

RAPPORT

HMS-utfordringer i nordområdene - litteraturgjennomgang



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Innhold

1 FØRINGER FRA REGJERING/MYNDIGHETER	6
Petroleumstilsynet (2013). Hovedprioriteringer 2014.	6
Karde, H.O (ed.) (2013). Sluttrapport fra Nordområdeutvalget.	7
Nærings og handelsdepartementet (NHD) (2013). Stø kurs 2020. Regjeringens maritime strategi.	8
Utenriksdepartementet (UD) (2011). Nordområdene. Visjon og virkemidler. (Nordområdemeldingen). Meld. St. 7.	9
PAME (Protection of the Arctic Marine Environment Working Group) (2014). Arctic Offshore Oil and Gas Guidelines (AAOGG): Systems Safety Management and Safety Culture. Avoiding Major Disasters in Offshore Oil and Gas Operations.	10
2 TVERRFAGLIG.....	14
Olsen, A. (Transocean) (2013). Arctic safety experiences and challenges. Arctic safety conference.	14
NOROG (2012). HMS-utfordringer i nordområdene.	16
SINTEF (2012). Marsafe Summary. Maritime Safety Management in the High North.	18
Gudmestad, O.T., Quale, C. (2011). Technology and Operational Challenges for the High North. Report.	20
AMAP (Arctic Monitoring and Assessment Programme) (2009). Arctic oil and gas.	22
3 KLIMATISKE FORHOLD.....	24
Meteorologisk Institutt (2012). Bistand til OEDs åpningsprosesser for petroleumsvirksomhet i nord. Barentshavet SØ (Område 1). Rapport No. 2012/11.	24
4 KOMMUNIKASJON	25
Kvamstad B. (SINTEF) (2013). Flying High: Arctic Communication. Ocean Technological Summit, Conference.	25
Barth, V.L. (2012). Romværinfrastruktur i Norge - eksisterende og ønsket infrastruktur. Norsk Romsenter- Rapport.	27
5 HELSE OG ARBEIDSMILJØ	29
Balfour, A. (HFS) (2013). Human factors in the Arctic. Arctic Oil& Gas conference 2013.	29
Brown, R. (2013). Evacuation, survival and rescue in cold regions - goals, gaps and solutions. Arctic Oil& Gas conference 2013.	30
Ergopro (2012). Arbeid i kaldt klima. Personlig beskyttelse mot varmetap i kalde omgivelser.	31
THELMA AS (2010). Kalde utfordringer. Helse og arbeidsmiljø på innretning i nordområdene. Rapport nr. 10-31. ISBN 978-82-8032-024-7.	32
6 RISIKOSTYRING OG DRIFT, INKLUDERT DESIGN	34

Bos, R.W., Huisman, T.J., Obers, M.P.W., Schaap, T., van der Zalm, M. (2013). Servicing the Arctic. Report 1: Design requirements and operational profile of an Arctic Offshore Support Vessel (AOSV). Literature Survey.	34
Crome, T. (Technip) (2013). The Arctic subsea landscape. Arctic Oil& Gas conference 2013.	36
Ehlers, S. (NTNU) (2013). Technological frontiers in the high north. Ocean Technological Summit, Conference.	37
Gordeeva, T.S. (2013). Identification of Criteria for Selection of Arctic Offshore Field Development Concept.	38
Henningsgård, S. (2013). Operational Risk in the Norwegian Barents Sea.	40
Torsæter, M. (SINTEF) (2013). Ensuring safe and cost efficient Arctic wells. Arctic Oil& Gas conference 2013.	41
US Dep. of the Interior (2013). Review of Shell's 2012 Alaska offshore oil and gas exploration program.	43
Wassing, A., van der List, R. (2013). Development of solutions for Arctic offshore drilling. SPE Arctic and Extreme Environments Conference, Moscow, Russia, 15.17 October, 2013.	45
Berg, T.E., Berge, B.O. (2012). Arctic intervention vessels - design considerations and verification studies. Berg, T.E., Berge, B.O. (2012). Arctic Technology Conference, Texas, USA, 3-5 December, 2012.	47
Masterson, D.M. (Chevron, Canada) (2012). The Arctic Islands Adventure and Panarctic Oils Ltd. Cold Regions Science and Technology 85 (2013) 1–14.	50
Oljedirektoratet (2012). Teknologikutvikling. Konsekvensutredning for Barentshavet sørøst.	52
Lubbad, L.K. (2011). Some Aspects of Arctic Offshore Floating Structures.	53
Zhang, D., Yue, Q. (2011). Major challenges of offshore platforms design for shallow water oil and gas field in moderate ice conditions.	54
Eik, K.J. (2010). Ice Management in Arctic Offshore Operations and Field Developments.	55
Hauge, M. (2012). Arctic Offshore Materials and Platform Winterisation. Proceedings of the Twenty-second (2012) International Offshore and Polar Engineering Conference Rhodes, Greece, June 17–22, 2012.	58
Horn, A.M., Østby, E., Hauge, M., Aubert, J.-M. (2012). Robust Material Qualification for Arctic Applications. Proceedings of the Twenty-second (2012) International Offshore and Polar Engineering Conference Rhodes, Greece, June 17–22, 2012.	59
7 BEREDSKAP	60
Ims, B. (2013). Emergency preparedness in Arctic oil and gas exploration.	60
Basharat, S. (2012). Proactive Emergency Preparedness in the Barents Sea.	61
Jacobsen, S.R., Gudmestad, O.T. (2012). Evacuation from Petroleum Facilities Operating in the Barents Sea. Proceedings of the ASME 2011 31st International Conference on Ocean, Offshore and Arctic Engineering OMAE2012 July 1-6, 2012, Rio de Janeiro, Brazil.	62
Jacobsen, S. (2012). Evacuation and Rescue in the Barents Sea, Critical issues for safe petroleum activity.	63
Preventor as (2012). Områdeberedskap på norsk sokkel. Underlagsrapport med dokumentasjon av forutsetninger og faglige vurderinger i Norsk olje og gass 064: Anbefalte retningslinjer for etablering av områdeberedskap. Rev. li , 12.9.2012.	66

Proactima (2012). Beredskap og støttefunksjoner. Underlag for konsekvensutredning Barentshavet sørøst.	67
Safetec (2012). SAR-ressursene i oljenæringen og fiskerinæringen. ST-04555-2. Rev. 2.	71
Ly, J.M., Bjerkemo, O.K. (2011). Prevention, preparedness, and response to shipping incidents in the Barents Sea. 2011 International Oil Spill Conference.	72
Forsvarets Forskningsinstitutt (FFI) (2010). Kystvaktens oppgaver. FFI-rapport 2010/01312	73
8 LOGISTIKK.....	75
Analyse&Strategi, Multiconsult, DNV, Perpetuum as (2012). Infrastruktur og logistikk ved petroleumsvirksomhet i Barentshavet sørøst.	75
Konsekvensutredning for Barentshavet sørøst.....	75
AVINOR (2012). Konsekvenser for luftfart. Konsekvensutredning for Barentshavet sørøst. Avinor rapportnr: 12/04416.....	77
9 REGELVERK, STANDARDER, RETNINGSLINJER	78
Eriksson, S. A. (2013). Standardization – cooperation for safety in the High North. Arctic safety conference.	78
Mosesyan, M., Mukhoryamov, M. (2013). Arctic Drilling Activities: Critical Review of the International Safety Standards, Technical Regulations and Regulatory Regimes. SPE Arctic and Extreme Environments Conference & Exhibition, Moscow, Russia, 15–17 October 2013.	79
Aronson, J.G, Raykin, V. (2012). Achieving international standards in the Arctic: the need for modern interdisciplinary technical and management approaches. SPE/APPEA International conference on health, safety, and environment in oil and gas exploration and production, Perth, Australia, 11-13 September, 2012.	81
Barents2020 (2012). 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 Phase 4.....	82
Arctic Council (2009). Arctic offshore oil and gas guidelines.....	86
10ANNET	87
i-Sea as (2013). A report on the Arctic Council.	87
Maritim21 (2012). En Helhetlig Maritim Forsknings- og Innovasjonssatsing. Innsatsområde: Maritim transport og operasjon i arktiske områder.	89
Taylor, R.S., Murrin, D.C., Kennedy, A.M., Randell, C.J. (2012). Arctic development roadmap: Prioritization of R&D. Offshore Technology Conference, Houston Texas, USA, 30 April - 3 May, 2012.	91
University in Tromsø, University in Stavanger, IRIS, Norut, Akvaplan-niva. (2012). Roald Amundsen Petroleum Research.	93

Rapporten er utarbeidet av Proactima ved Sigrun Einarsson, Espen Hoell og Hans Jacob Beck. Rapporten er ikke komplett, men representerer det omfang som har vært tilgjengelig for sekretariatet / HMS-Utfordringer i Nordområdene fram til sommeren 2014.

