challenges that add risks to the existing safety risk picture in the North Sea. If offshore operations in the Barents Sea shall meet the same safety level as in the North Sea, these factors must be addressed in technical solutions and operational best practices for the Barents Sea. The arctic challenges are identified based on the knowledge and experience we have today.

The following preliminary recommendations to improvement of operational issues related to offshore activities in the Barents Sea were suggested in the position paper:

Human performance in arctic condition
- Establish role as "arctic competent person" to follow up arctic issues in design and operations.
- Select and train personnel according to specific requirements to work in arctic conditions.
- Include effect of cold climate on personnel when scheduling work task and in work permit system.

Rescue and medical treatment
- Define Russian-Norwegian working group to describe common requirements to rescue and medical treatment related to offshore activities in the Barents Sea.
- Map existing resources and practice for rescue and medical treatment for the relevant parties in the Barents Sea.
- Establish Russian-Norwegian working group to align resources and work practices with defined requirements.
- Establish limitation to "work above sea" in arctic conditions, and corresponding required rescue services for situation with man over board during work above sea in arctic conditions (low temperature and reduced visibility)

High activity periods on and around installations in summer period
- Assess and plan high activity level and possible simultaneous operations in summer period to control increased potential for failures and exposure of personnel.
- Establish maritime traffic control related to high activity periods.

Ice management
- Improve weather-, ice- and iceberg forecasts by improved observational network for weather forecasting and meteorological databases for Barents Sea.
- Implement management of sea ice and icebergs around installations (surveillance, tracking, forecasting and mitigation)
- Implement procedures for allowable operations in areas with sea ice or icebergs.
- Establish methods for inspection of subsea equipment in areas with sea ice.

Maritime traffic control
- Establish maritime traffic control centre for field- and non-field related maritime traffic, also effectively managing possible language barriers in Barents Sea.

3.2.4 Baseline Offshore HSE Standards

The standards used in the North Sea have been taken as the basis for further work with standards for the Barents Sea. More than 30 years of operations in the North Sea provides a good experience basis. See reference /4/.

The regulatory body for oil & gas activities on the Norwegian Continental Shelf is the Norwegian Petroleum Safety Authority (PSA). The PSA Regulations consist of functional regulatory requirements supplemented by guidelines, which again refer to a selection of industry standards and practices.

The PSA Framework Regulations § 18 stipulate how standards are to be applied:

When the party responsible makes use of a standard recommended in the guidelines to a provision of the regulations, as a means of complying with the requirements of the regulations in the area of health, working environment and safety, the party responsible may as a rule take it that the regulation requirements have been met.

When other solutions than those recommended in the guidelines to a provision of the regulations are used, the party responsible shall be able to document that the chosen solution fulfils the requirements of the regulations. Combinations of parts of standards shall be avoided, unless the party responsible is able to document that an equivalent level of health, working environment and safety is achieved.

The majority of the standards currently referred to by PSA, are NORSOK standards. As an example the Facility Regulations guidelines list 37 NORSOK references, 16 ISO, 15 DNV, 6 EN (European Standard), 5 IEC (International Electro technical Commission), 6 NS (Norsk Standard), 4 IMO (International Maritime Organization) and 2 API.

3.2.5 Baseline Maritime Standards

This baseline report, reference /5/, describes the challenges of the harmonization of rules and regulations related to maritime transport and operation in the Barents Sea.

Unlike the offshore operation part, the maritime transport regime has a set of accepted international standards like IMO and SOLAS. In addition to the international standards, a ship has to be built according to an accepted technical class standard issued by a recognized Class Society. As the major part of the Barents Sea is an international sea, international rules and requirements will govern the maritime transport and operation.

The main challenges for harmonisation of standards are identified to be local port state requirements and possible national requirements which needs to be identified, and as far as possible these requirements should be general for all ships operating in the Barents Sea, independent of where in the Barents Sea the operation takes place and independent of flag and owner.

The preliminary risk study shows that in general risks increase when moving from world wide operation into cold areas and areas with ice, due to the increase in consequence of an accident. The risk increases for all accident categories in the Barents Sea, so the project needs to focus on possible measures to reduce the probability of an accident as well as the consequence.

References:

/1/ Report no. 2008-0664 Barents 2020 phase 1: Ice and Met Ocean (Maritime & Offshore)

/2/ Report no. 2008-0716 Barents 2020 phase 1: Environmental Baseline Maritime and Offshore.

/3/ Report no. 2008-0694 Barents 2020 phase 1: Safety Baseline Offshore

/4/ Report no. 2008-1125 Barents 2020 phase 1: Baseline on HSE Standards

/5/ Report no. 2008- 953 Barents 2020 phase 1: Baseline maritime Transport and Operations

3.3 Selected Study Topics

3.3.1 Final List of Topics for expert working groups

The final topics for further work in phase 3 are listed below. The descriptions of the topics were rewritten and refined several times, both in Russian and English, in order to make absolutely sure that a common understanding existed between the Norwegian and the Russian side. The final topic descriptions, as listed below, were approved by the project steering committee 27.01.2009.

1	Recommend the basic list of internationally recognized standards for use in the Barents Sea
2	Recommend standards for design of stationary offshore units against ice loads in the Barents Sea
3	Recommend standards for Risk Management of major Hazards, such as Fires, Explosions and Blow-outs on offshore drilling, production and storage units in the Barents Sea.
4	Recommend standards for evacuation and rescue of people from ships and offshore units, including standards for rescue equipment
5	Recommend standards for working environment and safety related to human performance and decision making (Human factors) for operations in the Barents Sea
6	Recommend safe standards for loading, unloading and ship transportation of oil in the Barents Sea – to minimize risk of accidental oil spills
7	Recommend standards for operational emissions and discharges to air and water in the Barents Sea

3.4 Expert Working Groups

3.4.1 7 Coordinators for 7 Work Groups

DNV, responsible for project management, has appointed coordinators for all expert working groups. The coordinator plans, facilitates and leads the Russian-Norwegian expert working groups through the workshops to the final presentation of results. The coordinator is also responsible for compiling the group's recommendations in a written report.

The coordinators were selected for their special competence and experience related to the topic of their group. The competences of the selected coordinators were reviewed and all nominations were approved by the project steering committee 27.01.2009.

The coordinators were as follows:

No	Group Topic	Group Coordinator	Coordinator Education	Coordinator Experience
1	Basic list of standards	Tore.Sildnes@dnv.com	MSc	25 years
2	Design against Ice loads	Lars.Ingolf.Eide@dnv.com	MSc	30 years
3	Risk Management of major hazards	Borre.Johan.Paaske@dnv.com	MSc	15 years
4	Evacuation and Rescue	Gus.Cammaert@dnv.com	PhD	30 years
5	Human factors	Steven.Sawhill@dnv.com	MSc	20 years
6	Loading/unloading, ship transportation of oil	Morten.Mejlaender-Larsen@dnv.com	MSc	23 years
7	Operational discharges to air and water	Steinar.Nesse@dnv.com	MSc	15 years

3.4.2 Nomination of Norwegian and Russian Experts to Work Groups

The Russian side nominated the Russian experts, and the Norwegian Sponsors and DNV nominated the Norwegian experts. The project steering committee approved the nominations. The companies and institutions in the groups represent leading organisations within the maritime and offshore petroleum industries in Norway and Russia, and bring the required competence to the groups to assess the selected safety critical topics. The participating experts were:

Expert Group RN 01.
Task: Recommend the basic list of internationally recognized standards for use in the Barents Sea

Name	Organisation	Note
Dmitry P. Ilyushchenko-Krylov	CNIIMF	
	TK 318 Deputy Chairman	
Valery P. Nekrasov,	VNIIPO	
Alexey I. Novikov	GAZPROM	
Andrey A. Pervushin	GIPROSPETSGAZ	
Viatcheslav M. Samkov	Standard TEC Fund	
Vladimir V. Vernikovsky	GAZPROM, TK23 secretary	Russian Coordinator
Morten Bøhlerengen	Moss Maritime	
Jan Gustaf Eriksson	Standards Norway	
Per Eirik Fosen	Statoil Hydro	
Tore Sildnes	DNV	Norwegian Coordinator
Alf Reidar Johansen	OGP	Invited expert
Maxim B. Marchenko	Shtokman Development Company AG (SDag)	Invited expert
Odd Thomassen	PSA (Norwegian Petroleum Safety Authority)	Observer

Expert Group RN 02.
Task: Recommend standards for design of stationary units against ice loads in the Barents sea

Name	Organisation	Note
Marat Mansurov	Gazprom - VNIIGAZ	Russian Coordinator
Alexander Melnik	RN-SakhalinNIPImorneft	
Sergey Balagura	RMRS	
Alexander Zimin	Krylov	
Irina Surikova	RMRS	
Marina Karulina	Krylov	
Dmitry Onishschenko	VNIIGAZ	
Sergey Kim	VNIIGAZ	
Vitaliy Ya. Glushko	RTC Testing and Diagnostics	
Per Olav Moslet	Olav Olsen	
Arne Gurtner	Statoil	
Hans M Sand	Moss Maritime	
Sveinung Løseth	NTNU	
Lars Ingolf Eide	DNV	Norwegian Coordinator
Mitch Winkler	Shell /OGP	Invited expert
Pavel Liferov	SDAG	Invited expert

Expert Group RN 03.
Task: Recommend standards for Risk Assessment of major hazards, such as fires, explosions, and blow-outs on offshore drilling, production and storage units in the Barents Sea

Name	Organisation	Note
Vladimir Safonov	VNIIGAZ	Russian Coordinator
Denis M Gordienko	FGU VNIIPO Emercom	
Mikhail Lisanov	Industrial Safety Institute	
Mikhail Yaroshevich	Giprospetsgaz	
A Petrulevitch	VNIIGAZ	
Alexander Zalogin	NANIO CSVE	
Evgueny S. Golub	ZAO CNIIMF	
Nikolay A. Valdman	Krylov Shipbuilding Research Institute	
Odd Thomassen	Petroleum Safety Authority	Observer
Bjørn Abrahamsen	Statoil	
Ole Rekdal	Eni Norge	
Thore Andersen	NEK Norway	
Geir Bull Njaa	NEK Norway	Invited expert
Børre Johan Paaske	DNV	Norwegian Coordinator

Expert Group RN 04.
Task: Recommend standards for escape, evacuation and rescue of people from ships and offshore units, including standards for rescue equipment.

Name	Organisation	Note
Sergey Gubkin	Ministry of Defence	
Alexander Kogan	Krylov	
Valery Kravchenko	Lukoil	
Sergey Kovalov	VNIIGAZ	Russian Coordinator
Vladimir Shlyachkov	Krylov	
Dmitry S Melekhov	Giprospetsgaz	
Albert R. Shigabutdinov	ZAO CNIIMF	
Gus Cammaert	DNV	Norwegian Coordinator
Sigurd Jacobsen	Petroleum Safety Authority	Observer
Kjersti Høgestøl	Norwegian Shipowner's association	
Tor Einar Berg	Marintek	
Frode Brattum	DNV	
Ekaterina Safonova	DNV	
Fredric Turlan	Total /OGP	
Ketil Karlsen	Industri Energi, Norway	Invited expert
Erik Holand	ENI Norge	
Alexandre Viaud	SDAG	Invited expert

Expert Group RN 05.
Task: Recommend standards for working environment and safety related to human performance and decision making (human factors) for operations in the Barents Sea

Name	Organisation	Note
Alexander Terekhov	VNIIGAZ	Russian Coordinator
Nikolay Daki	Gazprom Promgaz	
Aleksandr Ivanov	Giprospetsgaz	
Mikhail Sokolov	CNIIMF	
Sergey Astachov	CNIIMF	
Steven Sawhill	DNV	Norwegian Coordinator
Pal Tufto	ENI Norge	
Arne Haugan	Statoil	
Anne-Reidun Fuglestad	Transocean	
Hilde Heber	Petroleum Safety Authority	Observer
Arild Øvrum	University of Tromsø	Invited expert
Liv Landstad Ervik	Statoil / OGP	Invited expert

Expert Group RN 06.
Task: Recommend safe standards for loading, unloading and ship transportation of oil in the Barents Sea – to minimize risk of accidental oil spills

Name	Organisation	Note
Y.M. Ivanov	CNIIMF	Russian coordinator
G.N. Semanov	CNIIMF	
Vasily Dmitrov	Sovcomflot	
A.N. Chetyrkin	Krylov	
B.V. Kurylev	Krylov	
V. Shurpyak	Russian Maritime Register	
I. Surikova	Russian Maritime Register	
Sami Saarinen	Aker Arctic	Invited expert
Morten Mejlænder-Larsen	DNV	Norwegian Coordinator
Geir Fuglerud	DNV	
Espen Nilsen	DNV	
Christian W. Mosgren	APL	
Johan L. Eidem	Teekay	
Tor Erik Hilden	Statoil	
Harald Kleppestø	PSA	Observer
Odd P. Torset	DNV	Steering committee member

Expert Group RN 07.
Task: Recommend standards for operational emissions and discharges to air and water in the Barents Sea

Name	Organisation	
Eduard Bukhgalter	VNIIGAZ	Russian Coordinator
Nikolai Waldman	Krylov	
Gennadi Semanov	CNIIMF	
Elena Ilyakova	VNIIGAZ	
Natalia Kruglova	VNIIGAZ	
Knut Aasnes	Statoil	
Svein Flornes	Transocean	
Axel Kelley	Eni Norge	
Haakon Hustad	DNV	
Steinar Nesse	DNV	Norwegian Coordinator
Ingvild Skare	ExxonMobil / OGP	Invited expert

3.5 Workshops and Conferences

The project has facilitated the dialogue between Russian and Norwegian experts through the following arrangements:

28 workshops:

Workshops	Time	Group work	Venue
1. round of 7 expert groups	April – May 2009	Select key standards	VNIGAZ, Moscow
2. round of 7 expert groups	June 2009	Indentify need for change	DNV Norway
3. round of 7 expert groups	September – October 2009	Propose and discuss change	VNIIGAZ, Moscow, DNV St Petersburg
4. round of 7 expert groups	December 2009	Review draft final report	VNIIGAZ, Moscow

3 conferences:

Time	Topic	Venue
November 2008	Select 7 safety critical topics	VNIIGAZ, Moscow
July 2009	Review progress and coordinate between expert groups	DNV Oslo
December 2009	Final conference	VNIIGAZ, Moscow

3.6 Hearing process, approval of the final report and status of the report

This report is the final report, which is the updated and corrected version of the draft final report which was issued in English and Russian and sent to all the participating experts in all the working groups prior to the final conference in Moscow in December 2009.

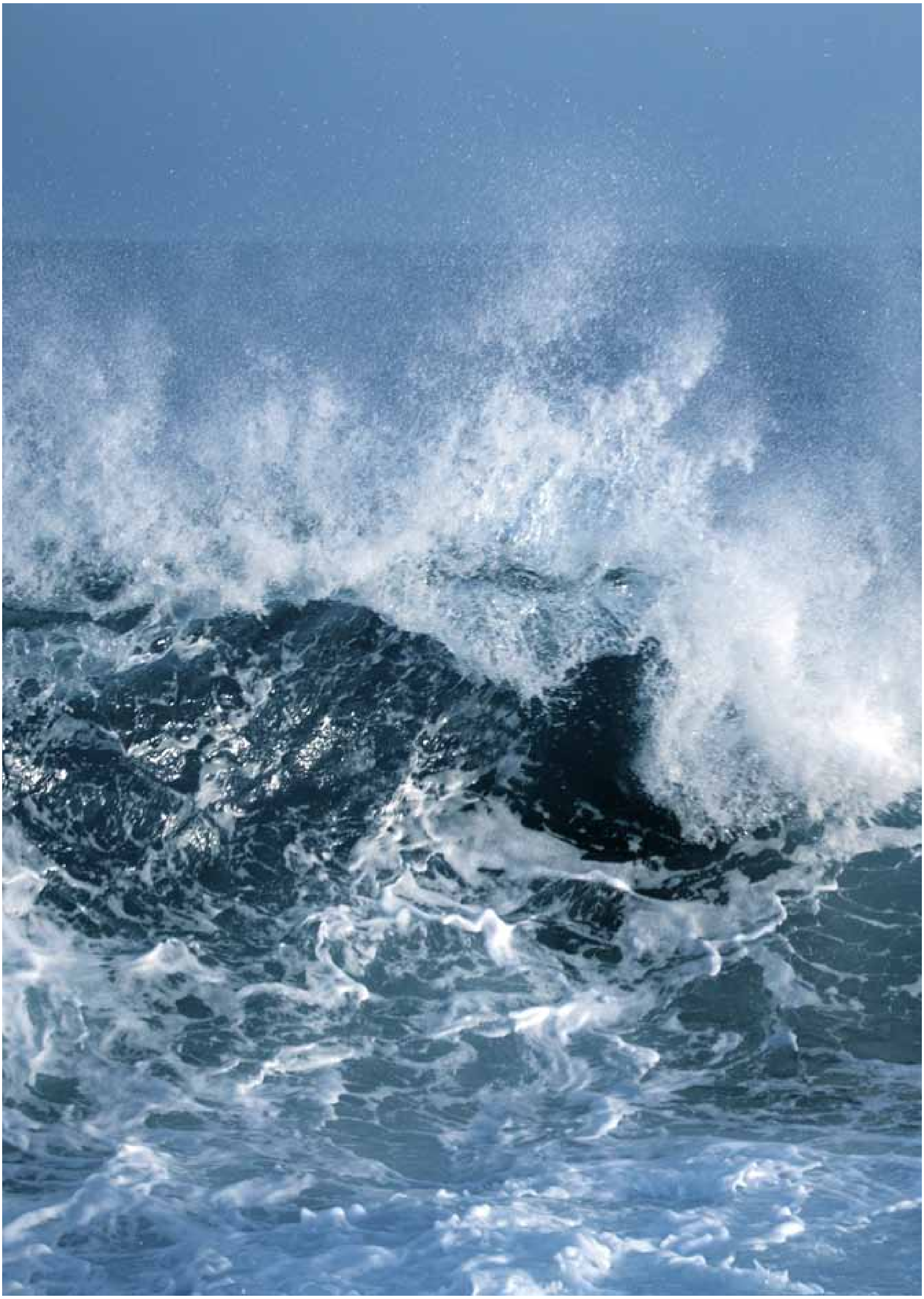
All comments received from Russian and Norwegian experts have been considered by the group coordinators and implemented based on their best professional judgement.

Subject to final approval by the project steering committee (March 2010), this report will be submitted to regulatory bodies, authorities and standardisation organisations in Russia and Norway, for their consideration.

The recommendations in this report have no formal or legal status.

Implementation of the recommendations of this report will be through the relevant authorities, regulatory bodies and standardisation organisations, to the extent these organisations wish to apply them.

Operators, contractors and manufacturers are of course free to apply the recommendations as they see fit, for instance in project specific technical specifications.



4. Recommendations

4.1 Design of stationary offshore units against ice loads in Barents Sea

4.1.1 Conclusions and recommendations

Following the analysis of the most used standards and rules on ice loads against stationary structures, the group concludes and recommends the following to the Barents2020 Steering Committee:

Main conclusion of Working Group on Design of stationary units against ice loads:

- ISO 19906 shall be used as basis for design and operations of stationary units in the Barents Sea
- Internationally approved (direct translations) ISO 19906 are to be implemented as national standards
- The Working Group has identified ten topics, of which four are prioritized, that should be amended in ISO/DIS 19906 (Draft International Standard). A Guidance Document has been identified as the best way to address these topics.

  The Guidance Document should
  - Be prepared in close cooperation with ISO WG8,
  - Pay due considerations to ongoing projects
  - Be ready in draft form by end 2010.
  - The guidance document should
  - Meet the immediate and future needs for the Barents Sea
  - Be a common Russian-Norwegian supplement to ISO 19906 until an update is available
  - Be submitted to ISO as a proposed international supplement to ISO 19906 at the first update

Furthermore, the Working Group has identified
- **A need to harmonise the <u>understanding</u> and <u>interpretation</u> of ISO 19906.**

Recommendations for work in 2010 and beyond:
- **Arrange Russian-Norwegian workshops to address:**
  - ISO vs. Russian & Norwegian standards (design philosophies)
  - Risk and reliability
  - Probabilistic based design as suggested by ISO 19906
  - Definition of deterministic values for design based on e.g. probabilistic data processing
- Prepare a Guidance Document for design of floating structures against ice loads in the Barents Sea

4.1.2 Scope of Work

Phase 1 of the Barents 2020 Project identified a range of new risks or hazards from the physical environment that may be faced by the offshore industry and shipping in the Barents Sea compared to the North Sea. These are summarized in Chapter 3.2.1 of this report and elaborated on in References /1/, /3/ and /4/.

The scope for the Working Group on Design of stationary units against ice loads was limited to loads coming from sea ice or glacial ice on stationary units and consisted of the following tasks:

- Evaluate existing maritime and offshore oil and gas standards relevant for design of stationary units in the Barents Sea against ice loads;
- Recommend standards for common use;
- Propose recommended amendments and/or changes to the identified standards.

Stationary installations include:
- Fixed structures, e.g. gravity based and jacket installations
- Floating units kept in position by moorings or dynamic positioning, e.g. drilling and production vessels, spar and buoy shaped platforms

Sub-sea installations like pipelines are excluded from this review.

The loads can be local or global. Local loads are typically important for plate thickness and stiffener distances, i.e. dimensions of the outer faces and supporting elements. The global load sets the limit for the overall capacity of the structure. The global load also determines the dimensions for structural details as forces are transmitted between different parts of the structure, as well as for the foundation or mooring. The load will depend upon various ice properties, structure, geometry and response, whether the ice is broken up or solid, the forces that drive the ice, and the ability of the structure to withstand the forces.

4.1.3 Standards addressing ice loads considered by working group RN02

The Working Group considered the following standards, codes, guidelines etc as input to the Barents2020 incentive:

Issuing country/organization	No.	Title
Russia	SNiP 2.01.07-85 *	Loads and impacts
	SNIP 2.06.08-87	Concrete and reinforced-concrete structures for hydraulic facilities
	SNiP II-23-81 *	Steel structures
	SNiP 2.06.04-82*	Loads and Forces on Hydraulic Engineering Structures (Wave, Ice, Vessel)
	VSN 41.88	Design of ice-resistant fixed platforms
	SNiP 33-01-2003	Hydraulic facilities. Main provisions
	SP 11-114-2004	Engineering surveys on continental shelf for construction of offshore oil and gas development structures
	SNIP 11.02.96	Engineering surveys for construction. Main provisions
	SNiP 23-01-99*	Construction Climatology
	GOST 16350-80	Climate of the USSR. Regional assignment and statistical data of climatic parameters for engineering purposes
	GOST 25870-83	Macroclimatic regions of the world with cold and moderate climate
		Rules for the Classification, Construction and Equipment of Mobile Offshore Drilling Units and Fixed Offshore Platforms, 2008
		Rules for the classification and construction of offshore vessels, 2008
	SP 11-103-97	Engineering and hydrometeorological surveys for construction
International Organization for Standardization, ISO	ISO 19906	Arctic Offshore Structures
	ISO 1990-01	Metocean design and operating considerations
Norway, NORSOK	N-002	Collection of metocean data
	N-003	Action and Action Effects
Canada/Canada Standards Association, CSA	CSA S471-04	General requirements, design criteria, the environment and loads
USA, American Petroleum Institute, API	API RP 2N	Recommended Practice for planning, designing and constructing structures and pipelines fro Arctic conditions
Norway/Det norske Veritas, DNV	RP-C205	Environmental Conditions and Environmental Loads
		Rules for classification of ships, newbuildings, special service and type, additional class, Part 5, Chapter 1: Ships for navigation in ice
Germany/ Germanischer Lloyd		Rules and Guidelines IV Industrial Services, 6 Offshore Installations, 7 Guidelines for the construction of fixed offshore structures in ice infested waters
China	Q/HSn 3000-2002	Regulations for Offshore Ice Conditions & Applications in China Sea.
International Maritime Organization, IMO	IMO doc. MSC/ Circ.1056 and MEPC/ Circ.399, 22 December 2002	Guidelines for Ships Operating in Arctic Ice-Covered Waters (IMO doc. MSC/Circ.1056 and MEPC/Circ.399, 22 December 2002) (follow-up of International Code of Safety for Ships in Polar Waters (IMO doc. DE41/10)) Relates to ship, not considered further
International Association of Classification Societies. IACS	UR I1,I2,I3	Requirements concerning Polar Class Relates to ship, not considered further
Russian Maritime Register of Shipping	No 2-020201-009-E	Rules for the classification, construction and equipment of floating offshore oil-and-gas production units
Russian Maritime Register of Shipping	No 2-020201-007-E	Rules for the classification, construction and equipment of mobile offahore drilling units and fixed offshore platforms
Finland and Sweden		Finnish-Swedish Ice class Rules with Guidelines

The Working Group concluded the following:

ISO 19906 is the standard best suited to meet the objectives of the Working Group. Most of the Russian standards deal with fresh water ice and are not directly applicable for use in the Barents Sea, whereas the most relevant national standards such as API RP 2N and CSA S471-04 have been integrated into the more recent ISO19906 and will be withdrawn when ISO 19906 is adopted.

The Working Group has identified shortcomings in ISO 19906. These shortcomings, regarding to safe and reliable design in the Barents Sea, are commented on in the next section. **However, it should be noted that the group has only had the Draft International Standard (DIS) of ISO 19906, ISO/DIS 19906, available for review.** The Group is fully aware that the deadline for comments to this document expired in the early phase of the current project and that any comments/recommendations from this review cannot be taken into the Final Draft International Standard (FDIS) that will be published in early 2010.

It is expected that an update of ISO 19906 will not start before 2014 and that changes will not be made until then. The Working Group recognizes that there will be a need to address the identified shortcomings before the next update of ISO 19906. This has led to recommend that a Guidance Document for design and operations of stationary units in the Barents Sea be prepared. This document can be used as a common Russian-Norwegian supplement or regional annex to ISO 19906 and submitted to ISO as suggestion for update for the next version. It is recommended that this activity is performed in close cooperation with ISO WG8 and that it takes due considerations to related activities already ongoing.

4.1.4 Comments from Working Group RN02 on ISO 19906

The Working Group performed a simplified gap analysis. As a result, the group identified ten (10) topics for considerations with respect to further preparation of amendments to or changes in ISO/DIS 19906. The ten topics which were identified by the group are shown in Figure 1 and elaborated on in the text.

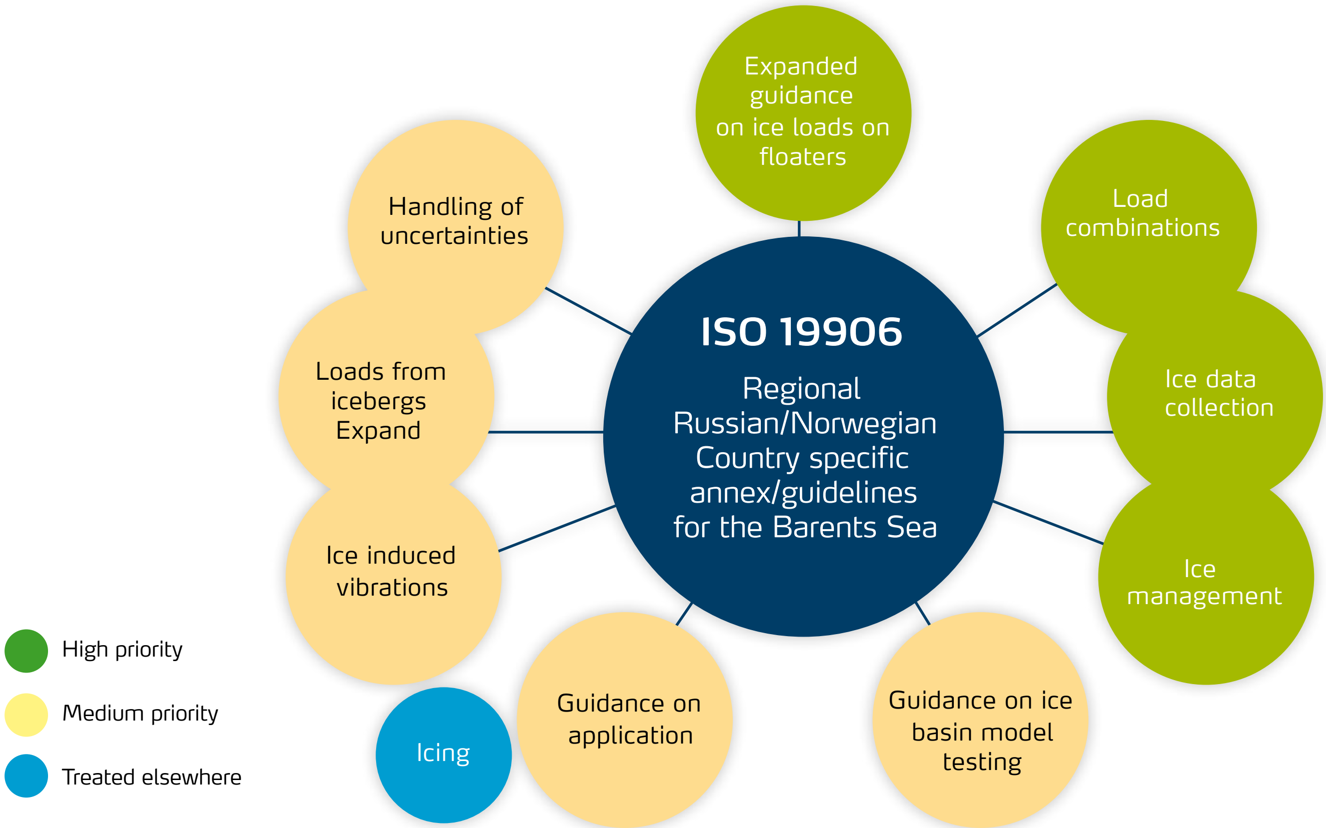


Figure 1. The ten topics identified by the Working Group as needing improvements relative to ISO/DIS19906. The colour coding reflects priorities.

4.1.4.1 Floating structures

Information on floating structures in the ISO 19906 standard is found mainly in Clauses 13 and A13 Floating structures, with additional information in Clauses 8 and A8 (Actions and action effects) and 16 and A16 (Ice engineering) but the guidance offered is limited. E.g., only generalities are offered in the normative part (Clauses A8 or A13), involving check lists and general recommendations for design, but no guidance on applicable methods on induced ice actions, including ice scenarios is offered.

Ideally one would like a standard/code to include information and guidance on a methodology that is accurate. ISO/DIS 19906 is weak on guidance for moored stuctures in ice. There are also significant gap areas for *floating systems* that need to be addressed to enable cost-effective design (they are currently under research and it will not be possible to address them to the full extent during the next 1-2 years but the present text can be expanded):

- Design scenarios of ice interaction. Design combinations of external loads
- Global loads under various combinations of ice conditions and other environmental forces
- Local loads
- Dynamic response, coupling all degrees of freedom (sway, heave, pitch, accelerations etc)
- Effect of ice management on design and operations

The standard/code could include (in the informative part):

- Examples of how the methodology is applied to a selection of floater type vs. ice scenario.
- Guidance on use of model testing of floating structures in ice basins, including calibration and validity of the test results. This guidance should include a table on the most important model tests to be performed for various structure alternatives.
- A consistent methodology for application of the recommended analytical ISO formulas to derive the global ice load as a function of the floater's response

4.1.4.2 Load combination and load application

The subject of combining ice actions with other actions is covered in ISO/DIS 19906. However, the provisions could use amplification, examples, and extension to ensure comprehensive coverage. For the application to structures in the marginal ice zone the combination of several actions will most probably constitute the design scenario, e.g. wind in combination with ice loads.

In particular, Table 7-3 in ISO/DIS 19906 needs enhancement. The group has found that it lacks sufficiently comprehensive guidance on how to consider joint events. Also Clause 7.2.3 should be re-visited, e.g. Table 7-2 with respect to the combination of icebergs/isolated ice features and wind and waves. It may be a challenge for practical design that when icebergs and isolated ice features are the principal actions, wind shall be considered stochastically dependent and waves stochastically independent.

For design of semi-submersibles and ships in non-ice conditions the effects of wave loading is well known and the design load scenarios are well defined. This means that designers have to check certain wave directions to achieve a given action effect. For ice actions these detailed recommendations/provisions are not yet defined. One example is how the load should be distributed between the legs for a multi leg-structure due to the effect of sheltering.

The Working Group has identified the following elements that would improve the guidance of the standard:

- Define some Barents Sea ice scenarios that include icebergs, bergy bits, level ice, and waves and combinations thereof.
- Mention effects like directionality and require full exercise of impacts
- Include examples

4.1.4.3 Ice data collection

Collection of ice data is only mentioned in ISO/DIS 19906 at a very high level. Ice data collection is performed in many different ways and it is important that measurement methods are documented in such a way that results from different measurement campaigns are compatible.

Ideally one would like to

- Harmonize data collection with actual needs for a) design and b) operations. Measurement programs may be quite different in their objective and scope.
- Have common guidelines on how to classify ice types and glacial ice.
- Have common guidelines on how to measure various ice parameters, set-up of the measurement program, requirements to accuracy and repeatability
- Have guidance on how to interpret the data, a check list with possible pitfalls, requirements for representativeness and for documentation
- Have common classification of ice types and glacial ice. Definitions of ice types are given in ISO/DIS 19906, Clause A6.5, but the iceberg

classification has been left out. Icebergs are important in the Barents Sea. It is suggested to use the classification of the International Ice Patrol (IIP), which is also referred to by the World Meteorological Organization (WMO).

The Working Group suggests that at least some of these topics are addressed in an amendment to ISO 19906.

4.1.4.4 Ice management (IM)

There exists substantial experience with iceberg management from the Grand Banks. Sea ice management comes mainly from drilling operations north of Canada and the Caspian Sea. Ice management acts as a tool to increase operability, but has not yet been taken into account for design. It may be anticipated that the icebreakers conducting the ice management operation will have problems operating during the heavy ice conditions that drive the design.

ISO 19906/DIS mentions IM by setting performance standards but gives no guidance on how to include IM in design. Clause 17.2.1 states that the level of system reliability shall be maintained according to the general principles of Clause 7 and that IM may be used to reduce both frequency and severity of ice action (Clause 8.2.7). To do so the performance and reliability of IM must be known or assumed. Presently there exists empirical data allowing judgements on performance and reliability in case of IM on glacial features but not sufficient data for pack ice with a high rate of ridges etc. Furthermore, there is no guidance (and only limited experience) from handling glacial features surrounded by or frozen into an ice sheet.

Thus, it may not be possible to reduce the design ice actions (tail of the load distribution) using ice management, unless one has information or can make qualified assumptions on the performance and reliability connected to the ice management operation.

Given the lack of IM experience in ice the Working Group recommends to consider if models, numerical as well as ice basin test, may be used to derive minimum guidelines for use of IM in design.

4.1.4.5 Ice basin model tests

Ice basin model testing requires considerable experience and knowledge in order to produce meaningful and trustworthy results. However, due to its complexity, it still involves some degree of uncertainty. On the other hand, ice basin model testing provides an available method for assessing ice actions, although it may be of questionable value for accurately modelling crushing phenomena. Even though substantial experience exists at the different facilities there can be differences in ice modelling techniques, test procedures and achieved results. The test procedures have to some extent been formalized through the Specialist Committee on ice of the International Towing Tank Conference. There is also some guidance in ISO/DIS 19906 Clause A16.5, with apparent emphasis on model ice properties. However, little guidance is provided on how to perform tests with offshore structures in ice and how to accurately model and produce ice ridges, which in many cases would yield the design load.

Very good agreement has been obtained between the model tests and full scale experience for ships running ahead thorough level ice. This has been confirmed by the design, construction and operation of countless icebreakers and ships running in ice. However, for offshore structures, both fixed and moored, the model testing is much more complex and the validity of model tests are not on the same level as for icebreakers and ships in transit. Thus, a general validation method to full scale does not exist. In some cases there is a need to decide before conducting a model test, how to scale the test, e.g. it is difficult to scale both the compressive and flexural strength as well as the elastic modulus of the ice correctly at the same time. In ice-structure interaction scenarios where the failure mode should shift between bending and crushing the model tests may not yield the correct result.

The Working Group recommends that guidance to inform the users of potential pitfalls and methods to address these is described in the Guidance Document.

4.1.4.6 Improved guidance on when and how the ice load approaches in ISO 19906 are applicable and their ranges of validity

Calculation methods for global ice actions are provided in ISO 19906 and are based on well documented work by many experts. For sea ice the methods mainly differ between vertical and sloping structures, but little advice on the range and validity of the methods are given. If the methods are applied to structures they originally were not developed for (e.g. wide cones) the results may not be correct any longer. Hence, an applicability envelope is missing, which as an extreme consequence may result in fundamentally wrong application of the provided formulas and thereby in wrong results.

The Working Group recommends to derive a table with the suggested applicability ranges of all formulas contained in the informative part of the standard. This will require review of most relevant original.

4.1.4.7 Ice induced vibrations

Dynamic ice actions are addressed in ISO/DIS 19906 Clause A8.2.6. However, the ISO provisions are not enough to conduct a fully dynamic design of an offshore structure under ice action. Therefore, additional guidance should be developed for design approaches for dynamic loading and structural response and examples clearly provided.

4.1.4.8 Loads from icebergs

No explicit guidance is offered on this topic in ISO/DIS 19906 but much can be inferred from Clause A8. A list of references of actual design work/recommendations with according overall methodologies is missing and should be part of an amendment. It is recognized that this topic is under current research and, therefore, only limited guidelines may be included in near future.

4.1.4.9 Uncertainties

One overall objective of Barents2020 is to achieve the same safety level is in the Barents Sea as in the North Sea. The consequences of an accident for humans, the environment and assets are generally perceived by media, politicians and the general public to be higher in the Barents Sea than further south. In order to keep the same safety or risk level the probability of occurrence of each load factor has to be reduced when the consequence is higher or more factors contribute to the overall probability. The action factor proposed in ISO/DIS 19906 is 1.35 compared to an environmental load factor of 1.3 in some design standards, e.g. DNV-OS-101. It is unclear if this increased factor is due to

- Increased overall probability due to ice being a new parameter
- More severe consequences being taken into account.
- Ice action calculations not being of the same accuracy as e.g. wave action calculation.
- Less amount of data and data with higher uncertainties for ice than metocean parameters in the North Sea

Further it is unclear how this shall be treated in probabilistic methods.

Following the first draft of this report the Working Group has been made aware that the factor 1.35 is a result of a calibration study. The calibration report is presently not available and no recommendations can be made at this stage.

4.1.4.10 Icing

Ship codes and offshore standards give guidelines for calculation of ice accretion but they are rudimentary. The November 2008 draft version of the new ISO/DIS19906 standard for Arctic Offshore Structures refers to the models and information from the 1970's and 1980's as well as the NORSOK N-003 standard,

Table 1. Suggestions for specific amendments/changes to ISO/DIS 19906

Clause	Topic	Some items to be addressed
9.7, 13, A8, A13, A16	Floating structures	Examples of how the methodology is applied to a selection of floater type vs. ice scenario. Guidance on use of model testing of floating structures in ice basins, including calibration and reliability of the test results. This guidance should include a table on the most important model tests to be performed for various structure alternatives. A consistent methodology for application of the recommended analytical ISO formulas to derive the global ice load as a function of the floater's response
7.2.3	Load combinations, Principal and companion environmetal loads	Examples
17.2.1	Ice management system/ Overall reliability and design service life	Limitations of ice management to reduce extreme loads.
A.17.3.3	Physical ice management	Guidance and experience from handling glacial features surrounded by or frozen into an ice sheet
A.8	Actions and action effects	Table over calculation methods for ice loads with original references and applicability ranges
A.6.5.2	Ice types	Definition/classification of icebergs (use IIP/WMO)
A.6	Physical environment	Section addressing ice data collection with at least - Guidelines for documentation - Guidelines for interpretation - Guidelines for how to obtain representativeness (e.g. repeatability and accuracy)

which shows a table of ice accretion as function of latitude and height above sea level. No references are given in the NORSOK N-003. API RP-2N (1995) and the Canadian CSA S471-04 (2005) refer, among others, to the same authors as ISO/DIS19906.

CSA S471-04 refers to comparisons between one Norwegian (ICEMOD) and one Canadian (RIGICE) model makes a statement regarding verification.