[Tittel]

1 FØRINGER FRA REGJERING/MYNDIGHETER

Petroleumstilsynet (2013). Hovedprioriteringer 2014.			
Oppdragsgiver:		Dokument:	Rapport
Nøkkelord:	Petroleumstilsynet, hovedprioriteringer, nord, 2014		
Bakgrunn Hovedprioriteringene (HP ene) er områder Ptil mener det er spesielt viktig at næringen arbeider med i året som kommer. HP ene er valgt på bakgrunn av vår kunnskap og erfaring om virksomheten, og er tydelig forankret i risiko- bildet i petroleumsvirksomheten. Prioriteringene skal både vise vei og påvirke næringen i arbeidet med å kontinuerlig forbedre sikkerhetsnivået - og bidra til å nå Stortingets mål om at Norge skal være verdensledende på sikkerhet i petroleumsvirksomheten. Hovedprioriteringer for 2014: er (1) Nord, (2) Barrierer, (3) Risikoutsatte grupper, (4) Ledelse og storulykkesrisiko. Mål for nordlige farvann Petroleumsvirksomhet i nordlige farvann av norsk sokkel skal foregå forsvarlig og ivareta sikkerheten for mennesker, miljø og økonomiske verdier. Begrunnelse Nordlige farvann av norsk sokkel er sensitive og krevende områder som introduserer nye og flere risikoforhold som må håndteres for å drive forsvarlig virksomhet. De naturgitte forholdene på den nordlige delen av sokkelen byr på utfordringer knyttet til teknologiske og operasjonelle løsninger, beredskap, logistikk, personlig utstyr/bekledning, geografi, tilgang på rigger og utstyr, kvalitet på rigger, samarbeid om rigger, vinterisering og transportløsninger. Petroleumsvirksomhet i nordområdene vil øke i årene som kommer – både på norsk og utenlandsk sokkel. Viktige beslutninger skal tas om aktiviteten i nord i tiden framover, og Ptil har en avgjørende rolle i dette. Næringen - må ha nødvendig oversikt og kontroll over de viktigste bidragsyterne til risiko for storulykker, skader på det ytre miljø og arbeidsbetinget sykdom og skade knyttet til virksomhet i nord. Selskapene må være proaktive og systematiske i sin kunnskapsutvikling og læring fra forskning, utvikling og erfaring fra operasjoner i nordområdene. Oppmerksomhet må rettes mot tetting av kunnskapshull. Næringen må utvikle og videreutvikle robuste tekniske og operasjonelle løsninger for å opprettholde et forsvarlig sikkerhetsnivå. Samarbeid er nøkkelen til god sikkerhet knyttet til operasjoner i nord. Det må inngås forpliktende og konkret samarbeid mellom selskapene. Bransjeorganisasjonene må jobbe for felles løsninger. Partene må bidra til et godt og velfungerende trepartssamarbeid om utfordringer i nord. Petroleumstilsynet - Vi vil bidra til at næringen arbeider mot en helhetlig og robust tilnærming til utfordringene i nord. Vi stiller strenge krav og har store forventninger til selskapene som skal operere i de klimatisk og geografisk utfordrende nordområdene. Vi vil følge opp at aktørene bidrar til utvikling av ny kunnskap og bedre løsninger for sikkerhet, beredskap og arbeidsmiljø i nord. Hver enkelt aktør – og næringen samlet - må arbeide for et seriøst, trygt og inkluderende arbeidsliv. Vi vil videreutvikle samarbeidet innenfor vårt myndighetsområde i nord med andre relevante myndigheter. Vi vil også videreutvikle samarbeidet med andre arktiske lands myndigheter. I 2014 vil vi vurdere behov for tilpasninger/oppdateringer i regelverket og følge opp standardiseringsarbeidet for arktiske operasjoner.			

Oppdragsgiver:

UD

Dokument:

Rapport

Nøkkelord:

Nordområdene, strategi

Bakgrunn

Utenriksministeren oppnevnte i april 2010 Nordområdeutvalget for å få råd om hvordan handlingsrommet som følger av utviklingen i nordområdene kan nyttes for å bedre grunnlaget for verdiskaping i Norge, men særskilt den nordlige landsdelens rolle i verdiskapingen. Utvalgets funksjonstid var 2010-2013 (3 år).

Oppsummerende tiltak

- Gi kunnskapsinstitusjonene i nord nasjonalt ansvar for utvikling av kunnskap innenfor områder som er særlig relevant som grunnlag for verdiskaping i nordområdene.
- Sentrene i nord, som arbeider med å utvikle kunnskap om verdiskaping, bør forsterkes og flere nasjonale oppgaver bør kanaliseres gjennom disse sentrene.
- "Forskningsløft i nord" må videreføres og bidra til å forsterke koblingene mellom næringslivet og kunnskapsinstitusjonene i de tre nordligste fylkene.
- I Barentssamarbeidet må arbeidet med utvikling av kunnskap forsterkes.
- Stimulere til en styrket arena i nord for formidling av kunnskap på nordområde-arktiske forhold.
- Etablere et senter eller nettverk for kunnskapsutvikling for alle sider av oljevern i nord.
- Etablere et senter eller nettverk for kunnskapsutvikling innenfor beredskap og sikkerhet i nord.
- Utvikle grenseoverskridende kunnskap om verdiskaping og levekår, med fokus på urfolk.
- Stille krav til dokumentasjon av urfolkskompetanse hos store selskaper som skal operere i områder med urfolk.
- Ved utvinning av naturressurser, pålegge selskapene å bidra til utviklingsfond/program for de tradisjonelle urfolksnæringer.
- Utvikle modeller som bidrar til at relevant utdanning for næringslivet kan skje i nærmere samarbeid mellom videregående skole og høyskole/universitet.
- Etablere finansiell ordning for unge entreprenører som starter ny virksomhet i nord.
- Nordområdekunnskap må inn i grunnskolenes læreplaner.
- Styrke fagutdanninger i nye sektorer med stort utviklingspotensial som energisektoren og bergindustri.
- Flere basis studieplasser i nord på det maritime fagområdet
- Økt forskning i alle ledd innenfor bergindustri/ mineralressurser.
- Videre satsing på rom-jordaktivitet i aksene Svalbard-Tromsø-Andøy-Narvik.
- Etablere nasjonale knutepunkt for maritim næring for å sikre kompetanse innenfor teknologi, operasjoner, ledelse og sikkerhet.
- Etablere forskningsprogram for sikre operasjoner i nord som dekker hele fagområdet.
- Sikre nødvendige driftsmidler for bruk og videreutvikling av simulator for isnavigasjon.
- Satsingen på oppdrett av nye (marine) arter må videreføres.
- Satsingen på (marin) bioteknologi må videreføres/ styrkes – også på virkemiddelapparatetsiden.

Industriklynger og verdikjeder: Petroleumsnæringen - forslag til tiltak

- Utvalget ser det som meget viktig at oljeselskapene sikres tidsriktig tilgang til nye leteområder.
 - Utvalget mener det bør åpnes for en konsekvensutredning etter Petroleumsloven av Nordland VI, VII og Troms II med sikte på å åpne disse for petroleumsvirksomhet, men med strenge krav til miljø, sikkerhet og beredskap, samt til sameksistens med andre næringer.
 - Havområdene ved Jan Mayen og Barentshavet sørøst bør åpnes.
- Utdanning/kompetansetiltak
 - Konkretisering av mål for regionale og lokale ringvirkninger i PUD.
 - Etablerte base- og driftsmiljøer i nord må styrkes og videreutvikles.
 - Offentlig tilstedeværelse i Nord-Norge av myndighetsorganisasjoner, herunder spesielt reetablering av Petroleumstilsynet.
 - Planprosesser må effektiviseres for ikke å undergrave vekst og videre utvikling og for å sikre gjennomføringsevne.

Nærings og handelsdepartementet (NHD) (2013). Stø kurs 2020. Regjeringens maritime strategi.

Oppdragsgiver:

NHD

Dokument:

Rapport

Nøkkelord:

NHD, maritim, strategi

Strategiske innsatsområder:

1. Global regulering og konkurransedyktige rammevilkår
2. Miljøvennlige maritime næringer
3. En kompetansebasert maritim næring
4. Maritim forskning og innovasjon
5. *Det maritime nord*

Det maritime nord - muligheter og utfordringer frem mot 2020

Bærekraftig utvikling av økt aktivitet i nord representerer store muligheter. Allerede vedtatt utvikling av olje- og gassressurser på norsk sokkel i nordområdene vil bidra til betydelig verdiskaping. De maritime næringer spiller en viktig rolle for at denne utviklingen kan skje på en miljøvennlig og sikker måte.

Økt maritim aktivitet og nye seilingsleder lenger nord og øst vil etter hvert også skape nye muligheter. Samtidig representerer ekstreme værforhold, periodevis mørketid, tidvis islagte farvann, lange avstander, mangelfulle kommunikasjonssystemer og infrastruktur utfordringer for både skip og mannskap. Det blir viktig å bidra til utvikling av forskning og innovasjon rettet mot maritim aktivitet i nordområdene, og å styrke infrastruktur for kommunikasjon og kartdekning.

- Manglende infrastruktur og lange avstander gjør søk og redning vanskelig.
- Manglende kartdekning av havområdene i nordområdene utgjør en sikkerhetsrisiko for sikker navigasjon.

Det maritime nord - tiltak

1. Norsk Romsenter igangsetter "Prosjekt satellittbasert kommunikasjon" på vegne av Nærings- og handelsdepartementet for å utrede mulige konsepter for å sikre etablering av robuste systemer for kommunikasjon via satellitt, samt vurdere behov for eventuelle ad hoc nød- løsninger for kommunikasjon nord for 75 grader nord.
2. Regjeringen vil være en pådriver gjennom IMO for å ferdigstille et bindende globalt regelverk for seilas i polare farvann (Polarkoden).
3. Regjeringen vil arbeide aktivt gjennom IMO for å få på plass et bindende globalt regelverk med krav til opplæring av sjøfolk som skal operere i polare farvann.
4. Regjeringen vil arbeide for å få på plass en bedre kartdekning av havområdene rundt Svalbard.
5. Regjeringen vil utrede behovet for å etablere et nasjonalt kompetansesenter for utdanning av sjøfolk for seilas i polare farvann, innenfor rammen av etablerte institusjoner lokalisert i landsdelen.
6. Regjeringen vil vurdere å bygge ut et system for landbasert AIS-kjede langs de mest trafikkerte seilingsledene på Svalbard.
7. Regjeringen vil gjennomgå faggrupperapporten om norske interesser i lys av at nordlige hav- og kystområder åpnes for økt maritim aktivitet, med sikte på oppfølging av relevante anbefalinger.
8. Regjeringen vil sette av inntil 200 millioner kroner i NTP 2014-2023 til oppgradering og bygging av ny havneinfrastruktur i Longyearbyen.

Utenriksdepartementet (UD) (2011). Nordområdene. Visjon og virkemidler. (Nordområdemeldingen).

Oppdragsgiver:	UD	Dokument:	Meld.St. 7 -2011
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Nøkkelord:	Nordområdene, strategi
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Bakgrunn

Nordområdene er regjeringens (Stoltenberg II) viktigste strategiske satsingsområde i utenrikspolitikken, som nedfelt i regjeringserklæringene Soria Moria I og Soria Moria II. I Meld. St. 7 er det en helhetlig gjennomgang av norsk nordområdepolitikk, med vekt på hvordan regjeringen mener Norge bør møte utfordringer og muligheter i nord i et generasjonsperspektiv.

Strategiske satsinger - resultater og prioriteringer

1. Norge skal være ledende på kunnskap om, for og i nordområdene
2. Regjeringen vil hevde suverenitet og utøve myndighet i nord på en troverdig, konsekvent og forutsigbar måte
3. Regjeringen vil at Norge skal være den fremste forvalter av miljøet og naturressursene i nordområdene
4. Regjeringen vil styrke overvåking, beredskap og sjøsikkerhet i de nordlige havområder
5. Regjeringen vil styrke og videreutvikle samarbeidet med Russland
6. Regjeringen vil styrke og videreutvikle samarbeidet med de øvrige arktiske stater og intensivere dialogen med andre partnere vi har felles interesser med i Arktis
7. Regjeringen vil styrke samarbeidet i Arktis råd og i regionale fora som Barentssamarbeidet og Den nordlige dimensjon
8. Regjeringen vil fortsette arbeidet for gjennomføring av havretten, og videreutvikle standarder og regelverk på relevante områder
9. Regjeringen vil legge til rette for videreutvikling av en bærekraftig fiskeri- og havbruksnæring i nord
10. Regjeringen vil *legge til rette for en forsvarlig utnyttelse av petroleumsressursene i nord*
11. Regjeringen vil *legge til rette for sikker sjøtransport og maritim næringsvirksomhet i nord*
12. Regjeringen vil fremme landbasert næringsutvikling i nord
13. Regjeringen vil, også i samarbeid med våre naboland, videreutvikle infrastrukturen i nord for å støtte opp om næringsutvikling
14. Regjeringen vil at nordområdepolitikken fortsatt skal bidra til å trygge urfolks kultur og livsgrunnlag
15. Regjeringen vil videreutvikle kultursamarbeidet og folk-til-folk-samarbeidet i nord

PAME (Protection of the Arctic Marine Environment Working Group) (2014). Arctic Offshore Oil and Gas Guidelines (AAOGG): Systems Safety Management and Safety Culture. Avoiding Major Disasters in Offshore Oil and Gas Operations.

Oppdragsgiver: Arctic Council

Dokument:

Report

Nøkkelord: Arctic, safety

Purpose:

The discussion and guidance provided in this report serve to identify some of the areas that are under the control of Arctic regulators and the measures governments can take to improve systems safety and safety culture in the industry while operating in the Arctic offshore.

The areas recommended for safety systems management guidance are limited to the following nine categories:

1. Continuous Improvement
2. Risk Assessment/Hazard Identification
3. Management of Change
4. Training and Competence for Arctic
5. Accountability and Responsibility
6. Operating Procedures
7. Quality Assurance/Mechanical Integrity
8. Documentation and Reporting
9. Communication

In preparing the guide, PAME drew on the investigations and recommendations from the Deepwater Horizon accident (as well as numerous other investigations and hearings) and two specific workshops where international experts from governments, various industries, academia, indigenous peoples organizations, and other Arctic stakeholders were brought together for presentations and discussions.