A large project is underway in Norway to remedy these deficiencies and no further action is recommended.

4.1.5 Recommendations from Working Group RN02

4.1.5.1 Suggestions for specific amendments/changes to ISO 19906

Table 1 lists su ggestions for some specific amendments/changes to ISO/DIS 19906.

4.1.5.2 Workshops to harmonise understanding of ISO 19906

The work in the Working Group substantiated the need for having a common review of ISO/FDIS19906 as soon as it becomes publically available in order to secure the same interpretation and understanding of the text between Russian and Norwegian users. This is necessary not only because there are differences between Russia and Norway with respect to rules, traditions and practice within reliability analysis and the probabilistic versus deterministic approaches to design but also because the text in ISO/DIS19906 is difficult to interpret (significant improvements in ISO/FDIS19906 are not expected). The Working group therefore recommends to arrange Russian-Norwegian workshops to harmonise the understanding and application of ISO 19906.

A joint Russian-Norwegian organizing committee should be appointed as soon as possible in 2010 to work out detailed plans and budget for the workshops. The planning can be done using e-mails and one 2-3 days meeting to finalize the program and budget and should be completed no more than four weeks after receiving go-ahead. It is clear from the work in the group that the topics of the workshops must include:

- Definition of risk and reliability
- Probabilistic based design as suggested by ISO 19906 as well as other documents in the ISO 19-series
- Definition of deterministic values for design based on e.g. probabilistic data processing
- ISO vs. Russian & Norwegian standards (design philosophies)

It is envisaged that the workshop series will consist of 2-3 workshops each of length two days. International experts, particularly from amongst the contributors to ISO 19906, should be invited and the workshops completed by within six months from the decision is made to go ahead.

The workshops should be organized with support from Russian and Norwegian authorities and industry.

4.1.5.3 Outline of contents and Scope of Work, Guidance Document for unit design in the Barents Sea

Barents2020 Working Group RN02 has identified ten topics that should be improved in ISO 19906. The group therefore suggests developing a Guidance Document for design of units in the Barents Sea that can be used by designers and other stakeholders and actors in the Barents Sea in the interim period until the next the current ISO 19906 will be updated and revised. This is unlikely to happen before 2014. The guidance document should focus on floating structures and the other prioritized topics in Figure 1. The document, or parts of it, may be submitted to ISO as e.g. a proposal for a Regional Annex or Regional Information for the next version of ISO 19906.

4.1.5.4 Organization

The organizing committee for the workshops should also be charged with the task to develop the detailed plans and budget for developing the Guidance Document. The work will be performed as a joint project between Russian and Norwegian scientists and engineers, with assistance from other experts according to need.

SDag and other companies should be invited to the project and encouraged to provide relevant documents and other information that will aid, guide and support the work. Interfacing with ongoing projects should also be secured as far as possible.

4.1.5.5 Funding

To be funded as a Joint Industry Project with due regards to other ongoing or complete projects whenever possible. Government support from Russia and Norway is considered essential to get the project established and both Norwegian and Russian industry will have to contribute to achieve the recommended project goal.

A working budget is 500 000 Euros.

4.1.5.6 Schedule

The plan and budget for the development of Guidance document for design of units in the Barents Sea should be finished by end of April 2010 and funding secured by end of June 2010. Securing funding must go in parallel with the planning process.

The draft of the Guidance Document should be completed within 12 months.

4.1.5.7 Outline of content

The regional Guidance Document should address all aspects needed for designing and operating floating structures, including movements to and from location, installation, connection, disconnection and removal. Thus it should address topics like scenarios, ice management (IM), load combinations, handling of uncertainties and ice basin model tests.

A *possible* table of content could include the following and also the structuring may be different:

First priority:

1. Ice loads of floating structures
   a. gap analysis
   b. guidance based on today's knowledge
   c. scope for further research
   d. Global loads, pack ice and glacial ice
   e. Local loads, pack ice and glacial ice
   f. Dynamic response, coupling all degrees of freedom (sway, heave, pitch, accelerations etc), pack ice and glacial ice
   g. Ice induced vibrations
   h. Guidance to application of the different approaches for load calculations, including numerical models, e.g. the range and validity.
   i. Uncertainties and action factors
   j. Directional change of ice movement
   k. list of requirements for floaters (normative)
   l. guidance on approaches in informative part
   m. ice threats
   n. effect of compliance
   o. design philosophy vs. disconnection philosophy vs. operating philosophy
   p. axisymmetrical vs. ship-shape
   q. ISO vs. Class requirements & recommendations
   r. characteristic loads, load factors & safety factors in mooring design
   s. DP in ice
   t. under hull ice transport
   u. ice impact on risers
   v. requirements to ice load and response monitoring

2. Load combinations and ice scenarios
   a. Revised load combination table for Barents Sea
   b. Some Barents sea scenarios
   c. How to combine different external loads (ice and ice in combinations with other environmental loads, directionality etc)
   d. Likely ice scenarios
   e. Examples of how the tools in 1 are applied to a selection of floating structures in selected scenarios
   f. ice threats
   g. ice scenarios, in particular for floaters
   h. ice combination (also scenarios) with..
   i. Case studies for selected combinations
   j. Define some Barents Sea ice scenarios that include icebergs, bergy bits, level ice, and waves and combinations thereof.
   k. Mention effects like directionality and require full exercise of impacts
   l. Revise Table 7-2 to fit Barents Sea ice scenarios
   m. Include examples

3. Ice Management
   a. Outline ice management systems for pack ice with and without glacial ice features
   b. Reliability of such systems
   c. Approaches to include IM in design of floating structures
   d. possibilities and limitations
   e. ice surveillance
   f. physical ice management
   g. effect & reliability of ice management
   h. ice managements plans & procedures
   i. interface with stakeholders
   j. ice alerting and threat assessment
   k. lessons learnt
   l. self management

4. Ice data collection
   a. Classification of ice features, icebergs and other glacial features (partly by referring to ISO 19906)
   b. Requirements on documentation of measurements
   c. How to obtain representative data
   d. Different ways to perform ice measurements and monitoring
   e. seasonal variation of ice conditions
   f. use "snapshot" observation principle
   g. monitor ice conditions during the entire ice season
   h. iceberg 3D profiling & temperature measurements (core)
   i. ice & iceberg drift with adequate discreteness of measurements
   j. collection of metocean data
   k. forecast recording
   l. remote sensing
   m. measurements to provide input for ice load calculations per ISO
   n. keel strength in situ & in ice model basin

o. measurements to allow comparison with ice basin model tests
p. extreme & abnormal ice features
q. compression in the ice cover
r. How data are sampled
s. Relevance of the data
t. Processing and interpretation Requirements for model basin tests
u. Classification of icebergs and other glacial features
v. Requirements on documentation of measurements
w. How to obtain representative data
x. Different ways to perform ice measurements and monitoring

5. Ice Basin Model tests
   a. Production of artificial ice, including ridges
   b. Scaling
   c. develop requirements to ice basin model tests based on SDag specs (for both generic axisymmetrical and ship-shaped moored structures)

Second priority:

6. Improved guidance on how and when to use approaches in ISO 19906
   a. define applicability (e.g. max/min cone angle
   b. clear recommendations on parameters to be used
   c. calculated values vs. results from model tests
   d. numerical methods
   e. Icebergs in ice
   f. Improved guidance on when and how the ice load approaches in ISO 19906 are applicable and their ranges of validity by going back to source

7. Ice induced vibrations
   a. List of projects/studies old and present
   b. Compilation and synthesis studies

8. Loads from icebergs
   a. List of projects/studies old and present
   b. Compilation and synthesis studies
   c. Probability of collision with hull / mooring
   d. Local loads on hull (and interface with hull deformation acceptance criteria)
   e. Global loads on hull (and mooring)
   f. Iceberg contact with mooring

9. Uncertainties
   a. definition of ice conditions (pdf, cut-off, extreme values)

10. Icing. To be based on new research results from ongoing project
   a. List of projects/studies old and present
   b. Compilation and synthesis studies
   c. Sea spray icing
   d. Atmospheric icing
   e. Icing "atlas"

4.2 Risk Management of Major Hazards

The scope of the working group has been to identify need for change, if any, in existing offshore oil and gas standards related to risk management of major hazards for operations in the Barents Sea. Risk management of major hazards is here understood as controlling the risks related to major hazards through developing safe designs and how the risk assessment techniques is a tool in this process. The group have considered standards for the technical safety barriers that shall prevent and mitigate major hazards, and the risk assessment tools used to define requirements to barriers and to measure the risk level reflecting the functionality and performance of the safety barriers.

A major hazard is here understood as an incident that may cause multiple fatalities, and/or which has a potential to escalate and threaten the integrity of an installation if it is not controlled. The work has been limited to major hazards related to the topside and main process systems, and loss of well control. This implies that loss of containment of well/process hydrocarbons and ignitions of such releases has been the focus for the work.

The area of offshore safety and risk management has many interfaces to other engineering disciplines, and includes aspects within many engineering areas. It has therefore been necessary to select some areas for prioritization, since the mandate for the work has been review of *a limited number* of key recognised standards.

The following issues have been prioritized:

- Standards for functionality and performance of technical safety barriers in arctic conditions, see Figure 1:
  - Containment of hydrocarbons in order to prevent and mitigate uncontrolled releases
  - Ignition source control
  - Fire and explosion risk management
  - Prevention of loss of well integrity and blow outs
- Standards for safety risk assessment of major hazards for topside facilities on offshore drilling, production and storage units in the Barents Sea, all with the aim to prevent occurrence and escalation of incidents.

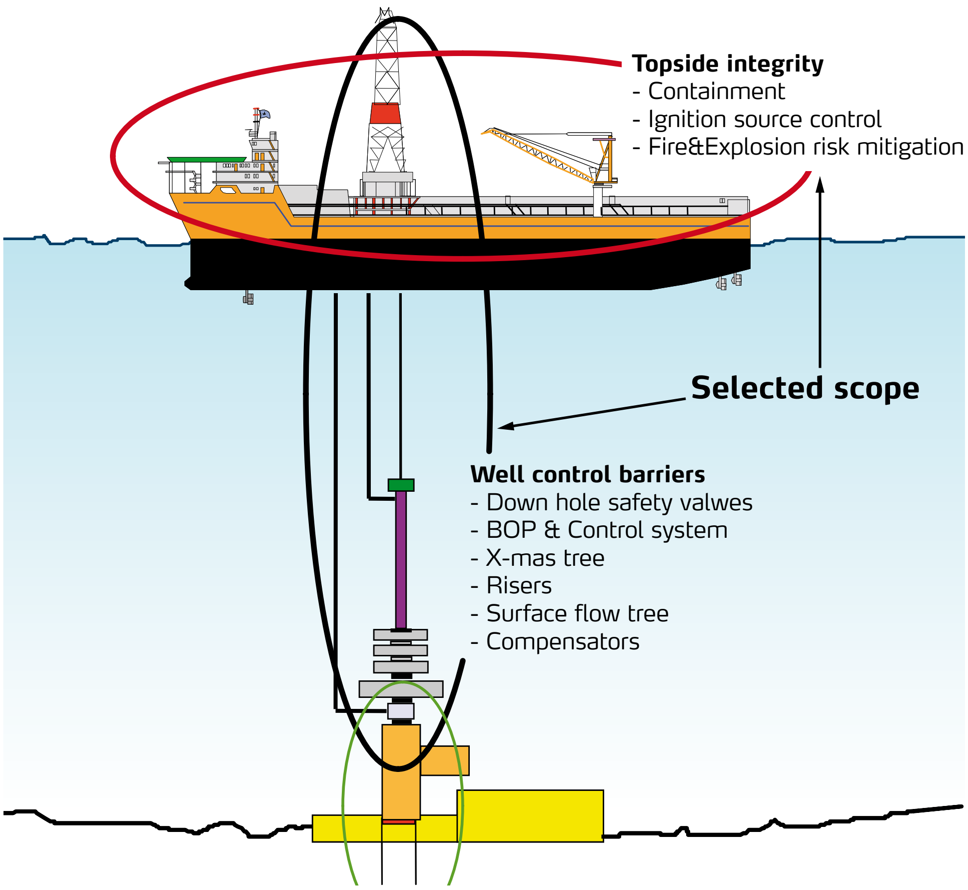


Figure 1. Technical safety barriers and standards for risk assessment of major hazards

Special attention has been paid to the challenge enclosing/ sheltering (winterisation) of hazardous areas due to cold climate, and the effect this may have with respect to ventilation, ignition probability and explosion pressures. In these areas the group have produced and co-ordinated comments and suggestions for change to standards relating to use of electrical and non-electrical equipment in explosive atmospheres and ventilation of offshore installations.

Risk is understood as the combination of the probability of an event and its consequences. The term "risk" is generally used only when there is at least the possibility of negative consequences, ref. /4/.

Risk management is the process of:

- Identifying risk factors
- Assessing and describing the risk factors
- Prioritizing risk contributors
- Evaluating the risk against risk tolerance criteria
- Implementing measures to control the risks in the areas that give the highest benefit.

The generic process for risk management is given in ISO 3100 "Guidelines on principles and implementation for Risk Management".

4.2.1 Risk Identification for the Barents Sea

Offshore activities in the Barents Sea need to take into account the challenges that arctic climate and remoteness introduces. The work has identified several arctic challenges that add risks to the existing safety risk picture in the North Sea. If offshore activities in the Barents Sea shall be performed with the same safety level as in the North Sea, these factors must be accounted for in technical solutions and operational best practices.

The main focus of the work has be to assess how the arctic factors impact the functionality of the technical safety barriers that are in place to prevent and mitigate major hazards, and how the technical standards should reflect this, see Figure 2.

In the present report safety barrier means the set of technical protection measures aimed at mitigation risk related to major hazards.

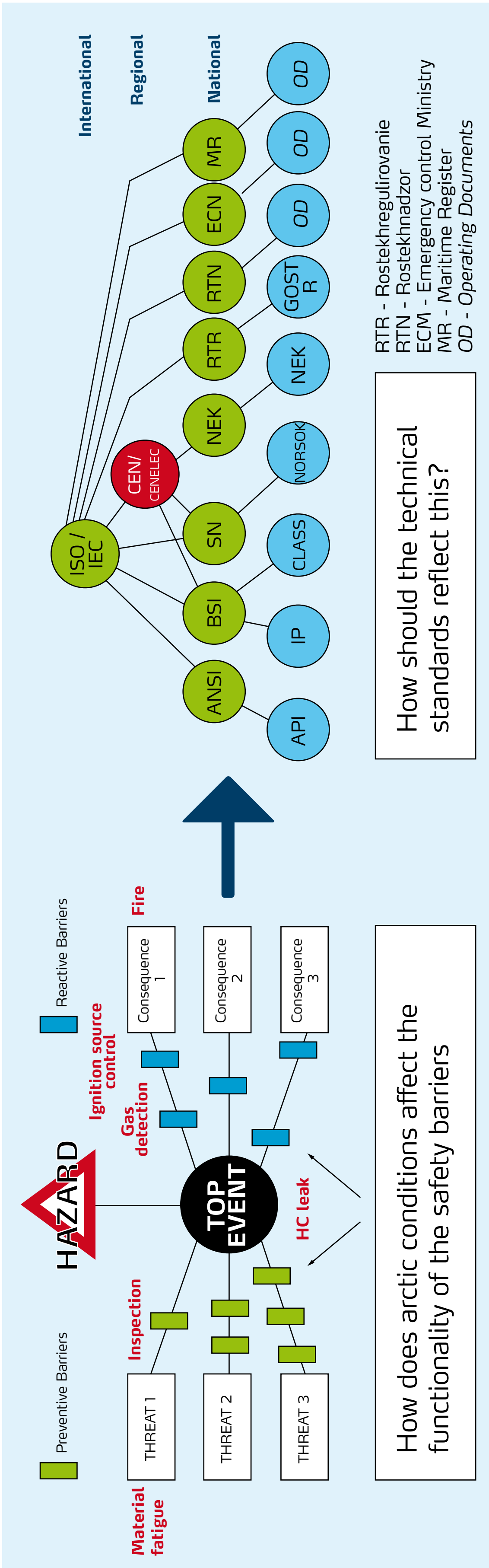


Figure 2. Functionality of safety barriers in arctic conditions

Phase 1 of the Barents 2020 project defined the safety baseline, and ranked the different contributors to the safety risk picture for arctic offshore activities, ref. /5/. This ranking and risk identification has been applied when discussing the impact on the different safety barriers from arctic conditions. In this work the following safety barriers has been selected for review:

- Containment and control of spills
  - Isolation/segmentation through emergency shut down
  - Emergency depressurization
- Gas detection
- Ignition source control
- Passive fire protection
- Active fire protection
- Explosion barriers
- Natural ventilation and HVAC
- Well control barriers

The Barents 2020 Phase 1 report describes how Barents Sea and cold climate factors may affect the functionality of these safety barriers, ref. /5/. The standards selected for review are those that relate the main working principles to establish the need for, the role of and the requirements to the safety barriers listed above.

Within the scope of RN-03 the main factors influencing the risk for offshore activities in the Barents Sea are:

- Enclosing the process area reduces the ventilation compared to more traditional open offshore design. Reduced ventilation conditions leads to increased accumulation of ignitable gases during accidental releases, and also for normal operation. Reduced ventilation may increase the potential for releases to build up ignitable gas clouds, thus increasing the explosion probability compared to an open design. Weather protection panels increase explosion loads in case of ignition of combustible gases (vapors). Enclosed areas may also give higher heat loads and the increase the accumulation of toxic combustion products (smoke) and oxygen depletion as compared to a traditional open design of offshore installations. Such effects can be controlled and mitigated in design, but requirements and guidance is needed to find the optimum solutions.
- The low temperature affects material properties and operational characteristics of equipment, process fluids and utility fluids etc. If not properly taken into account these effects can cause safety critical failures.
- Low temperatures, snow, slush, fog and icing may affect the safety barriers, and reduce their functionality and availability. An example is the application of water based fire fighting in cold climate, or gas detectors which are exposed to atmospheric icing or heavy fog.
- Low temperatures cause a need for additional heating and mechanical ventilation. These systems can be safety critical for certain functions, and this has to be taken into account in requirements and guidance.
- The remote location for offshore activities in the Barents Sea in combination with long periods of darkness, cold climate and also sea ice cause evacuation and rescue operations to be more challenging and time consuming than in the North Sea. This needs to be reflected in the integrity of the installation to withstand accidental loads without threatening the safe areas or the stability of the installation.

The detailed working document for RN-03 includes the review table for the standards mapped against the safety barriers, and lists the arctic risk features that the standards should reflectThe existing technical standards for offshore activities reflect the operating experience and best practice established from several decades of operation in the North Sea. When moving offshore activities into the Barents Sea the environmental conditions require new technical solutions, of which some has not been tested in practice. This risk management and risk assessment approach can then be used to assist in developing these solutions, and to measure the risk level against established risk tolerance criteria. In this sense the risk assessments will have an even more important role in the Barents Sea, since it can be used to compile the contributions from the additional risk factors in the Barents Sea and the effect of the risk control and mitigating actions that is put into place.

Risk management requires that the sources of risks are known. To achieve a sufficient understanding of the risk sources a risk assessment is required. The risk assessment is based on available knowledge, and a set of assumptions and study limitations. Experience in combination with assessments of identified challenges and the expected capacity of technical solutions to meet these challenges are hence included in the assessments. This implies that all risk based decisions are made under uncertainty. Offshore activities in the Barents Sea represent operational conditions that add uncertainty to the current risk picture for offshore activates as we know it.

The risk assessment will need to use suitable frequency data, consequence assessment and calculation tools, in order to evaluate cold climate effects, inherent safety and winterization, on the resulting risk picture.

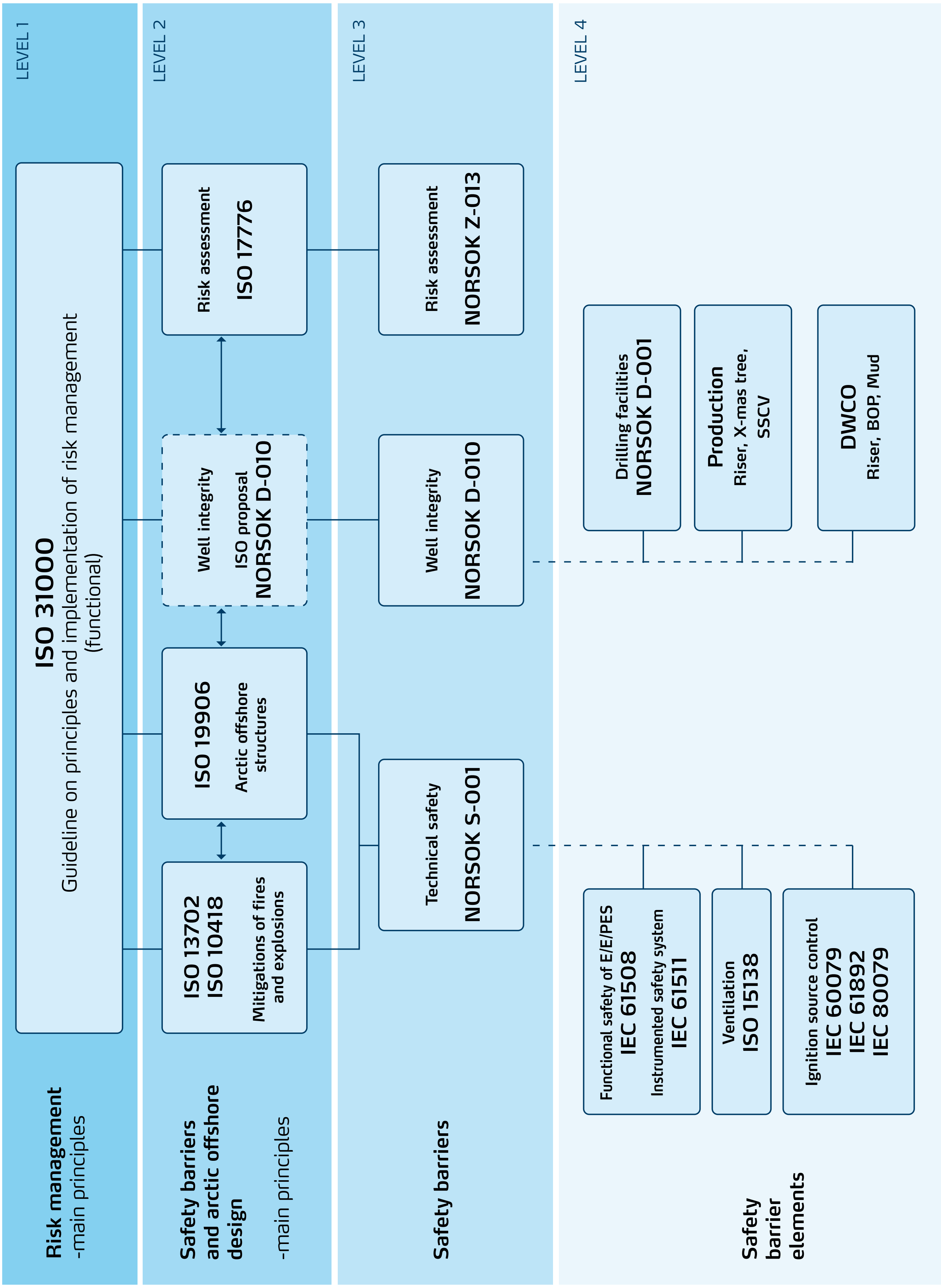


Figure 3. Recommended Key HSE standards related to risk management of major hazards

The technical standards and risk assessment methodologies for the Barents Sea must reflect these challenges and result in providing, if needed, additional requirements to the technical safety barriers.

4.2.2 Recommended Key HSE Standards

The working group have agreed to assess the applicability of technical standards applied in the North Sea, for application in the Barents Sea. The main reason for this decision has been that the standards to be applied in the Barents Sea must represent a set of best practice standards that have been applied successfully in an area that is comparable to the Barents Sea.

The recommended standards represent the standards applied and developed within the fields of risk management and technical safety in the North Sea, based on more than 30 years experience from offshore activities. The standardisation regime in the North Sea also reflects the principles of risk management.

The North Sea also represents an area that in many ways can be compared to the Barents Sea, but still with differences with respect to specific arctic conditions. The implications of these differences are the subject of this project.

There are important challenges with respect to the interface between the proposed standards, and national legislation and national standards. Solving the challenges that this interface represents has not been within the scope of the project, but rather to agree on a common set of prioritized standards which the group members see as a starting point to develop a coherent safety regime in the Barents Sea based on internationally accepted standards.

A total of 27 standards have been through an initial review within this framework:

- ISO: 13
- IEC: 5
- IMO:1
- API: 7
- NORSOK: 4

Based on these 27 standards, a set of 14 standards were selected as prioritized and recommended standards, to be included in the basis list of standards for offshore activities in the Barents Sea. The recommended standards are shown in Figure 3.

The prioritized standards are those that give functional requirements for risk management, risk assessment, mitigation of fires and explosions by technical safety barriers and well integrity. The group was asked by the Steering Committee to pay particular attention to ignition probability and explosion pressures due to effects of enclosed/ sheltered hazardous areas in cold climate. In these areas the group have selected key standards related to ventilation and ignitions source control.

The ISO 3100 guideline for risk management represents the overarching principles for risk management of major hazards. The group recommend that the ISO 3100 is used as the overarching standard to define principles and implementation of risk management for offshore activities in the Barents Sea. This guideline is functional and generic, and can be used for activities in the Barents Sea as it is.

The next level of standards recommended for use in the Barents Sea comprise international standards that gives functional requirements and guidance on design of arctic offshore structures, control and mitigation of fires and explosions, design of process safety systems and risk assessment. These standards are:

- ISO 19906 – Arctic offshore structures
- ISO 13702 – Control and mitigation of fires and explosions on offshore production installations
- ISO 10418 – Basic surface safety systems
- ISO 17776 – Guidelines and techniques for hazard identification and risk assessment

ISO 19906 is considered to be the main reference for requirements and guidance on arctic offshore structures. This standard gives overarching design principles for winterization of topsides and drilling systems. It is recommended that the other standards listed above give informative references to ISO 19906. ISO 19906 gives limited guidance on topside safety systems and risk assessment of major hazards. For these systems it is therefore recommended that ISO19906 give informative reference to ISO13702 and ISO 17776. Recommendations for update of these two standards to reflect offshore activities in the Barents Sea is summarized in section 4.2.3.. An alternative is to include the requirements and guidance in ISO19906, but this is considered to give less consistent and complete guidance, and would make ISO 19906 very extensive.

The next level of recommended standards consists of NORSOK standards that give requirements and guidance for safety barrier elements and risk assessment. The reason to bring in the NORSOK standards is that the group agreed to assess a set of standards that has proved to work in practice to maintain an acceptable safety level in relatively harsh climate, and that applies the principles of risk management and functional standards. The NORSOK standards that are recommended to consider for use in the Barents Sea are:

- NORSOK S-001 – Technical Safety
- NORSOK D-010 – Well Integrity
- NORSOK Z-013 – Risk and Emergency Preparedness analysis

Lastly the group recommended to include a set of international standards that give requirements and guidance on specific barrier elements. These barrier elements are particularly relevant for situations with enclosed/weather protected hazardous areas. These standards are:

- IEC 61508 - Functional safety of electrical/electronic/programmable electronic safety related systems
- IEC 61511 – Functional safety – Safety instrumented systems for the process industry sector
- ISO 15138 – Offshore Production Installations – Heating, ventilation and air conditioning
- IEC60079 – Electrical equipment, Explosive atmospheres
- IEC/ISO80079 – Non electrical equipment, Explosive atmospheres
- IEC 61892 – Mobile and fixed offshore units, electrical installations

Most of the proposed standards are not issued to specifically cover mobile offshore units which are under the jurisdiction of IMO and national maritime legislations for the area in question and class rules. The requirements and guidance in these are still considered to be applicable to such units, and for some of the standards it is also explicitly said in the text that where other codes give less stringent requirements the standard in question shall be applied. This implies that the requirements, principles and guidance will be relevant for offshore units that follow the IMO *"Mobile Drilling Unit Code"* and Russian Maritime Ship Registry *"Rules for classification, construction and equipping of floating drilling units (FDU) and fixed offshore platforms"*.

4.2.3 Recommended Changes to Key Standards for Application in Barents Sea

The group has produced detailed comments and recommended changes to the proposed key standards. In the following sections a summary of the main comments and proposed changes is presented.

4.2.3.1 Standards for risk Assessment in the Barents Sea

Risk Assessment and risk management is required to achieve an optimum design for offshore installations. New conceptual design and environmental conditions need to be reflected in the modelling of major accidents, both the occurrence of accidents and the outcomes of the accident. ISO 17776 and NORSOK Z-013 can be used as basis for the risk assessment of offshore installations. Including risk assessment in the design process has a history of nearly four decades in the North Sea. Risk assessment is now a well established tool that the designers use a to define accidental loads and to develop performance requirements for the safety barriers, as well as to give a complete overview of the risk level and its contributors.

In Russia risk assessment has its place in the law on Industrial Safety and Fire Safety, which requires a Industrial Safety Declaration to be established for industrial activities that includes potential for major hazards accidents and a Fire Safety Declaration to be established for fire risk. The purpose of the Industrial Safety Declaration is to inform interested bodies and individuals about the main hazards and risks of major accidents, as well as safety measures taken by the owner of the facility. The Industrial Safety Declaration serves as the basis for decision making on preventing and mitigating accidents, including decisions to ensure public safety and protect the environment. The main Russian reference documents for performing risk assessment of accidents are:

- RD-03-14-2005 "Procedure for formalizing Declaration of Safe Industrial Practices of Hazardous Process Facilities and the List of Required Data to be included in the Declaration" (approved by Rostechnadzor, 29 November 2005, Order No. 893)
- RD 03-418-01 "Procedural Instructions for Risk Analysis of Hazardous Production Facilities," (approved Gosgortekhnadzor of Russia, July 10, 2001, Order No. 30)
- RD 03-357-00 "Procedural Recommendations for Developing Declaration of Industrial Safety on Hazardous Process Facilities" (approved by Gosgortekhnadzor of Russia, April 24, 2000, Order No. 23)
- RD 03-409-01 "Estimation Procedure for Consequences of Accidental Explosions of Fuel-Air Mixtures" (approved by Gosgortekhnadzor of Russia, 26 June 2001)
- RD-03-26-2007 "Procedural Guidelines on Estimation of Consequences of Accidental Releases of Hazardous Substances" (approved by Rostechnadzor, 14 December 2007, Order No. 859)
- RD 03-496-02 "Procedural Recommendations on Assessment of Damages from Accidents at Hazardous Process Facilities" (approved by Gosgortekhnadzor of Russia, 25 July 2000)
- The Procedure of Calculation of Design Fire Risk Values at Process Facilities (approved by EMERCOM of Russia, 04 July 2009, Order No. 404).

For certain cases the need for preparing a fire safety declaration is specified in the legislation. Moreover, under some circumstances fire risk assessment shall be an integral part of design documentation. The following basic Russian regulatory legislative acts are used for fire risk assessment:

- Federal Law No. 123-FZ as of 22 July 2008 "Technical Regulations on Fire Safety Requirements";
- Decree of the Government of the Russian Federation as of 31 March 2009 No. 272 "Procedure of making Calculations to assess Fire Risks";
- "Procedure of Calculation of Design Fire Risk Values at Process Facilities" (approved by EMERCOM of Russia, 10 July 2009, Order No. 404 registered at the Ministry of Justice of the Russian Federation on 17 August 2009 No. 14541).

At present in Russia there is a requirement for any new projects to include the section devoted to risk analysis. This requirement is specified in the Decree of the Government of the Russian Federation No.87 as of 16 February 2008 "Sections of Design Documentation and Requirements for their Content".

The interface between design development and risk assessment as a continuous process throughout the design development and into operation has still to be developed for offshore activities in Russia. The ISO 31000 together with ISO 17776 (and NORSOK Z-013) is recommended to use as basis to define the working process and methodologies for risk assessment of offshore activities in the Barents Sea.

It is as important to have a common understanding of how the risk assessment shall be used in design, as what methodologies and tools should be applied. The practice of using risk tolerance criteria set by the operator in combination with demonstration of an ALARP (As Low As Reasonably Possible) process to determine when a design is "safe enough", need to be applied in the Barents Sea. Probabilistic design is well established in the North Sea, but has not been applied for Russian oil and gas industry. This implies that the work process, meaning to describe how the risk assessment is used and what decisions are made based on it, needs to be harmonised together with the actual risk assessment methodologies. This work can be started by arranging Russian-Norwegian workshops doing case studies of actual engineering projects and the interface with risk assessment. This can also include experience exchange on risk assessment methodologies and tools.

The risk assessment standards could also be updated to include Informative Annex describing the actual work process during design development; the information flow between the risk assessment and the other engineering disciplines, when and how decisions are taken, which safety studies that are performed to give input to the risk assessment etc.

Availability of relevant experience and failure data is important when performing risk assessments. A common and agreed Russian Norwegian dataset would strengthen the trust in risk assessments performed for offshore activities in the Barents Sea. NORSOK Z-013 contains a list of failure date that is recommended for application in the North Sea. These data sources can also be used in the Barents Sea, but with some caution to discuss the validity of such data in cold climate. There are Russian data sources that can be made available, and it would be of benefit to the harmonisation process to have these data reviewed and analysed to see how they may be used to strengthen the existing data sources. The data sheets for risk assessment provided by OGP can also be a common basis, although these data is generic and high level and would also take benefit from a common Russian-Norwegian review to agree on the usability for the Barents Sea. Relevant information sources in Russia for quantitative risk assessment of oil and gas facilities are:

- Annual Rostechnadzor reports on industrial safety status and information papers
- Papers of Gazprom gaznadzor
- Papers of Gazprom gazobezopasnost'
- Papers of EMERCOM of Russia

"ISO17776 - Offshore production installations – Guidelines on tools and techniques for identification and assessment of hazards"

This international standard describes some of the principal tools and techniques that are commonly used for identification and assessment of hazards related to offshore oil and gas exploration and production activities.

The standard is generic and can be used for the Barents Sea, but in the project documents the environmental conditions need to be stated.

An informative annex is proposed to be included to list arctic challenges that need to be reflected in risk assessments, and how these arctic challenges impact the different safety barriers. The Barents2020 Phase 1 Safety Baseline report includes such a description

The informative annex should also include guidance on strategies to develop safe design for arctic conditions with respect to explosion risk management, focusing on sensitivity assessments for:

- Optimization of natural ventilation and configuration of ventilation opening, and effect on ventilation rates, Wind Chill Index, gas dispersion and explosion overpressure design loads.
- Size of fire zones and location of fire and explosion barriers.
- Effect of active weather panels and explosion panels.

The standard should refer to ISO19906 on guidance for risk assessment of escape, evacuation and rescue in arctic climate.

"NORSOK Z-013 - Risk and emergency preparedness analysis"
This standard presents requirements to planning, execution and use of risk assessments and emergency preparedness assessment, with an emphasis on providing insight into the process and concise definitions. This standard covers analysis of risk and emergency preparedness associated with exploration, drilling, exploitation, production and transport of petroleum resources as well as all installations and vessels that take part in the activity.

The standard is generic and can be used for the Barents Sea, but in the project documents the environmental conditions need to be stated. The standard should be aligned with ISO19906 on guidance for risk assessment of escape, evacuation and rescue in arctic climate.

It is proposed to include an informative annex that contains a list of reference documents for offshore operations in arctic conditions. The informative annex could also include suggestions for adjustment factors of leak frequencies and generic failure rates to reflect lack of operating experience and failure data for Barents Sea operations.

"Annex G - Procedure for probabilistic explosion simulations" should be updated to give guidance on:

- Sensitivity assessments to optimization of natural ventilation
- Configuration of ventilation opening, and effect on ventilation rates, Wind Chill Index, gas dispersion and explosion overpressure design loads
- Effect of active weather panels and explosion relief panels

4.2.3.2 Standard for arctic offshore structures

"ISO 19906 – Arctic offshore structures"
This standard is the main reference to principles for design for cold climate offshore structures. It specifies requirements and provides guidance for the design, construction, transportation, installation, and decommissioning of offshore structures, related to the activities of the petroleum and natural gas industries, in arctic and cold regions environments. Requirements and guidance for the safety barriers for topside, drilling facilities and well integrity in arctic and cold climate conditions is not reflected in the document. It is proposed that the standard is updated to refer to the ISO and IEC standards reviewed in this report, for guidance and requirements to the specific safety barriers. The standard is also proposed to be updated to include guidance on developing a winterization strategy; the process to identify need for winterization, and selection and implementation of winterization solutions.

4.2.3.3 Standards for technical safety barriers

"ISO 13702 - Control and mitigation of fires and explosions on offshore production installations"
The main reference for guidance and requirements for technical safety barriers is "ISO 13702 - Control and mitigation of fires and explosions on offshore production installations". The objectives and main principles of the standard are generic and can be used for the Barents Sea. The project documentation should also include a description of the process to identify need for winterization, and selection of winterization solutions. The standard should include an informative reference to ISO 19906 for general design principles of offshore arctic structures.

The functional requirements of ISO 13702 can be used as they are. The informative parts of ISO13702 should be updated to reflect specificities related to design of offshore structures in cold climate. The need for update of the different sections in ISO 13702 giving requirements and guidance on each specific safety barriers is described below.

Containment (prevent releases of hydrocarbons, chemicals and/or toxic substances)

The standard has no specific section on the "Containment" barrier, as for example NORSOK S-001. Some guidance is given in section 6 "Emergency shutdown systems and blowdown" and section 8 "Control of spills". It is therefore proposed to include a section in the standard that specifically addresses the Containment barrier, and issues that need to be reflected in design to avoid loss of containment in cold climate. The standard needs updating with functional requirements related to the challenges to the containment barrier in cold climate.

Ignitions source control
Section 2 of the standard gives main functional requirements to minimize the likelihood of ignition.

Annex A.4 and B.4 gives informative guidance on ignition sources and control of ignition. The main functional requirements does not need to be updated, but the informative guidance should reflect the extended use of electrical heat tracing, mechanical ventilation/fans and potential for accumulation of static electricity and sparking in cold climate. The standard refers to IEC 60079 for use of equipment in explosive atmospheres, and a proposed update of this standard for arctic conditions is included in this report.

Gas detection
Section 10 gives requirements to gas detection systems. Annex B.6 gives informative guidance on gas detection systems. The main functional requirements do not need to be updated, but the informative guidance should reflect of arctic factors impact on the gas detection system.This mainly implies an update to describe principles for robust and protected installation of gas detectors, strategies to determine optimum type and location of detectors, and operational precautionary measures in extreme weather conditions.

Active fire protection
Section 11 gives functional requirements to the active fire protection system, and Annex B.8 gives informative guidance. The functional requirement does not need to be updated, but the informative annexes need to be updated to include arctic challenges. The main areas to give guidance on are proposed to be:

- location of critical parts of the fire water system in heated areas
- heat tracing and anti-freezing strategies (circulation, anti-freeze, enclosing etc.) for equipment in non-heated areas
- foam specification for low temperatures
- manual operability of firewater system in low temperatures

Passive fire protection
Section 12 gives functional requirements to the passive fire protection system, and Annex B.8 gives informative guidance. The functional requirements do not need to be updated, but the informative annexes need to be updated to include arctic challenges. The main areas to give guidance on are proposed to be:

- Effect of ice/snow on passive fire protection
- Condensation inside passive fire protection due to low temperatures, causing corrosion and/or ice formation.
- Use of new materials for cold climate, with other material properties and hence protection requirements.
- Need for change in specification tables for protection times due higher heat radiation in enclosed areas (more reflected heat from surroundings).
- Prolonged protection times, due to potentially more critical situation in case of escalation in remote areas where evacuation and rescue is challenging and potentially more time consuming.