Ch. 5: Lessons learned from international experience

The report briefly reviews major accidents, such as Piper Alpha and Deepwater Horizon.

A study done by Det Norske Veritas (DNV) for the National Energy Board Canada's Arctic Drilling Review on causes of eight major industrial accidents showed failure in four main safety management systems elements:

- **Disconnect in Policies vs. Plan--Do--Check--Act (Safety Culture):** There was a notable disconnect between the company's vision and policies ('what they say') and their planning, implementation, monitoring and review ('what they do').
- **Policy, Commitment and Planning:** Policy and Commitment statements were present in all accidents but planning elements such as the following were deficient including: hazard identification, risk assessments, and related controls.
- **Implementation:** Management system elements common to all of the accidents included: the lack of communication; documentation and document control; poor operational control; and inadequate management of change; and lack of adequate training.
- **Corrective Actions & Management Review:** Checking and review elements are critical to ensuring continuous improvement within the system and the following factors contributed to all of the accidents: deficient inspections and monitoring; inadequate corrective and preventive actions to address identified deficiencies; poor records management; poor internal audits; and lack of adequate management review.

In a Bureau of Safety and Environmental Enforcement-BSEE (U.S.) analysis of 1000 accident investigations in the U.S., failure to address at least one of the following safety management elements was found as a contributing factor or root cause in each of the 1000 incidents evaluated:

1. Hazard Analysis
2. Operating Procedures
3. Quality Assurance and Mechanical Integrity

4. Management of Change

Two offshore oil and gas workshops were held in support of the project. The workshops concluded (i.a.) that certain elements of safety management systems have been found to be at the core of major accidents (see the nine categories listed under Purpose, above).

Ch. 6: Some regulatory regimes and standards around the Arctic

The report discussed briefly *Performance Based Regulations* vs. *Prescriptive Regulations*, and common Arctic standards and Best Practices. There are few standards related to the Arctic specific aspects of offshore operations. Many existing and newly-developed international standards may be appropriate in the Arctic and thus address to some extent the call for the use of international standards in the Arctic²³. However, systematic review of globally applicable international standards for suitability in the Arctic has only been done for a few of the available standards.

Ch. 7: Guidance Tools and Approaches for Improving Safety Culture and Safety Management Systems

See report for Recommended Actions/Approaches on the topics below.

Safety Culture:

Some key challenges to fully adopting and delivering an effective safety culture include:

- Unacceptable Behaviour accepted as Normal Practice (Normalization of Deviance from Safety Policy and Procedures)
- Complacency
- Tolerance of Inadequate Systems or Resources
- Work Pressure

Safety Management System:

Some key challenges related to Safety Management System:

1. Continuous Improvement

- Cooperation between Regulator and Operator can sometimes be elusive or strained.
- Data are not always available or collected routinely.
- Data are not analyzed for identifying opportunities for improvement.
- Data collected may vary considerably and lack of industry standards may result in an inability to benchmark or compare performance.
- Operator may not have an effective system to improve performance based on their performance assessments.
- Operator may not always implement their safety management systems effectively.

2. Risk Assessment/Hazard Identification

- Risk analysis for low-probability, high-consequence events is complicated due to the lack of adequate statistical data.
- The complex structure of the offshore oil and gas industry and the variety of technical expertise can adversely affect the ability to perform and maintain margins of safety.
- Different methodologies used by regulators and industry present challenges to establishing and comparing risk assessment and hazard analyses.
- Detecting and mitigating change in risk can sometimes be elusive.
- Uneven levels of uncertainty, complexity, hazards, consequences, and overall risk in Arctic conditions can frustrate analyses.
- Incremental addition of risk resulting from decisions and actions taken across units, departments, and contractors that individually fall within the prescribed safety envelope can cumulatively raise the level of total risk for the operation beyond acceptable limits.
- Possible difficulty convincing shareholders to spend the money necessary to prevent a 'once-in-a-career' disaster.

3. Management of Change

- Developing appropriate risk analysis processes and tools for handling of changes to the drilling plan during the operational phase.
- Managing complex operations that change due to extreme or dynamic Arctic environmental conditions.
- Improving safety management systems which might include poor training, poor risk assessment,

deficient documentation and inadequate communications.

- Augmenting awareness of exactly what constitutes 'change'.
- Ensuring resiliency/flexibility is built into the safety management systems.
- Reversing the poor safety culture that may exist.

4. Training and Competence for Arctic

- Qualified and Arctic-experienced personnel may be difficult to recruit.
- It may be difficult to find and hire personnel experienced and capable in more than one subject area and who are expected to perform well often under extreme and isolated conditions with limited supervision, communications and transport capability.
- Difficulty engaging regulators with the training and experience needed to effectively handle a wide scope of issues and circumstances.
- Recruiting and maintaining a trained and competent regulatory workforce is difficult

5. Accountability and Responsibility

- Standard communication processes do not necessarily translate to the Arctic. Lines of authority can sometimes be blurred or unclear between the field and the head office and even between the drill floor and the control room.
- Shifting the focus of the regulator from prescribing operational specifics to assessing, verifying, improving and enforcing the operators' management system and safety performance levels.
- Preventing corporations from sometimes undermining positive safety culture
- Maintaining strong, direct management and oversight and dealing clearly and effectively with layers of contractors, subcontractors and sub-subcontractors in the Arctic petroleum industry.
- Addressing the many and varied cultural attitudes and responses to high-hazard operations.

6. Operating Procedures

- Limited experience related to Arctic-specific features compared to other offshore petroleum operating regions.
- Use of subarctic operating practices may be inappropriate, ineffective, or need modification in some parts of the Arctic.
- Higher operating costs.
- Lack of adequate preparation can put pressure on operations and schedules at the end of the operating season
- Operating procedures at different locations can, to varying degrees, be affected by darkness, extreme cold, ice, extreme weather, structure icing, environmental sensitivity, remoteness, and a relatively short exploratory drilling season. This can place extra work pressure on operators to get the job done
- Operating procedures used in the Arctic must often be adjusted to respond to the diverse conditions in different regions and seasons.
- Operational procedures may need to be modified for drilling and non-drilling activities and from periods of mobilization to demobilization.

7. Quality Assurance/Mechanical Integrity

- Equipment and facilities may require especially scarce or difficult to replace components.
- Depending on location, exploratory drilling season may last only 2-3 months and place extra pressure to perform makeshift repairs or delay maintenance in order to meet operational schedules.
- Maintenance management can be particularly challenging due to remoteness and difficult working conditions adversely affecting ready access to equipment.

8. Documentation and Reporting

- Timely documentation may be compromised by relatively short exploratory Arctic drilling seasons as compared to other regions.
- Documentation, reporting and approvals may be more difficult for some Arctic operations due to inadequate or interrupted communications with the headquarters office and with the regulators.
- Operational changes due to sudden harsh environmental conditions or unexpected equipment issues may be hampered by working and/or environmental conditions or go undocumented due to pressures to stay on schedule.

9. Communication

- Communications on the drilling rig or production platform may be difficult due to a lack of support infrastructure and decreased satellite coverage at high latitudes.
- Delays or interruptions in communications due to extreme cold or extreme weather conditions.
- In a relatively short exploratory drilling season, pressures for completion of the program may defer or

reduce important communications between the different operations groups.

Appendix A. Summary Table of Selected Safety Management Systems Requirements for Norway, Canada, Greenland and the United States.

Appendix B. Deepwater Horizon Findings and Recommendations and Results of Regulatory Reviews and Reforms from the HSE Management Systems and Safety Culture Workshops.

Appendix C. Table of Deepwater Horizon and Other Investigations

Appendix D. List of HSE Guidance

Appendix E. Current National HSE Initiatives

Appendix F. Safety Culture - Definitions, Attributes and Indicators

Appendix G. Some Regulatory Coordination Mechanisms

Appendix H. Existing Arctic Council Guidance

2 TVERRFAGLIG

Olsen, A. (Transocean) (2013). Arctic safety experiences and challenges. Arctic safety conference.			
Oppdragsgiver:	PSA	Dokument:	Presentation
Nøkkelord:	Arctic, safety		
Lessons learned • Helicopter transport ◦ Irregular flights, de-icing, loading capacity versus crew change needs, etc. • Emergency preparedness ◦ SAR – customer handle very well ◦ Evacuation ◦ Diagnosing facilities for medical emergencies • Clean rig – environmental focus ◦ Procedures – constantly improving ◦ Isolation of hydraulic systems & routine checks ◦ Drills, familiarization to enhance awareness ◦ Bunkering processes ◦ Drain system • Cold climate ◦ PPE, dress requirements, learning ◦ Use of habitats to protect outdoor work areas (BOP) ◦ Monitoring Chill-Factor • Support systems or infrastructure ◦ Weather forecasts ◦ Station keeping reference systems ◦ Selection process for support vessels – is robust ◦ Longer logistic routes can lead to waiting on supplies • Rig condition ◦ Winterization systems – maintenance and upkeep ◦ Dropped objects due to ice – an additional risk ◦ Ice & Snow clearing - not a major challenge on our rigs ◦ Prefer enclosed drill floors, with proper risk evaluation (gas)			
Summary experiences • Weather conditions are more stable and favorable than the Norwegian Sea, but the temperatures are lower - often long wave periods • Icing, snow, darkness not so challenging, Chill Factor is a key issue • Environmental awareness training, procedures and constant focus • Feedback from personnel; there are few challenges and not so many differences compared to other Norwegian Sea operations • Procedures must be tailored towards colder climates, experience over years is a significant advantage preventing stops and problems • Winterization Manual is appropriate to ensure robustness of the unit's equipment and systems in Arctic waters • Planning, cooperation and support from customer and customer provided infrastructure is key			
Future high Arctic - some considerations • Perception and public opinion • Polar ecosystems – environmental footprint • Risk approach ◦ Multi DSHA scenarios - remoteness • Ultimately operations in ice infested waters ◦ Moored – DP ◦ Ice management			

- Drillship seem to becomes the preferred rig solution
- R&D on equipment components
 - Cold climate – reliability «outdoor» equipment incl integrity
- Several logistical topics to be addressed
 - Waste, crew, remoteness, etc. Including risk evaluation

NOROG (2012). HMS-utfordringer i nordområdene.			
Oppdragsgiver:	Sikkerhetsforum	Dokument:	Presentasjon
Nøkkelord:	HMS, nordområdene		

Sikkerhetsforum - er den sentrale samhandlingsarenaen mellom partene i næringen og myndighetene innen helse, miljø og sikkerhet i petroleumsvirksomheten på norsk sokkel og på land.

Utfordringer:

- **Subpolart klima**
 - Ising
 - Polare lavtrykk
 - Vind
 - Lavtrykk og nedbør
 - Lave lufttemperaturer
 - Driv-is: kan representere et alvorlig problem for olje- og gassaktivitet i enkelte områder
 - Havstrømmer: kan føre til at overlevelse i vann kan bli fysisk mer krevende
- **Kommunikasjon**
 - Infrastruktur
 - Dekningsområder
 - Jordmagnetisme - avvik p.g.a.«magnetisk nordpol»
 - Geomagnetiske stormer
 - Satelittdekning
- **Vinterisering og beskyttelse**
 - Innebygging av bemannede arbeidsstasjoner
 - Oppvarming av rømningsveier, redningsutstyr, sikkerhetskritisk utstyr, samlingsplasser etc.
 - Isolering
- **Bekledning og verneutstyr**
 - Tykk bekledning: Uhamslig; Vanskelig å bevege seg; Finmotorikk svært vanskelig
 - Ising / tetting av personlig verneutstyr
 - Teknologisk utvikling; nanoteknologi, ColdWear etc
- **Effekt av kulde på ytelse**
 - Arbeidsytelsen faller ved stigende og fallende gjennomsnittstemperaturer
 - Risiko for arbeidsulykker øker ved stigende og fallende temperaturer
- **Frostskafer og immersjonsulykke**
- **Kulderelaterte sykdommer**
 - I lavere temperatur øker forekomst av hjerte-karsykdom, hjerneslag, kuldeindusert astma, Raynards syndrom, kuldeurtikaria, muskel-skjelett sykdommer
- **Psykologiske aspekter (?)**
- **Avstander og logistikk**
 - Helikoptertransport (transport av personell)
 - Marine operasjoner (transport av utstyr og forsyninger)
 - Beredskap: Redning og evakuering
- **Beredskap - redningsressurser**
- **Redningsmidler**

- Utfordringer: Temperatur, Is, Tidsfaktor, Infrastruktur, •Avstander

- Overlevelse i kaldt vann

- Isolering og beskyttelse

- Telemedisin

- Det forventes økt bruk av telemedisinske løsninger for operasjoner i nordområdene

- Begrensende faktorer

- Operasjoner i Nordsjøen er i mindre grad berørt av at klimaet fører til produksjonsstopp eller operasjonelle begrensninger
- Må operasjoner i nordområdene organiseres annerledes?
 - Værrelaterte begrensninger
 - Mangel på dagslys
 - Infrastruktur
 - Avstander
 - Beredskap
 - Medisinsk evakuering

- Aggressive sjøfugler

- Angriper øyne på personer som flyter på havet

- Hyperbare mottaksfasiliteter

- Områdeberedskap (se eget sammendrag)

- Norsk olje og gass' anbefalte retningslinje 064 – Områdeberedskap er nylig revidert
 - Større redaksjonelle endringer
 - Innført ny DFU 8 – Helikopterulykke på innretningen
- Problemstillinger som ikke ble behandlet i dette arbeidet:
 - Beredskapskrav for operasjoner som ligger utenfor etablerte samarbeidsområder for beredskap, herunder nordområdene

SINTEF (2012). Marsafe Summary. Maritime Safety Management in the High North.			
Oppdragsgiver:	Norwegian Research Council	Dokument:	Report
Nøkkelord:	environment, emergency preparedness, information, communication, governance		
Objective: to identify the user requirements and technological possibilities to be able to perform safe and efficient operations in the High North. Scope: The project has studied the environmental challenges within maritime operations in the High North and has especially focused on the impact of harsh weather, low temperatures, reduced visibility, ice and icing, as well as use of on-board equipment within maritime operations in the Arctic environment. The large geographical distances in combination with poor access to qualified information, limited SAR/emergency preparedness resources, and poorly developed communication and surveillance infrastructures represent specific challenges. The project finished in 2011. MarSafe North main findings - Environment and geography • There is a need to improve the local meteorological- and ocean information forecasts, including ice forecasts, and the information should be made available to ships in near real time • Detection of ice thickness, ice bergs and smaller bergy bits is important to maintain safe navigation • Icing on ship equipment leads to hazardous work operations on deck • Qualification, certification and training of ice navigators is crucial for maritime safety • Escape, Evacuation and Rescue equipment is unfit to handle harsh Arctic environmental conditions • Long distances combined with few SAR and emergency preparedness resources and poorly developed surveillance system infrastructures leads to long response time in critical situations • Six ice trackers on ice floes drifting from the northern parts of the Barents Sea along the eastern side of Svalbard have shown that ice drifts with an average speed of 0.18 m/s and contributes to ice pollution in Isfjorden and Adventsfjorden. MarSafe North main findings - Emergency preparedness, SAR and EER • Limited SAR resources versus large distances and areas of responsibility reduce safety at sea in the High North. • Escape, evacuation and rescue (EER) equipment are often unfit for operations in Arctic areas • There are no or very limited traditions for information sharing across organisations, companies and nations in SAR operations. Shared situational awareness is important, but today completely absent, in such operations. • Places of refugee and stranding zones are so far not developed at Svalbard • Today's towing capacity in the High North is limited and does not meet the future requirements on bollard pull • The ships operating in arctic waters must have strong focus on autonomous solutions both regarding operational conditions as well as in a distress situation. If emergencies they can not rely on others then themselves. One possibility is to have collaborator operations where several ships are working in the same area at the same time. MarSafe North main findings - Information and data capture • The quality on meteorological and oceanographic forecasts and data is rather low due to low resolutions • There are no available techniques and methodologies for identifying and broadcasting information integrity. • The availability of Dynamic Risk Assessment tools for use in vulnerability analyses for Arctic operations is limited • Electronic Navigational Charts (ENC) is being used by most vessels today. However, the accuracy of these maps in Arctic areas is low due to few hydrological measurements. • Information exchange between Arctic actors only exists on a very low level today MarSafe North main findings - Communication, surveillance and tracking			