Ventilation (natural and mechanical)
Section 5 gives some coarse requirement on how ventilation shall be assessed in relation to other safety barriers, but there is no separate section to give requirements to ventilation. More informative guidance on the ventilation is given in Annex B. Optimising ventilation of hazardous areas with respect to working environment and minimum fire and explosion risk is of outmost importance in cold climate. It is therefore proposed to update Annex B to include a section on ventilation for arctic designThe informative guidance need to be seen in context with Annex B.10 on “Explosion mitigation and protection systems”. The following factors should be considered:

- Design and proper operation of HVAC systems in cold environments.
  - Reference to ISO 19906 main principles for design of HVAC system for cold regions.
  - Redundancy in power supply for HVAC systems, and reference to IEC 61892-7 for requirements for redundant supply.
  - Requirements for securing the artificial ventilation back up system by eventual breakdowns due to failure caused by ice and snow

- Optimisation of natural ventilation of hazardous areas to achieve satisfactory working environment balanced towards ALARP fire and explosion risk:
  - Analytical strategies to optimize natural ventilation of hazardous areas
  - Consideration of module sizing
  - Design of weather panels to avoid clogging by ice and snow
  - Location of ventilation openings in walls and roof openings
  - Use of active weather panels (open in low wind conditions and/or at confirmed gas detection)

Explosion mitigation and protection
Section 13 gives functional requirements to explosion

mitigation and protection, and Annex B.10 and B.11 gives informative guidance in the same areas. The functional requirements do not need to be updated, but the informative annexes need to be updated to include arctic challenges.. The guidance in Annex B gives generic type of guidance on the working process, and be used in the Barents Sea but has to be further developed to cater for winterization such as enclosed modules /areas. This aspect may be the most important to develop good solutions for as North Sea practice are not fully valid. The guidance should be linked with guidance on ventilation of hazardous areas, as described above.

The informative annex should also include guidance on strategies to develop inherently safe design for arctic conditions, focusing on assessments with respect to:

- Optimization of natural ventilation and configuration of ventilation opening, and effect on ventilation rates, Wind Chill Index, gas dispersion and explosion overpressure design loads
- Size of fire zones and location of fire and explosion barriers
- Effect of active weather panels on explosion overpressures.

With respect to explosion risk management, the starting point is that in cold climate there is a need to protect equipment and personnel working outdoor by weather shielding. Weather shielding reduces ventilation, increases confinement and thereby also the explosion overpressures. The preferred solution is to rely on natural ventilation for weather protected areas, as opposed to mechanical ventilation. In the North Sea the open platform design typically gives 100-200 Air Changes per Hour (ACH) in hazardous areas 50% of the time and this high air change rate gives a reduction in explosion risk. Generally enclosed hazardous areas are designed to have at least 12 ACH, and the requirement in NORSOK S-001 is that "natural ventilation in hazardous areas shall be as good as possible and shall as a minimum provide an average ventilation rate of 12 AC/h for 95 % of the time. Meeting this requirement is not alone sufficient to control the explosion risk level to the same extent as for an open North Sea design. Hence the limited number of air changes per hour must be reflected both in the explosion design and in the risk assessments. One should also look at smart designs and operational procedures that reduce the need for manual operations in exposed areas during cold periods. This will make it possible to increase the natural ventilation rates in hazardous areas. A strategy could also be not to protect for every combination of weather, meaning that if the weather is harsh work is not performed in exposed areas.

The factors should also be considered for inclusion in the informative guidance in Annex B.10.

For Explosion risk management the main standards are ISO13702 and NORSOK S-001. Both these standards represent functional approaches to defining requirements to elements involved in explosion risk management. There is no need to amend the general approach in these standards, but it is proposed to update the informative guidance in these standards to better reflect explosion risk management for cold climate. This implies that the standards should reflect the following issues:

- Describe the relationship between arctic design of offshore structures, and the impact on explosion risk.
- Describe control measures for reducing explosion risk, and prioritize preventive measures
  - Preventive measures: Avoid releases, ignition source control, optimize ventilation,
  - Mitigating measures: Optimize module sizing, optimize module layout to reduce congestion and turbulence, use of active weather panels and explosion relief panels, design explosion barriers that withstand the defined design accidental load.
- Guidance on methodology for explosion risk modelling. The NORSOK Z-013 standard for has an informative annex on probabilistic explosion modelling, and this guidance is proposed be used as basis or reference. The ISO standard 15130 on "Heating, ventilation and air conditioning" also has an informative annex that gives a general description of the process for modelling explosion risk.

"ISO10418 - Offshore production installations – Basic surface process safety systems"

This standard describes objectives, functional requirements and guidelines for the analysis, design and testing of surface safety systems for offshore production of oil and gas. This standard can be used in the Barents Sea as it is, assuming that winterization issues are be covered by ISO 19906, ISO 13702 (and NORSOK S-001).

"NORSOK S-001 – Technical safety"

The NORSOK standards are adding the provisions that together with ISO 13702 are deemed necessary to fill the broad needs of the Norwegian petroleum industry. The standard describes requirements for the individual safety barriers/-systems, and represents a generic performance standard for the different safety barriers. The standard can be used for the Barents Sea as it is.

The project documentation should include a description of the process to identify need for winterization, and selection of winterization solutions. The standard should include an informative reference to ISO 19906 for general design principles of offshore arctic structures. ISO 13702 applies generic and functional requirements in combination with informative annexes. NORSOK S-001 adds more specific requirements that shall be used in addition to the ISO 13702, and gives less informative guidance. This implies that updating the informative parts of ISO 13702 with respect to cold climate, with NORSOK S-001 referencing to this standard and ISO 19906 on cold climate, should be sufficient.

To update NORSOK S-001 with respect to application in the Barents Sea, it will have more or less the same needs for update as ISO 13702 for each of the safety barriers described above.

Containment (prevent releases of hydrocarbons, chemicals and/or toxic substances)

The standard needs updating with informative guidance and possibly functional requirements related to the challenges to the containment barrier in cold climate.

Ignitions source control
Same need for update as ISO 13702.

Gas detection
Same need for update as ISO 13702.

Active fire protection
Same need for update as ISO 13702.

Passive fire protection
Same need for update as ISO13702, and in addition the following issues should be considered for update in section "19 – Passive fire protection":

- Section 19.2 - Interfaces: The list of safety functions/barriers that determines the extent and requirement for passive fire protection should be updated to also include the integrity of Temporary refuge. In remote arctic areas evacuation and rescue can be a challenge to perform and can be time consuming, hence this can give impact on requirements for the fire integrity of the temporary refuge.

- Section 19.4.1 – Fire divisions: Escalation can be more critical for remote arctic areas, and this implies that it should be considered whether it still can be accepted to have no fire division between drilling area and wellhead area.

- Systems that are critical to maintain winterization is in NORSOK S-001 required to be within A0/A60 fire divisions. It should be considered whether this requirement is sufficient for remote areas where rescue is challenging. The criteria can be made functional and linked to the dimensioning endurance time for a rescue operation and to ensure survivability for personnel onboard.

Ventilation (natural and mechanical)
Section 16 gives specific requirements to natural ventilation and HVAC systems. These requirements can be used as they are. Optimising ventilation of hazardous areas with respect to working environment and minimum fire and explosion risk is of outmost importance in cold climate. It is therefore proposed to update the standard to include either a section or an informative annex concerning ventilation for arctic offshore designThe informative guidance can also be provided by referring to a version ISO13702 updated with respect to cold climate design. The same factors as for ISO 13702 should be considered:

- Design and proper operation of HVAC systems in cold environments.
  - Reference to ISO 19906 main principles for design of HVAC system for cold regions.
  - Redundancy in power supply, and reference to IEC 61892-7 for requirements for such.

- Optimisation of natural ventilation of hazardous areas to achieve satisfactory working environment balanced towards ALARP fire and explosion risk:
  - relationship between ventilation and control of explosion risk
  - analytical strategies to optimize natural ventilation of hazardous areas
  - consideration of module sizing
  - design of weather panels to avoid clogging by ice and snow
  - location of ventilation openings in walls and roof openings
  - use of active weather panels (open in low wind conditions and/or at confirmed gas detection)

Explosion mitigation and protection
NORSOK S-001 describes good engineering practice which can be used also for the Barents Sea. The standard has the same need for update and informative considerations as for ISO 13702 on explosion risk management. Since this is considered to be the most important area with respect to safe design of arctic offshore installations, it is proposed to include an informative Annex B that includes guidance on explosion risk management

for hazardous areas in cold climate. The new Annex should also include considerations related to ventilation of hazardous areas as described for ISO 13702.

"IEC 61508 – Functional safety of electrical/ electronic/programmable electronic safety related systems"

This Standard covers those aspects to be considered when electrical/electronic/programmable electronic systems are used to carry out safety functions. The standard consists of following main parts:

- General requirements
- Requirements for E/E/PESs
- Software requirements
- Examples of methods for determination of safety integrity levels (SILS)
- Guidelines for the application
- Overview of techniques and measures

The standard sets out a generic approach for all lifecycle activities for E/E/PESs considering safety systems strategy relying also on other technologies (hydraulic, pneumatic etc.). The standard can be applied for Barents Sea as it is.

The project documentation should include a description of aspects of winterization that could impact performance of safety critical systems and components.

The Norwegian petroleum industry have developed a guideline named "Application of IEC 61508 and IEC 61511 standards for use in the Norwegian petroleum industry". This guideline can also be used for the Barents Sea, but with consideration of the validity of generic failure rates for hardware components that are included in the guideline. The guideline includes standard values for failure rates/failure on demand to be applied in SIL assessments and quantitative risk. The failure rates are based on North Sea operation and test data. When using the failure data to reflect operations in the Barents Sea, some caution should be made to discuss and reflect with sensitivity assessments the validity of these failure rates for operations in cold climate.

"IEC61511 - Functional safety – Safety instrumented systems for the process industry sector"

This standard addresses the application of IEC 61508 for the process industry. It requires a process hazard and risk assessment to be carried out to derive the requirements for safety instrumented systems and details required safety management activities. IEC 61511 is to be used for system designers, integrators and users referring to 61508 for manufacturers and suppliers of devices. The standard is generic and addresses all safety lifecycle phases from initial concept, design, implementation, operation, maintenance and can be used for the Barents Sea as it is.

"ISO 15138 Offshore Production Installations – Heating, ventilation and air conditioning"

This standard specifies requirements and provides guidance for design, testing, installation and commissioning of HVAC and pressurization systems and equipment for offshore installations, fixed or floating, normally and not normally manned. The standard includes requirements and guidance for both natural and mechanical ventilation.

The functional requirements and guidance can be used in the Barents Sea as they are. It is considered that this standard in combination with ISO13702 and NORSOK Z-013 Annex G, gives the best guidance on the relationship between ventilation and explosion risk, and need for simulations to investigate this relationship and provide input to design. The standard will however be further strengthened by including or referring to the same kind of guidance on ventilation and explosion risk in cold climate as is proposed for ISO 13702 and NORSOK S-001.

The standard should also refer to ISO19906 for main principles with respect to design of HVAC systems for cold regions, and to IEC 61892 for requirements to power supply for HVAC systems.

"IEC60079 – Electrical equipment, Explosive atmospheres and IEC/ISO 80079 Non-electrical equipment - Explosive atmosphere."

These serial of standards contain descriptions on how to produce and calculate explosion protected equipment and systems with different methods of protection, selection of equipment, and installation requirements for each protection type to avoid ignition. Both IEC60079 and IEC/ISO 80079 need to be updated for application in cold regions and in the Barents Sea.

The work with the two IEC standards have been shared between the Russian and Norwegian experts, and co-ordinated towards a common report to the IEC Technical Committee (TC) 31 meeting in Tel Aviv in October 2009. The Russian experts reviewed standards specific for equipment, while the Norwegian experts reviewed standards relating to installation of equipment and area classification. The work was presented in one common report to TC 31. Based on the presentation of the Russian-Norwegian report, TC31 agreed to form Ad Hoc Working Group (AHG) to investigate the issues associated with very low temperatures for example in the arctic and their impact on the protection techniques in the IEC 60079 series and future non-electrical standards. Five member countries have so far joined the working group; Germany, Finland, USA, Russia and Norway. The recommendations from the working group shall be given to the IEC TC31 plenary meeting in Seattle in 2010. IEC TC 31 have also updated their strategy to include:

"The movement for exploration for oil and gas in the arctic and other very cold regions is expected to bring a further examination of how explosion protection techniques apply at very low ambient temperatures and"

The main areas for change as proposed in the joint Russian-Norwegian report to TC 31 are:

- Validity for temperatures below -20° C. IEC TC31 MT to consider the operating temperature range -20° C to -60° C, in all relevant standards listed.
- Low ambient air temperature can have a significant impact on the selection of materials for construction.
  - Certain metals can become brittle at low temperatures and shall be avoided in the construction of equipment.
  - Certain polymers become brittle and crack easily at low temperatures. Thus these polymers should be avoided.
- Component protection according to Part 5 and 18 of IEC 60079 which must be used inside other protections need to be fit for arctic temperatures like lighting fittings, electronic units, amplifiers, transmitters, fuses, control units.
- Requirements for temperature during installation and maintenance
- Lubrication of bearings, need for special grease for low temperatures
- Semi conductors can fail at low temperatures (control and logical systems)
- Charging of batteries is difficult at low temperatures (below -5° C)
- Fluorescent lightning will have reduced/no effect (not possible to switch on below – 25° C)
- Electric heat tracing provides more accurate temperature control. Since electric heat tracing is sized based on heat losses, the quality and condition of the piping insulation is a critical aspect that shall be considered. Excessive heat loss at missing or poorly insulated areas could make an electric traced system ineffective.
- Certain types of heat tracing cannot be used at all in classified (designated hazardous) areas and defects are usually more difficult to locate.
- The operating procedures of equipment shall be adjusted for operation in arctic and cold regions environments, and the criticality of such equipment or systems shall be taken into consideration.
- Intrinsically safe characteristics can change and this must be reflected by selecting barriers accordingly.
  - Intrinsically safe units with semiconductors and a liquid crystal indicator do not operate at low temperatures. The lower operating temperature range of the semi-conducting components shall be lower than -40° C. Special heating systems could be required

"IEC 61892-7 – Mobile and fixed offshore units, electrical installations , Part 7 – Hazardous areas"
IEC 61892 forms a series of International Standards intended to enable safety in the design, selection, installation, maintenance and use of electrical equipment for the generation, storage, distribution and utilization of electrical energy for all purposes in offshore units which are used for the purpose of exploration or exploitation of petroleum resources. Part 7 contains provisions for hazardous areas classification and choice of electrical installation in hazardous areas in mobile and fixed offshore units.

Arctic condition require that the standard need to take in new requirements for selection of materials to be described, cable and cable installation requirements, layout to get access to exposed equipment for maintenance purposes and heating methods of walls and structures.

Part 7 does not give any general requirements to ambient temperatures. In Part 1 cl. 4.7.2.1 it is stated that unless other "high air temperature" has been stated in other parts of the standard, a value of 45° C shall apply. No min. temperature has been specified. However, in Table 3 of Part 1 it is given a min. temp. of 5° C for instrumentation and -25°C for open deck. A normative Annex should be included, listing the ambient temperatures for various locations. As the requirement to temperature may be relevant for other parts than Part 7, the Annex should be included in Part 1 (general requirements) or Part 2 (System design) of the standard.

The standard need to take in additional requirements for arctic conditions to secure that the artificial ventilation will function even if the main system failure. The air intakes and capacity of the HVAC system must not be affected by atmospheric or sea spray icing. The HVAC system must also ensure that the concentration of explosion substances in atmosphere shall not increase due to sheltering of process or drilling areas. On these areas it is recommended that the standard refer to ISO 13702 and ISO 19906, to give consistent guidance. ISO 19906 requires that redundancy shall be provided for emergency power generation for all structures in cold regions (ISO19906). Relevant parts of IEC61892 must describe back up sources requirements to maintain the ventilation required for area classification or other means of protecting the plant if the system should fail. This can for example be to require a higher level of explosion protection of operating equipment.

The Norwegian members of the Maintenance Committee (MT) for IEC TC18 will bring forward the comments for implementation in the next revision of IEC61892 which is scheduled to start in 2010.

"NORSOK D-010 Well Integrity in Drilling and well operations"

This standard describes the principles and requirements for establishing and maintaining well control barriers in different phases of drilling and completion operations including drilling, well testing, completion, production, wireline and coiled tubing operations.

The standard is generic and can be used for the Barents sea as an operational guideline. To cover Barents Sea specific issues it need to address the impact on electrical installations, automated systems and hydraulic systems from cold climate. The main issues that that should be discussed for these systems are:

- Design temperatures
- Power supply /UPS
- Heat tracing of pipes
- Fluid properties
- Material properties
- Seals and bearings
- Weather shielding/protection against arctic environmental loads on equipment, both as single and combined loads.

The standard should refer to ISO 19906 for guidance on design of arctic offshore structures.

"NORSOK D-001 Drilling facilities"

This standard describes the principles and requirements for design, installation and commissioning of drilling facilities and their systems and equipment on fixed and mobile offshore installations. The standard is currently under revision. The standard is generic and can be used for the Barents Sea as best practice. The standard is generic and can be used for the Barents Sea as best practice. To cover Barents Sea specific issues the standard needs to address the following issues related to cold climate:

- Design loads
  - Accidental loads
  - Environmental loads, as single and combined loads, including movements due to impact from ice, wind, waves and current
- Design temperatures, both air and seawater.
- Logistics
- Deck arrangement
- Area requirements
- Handling requirements
- Power supply /UPS

The standard should refer to ISO 19906 for guidance on design of arctic offshore structures.

In Russia there is significant experience from cold climate onshore drilling operations. There is also experience from Sakhalin and Shtokman drilling operations. This experience should be collected and summarized, and used as reference for drilling operations in the Barents Sea. It could also be used as an informative annex to NORSOK D-001.

4.2.4 General Comments, findings and priorities

The main priority of the group has been to agree on a set of technical standards that can work as a framework for risk management and risk assessment of major hazards in the Barents Sea. In this work the group agreed that it would be beneficial to select a set of standards that has proven to work in an area that is comparable to the conditions in the Barents Sea, and which is based on international best practice. It was on this background that the group selected the set of standards that has been developed and applied in the North Sea as basis for development of standards applicable for offshore activities in the Barents Sea.

These standards have then been through a review to identify possible needs for change to reflect Barents Sea and cold climate conditions for offshore activities. In general it can be said that the standards that give general principles of design and basic functional requirements (ISO 3100, ISO 19906, ISO 13702, ISO 17776, IEC 61508, IEC 615011, NORSOK S-001, NORSOK Z-013, NORSOK D-010) can be used as they are, but that the informative parts of the standard needs to be updated to give sufficient guidance on design and risk assessment for the Barents Sea. These standards should also, as far as possible, be updated to make relevant reference to each other and in particular to ISO 19906 on Arctic offshore structures. The latter standard together with ISO 13702 and ISO 17776 are proposed to be the main sources of functional requirements and informative guidance for risk management and risk assessment of major hazards in the Barents Sea. For the standards that give more specific requirements, it is identified some areas where these requirements itself needs to be updated to reflect Barents Sea conditions. This applies to the IEC 60079 and 80079 series, and to IEC 61892-7 on ignition source control and hazardous areas classification.

The standards and updates which are proposed represent the recommendation from the Russian and Norwegian Industry for a set of harmonised technical standards that will contribute to an acceptable safety level for offshore activities in the Barents Sea. Some of the international standards are already harmonised in Norway and Russia, and in addition some international and Norwegian standards have been proposed as basis for further harmonisation.

International and Norwegian standards considered by the Group do not contradict the basic provisions of the similar Russian documents and can be used as informational and reference documents for risk analysis and offshore design as well as for development of special regulations, safety rules and oil & gas industry standards. During the work it has come clear that there will be a need for further work and clarifications to ensure the interface with Russian legislation and national standards. There will inevitably be issues resulting from this work which need to be considered further by the appropriate authorities. To accelerate this process and get experience from application of the standards as soon as possible, it is possible to make use of the proposed standards as corporate standards or as project specific standards.

In the work the group have prioritized three areas:

Risk assessment and risk based development of design is required to achieve optimum solutions for offshore installations in the Barents Sea. There is a difference in how risk assessment is performed and included in the design and approval process in Russia and Norway, and there are differences in the use of risk terminology, datasets and risk modelling tools. The group have had detailed discussions on the role of the risk assessment in the design development, and it is concluded that further work is needed to create a common understanding of the work process. This can achieved by arranging workshops with cases studies on North Sea development projects or ongoing Barents Sea developments. Topics in these workshops should be interface between engineering and risk assessment, use of functional requirements and risk tolerance criteria, decision making based on output from risk assessment and probabilistic analysis.

Explosion risk management is considered to be the most important area with respect to safe design of arctic offshore installations. It is therefore proposed to strengthen the relevant standards by including informative guidance on explosion risk management for hazardous areas in cold climate. The intention with the additional guidance is to:

- Describe the relationship between arctic design of offshore structures, and the impact on explosion risk (weather protection reduces ventilation compared to traditional design, which again increases the potential for gas cloud build up which upon ignition inside an enclosed module may give significantly higher explosion overpressures than for traditional open design).

- Describe control measures for reducing explosion risk, and prioritize preventive measures
  - Preventive measures: Avoid releases, ignition source control, optimize ventilation,
  - Mitigating measures: Optimize module sizing, optimize module layout to reduce congestion and turbulence, use of active weather panels and explosion relief panels, design explosion barriers that withstand the defined design accidental load.

- Clarify methodology for explosion risk modelling. The NORSOK Z-013 standard has an informative annex on probabilistic explosion modelling, and this guidance is proposed be used as basis or reference.

Ignition source control: Cold climate will require increased sheltering of hazardous areas. This reduces the ventilation rate compared to naturally ventilated areas. This may cause even a relatively small release of hydrocarbons to build up an ignitable gas cloud of sufficient size to expose an ignition source. Hence, ignition source control, gas detection and ventilation should be designed to counteract the effect of increased sheltering of process areas. The work has produced common a Russian-Norwegian report on the need for update of IEC 60079 and IEC 80079, delivered to the Technical Committee 31. TC31 agreed to form an ad hoc working group to investigate the issues associated with very low temperatures. The recommendations from the working group shall be given to the IEC TC31 plenary meeting in Seattle in 2010.

4.2.5 Proposals for further work

The group has proposed the following basic areas of further cooperation on harmonization of risk management standards for the main hazards (fires, explosions) at offshore oil and gas platforms in the Barents Sea applied in Russia and Norway:

1. Continue the work for implementation of recommendations and proposals in IEC and ISO

2. Ensure dialogue between Russian and Norwegian experts and executive authorities (regulation bodies) about **risk management and risk assessment** in the offshore design process, and application of functional safety standards.
   - Methodology and practice of for risk based development of safe design of offshore installations.
   - Practical application of safety standards during platform engineering, evaluation of platform safety barriers for existing facilities;
   - Practical aspects of risk analysis for major hazards, with particular attention to risk related to fires and explosions.

3. Experience exchange and comparative analysis of efficiency of methods and software for accident risk modeling and estimation as well as required databases to increase safety of offshore facilities, including:
   - Modeling of hydrocarbon leaks, including dispersion and impact of natural and mechanical ventilation on generation of explosive mixtures;
   - Modeling and assessment of explosion and fire risks at process facilities for enclosed and open designs, including effects of active weather panels.
   - Comparison of Russian and Norwegian databases on incidents, accidents, failure and reliability data for use in risk assessments.

4. Development of harmonized Norwegian-Russian standards on risk management of major hazards (fires, explosions) at offshore oil and gas platforms in the Barents Sea:
   - Joint review of effective design decisions and the best practice cases (Norway – offshore platforms, Russia – Arctic conditions).
   - Development and joint approval of some standard provisions, which contain specific requirements and recommendations for offshore platforms of the Barents Sea and take into account specific features of national legislative, regulatory and methodical bases of both countries.

   - The result of the work can have the form as a Barents Sea regional addendum or guideline for the application of the recommended standards.
   - It is reasonable for the Russian party to develop recommendations on the use of risk analysis results in platform design phase (see scope of work for the first area of cooperation) and agree these recommendations with the Russian regulatory bodies (which safety assurance decisions are made at which stages of platform engineering; what data and criteria they are based on, etc.)

References:

/4/ ISO/IEC Guide 73:2002 – Risk Management Vocabulary, Guidelines for use in standards

/5/ Safety Baseline Offshore – Harmonisation of HSE standards in the Barents Sea, DNV report 2008-0694, rev.01

4.3 EER – Escape, Evacuation and Rescue of People

The RN04 Work Group has identified the need for change in existing maritime and offshore oil and gas standards for escape, evacuation and rescue (EER) operations in the Barents Sea, and has proposed recommended changes in the standards. The panel has assessed a number of Norwegian, Russian and other international standards for maritime and offshore work typical for Barents Sea conditions, taking into account Russian and Norwegian experience with cold climate operations of ships in Arctic and sub-arctic conditions, including the northern Caspian Sea and offshore Sakhalin Island. The assessment has included a review of a limited number of key recognised standards, which currently contribute to the definition of the safety level for people, environment and investments within the topics reviewed by the work group.

4.3.1 Risk Identification for the Barents Sea

In the Barents Sea, as well as in other ice-infested regions of the world, a wide range of ice and weather conditions and structure dependent factors can be seen at any particular point in time. Because of this, safe EER approaches must be capable of accommodating a full spectrum of ice or open water situations, which are often complicated by many other environmental and logistical factors.

The major EER risks which have been identified by the work group include the following:

- Traditional methods of EER may not be appropriate for most of the year.
- The full range of ice conditions, including icebergs and sea ice, combined with cold weather, wind and other weather conditions which may be encountered.
- The logistics systems that may be available to support any required evacuation from the structure or vessel, including the presence of standby vessels.
- The long distances from the potential emergency site to the support bases and other facilities.
- The shortage of duly equipped support vessels that may be called on for assistance, with regards to their manoeuvring and station keeping abilities in ice.
- The accumulation of icing on external surfaces, and its effect on equipment operation.

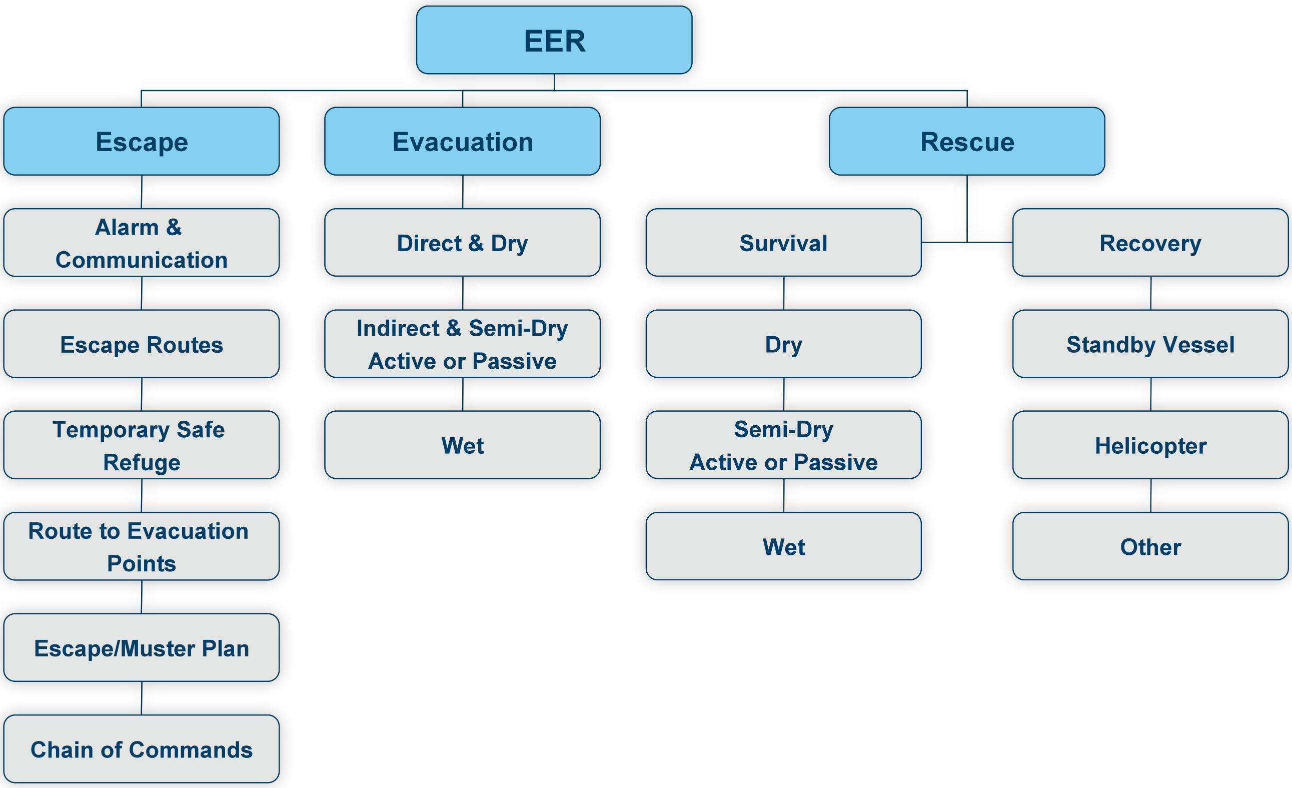


Figure 4.3.2 – Suggested Framework for EER Activities

- The limited amount of time that is available to react to a particular emergency situation.
- The effect of cold temperatures on human physiology and psychology, equipment, materials and supplies.
- The lack of experienced personnel and training facilities for the specific evacuation systems which have been proposed for the Barents Sea.
- The effect of the polar night, with extended periods of darkness, on personnel activities in Arctic conditions.
- Difficulties caused by communication due to magnetic conditions and high latitude, lack of satellite coverage, and language differences.
- Special features of navigation at high latitudes.
- The possible lack of qualified medical help.

The EER risks are closely related to type of installation, its function, location in the Barents Sea, and distance from rescue bases and resources. Hence the EER risks are, and should be, an integral part of the overall risk assessment for the installation itself.

4.3.2 Recommended Key HSE Standards

The RN04 Work Group reviewed an extended list of applicable standards, and concluded that no single standard (international, Russian or Norwegian) adequately addresses HSE concerns related to EER for the Barents Sea. The Work Group decided that a certain minimum number of key standards should be identified as the standards which should be identified for possible "upgrading" to Barents Sea standards for use in Norway and Russia. The remaining standards to be investigated should be treated as reference documents.

The process for the selection of standards to review was discussed. The following criteria were established:

- Best international offshore practice.
- Relevance to Barents Sea conditions
- Relevance to general Arctic / cold climate operations
- High level in the standards hierarchy
- High level of satisfying functional standards.

The framework presented in **Figure 4.3.2** (from the Canadian Performance-Based Standards) was judged to be the best example to follow in terms of the various EER activities which should be covered. The Russian side of the work group proposed to further divide the evacuation process into two components:

- Preventive evacuation (without interaction with water or ice), and
- Emergency evacuation (followed by a rescue operation).

The main Norwegian and Russian standards and other international or national standards were reviewed, and the compliance of these documents with respect to the above criteria was discussed in brief. Key standards were those which covered all main EER topics and satisfied most of the issues listed. Reference standards would largely serve as support for recommendations for change.

Table 4.3.1 – List of Key EER Standards:

Standard	Title
ISO19906	Petroleum and natural gas industries – Arctic offshore tructures (Chapter 18, Escape evacuation and rescue, and Appendix A18)
ISO/15544	Petroleum and natural gas industries - Offshore production installations - Requirements and guidelines for emergency response
NORSOK Z-013	Risk and emergency preparedness analysis
NORSOK S-001	Technical safety

It was concluded that the Draft International Standard (DIS) for ISO 19906 should be used as a common basis for the working group's s comments or recommendations. The working group also recommended the Canadian Offshore Petroleum Installations Escape, Evacuation and Rescue Performance-Based Standards as a valuable reference document.

In addition to the key standards identified above, a number of reference standards were suggested, as presented below:

Table 4.3.2 – List of Reference EER Standards:

Standard	Title
NORSOK C-001	Living Quarters Area
NMD Reg. No. 853	Evacuation and Rescue Means on Mobile Offshore Units**
OLF/NR No. 002	Guidelines for Safety and Emergency Training
OLF/NR No. 064	Guidelines for Area Emergency Preparedness
OLF/NR No. 066	Recommended guidelines for helicopter flights to petroleum installations
IMO, SOLAS	International Convention for the Safety of Life at Sea
IMO, MSC/Circ. 1056	Guidelines for ships operating in Arctic ice-covered waters
OLF/NR No. 094	Guidelines for Survival Suits
OLF/NR No. 096	Guidelines Man Over Board **

Standard	Title
DNV Rules	Rules for Classification of Ships, Newbuildings, Part 5, Chapter 7: Tugs, supply vessels and other offshore/harbor vessels
DNV Rules	Rules for Classification of Ships, Newbuildings, Part 1, Chapter 1
IMO, MSC.1/Circ.1206	Measures to prevent accidents with lifeboats
SAR-79	International convention of Search and Rescue 1979
PB 08-623-03	Safety Rules for Exploration and Development of offshore Oil and Gas fields
RMRS	Rules for Construction and Classification of MOU and fixed offshore installations
TDC (Canada) - Canadian PBS	Canadian offshore petroleum installations escape, evacuation and rescue performance-based standards.
SP 1.13130.2009	The systems of fire protection. Evacuation ways and exits.
SP 2.13130.2009	Systems of fire protection. Fire-resistance security of protecting units
SP 3.13130.2009	Systems of fire protection. System of annunciation and management of human evacuation at fire. requirements of fire safety
SP 4.13130.2009	Systems of fire protection. Restriction of fire spread at object of defense. Requirements to special layout and structural design
SP 5.13130.2009	Systems of fire protection. Automatic fire-extinguishing and alarm systems. Designing and regulations rules
SP 6.13130.2009	Systems of fire protection. Electrical equipment. Requirements of fire safety
SP 7.13130.2009	Heating, ventilation and conditioning. Fire requirements
SP 12.13130.2009	Determination of categories of rooms, buildings and external installations on explosion and fire hazard

4.3.3 Recommended Changes to Key Standards for Application in Barents Sea

The Working Group focussed specifically on ISO19906 as this was the most appropriate key standard as a basis for further development for Barents Sea use, and also is the only international EER standard which deals with Arctic issues. The following table summarises the main recommended revisions and amendments to this Standard – other issues were discussed but are too numerous to mention here.

Topic	Issue	Recommendation
General	Regional application	Specific reference to Barents Sea operating conditions and range of ice and environmental conditions should be included.
General	Definitions	Definitions shall be expanded and / or corrected in order to include common terms used in Russian practice.
General	References	References should be made to relevant and applicable Russian and Norwegian standards governing specific HSE issues.
General	EER strategy	Suitable EER strategies for different ice and environmental zones in the Barents Sea should be developed.
General	Training	Requirements should be formulated for the training of the personnel with regard to EER in the conditions similar to those of sites and facilities in the Barents Sea.
General	Risk Assessment	Requirements should be based on the risk assessment process for specific installations, and the EER operation taking into account the requirements of the Shelf State, the Flag State and the Classification Society.
Escape	Sheltered escape ways	Requirements for sheltered escape ways should be clarified.
Escape	Public address systems	Need for adequate public address systems when wearing extensive and bulky clothing, should be made clear.
Evacuation	Preferred methods	References should be made to type of preferred means of evacuation in typical Barents Sea ice conditions.
Evacuation	Equipment standards	References should include suitable EER equipment and material standards.
Evacuation	Evacuation methods	References should be made to suitable primary, secondary and tertiary evacuation methods for different Barents Sea zones.
Rescue	Arctic conditions	Development of basis for performance of rescue operations in different regions of the Barents Sea.
Rescue	Means of rescue	Requirements should be made for the response times for all means of rescue identified in the risk and emergency response analysis.
Rescue	Rescue of personnel evacuated from the emergency site	Requirements should be developed for the conditions of personnel survival after evacuation and methods of their rescue, since the people are not safe just by evacuating the emergency site.
Rescue	Medical treatment	Provisions should include minimum suitable levels of medical treatment requirements.
Rescue	Medevac	Preferred methods of evacuation of a patient and treatment underway should be addressed.
Rescue	Polar night or low visibility	Suitable equipment for finding lost people at sea or in periods of low visibility should be addressed.

The work group recognized and agreed that the relevant sections (Chapter 18, Appendix A18) of ISO 19906 provide appropriate general and functional guidance for EER operations for Arctic Conditions. However, the standard does not provide adequate EER recommendations for the Barents Sea. It was realised, therefore, that the best way to address the findings of the group would be to propose a separate addendum or guidance document to ISO 19906 for the Barents Sea. (See paragraph 4.3.5 below).

4.3.4 General Comments, Findings and Priorities

The EER provisions of ISO19906 are based on applying a systems approach intended to promote the successful escape from the incident, subsequent evacuation from the installation (when the incident cannot be controlled), and the ultimate rescue of installation personnel. It is clear that these EER provisions should be used as part of a continuous improvement process for managing risks and the safety of personnel working offshore in arctic and cold regions environments.

The EER provisions of ISO are performance-based, in which verifiable attributes or benchmarks that provide qualitative levels or quantitative measures of performance shall be achieved. The key characteristic of a performance based standard is its focus on what shall be achieved rather than on how it should be done. The performance target shall be development of an EER system that incurs no additional casualties (i.e. a serious life threatening injury or fatality resulting from an incident including cases when emergency medical help cannot be provided) when prescribed EER methods and technical means are undertaken. The performance target is developed in the context of a design health, safety and environment (HSE) case together with the relevant emergency preparedness plans. The provisions of a modified ISO19906 should be used by stakeholders including designers and owners.

It is clearly recognized that safe emergency evacuation of personnel from offshore structures and vessels is of critical importance in the event of a major onboard problem. In addition to the issue of specific evacuation systems and their capabilities, the question of safe evacuation also involves the procedures and training that are necessary for personnel to systematically respond in emergency situations, and a clear understanding of the range of environmental situations that may be met.

However, while progress is being made in HSE standards and guidelines, similar progress has not been made in the development of suitable evacuation methods and equipment in order to deal with different emergency situations in both ice and open water conditions. Although it is not commonly stated, most practitioners recognize that most of the evacuation systems developed to date do have some limitations, depending on the specific conditions encountered. This is particularly true for offshore structures operating in ice.

Due to Arctic conditions special attention should be paid to development of amphibious vehicles that are able to perform evacuation and rescue operations in open water and a variety of ice conditions. Standards for such vehicles do not exist, and this limits development of these vehicles. First of all it is necessary to define operational Barents Sea conditions for new types of amphibious vehicles (including rescue operation conditions). Also it is essential to clarify requirements for stand-by and support vessels in order to verify their ability to pick up personnel from water, ice and rescue means.

Existing infrastructure for the most part of the Barents Sea is not developed and does not allow providing adequate rescue operations. Therefore it is essential to develop technical means for supporting oil and gas activities in the Barents Sea, coastal infrastructure and mobile support bases. It is important to establish cooperation between Russian and Norwegian authorities to develop regional standards and joint participation of EER efforts (including navy fleet) during emergency operations.

Examples of changes expected for Barents Sea conditions in relation to North Sea industry practice may include:

- Survival suits adapted to Arctic conditions;
- Built-in or covered escape ways;
- Temporary safe refuge for personnel providing protection for days rather than hours;
- Alternatives to free fall lifeboats in case of ice conditions;
- Specific consideration of amphibious vehicles;
- Hospital / medical capability on installations;
- Better equipped standby vessels, adapted to take on board new types of life crafts, and to suit man overboard rescues;
- Helicopters adapted to actual distances and climate conditions.

The group was not able to properly address all these issues, which is why further work is proposed.

4.3.5 Proposals for Further Work

The main recommendation for further work for 2010 was the following:

- *Prepare a new guidance document for Escape, Evacuation and Rescue for all Barents Sea conditions as an independent report structured in accordance with ISO 19906 (possibly in the form of a Regional Annex).*

The time spent by the RN04 work group in 2009 has been directed towards recommended changes and revisions in current standards, with a focus on ISO 19906. At this time, however, the ISO standard is only available in draft form, and contains virtually no site-specific provisions for the Barents Sea. The suggested revisions mentioned in the previous section are too comprehensive to include in the current version of the document, and in any case, it is too late to influence the drafting of the final version of the Standard, as it will be issued sometime in 2010. A new revision of this standard is probably not due for 5 years or more, and this would be too late for industry use in the Barents Sea. Therefore a new temporary guidance document is needed in the interim before a regional Annex to ISO 19906 is accepted.

It is suggested that this work could be done with 3 to 4 meetings of a reconstituted Work Group (but no more than the current number), with Russian and Norwegian representation, but with possibly one or two Canadian guest representatives, as the Canadian performance-based standard is probably the best reference for a new guidance document.

It will be essential to communicate to industry and authorities any further work on HSE standards and industry guidelines for the Barents Sea next year, and the work group will therefore support:

- Organising an international conference with Norwegian and Russian representation, as well as invited Canadian experts on Barents Sea EER in late 2010.
- Preparation of a working international glossary of EER terms.

As part of a continuous improvement process for managing safety and risk in the offshore industry, the Working Group also recommends

- *Assessing personnel evacuation and rescue training requirements.*
- *Evaluating medical evacuation and other medical aspects, in cooperation with other working groups and medical consultants.*

In addition to the recommendations described above, in Russia additional guidance from the following Governmental Departments may be obtained:

- Transportation Ministry (first of all, its sea rescue agency – GlavMorSpasSluzhba).
- Ministry for Emergency Situations (dealing with the prevention of and response to an emergency situation).
- Ministry for Industry and Trade (which takes active role in financing R&D work for technical systems and training facilities for EER under emergency conditions).

4.4 Working Environment and Human Factors

4.4.1 Risk Identification for the Barents Sea

The focus of this Work Group was the working environment and human factors, with the objective of ensuring optimal health, safety, performance and decision-making of people working on vessels and installations in Arctic environmental conditions in the Barents Sea. The Work Group focused on how to mitigate risk to health, of accidents and human work capacity due to Arctic environmental conditions in the Barents Sea, including:

- Physical environment and safety of workers in cold climate (e.g., hypothermia, cold related injuries and diseases)
- Risk of accidents from accumulations of ice and snow (e.g., slippery surfaces, falling ice)
- Impairment of physical tasks and work efficiency
- Fatigue and impairment of complex mental tasks, cognition and decision making
- First aid and medical provision

4.4.2 Recommended key HSE Standards

The Work Group reviewed various international, national and industry standards related to working environment and human factors for operations in cold climate. The Work Group concluded that the following comprise the key functional-level standards and guidelines in this topic area:

- NORSOK S-002, Working environment;
- R 2.2.2006-05, Guidelines on hygienic assessment of working environment and labour process: criteria and classification of labour conditions;
- RD 31.81.10-91, Rules for safety on seagoing ships [operations];
- RD 31.81.01-87, Requirements for safety for seagoing ships [construction];
- RD 31.87.02-95, Instruction on labour safety training for personnel on seagoing ships.

In addition, the following international standards are relevant and should be consulted regarding working environment/human factor elements of offshore operations in the Barents Sea:

- OGP Report 398, Health aspects of work in extreme climates: a guide for oil and gas industry managers and supervisors;
- ISO 11079:2007, Ergonomics of the thermal environment: determination and interpretation of cold stress when using required clothing insulation (IREQ) and local cooling effects;
- ISO 15743:2008, Ergonomics of the thermal environment: cold workplaces, risk assessment and management;
- ISO 19906, Petroleum and natural gas industries, Arctic offshore structures; and
- Relevant company standards of Gazprom, Statoil, Eni Norge, etc.

ISO 19906 is the ideal place for articulating an international functional standard for offshore operations in the Arctic. However, the current draft lacks any treatment of working environment or human factor issues, reserving these for future development. ISO 19906 therefore needs to be amended during its next revision cycle before it can provide any relevant guidance on working environment issues for operations in the Barents Sea.

In the meantime, the Work Group concluded that NORSOK S-002 is *the best, currently available functional standard* to use as a starting point for offshore operations in the Barents Sea. It provides reasonably comprehensive guidance—at a functional level—on working environment issues. Nevertheless, NORSOK S-002 is weak on Arctic-relevant aspects. The Work Group's recommendations to improve NORSOK S-002 are presented in the next two sections. A suitably revised NORSOK S-002 could be used as a basis for proposing amendments or a regional annex to ISO 19906 during its next revision cycle.

The Work Group underscores that health and labour safety conditions should be a primary consideration at the design stage of a planned operation. In this way, design is the main principle of ensuring an acceptable level of health and labour safety. Where design is not entirely adequate to do so, then adequate operational standards must be developed. Both NORSOK S-002 and ISO 19906 include operational standards, though these documents are principally design standards and some have questioned whether they are the optimal documents for specifying operational requirements on health and labour safety.

4.4.3 Recommended Change to Key Standards for Application in Barents Sea

The Work Group concluded that NORSOK S-002 provides the best baseline for further joint work on working environment and human factors for offshore and maritime operations in the Barents Sea. It offers reasonably comprehensive guidance—at a functional level—on working environment issues, yet is weak on Arctic-relevant aspects. These weaknesses can be resolved in two ways:

- By making specific changes to existing sections within NORSOK S-002; and
- By developing an Arctic Addendum and adding it to NORSOK S-002 as a new annex.

The Work Group has developed recommendations along both of these lines. First, the following table suggests specific revisions to NORSOK S-002. The table lists the relevant section number, provides the current text of sections to be revised, and then provides the suggested revision to that text. Second, the Work Group has sketched out the contents of a proposed Arctic Addendum. This proposal is provided Section 4.4.4, General Comments, Findings and Priorities.

Recommended revisions to NORSOK S-002, Working Environment

Number	Current text of NORSOK S-002	Comments / Suggested revision
4.3	**Working environment design basis**	
4.3.5	Psychosocial preconditions	
4.3.5.0-1	As input to detailed engineering, the company shall perform a systematic analysis of the preconditions for a safe, efficient and health-promoting interaction between the worker and the environment. The purpose is to analyse organisation, manning, and workplace design in order to identify potential problem areas related to psychosocial working environment in particular.	*Comment:* Systematic analysis of the preconditions for a safe, efficient and health-promoting interaction between the worker and the environment is necessary not only for detailed engineering of workplace design, but also for determining appropriate manning needs, personnel selection criteria, organisation, worker protection, and operational procedures. These preconditions should be part of the manning, organizational, and other studies required elsewhere in this standard.
4.3.5.0-2	For various positions on the installation, the analysis should, as a minimum, include an evaluation of the psychological job demands and the preconditions for social interaction/ support and control at work. The analysis should also consider the preconditions for restitution during the time off at the installation.	*Suggested addition:* On installations that are planned for use in areas with Arctic climate, the analysis should also include an evaluation of the psychological affects of additional stressors found in the Arctic environment, including cold, prolonged periods of darkness (polar winter) and light (polar summer), remoteness, etc.
4.4	**Working environment analyses**	
4.4.3	Job hazard/risk of occupational injuries	
4.4.3.0-2	A course Job Hazard Analysis shall be carried out for each work area on the installation. The analysis shall include the following: ...	*Suggested addition:* On installations that are planned for use in areas with Arctic climate, the analysis shall include additional potential job hazards/risk of occupational injury stemming from exposure to Arctic environmental factors, such as exposure to cold air and surfaces, icing and falling ice, wind and precipitation, snow drift, darkness/ brightness, low angle sunlight etc. Arctic installations may be designed with enclosed, semi-enclosed, and/or sheltered topsides to protect operators and operations from the cold weather. The possible indirect effects of reduced ventilation and increased vapour/ particle/gas exposure and explosion risk should be considered in Job Hazard Analysis for such areas.
4.4.3.0-6	For critical workplaces, which involve tasks with a high risk of accidents, a detailed Job Hazard Analysis shall be carried out. Minor accident risks should also be covered. Criteria for the selection of workplaces for the analyses include: ...	*Suggested addition:* On installations that are planned for use in areas with Arctic climate, the analysis shall include potential job hazards/risk of occupational injury stemming from exposure to Arctic environmental factors, such as exposure to cold air and surfaces, icing and falling ice, wind and precipitation, snow drift, darkness/ brightness, low angle sunlight etc.

Number	Current text of NORSOK S-002	Comments / Suggested revision
4.4.6	**Hazardous chemicals**	
4.4.6.0-1	During project development, a chemicals Health Risk Assessment shall be performed to identify, evaluate and control chemical health risks to an acceptable level.	*Suggested addition:* On installations that are planned for use in areas with Arctic climate, the analysis shall consider the operational need for using substitute chemicals better suited to Arctic environmental conditions, and the potential health risks to humans of using these substitute chemicals. Arctic installations may have more enclosed, semi-enclosed, and/or sheltered working areas to protect from the cold. The effect of reduced ventilation on increased vapour/particle/gas exposure and chemical health risks shall be assessed.
4.4.7	**Noise and vibration control**	
4.4.7.0-2 4.4.7.0-3	During concept definition and optimisation/ front-end engineering design, the activity shall ensure that: – major noise and vibration sources are identified.	*Suggested addition:* On installations that are planned for use in areas with Arctic climate, noise and vibration caused by external Arctic environmental conditions, such as the interaction of sea ice on the installation, and by icebreaking and ice management activities, shall be considered in the concept definition and optimisation/front-end engineering design.
4.4.7.0-9 4.4.7.0-10	During engineering, the activity shall ensure that: – significant noise and vibration sources are identified and their influences evaluated.	*Suggested addition:* On installations that are planned for use in areas with Arctic climate, noise and vibration caused by external Arctic environmental conditions, such as the interaction of sea ice on the installation, and by icebreaking and ice management activities, shall be considered in the evaluation. Evaluations should take into account the combined effects of noise and vibration on a person over a 24-hour period.
4.4.8	**Illumination**	
4.4.9.0-1	During engineering, quality of illumination should be analysed in all relevant rooms, including control rooms, offices, recreation rooms and galley. The illumination should be analysed especially in the control room, cabins and other rooms … during various weather conditions.	*Suggested addition:* On installations that are planned for use in areas with Arctic climate, this analysis should consider the illumination requirements for both internal and external spaces during the prolonged periods of darkness (polar winter) and light (polar summer), as well as low-angle sunlight.
4.4.9	**Outdoor operations/cold stress**	
4.4.9.0-1	Outdoor operations analyses shall be carried out for open work areas and semi-open work areas, in order to identify and remedy potential problem areas due to overall exposure to temperature, wind, icing and precipitation, including investigation of the weather protection necessary to comply with Wind Chill Index and other functional requirements identified in the analysis.	*Suggested addition:* Special attention shall be given to these analyses for installations that are planned for use in areas with Arctic climate.
4.4.9.0-4	The formula in ISO/TR 11079, Annex D, should be used to calculate Wind Chill Index.	*Comment:* Other wind chill indices may give better results. Need to compare, evaluate, and determine which is best to use. See the Work Group's recommendation for further work.
5.0	**Working environment requirements**	
5.1.2	Means of access	
5.1.2.0-1	All work areas shall have a layout that provides for safe and easy access for operation, inspection, readings and maintenance.	*Suggested addition:* On installations that are planned for use in areas with Arctic climate, work areas shall have a layout that takes Arctic environmental conditions into account and provides for safe and easy access for operation, inspection, readings and maintenance.
5.1.2.0-19	Slippery floor surfaces shall be avoided in work areas and access ways.	*Suggested addition:* On installations that are planned for use in areas with Arctic climate work areas and access ways shall be designed to prevent the icing on floor surfaces.

Number	Current text of NORSOK S-002	Comments / Suggested revision
5.1.2.0-20	Non-slip systems shall be installed in exposed stairways and stepladders, including the uppermost step at deck/platform level.	*Suggested addition:* On installations that are planned for use in areas with Arctic climate, anti-icing and non-slip systems for exposed work areas and access ways, including stairways and stepladders, shall function under expected conditions of the Arctic environment.
5.2	**Ergonomics**	
5.2.1.0-1	Workplaces shall be designed such that the personnel are not exposed to excessive workloads with risks of musculoskeletal injury.	*Suggested addition:* On installations that are planned for use in areas with Arctic climate, the design shall prevent additional musculoskeletal stress caused by exposure to low temperature and other aspects of the Arctic physical environment.
5.2.2	Human-machine interfaces/human factors	
		Suggested addition: On installations that are planned for use in areas with Arctic climate, the design of displays and controls shall take into account the wearing of winter clothing and personal protective equipment, as appropriate (e.g., the ability to operate while wearing gloves, the ability to read during conditions of polar winter, low sun angle etc.).
5.3	**Technical appliances**	
5.3.2	Hot/cold surfaces	
	It shall not be possible to reach surfaces with a temperature above +70°C or below -10°C from work areas, walkways, ladders, stairs or other passageways.	*Suggested addition:* This functional requirement may be impossible to meet on installations located in some Arctic areas. Where ambient temperatures despite optimal measures taken may fall below -10°C, workplace design and protective clothing and equipment shall counter the additional risk of this low temperature.
5.5	**Noise and vibration**	
5.5.1	General	
	---------	*Suggested addition:* On installations that are planned for use in areas with Arctic climate, noise and vibration control measures shall take into account additional sources of noise and vibration from the external environment, such as the interaction of sea ice on the installation, and by icebreaking and ice manage¬ment activities. Measures should take into account the combined effects of noise and vibration on a person over a 24-hour period.
	----------	*Comment:* The harmful effects on human health of noise and vibration may be magnified by cold and other Arctic environmental conditions. This interaction is not well understood. See Work Group recommendation for further work.
5.6	**Illumination**	
5.6.0-10	Provision shall be made to avoid direct glare from sunshine, from artificial light sources and from reflecting surfaces.	*Suggested addition:* On installations that are planned for use in areas with Arctic climate, special consideration shall be given to the prolonged periods where the sun is low on the horizon and the problems this causes for direct glare and reflected glare from the sea/ice surface.
		Suggested addition: On installations that are planned for use in areas with Arctic climate, special lighting shall be provided to assist in preventing Seasonal Affective Disorder during the polar winter.

Number	Current text of NORSOK S-002	Comments / Suggested revision
5.8	**Outdoor operations**	
5.8.0-3	On installations that are planned for use in areas with Arctic climate, outdoor operations shall be identified and reduced to a minimum.	Suggested addition: To the greatest degree possible, Arctic installations should be designed with enclosed, semi-enclosed, and/or sheltered topsides to protect operators and operations from the cold weather, ice and snow. The possible indirect effects of reduced ventilation and increased explosion risk should be considered for such areas.
5.8.0-6	It should be possible to operate outdoor handles, switches, etc. while wearing gloves.	*Suggested addition:* On installations that are planned for use in areas with Arctic climate, it should be possible to operate outdoor handles, switches, valves, etc. while wearing insulated gloves and other personal protective equipment required for working in an extremely cold and potentially icy environment.

4.4.4 General Comments, findings and priorities

Much relevant information, standards, regulations and guidance, are available, particularly from Russian sources, on cold climate and Arctic operations. The Work Group felt that this guidance should be collected and further developed in a single place and expressed in functional terms.

This addendum could then be attached to the existing NORSOK S-002 standard and thereby used to inform the planning, development and implementation of offshore operations in the Barents Sea. At an appropriate time, this Arctic Addendum could be used as a basis for proposing amendments to ISO 19906 during its next revision cycle.

Proposed contents for an Arctic Addendum on Working Environment

Part 1	**Safety and health aspects of work in cold climate**
1.1	Arctic climate zones
1.2	Health assessment for fitness to work in cold climate
1.3	Cold risk assessment
1.4	Cold risk management
1.4.1	Safety of outdoor work in cold climate
1.4.2	Clothing and personal protection equipment (PPE): design and use requirements
1.4.3	First aid and medical provision
Part 2	**Winterization: design and technical solutions related to Arctic climate**
2.1	Means of access: de-icing and ensuring non-slip conditions
2.2	Safety dangers from icy conditions and vessel/ installation motion at sea
2.3	De-icing and preventing falling ice
2.4	Illumination in an Arctic environment
2.5	Heating
2.6	Ergonomics in an Arctic environment
2.7	Visibility, specifically in relation to clearing of snow and ice from windows
2.8	Electrical and static safety (voltage safety limits in Arctic environmental conditions)
Part 3	**Noise & vibration in Arctic climate and Arctic operations**
3.1	Noise and vibration analyses related to Arctic environment and Arctic operations
3.2	Additional health risks from Hand Arm Vibration in cold
Part 4	**Stress management: work situations in extreme climate zones**
4.1	Physical/psychosocial stress exposure analysis
4.2	Stress management regimes
4.2.1	Medical requirements for working in the Arctic
4.2.2	Medical support requirements
4.2.3	Stress monitoring surveillance
4.2.4	Work/rest/rehabilitation regimes
4.2.5	Fatigue management measures
Part 5	**Training and competence: working in the Arctic**
5.1	Health safety in cold climate
5.1.1	Nutrition in cold climate
5.1.2	UV protection
5.2	Work and safety in Arctic climate
5.3	Acclimatisation to Arctic climate
5.3.1	Coping with dark winter days and light summer nights
5.4	Stress and fatigue management
5.5	Emergency survival in Arctic climate [Note: This is a cross-over issue with Work Group 4 on Escape, Evacuation and Rescue of People.]

The Work Group has developed specific recommendations and comments for some, but not all, of the above sections. These are explained below.

Part 1.1 Arctic climate zones

Fundamental to the risk management strategy incorporated in ISO and other international standards is the philosophy of assessing the expected environmental conditions at the specific geographic location an installation will be placed or an operation will be conducted. This approach has the advantage of tailoring risk management efforts.
Defining generalized environmental climate zones, however, can be an efficient means of promoting certain risk management efforts, such as the design and provision of cold weather clothing.

I Spitsbergen / Svalbard
II Norwegian
III Franz Josef Land
IV Northeast Barents Sea
V Novozemelsky
VI Kola
VII Pechora Sea
VIII White Sea

Sub-area II is generally ice-free.

Sub-areas I, III, IV, VII, VIII usually have ice every winter.

Sub-areas V and VI are in-between

In the Barents Sea, environmental conditions vary substantially from north to south and east to west. In the judgment of the Work Group, the regional breakdown for the Barents Sea found in Annex B.16 of the draft ISO 19906 standard does not adequately differentiate the conditions, particularly from north to south. To better harmonize cold risk assessment and management for work operations in the Barents Sea, the Work Group therefore recommends using the climate zones defined by the Arctic and Antarctic Research Institute of St. Petersburg and used in the Barents 2020 Environmental Baseline report. [1]

Part 1.2 Health assessments for fitness to work in Arctic climate

It is easier for a person to perform well—both physically and mentally—in extreme cold when medically fit and in good health.

Today, personnel who work offshore or aboard ship are typically subject to a standard medical examination. The examinations are generally prescribed by regulations in the country of operation. In the oil and gas industry, these examinations often incorporate elements from OGP Report no. 343, *Managing health for field operations in oil and gas activities*. Additional guidance relevant for work in the Arctic is contained in OGP Report no. 398, *Health aspects of work in extreme climates.*

The Work Group concurs with OGP Report 398 that the selection of people for work in extremes of temperature, such as the Arctic, requires a health assessment by a doctor with knowledge of the working conditions and requirements of the job[2].

Suggested functional standard: An Arctic health fitness assessment shall be undertaken prior to selecting an individual for work in an Arctic climate, at routine intervals throughout the working period, and whenever there is due cause to re-evaluate an individual's fitness. The Arctic health fitness assessment should, at a minimum, include the potential contra-indications to work in extremes of temperature and cold listed in OGP Report 398,[3] as well as the following:

- cold agglutinin (cold allergy) disease;
- peripheral vascular disease;
- peripheral neuropathy (damage to the peripheral nervous system), especially in diabetics;
- heavy tobacco use, alcoholism and/or drug abuse;
- symptoms, both physical and psychological, that indicate negative health effects due to working in the cold, in prolonged periods of light (polar summer) or dark (polar winter), or in remote or isolated conditions; and
- the use of medications which may pose problems when working in extreme cold.[4]

Part 1.3 Cold risk assessment

NORSOK S-002 section 4.4 currently provides functional requirements for conducting various Working Environment analyses, including Job Hazard Analyses, Health Risk Assessments, and Outdoor Operations/Cold Stress Analyses. An Arctic Addendum should expand on this guidance to include additional potential job hazards, risks of occupational injury, and health risks stemming from exposure to Arctic environmental factors, such as cold, icing of work surfaces, ice falling from heights, darkness, etc. The Work Group has presented its recommendations in Table 1, above (see particularly Sec. 4.4.3, Job hazard/risk of occupational injuries; Sec. 4.4.6, Hazardous chemicals; and Sec. 4.4.9, Outdoor operations/cold stress).

- ISO/TR 11079, Annex D, contains the current international standard for calculating the Wind Chill Index and classifying risk of exposure to cold. NORSOK S-002 prescribes the use of this Wind Chill Index for cold risk assessment. The wind chill index in ISO 11079 classifies risk of exposure in four risk categories. Other recognized wind chill indices classify risk of exposure differently, such as that in OGP Report 398, which uses five risk categories. Furthermore, Russia has several methods of cold exposure risk classification taking into account wind

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[1] Det Norske Veritas, *Barents 2020 Environmental baseline: maritime and offshore*, Report 2008-0716 (2008), p. 5.

[2] IPIECA & OGP, *Health aspects of work in extreme climates: a guide for oil and gas industry managers and supervisors*, OGP Report 398 (2008), p. 9.

[3] IPIECA & OGP (2008), p. 10: Potential contra-indications to work in extremes of temperature (both heat and cold) include: respiratory or cardiovascular problems; severe obesity, which impedes the acclimatization process; metabolic disorders (e.g. thyroid disease); and previous cold-related illness. Potential contra-indications specific to cold include: Raynaud's syndrome (white finger); cold-induced asthma; cold-induced urticaria (an itchy skin condition); and cryohaemoglobulinaemia (a rare blood condition).

[4] IPIECA & OGP (2008), p. 10: Medications which may pose a problem in extremes of temperature include: medications which alter vigilance or sweating (tranquillizers, sleeping pills, antidepressants, antihistamines); medications which act on blood circulation (blood pressure and heart treatments); diuretics (medications which alter body fluid balance); drugs which have antipyretic properties and may interfere with temperature regulation (for example many analgesics or anti-inflammatories); and photosensitizers (both systemic and topical), which increase the skin's reaction to sunlight.

load, which are based on ISO 15743:2008. As these indices and risk categories are used as a fundamental categorization for cold risk management, the Work Group recommends that they be assessed for their comparative advantages and disadvantages, and a determination made as to which is the most appropriate for application in Arctic offshore operations in general and the Barents Sea in particular. See the Work Group's recommendation for further work.

Part 1.4 Cold risk management

1.4.1 Safety of outdoor work in cold climate
Suggested functional standard: Operators shall develop and implement a work practice regime/system for outdoor work in cold climate. This regime should be developed according to the wind chill index. The work regime shall define the type of work that is allowed under different wind chill conditions, the length of time that workers may work outdoors, the types of clothing and personal protective gear that shall be used, personnel monitoring and surveillance, and any other special conditions that shall apply. A suggested work regime could classify work as follows:

- Stage 1: Normal work
- Stage 2: Shorter work periods
- Stage 3: Short work periods and buddy solutions
- Stage 4: Emergency work in extreme wind chill conditions

For work under extreme cold conditions (e.g., Stage 4), the operator should develop and implement appropriate procedures to:

- Assess the risk before permitting work to be undertaken; and
- Require workers to obtain a Permit for Cold Work before commencing work under extreme cold conditions. The Permit shall prescribe precautions and assign responsibilities to ensure the worker's safety.

1.4.2 Clothing and personal protection equipment (PPE)
Suggested functional standard: On installations that are planned for use in areas with Arctic climate, outdoor operations shall be identified and reduced to a minimum. Where outdoor operations must be undertaken, cold climate clothing and personal protection equipment (PPE) shall be provided and used. Clothing and PPE must be appropriate to the working environment. The Arctic climate zones defined in Part 1.1 should be used in setting clothing and personal protection equipment guidelines.

Clothing shall be provided to best match the comfort of the worker whilst facilitating completion of the work tasks. The need for external waterproof materials and for UV protection should be evaluated and provided for as appropriate.

If work cannot be routinely completed using appropriate cold climate clothing and personal protection equipment PPE to preserve health and safety, then other measures such as active heating systems or locality enclosure (temporary/permanent) may be required.

Emergency evacuation suits for use in Arctic offshore environment should take into account the cold weather clothing and other personal protection equipment that workers are likely to wear in the Arctic climate zone in which they are located. [*Note*: This is a cross-over issue with Work Group 4 on Escape, Evacuation and Rescue of People.]

The Work Group suggests further industry collaboration on the development and testing of clothing and personal protection equipment for use in the various Arctic climate zones identified in Part 1.1. See proposals for further work

1.4.3 First aid and medical provision
Arctic operations are likely to require a greater degree of self-sufficiency given their distance from shore side medical facilities and the potential for delays in evacuating personnel for medical attention.

Suggested functional standard: The company shall perform a systematic analysis of the preconditions for providing adequate first aid, emergent and interim medical care. The analysis shall consider the intended geographic location of the installation or operation, its proximity to shore side medical facilities, the conditions for medical evacuation from the facility, and the potential for extended delays in evacuation due to adverse Arctic weather conditions. The assessment shall be used in determining the provision of adequate medical care in the workplace design (medical facilities), staffing (doctors, nurses, paramedics), supply (medicines, medical equipment and supplies), communications (telemedicine), and organisation of the installation or operation.

Part 3.1 Noise and vibration analyses related to Arctic environment and Arctic operations

Noise and vibration accumulate as an exposure situation for workers. On installations that are planned for use in areas with Arctic climate, additional noise and vibration sources should be considered and provided for. These include external Arctic environmental conditions, such as the interaction of sea ice on the installation, and by special Arctic operations, such as icebreaking and ice management activities. For icebreakers, further sources include the use of thrusters and compressed air bubbling systems. Analyses should consider the combined effects of noise and vibration over a 24-hour period.

Suggested functional standard: See the Work Group's recommended changes to sections 4.4.7 and 5.5 to NORSOK S-002.

The harmful effects on human health of noise and vibration may be magnified by cold and other Arctic environmental conditions. This interaction is not well understood. See the Work Group's recommendation for further work.

Part 3.2 Additional health risks from Hand Arm Vibration in cold

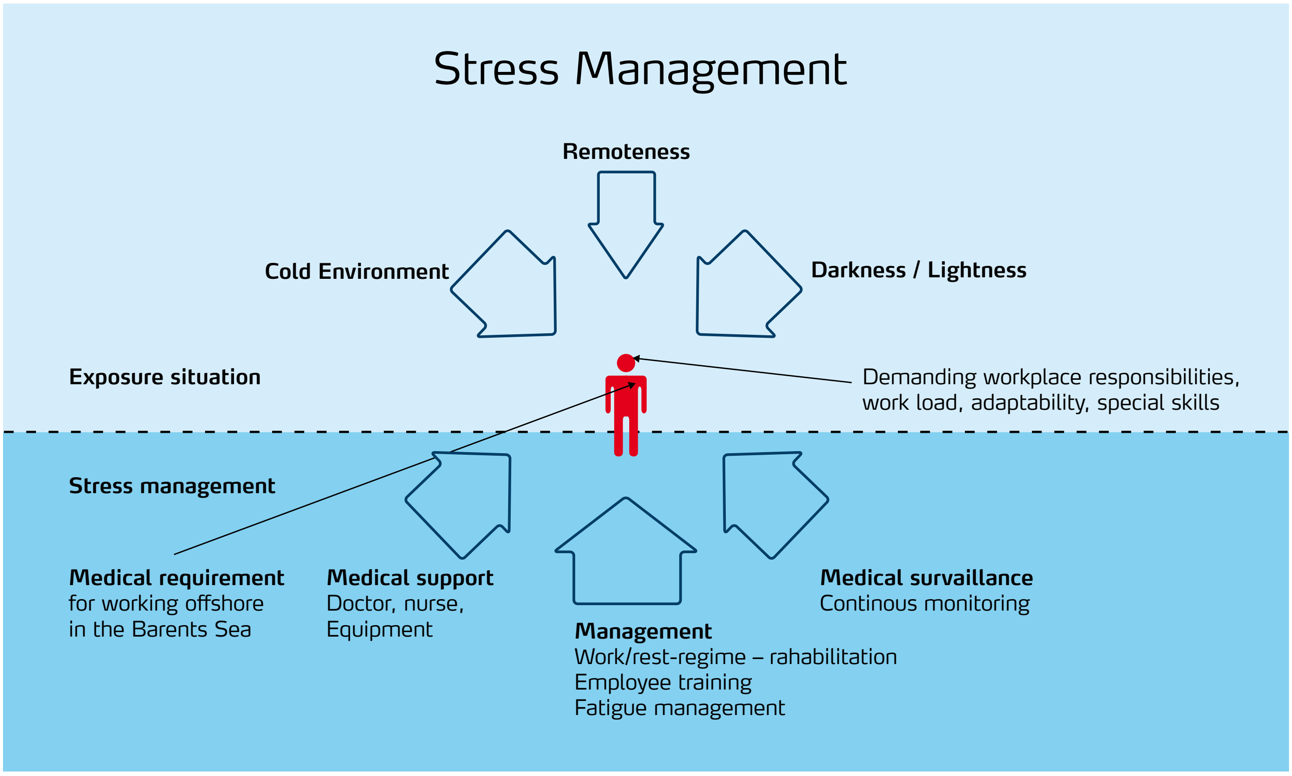
Exposure to hand arm vibration (HAV), particularly from handheld tools, is a risk factor related to peripheral vascular disease and Raynaud's disease (white finger). Cold environment is known as a co-factor increasing the risk for developing disease. Exposure is particularly relevant during maintenance periods. Even if most maintenance is performed in the summer, Arctic summer climate conditions are still defined as a cold environment working environment (that is, temperatures below +10C).

Suggested functional standard: Use of hand/arm vibration tools should be kept to a minimum when working in a cold climate. Vibration requirements should be established for tools used in cold. Workers shall be monitored routinely for signs of disease related to hand arm vibration.

Part 4: Stress management

Workers in an Arctic offshore environment will be exposed to multiple stressors (cold, snow and ice, darkness/light, remoteness, motion, work responsibilities, electromagnetic radiation of various frequencies, etc.), the combination of which can lead to fatigue and impair complex mental tasks, cognition and decision making. To ensure performance and safety, operators should establish personnel selection guidelines, provide medical support, establish appropriate medical surveillance routines, work/rest regimes, and other operational routines to help workers prevent fatigue and manage stress.

Part 4.2.4 Work/rest/rehabilitation regimes
The Work Group recommends that the work/rest schedule contained in OGP Report no. 398 be used as the basis for a work/rest regime for offshore operations in the Barents Sea.



Picture 2: Exposure situation and Stress management

Part 5: Training and competence

Suggested functional standard: All personnel should be trained in the special aspects of working in the Arctic. This training should address their own health and safety as well as that of their co-workers. Training should take place prior to arrival at an installation or operation located in an Arctic climate zone, and then as needed throughout employment. Training should include, among other things, the following subjects:

- The basics of body temperature and heat exchange
- Recognition of hypothermia, temperature-related symptoms, and cold stress effects
- Actions to be taken in the event of hypothermia, cold injury or concern of adverse effects of the cold
- Hazards related to carbon monoxide poisoning and alcohol in cold weather
- Preventive practices
- Clothing requirements
- Nutrition
- The potential for other illness to impact on tolerance to extremes cold
- Acclimatization
- Fatigue and stress management

4.4.5 Proposals for further work

Discussions within the Work Group have contributed a great degree towards developing a common understanding on how to ensure the optimal health, safety, performance and decision-making of people working on vessels and installations in Arctic environmental conditions in the Barents Sea. Further specification of the proposed Arctic Addendum to NORSOK S-002 will be required to adequately cover the wide range of issues within this topic area. Additional research and development activities are needed in some areas that are not currently well understood. In particular, the Work Group proposes the following for additional work:

- Develop a matrix of relevant Russian normative documents supplementing NORSOK-002 and the proposed Arctic Addendum. This information, including the normative documents, should be translated into English to facilitate its dissemination, understanding and use within the international offshore and maritime communities. Where appropriate, this guidance should be used to further refine functional requirements in the proposed Arctic Addendum and be used as a basis for proposing amendments to ISO 19906 during its next revision cycle.

- Study of work stress and fatigue in Arctic climate. Workers in an Arctic offshore environment will be exposed to multiple stressors (cold, snow and ice, darkness/light, remoteness, motion, work responsibilities, etc.) that can lead to fatigue and impair complex mental tasks, cognition and decision making. Understanding the interaction of combined stressors is crucial for developing appropriate methods to ensure performance and safety. Basic and applied research are needed in this area. Applied research in this area should be fostered through a joint industry project, with support from national research bodies as appropriate.

- Study on the interaction between cold, noise and vibration on human health. The harmful effects on human health of noise and vibration may be magnified by cold and other Arctic environmental conditions. This interaction is currently not well understood, making it difficult to develop appropriate guidance or standards for offshore operations in the Arctic. Applied research in this area should be fostered through a joint industry project, with support from national research bodies as appropriate.

- Compare wind chill indices and their accompanying cold exposure risk classifications, assess their relative advantages and disadvantages, and determine which is the most appropriate for application in Arctic offshore operations in general and the Barents Sea in particular. This should be addressed through a joint scientific and industry workshop.
- Industry collaboration on the joint development and testing of clothing and personal protection equipment for use in the various Arctic climate zones identified in Part 1.1. In particular, Work Group members suggested a joint industry project to develop Arctic PPE for offshore use, and that relevant national and commercial testing laboratories collaborate on testing Arctic clothing and personal protection equipment as a means of fostering common testing methodologies.

4.5 Loading, Unloading and Transportation of Oil in the Barents Sea

4.5.1 Risk identification for the Barents Sea

In order to establish and maintain an equivalent safety level in the Barents Sea compared with North Sea, a risk analysis was performed. The results identified the main hazards and highlighted the different operations which needed specific attention. Prevailing procedures and standards relevant to the risk aspects were identified and weaknesses found in these standards related to operational conditions in different areas of the Barents Sea.

A work group with both Russian and Norwegian experts was established to give operational, technical and regulatory input related to Loading, Unloading and Transport of oil in the Barents Sea. The mandate for the work group was to identify relevant standards, identify possible gaps and recommend possible modifications to these standards in order to secure safe operation and minimize environmental risk of accidental oil spills.

The work group participants of working group 6 are listed in paragraph 3.4 of this report.

Working group 6 has arranged four workshops in 2009, one in Oslo, two in St. Petersburg and finally one in Moscow. The topic for the three first workshops was:

- Definition and Clarification of Scope,
- Risk assessment and identification of relevant standards, and
- Suggestions/Recommendations for changes/ improvements.

The fourth and final workshop was arranged in Moscow before the final conference, were the final report was agreed upon.

Method

In order to identify the main risks involved, a thorough scenario based risk analysis was performed with different field configurations and shuttle tanker characteristics for each scenario. The expert group has an extensive experience with regard to shuttle tanker operations and offshore loading in the North Sea, and long experience from Russian Arctic operations.

The detailed risk analysis was carried out during the 2nd workshop. The risk analysis of the different operational phases was categorized into:

- transit,
- approaching,
- loading, offloading and
- departure

Table 4.5.3 Steps in the risk based methodology:

Step	Scope
1	Identify relevant tanker loading / offloading / transportation scenarios in the Barents Sea
2	Hazard identification: What are the critical operations in different operational phases
3	Relative risk by moving operations into the Barents Sea (low temperatures and ice)
4	Assess additional risk management measures required to ensure safety equivalence with North Sea

Risk assessment

The main risks were identified and summarized in the following paragraphs:

- Parts of the Barents Sea includes more environmentally sensitive areas, thus the consequences of a major accidental oil spill may be more severe.
- The consequence severity varies between the risk events and the operational phases (transit, approach, connection, cargo transfer, disconnection etc.). It is during transit fully loaded as well as during the cargo transfer phase that the consequence severity is the greatest
- In the parts of Barents Sea where there normally is open water year around, the conditions are, except for lower temperatures, very comparable to the North Sea. In this area, the frequency / probability of incidents are therefore comparable for most risk events
- In the rest of the Barents Sea, where ice normally is present every winter, more difficult operating conditions will occur and the need for ice management, increases the probability of incidents occurring for all major risk events, i.e.:
  - Grounding
  - Collision with ice in open water
  - Collision with installation
  - Collisions with another ship
  - Hose fracture / leakage during connection / offloading / disconnection

Without additional risk management measures being implemented the risk levels will generally higher in the Barents Sea compared to the North Sea, hence additional safeguards must be implemented to ensure equivalent environmental safety level in the Barents Sea

Results

Comparing Barents Sea with North Sea conditions, the different possible incidents were thoroughly discussed with regard to additional risk and evaluated with regard to environmental consequence severity.

The operation identified as the most vulnerable i.e. largest oil spills, is considered to be during offloading from an offshore installation to a shuttle tanker. Due to the temporary connection with several parties involved a cargo transfer operation is a complex process, and a hose fracture/leakage can be considered as the most probable cause of an oil spill. There are today introduced measures to monitor the oil flow in the hose, and in case a deviation between what is transferred and received is registered, the transfer will be stopped automatically. This equipment is so far not mandatory, but is being more commonly used by the operators.

The Ice Management carried out in connection with the loading operation taking place in ice covered waters is also identified with high risk due to lack of formal procedures related to competence training and the actual operation. Today Ice Management is basically carried out and based on the experience of the Captain onboard the Ice Breaker.

In addition, grounding of a tanker is identified with a risk of severe oil spill, mainly due to shallow waters and possible ice interaction resulting in reduced manoeuvrability of the vessel.

There is an ongoing process in IMO to further develop and make the "*IMO Guidelines for Ships Operating in Polar Waters*" (issued 2009) mandatory for all vessels entering Arctic and Antarctic waters. It was in the group decided to focus on the special operations related to loading and transport of oil, and not the regular operation of a vessel in transit. It was agreed that the regular transit operation of vessel will be covered by the updated Guideline which will be made mandatory. It is not the mandate for this group to discuss the IMO Guideline in general, but identified issues related to the mandate for this group and relevant for IMO, will be addressed to IMO.

The following issues related to additional risks were selected for further assessment:

- **Ice management**
  - Procedures
  - Training
  - Competence
  - Capabilities of Ice Breaker and Tanker (size, power, manoeuvrability)

- **Collision with ice in open water**
- **Cargo transfer operations in general**
  - Procedures
  - Equipment standards

4.5.2 Recommended standards for loading operations and oil transfer in the Barents Sea

The following section gives a short description of relevant key standards with regard to the identified high risk areas. In order to aim at a common set of standards to be referred to, a limited set of international standards have been selected. Improvements are recommended to these standards and the proposals from the group should be considered for implementation in these standards by the organisations responsible for the standards.

Following key standards for loading operations and oil transfer were selected:

- IMO Guidelines for ships operating in Arctic ice-covered waters
- ISO/CD 19906 under development, last updated 21.04.2008. Chapter 17.
- Industry standards/guidelines, i.e. OCIMF
- The Northern Sea Route Guidelines
- DNV Competence Standard for Officers for Navigation in Ice

IMO guidelines have some coverage on icebreaker escort operations, but are not too specific on physical Ice Management. The guidelines also fell short on competence and training requirements for navigation in Arctic ice covered waters. Chapter 13.3.3 "Contents of the training manual" and Ch. 14 "Theoretical training" can be further developed to include training in ice or ice simulator. Currently there is an ongoing development in IMO to include competence requirements, but this will only cover minimum requirement and will not come into force in the nearest future. There may also come some competence requirements in the STCW.

The ISO/CD 19906 chapter 17 standard is addressing Ice Management. The document is a high level guidance which in our opinion is appropriate for Ice Management procedures. The document has identified many key issues and has a wide approach to Ice management, addressing the entire Ice management system and not only the actual ice breaking/towing. Chapter 17.4.3 c) and 17.3.4 are rather vague on specified training. It should be defined which competencies that are required in order to be "qualified" or "trained". A thorough review of the standard is recommended to identify possible weak parts and areas which need elaboration. We recommend further development of ISO/CD 19906 Ch. 17.

OCIMF. The international oil, gas and shipping industry have a set of recognised technical standards which are used worldwide. The accumulated experience of the industry over many years and from all parts of the world is continuously included in these standards through systematic updating and issuance of new revisions. These standards therefore represent best international practice for oil, gas and shipping activities (ref. 3.2.4.2). OCIMF Ch. 14 proposes different training methods before operating in low temperature and ice:

"A vessel's officers and crew should be adequately trained for all circumstances likely to be encountered when operating in low temperatures, ice navigation and/or icebreaker escort. This may take the form of simulator training; CBT training or other acknowledged training method". This chapter can be elaborated with a standard for training in ice, i.e. DNV competence standard or STCW.