- AIS coverage in the High North is limited and should be improved, both on ground and by satellite. Increased maritime traffic needs to be monitored to obtain safety at sea.
- There is limited dGPS coverage in the High North, too limited to meet future demands from increased maritime traffic and more advanced maritime operations such as for example DP operations.
- Services based on geostationary satellites can not be considered reliable in areas above 75° North
- There is poor coverage from terrestrial communication systems such as VHF
- The only communication system offering truly global services is Iridium. However, Iridium has a limited bandwidth capacity and is for many operations not sufficient.
- Digital HF has a very large coverage area, however it has very limited bandwidth capacity

MarSafe North main findings - National and international governance

- The UNCLOSIII, SOLAS, MARPOL, STCW and SAR conventions relates to the Arctic waters in the same way as other international waters. As of today, none of these includes specific requirements for the Arctic.
- A few guidelines on how to operate in the Arctic exists, such as the IMO 'Guidelines for Ships Operating in Arctic Ice covered Waters'. Shipping companies and others decides if they want to follow the guidelines.
- Important emerging standards for Arctic maritime operations are the IMO Polar Code, ISO 19906 and IMO e-Navigation.

Gudmestad, O.T., Quale, C. (2011). Technology and Operational Challenges for the High North. Report			
Oppdragsgiver:	PSA	Dokument:	Report IRIS - 2011/166.
Nøkkelord:	operation challenges, high north, industry views, HSE		
• Background • The report summarizes information which has been collected and systemized during a project carried out in 2009-2010 with the view to map existing technologies and ongoing and needed technology developments which will contribute to safe exploitation of petroleum resources in High North areas. • The project was aimed at aspects of importance for the Health, Safety and Environment (HSE) in the Norwegian High North and covered what is relevant to: • employees' working environment, health and life • prevention of major accidents and near-miss incidents that could lead to a major accident • accident-fighting, rescue and evacuation in the event of a major accident • better risk management, including better understanding of risk, better maintenance, better • information about risk influencing factors (weather, reservoirs, etc.), better standards, etc • Information received from the industry • The most frequently mentioned concern was how to deal with oil spills. Among the ten most listed areas are a number of generic challenges (ice, logistics, working environment, rescue situations). • Some overall challenges or key factors that would influence all activities were referred as: • Harsh climate • Darkness • Understanding of cold climate issues • Snowdrift and snow protection • Operation of equipment and ships in rough, cold weather • Design and performance with weather protection in place • Low temperature design properties for equipment and materials • Distance to supply base, helicopter base and medical facilities • Technology needed for improved safety during operations - industry views: • Ergonomics and human factors • There will be need for practical solutions for the working environment, related to darkness, cold climate and distances. • Rescue and evacuation • A new preparedness regime is required for EER (emergency, evacuation and rescue). The additional requirements need to be better defined for remote EER capability, i.e. preparedness must be in place relative to factors such as distance, existing infrastructure, time to mobilise and storage of equipment. • Transport and maritime operations • Logistics functions for efficient development and operations in remote areas become challenging due to darkness, limited infrastructure, distance for oil and gas to the market, access to equipment and facilities, logistics planning. • There will be higher demands for surveillance of increased ship traffic in remote areas. • Helicopter transport • With activities distant from land, far outside the reach of helicopters, there will be lack of options for shore bases and helicopter-landing sites. This is a logistics as well as a rescue preparedness challenge. • Vessel operations • Monitoring of ice and better understanding of offshore ice conditions become important, as will technical facilities for optimization of sailing routes with respect to sea ice. • One can foresee issues related to transfer of diesel, drilling fluids, cement and other material from supply vessel onto the installation. • Dynamic positioning of stationary and mobile vessels will be more challenging since navigation tools like GPS, GLONASS etc. have limitations north of 75 degrees. • Vessel design and operation • Development of supply vessels and construction vessels for arctic conditions is addressed by the maritime sector. Hull design and maneuverability resistance in ice are some criteria that are addressed. • Challenges related to understanding of risk and the physical environment as well as listing status regarding international standards - industry views:			

- Meteorological and oceanographic data
- Metocean, ice and environmental data bases are required for improved design criteria and for timely prediction or warning of ice, extreme waves and polar lows.
- Reliable field specific data must be provided prior to development in order to meet technology challenges in a satisfactory way. It is seen as critical that existing data is made available and that newly gathered data related to the physical environment is shared.
- Seabed stability and ground
- Access to more and better (quality assured) data related to the physical environment and better understanding of seafloor conditions is required for understanding of shallow sediments and seafloor conditions, which will contribute to reduced safety risks associated with operations in the area.
- Mapping of shallow gas and hydrates is especially important.
- Recommendations
- The specifics of the High North should be highlighted in relation to personnel health and safety, the environment and to the specific requirements to ensure “winterization” of all facilities for operations in the region. The necessity to take the actual weather conditions into account during all activities must always be kept in mind.
- Research Council of Norway has an important function in supporting relevant activities. It is envisaged that the newly established Centre for Research Based Innovation at NTNU will play a major role, also for the education of specialists that are needed for the safe development of the High North. In this respect the availability to use facilities at UNIS, Longyearbyen for research should be further encouraged.
- It is recommended that contractors and oil companies continue to prepare themselves for activities in the High North. For involvement in the region there are specific challenges that require relevant competence. The training course offered by the University of Stavanger, UiS and the newly established education program between UiS and Gubkin University in Moscow may serve as basis or models for competence building.
- It is also envisaged that the educational institutions located in the High North get heavily involved in education of the personnel that will operate the onshore as well as the offshore facilities in this region.
- In order to follow international technology developments suitable for the High North it is, furthermore, recommended that international contacts be nourished. This also implies support to the potential for Norwegian authorities and specialists to contribute nationally and internationally to the safe and sustainable development of the petroleum reserves of the High North. Funds should in this respect be made available by the authorities so not only the larger oil companies and institutions can keep updated on ongoing developments. The Barents 2020 project has been an excellent program with wide national involvement.
- It is recommended that keeping abreast with technology for ice covered waters is important in view of potential resources on the Norwegian Shelf in the far High North, for example in the Svalbard Offshore Zone. The potential for export of technology and technical solutions to projects in other Arctic countries is in this respect also important for oil companies and contractors.
- It is recommended that the technology and operational needs of the normally ice free region of the Barents Sea receive an increased attention in the near future. This will be particularly important in view of the activities that can be expected relatively soon in relation to the newly identified petroleum resources in the High North and to potential activities in the former disputed zone between Norway and Russia. One may assume that large joint development projects will take place with Norwegian and Russian companies working closely together in all project phases. Where reservoirs are identified across the boundary, such joint projects might even be shared on the national level.