The Northern Sea Route (NSR) Guideline are originally not applicable west of the Kara Gate but is often used as a standard for ships navigating in the Russian Arctic waters. In Russia it is the government that is responsible for the regulations to be followed by all ships navigating in the Arctic region. The NSR Administration has many mandatory regulations for ships operating in the NSR. This is a comprehensive regime that has ensured a relatively high safety level for ships operating the NSR. For ships operating in the NSR, the vessel shall comply with the requirements of the Russian Maritime Register. The ship owner has to demonstrate to the register that the ship has the required ice class, if the ship is not registered with the Russian Maritime Register.

According to the NSR administration, the results from 40 years of intensive operations of the renewed Russian fleet in the Arctic (from 1950 – 1990), only 4 ships were lost in the NSR due to ice impact. Taking into account that annually about 250 ships participated in Arctic navigation, the annual probability of total loss for this period amounted to 0,0004 (0,04%) which is considerably lower compared to the world average For the recent 20 years, only two ships have been lost in the NSR operation.

"DNV Competence of Officers for navigation in ice" has a sound basis for assessing competence in navigation, but does not specifically address Ice Management. However, some relevant areas are included.

- Ice recognition
- Ship handling in ice and in high latitudes
- Performance Monitoring
- Vessel and crew preparation

4.5.3 Recommended Change to Key Standards for Application in Barents Sea

The key standards included in the assessment shows weaknesses in addressing the additional attention needed when operating in the Barents Sea environment. Changes and additional proposals to these standards thoroughly discussed and recommended by the group are listed below.

Ice Management (IM)

- Proposal for functional description for IM as input to IMO and ISO standards with regard to requirements to minimum content for IM manual.

- Propose for IMO a training standard for training institutions for IM (Quality standards for training centres)

- Propose for industry, e.g. OCIMF, INTERTANKO and ICS (International Chamber of Shipping), capability standard/guideline for IM vessel with regards to design, speed and engine power on a system level. Minimum requirements to be based on Ice Class Rules for area of operation. Capabilities of both Ice Breaker and Tanker should be considered, in order for Ice Breaker to compensate for, or match the capabilities of the tanker.

- Propose a set of specific requirements for the IM procedures. The procedural standards must be at an appropriate level of detail. As a minimum they should include:
  - The objectives for the different parts of the IM system
  - The IM strategy for different ice conditions
  - Describe the scope and range for the IM operations.
  - Describe specific ice events/conditions and the corresponding IM operations
  - A requirement for assigning responsibilities for actions for each ice event. All personnel involved in IM should have clear responsibilities and procedures to follow.
  - Define the point of installation shut down and the point of installation disconnection and removal
  - Continuous improvement plan (Important as safe operation in ice is very dependant on experience)

To be able to assess the performance of the IM system in a structured, repeatable and transparent way a framework for how this should be measured must be established and agreed upon.

- The standard should/could include specific minimum performance requirements linked to the operational area for the ice management vessels, reflecting the minimum ship requirements for handling the worst expected ice conditions
- The standard could also include requirements for the propulsion system, e.g. 360 degrees rotating podded propulsion, for increased manoeuvring capabilities. This is important when operating in close proximity to offshore installations and other ships.
- Allow for designing the offshore structure and the IM as an integrated system. Hence an offshore structure designed for handling severe ice conditions should have lower requirements for the IM system.

Collision with ice in open waters

- ISO 19906 Chapter 17.3.4 and 17.4.3c are rather vague on specified training. It should be defined which competencies that are required in order to be "qualified" or "trained".

- Propose amendment to the ISO 19906 standard on competence and training in ice/Arctic navigation. Focus on minimum requirements for competence to ensure international consistency independent of area of operation.

- Propose specific requirements for training before sailing in the Barents Sea. They should at least include:
  - Specific requirements for experience/training before operation
  - Ice management experience (Distinguish between ice navigation and ice management), and/or:
  - Simulator training
  - Minimum content of the training manual, and locations where it should be available.
  - Knowledge about the vessels ice class and corresponding limitations with regard to operation
  - The crew of this vessel should be trained as the NSR requires

- Same amendment could be included in the IMO proposed Polar Code.

- The threat of growlers/Multi-year ice features is usually not covered by typical ice class strengthening if sailing with open water speed. This threat is most relevant for the Shuttle Tankers.

- Some actions must be taken to reduce the risk of colliding with ice features in open water. For instance:
  - Speed limitations in certain areas
  - Requirements for additional bow strengthening, more than the class requirement
  - Requirements for bow design and fore part of hull so that probability of oil spill is reduced if hull is damaged.
  - Requirements for improved ice identification systems. This is also an issue for the Ice Management.

Loading/offloading offshore

- Proposal to OCIMF, INTERTANKO and ICS to develop guidelines for minimum competence requirement for cargo transfer operations in Arctic waters. Level of detail is today specified in Company specific requirements. (Example: Statoil "Competence Requirements for Shuttle Tanker Personnel").

- Proposal for STCW related to crew, endorsement for offshore loading/offloading with shuttle tankers (similar for chemical tankers) in ice covered waters

- Proposal for OCIMF, INTERTANKO and ICS to develop standards for the equipment to be used to secure that it is designed and manufactured for the Barents Sea conditions. Requirements to equipment are today covered by voluntary Classification Notations like DNV WINTERIZATION and similar Russian Maritime Registry requirements.

- Proposal for OCIMF, INTERTANKO and ICS to develop operational procedures

- In the aftermath of the recent incidents during offshore loading in the North Sea, an obvious need for further development, standardization and harmonization of the current requirements and standards have been highlighted. In such a context and in the absence of relevant standards for offshore loading in cold climate/ice-covered waters, it is recommended that the following is developed further:
  - Joint Industry Standards on Offshore Loading - harmonized minimum operational and technical requirements for shuttle tankers with **special relevance to hash weather zones and cold climate/ice-covered waters**

4.5.4 General comments, findings and priorities

- Work Group 6 agreed that there are significant weaknesses in current international and industry standards with regards to navigation in ice in general and the topic of management in particular. The group has some suggestions on how these standards can be updated.

- It is noted that the Russian government wants to go for international standards rather than local standards. CNIIMF, Krylov Institute and Russian Maritime Register agree on this issue.

- Russia will follow to international binding instruments and at the same time the national Russian Regulations for Navigation on the Seaways of the Northern Sea Route (NSR). The state control of the shipping along the Northern Sea Route will remain mandatory all the year round. The Russian Federation will continue actively participate in the improvement of international and national standards.

- Detailed requirements currently included in local Russian standards (e.g. related to ice management etc.) are based on long experience from operation in Arctic waters and should be included as input to international standards as part of this project. Today IM operations normally is carried out based on the experience from the ice breaker navigators only, with limited written procedures and international standards. Valid and being improved are national Russian Regulations for Navigation on the Seaways of the NSR, Regulations of ice-breaker-assisted pilotage, and regulations of the legislation of the Russian Federation concerning navigation in the Arctic. All ships, including foreign ones, are admitted for the mandatory state leading through the NSR. The policy of the navigation in ice is determined by the Marine Operations Headquarters.

- It was stated by CNIIMF that in the Russian ship owner's opinion, the regulatory regime in the Russian Barents Sea is sufficient and that no additional standards are required. But, some of the Russians standards are not easily available and are often not translated into English.

- International standards should include guidelines for what functional requirements that must be complied with and what information and verification that should be covered and required by local standards (e.g. area/field specific requirements). A functional approach is significantly easier to implement into existing standards.

- Functional requirements are preferred and should be the basis both for standards related to offshore loading in cold climate and ice management.

Table 4.5.4 Summary of findings in the relevant standards and guidelines

Topic	Standards/guidelines	Reference	Main Comment
Ice Management – Procedures	IMO guidelines for ships operating in Arctic Ice Covered waters. ISO/CD 19906.	IMO Ch.1 ISO Ch. 17	IMO have some comments w.r.t. icebreaker assistance, little about IM. ISO Ch17.2. Availability of IM system.
Ice Management – Training	ISO/CD 19906 under development. IMO guidelines for ships operating in Arctic Ice Covered waters. OCIMF.	IMO Ch. 13 and 14 ISO Ch. 17 OCIMF Ch. 14	No international standard with requirements wrt training. Makarov Training Centre has got courses in Ice Management.
Ice Management – Competence	DNV Seaskill: Competence of Officers for Navigation in Ice, and ISO/CD 19906	ISO Ch.17	No specific competence requirements in IMO or ISO guideline
Ice Management – Capability	ISO/CD 19906, OCIMF and relevant industry guidelines.	ISO Ch. 17 OCIMF Ch. 5	Company specific procedures exists.
Collision with ice in open water	IMO guidelines, IACS unified Requirements for Polar Ships. DNV WINTERIZED notation. Northern Sea Route	IMO Ch.12 DNV Pt.5 Ch.1	KRYLOV institute has a hull stregth calculation methodology, but not available in English. Russian Government, NSR Admin. Guideline
Loading / offloading Offshore	Industry Standards, OCIMF, ISGOTT and ARCOP	ISGOTT Ch. 11, ARCOP Ch. 4.4	Russian Government, Northern Sea Route Admin. guideline

Table 4.5.5 Summary of findings from work group 6 – Loading offshore

Topic	Russian Standards	Industry Standards	Main Comments	Standards/Guidelines for further development	Conclusion
Procedures	- Ministry of transport "regulations on offshore loading" (only Russian version)	- Company specific procedures, Teekay, Statoil - Industry practice/ standards, OCIMF/ ISGOTT - No specific procedures/ requirements covering loading in Arctic waters of today - Norwegian Standard procedures fell short on these aspects in Barents In Russian waters there are requirements for support vessels to be present at the field to assist in the event of environmental spills	*-Russian Federation Government orders dated on 28.08.2000 #613 "On urgent measures for prevention and response to accidental oil and oil product spills", and 15.04.2002 # 240 "on procedure for implementation of measures to prevent and response to oil and oil product spills at the territory of the Russian Federation".* *Oil Company shall provide on oil terminals and offshore platforms adequate preparedness to respond to oil spill sizes up to 1500 tons. In case of tanker incident in zone of responsibility of oil company the response capacity shall be adequate to oil spill from two tanks. Near terminal and offshore platform shall be stand-by vessel with oil spill response equipment. Oil film shall be localized in 4 hours. REF: Russian Register of shipping: Volum 2, part 8.* Document/presentation from Laboratory of icebreaking technology of CNIIMF: *Probability of the loss of ship in the Russian Arctic – 0,04%. Probability of the loss of ship in the world ocean*	- Common (NO & RU) standards for oil spill recovery and emergency preparedness. Currently no sufficiently effective methods for oil spill recovery exists. - Establish response plans for Arctic areas. Consider remote locations, low temperature, darkness and ice conditions. - Technical regulations are different from area to area. Regulations in Russia are terminal/field specific. Thus there is a need for minimum requirement for position of tankers and tug boat assistance. - In addition functional requirements as underlying basis in addition to local field specific requirements. - The standards must be made more specific for operation in cold climate. -Very few written procedures on topic, ice navigator.	–"group 6 discussed and proposed the following proposal to Arctic Council and IMO to develop guidelines for oil spill recovery in Arctic waters. There exist several site specific regulations, but minimum functional requirements should be made as a basis wrt offshore loading. -> Propose Amendments to IMO polar Requirements for offshore loading to be more closely linked to ice conditions, locations and Ice Management -few vessels near by, due to little general traffic in the Barents Sea.
	- Harbour master decides the compulsory regulations in the field specific area				
	- Russian standard has oil spill response capability		Comment from the Russian Maritime Registry: Most accidents and spills are due to damage to hoses. Hoses to be used by ships with ice class and for use in polar waters shall be designed and tested for applicable cold conditions.		

Training	Special training course for IM at Makarov Agreement from Lukoil Both for general navigation and offshore loading Technical regulations also include training req's SCF has only got Russian (Murmansk) manning in Arctic	Company specific requirments, see Statoil "Competence Requirements for Shuttle Tanker Personnel" No min req on training/comp in ice No specific requirement covering loading in Arctic waters of today	Need for min req to personnel involved with loading in Barents sea/Arctic. Both OCIMF and NSR- rules says very little about competence requirements Today Barents have relatively few oil/gas fields, but in the future there may be many. This forces an introduction of competence req's.		There is a need for a competence definition. Who should define competence and level in the courses needed to comply with the req's? What do we mean by "qualified" for the specific operation? We recommend the development of general minimum requirements to competence, but not the details of these. Propose/Introduce a specification for offshore loading and IM. STCW incusion? Revise training element and human behaviour in STCW. -endorsement for offshore loading with shuttle tankers (similar for chemical tankers) -need to cover both open and ice covered waters Propose simulation training for shuttle tanker loading in Arctic waters, incl. ice conditions and interactions with ice man operations. Proposal to OCIMF to develop a guideline for min. competence req. for loading operations in Arctic waters. Function req. plan. Norway has additional offshore loading courses: currently 3 levels. We may propose one additional level to cover ice navigation etc. More specific competence requirements for various positions/roles onboard Distinguish between offshore loading, navigation and IM. Training and competence matrix Propose framework and highlight areas of competence and simulator training
Equipment Standard	There should be no specific req's for system specification	APL		Need for more specific min req's for equipment to be used in cold climate Winterization req's Should equipment for loading follow the ice class req's for the vessel? Preparing equipment for operation in winterization -> req's for this Inboard connection as part of winterization req's in ice? -> Might be difficult	Minimum req for emergency shut down (ESD 2/3) – update OCIMF guideline based on Arctic conditions. Hose connection, mooring equipment & safety systems (telemetry) is standardized in North Sea. This leads to a desire for harmonisation also in Barents sea.

Table 4.5.6 Summary of findings from workshop 6 – Ice Management

Topic	Russian Standards	Industry and Norwegian Standards	Main Comments	Standards/ Guidelines for further development	CONCLUSION
Procedures	- Ministry of transport: Regulations on offshore loading" (only Russian version) - Harbour master decides the compulsory regulations in the field specific area - Russian standard to oil spill response capability: Sovcomflot have adopted the CNIIMF Ice Passport on its vessels.	The IMO guideline may become integrated into SOLAS and/or MARPOL		Common (N&R) standards for oil spill in ice conditions/Arctic	- Minimum requirement for ice management manual should be defined - IMO and ISO standards should be supplemented with ice management related issues - Northern Sea Route guidelines can be used as input to IMO and ISO standards, but ice management should be specified. - The roles and responsibilities for all involved parties on ice management to be defined. - An addendum proposal for the ISO standard should be realised. - Functional description for ice management as input to IMO and ISO standards should be established on a general level with illustrations of key principles and key issues regarding ice management operations.
Training/ competence	- Makarov most advanced/ experienced training centre/ice simulator in Russia - Signs contract with Russian ship owners - Plan to establish course for Arctic pilots/navigators, but will need funds/finance	Navigation Schools in Russia, Norway (SMSC) Sweden Finland, Canada and others	- Russian Maritime Register does not have specific requirements related to Ice Management training. They just check competence / training certificates based on international requirements (STCW, ISM) - At least one navigation officer should have competence for navigation in ice (input to STCW and / or OCIMF)		- The focus to be related to minimum requirement on competence to ensure international consistency. Not on location. - Propose to ISO standard - Propose a training standard for all training institutions - The combination of practical experience i.e. sailing with ice management operations and training course/ simulator/CBT - Commanding officers to have specific competence, while other crew members do not need the same competencies. - Establish special training centres for on board vessel training and requirements for on the job training - Establish tailored requirements for ship owners and ship operators - Establish simulator training with Arctic conditions and requirements to and standards related to such training facilities.
Capabilities	- RS has established 9 ice classes for each class, min capabilies on engine specified of vessel displacement in full load - RS navigation conditions related to ice class and safety speed is specified with and without ice breaker assistance, either in broken or solid ice - Krylov, designer, speed, engine, power, CNIIMF, ice basin for testing, recommendations to costumer - RS ice req's construction of tanker	DNV Ice class	Generally IACS Polar Class and the FMA rules should be referred to as the basic standard.		Analysis made for whole system? Min req? linked to capacity, Ref. DP capability plots Min req's for analyses that should be carried out Saving power is a way of having redundancy Need for refuelling? IM operations 24/7

Table 4.5.7 Summary of findings from workshop 6 – Collision in open waters

Topic	Russian Standards	Norwegian Standards	Main Comments	Standards/ Guidelines for further development	CONCLUSION
Procedures	RS navigation conditions related to ice class and safety speed is specified with and without ice breaker assistance, either in broken or solid ice. Krylov, designer, speed, engine, power, CNIIMF, ice basin for testing, recommendations to costumer A. Chetyrkin: For ships navigating in the Barents Sea a minimum of A1 Ice Class should be applicable	DNV Ice class	One could look into improved sensor technology for detecting growlers of multi-year ice, e.g. infrared sensors that would detect objects colder than the seawater (i.e. ice)		A ships navigator will find it hard to see an approaching ice growler if it is too small to be seen on radar. Hence, the ice berg bit is too large to encounter even with hull strengthening. It is hard to define standards to cover this specific challenge.

4.5.5 Proposals for further work

During the work, Working Group 6 has identified and agreed that there are weaknesses and missing requirements in the current national standards and international industry standards with regards to operation and maritime navigation in Arctic open and ice covered waters related to offshore activity. The group also agreed that there is a need to continue the development and cooperation between the Russian and Norwegian delegations further, in order to ensure future international consistency. This can be done by including and making best practices more transparent and work towards making local guidelines and regulations more generic and transformed into formal international standards.

Standards related to *Ice Management* have been highlighted in particular to be a topic that needs to be further developed. The ISO 19906 standard, chapter 17, has a sound basis for further work. Standards for *offshore loading and offloading operations in Arctic areas* have also been identified as an area which needs to be further developed.

The risk for collision when navigating in regular transit in the Barents Sea was identified and discussed by the group, but compared to world wide shipping the increase in probability was identified as relatively low and therefore not included in the groups recommendations.

The proposals for input to relevant standards agreed by the group are included in this report, but the detailed wording and placing in the referred standards have not been concluded as this has to be worked out in cooperation with the owners of the different standards or sub committees.

Other issues identified during the work which has been discussed but not included as concrete proposals to existing standards are listed below. The topics may not fit into a standard or they will be equipment specific or depend on how the operation is planned to be carried out.

Topics discussed and found important by the working group, but not addressed as an input to a particular standard, are:

- Principles and minimum requirements for an Ice management manual
- Basis for functional requirements for Ice management operations based on ISO standard
- Definition of roles and responsibilities for all involved parties in Ice management operations
- Minimum requirements with regards to competence, training and experience for navigators involved in:
  - Physical ice management operations
  - Offshore loading and offloading operations
  - General navigation in Arctic ice covered waters

In a potential further work, principles for a guideline including functional requirements for the oil spill response system in Arctic conditions should be worked out.

4.6 Operational Emissions and Discharges to Air and Water

4.6.1 General comments, findings and priorities

Through the work undertaken by working group RN07 we have identified and reviewed a number of relevant technical standards regarding emissions and discharges on different levels. These include e.g.:

- International formal technical standards, e.g. ISO
- International conventions, e.g. MARPOL
- Descriptive guidelines set by international organizations, e.g. IFC[1] /World Bank.
- International technical standards for shipping as represented by the IMO[2] requirements.
- National technical standards (formal normative and/or descriptive standards, practices, guidelines and also standards integral in regulation in the case of Russia: Temporary Department Regulatory Document (VRD) is valid for 2-3 years before it becomes a formalized standard (STO))
- Industry standards and guidelines (e.g. by OGP[3])

The number of international formal technical standards relevant to environmental aspects of offshore petroleum activities in the Barents Sea is low. However, some key international generic standards covering a wide scope and range of activities are identified and prioritized. They are supported with more narrow scoped/targeting national or industry standards where applicable.

Most standards identified and recommended are basically on a superior level, not going into the details of every aspect. This is considered a natural first step of harmonization, where the next step could focus on more detailed standard for certain applications. References to the detailed level technical standards are however normally given in the superior standards.

The work scope of RN07 is wide, covering all relevant operational (planned) emissions to air, discharges to sea, and relevant waste management and supply services. Maritime transport activities directly linked to offshore petroleum activities form a natural part of this scope. The group has generally not looked into land-based associated petroleum activities (e.g. terminals, LNG plants etc.), however has included land-based facilities and infrastructure with relevance to the offshore activities (e.g. waste handling facilities and relevant infrastructure). The scope of activities and supporting activities studied by RN07 is illustrated in Figure 4.6.1

It is important to note that the RN07 scope does not include unplanned discharges to sea, e.g. oil and chemical spills and related standards for prevention and/or clean-up (or methane emission as result of pipeline leakage/rupture). Standards relevant for preventing such discharges are however principally covered by the work performed by RN03, 05 and 06. Standards and R&D related to clean-up activities were defined outside the Barents 2020 HSE Standards Harmonization scope in phase 2 as it is generally covered by parallel ongoing initiatives.

4.6.2 Particular issues / risk identification for the Barents Sea

In the context of physical and ecological (environmental) issues it is important to note that the Barents Sea is not a homogenous area. The Barents Sea varies significantly among different parts of this vast oceanic area. Ocean climate, ice conditions and the presence and distribution of natural resources (fish, seabirds etc.) varies both spatially and temporary. Such conditions were evaluated in more detail in the phase 1 reports. For further information it is recommended to consult the “Environmental Baseline – Maritime and offshore” /ref. 1/ and “Ice & Metocean” /ref. 2/. These factors may affect on the selection of technical environmental standards, making different standards (or environmental solutions) applicable in different parts of the Barents Sea. In the work performed it has been focused on identifying generic environmental standards for the Barents Sea and in addition trying to point at conditions that may trigger the application of different standards or solutions.

The particular Barents Sea issues discussed include:

- Ice conditions
- Temperature
- Natural resources
- Light conditions
- Remoteness/Infrastructure

Temperature and light conditions are important issues with regard to oil spill preparedness/ response, but for operational (planned) discharges and emissions they are not considered of primary importance. The presence of ice and/or particular vulnerable natural resources may be of importance with regard to the environmental performance of offshore and maritime activities hence may influence on the level of standards recommended. This has e.g.

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[1] International Finance Corporation

[2] International Maritime Organization

[3] International Association of Oil & Gas Producers

been identified as important with regard to proximity to the ice edge, burning of liquids with precipitation of particulate matter (black carbon) on ice, etc.

Remoteness of major parts of the Barents Sea with regard to relevant infrastructure (or lack of such) has been identified as the most important particular condition in the area with regard to technical environmental standards. In order to ensure the full implementation of sound environmental standards the associated infrastructure must be in place and functional. This may be challenging and in some circumstances not technically or economically feasible, trigging the need for establishing new standards without such special needs (if possible).

Gas associated with oil production (associated gas) is a valuable resource which historically has been flared in many areas. Today, in developed areas this gas is most often collected and monetarized, or used as lifting gas. Due to lack of developed infrastructure and remoteness associated gas is considered a priority environmental challenge for major parts of the Barents Sea. Development solutions, infrastructure, technology development and standards may form important means in avoiding this gas being flared and CO2 and other exhaust gases being emitted to the atmosphere. So, even if the aspect is covered by existing standards there is no simple solution to comply with the standard.

Waste management is another issue for which relevant standards exist however the issue is particular challenging in remote areas with limited or no infrastructure. Ensuring that the adequate onshore reception facilities exist, means of transport and logistics are crucial to achieve a proper environmental performance trough the entire "waste life cycle".

Parts of the Barents Sea have previously been subject to nuclear testing with the consequence of elevated background level of radioactive components in water and seabed sediments. Such background conditions are relevant to some areas and not generally to lager areas of the Barents Sea. However, in the case of petroleum exploration and production activities in such areas this may trigger the need for particular environmental precautions and technical standards. This issue has not been addressed in detail by RN07.

In summary, the particular conditions evaluated, with a few exceptions, do not justify a level of standards for the Barents Sea different to the high level of environmental standards being applied within the offshore oil and gas industry in comparable areas

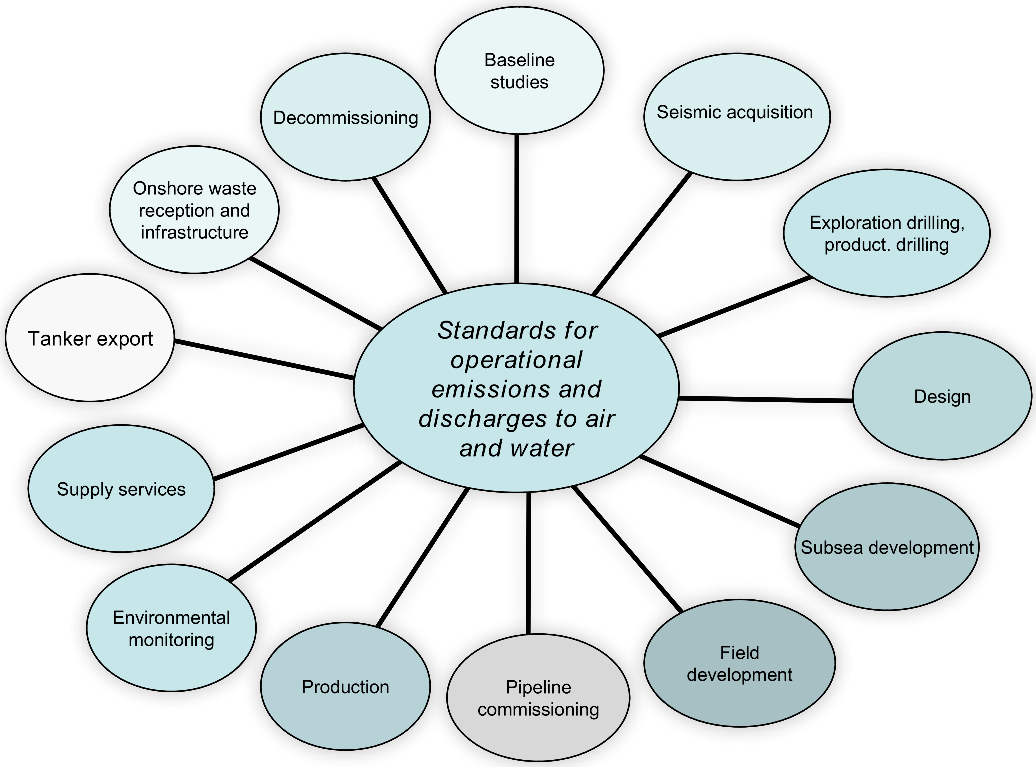

Figure 4.6.1 Scope of petroleum activities and supporting aspects covered by RN07.

today (e.g. on the Norwegian Continental Shelf, the North Sea). However, harmonization is necessary in order to ensure a proper level of standards and a common set of standards throughout the Barents Sea. For the "exception areas" with particular issues/conditions changed or new stricter standards may be adequate. This process is illustrated in Figure 4.6.2. For the maritime sector the standards are generally on a harmonized and international level already. However, more stringent standards are considered recommendable on certain issues.

4.6.3 Recommended key standards

The working group has reviewed relevant international and national standards by categorizing offshore petroleum activities into the following sub-activities/areas:

- Environmental management
- Seismic acquisition
- Drilling (exploration and production drilling)
- Design/Field development/Subsea development
- Production
- Maritime transport
- Support services
- Onshore facilities
- Decommissioning

Relevant aspects of operational (planned) emissions to air, discharges to sea and waste management related to these activities have been addressed, identifying existing standards (or lack of such) for each environmental aspect.

Generally there are different environmental standards applicable to offshore oil and gas activities and maritime transport activities respectively. For maritime transport activities generally the IMO MARPOL 73/78 with its annexes applies. For offshore oil and gas activities a higher diversity of standards exists, each standard often targeting one or a few aspects. In order to recommend a set of harmonized environmental standards being relevant to most activities it is considered preferable to suggest a set of generic and descriptive/functional standards. These will form as the "basic standards" valid for the entire Barents Sea and more stringent standards will be recommended for areas of particular concern (cf. section 4.6.2).

Figure 4.6.2 Illustration of the results of the work group, identifying a basic set of environmental standards which will generally be applicable for the Barents Sea with the exception on some particular areas where changes to existing standards or establishing of new standards may be needed.

In order to achieve harmonization descriptive standards are further considered more suitable than detailed normative standards as each country on a national level may have well established practices on the more detailed aspect level[4] (e.g. emission factors for calculation of emissions) preventing an effective harmonization, and which will anyway not affect environmental performance. A set of descriptive standards is also considered better applicable to align with differences within the regulative framework of each country.

The level of standards recommended are considered being on a sound "Norwegian North Sea" level and with stricter standards on areas with particular concern/challenge in the Barents Sea (cf. illustration in Figure 4.6.3). If such stricter standards have not been identified the need for such are discussed under the subsections "need for changes to existing standards" and "need for new standards" respectively.

The standard level recommended and its areas of application are considered relevant to open sea parts of the Barents Sea (i.e. areas not associated with ice or the coastal zone with particular issues). Hence they will apply to major parts of the Barents Sea including e.g. the Shtokman area.

As a basis for the recommendation of harmonized key standards for the Barents Sea an important presumption is important to underline. If one of the countries has a national standard or frame conditions which define higher requirements on the specific discharge/emissions level or environmental performance, these requirements are to be met (in the respective country). The Barents 2020 standards harmonization process gives recommendations for functional standards addressing actual performance on the individual aspect. General area regulations or frame conditions as "zero discharge regimes" are superior to this, managed by national authorities, and as such not relevant with regards to technical standards. Hence such issues are not addressed by the current standards harmonization initiative.

[4] It should be acknowledged that some Russian standards are common for the entire Russia and for all/most industrial activities. Hence changing the basic principles of such well established standards is not practicable, and the harmonization must be on a more superior level making a harmonized foundation/common platform.

The key standards for reference recommended by Working Group 07 are:

ISO 14001 *Environmental Management System (2004)*. This standard is a universal standard which will apply also to environmental management of offshore oil and gas activities in the Barents Sea. The ISO 14001 implies that activities are planned for and executed in a systematic manner considering relevant environmental aspects and aiming at continuous improvement. Recommendation for reporting makes the environmental performance subject to transparency and benchmarking.

- International Finance Corporation/ World Bank Group *Environmental, Health, and Safety Guidelines: Offshore Oil and Gas Development (2007)*. Covers the following aspects/activities:

  – Air Emissions
    - Exhaust gases
    - Venting and flaring
    - Well testing
    - Fugitive emissions

  – Wastewaters
    - Produced water
    - Hydrostatic Testing water (pipelines commissioning)
    - Cooling water
    - Desalination brine
    - Sewage
    - Food waste
    - Storage displacement water
    - Bilge water
    - Deck drainage water

  – Waste management
    - "Normal waste" from topside operations
    - Drilling fluids and drilled cuttings
    - Produced sand
    - Completion and well work-over fluids
    - Naturally occurring radioactive materials (NORM)

  – Hazardous Materials Management
    - Chemical hazard assessment
    - Testing of chemicals
    - Documentation of chemicals based on OSPAR Harmonized Offshore Chemical Notification Format or similar internationally recognized system

  – Select chemicals with least hazard and lowest potential environmental impact

- Avoid chemicals suspected to cause taint or known endoctrine disruptors
  - Noise
  - Relevant to seismic acquisition, drilling and production (and maritime traffic)
  - Identification of sensitive areas and times of year
  - Identification of fishing areas
  - Specific measures listed to avoid or reduce possible negative effects
- Decommissioning
- IMO standards for safe sail-over
- OSPAR criteria for removal of installations

This standard ensures a focus on most of the important issues related to operational emissions to air, discharges to sea and waste management throughout the life cycle of an offshore oil and gas development. As it is functional based and not very detailed in its recommendations it gives flexibility with regard to technical solution and requires a good and targeted project follow-up process to ensure fulfillment of the standard's requirements. An example on produced water is given below:

"Feasible alternatives for the management and disposal of produced water should be evaluated and integrated into production design. These alternatives may include injection along with seawater for reservoir pressure maintenance, injection into a suitable offshore disposal well, or export to shore with produced hydrocarbons for treatment and disposal. If none of these alternatives are technically or financially feasible, produced water should be treated according to discharge guidelines [....] before disposal into the marine environment." (i.e. 30 day average should not exceed 29 mg/L).

Another example on drilling fluids and cuttings when drilling with non-aqueous drilling fluids (NADF):

- *"1) NADF – re-inject or ship-to-shore, no discharge to sea.*
- *2) Drilled cuttings – re-inject or ship-to-shore, no discharge to sea except:*
  - *Oil concentration lower than 1% by weight on dry cuttings*
  - *Hg – max 1 mg/kg dry weight in stock barite*
  - *Cd - max 3 mg/kg dry weight in stock barite*
  - *Discharge via a caisson at least 15 m below sea surface"*

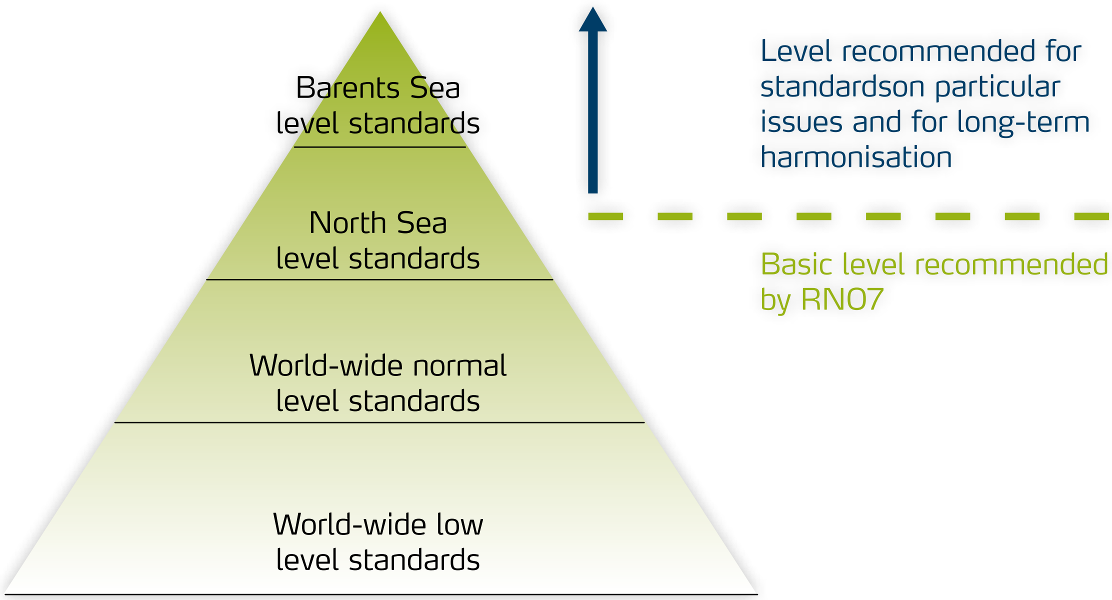

Figure 4.6.3. Hierarchy level of environmental standards illustrated the basic level recommended by RN07 and ambition for long term harmonization on particular issues.

For energy production and associated emissions to air the IFC/World Bank has a more specific standard than the general Offshore Oil and Gas development standard, which is recommended by RN07:

- International Finance Corporation/ World Bank Group *Environmental, Health, and Safety Guidelines: Ambient Air Quality (2007)*.
  - The guideline applies to facilities or projects that generate emissions to air at any stage of the project life-cycle. It complements the industry-specific emissions guidance (cf. above) by providing information about common techniques for emissions management that may be applied. Some examples on emission levels are cited below:

Nitrogen oxides (NOX) emitted from turbines running on gas:

- 42 ppm (el generation) for 3 – 15 MWh turbines
- 100 ppm (mechanical drive) for 3 – 15 MWh turbines
- 25 ppm for 15 – 50 MWh turbines

Sulphur dioxide: < 0.5 % S in fuel

However, if the country's industry is already provided with a national or corporate standard which define higher requirements on the emissions into the atmosphere, these requirements are to be met. In Russia, for example, according to the VRD 39-1.13-008-2000 "Environmental requirements for operation of power units at offshore oil and gas producing platforms on the Arctic shelf" the concentration of nitrogen oxides NOx must not exceed 50 mg/m3 (24 ppm) during the work of gas turbine engines with the 0.5-1.0 nominal load (combustion dry stock at 0oC, pressure of 101.3 kPa, 15% O2).

The IFC/World Bank standards to a certain degree overlap with the contents of the NORSOK S-003 standard. This is however more specific on certain phases of the offshore oil and gas activities, mainly related to design and engineering phases. It is also very focused on the BAT approach (Best Available Techniques); to identify, evaluate and document the best environmental solution for the relevant application.

- NORSOK S-003 *Environmental Care (2005)*.
  - Of particular relevance for decisions in the design, engineering and fabrication phases of an offshore field development, rig new-building and upgrading. Based on the principle of BAT (Best available techniques).

  Examples on aspects covered by the standard are listed below:
  - Emissions to air, e.g.:
    - Energy management
    - NOX control
    - Flaring
    - Emissions from oil storage and loading
    - Well testing
    - Emission control and monitoring
  - Discharges to sea, e.g.:
    - Produced water
    - Drain system
    - Displacement water
    - Drilling and well operations
    - Produced sans
    - Chemicals
    - Cooling water
    - Subsea systems
    - Pipelines
  - Waste management
  - Decommissioning
    - Cleaning
    - Disposal of installations
    - Drill cuttings

Some examples on functional requirements given by the NORSOK S-003 standard are cited below:

NOX control on turbines:

- *"New gas turbines should be of low-NOx type to achieve an emission level of 25 ppmv (dry offgas, 15 % O2) or better. Steam or water injection to achieve a similar level may be considered when this technology is proven for offshore application.*
- *The reasons for not achieving a low NOx emission level shall be clearly documented."*

Flaring:

- *"Should include, but not be limited to, consideration of the following measures:*
- *recycling of gas from high pressure relief systems during normal operation;*
- *recycling of low pressure relief systems during normal operation (subject to cost-benefit evaluation);*
- *process design that minimizes risk of tripping of compressors etc.;*
- *control and condition monitoring systems to reduce the number of trips;*
- *planning of start-up activities to reduce flaring."*

Oil storage and loading:

"FPSO, floating storage units, shuttle tankers, offshore and onshore loading systems shall be designed to minimize emissions of methane and

NMVOC. The following measures should be considered, but not be limited to:

- *sequential loading/unloading of oil,*
- *optimized geometry of tanks with respect to evaporation of hydrocarbons,*
- *loading/discharge rate with respect to evaporation,*
- *use of hydrocarbon gas as blanket gas in floating storage tanks, with recovery,*
- *installation of a VOC recovery plant to return NMVOC to crude oil,*
- *installation of a VOC recovery plant to condense NMVOC and use condensed liquid as fuel,*
- *incineration of VOC during loading operations.*

The process system should be designed to optimize the Reid vapour pressure and true vapour pressure and temperature of the oil, in order to minimize emissions of methane and NMVOC."

Produced water:
"The expected composition of produced water shall be identified, and natural components and added chemicals known to contribute to the environmental risk shall be assessed in terms of concentration and load.
The environmental risk should be calculated […].
The result of the modeling should be used for selection of fitted technologies, including, but not limited to, the following options:

- *minimize water production by well management and/or downhole or subsea separation of water;*
- *injection of the produced water by*
  - *subsea separation,*
  - *injection to reservoir to maintain pressure,*
  - *injection to disposal well.*
- *maximize regularity of injection system when relevant;*
- *treatment and discharge to sea." (Specific guidance is given for treatment options)"*

Waste management is covered by both the IFC/World Bank and the NORSOK S-003 standards and are generally applicable also to the Barents Sea. However a standard dedicated for areas with limited infrastructure has been developed by OGP and is recommended for the relevant parts of the Barents Sea.

- *Guidelines for waste management with special focus on areas with limited infrastructure,* rev 1. OGP (International Association of Oil & Gas Producers), March 2009. The guidelines provide guidance on principles and practices of effective waste management, taking into account conditions that may create limitations. Further they provide information on waste streams and technologies typically applicable in exploration and production operations.

Standards for sampling and monitoring of different environmental parameters (physical, chemical and biological) exist within most countries, not necessarily harmonized internationally. For sampling of e.g. pollutants in ice/snow harmonized standards are described within the context of the Arctic Monitoring and Assessment Program (AMAP), and not considered in detail by RN07.

The key standards for maritime transport for reference recommended by Working Group 07 are all international standards and conventions established within the scope of the International Maritime Organization.

- IMO MARPOL 73/78 Annexes with amendments:
  - Annex I. Prevention of pollution by oil
  - Annex II. Control of pollution by noxious liquid substances
  - Annex III. Prevention of pollution by harmful substances in packaged form
  - Annex IV. Prevention of pollution by sewage from ships
  - Annex V. Prevention of pollution by garbage from ships
  - Annex VI. Prevention of air pollution from ships

These annexes provide defined standards for emission level of the relevant substances to sea and air with variable standards depending on distance to shore, area of transit etc. For example, Annex I sets detailed requirements for the construction, equipment and discharge control for prevention of oil pollution from machinery spaces of all ships and from the cargo areas of oil tankers. While marginal operational oil discharge[5] from machinery spaces of all ships and cargo spaces of oil tankers is allowed outside so-called Special Areas, no discharge of oil from cargo spaces is allowed within such areas.

[5] The oily mixture from machinery spaces shall be proceeding through an approved oil filtering equipment, and the oil content of the effluent discharged to sea shall not exceed 15 parts per million. The total quantity of oil residues from cargo discharged to sea must not exceed 1/30000 of the total quantity of the cargo of which the residue formed a part (1/15000 for tankers delivered before 1980). The rate at which oil may be discharged must not exceed 30 litres per nautical mile.

Similar stricter regulation within Special Areas applies for other Annexes, except Annex III and IV. Among the requirements in Annex VI, are detailed limits for NOx emissions from different engine types (according to the so-called NOx curve), with stepwise reduction in allowed emission levels for new engines towards 2016. Sulfur emissions are regulated through stepwise reduction in allowed sulfur content in fuels towards 2020.

Although green house gas emissions from ships are not currently internationally regulated, IMO is developing a system with an Energy Efficiency Design Index (EEDI) for in the future to be able to require energy efficient design of new ships. In addition, IMO is developing an Energy Efficiency Operational Index (EEOI) for the purpose of enabling for more energy efficient operation of ships by the ship owners. The IMO measures for reduction of greenhouse gas emissions are considered applicable also for the petroleum related ship traffic in the Barents Sea.

- IMO Ballast water Convention; *International Convention for the Control and Management of Ships' Ballast Water and Sediments* (Stepwise international implementation between 2008 and 2016).
  - The Convention includes technical standards and requirements in the Regulations for the control and management of ships' ballast water and sediments (Requires from ships ballast water management plan and type approved ballast water treatment system)

- IMO Anti-fouling convention; *International Convention on the Control of Harmful Anti-fouling Systems on Ships* (2001/2008).
  - Prohibit the use of harmful organotins in anti-fouling paints used on ships and will establish a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems

In addition there will for certain aspects be national standards which are referred to on a national level. However as to ensure harmonization these national standards should generally be national implementation of the international standards recommended, i.e. same contents/standards level.

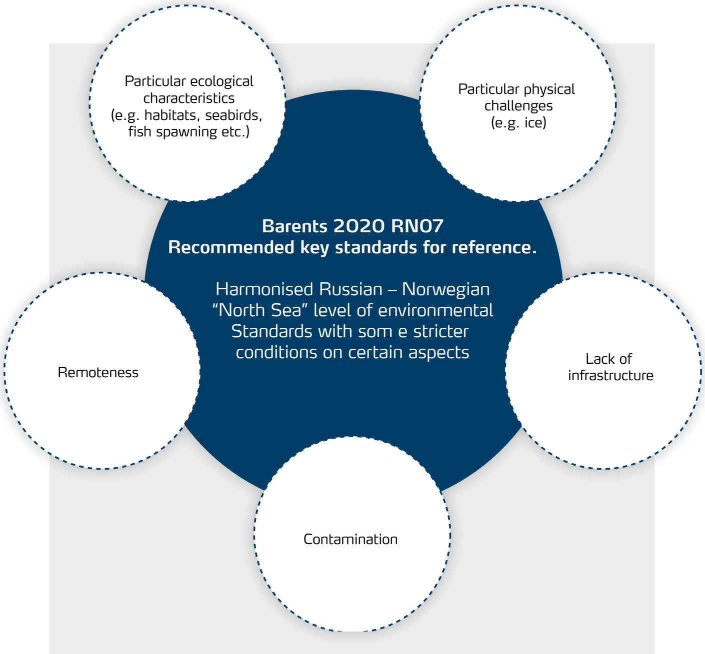

Figure 4.6.4. Illustration of the set of basic standards for the Barents Sea as recommended and specific "particular issues" which may require new standards or changes to existing standards.

4.6.4 Recommended change to key standards for application in the Barents Sea

Through the review of relevant international and national standards the Working Group RN07 has identified some areas on which existing standards may need to be expanded in order to better meet particular conditions of the Barents Sea, or the level of standards considered appropriate for the Barents Sea. The need for changes / or new standards are generally related to particular conditions of the Barents Sea (cf. 4.6.2) as illustrated in Figure 4.6.4.

It is difficult to advice on whether recommending change to an existing standard or establishing a new standard. As most of the recommended standards have a global coverage it is however generally considered unlikely to change these to align to Barents Sea conditions. This is more appropriate for regional or geographically limited standards. Hence, probably establishing new regional standards will be the most appropriate solution on most aspects where a need for change is identified.

- International Finance Corporation/ World Bank Group *Environmental, Health, and Safety Guidelines: Offshore Oil and Gas Development* (2007).
  - Amendment on chemical substitution plans also for external environment (today for human health).
  - Due to the vulnerability of arctic marine

environments to chemical (persistent) pollutants it is proposed to focus in particular on the process of selection of chemicals with the most favorable environmental characteristics and to establish phase-out plans for chemicals with unfavorable characteristics. This process could be amended in to the IFC/World Bank EHS Guidelines and will have applicability also outside the Barents Sea.

With regard to the eco-toxicity characteristics of offshore chemicals and relevant marine organisms in the Arctic, questions have been raised on the relevance of some of today's testing results. An initiative has been taken by the Norwegian Ministry of Foreign Affairs, under the Barents 2020 program, to establish an eco-toxicity laboratory dedicated for Arctic issues of concern. The laboratory will be located in Tromsø and will be in operation from 2010. This is considered a sound step in obtaining improved test results for relevant Arctic organisms, reducing gaps in knowledge.NORSOK S-003 on cementing is only addressing mobile drilling rigs. The standard should be similar also for fixed drilling units. This issue should to be forwarded to the NORSOK committee. The recommendation is not limited to the Barents Sea but valid for all areas.

4.6.5 Recommendation for new standards

With reference to the section above RN07 has no clear answer to whether it is most appropriate suggesting changes to existing standards or to establish new standards. New standards are however likely the best solution as they may then be more specific to the Barents Sea conditions.

RN07 recommends the development of new standards for the following issues.

- **Emission control measures at least equivalent to those applied in "Special Areas" under IMO MARPOL Annexes I and V for reduction of discharges from ships of garbage and oil to sea.**

  – Even if the Barents Sea is not formally designated as a Special Area, it is suggested that equivalent measures to those applied in Special Areas are used as the industry standard for petroleum related traffic in the Barents Sea. This suggested regional industry standard implies a zero-limit for discharges of garbage to sea from ships. It further sets special requirements for regular discharges of oily residues, including a zero-limit for the discharge of oil/oily mixtures from the cargo areas of oil tankers such as oily water from tank washing operations.

Special Areas allows for the disposal of food waste to sea. However, according to the suggested industry standard no food waste should be disposed to the environment in ice covered areas of the Barents Sea.

- **Regional industrial standard for maritime traffic and offshore installations to work on distillate fuel oils rather than heavy fuel oils**
  – Use of low sulfur marine diesel oils and marine gas oils ensures compliance with future IMO sulfur emission standards. Moreover a phase out of heavy grade fuel oils in the Barents Sea reduces environmental risk in connection with potential accidental bunker spills. It also reduces the emissions of soot/particles, it requires less energy for fuel heating and it generates less oily wastes (sludge) from fuel oil separators. Fuel oil limitations similar to those suggested by IMO for the Antarctic area can serve as a basis for the development of an industry initiated fuel quality standard for petroleum related ship traffic in the Barents Sea; i.e. the fuel oils should have a density at 15°C lower than 900 kg/m3 or a kinematic viscosity at 50°C lower than 180 mm2/s.

- **Standard to prevent burning of liquids in proximity to ice covered areas ("C"/PM/soot)**
  – Pollution of ice by particulate matter from incineration of waste and burning of liquids (e.g. well testing or using heavy oil fuels) in addition to the chemical and aesthetic effects has secondary impacts on melting and ice-bound ecosystems. Hence stricter standards than the "basic standards for recommendations" are recommended to avoid burning of liquids in areas with proximity to ice.
  – Establishing such a standard will reduce the amount of soot, particular matter and pollutants being emitted to air and which precipitate on ice and having negative impacts on the ice and its ecosystem (e.g. from well testing, flaring, incineration).

- **New standard for underwater noise reduction on maritime vessels**
  – Underwater noise, e.g. from offshore vessels working on dynamic positioning systems (and also various drilling-related activities), is posing negative risk on marine mammals and fish. The issue is generally addressed by the IFC/World Bank Standard, but not at the very detailed level.

- Areas of the Barents Sea have particular spatial and temporal aggregation of certain vulnerable marine mammal species, to which underwater noise could pose a threat. Such a standard is needed world-wide however such special conditions express a particular need for the Barents Sea /Arctic areas.
- The issue is currently focused by several international initiatives e.g. by the OGP and a Barents Sea initiative may await results from such existing initiatives prior to decide on particular regional standards. Work is also ongoing within class societies to develop dedicated class notations ("Silent Class") with low underwater noise performance.
- IMO has included the standard on regulation of noise from ships in its development list.

Several other issues have been identified on where new standards may be necessary in order to provide a sound level of environmental standards for the Barents Sea, with particular focus on certain issues. They have not been looked at on a detailed scale by RN07 hence are recommended for further study, cf. next section.

As mentioned in section 4.6.2 the reduction of flaring associated gas is considered a key environmental issue for remote areas of the Barents Sea. A world-wide initiative (Global Forum on Flaring Reduction) is however ongoing addressing this issue trying to establish investment incentives, an overview of best practices, technology solutions etc., including e.g. the World Bank and OGP. In the context of the current work of Barents 2020 it is recommended that associated gas should not be flared for disposal as such, only for safety purposes. Associated gas may also be used for EOR/pressure support or re-injected for disposal. The issue is not further addressed by RN07.

4.6.6 Proposals for further work

The work group RN07 has identified several issues on which more work is considered necessary in order to further harmonize on environmental standards for the Barents Sea. In general the further work implies to further elaborate on the issues where a need for changed or new standards are recommended, and to ensure a better basis of knowledge and assessment in order for these standards to be implemented.

The need for further work is divided in two:

1) Further work for the implementation of the new standards recommended
2) Further work on issues for harmonization on which it has not been possible to go into the sufficient level of details within the scope of 2009.

Further work and implementation is mainly relevant to the following recommendations in order of priority:

- Development of regional Industry Standard to reflect MARPOL Special Area (SA) requirements on relevant areas for petroleum related ship traffic
- Develop of regional Industry Standard for ships and offshore installations to work on distillate fuel
- New standard for the reduction of burning of liquids in the proximity to ice covered areas

Other new standards recommended in section 4.6.5 should await results for ongoing processes and/or be prioritized by other initiatives than Barents 2020 as they represent areas with a wider focus than the Barents Sea.

Issues for further harmonization and on which not sufficient effort has been possible to spend during 2009 are discussed below.

These issues are again split in two, **a**) issues on which standards exist on national (or international) level and the further work is technical harmonization, **b**) issues on where further work is needed to assess the possibility for harmonization. The latter is far more challenging but still very important as the achievement by such harmonized standards could be significant on environmental performance.

The first category issues for harmonization identified are:

- **Harmonised standard for pollution detection**
  - Emission and discharges sources are being monitored/controlled differently in Norway and Russia. A harmonised system will enable for better control and reporting and ensure a better environmental performance.

- **Harmonised standard for offshore environmental monitoring for the Barents Sea**
  - Both countries have systems today, but the Russian monitoring standards are not in depth aligned with offshore conditions, and the Norwegian system needs some development to apply with Barents Sea conditions (e.g. for ice covered areas). A harmonized system will ensure transparency in monitoring of environmental performance (impacts) and facilitate transparency in data exchange and improve opportunity for joint problem solving.

- **Waste Management – further development and harmonisation**
  - Remoteness and poorly developed infrastructure for waste reception and handling is a real waste management challenge of the Barents Sea (offshore and coastal areas). In order to ensure proper environmental performance through a life cycle approach the issue of waste management facilities and logistics both offshore and onshore is crucial and needs to be further addressed. Standards exist on an international and national level but need to be adjusted and harmonized to the relevant situation.

Issues that are considered very important with regard to environmental performance of operational (emissions to air and) discharges to sea in the Barents Sea include "Chemical management" and "Discharge levels". The issues have been discussed by RN07 in the course of 2009 and the basic standards level as stated by the IFC/World Bank is recommended for chemicals management. However this issue is considered being among the highest priority for offshore petroleum related activities, with a significant potential for improvement on the standards level and is highly recommended for further work in 2010. On discharge levels it is mainly an issue of looking into the possibility for further harmonization between Russia and Norway with regard to approach and applicability. The two issues are further detailed below:

- **Chemicals assessment and management**
  - The risk associated with the use and discharge of chemicals offshore Norway has been significantly reduced (<98 %) over the last decade and is today probably posing the lowest risk referring to other countries operations.
  - The system for chemicals assessment and management in Russia is very different and related manly to onshore activities, hence needs to be further developed for offshore operations.
  - A stepwise harmonisation with the Norwegian (OSPAR) approach could have significant positive impact on the future environmental performance of all offshore oil and gas activities in the Barents Sea.
  - The harmonization process should consider all relevant aspects of the chemicals management, e.g. eco-toxicity information availability and handling (accessibility), criteria for evaluation, chemical assessment, substitution planning etc.

- **Further harmonization on recommended** discharge levels (air and sea)
  - Today's recommendation forms a basic standard (cf. IFC/World Bank and NORSOK S-003).
  - There is a need to further expand and harmonise on these aspects adopt to the Barents Sea offshore conditions. The work should cover all relevant activities from exploration through operation phase.
  - Norway has a risk based approach Environmental Impact Factor (EIF) and Russia has a system based on Maximum allowable concentration (MACs) however the latter not specifically adjusted for offshore areas/the Barents Sea.
  - The work should look into the possibility for further harmonization on these areas without having impact on the regulative approaches of the two countries.

References:

/1/ Barents 2020. Phase 1. Environmental baseline Maritime and Offshore. DNV Report 2008 – 0716. Hanna Lee Behrens, Håkon Hustad and Steinar Nesse, DNV Maritime Solutions.

/2/ Barents 2020 PHASE 1 – Establish Norwegian Baseline on HSE standards. Ice and Metocean (Maritime and Offshore). DNV Report No. 2008-0664. Lars Ingolf Eide, DNV Research and Innovation.

4.7 Basic List of International Standards for Use in the Barents Sea

4.7.1 Introduction

Summary

The basic list of recommended international standards for use in the Barents Sea based on the work of group RN01, including input from all the other groups, is presented in Appendix 1. The list contains 130 standards.

Mandate

The Barents 2020 Russian-Norwegian working panel RN01 was given the task of:

1. working out a basic list of internationally recognised standards for use in the Barents Sea, common for the Russian and Norwegian side.
2. assessing these standards' suitability for Barents Sea application and
3. where appropriate, identifying tasks for further work to improve standards for Barents Sea use

Participants

The delegates participating in the work are listed in this report in section 3.4.

Working method

The panel has met for 3 workshops during 2009, each lasting one-two days. Two workshops have been held at VNIIGAZ premises in Moscow, and one workshop has been arranged at DNV Head Office in Oslo, Norway.

4.7.2 Principles of standardisation

The panel's work started by identifying available standardisation bodies providing relevant standards. A short overview is given in this section.
Levels of Standards
Standardisation within the petroleum industry can be grouped into 4 main levels:

1. International standards
2. Regional standard
3. National standards
4. Industry and association standards

International Standards

International standards are those developed and recommended by the International Organization for Standardization (ISO) and other authorized international organizations for specific areas, like the International Electrotechnical Commission (IEC) and the International Telecommunication Union (ITU).

ISO: Oil and gas industry standardisation in ISO is mainly undertaken through technical committee TC 67; "Materials, Equipment and Offshore Structures for the Petroleum and Natural Gas Industries". This TC currently has six subcommittees and 42 work groups. As of 2009 TC 67 has published some 140 standards and has a further 70 new or revisions underway under the current work programme. The oil & gas industry also use many standards from other ISO committees.

IEC: IEC is the International Electrotechnical Commission and complements ISO by issuing international electrotechnical standards. The oil and gas industry's work for the exploration and production industry is mainly undertaken through IEC TC 18: "Electrical equipment of ships and of mobile and fixed offshore installations". As of 2009 the TC has published 7 standards dedicated to the offshore industry and approximately 30 standards for ships, most of which are applicable to mobile offshore installations.

ITU: is the leading United Nations agency for information and communication technology standards, and its membership include 191 Member States.

Regional Standards

CEN (The European Committee for Standardisation): CEN's mission is to promote voluntary technical harmonization of standards in Europe in conjunction with worldwide bodies and its partners in Europe. CEN is set up along a similar pattern to ISO. In 1991, ISO and CEN concluded the 'Vienna Agreement' that provides for technical cooperation, and the transfer of work from CEN to ISO and vice versa with parallel voting in both organisations.

CEN TC12 is the CEN committee corresponding to ISO TC67. CEN TC12 is named: "Materials, equipment and offshore structures for petroleum and natural gas industries" The committee has so far published 110 EN ISO standards, all adopted from ISO TC67. TC 12 currently has 68 ongoing work items.

CENELEC: Similarly to IEC, CENELEC works with European standardisation within the electrotechnical area.

Interstate standards (GOST)

State Committee for Standardization, Metrology and Certification (last name) – Gosstandart of the USSR - used to be the national standard body in the USSR. It was responsible for development, approval, introduction and use of state standards – GOST – at the whole territory of the Soviet Union.

After the collapse of the Soviet Union, the Interstate Council for Standardization, Metrology and Certification (ISC) of the Commonwealth of Independent States (CIS) was founded. The Council was established on 13 March 1992 in accordance with the “Agreement on realization of coherent policy in the field of standardization, metrology and certification” (hereinafter – the Agreement) to coordinate the works in the field of standardization, metrology and certification and to define the main directions of the interstate standardization, metrology, certification and accreditation in various fields of activities.

All state standards approved by Gosstandart of the USSR before acquired the status of “interstate standards”.

The ISC high-level body is the Interstate Council members meeting, which holds twice a year in the state - participants of the Agreement in turn.

The Interstate Council working body is the Bureau for standards consisting of experts group and the Regional Information Centre.

More than 230 interstate technical committees for standardization (ITC) were created under the Council. These committees are drawing up interstate standards (which have the status of regional standards) – GOST.

ITC 523 “Technique and technology of oil and gas production and processing” is one of such technical committees. It is an analogue of the Russian technical committee for standardization – TC 23.

If the state-participant of the Agreement votes for adopting the interstate standard, it acquires the status of a national standard of this state as well.

The Interstate Council is recognized by the International Organization for Standardization (ISO) as the Regional Organization for standardization as the Euro Asian Council for Standardization, Metrology and Certification (EASC) (ISO Council Resolution of 26/1996).

National Standards

GOST R, ANSI, BSI, DIN, AFNOR, NS are all examples of national standards. Each country has its own national standardisation body. In Europe there is a drive for harmonisation of national standardisation through CEN. The same applies to the CIS countries through EASC. Whenever CEN issues a new standard, this will be binding among all member countries and the new CEN standard shall be adopted by the countries as EN-standards and possible existing national standards within the same area shall be withdrawn within six months. Such standard will for example be NS EN ISO in Norway. The technical provisions of the standards remain normally unchanged (denoted IDT), but national forewords may be added and sometimes modifications (denoted MOD) are added to the adopted standard.

Industry and Association Standards

A wide range of organisations and institutions produce standards and guidelines for the petroleum industry. Examples of such bodies are:

- API (American Petroleum Institute)
- ASTM (American Society for Testing Materials)
- NORSOK (Norwegian offshore petroleum industry standards)
- Energy Institute UK (former IP, Institute of Petroleum)
- OGP, International Association of Oil & Gas Producers,
- UK Oil & Gas (former UKOOA, UK Offshore Operators Association),
- EEMUA, Engineering Equipment & Materials Users’ Association,
- RS, Russian Maritime Register of Shipping,
- DNV, Det Norske Veritas,
- ABS, American Bureau of Shipping
- LR, Lloyds Register of Shipping,
- IMO, International Maritime Organisation,
- OLF, The Norwegian Offshore Operators Organisation,
- EFC (European Federation of Corrosion),
- FEM (Fédération Européenne de la Manutention),
- IMCA (International Marine Contractors Association),
- OCIMF (Oil Companies International Marine Forum).

4.7.3 Offshore Regulatory regimes in Russia and Norway

Selection and use of standards for offshore application is dependent on and closely linked to the regulatory regime of the relevant coastal state authority. In order to understand the possible role and use of standards in the Barents Sea, the working panel concluded that it was important also to investigate the offshore regulatory schemes in Russia and Norway and how they relate to use of standards. A short overview of the panel’s findings is given in this section.

4.7.3.1 Russian regulatory regime for offshore oil and gas activities

Russian Governmental bodies on regulatory regime for oil and gas activities

There is no single governmental body responsible for the offshore petroleum activity in Russia. Different ministries and regulating bodies are responsible within their areas of expertise.

Which regulatory body should be in the lead for an installation will depends on the type of installation and the aspect to be regulated.
Some important ministries and agencies/inspectorates are presented below.

Ministry: **MINZDRAVSOCRAZVITIYA OF RUSSIA - Ministry of public health and social development of the Russian Federation**
Federal executive body responsible for normative regulation for public health services, social development and labour protection and employment.

Inspectorate: **ROSZDRAVNADZOR - the Federal Inspectorate for Health, and Social Development**
Federal enforcement authority carrying out control and supervision in sphere of public health services and social development.

Ministry: **MINPRIRODY -Ministry for Protection of the Environment and Natural Resources of Russia**
Federal enforcement authority which is carrying out functions on development of a state policy and normative legal regulation in sphere of studying, use, reproduction and protection of natural resources, including mineral resources,The Ministry of Natural Resources has the control of utilisation of subsoil resources and is therefore a very important authority for negotiations of licences, drilling programs and questions related to reserves and geophysics. This ministry also sets the environmental protection policies.

Inspectorate: **ROSTEKNADZOR - The Russian Federal Mining and Industrial Inspectorate**
Federal executive body, which is authorized inspectorate of industrial safety of production facilities. Since all oil and gas facilities in compliance with the Federal Law “On industrial safety” belong to the category of hazardous production facilities, they are regulated by Rostekmadzor.

Inspectorate: **ROSPRIRODNADZOR - The federal inspectorate on supervision in sphere of wildlife management**
Federal enforcement authority carrying out control and supervision in sphere of wildlife management.
Responsible for environmental protection policy, and executes environmental control.

ROSNEDRA – The Federal Russian Agency of Sub-soil Resources
Responsible for regulation of sub-soil licences

Ministry: **MChS Rossii - The ministry of the Russian Federation for civil defense, Emergencies and elimination of consequences of natural disasters (the Ministry of Civil Defense and Emergencies (EMERCOM))**
normative legal regulation, and also on supervision and the control over a civil defense, protection of the population and territories from extreme situations, maintenance of fire safety and safety of people on water objects.

This federal service will assess emergency preparedness plans such as evacuation and rescue plans, oil spill mitigation plans etc.

The emergency situations service will also coordinate from the authorities side any combined efforts in connection with accidents and rescue operations.

Regulates Fire Safety, Oil spill preparedness and mitigation plans
This ministry does not oversee any services or agencies

Ministry: **MINENERGO OF RUSSIA – Ministry of Energy of the Russian Federation**
Federal executive body with functions of making and implementing the governmental policy and fulfilment of normative-legal acts in fuel-energy sector.

Ministry: **MINPROMTORG (Ministry of Industry and Trade of the Russian Federation)**
Federal executive body that develops governmental policy in technical regulation, authorized federal executive body in technical regulation,

carries out organization and control of technical regulation development.

Inspectorate and executive body: **ROSTEKHREGULIROVANIYE - Federal Agency on Technical Regulation and Metrology**
Federal executive body that serves as a national standardization body of the Russian Federation.
The agency also carries out inspection of compliance with technical regulations and represents the Russian Federation to international and regional standards organizations (such as the ISO and IEC) and administering the GOST R certification program for products.

Ministry: **MINTRANS OF RUSSIA – Ministry of Transport of the Russian Federation**
Federal executive body with the functions of governmental policy development and normative legal regulation, including in the area of sea transport (including sea ports).

Executive body: **GOSMORSPASSLUZHBA of Russia**
The leading state system of emergency response. According to performed sea rescue tasks (Merchant Shipping Code of the Russian Federation, Government Decree dd. 30.12.2000 No. 1038) carries out the following functions:

- Coordinates actions of search and rescue services of the marine transport and similar services regulated by other federal executive bodies, cooperates with analogue foreign services during emergency prevention and response works, including during search and rescue of people and ships that are suffering or suffered the shipwreck at sea;
- Organizes and coordinates work of specialized organizations during oil and oil products spills from ships and facilities at sea irrespective of their department and national subordination;
- Carries out general coordination of operations for rescuing people and ships that are suffering shipwreck at sea, response to spills of oil, oil products and other hazardous chemical substances at sea;
- Organizes, coordinates and controls the fulfillment of obligations under international agreements of the Russian Federation, which concern search and rescue of people and ships suffering the shipwreck at sea and response to emergency spills of oil and oil products at sea.

4.7.3.2 Federal laws

The following laws are relevant for activities on the continental shelf. The laws represent the highest level of legal documents, ranking higher than regulations and standards.

- Federal Law 1995 No 187-FZ: "About a Continental Shelf of the Russian Federation
- Federal Law 1998 No 155-FZ: "On Inland Sea Waters, Territorial Sea and Adjacent Zone of the Russian Federation"
- Federal Law 1997 No 116-FZ "On Industrial Safety of Hazardous Production Facilities"
- Federal Law 2002 No 7-FZ, "On Environmental Protection"

The new revision of the Federal Law "On Technical Regulation"

The Federal Law No.184-FZ "On technical regulation" dd. 27.12.2002 is of particular importance with respect to use of standards in Russia. The implementation of the Federal Law "On technical regulation" is a step towards the reforming of the relevant system of technical regulation, which is functioning and developing on the basis of market principles.

The technical regulation system is based on technical regulations setting mandatory requirements to products or processes of engineering (including studies), production, construction, installation, adjustment, operation, storage, transmission, marketing and disposal.

Compliance with technical regulations is provided by fulfillment of requirements of standards that the manufacturer chooses on the voluntary basis. These can be any feasible standards, including Russian national standards, standards of Russian organizations, Regulation codes, international standards, regional standards, regional regulation codes, standards of foreign countries and regulation codes of foreign countries (if foreign documents are registered in Rostekhregulirovaniye). Moreover, cost efficiency of certain standards should not contradict the need for compliance with requirements of technical regulations that are priority in technical regulation area.

Today a number of technical regulations of oil and gas complex are approved, including:

- "On requirements to motor and aircraft gasoline, diesel and marine fuel, jet engine fuel and furnace oil" (Resolution of the Government of the Russian Federation dd. 27 February 2008, No. 118) ;
- "On requirements to fire safety" (Federal Law dd. 22 June 2008, No. 123-FZ);
- "On safety of wheeled vehicles" (Resolution of the Government of the Russian Federation dd. 10 September 2009, No. 720);
- "On safety of machinery and equipment" (Resolution of the Government of the Russian Federation dd. 15 September 2009, No. 753);
- "On safety of lifts" (Resolution of the Government of the Russian Federation dd. 2 October 2009, No. 782);
- "On safety of buildings and constructions" (Federal Law dd. 30 December 2009, No.384-FZ);
- "On safety of low voltage equipment" (Federal Law dd. 27 December 2009, No. 347-FZ).

There are 17 technical regulations under development applicable for offshore oil and gas industry.

4.7.3.3 Russian Standardisation

In 2006 the Government of the Russian Federation approved "The concept of national standardization system development" worked out by the Federal Agency on Technical Regulation and Metrology (Rostekhregulirovaniye). The implementation of the Concept will allow to set uniform objectives and improve standardization methodology and structure of technical committees, ensure gradual establishment of inter-industrial standardization councils in the most important national economy sectors, including the oil and gas industry, introduce short-term standardization program development practice and compare technical regulations and national standards.

A council for technical regulation and standardisation in the oil and gas industry was established on the basis of RSPP (Russian Union of Industrialists and Entrepeneurs), with assistance from Rostekhregulirovaniye .

A Russian standardisation committee for the oil and gas industry is Technical committee TK23, "Technique and technologies of oil and gas producing and refining".

The committee is established by the national body on standardization, Rostekhregulirovaniye, as a form of co-operation between companies, organizations, enforcement authorities, other experts, etc., with the aim of working with standardisation on a voluntary basis in the field of national, regional and international standardization within oil and gas industry.

The committee is divided into 8 sub-committees:

1. Industry wide norms and regulations
2. Crude oil production
3. Natural gas production
4. Gas distribution and consumption
5. Offshore oil and gas production
6. Materials and equipment
7. Oil Pipeline transportation systems
8. Natural gas pipeline transportation systems

A comprehensive program of standardisation has been initiated. The program currently involves development of some 20 Russian standards based on ISO standards, to be issued as GOST-R ISO standards, either as identical or modified standards to reflect specific Russian technology. (Preface will indicate degree of modification).
TC23 is a basic organization for the interstate technical committee (MTK 523) including representatives of Ukraine, Rep. of Kazakhstan, Rep. of Azerbaijan, Rep. of Belorus and Moldova.

4.7.4 Norwegian regulatory regime for offshore oil and gas activities

4.7.4.1 Norwegian regulatory bodies

The Ministry of Labour and Social Inclusion has the coordinating responsibility for health, safety and environment (HSE) in the petroleum industry.

The ministry has delegated the responsibility for coordinating the total supervision of the activities to the Petroleum Safety Authority (PSA). PSA is itself the responsible regulatory authority for safety and working environment, and coordinates the total HSE supervision with assistance from other authorities and inspectorates.

4.7.4.2 Laws and regulations

New Regulations relating to Health, Safety and the Environment in the Petroleum Activities (the framework regulations) were laid down by the King in Council 31 August 2001.

The Petroleum Safety Authority (PSA), the Norwegian Pollution Control Authority and the Norwegian Board of Health issued four supplementary regulations in the field of health, safety and the environment on 3 September 2001. These five regulations entered into force 1 January 2002 and form the regulatory basis for offshore oil and gas activities on the Norwegian Continental Shelf.

The regulations are common to the Ministry of Labour and Social Inclusion, the Ministry of the Environment and the Ministry of Health and Care Services in the field of health, safety and the environment. The aim of introducing a set of common regulations is to secure a regime of regulation and supervision of health, safety and the environment in the petroleum activities that is as coherent and co-ordinated as possible.

The Petroleum Safety Authority, the Norwegian Pollution Control Authority and the Norwegian Board of Health supervise/audit the fulfillment of these regulations in their respective spheres. The Petroleum Safety Authority co-ordinates supervision/auditing of the petroleum activities under these regulations.

The five regulations are:

- **Regulations relating to Health, Safety and the Environment in the Petroleum Activities** (the framework regulations). The Framework Regulations contain provisions on, responsibility, principles relating to risk reduction, application of maritime legislation as an alternative to technical marine requirements in the regulations, principles relating to health, safety and the environment, working hours, periods of stay and off-duty time.
  The regulations emphasize employees' right to contribute to all processes likely to have a bearing on health, safety and the environment in the petroleum activities;

- **Regulations relating to Management in the Petroleum Activities** (the management regulations). The Management Regulations assemble all overarching requirements to management in the field of health, safety and the environment. They contain requirements to risk reduction, management elements, resources and processes, analyses and measuring, follow-up and improvement.

- **Regulations relating to Material and Information in the Petroleum Activities** (the information duty regulations). The Information Duty Regulations set requirements to material and information to be submitted or made available to the authorities. They contain requirements to e.g. applications for consent, alerts, notification and reporting

- **Regulations relating to the Design and Outfitting of Facilities etc. in the Petroleum Activities** (the facilities regulations). The Facilities Regulations regulate the design and outfitting of facilities, such as safety functions and loads, materials, work areas and accommodation areas, physical barriers and emergency preparedness

- **Regulations relating to Conduct of Activities in the Petroleum Activities** (the activities regulations). The Activities Regulations regulate the conduct of various activities and set requirements to e.g. planning, prerequisites for use, the working environment, work arrangements, health-related aspects, the external environment, maintenance and emergency preparedness.

The regulations are largely formulated as functional requirements. The functional requirements impose requirements to the various aspects, characteristics or qualities that the product, process or service in question is intended to have. The particular requirement expresses what result the product, process or service is to produce, what the supervisory authorities wish to achieve with the requirement. No references to standards are given in the regulations.

Each regulation is supported by a guideline. These guidelines contain references to standards and guidelines which are recommended by the authorities to be applied in order to meet the functional requirements.

The PSA Framework Regulations § 18 stipulate how standards are to applied:

> *When the party responsible makes use of a standard recommended in the guidelines to a provision of the regulations, as a means of complying with the requirements of the regulations in the area of health, working environment and safety, the party responsible may as a rule take it that the regulation requirements have been met.*
>
> *When other solutions than those recommended in the guidelines to a provision of the regulations are used, the party responsible shall be able to document that the chosen solution fulfils the requirements of the regulations. Combinations of parts of standards shall be avoided, unless the party responsible is able to document that an equivalent level of health, working environment and safety is achieved.*

The majority of the standards referred to by PSA, are NORSOK standards. As an example the Facility Regulations guidelines list 37 NORSOK references, 16 ISO, 15 DNV, 6 EN (European Standard), 5 IEC (International Electrotechnical Commission), 6 NS (Norsk Standard), 4 IMO (International Maritime Organization) and 2 API.

4.7.4.3 Organisation of the Norwegian Petroleum Sector Standardisation

The standardisation activities in the Petroleum sector are managed by an executive committee, Sector Board Petroleum Industry, with wide industry, regulators and labour union (three-partites) participation. The formal administration is handled by the national Norwegian standards organisation Standards Norway.

Standards Norway is responsible for all standardisation areas except electrotechnology and tele communication. Standards Norway adopts and publishes some 1,500 new Norsk Standard (Norwegian Standards) annually. NS is based on national, European and International standards. Standards Norway is the Norwegian member of CEN and ISO.

Experts from a wide range of Norwegian companies participate heavily in the development of ISO and EN standards. However, Norwegian continental shelf regulatory safety framework and working/climate conditions sometimes lead to amendments to ISO standards. The NORSOK standards are developed by the Norwegian petroleum industry to form this amendment.

The preparation and publication of the NORSOK standards were initially started in 1993 by an initiative from the industry and the Government. NORSOK standards are owned by the Norwegian Oil Industry Association (OLF) and the Federation of Norwegian Industry, and were subsequently transferred to and are now managed and issued by Standards Norway.

Availability of international standards is the main goal, but for some areas NORSOK standards are necessary. NORSOK standards shall be withdrawn when they can be replaced by equivalent international standards.

4.7.5 Principles and methodology for selection of standards by Working Panel RN01

Principles for selection of standards

As a principal basis for selecting standards for the basic list of standards for Barents Sea use, the following priorities were agreed upon:

- Priority1 should be given to international standards, defined as:
  - ISO
  - IEC
  - International Maritime Organizations (IMO)
  - International Labor Organizations (ILO)
- Priority 2: Relevant national and industry standards may be selected for areas where it is found that priority 1 standards do not exist or do not fully cover the identified needs.
- (this includes relevant national standards of Russia and transnational standards accepted as national standards of Russia (GOST, GOST R))

- RN01 shall not perform independent work within the area covered by other working panels, but adopt the results and recommendations from these groups into their conclusions.

Areas covered

In order to enable a structured discussion of which relevant standards to be nominated, the panel first agreed on the technical areas that should be covered by a basic standardization list. The following 26 areas were selected:

1. Arctic technology (incl. Ice management, ice loading) - (RN02)
2. Civil and structural engineering
3. Completion (mechanical completion and commissioning)
4. Drilling and well
5. Electrical
6. Emissions and discharges to air and water (RN07)
7. Environmental conditions, loads and load effects
8. Evacuation and rescue of people (RN04)
9. Geotechnology & foundations
10. Instrumentation and automation
11. Life cycle information (LCI)
12. Lifting appliances
13. Materials technology
14. Mechanical (mechanical static and rotating, HVAC, piping engineering, valves and layout)
15. Operation and maintenance (incl regularity & criticality)
16. Pipeline technology
17. Platform technology
18. Process technology, incl. cold climate protection of process plants and flow assurance / fiscal measurement
19. Riser technology
20. Risk management of major hazards (e.g. fires, explosions, blow-outs) (RN03)
21. Safety, Health and Environment (SHE)
22. Ship transportation (RN06)
23. Station keeping (mooring)
24. Subsea technology
25. Telecommunication
26. Working environment and safety related to human factors (RN05)

4.7.6 Baseline standards Selected

130 standards were selected for the baseline list. These were unanimously agreed to represent best available engineering practice as a basis for execution of projects and operation in the Barents Sea,
It is assumed that the list will provide useful input to relevant regulatory and standardisation bodies in Russia as well as Norway.

Furthermore, it is assumed that the list will provide useful input to TK23's plan for new GOST R standards and for use of standards by operators in development of oil and gas fields in the Barents Sea. The list of standards with descriptions of the individual standards is enclosed as annex1 to the report.
The standards were selected from 21 different standardisation bodies, and were distributed as follows:

- ISO (International Standardisation Organisation): 65 standards
- IEC (International Electrotechnical Committee): 14 standards
- NORSOK (Norwegian oil and gasindustry standards): 13 standards
- IMO (International Maritime Organisation – UN): 6 conventions
- DNV (Det norkse Veritas): 6 rules and standards
- RS (Russian Maritime Register of Shipping): 5 rules and guidelines
- GOST (Gosudarstvennyy Standart – Russia): 4 standards
- EN (Euronorm): 3standards
- World Bank: 2 guidelines
- ILO (International Labour Organisation – UN): 1 regulation
- IACS (International Association of Classification Socities): 1 rule doc.
- PSA (Norwegian Petroleun Safety Authority): 1 guideline
- EEMUA (Engineering Equipment & Materials Users' Association-UK): 1 guideline
- OGP (International Association of Oil and Gas Producers): 1 report
- OCIMF (Oil Companies International Marine Forum): 1 guideline
- ISGOTT (International Safety Guide for Oil Tankers and Terminals: 1 guideline
- CAA (Civil Aviation Authority): 1 guideline
- API (American Petroleum Institute):1 standard
- NFPA (National Fire Protection Agency): 1 standard
- Class Rules for floating units: General reference to IACS member Class Societies' rules for Mobile Offshore Units and floating offshore installations: 6 references

4.7.7 Assessment of standards for Barents Sea Suitability

Methodology
Work panel RN01's scope and allocated time did not allow for an in-depth scrutiny of all nominated standards for Barents Sea suitability. However, in order to carry out a coarse screening of the standards, the panel selected a set of conditions which could be applied for a uniform simplified check of the standards for suitability for Barents Sea application.

The conditions were:

- Low temperature
- Ice loading
- Darkness
- Remoteness
- Vulnerable environment

The standards not covered by other groups were examined against these conditions as follows:

- Condition is relevant and has been has been addressed
- Condition is relevant, but is not addressed
- Condition is not relevant for the scope of the standard

Based on this evaluation the standards were indicated in the following categories:

A: Standard can be used for Barents Sea
B: Standard needs special consideration/ amendment for Barents Sea use

Due to lack of Russian translations, the assessment was carried out by the Norwegian participants of the working panel.