AMAP (Arctic Monitoring and Assessment Programme) (2009). Arctic oil and gas.			
Oppdragsgiver:	Arctic Council	Dokument:	Report
Nøkkelord:	Arctic, oil and gas		
Objective			
The objective of the report is to present an holistic assessment of the environmental, social and economic, and human health impacts of current oil and gas activities in the Arctic.			
Managing Arctic oil and gas development: recommendations			
Laws and regulations		Technology and practices ⁴	
• <i>Laws and regulations in all Arctic countries and their regional and local subdivisions should be enacted, periodically reviewed and evaluated and where necessary strengthened and rigorously enforced, in order to minimize any negative effects and maximize any positive effects of oil and gas activity on the environment and society.</i> • <i>The requirement to use best industry and international standards should be addressed in laws and regulations. Management systems and regulations should be clear and flexible, and reviewed regularly to ensure that they are effective, adequate, consistently applied, and accommodate changes in technology in a timely manner.</i> • <i>Monitoring of compliance and implementation of regulations should be improved in the Arctic countries, and appropriate authorities across the Arctic should be encouraged to adhere to and to enforce compliance with regulations.</i> • <i>An assessment of the oil and gas industry's degree of compliance with applicable domestic regulations and monitoring programmes should be undertaken.</i> • <i>Guidelines for oil and gas activities in the marine environment, and the legal framework for planning and controlling oil spill response operations in the Arctic, should be improved where necessary to reduce risks and minimize environmental disturbances.</i> • <i>Oil and gas companies should be responsible for the costs associated with risk reduction, spill response, remediation and decommissioning activities, and be prepared to share in the costs for studies and for monitoring of effects on the environment and on society associated with oil and gas development</i> • <i>Environmental impact assessments, strategic environmental assessments, and risk assessments should continue to be rigorously applied and streamlined to increase their relevance and usefulness for all stakeholders.</i> • <i>The ways in which local and indigenous knowledge has been and can be used in project planning, environmental assessment and monitoring, and regulatory decision-making should be evaluated to determine how best to involve such knowledge and its holders.</i>		• <i>Oil and gas industry should adopt the best available Arctic technology and practices currently available in all phases of oil and gas activity when undertaking such activities in the Arctic.</i> • <i>Oil and gas industry should take action to reduce the physical impacts and disturbances associated with oil and gas activities, including, where appropriate: using 'road-less' development techniques to reduce physical impacts of roads; conducting as much activity as possible in winter months to avoid effects on tundra, permafrost, streams, and water bodies.</i> • <i>Where appropriate, real-time monitoring should be used to minimize disturbances and impacts on wildlife, and scientifically-based best practices used to avoid adverse effects on marine mammals during seismic operations.</i> • <i>Tanker operations in Arctic waters should employ the strictest measures for spill prevention and response, including improved communication, training, and cargo handling techniques and the use of ice-strengthened and double-hulled vessels. International coordination of oil transport information should be improved. International standards and national legislation for ships engaged in oil transportation in seas with potential for ice problems should be reviewed for adequacy and strengthened as appropriate.</i> • <i>All pipeline projects should use the best available Arctic engineering and environmental standards, including right-of-way selection, inspection using state-of-the-art leak and corrosion detection systems, monitoring and environmental studies. Arctic design, engineering, construction and monitoring standards, and response capabilities, should be strictly adhered to and, if necessary, improved. Existing pipelines should be properly maintained and, if necessary, replaced.</i>	

Selected key characteristics of the Arctic relevant to oil and gas activities and their effects

Selected key characteristics of the Arctic relevant to oil and gas activities and their effects	
Characteristic	Relevance
Physical environment	
Cold	Difficult work conditions, especially in winter Slow weathering of oil compounds
Light/dark regime	Difficult work conditions in winter Extreme seasonality of biological production
Permafrost	Surface easily disturbed, with long-lasting effects and slow recovery of surface vegetation
Sea ice	Difficult access; difficult to respond to oil spills
Biological environment	
Seasonal aggregations of animals	Major impacts possible even from localized oil spills or other disturbance
Migration	Effects in the Arctic impact other parts of the world Effects elsewhere impact the Arctic
Intact habitats	Landscapes and wide-ranging species susceptible to major developments and to incremental growth
Short, simple food chains	Disruption to key species (lichen, polar cod) can have major impacts to many other species
Human environment	
Remote, largely roadless	Difficult to reach, especially in response to disaster Expensive to develop, transport oil and gas Major impacts possible from new roads Improved access
Few people	Major demographic changes possible from industrial activities Limited human resources to support industry; many workers required from elsewhere
Many indigenous peoples	Already changing cultures susceptible to further impacts on society, environment Indigenous rights and interests, including land ownership Business and employment opportunities Access to services (health care facilities, schools)

3 KLIMATISKE FORHOLD

Meteorologisk Institutt (2012). Bistand til OEDs åpningsprosesser for petroleumsvirksomhet i nord. Barentshavet SØ (Område 1).			
Oppdragsgiver:	OED	Dokument:	Rapport No. 2012/11.
Nøkkelord:			
Bakgrunn Rapporten gir en oversikt over dagens kunnskap om tema som vind, bølger, lufttemperatur, sjøtemperatur, fare for ising, isutbredelse og siktforhold. Rapporten angir trender som er observert samt forventet endring i et fremtidig klima. Rapporten tar også opp temaet Polare lavtrykk og aktuelle tiltak som kan bedre operasjoner under slike (lite forutsigbare) forhold. Område 1 (Barentshavet SØ) har lite måledata. Denne rapporten er derfor for en stor del basert på såkalte HINDCAST data fremskaffet vha. modeller. Modellene tar utgangspunkt i data fra observerte geofysiske felt og i dette tilfelle er det etteranalyserte felt fra det Europeiske værvarslingssenteret i Reading (ECMWF) som er benyttet.			
Sammendrag Modelldata - Utredningen baserer seg for en stor del på modell data. Disse er avledet fra etteranalyserte atmosfærefelt fra det europeiske værvarslingssenteret (ECMWF) sine etteranalyserte atmosfærefelt. Ved å benytte feltene fra ECMWF som input til atmosfære modellen HIRLAM og bølgemodellen WAM genereres NORA10 databasen som har tidsoppløsning på 3. timer og rom oppløsning på 10. km og dekker perioden 1958-2011. For Område 1 er det benyttet tidsserier fra 5 posisjoner fra denne databasen til utredningen. Ising - Sannsynligheten for ising i Område 1 øker med økende bredde. I de to nordligste posisjonene forekommer sterk ising ca.1,3 % av tiden på årsbasis mens tilsvarende tall er 0,0-0,3 % for punktene lengre sør. Lett ising forekommer i middel ca. 17 % av tiden i de to nordligste posisjonene, mens tilsvarende verdier i de tre posisjonene lengre sør er 14-16 % på årsbasis. Til sammenlikning har Goliat ikke sterk ising mens moderat ising her forekommer i ca. 10,5 % av tiden på årsbasis, som er en del lavere enn tallene fra Område1. Tåke - For Bjørnøya og Hopen er hyppigheten av tåke vesentlig høyere enn det en har på stasjonene på Svalbard. På Bjørnøya og Hopen er prosenten høyest i månedene juni-september hvor den varierer i intervallet 11-27. Resten av året ligger den i intervallet 4-8 prosent på disse stasjonene. Vardø radio har størst hyppighet av tåke i juli-august og februar med 4-7 prosent av tiden. Resten av året ligger den i intervallet 1-3 prosent med unntak for oktober da forekomst av tåke er under 1 prosent av tiden. Polare lavtrykk - Forekomsten av polare lavtrykk avtar gradvis østover i Barentshavet, men er likevel forholdsvis nært kjerneområdet for dannelse av polare lavtrykk. Det finnes ikke eksakt data på antall, men området har tilfang av polare lavtrykk ved alle vindretninger mellom vest, omkring nord og til sørøst. Et naturlig tilfangsområde kan beskrives som avgrenset av 20 graden øst til Novaja Semlja, og fra Finnmarkskysten til iskanten i nord. Innenfor dette området er det registrert ca. 40 polare lavtrykk fra 2000 til 2012, hvorav en del har bestått av to eller flere sentra. Is - I perioden som er dekket av iskart 1967-2012 er forekomst av havis vanlig i den nordlige delen av Område 1, men en har ikke observert at Barentshavet har vært dekket av is og nærmet seg Finnmarkskysten etter 1929. Isutbredelse har sesongvariasjon med maksimum i februar mars. Månedene juli-september er isfrie. Tendensen er at isutbredelse i Barentshavet minker.			