Findings
Based on the simplified assessment criteria described above the following conclusions could be made:

- 64 standards can be applied "as is" for Barents Sea
- 66 standards can be applied provided special considerations are made for low temperatures and/or ice loadings

4.7.8 Standards selected and suitability considerations

1. Arctic Technology (incl. ice management, ice loading) - (Scope of Group RN02)

Standard	Title	Barents Sea Suitability	Comments
ISO 19906	Petroleum and Natural Gas Industries – Arctic Offshore Structures	A	- Further amendments proposed by RN02

2. Civil and Structural Engineering

Standard	Title	Barents Sea Suitability	Comments
NORSOK C-001	Living quarters area	B	Air condition, ventilation, heating needs additional low temp. consideration. Dimensions due to special arctic clothing and tools
NORSOK C-002	Architectural components and equipment	B	Dimensions need special consideration due to special arctic clothing and tools

4. Drilling and Well

Standard	Title	Barents Sea Suitability	Comments
ISO 10423	Drilling and production equipment -- Wellhead and christmas tree equipment	A	
ISO 10432	Downhole equipment -- Subsurface safety valve equipment	A	
ISO 11960	Steel pipes for use as casing or tubing for wells	A	
ISO 13535	Drilling and Production Equipment - Hoisting Equipment	B	Needs additional low temp. consideration
ISO 14693	Drilling and well servicing equipment	B	Needs additional low temp. consideration

5. Electrical

Standard	Title	Barents Sea Suitability	Comments
IEC 60085	Electrical insulation - Thermal evaluation and designation	A	
IEC 60034	Rotating electrical Machines	A	Needs additional low temp. consideration Russian version = ГОСТ Р МЭК 60092
IEC 60364	Low-voltage electrical installations (relevant parts)	B	Needs additional low temp. consideration
IEC 60529	Degrees of protection provided by enclosures (IP Code)	A	
IEC 61000	Electromagnetic compatibility (EMC)	A	
IEC 61892	Fixed and mobile offshore units – Electrical Installations	B	Needs additional low temp. consideration
IEC 61936	Power installations exceeding 1 kV a.c.	B	Needs additional low temp. consideration

6. Emissions and Discharges to Air and Water (RN07)

Standard	Title	Barents Sea Suitability	Comments
ISO 14001	Environmental Management Systems	A	Ref.RN07
International Finance Corporation / World bank Group	Environmental, Health, and Safety Guidelines: Offshore Oil and Gas Development	B	Ref.RN07
International Finance Corporation / World bank Group	Environmental, Health, and Safety Guidelines: Ambient Air Quality (2007)	B	Ref.RN07
IMO	MARPOL 73/78 Annexes with amendments	B	Ref.RN07
IMO	Ballast Water Convention	B	Ref.RN07
IMO	Antifouling Convention	B	Ref.RN07
NORSOK S-003	Environmental Care	B	Ref.RN07

7. Environmental Conditions, Loads and Load Effects

Standard	Title	Barents Sea Suitability	Comments
ISO 19900	Petroleum and natural gas industries – General requirements for offshore structures	B	- To be used together with ISO 19906 for arctic application
ISO 19901-1	Petroleum and natural gas industries – Specific requirements for offshore structures – Part 1: Metocean design and operating considerations	B	- To be used together with ISO 19906 for arctic application
ISO 19901-2	Petroleum and natural gas industries – Specific requirements for offshore structures – Part 2: Seismic design procedures and criteria	A	
NORSOK N-002	"Collection of metocean data"	A	
CLASS RULES	Relevant Classification rules for floating offshore units	A	Cat. A, provided including Polar Class notations

8. Evacuation and rescue of people (RN04)

Standard	Title	Barents Sea Suitability	Comments
ISO 15544	Offshore production installations – Requirements and guidelines for emergency response	B	Ref. RN04 report

9. Geotechnology & Foundations

Standard	Title	Barents Sea Suitability	Comments
ISO 19901-4	Petroleum and Natural Gas Industries – Specific Requirements for Offshore Structures – Part 4: Geotechnical and Foundation Design Considerations.	B	Ice needs additional consideration
ISO 19901-8	Marine soil investigations	A	

10. Instrumentation and automation

Standard	Title	Barents Sea Suitability	Comments
IEC 61508	Functional safety of electrical/electronic/ programmable electronic safety-related systems	A	
IEC 61511	Functional safety – Safety instrumented systems for the process industry sector	A	
ISO 11064	Ergonomic design of control centres	A	
EEMUA 191	Alarm Systems – A Guide to Design, Management and Procurement	A	
PSA YA-711	Principles for alarm system design	A	
NORSOK I-002	Safety and automation systems (SAS)	A	
NORSOK I-005	Systems Control Diagrams	A	
CLASS RULES	Relevant Classification rules for floating offshore units	A	Cat. A, provided including Polar Class notations

11. Life Cycle Information (LCI)

Standard	Title	Barents Sea Suitability	Comments
ISO/TR 13881	Classification and conformity assessment of products, processes and services	A	
ISO/TS 29001	Sector-specific quality management systems – Requirements for product and service supply organizations	A	
ISO 14040	Environmental management -- Life cycle assessment -- Principles and framework	A	
NORSOK Z-001	Documentation for Operation	A	

12. Lifting Appliances

Standard	Title	Barents Sea Suitability	Comments
EN 13852-1	General-purpose offshore cranes	B	Needs additional low temperature considerations
ILO 152	Cargo Gear Safety and Health in Dock Work	B	Needs additional low temperature considerations

13. Materials technology

Standard	Title	Barents Sea Suitability	Comments
ISO DIS 21457	Materials selection and corrosion control for oil and gas production systems	B	Needs additional low temperature considerations
ISO 15156:	Materials for use in H2S-containing environments in oil and gas production	A	
ISO 23936-1	Non-metallic materials in contact with media related to oil and gas production - Thermoplastics	A	
EN 1090-3	Execution of steel structures and aluminium structures – Part 3: Technical requirements for aluminium structures	B	Needs additional low temperature considerations
NORSOK M-101	Structural steel fabrication (referred to from ISO 19902)	B	Needs additional low temperature considerations
CLASS RULES	Relevant Classification rules for floating offshore units	A	Cat. A, provided including Polar Class notations

14. Mechanical (Mechanical static and rotating, HVAC, piping engineering, etc.)

Standard	Title	Barents Sea Suitability	Comments
ISO 3977	Gas Turbines – procurement	B	Needs additional low temperature considerations
ISO 10437	Petroleum, petrochemical and natural gas industries – Steam turbines – Special-purpose applications	B	Needs additional low temperature considerations
ISO 10439	Petroleum, chemical and gas service industries – Centrifugal compressors	B	Needs additional low temperature considerations
ISO 10440	Petroleum, petrochemical and natural gas industries – Rotary-type positive-displacement compressors	B	Needs additional low temperature considerations
ISO 10442	Petroleum, chemical and gas service industries – Packaged, integrally geared centrifugal air compressors	B	Needs additional low temperature considerations
ISO 13631	Petroleum and natural gas industries – Packaged reciprocating gas compressors	B	Needs additional low temperature considerations
ISO 13703	Design and installation of piping systems on offshore production platforms	B	Needs additional low temperature considerations
ISO 13707	Petroleum and natural gas industries – Reciprocating compressors	B	Needs additional low temperature considerations
ISO 13709	Centrifugal Pumps	B	Needs additional low temperature considerations
ISO 13710	Reciprocating positive displacement pumps	B	Needs additional low temperature considerations
ISO 14692	Petroleum and natural gas industries -- Glass-reinforced plastics (GRP) piping	B	Needs additional low temperature considerations
ISO 15138	Petroleum and natural gas industries – Offshore production installations – Heating, ventilation and air-conditioning	B	Needs additional low temperature considerations
ISO 15547	Petroleum, petrochemical and natural gas industries -- Plate-type heat exchangers	B	Needs additional low temperature considerations
ISO 15649	Piping	B	Needs additional low temperature considerations
ISO 16812	Petroleum, petrochemical and natural gas industries -- Shell-and-tube heat exchangers	B	Needs additional low temperature considerations
API 616	Gas turbines for refinery services	B	Needs additional low temperature considerations

Standard	Title	Barents Sea Suitability	Comments
EN 13445	Unfired pressure vesssels	B	Needs additional low temperature considerations
NFPA 20	Standard for the installation of stationary pumps for fire protection	B	Needs additional low temperature considerations
CLASS RULES	Relevant Classification rules/standards for floating offshore units	A	Cat. A, provided including Polar Class notations

15. Operation and maintenance (incl Regularity & Criticality)

Standard	Title	Barents Sea Suitability	Comments
ISO 14224	Collection and exchange of reliability and maintenance data	A	
ISO 19901-6 (FDIS)	Specific requirements for offshore structures – Part 6: Marine operations	A	
ISO 20815	Petroleum, petrochemical and natural gas industries – Production assurance and reliability management	A	

16. Pipeline Technology

Standard	Title	Barents Sea Suitability	Comments
ISO 13623	Petroleum and natural gas industries – Pipeline transportation systems	A	
ISO 21809	External coatings for buried or submerged pipelines used in pipeline transportation systems	A	
DNV OS-F101	Submarine Pipeline System	A	
Russian Maritime Register of Shipping (RS)	Rules for the Classification and Construction of Subsea Pipelines	A	
Russian Maritime Register of Shipping (RS)	Guidelines on Technical Supervision during Construction and Operation of Subsea Pipelines	A	

17. Platform Technology

Standard	Title	Barents Sea Suitability	Comments
ISO 19901-3 (DIS)	Petroleum and natural gas industries -- Specific requirements for offshore structures -- Part 3: Topsides structure	B	- To be used together with ISO 19906 for arctic application
ISO 19902	Petroleum and natural gas industries — Fixed steel offshore structures	B	- To be used together with ISO 19906 for arctic application
ISO 19903,	Petroleum and natural gas industries — Fixed concrete offshore structures	B	- To be used together with ISO 19906 for arctic application
ISO 19904-1,	Petroleum and natural gas industries — Floating offshore structures – Part 1: Monohulls, semi-submersibles and spars	B	- To be used together with ISO 19906 for arctic application
ISO 19905-1 (DIS)	Petroleum and natural gas industries -- Site-specific assessment of mobile offshore units -- Part 1: Jack-ups	B	- To be used together with ISO 19906 for arctic application
CAA CAP 437	Offshore Helicopter Landing Areas - Guidance on Standards	A	
Russian Maritime Register of Shipping (RS)	Rules for the Classification, Construction and Equipment of Floating Offshore Oil-and-Gas Production Units	A	Cat. A, provided including Polar Class notations
Russian Maritime Register of Shipping (RS)	Rules for The Classification, Construction and Equipment of Mobile Offshore Drilling Units and Fixed Offshore Platforms, 2008	A	Cat. A, provided including Polar Class notations
Russian Maritime Register of Shipping (RS)	Guidelines on Technical Supervision of Mobile Offshore Drilling Units and Fixed Offshore Platforms in Service, 2004	A	
DNV	Rules for Classification of Offshore Drilling and Support Units	A	Cat. A, provided including Polar Class notations
DNV	Rules for Classification of Floating Production, Storage and Loading Units	A	Cat. A, provided including Polar Class notations

18. Process Technology, incl. cold climate protection of process plants and flow assurance / fiscal measurement

Standard	Title	Barents Sea Suitability	Comments
ISO 4126	Safety devices for protection against excessive pressure	B	Needs additional low temperature and icing considerations
ISO 10418	Basic surface process safety systems	A	
ISO 23251	Pressure relieving and depressurizing systems	B	Needs additional low temperature and icing considerations
ISO 25457	Petroleum, petrochemical and natural gas industries -- Flare details for general refinery and petrochemical service	B	Needs additional low temperature and icing considerations

19. Riser technology

Standard	Title	Barents Sea Suitability	Comments
ISO 13628-2 (API 17J),	Design and operation of subsea production systems -- Part 2: Unbonded flexible pipe systems for subsea and marine applications	A	
ISO/NP13628-12 (DNV OS-F201)	Design and operation of subsea production systems -- Part 12: Dynamic production risers	B	Needs additional low temperature and ice load considerations

20. Risk Management of major Hazards (e.g. fires, explosions, blow-outs) – RN03

Standard	Title	Barents Sea Suitability	Comments
ISO 13702:	Control and mitigation of fires and explosions on offshore production installations – Requirements and guidelines	B	Ref. RN03 report
ISO 17776	Offshore production installations – Guidelines on tools and techniques for identification and assessment of hazards.	B	Ref. RN03 report
ISO 31000	Risk management -- Principles and guidelines	A	Ref. RN03 report
IEC 60079	Explosive atmospheres	B	Ref. RN03 report
IEC 61508	Functional safety of electrical/electronic/ programmable electronic safety-related systems	A	Ref. RN03 report
IEC 61892-7	Mobile and fixed offshore units - Electrical installations - Part 7: Hazardous areas	B	Ref. RN03 report
ISO/IEC 80079 (CD)	Explosive atmospheres -- Part 34: Application of quality systems for electrical and non-electrical equipment	B	Ref. RN03 report
NORSOK D010	Well integrity in drilling and well operations	B	Ref. RN03 report
NORSOK S-001	Technical Safety (for review by Russian delegates)	B	Ref. RN03 report
NORSOK Z-013	Risk and emergency preparedness analysis	B	Ref. RN03 report

21. Safety, Health and Environment (SHE)

Standard	Title	Barents Sea Suitability	Comments
IMO MODU CODE	Code for the construction and equipment of mobile offshore drilling units	B	Needs additional consideration on life saving appliances
DNV-OS-A101	Safety Principles and Arrangement	A	
CLASS RULES	Relevant Classification rules/standards for floating offshore units	A	Cat. A, provided including Polar Class notations

22. Ship Transportation – (RN06)

Standard	Title	Barents Sea Suitability	Comments
IMO	International Code of Safety for Ships in Polar Waters (Polar Code) (IMO doc. DE41/10)	B	Ref. RN06 report
IMO	IMO guidelines for ships operating in Arctic Ice Covered waters (MEPC/Circ.1056)	B	Ref. RN06 report
IACS	International Association of Classification Societies (IACS): Requirements concerning Polar Class	A	Ref. RN06 report
DNV	DNV: Rules for classification of ships, Part 5, Chapter 1: Ships for navigation in ice	A	Ref. RN06 report
DNV	DNV Seaskill no.3.312: Competence of Officers for Navigation in Ice	B	Ref. RN06 report
ISGOTT	International Oil Tanker and Terminal Safety Guide	A	Ref. RN06 report
OCIMF	Oil Companies International Maritime Forum Publications	B	Ref. RN06 report

23. Station keeping (mooring)

Standard	Title	Barents Sea Suitability	Comments
ISO 19901-7	Petroleum and natural gas industries -- Specific requirements for offshore structures -- Part 7: Stationkeeping systems for floating offshore structures and mobile offshore units	B	- To be used together with ISO 19906 for arctic application
CLASS RULES	Relevant Classification rules/standards for floating offshore units	A	Cat. A, provided including Polar Class notations

24. Subsea Technology

Standard	Title	Barents Sea Suitability	Comments
ISO 13628 -1	Design and operation of subsea production systems -- Part 1: General requirements and recommendations	A	
ISO 13628 -4	Design and operation of subsea production systems -- Part 4: Subsea wellhead and tree equipment	A	
ISO 13628 -5	Design and operation of subsea production systems -- Part 5: Subsea umbilicals	A	
ISO 13628 -6	Design and operation of subsea production systems -- Part 6: Subsea production control systems	A	
ISO 13628 -7	Design and operation of subsea production systems -- Part 7: Completion/workover riser systems	A	
ISO 13628 -8	Design and operation of subsea production systems -- Part 8: Remotely Operated Vehicle (ROV) interfaces on subsea production systems	A	
ISO 13628 -9	Design and operation of subsea production systems -- Part 9: Remotely Operated Tool (ROT) intervention system	A	
ISO 13628 -10	Design and operation of subsea production systems -- Part 10: Specification for bonded flexible pipe	A	
ISO 13628 -11	Design and operation of subsea production systems -- Part 11: Flexible pipe systems for subsea and marine applications	A	
ISO (DIS) 13628-15	Petroleum, petrochemical and natural gas industries — Design and operation of subsea production systems — Part 15: Subsea structures and manifolds	B	Iceberg considerations

25. Telecommunication

Standard	Title	Barents Sea Suitability	Comments
NORSOK T-001	Telecom systems (for further study)	A	
GOST P 50829-95	GOST P 50829-95 Safety of radio stations, the radio-electronic equipment with transmit/receive equipment and its constituent parts. General requirements and test methods	A	
GOST P 52454-2005	GOST P 52454-2005 Global navigating satellite system and global system of positioning. Personal receiver. Technical requirements	A	
GOST P 52455-2005	GOST P 52455-2005 Global navigating satellite system and global system of positioning. Marine receiver for common use. Technical requirements	A	
GOST P 52866-2007	GOST P 52866-2007 Global navigating satellite system - Station control-adjusting local civil purpose. Technical requirements	A	
ISO/IEC 18044	Information technology. Methods and supporting means of a safety. Management of incidents of information safety.	A	

26. Working Environment and safety related to Human factors (input from RN05)

Standard	Title	Barents Sea Suitability	Comments
NORSOK S-002	Working Environment	B	Ref. RN05 report
OGP	Health Aspects of Work in Extreme Climates (Report 398, Dec 2008)	A	Ref. RN05 report

4.7.9 Further Studies

During the work RN01 identified the following tasks for further study which could not be implemented in the current scope of phase III of the Barents 2020 project:

1. Comparison of the Barents 2020 basic list of standards with the new emerging Russian Technical Regulations (providing mandatory minimum requirements on targets of technical regulation).
   - Identify relevant Russian regulations/ standards
   - Identify differences
   - Issue recommendations
2. Study supporting documents and standards referred to by the B2020 basic list of standards
   - Agree on suitability of these reference documents for BS application
3. Carry out further detail study of Barents 2020 suitability of standards on the basic list of standards

5. Recommended use of the Project Report

Guidance for operators, contractors and manufacturers

This report is intended to be used as guidance for operators, contractors and manufacturers in Norway, Russia and internationally for projects related to petroleum exploration, production and transportation in the Barents Sea. The recommendations are worked out by Russian – Norwegian groups of experts and represent their common and agreed expert opinions. The recommendations are based on best available industry practice for offshore operations, including proposed amendments for Barents Sea conditions. The recommendations may be proposed as Project Specific Technical Specifications (PSTS) in projects both in Norwegian and Russian waters. However, there is no guarantee that regulatory bodies will accept or approve the recommendations.

Guidance to Regulatory Organisations

This report will be sent for information to all relevant regulatory bodies and authorities in Norway and Russia, who is involved in review and approval of projects for oil and gas development in the Barents Sea.

It is assumed that the report will provide useful information for authorities regarding best available industry practice on the reported topics.

Information to national and international standardisation organisations

The report will be sent to standardisation organisations and committees for their consideration and input for possible future updating of industry standards.

6. Distribution of the Report

This is the final Report, which will be sent to

- Barents 2020 partners and sponsors
- National Authorities in Russia
- National Authorities in Norway
- Standardisation organisations and committees in Norway
- Standardisation organisations and committees in Russia
- International Organisations (e.g. IMO, ILO etc.)

Final lists of recipients of the final report will be agreed with Rostekregulirovanie and Rosteknadzor in Russia and Standard Norge and the Petroleum Safety Authority in Norway.

This final report is expected to be sent out after approval by the Project Steering Committee in March 2010.

Appendix 1

LIST OF RECOMMENDED STANDARDS

Technical areas covered:

1. Arctic technology (incl. Ice management, ice loading) (RN02)
2. Civil and structural engineering
3. Completion (mechanical completion and commissioning)
4. Drilling and well
5. Electrical
6. Emissions and discharges to air and water (RN07)
7. Environmental conditions, loads and load effects
8. Evacuation and rescue of people (RN04)
9. Geotechnology & foundations
10. Instrumentation and automation
11. Life cycle information (lci)
12. Lifting appliances
13. Materials technology
14. Mechanical (mechanical static and rotating, hvac, piping engineering, valves and layout)
15. Operation and maintenance (incl regularity & criticality)
16. Pipeline technology
17. Platform technology
18. Process technology, incl. Cold climate protection of process plants and flow assurance / fiscal measurement
19. Riser technology
20. Risk management of major hazards (e.G. Fires, explosions, blow-outs) (RN03)
21. Safety, health and environment (she)
22. Ship transportation (RN06)
23. Station keeping (mooring)
24. Subsea technology
25. Telecommunication
26. Working environment and safety related to human factors (RN05)

Colour Coding:

Standard needs special consideration/amendment for Barents Sea use

Standard can be used for Barents Sea

STANDARD No	TITLE	DESCRIPTION	RESPONSIBLE COMMITTEE
TECHNICAL AREA: 1. Arctic Technology (incl. Ice management, ice loading) - (Scope of Group RNO2)			
ISO (DIS) 19906* *) On TC23 GOST-ISO development program	Petroleum and Natural Gas Industries – Arctic Offshore Structures (this standard is also applicable for other technical areas)	Specifies requirements and provides guidance for the design, construction, transportation, installation, and decommissioning of offshore structures, related to the activities of the petroleum and natural gas industries, in arctic and cold regions environments. Objective to ensure that arctic and cold regions offshore structures provide an appropriate level of reliability with respect to personal safety, environmental protection and asset value to the owner, to the industry and to society in general. ISO 19906 does not contain specific requirements for the operation, maintenance, servicelife inspection or repair of arctic offshore structures. Does not apply specifically to mobile offshore drilling units (see ISO 19905-1), the procedures relating to ice actions and ice management contained herein may be applicable to the assessment of such units. Mechanical, process and electrical equipment and any specialized process equipment associated with arctic or offshore operations are not covered except insofar as the structure needs to sustain safely the loads imposed by the installation, housing, and operation of such equipment. ***Notes:*** *Nominated by RNO2, RNO4*	ISO/TC67/SC7
TECHNICAL AREA: 2. Civil and Structural Engineering			
NORSOK C-001	Living quarters area	Defines the requirements for the architectural design and engineering of the LQ area on offshore installations in the petroleum industry. Primarily applicable to fixed installations, but may also be used for mobile installations.	SN-PET
NORSOK C-002	Architectural components and equipment	Defines the minimum functional requirements for design and construction of architectural components and equipment to be installed and used on offshore installations in the petroleum industry. Primarily applicable to fixed installations, but may also be used for mobile installations.	SN-PET
TECHNICAL AREA: 3. Completion (Mechanical Completion and commissioning)			
		No standards nominated	
TECHNICAL AREA: 4. Drilling and Well			
ISO 10423	Drilling and production equipment -- Wellhead and Christmas tree equipment	ISO 10423:2003 specifies requirements and gives recommendations for the performance, dimensional and functional interchangeability, design, materials, testing, inspection, welding, marking, handling, storing, shipment, purchasing, repair and remanufacture of wellhead and christmas tree equipment for use in the petroleum and natural gas industries.	ISO/TC67/SC4

		ISO 10423:2003 does not apply to field use, field testing or field repair of wellhead and christmas tree equipmeISO 10423:2003 is applicable to wellhead equipment (casing head housings, casing head spools, tubing head spools, cross-over spools, multi-stage head housings and spools), connectors and fittings (cross-over connectors, tubing head adapters, top connectors, tees and crosses, fluid-sampling devices, adapter and spacer spools), casing and tubing hangers (mandrel hangers, slip hangers), valves and chokes (single valves, multiple valves, actuated valves, valves prepared for actuators, check valves, chokes, surface and underwater safety valves and actuators, back-pressure valves), loose connectors [flanged, threaded, other end connectors (oec), and welded] (weld neck connectors, blind connectors, threaded connectors, adapter and spacer connectors, bullplugs, valve-removal plugs), other equipment (actuators, hubs, pressure boundary penetrations, ring gaskets, running and testing tools, wear bushings). ISO 10423:2003 defines service conditions, in terms of pressure, temperature and material class for the well-bore constituents, and operating conditions. ISO 10423:2003 establishes requirements for five product specification levels (PSL). These five PSL designations define different levels of technical quality requirements ***Notes:*** *On TC23 GOST-R ISO development program.*	
ISO 10432	Downhole equipment -- Subsurface safety valve equipment	ISO 10432:2004 provides the minimum acceptable requirements for subsurface safety valves (SSSVs). It covers subsurface safety valves including all components that establish tolerances and/or clearances which may affect performance or interchangeability of the SSSVs. It includes repair operations and the interface connections to the flow control or other equipment, but does not cover the connections to the well conduit. Redress activities are beyond the scope of ISO 10432:2004	ISO/TC67/SC4
ISO 11960	Steel pipes for use as casing or tubing for wells	ISO 11960:2004 specifies the technical delivery conditions for steel pipes (casing, tubing, plain end casing liners and pup joints), coupling stock and accessories and establishes requirements for three Product Specification Levels (PSL-1, PSL-2, PSL-3). The requirements for PSL-1 are the basis of ISO 11960:2004. The requirements that define different levels of standard technical requirements for PSL-2 and PSL-3, for all Grades except H-40 and L-80 9Cr, are contained in Annex H. ISO 11960:2004 is applicable to the following connections in accordance with API Spec 5B: -- short round thread casing (STC); - long round thread casing (LC); -- buttress thread casing (BC); -- extreme-line casing (XC); -- non-upset tubing (NU); -- external upset tubing (EU); -- integral joint tubing (IJ). For such connections, ISO 11960:2004 specifies the technical delivery conditions for couplings and thread protection. Supplementary requirements that may optionally be agreed for enhanced leak resistance connections are given in Annex A.11 (SR22). ISO 11960:2004 can also be applied to tubulars with connections not covered by ISO/API standards. For pipes covered by ISO 11960:2004, the sizes, masses and wall thicknesses as well as grades and applicable end finishes are given. By agreement between the purchaser and manufacturer, ISO 11960:2004 can also be applied to other plain end pipe sizes and wall thicknesses. The four groups of products to which ISO 11960:2004 is applicable include the following grades of pipe: -- Group 1: All casing and tubing in Grades H, J, K and N; -- Group 2: All casing and tubing in Grades C, L, M and T; -- Group 3: All casing and tubing in Grade P; -- Group 4: All casing in Grade Q. Casing sizes larger than Label 1: 4-1/2 but smaller than Label 1: 10-3/4 may be specified by the purchaser to be used in tubing service. Supplementary requirements that may optionally be agreed between purchaser and manufacturer for non-destructive examination, coupling blanks, upset casing, electric-welded casing, impact testing, seal ring couplings and certificates are given in Annex A. ISO 11960:2004 is not applicable to threading requirements.	ISO/TC67/SC5

STANDARD No	TITLE	DESCRIPTION	RESPONSIBLE COMMITTEE
ISO 13535	Drilling and Production Equipment - Hoisting Equipment	***Notes:*** On TC23 GOST-R ISO development program	ISO/TC67/SC4
ISO 14693	Drilling and well servicing equipment	ISO 14693:2003 provides general principles and specifies requirements for design, manufacture and testing of new drilling and well-servicing equipment and of replacement primary load-carrying components manufactured subsequent to the publication of ISO 14693:2003. ISO 14693:2003 is applicable to the following equipment: -- rotary tables; -- rotary bushings; -- rotary slips; -- rotary hoses; -- piston mud-pump components; -- drawworks components; -- spiders not capable of use as elevators; -- manual tongs; -- safety clamps not used as hoisting devices; -- power tongs, including spinning wrenches. Annex A gives a number of standardized supplementary requirements which apply only when specified.	ISO/TC67/SC4
TECHNICAL AREA: 5. Electrical			
IEC 60085	Electrical insulation - Thermal evaluation and designation	IEC 60085:2007 now distinguishes between thermal classes for electrical insulation systems and electrical insulating materials. It establishes the criteria for evaluating the thermal endurance of either electrical insulating materials (EIM) or electrical insulation systems (EIS). It also establishes the procedure for assigning thermal classes. This standard is applicable where the thermal factor is the dominant ageing factor. The major technical changes with regard to the previous edition concern the fact that this edition is an amalgamation of the third edition of this standard together with IEC 62114:2001. It has the status of a horizontal standard in accordance with IEC Guide 108.	IEC/TC65
IEC 60034	Rotating electrical machines	Applicable to all rotating electrical machines	IEC/TC2
IEC 60092	Electrical installations in ships (relevant parts)	Gives definitions and general requirements common to all apparatus and installations in ships. ***Notes:*** *Russian version = ГОСТ Р МЭК 60092*	IEC/TC18
IEC 60364	Low-voltage electrical installations (relevant parts)	Gives the rules for the design, erection, and verification of electrical installations. The rules are intended to provide for the safety of persons, livestock and property against dangers and damage which may arise in the reasonable use of electrical installations and to provide for the proper functioning of those installations	IEC/TC64
IEC 60529	Degrees of protection provided by enclosures (IP Code)	Applies to the classification of degrees of protection provided by enclosures for electrical equipment with a rated voltage not exceeding 72,5 kV. Has the status of a basic safety publication in accordance with IEC Guide 104.	IEC/TC70

IEC 61000	Electromagnetic compatibility (EMC)	Establishes a methodology for the achievement of functional safety only with regard to electromagnetic phenomena of electrical and electronic systems and installations, as installed and used under operational conditions. This methodology includes the implication it has on equipment used in such systems and installations	IEC/TC77
IEC 61892	Fixed and mobile offshore units – Electrical Installations	Contains provisions for electrical installations in mobile and fixed units used in the offshore petroleum industry for drilling, production, processing and for storage purposes including pipeline, pumping or 'pigging' stations, compressor stations and exposed location single buoy moorings. It applies to all installations, whether permanent, temporary, transportable or hand-held, to a.c. installations up to and including 35 000 V and d.c. installations up to and including 1 500 V. This standard does not apply either to fixed equipment for medical purposes or to the electrical installations of tankers.	IEC/TC18
IEC 61936	Power installations exceeding 1 kV a.c.	Provides, in a convenient form, common rules for the design and the erection of electrical power installations in systems with nominal voltages above 1 kV a.c. and nominal frequency up to and including 60 Hz, so as to provide safety and proper functioning for the use intended. This standard applies to all high voltage installations except as stated otherwise in some cases specified in other parts of IEC 61936.	IEC/TC99
TECHNICAL AREA: 6. Emissions and Discharges to Air and Water (RN07)			
ISO 14001	Environmental Management Systems	ISO 14001 specifies requirements for an environmental management system to enable an organization to develop and implement a policy and objectives which take into account legal requirements and other requirements to which the organization subscribes, and information about significant environmental aspects. It applies to those environmental aspects that the organization identifies as those which it can control and those which it can influence. ***Notes:*** *Nominated by RN07*	ISO/TC207/SC1
International Finance Corporation / World bank Group	Environmental, Health, and Safety Guidelines: Offshore Oil and Gas Development	***Notes:*** *Nominated by RN07*	
International Finance Corporation / World bank Group	Environmental, Health, and Safety Guidelines: Ambient Air Quality (2007)	***Notes:*** *Nominated by RN07*	

STANDARD No	TITLE	DESCRIPTION	RESPONSIBLE COMMITTEE
IMO	MARPOL 73/78 Annexes with amendments	The MARPOL Convention is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 respectively and updated by amendments through the years. Notes: Nominated by RN07	IMO
IMO	Ballast Water Convention	International Convention for the Control and Management of Ships' Ballast Water and Sediments ***Notes:*** *Nominated by RN07*	IMO
IMO	Antifouling Convention	The International Convention on the Control of Harmful Anti-fouling Systems on Ships will prohibit the use of harmful organotins in anti-fouling paints used on ships and will establish a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems. ***Notes:*** *Nominated by RN07*	IMO
NORSOK S-003	Environmental Care	***Notes:*** *Nominated by RN07*	SN/PET
TECHNICAL AREA: 7. Environmental Conditions, Loads and Load Effects			
ISO 19900	Petroleum and natural gas industries – General requirements for offshore structures	ISO 19900:2002 specifies general principles for the design and assessment of structures subjected to known or foreseeable types of actions. These general principles are applicable worldwide to all types of offshore structures including bottom-founded structures as well as floating structures and to all types of materials used including steel, concrete and aluminium. ISO 19900:2002 specifies design principles that are applicable to the successive stages in construction (namely fabrication, transportation and installation), to the use of the structure during its intended life and to its decommissioning. Generally, the principles are also applicable to the assessment or modification of existing structures. Aspects related to quality control are also addressed. ISO 19900:2002 is applicable to the design of complete structures including substructures, topsides structures, vessel hulls, foundations and mooring systems. ***Notes:*** *On TC23 GOST-ISO development program*	ISO/TC67/SC7
ISO 19901-1	Petroleum and natural gas industries – Specific requirements for offshore structures – Part 1: Metocean design and operating considerations	Gives general requirements for the determination and use of meteorological and oceanographic (metocean) conditions for the design, construction and operation of offshore structures of all types used in the petroleum and natural gas industries. The requirements are divided into two broad types: a) those that relate to the determination of environmental conditions in general, together with the metocean parameters that are required to adequately describe them; b) those that relate to the characterization and use of metocean parameters for the design, the construction activities or the operation of offshore structures.	ISO/TC67/SC7

		Metocean parameters are applicable to • the determination of actions and action effects for the design of new structures, • the determination of actions and action effects for the assessment of existing structures, • the site-specific assessment of mobile offshore units, • the determination of limiting environmental conditions, weather windows, actions and action effects for pre-service and post-service situations (i.e. fabrication, transportation and installation or decommissioning and removal of a structure), and the operation of the platform, where appropriate.	
ISO 19901-2	Petroleum and natural gas industries – Specific requirements for offshore structures – Part 2: Seismic design procedures and criteria	ISO 19901-2:2004 contains requirements for defining the seismic design procedures and criteria for offshore structures; guidance on the requirements is included. The requirements are applicable to fixed steel structures and fixed concrete structures. The effects of seismic events on floating structures and partially buoyant structures are also briefly discussed. The site-specific assessment of jack-ups in elevated condition is only covered in ISO 19901-2:2004 to the extent that the requirements are applicable. Only earthquake-induced ground motions are addressed in detail. Other geologically-induced hazards such as liquefaction, slope instability, faults, tsunamis, mud volcanoes and shock waves are mentioned and briefly discussed. The requirements are intended to reduce risks to persons, the environment, and assets to the lowest levels that are reasonably practicable. This intent is achieved by using seismic design procedures which are dependent on the platform's exposure level and the expected intensity of seismic events and a two-level seismic design check in which the structure is designed to the ultimate limit state (ULS) for strength and stiffness and then checked to abnormal environmental events or the accidental limit state (ALS) to ensure that it meets reserve strength and energy dissipation requirements. For high seismic areas and/or high exposure level fixed structures, a site-specific seismic hazard assessment is required; for such cases, the procedures and requirements for a site-specific probabilistic seismic hazard analysis (PSHA) are addressed. However, a thorough explanation of PSHA procedures is not included. Where a simplified design approach is allowed, worldwide offshore maps are included that show the intensity of ground shaking corresponding to a return period of 1 000 years. In such cases, these maps may be used with corresponding scale factors to determine appropriate seismic actions for the design of a structure.	ISO/TC67/SC7
NORSOK N-002	"Collection of metocean data"	This NORSOK standard presents functional requirements and common principles for the collection of metocean data, i.e. meteorological and oceanographic data.	SN/PET
CLASS RULES	Relevant Classification rules for floating offshore units	Rules and standards from class society which has recognized and relevant competence and experience with offshore petroleum activities, and has established rules, standards and procedures for classification of floating offshore units;	Relevant Class Society

STANDARD No	TITLE	DESCRIPTION	RESPONSIBLE COMMITTEE
TECHNICAL AREA: 8. Evacuation and rescue of people (RNO4)			
ISO 15544:	Offshore production installations – Requirements and guidelines for emergency response	***Notes:*** *Nominated by RNO4* *On TC23 GOST-ISO development program*	ISO/TC67/SC6
TECHNICAL AREA: 9. Geotechnology & Foundations			
ISO 19901-4	Petroleum and Natural Gas Industries – Specific Requirements for Offshore Structures – Part 4: Geotechnical and Foundation Design Considerations.	ISO 19901-4:2003 contains requirements and recommendations for those aspects of geoscience and foundation engineering that are applicable to a broad range of offshore structures, rather than to a particular structure type. Such aspects are site characterization, soil and rock characterization, and design and installation of foundations supported by the seabed (shallow foundations) and the identification of hazards. Aspects of soil mechanics and foundation engineering that apply equally to offshore and onshore structures are not addressed. The user of this part of ISO 19901-4:2003 is expected to be familiar with such aspects.	ISO/TC67/SC7
ISO 19901-8	Marine soil investigations	***Notes:*** *(in development)*	ISO/TC67/SC7
TECHNICAL AREA: 10. Instrumentation and automation			
IEC 61508	Functional safety of electrical/ electronic/programmable electronic safety-related systems	Sets out a generic approach for all safety lifecycle activities for systems comprised of electrical and/or electronic and/or programmable electronic components (electrical / electronic / programmable electronic systems (E/E/PESs)) that are used to perform safety functions. This unified approach has been adopted in order that a rational and consistent technical policy be developed for all electrically-based safety-related systems ***Notes:*** *Russian version* = ГОСТ Р МЭК 61508	IEC/TC65
IEC 61511	Functional safety – Safety instrumented systems for the process industry sector	Gives requirements for the specification, design, installation, operation and maintenance of a safety instrumented system, so that it can be confidently entrusted to place and/or maintain the process in a safe state. This standard has been developed as a process sector implementation of IEC 61508. ***Notes:*** Nominated std by Group RNO3	IEC/TC65
ISO 11064	Ergonomic design of control centres	Presents principles and gives requirements and recommendations for displays, controls, and their interaction, in the design of control-centre hardware and software.	ISO/TC159/SC4

EEMUA 191	Alarm Systems – A Guide to Design, Management and Procurement	The Engineering Equipment and Materials Users' Association, more commonly known as EEMUA, is a European based, non-profit distributing, industry Association run for the benefit of companies that own or operate industrial facilities. EEMUA aims to improve the safety, environmental and operating performance of industrial facilities in the most cost-effective way.	EEMUA
PSA YA-711	Principles for alarm system design	Norwegian Petroleum Safety Authority guideline describing a set of established principles for well-functioning alarm systems. The purpose of this document is to help those involved in the design, procurement, maintenance and operation of alarm systems. It is intended to help both in improving existing systems as well as during development of new systems and modifications. This document gives guidance on alarm generation, structuring, prioritisation, presentation and alarm handling. The requirements are based on the latest international recognised requirements on alarm systems available at the time of writing, with focus on realistic solutions based on research and best practice from different process industries.	PSA
NORSOK I -002	Safety and automation systems (SAS)	This standard covers functional and technical requirements and establishes a basis for engineering related to Safety and Automation System Design.. The SAS Life Cycle Cost should be used as a criterion for the evaluation of the system. This includes engineering, commissioning, documentation, spare parts, and production loss during system repair and modifications/maintenance in the operational phase.	SN/PET
NORSOK I-005	Fiscal measurement systems for hydrocarbon liquid	This NORSOK standard describes the functional and technical requirements for fiscal measurement systems for liquid hydrocarbons based on dynamic methods. Further the standard provides criteria for selection of such systems or main components thereof.	SN/PET
CLASS RULES	Relevant Classification rules for floating offshore units	Rules and standards from class society which has recognized and relevant competence and experience with offshore petroleum activities, and has established rules, standards and procedures for classification of floating offshore units;	Relevant Class Socitiy
TECHNICAL AREA: 11. Life Cycle Information (LCI)			
NORSOK Z-001	Documentation for Operation	This standard defines the extent and details of technical information which shall be available for use in the operational phase. The main objectives are to ensure that only necessary information is kept available, to facilitate the safe, effective and rational operation, and maintenance and modifications of the installation.	SN/PET
ISO/TR 13881	Classification and conformity assessment of products, processes and services		ISO/TC67

STANDARD No	TITLE	DESCRIPTION	RESPONSIBLE COMMITTEE
ISO/TS 29001	Sector-specific quality management systems – Requirements for product and service supply organizations	ISO/TS 29001:2007 defines the quality management system for product and service supply organizations for the petroleum, petrochemical and natural gas industries. Boxed text is original ISO 9001:2000 text unaltered and in its entirety. The petroleum, petrochemical, and natural gas industry sector-specific supplemental requirements are outside the boxes.	ISO/TC67
ISO 14040	Environmental management -- Life cycle assessment -- Principles and framework	***Notes:*** Russian version = гост р исо 14040-99	ISO/TC207/SC5
TECHNICAL AREA: 12. Lifting Appliances			
EN 13852-1	General-purpose offshore cranes	This European Standard specifies the requirements for general purpose offshore cranes. This standard applies to cranes, which are manufactured after the date of issue of this standard. For the purposes of this standard the boundary bewteen a general purpose offshore crane and its support is assumed to be as follows: When welding a pedestal to the structure, the boundary is the first horizontal weld following the flange in a downward direction, normally not less than 1,5 X the pedestal diameter from the flange	CEN
ILO 152	Cargo Gear Safety and Health in Dock Work		ILO
TECHNICAL AREA: 13. Materials technology			
ISO DIS 21457	Materials selection and corrosion control for oil and gas production systems	Materials Selection (based on NORSOK M-001)	ISO/TC67
ISO 15156:	Materials for use in H2S-containing environments in oil and gas production		CEN/TC12
ISO 23936	Non-metallic materials in contact with media related to oil and gas production	ISO 23936 as a whole presents general principles and gives requirements and recommendations for the selection and qualification, and gives guidance for the quality assurance, of non-metallic materials for service in equipment used in oil and gas production environments, where the failure of such equipment could pose a risk to the health and safety of the public and personnel or to the environment. It can be applied to help to avoid costly corrosion failures of the equipment itself. It supplements, but does not replace, the material requirements given in the appropriate design codes, standards or regulations. ISO 23936-1:2009 addresses the resistance of thermoplastics to the deterioration in properties that can be caused by physical or chemical interaction with produced and injected oil and gas-field media, and with production and chemical treatment. Interaction with sunlight is included; however, ionizing radiation is excluded from the scope of ISO 23936-1:2009.	ISO/TC67

		ISO 23936-1:2009 is not necessarily suitable for application to equipment used in refining or downstream processes and equipment. The equipment considered includes, but is not limited to, non-metallic pipelines, piping, liners, seals, gaskets and washers.	
EN 1090-3	Execution of steel structures and aluminium structures – Part 3: Technical requirements for aluminium structures		CEN/TC135
NORSOK M-101	Structural steel fabrication (referred to from ISO 19902),	This standard covers the requirements for fabrication and inspection of offshore steel structures with SMYS < 500 Mpa and with a minimum design temperature down to -14°C. For special application steels with SMYS up to 690 MPa may be used.	SN/PET
CLASS RULES	Relevant Classification rules for floating offshore units	Rules and standards from class society which has recognized and relevant competence and experience with offshore petroleum activities, and has established rules, standards and procedures for classification of floating offshore units;	Relevant Class Socities
TECHNICAL AREA: 14. Mechanical (Mechanical static and rotating, HVAC, piping engineering, valves and layout)			
ISO 3977	Gas Turbines – procurement		ISO/TC192
ISO 10437	Petroleum, petrochemical and natural gas industries – Steam turbines – Special-purpose applications	ISO 10437:2003 specifies requirements and gives recommendations for the design, materials, fabrication, inspection, testing and preparation for shipment of special-purpose steam turbines. It also covers the related lube-oil systems, instrumentation, control systems and auxiliary equipment. It is not applicable to general-purpose steam turbines, which are covered in ISO 10436.	ISO/TC67/SC6
ISO 10439	Petroleum, chemical and gas service industries – Centrifugal compressors	ISO 10439 specifies requirements and gives recommendations for the design, materials, fabrication, inspection, testing and preparation for shipment of centrifugal compressors for use in the petroleum, chemical and gas service industries. It is not applicable to machines that develop less than 35 kPa above atmospheric pressure, nor is it applicable to packaged, integrally geared centrifugal air compressors, which are covered in ISO 10442.	ISO/TC118/SC1

STANDARD No	TITLE	DESCRIPTION	RESPONSIBLE COMMITTEE
ISO 10440	Petroleum, petrochemical and natural gas industries – Rotary-type positive-displacement compressors	ISO 10440-1:2007 specifies requirements for dry and oil-flooded, helical-lobe rotary compressors used for vacuum or pressure or both in petroleum, petrochemical, and gas industry services. It is intended for compressors that are in special-purpose applications. It is not applicable to general-purpose air compressors, liquid-ring compressors, or vane-type compressors.	ISO/TC118/SC1
ISO 10442	Petroleum, chemical and gas service industries – Packaged, integrally geared centrifugal air compressors	ISO 10442:2002 specifies requirements and gives recommendations for the design, materials, fabrication, inspection, testing and preparation for shipment of constant-speed, packaged, integrally geared centrifugal air compressors, including their accessories, for use in the petroleum, chemical and gas service industries. It is also applicable to gas services other than air that are non-hazardous and non-toxic. It is not applicable to machines that develop a pressure rise of less than 35 kPa above atmospheric pressure, which are classed as fans or blowers.	ISO/TC118/SC1
ISO 13631	Petroleum and natural gas industries – Packaged reciprocating gas compressors	ISO 13631:2002 gives requirements and recommendations for the design, materials, fabrication, inspection, testing and preparation for shipment of packaged skid-mounted, reciprocating, separable or integral compressors with lubricated cylinders and their prime movers, for use in the petroleum and natural gas industries for the compression of hydrocarbon gas. It is also applicable to all necessary auxiliary equipment, such as water and gas coolers, silencers, emission control equipment, filters, separators, control panel, piping, etc., required to install an operable unit in compliance with the purchase specifications and with the intent of minimizing field construction and field-purchased equipment. ISO 13631:2002 is not applicable to the following: reciprocating compressors for petroleum and natural gas industries covered by ISO 13707; column-mounted compressors; non-lubricated compressors; compressors having trunk-type (automotive-type) pistons that also serve as crossheads; utility or instrument air compressors with a discharge gauge pressure of 0,9 Mpa (9 bar) or less; compressors driven by diesel engine, gas turbine and steam turbine prime movers.	ISO/TC118/SC1
ISO 13703	Design and installation of piping systems on offshore production platforms		ISO/TC67/SC6
ISO 13707	Petroleum and natural gas industries – Reciprocating compressors		ISO/TC118/SC1
ISO 13709	Centrifugal Pumps		ISO/TC115/SC3
ISO 13710	Reciprocating positive displacement pumps		ISO/TC115/SC3
ISO 14692	Petroleum and natural gas industries -- Glass-reinforced plastics (GRP) piping	ISO 14692-parts 1-3 describes specification, manufacture, testing and installation of glass-reinforced plastic (GRP) piping installations associated with offshore applications on both fixed and floating topsides facilities for oil and gas industry production and processing.	ISO/TC67/SC6

ISO 15138	Petroleum and natural gas industries – Offshore production installations – Heating, ventilation and air-conditioning	ISO 15138:2007 specifies requirements and provides guidance for design, testing, installation and commissioning of heating, ventilation, air-conditioning and pressurization systems and equipment on all offshore production installations for the petroleum and natural gas industries that are new or existing, normally occupied by personnel, or not normally occupied by personnel; or fixed or floating but registered as an offshore production installation. For installations that can be subject to "Class" or "IMO/MODU Codes & Resolutions", the user is referred to HVAC requirements under these rules and resolutions. When these requirements are less stringent than those being considered for a fixed installation, then it is necessary that ISO 15138:2007, i.e. requirements for fixed installations, be utilized.	ISO/TC67/SC6
ISO 15547	Petroleum, petrochemical and natural gas industries -- Plate-type heat exchangers	ISO 15547-1:2005 gives requirements and recommendations for the mechanical design, materials selection, fabrication, inspection, testing, and preparation for shipment of plate-and-frame heat exchangers for use in petroleum, petrochemical and natural gas industries. It is applicable to gasketed, semi-welded and welded plate-and-frame heat exchangers.	ISO/TC67/SC6
ISO 15649	Piping	This International Standard specifies the requirements for design and construction of piping for the petroleum and natural gas industries, including associated inspection and testing. This International Standard is applicable to all piping within facilities engaged in the processing or handling of chemical, petroleum, natural gas or related products.	ISO/TC67/SC6
ISO 16812	Petroleum, petrochemical and natural gas industries -- Shell-and-tube heat exchangers	ISO 16812:2007 specifies requirements and gives recommendations for the mechanical design, material selection, fabrication, inspection, testing and preparation for shipment of shell-and-tube heat exchangers for the petroleum, petrochemical and natural gas industries	ISO/TC67/SC6
API 616	Gas turbines for refinery services		API
EN 13445	Unfired pressure vesssels	Defines the terms, definitions, symbols and units that are used throughout the EN 13445. This Part of EN 13445 also gives guidelines on the principles on which each part of the standard has been based. This information is aimed to aid the user of the EN 13445. This European Standard applies to unfired pressure vessels subject to a maximum allowable pressure greater than 0,5 bar gauge but may be used for vessels operating at lower pressures, including vacuum.	CEN/TC54
NFPA 20	Standard for the installation of stationary pumps for fire protection		NFPA
CLASS RULES	Relevant Classification rules/ standards for floating offshore units	Rules and standards from class society which has recognized and relevant competence and experience with offshore petroleum activities, and has established rules, standards and procedures for classification of floating offshore units;	Relevant Class Societies

STANDARD No	TITLE	DESCRIPTION	RESPONSIBLE COMMITTEE
TECHNICAL AREA: **15. Operation and maintenance (incl Regularity & Criticality)**			
ISO 14224	Collection and exchange of reliability and maintenance data	ISO 14224:2006 provides a comprehensive basis for the collection of reliability and maintenance (RM) data in a standard format for equipment in all facilities and operations within the petroleum, natural gas and petrochemical industries during the operational life cycle of equipment. It describes data-collection principles and associated terms and definitions that constitute a "reliability language" that can be useful for communicating operational experience. The failure modes defined in ISO 14224:2006 can be used as a "reliability thesaurus" for various quantitative as well as qualitative applications. ISO 14224:2006 also describes data quality control and assurance practices to provide guidance for the user. Standardization of data-collection practices facilitates the exchange of information between parties, e.g. plants, owners, manufacturers and contractors. ISO 14224:2006 establishes requirements that any in-house or commercially available RM data system is required to meet when designed for RM data exchange. Examples, guidelines and principles for the exchange and merging of such RM data are addressed. ISO 14224:2006 recommends a minimum amount of data that is required to be collected and focuses on the two main issues: data requirements for the type of data to be collected for use in various analysis methodologies and standardized data format to facilitate the exchange of reliability and maintenance data between plants, owners, manufacturers and contractors. ***Notes:*** *On TC23 GOST-ISO development program. Draft GOST R-ISO planned for 2010*	ISO/TC67
ISO 19901-6 (FDIS)	Specific requirements for offshore structures – Part 6: Marine operations	ISO 19901-6:2009 provides requirements and guidance for the planning and engineering of marine operations, encompassing the design and analysis of the components, systems, equipment and procedures required to perform marine operations, as well as the methods or procedures developed to carry them out safely. This part of ISO 19901 is applicable to marine operations for offshore structures, including steel and concrete gravity-base structures (GBS); piled steel structures and compliant towers; tension leg platforms (TLP); deep-draught floaters (DDF), including spars or deep-draught caisson vessels (DDCV); floating production semi-submersibles (FPSS); floating production, storage and offloading vessels (FPSO); other types of floating production systems (FPS); mobile offshore units (MOU); topsides and components of any of the above; subsea templates and similar structures; gravity, piled, drag-embedded and suction or other anchors; tendon foundations; and associated mooring systems. This document is also applicable to modifications of existing structures, e.g. installation of additional topsides modules. This part of ISO 19901 is not applicable to the following marine operations: — construction activities, e.g. in a fabrication yard onshore, where there is no exposure to the marine — environment; — drilling, processing and petrochemical activities; — routine marine activities during the service life of the structure; — drilling from mobile offshore drilling units (MODU); — installation of pipelines, flowlines, risers and umbilicals; — diving. ***Notes:*** *On TC23 GOST-ISO development program*	ISO/TC67/SC7
ISO 20815	Petroleum, petrochemical and natural gas industries – Production assurance and reliability management	ISO 20815:2008 introduces the concept of production assurance within the systems and operations associated with exploration drilling, exploitation, processing and transport of petroleum, petrochemical and natural gas resources. ISO 20815:2008 covers upstream (including subsea), midstream and downstream facilities and activities. It focuses on production assurance of oil and gas production, processing and associated activities and covers the analysis of reliability and maintenance of the components.	ISO/TC67

		ISO 20815:2008 provides processes and activities, requirements and guidelines for systematic management, effective planning, execution and use of production assurance and reliability technology. This is to achieve cost-effective solutions over the life cycle of an asset-development project structured around the following main elements: production-assurance management for optimum economy of the facility through all of its life-cycle phases, while also considering constraints arising from health, safety, environment, quality and human factors; planning, execution and implementation of reliability technology; application of reliability and maintenance data; and reliability-based design and operation improvement. For standards on equipment reliability and maintenance performance in general, see the IEC 60300-3 series. ISO 20815:2008 designates 12 processes, of which seven are defined as core production-assurance processes and addressed in ISO 20815:2008. The remaining five processes are denoted as interacting processes and are outside the scope of ISO 20815:2008. The interaction of the core production-assurance processes with these interacting processes, however, is within the scope of ISO 20815:2008 as the information flow to and from these latter processes is required to ensure that production-assurance requirements can be fulfilled. ISO 20815:2008 recommends that the listed processes and activities be initiated only if they can be considered to add value. The only requirements mandated by ISO 20815:2008 are the establishment and execution of the production-assurance programme (PAP). ***Notes:*** *On TC23 GOST-ISO development program*	
TECHNICAL AREA: 16. Pipeline Technology			
ISO 13623	Petroleum and natural gas industries – Pipeline transportation systems	ISO 13623:2009 specifies requirements and gives recommendations for the design, materials, construction, testing, operation, maintenance and abandonment of pipeline systems used for transportation in the petroleum and natural gas industries. ISO 13623:2009 applies to pipeline systems on land and offshore, connecting wells, production plants, process plants, refineries and storage facilities, including any section of a pipeline constructed within the boundaries of such facilities for the purpose of its connection. A figure shows the extent of pipeline systems covered by ISO 13623:2009. ISO 13623:2009 applies to rigid, metallic pipelines. It is not applicable for flexible pipelines or those constructed from other materials, such as glass-reinforced plastics. ISO 13623:2009 is applicable to all new pipeline systems and can be applied to modifications made to existing ones. It is not intended that it apply retroactively to existing pipeline systems. ISO 13623:2009 describes the functional requirements of pipeline systems and provides a basis for their safe design, construction, testing, operation, maintenance and abandonment.	ISO/TC67/SC2
ISO 21809	External coatings for buried or submerged pipelines used in pipeline transportation systems		ISO/TC67/SC2
DNV OS-F101	Submarine Pipeline System	***Notes:*** *(GOST R standard based on DNV issued as industry standard)*	DNV
Russian Maritime Register of Shipping (RS)	Rules for the Classification and Construction of Subsea Pipelines		RS

STANDARD No	TITLE	DESCRIPTION	RESPONSIBLE COMMITTEE
Russian Maritime Register of Shipping (RS)	Guidelines on Technical Supervision during Construction and Operation of Subsea Pipelines		RS
TECHNICAL AREA: 17. Platform Technology			
ISO 19901-3 (DIS)	Petroleum and natural gas industries -- Specific requirements for offshore structures -- Part 3: Topsides structure		ISO/TC67/SC7
ISO 19902	Petroleum and natural gas industries — Fixed steel offshore structures	ISO 19902:2007 specifies requirements and provides recommendations applicable to the following types of fixed steel offshore structures for the petroleum and natural gas industries: caissons, free-standing and braced; jackets; monotowers; towers. In addition, it is applicable to compliant bottom founded structures, steel gravity structures, jack-ups, other bottom founded structures and other structures related to offshore structures (such as underwater oil storage tanks, bridges and connecting structures), to the extent to which its requirements are relevant. It contains requirements for planning and engineering of the following tasks: design, fabrication, transportation and installation of new structures as well as their future removal; in-service inspection and integrity management of both new and existing structures; assessment of existing structures; evaluation of structures for reuse at different locations.	ISO/TC67/SC7
ISO 19903,	Petroleum and natural gas industries — Fixed concrete offshore structures	ISO 19903:2006 specifies requirements and provides recommendations applicable to fixed concrete offshore structures for the petroleum and natural gas industries, and specifically addresses the design, construction, transportation and installation of new structures, including requirements for in-service inspection and possible removal of structures, the assessment of structures in service, and the assessment of structures for reuse at other locations.	ISO/TC67/SC7
ISO 19904-1	Petroleum and natural gas industries — Floating offshore structures – Part 1: Monohulls, semi-submersibles and spars	ISO 19904-1:2006 provides requirements and guidance for the structural design and/or assessment of floating offshore platforms used by the petroleum and natural gas industries to support production, storage and/or offloading, drilling and production, production, storage and offloading, and drilling, production, storage and offloading. ***Notes:*** *On TC23 GOST-ISO development program*	ISO/TC67/SC7
ISO 19905-1 (DIS)	Petroleum and natural gas industries -- Site-specific assessment of mobile offshore units -- Part 1: Jack-ups		ISO/TC67/SC7

CAA CAP 437	Offshore Helicopter Landing Areas - Guidance on Standards	This publication gives guidance on the criteria applied by the CAA in assessing the standards of helicopter offshore landing areas for worldwide use by helicopters registered in the United Kingdom. The 6th Edition has been revised to incorporate valuable experience gained from CAA funded research projects conducted with the support of the UK offshore industry. It also includes new ICAO Standards and Recommended Practices, to be adopted in November 2009, relating to offshore helidecks and shipboard heliports, as well as material from the new fourth edition of the International Chamber of Shipping (ICS) Guide to Helicopter/Ship Operations. For the first time guidance is included for the design of winching area arrangements located on wind turbine platforms.	CAA
Russian Maritime Register of Shipping (RS)	Rules for the Classification, Construction and Equipment of Floating Offshore Oil-and-Gas Production Units		RS
Russian Maritime Register of Shipping (RS)	Rules for The Classification, Construction and Equipment of Mobile Offshore Drilling Units and Fixed Offshore Platforms, 2008		RS
Russian Maritime Register of Shipping (RS)	Guidelines on Technical Supervision of Mobile Offshore Drilling Units and Fixed Offshore Platforms in Service, 2004		RS
DNV	Rules for Classification of Offshore Drilling and Support Units		DNV
DNV	Rules for Classification of Floating Production, Storage and Loading Units		DNV
TECHNICAL AREA: 18. Process Technology, incl. cold climate protection of process plants and flow assurance / fiscal measurement			
ISO 4126	Safety devices for protection against excessive pressure	ISO 4126-1:2004 specifies general requirements for safety valves irrespective of the fluid for which they are designed. It is applicable to safety valves having a flow diameter of 6 mm and above which are for use at set pressures of 0,1 bar gauge and above. No limitation is placed on temperature. This is a product standard and is not concerned with applications for safety valves.	ISO/TC185

STANDARD No	TITLE	DESCRIPTION	RESPONSIBLE COMMITTEE
ISO 10418*	Basic surface process safety systems	ISO 10418:2003 provides objectives, functional requirements and guidelines for techniques for the analysis, design and testing of surface process safety systems for offshore installations for the recovery of hydrocarbon resources. The basic concepts associated with the analysis and design of a process safety system for an offshore oil and gas production facility are described, together with examples of the application to typical (simple) process components. These examples are contained in the annexes of ISO 10418:2003. ISO 10418:2003 is applicable to fixed offshore structures, floating production, storage and off-take systems for the petroleum and natural gas industries. ISO 10418:2003 is not applicable to mobile offshore units and subsea installations, although many of the principles contained in it may be used as guidance. ***Notes:*** *Nominated by RNO3* *On TC23 GOST-ISO development program*	ISO/TC67/SC6
ISO 23251	Pressure relieving and depressurizing systems	***Notes:*** *Nominated by RNO3*	ISO/TC67/SC6
ISO 25457	Petroleum, petrochemical and natural gas industries -- Flare details for general refinery and petrochemical service	ISO 25457:2008 specifies requirements and provides guidance for the selection, design, specification, operation and maintenance of flares and related combustion and mechanical components used in pressure relieving and vapour-depressurizing systems for petroleum, petrochemical and natural gas industries	ISO/TC67/SC6
TECHNICAL AREA: **19. Riser technology**			
ISO 13628-2 (API 17J)	Design and operation of subsea production systems -- Part 2: Unbonded flexible pipe systems for subsea and marine applications	ISO 13628-2:2006 defines the technical requirements for safe, dimensionally and functionally interchangeable flexible pipes that are designed and manufactured to uniform standards and criteria. Minimum requirements are specified for the design, material selection, manufacture, testing, marking and packaging of flexible pipes, with reference to existing codes and standards where applicable. ISO 13628-2:2006 applies to unbonded flexible pipe assemblies, consisting of segments of flexible pipe body with end fittings attached to both ends. ISO 13628-2:2006 applies to both static and dynamic flexible pipes used as flowlines, risers and jumpers. The applications addressed by this ISO 13628-2:2006 are sweet and sour service production, including export and injection applications for production products including oil, gas, water and injection chemicals. ISO 13628-2:2006 does not cover flexible pipes of bonded structure or flexible pipe ancillary components or to flexible pipes for use in choke-and-kill line applications. ISO 13628-2:2006 does not apply to flexible pipes that include non-metallic tensile armour wires. ***Notes:*** *On TC23 GOST-ISO development program*	ISO/TC67/SC4
ISO/NP13628-12 (DNV OS-F201)	Design and operation of subsea production systems -- Part 12: Dynamic production risers	***Notes:*** *Work ongoing on ISO 13628-12 based on the DNV documen)*	ISO/TC67/SC4

TECHNICAL AREA: **20. Risk Management of major Hazards (e.g. fires, explosions, blow-outs) – RNO3**			
ISO 13702:	Control and mitigation of fires and explosions on offshore production installations – Requirements and guidelines	***Notes:*** *Nominated by RNO3*	ISO/TC67/SC6
ISO 17776	Offshore production installations – Guidelines on tools and techniques for identification and assessment of hazards.	***Notes:*** *Nominated by RNO3*	ISO/TC67/SC6
ISO 31000	Risk management -- Principles and guidelines	ISO 31000:2009 provides principles and generic guidelines on risk management. ISO 31000:2009 can be used by any public, private or community enterprise, association, group or individual. Therefore, ISO 31000:2009 is not specific to any industry or sector. ISO 31000:2009 can be applied throughout the life of an organization, and to a wide range of activities, including strategies and decisions, operations, processes, functions, projects, products, services and assets. ISO 31000:2009 can be applied to any type of risk, whatever its nature, whether having positive or negative consequences. Although ISO 31000:2009 provides generic guidelines, it is not intended to promote uniformity of risk management across organizations. The design and implementation of risk management plans and frameworks will need to take into account the varying needs of a specific organization, its particular objectives, context, structure, operations, processes, functions, projects, products, services, or assets and specific practices employed. It is intended that ISO 31000:2009 be utilized to harmonize risk management processes in existing and future standards. It provides a common approach in support of standards dealing with specific risks and/or sectors, and does not replace those standards. ***Notes:*** *Nominated by RNO3*	ISO/TMB
IEC 60079	Explosive atmospheres	Specifies the general requirements for construction, testing and marking of electrical apparatus and Ex components intended for use in explosive gas atmospheres. Electrical apparatus complying with this standard is intended for use in hazardous areas in which explosive gas atmospheres, caused by mixtures of air and gases, vapours or mists, exist under normal atmospheric conditions. ***Notes:*** Nominated by RNO3	IEC/TC31
IEC 61508	Functional safety of electrical/ electronic/programmable electronic safety-related systems	Sets out a generic approach for all safety lifecycle activities for systems comprised of electrical and/or electronic and/or programmable electronic components (electrical / electronic / programmable electronic systems (E/E/PESs)) that are used to perform safety functions. This unified approach has been adopted in order that a rational and consistent technical policy be developed for all electrically-based safety-related systems. ***Notes:*** *Nominated by RNO3*	IEC/TC65A

STANDARD No	TITLE	DESCRIPTION	RESPONSIBLE COMMITTEE
IEC 61892-7	Mobile and fixed offshore units - Electrical installations - Part 7: Hazardous areas	This part of IEC 61892 contains provisions for hazardous areas classification and choice of electrical installation in hazardous areas in mobile and fixed offshore units, including pipeline, pumping or 'pigging' stations, compressor stations and exposed location single buoy moorings, used in the offshore petroleum industry for drilling, processing and for storage purposes. ***Notes:*** *Nominated by RNO3*	IEC/TC18
ISO/IEC 80079 (CD)	Explosive atmospheres -- Part 34: Application of quality systems for electrical and non-electrical equipment	Forecast publication: November 2010 ***Notes:*** *Nominated by RNO3*	ISO/TMB
NORSOK D010	Well integrity in drilling and well operations	The standard defines the minimum functional and performance oriented requirements and guidelines for well design, planning and execution of safe well operations. The focal of the standard is well integrity. ***Notes:*** *Nominated by RNO3* *ISO proposal under way based on this standard.*	SN/PET
NORSOK S-001	Technical Safety (for review by Russian delegates)	This NORSOK standard describes the principles and requirements for the development of the safety design of offshore installations for production of oil and gas. Where applicable, this NORSOK standard may also be used for mobile offshore drilling units. This standard, together with ISO 13702, also defines the required standard for implementation of technologies and emergency preparedness to establish and maintain an adequate level of safety for personnel, environment and material assets. ***Notes:*** *Nominated by RNO3, RNO4*	SN/PET
NORSOK Z-013	Risk and emergency preparedness analysis	This NORSOK standard presents requirements to planning, execution and use of risk and EPA, with an emphasis on providing insight into the process and concise definitions. This NORSOK standard is structured around the following main elements: ▪ Establishment of risk acceptance criteria prior to execution of the risk analysis. ▪ The relation between the risk and EPA, especially the integration of the two types of analysis into one overall analysis process. ▪ Planning and execution of analyses. ▪ Further requirements to use of risk and EPA for different activities and life cycle phases. ▪ Establishment of requirements based on risk and EPA. ***Notes:*** *Nominated by RNO3, RNO4*	SN/PET

TECHNICAL AREA: **21. Safety, Health and Environment (SHE)**			
IMO MODU CODE	Code for the construction and equipment of mobile offshore drilling units	The Code for the Construction and Equipment of Mobile Offshore Drilling Units,	IMO
DNV-OS-A101	Safety Principles and Arrangement	Provides general safety and arrangement principles for offshore units and installations. The standard is applicable to overall safety and integrity aspects of all types of floating offshore units and fixed installations	DNV
CLASS RULES	Relevant Classification rules/ standards for floating offshore units	Rules and standards from class society which has recognized and relevant competence and experience with offshore petroleum activities, and has established rules, standards and procedures for classification of floating offshore units;	Relevant Class Society
TECHNICAL AREA: **22. Ship Transportation – RNO6**			
IMO	International Code of Safety for Ships in Polar Waters (Polar Code) (IMO doc. DE41/10)	***Notes:*** *Nominated by RNO5*	IMO
IMO	IMO guidelines for ships operating in Arctic Ice Covered waters (MEPC/Circ.1056)	***Notes:*** *Nominated by RNO5*	IMO
IACS	International Association of Classification Societies (IACS): Requirements concerning Polar Class	***Notes:*** *Nominated by RNO5*	IACS
DNV	DNV: Rules for classification of ships, Part 5, Chapter 1: Ships for navigation in ice	***Notes:*** *Nominated by RNO5*	DNV
DNV	DNV Seaskill no.3.312: Competence of Officers for Navigation in Ice	***Notes:*** *Nominated by RNO5*	DNV

STANDARD No	TITLE	DESCRIPTION	RESPONSIBLE COMMITTEE
ISGOTT	International Oil Tanker and Terminal Safety Guide	ISGOTT was first published in 1978 and combined the contents of the 'Tanker Safety Guide (Petroleum)', published by the International Chamber of Shipping (ICS), and the 'International Oil Tanker and Terminal Safety Guide', by the Oil Companies International Marine Forum (OCIMF). The Guide provides operational advice to directly assist personnel involved in tanker and terminal operations, including guidance on, and examples of, certain aspects of tanker and terminal operations and how they may be managed. ***Notes:*** *Nominated by RNO5*	ISGOTT
OCIMF	Oil Companies International Maritime Forum Publications	The primary objectives of OCIMF are the promotion of safety and prevention of pollution from tankers and at oil terminals. ***Notes:*** *Nominated by RNO5*	OCIMF
TECHNICAL AREA: 23. Station keeping (mooring)			
ISO 19901-7	Petroleum and natural gas industries -- Specific requirements for offshore structures -- Part 7: Stationkeeping systems for floating offshore structures and mobile offshore units	ISO 19901-7:2005 specifies methodologies for a) the design, analysis and evaluation of stationkeeping systems for floating structures used by the oil and gas industries to support production, storage, drilling, well intervention and production, production and storage, drilling, well intervention, production and storage, and b) the assessment of stationkeeping systems for site-specific applications of mobile offshore units (e.g. mobile offshore drilling units, construction units, and pipelay units). ***Notes:*** *Nominated std by Group RNO3* *On TC23 GOST-ISO development program*	ISO/TC67/SC7
CLASS RULES	Relevant Classification rules/ standards for floating offshore units	Rules and standards from class society which has recognized and relevant competence and experience with offshore petroleum activities, and has established rules, standards and procedures for classification of floating offshore units;	Relevant Class Society
TECHNICAL AREA: 24. Subsea Technology			
ISO 13628 -1	Design and operation of subsea production systems -- Part 1: General requirements and recommendations	ISO 13628-1:2005 provides general requirements and overall recommendations for development of complete subsea production systems, from the design phase to decommissioning and abandonment. ISO 13628-1:2005 is intended as an umbrella document to govern other parts of ISO 13628 dealing with more detailed requirements for the subsystems which typically form part of a subsea production system. However, in some areas (e.g. system design, structures, manifolds, lifting devices, and colour and marking) more detailed requirements are included herein, as these subjects are not covered in a subsystem standard. The complete subsea production system comprises several subsystems necessary to produce hydrocarbons from one or more subsea wells and transfer them to a given processing facility located offshore (fixed, floating or subsea) or onshore, or to inject water/gas through subsea wells.	ISO/TC67/SC4

		ISO 13628-1:2005 and its related subsystem standards apply as far as the interface limits described in Clause 4. Specialized equipment, such as split trees and trees and manifolds in atmospheric chambers, are not specifically discussed because of their limited use. However, the information presented is applicable to those types of equipment. ***Notes:*** *On TC23 GOST-ISO development program*	
ISO 13628 -4	Design and operation of subsea production systems -- Part 4: Subsea wellhead and tree equipment	***Notes:*** *On TC23 GOST-ISO development program*	ISO/TC67/SC4
ISO 13628 -5	Design and operation of subsea production systems -- Part 5: Subsea umbilicals	ISO 13628-5:2002 specifies requirements and gives recommendations for the design, material selection, manufacture, design verification, testing, installation and operation of subsea control systems, chemical injection, gas lift, utility and service umbilicals and associated ancillary equipment for the petroleum and natural gas industries. ISO 13628-5:2002 applies to umbilicals containing electrical conductors, optical fibres, thermoplastic hoses and metallic tubes, either alone or in combination. ISO 13628-5:2002 applies to umbilicals that are for static or dynamic service, and with routings of surface-surface, surface-subsea and subsea-subsea. ISO 13628-5:2002 does not apply to the associated component connectors, unless they affect the performance of the umbilical or that of its ancillary equipment	ISO/TC67/SC4
ISO 13628 -6	Design and operation of subsea production systems -- Part 6: Subsea production control systems	ISO 13628-6:2006 is applicable to design, fabrication, testing, installation and operation of subsea production control systems. ISO 13628-6:2006 covers surface control system equipment, subsea-installed control system equipment and control fluids. This equipment is utilized for control of subsea production of oil and gas and for subsea water and gas injection services. Where applicable, ISO 13628-6:2006 can be used for equipment on multiple-well applications. ISO 13628-6:2006 establishes design standards for systems, subsystems, components and operating fluids in order to provide for the safe and functional control of subsea production equipment. ISO 13628-6:2006 contains various types of information related to subsea production control systems. They are informative data that provide an overview of the architecture and general functionality of control systems for the purpose of introduction and information; basic prescriptive data that shall be adhered to by all types of control system; selective prescriptive data that are control-system-type sensitive and shall be adhered to only when they are relevant; optional data or requirements that need be adopted only when considered necessary either by the purchaser or the vendor. In view of the diverse nature of the data provided, control system purchasers and specifiers are advised to select from ISO 13628-6:2006 only the provisions needed for the application at hand. Failure to adopt a selective approach to the provisions contained herein can lead to overspecification and higher purchase costs. Rework and repair of used equipment are beyond the scope of ISO 13628-6:2006	ISO/TC67/SC4

STANDARD No	TITLE	DESCRIPTION	RESPONSIBLE COMMITTEE
ISO 13628 -7	Design and operation of subsea production systems -- Part 7: Completion/workover riser systems	ISO 13628-7:2005 gives requirements and recommendations for the design, analysis, materials, fabrication, testing and operation of subsea completion/workover (C/WO) riser systems run from a floating vessel. It is applicable to all new C/WO riser systems and may be applied to modifications, operation of existing systems and reuse at different locations and with different floating vessels. ISO 13628-7:2005 is intended to serve as a common reference for designers, manufacturers and operators/users, thereby reducing the need for company specifications. ISO 13628-7:2005 is limited to risers, manufactured from low alloy carbon steels. Risers fabricated from special materials such as titanium, composite materials and flexible pipes are beyond the scope of ISO 13628-7:2005. Specific equipment covered by ISO 13628-7:2005 include riser joints, connectors; workover control systems; surface flow trees, surface tree tension frames, lower workover riser packages, lubricator valves, retainer valves, subsea test trees, shear subs, tubing hanger orientation systems, swivels, annulus circulation hoses, riser spiders, umbilical clamps, handling and test tools, tree cap running tools. Associated equipment not covered by ISO 13628-7:2005 include tubing hangers, internal and external tree caps, tubing hanger running tools, surface coiled tubing units, surface wireline units, surface tree kill and production jumpers	ISO/TC67/SC4
ISO 13628 -8	Design and operation of subsea production systems -- Part 8: Remotely Operated Vehicle (ROV) interfaces on subsea production systems	ISO 13628:2002 gives functional requirements and guidelines for ROV interfaces on subsea production systems for the petroleum and natural gas industries. It is applicable to both the selection and use of ROV interfaces on subsea production equipment, and provides guidance on design as well as the operational requirements for maximising the potential of standard equipment and design principles. The auditable information for subsea systems it offers will allow interfacing and actuation by ROV-operated systems, while the issues it identifies are those that have to be considered when designing interfaces on subsea production systems. The framework and detailed specifications set out will enable the user to select the correct interface for a specific application.	ISO/TC67/SC4
ISO 13628 -9	Design and operation of subsea production systems -- Part 9: Remotely Operated Tool (ROT) intervention system	NA	ISO/TC67/SC4
ISO 13628 -10	Design and operation of subsea production systems -- Part 10: Specification for bonded flexible pipe	ISO 13628-10:2005 defines the technical requirements for safe, dimensionally and functionally interchangeable bonded flexible pipes that are designed and manufactured to uniform standards and criteria. Minimum requirements are specified for the design, material selection, manufacture, testing, marking and packaging of bonded flexible pipes, with reference to existing codes and standards where applicable. ISO 13628-10:2005 applies to bonded flexible pipe assemblies, consisting of segments of flexible pipe body with end fittings attached to both ends. ISO 13628-10:2005 applies to pipes with a design pressure greater than or equal to 1,5 MPa (15 bar). ISO 13628-10:2005 can be used for lower design pressure pipes, though the requirements of these pipes have not been specifically addressed. ISO 13628-10:2005 does not cover flexible pipes of unbonded structure nor to flexible pipe ancillary components and does not apply to flexible pipes for use in choke and kill line applications.. ISO 13628-10:2005 can be applied to flexible pipes that include non-metallic reinforcing layers, though no effort was made to address the specific and unique technological aspects of this product, and to a bonded construction pipe that includes a material or layer construction that is covered in ISO 13628-2.	ISO/TC67/SC4

		ISO 13628-10:2005 can be applied to flexible pipes for pile hammer, gas flare, water supply and jetting applications, though no effort was made to address the specific and unique technological aspects relating to each of these requirements.	
ISO 13628 -11	Design and operation of subsea production systems -- Part 11: Flexible pipe systems for subsea and marine applications	ISO 13628-11:2007 provides guidelines for the design, analysis, manufacture, testing, installation and operation of flexible pipes and flexible pipe systems for onshore, subsea and marine applications. ISO 13628-11:2007 supplements ISO 13628-2 and ISO 13628-10, which specify minimum requirements for the design, material selection, manufacture, testing, marking and packaging of unbonded and bonded flexible pipes, respectively. ISO 13628-11:2007 applies to flexible pipe assemblies, consisting of segments of flexible pipe body with end fittings attached to both ends. Both bonded and unbonded pipe types are covered. In addition, ISO 13628-11:2007 applies to flexible pipe systems, including ancillary components. The applications covered by ISO 13628-11:2007 are sweet- and sour-service production, including export and injection applications. ISO 13628-11:2007 applies to both static and dynamic flexible pipe systems used as flowlines, risers and jumpers. ISO 13628-11:2007 does cover, in general terms, the use of flexible pipes for offshore loading systems. ISO 13628-11:2007 does not cover flexible pipes for use in choke and kill lines or umbilical and control lines.	ISO/TC67/SC4
ISO (DIS) 13628-15	Petroleum, petrochemical and natural gas industries — Design and operation of subsea production systems — Part 15: Subsea structures and manifolds		ISO/TC67/SC4
TECHNICAL AREA: 25. Telecommunication			
NORSOK T-001	Telecom systems (for further study)	This NORSOK standard describes the basis for design and engineering of telecommunication systems, given revision status in the table below, on-board a manned offshore installation.	SN/PET
GOST P 50829-95	Safety of radio stations, the radio-electronic equipment with transmit/receive equipment and its constituent parts. General requirements and test methods	Provides common requirements and test methods.	GOST
GOST P 52454-2005	Global navigating satellite system and global system of positioning. Personal receiver. Technical requirements	Provides technical requirements	GOST
GOST P 52455-2005	Global navigating satellite system and global system of positioning. Marine receiver for common use. Technical requirements	Provides requirements for the receiver of sea general purpose.	GOST

STANDARD No	TITLE	DESCRIPTION	RESPONSIBLE COMMITTEE
GOST P 52866-2007	Global navigating satellite system - Station control-adjusting local civil purpose. Technical requirements	Technical requirements.	GOST
ISO/IEC 18044	Information technology. Methods and supporting means of a safety. Management of incidents of information safety.	***Notes:*** *Russian version GOST R ISO_IEC 18044-2007*	ISO/JTC1/SC27
TECHNICAL AREA: 26. Working Environment and safety related to Human factors (input from RN05)			
NORSOK S-002	Working Environment	This NORSOK standard applies to the design of new installations and modification or upgrading of existing installations for offshore drilling, production, and utilisation and pipeline transportation of petroleum, including accommodation units for such activities. This NORSOK standard stipulates design requirements related to the working environment of petroleum installations as well as requirements regarding systematic management of working environment issues in project development and the design process. The purpose of this NORSOK standard is to ensure that the design of the installation promotes the quality of the working environment during the operational phase. ***Notes:*** *Nominated by RN05*	SN/PET
OGP	Health Aspects of Work in Extreme Climates (Report 398, Dec 2008)	The International Association of Oil & Gas producers (OGP) These guidelines aim to provide practical information to line management and health professionals in order to protect and maintain health and prevent accidents, illness and loss of life. In certain situations, additional measures may be required to ensure effective and efficient performance ***Notes:*** *Nominated by RN05*	OGP

Notes:

1) When an internationally recognised standard is not available for the subject matter, other standards have been listed.

Nomenclature:

ISO – International Standardisation Organisation
TC – Technical Committee
SC – Sub-committee
TMB - Technical Management Board
SN – Standard Norway
PET – Sector for Petroleum
IEC – International Electrotechnical Committee
OGP – International Association of Oil and Gas Producers