4 KOMMUNIKASJON

Kvamstad B. (SINTEF) (2013). Flying High: Arctic Communication. Ocean Technological Summit, Conference.

Oppdragsgiver:

Dokument:

Presentation

Nøkkelord:

Arctic, communication

Satellite communication in the Arctic

- LEO: Satellite->Gateway<->Satellite transmission
 - Low bandwidth (~ GSM -> GPRS ???)
 - High and unpredictable latency
 - Uncertain coverage of the High North
- GEO: Expensive low bandwidth
 - Insufficient coverage of the High North
- HEO:
 - No commercially available communication systems, yet

Communication at high latitudes

	System	Characteristics	Polar (>80°N)	Sub-Polar (70°N - 80°N)	Other (<70°N)
Terrestrial systems	HF, MF	Safety related messages and voice communications	OK, but unsuitable for digital communications	OK, but unsuitable for digital communications	OK, but unsuitable for digital communications
	VHF, digital VHF, GSM, 3G	Line-of-sight, voice and low data rate communications	No base stations, ship-to-ship OK	Few base stations, ship-to-ship OK	VHF is OK close to the coast, GSM/3G limited coastal coverage
Satellite systems	GEO satellites, including Inmarsat.	Medium capacity. Low to medium latency.	Not available	Potential problems with quality and availability	OK (except in fjords and similar special areas)
	LEO satellites; Iridium OpenPort	Currently max. 128 kbps. High and variable latency.	Potential problems with quality	Potential problems with quality	OK, except for areas around equator
	HEO satellites	Properties comparable to GEO. Currently unavailable.	Expected to provide good coverage, capacity and quality in the Polar and Sub-Polar areas. Spare capacity can be used in other sea areas. Not yet implemented.		

Other drivers for improved communication infrastructure in the Arctic

- Increased reporting in fishery, fishery surveillance (internet, sensors, video, satellite)
- Increased requirements to cargo surveillance (sensors and video)
- Environmental surveillance, preventive actions for hindering pollution (navigational and environmental information)
- Overview of external operational influencing factors within advanced marine operations (sensors, sensor networks, radars, internet, satellite images)
- Telemedicine (video)
- Less people offshore – more remote control and monitoring of operations from shore (video)
 - Use of video for real time monitoring of towing operations (the Norwegian Coastal administration)
- Largest requirements will appear from oil and gas industry

Summary

- Communication in the Arctic is challenging
- The user needs are increasing
- We need to develop long term robust and reliable communication systems (HEO satellites?)
- We need to raise awareness

Barth, V.L. (2012). Romværinfrastruktur i Norge - eksisterende og ønsket infrastruktur. Norsk Romsenter-Rapport.

Oppdragsgiver:

Dokument:

Rapport

Nøkkelord:

romværværsling

Bakgrunn

Romvær er betegnelsen på kortvarige forandringer av forhold i verdensrommet som påvirker jorda og våre teknologiske systemer. En god og pålitelig romværværsling vil være til stor nytte for Norge med den store og stadig økende aktiviteten i nordområdene.

Jordas øvre atmosfære og nære verdensrom påvirkes i hovedsak av aktiviteten på sola, og følges i stor grad av solsyklusen (11 år). Jorda påvirkes av disse solutbruddene når de har retning mot jorda. Romværet påvirker radiokommunikasjon og navigasjonssystemer, strålingen kan degradere og ødelegge elektronisk utstyr i rommet og den kan utgjøre en risikofaktor for menneskap på bemannede romferder. Forstyrrelsene fører også til induserte strømmer (Geomagnetic Induced Currents (GIC)) i jordoverflaten og induserte strømmer i elektrisk ledende strukturer på bakken.

Eksperter er uenige i konsekvensene av en ekstrem solstorm og en påfølgende ekstrem geomagnetisk storm. Konsekvenser for Norge kan være:

Satellitter

- Tap av satellitt, skade på elektronikk, solcellepanel og strømsystemer
- Ladede partikler, overflateladning
- Økt friksjon, orienteringsproblemer, romskrot kan utgjøre en
- kollisjonsrisiko osv.

Økt stråling

- Strålefare for crew og passasjerer ombord på fly
- Påvirke elektronikk
- Fare for mennesker i rommet, økt kreftrisiko
- Variasjoner i UV-stråling kan degradere baner under omlag 1000 km

Induserte strømmer (GIC)

- Kraftnettet: tap av transformatorer - strømbrudd
- Økt korrosjon på rørledninger
- GIC kan også påvirke signalsystem på tog

Navigasjon

- Feil i dynamisk posisjonering/navigering som følge av signalvringing eller tap av signal fra satellitt
- Eks: skip, biler, fly, retningsstyrt boring, jordbruk, anleggsbransjen

Kommunikasjon

- Ionosfæredynamikk kan degradere og forsinke signaler i kommunikasjonssystemer fra HF til L-bånd.
- VHF/HF påvirkes og kan falle helt ut, spesielt i nordområdene.

Brukere i Norge som vil ha stor nytte av en romværtjeneste:

Satellittoperatør

- AISSat-1:NRS/FFI/Kystverket
- Thor: TelenorSatelliteBroadcasting

Luftfart

- Luftfartsverket
- Søk og redningstjenesten
- Avinor
- Lufttransport
- Postfly
- Ambulansefly

Kraftmarked

- Statnett
- NVE

- Ønsket fra Europa er 24 timers dekning med data gjennom internasjonalt samarbeid.



Infrastruktur i Norge og i Nordområdene.
Blå skrift er eksisterende utstyr, mens rød skrift er ønsket infrastruktur.

- Tette opplagte hull i dagens dekningsområde i Arktis og i Antarktis
- Stimulere teknologiarbeid
- Planlegge fremtidig finansiering
- Politisk hjelp/rådgivning

5 HELSE OG ARBEIDSMILJØ

Balfour, A. (HFS) (2013). Human factors in the Arctic. Arctic Oil& Gas conference 2013.			
Oppdragsgiver:		Dokument:	Presentation
Nøkkelord:	human factors, Arctic		
Human factors			
Knowledge about people and how they interact with equipment and systems; the scientific study and practice of applying knowledge on people to the design and evaluation of products, systems, services and environments.			
Human factors is Interaction between what happens in the workplace/layout/environment, equipment/products, interaction design, and organization/manning.			
80% of incidents are related to human behavior, while 80% of the solutions are of technical nature.			
We don't have accepted standards in the arctic, neither common international standards.			
Impact of Arctic conditions on human behavior			
• Environmental conditions: ○ darkness, extreme temperatures/weather, ice • Living/working conditions: ○ i.a. equipment, icy surfaces, physical design ○ Norsok standard for e.g. hatches must be updated • Organisational factors: ○ Less manning/more manning? Selection process for the personnel? Different job design? • Emergency preparedness ○ Evacuation procedures, where do you escape to? ○ Rescue equipment ○ Communication equipment/methods ○ Weather conditions • Psychosocial factors ○ Darkness ○ Percieved safety ○ Weather ○ Less manning - Less social interaction?			
Increased risk of human errors?			
• Probability ○ Disorientation ○ Reaction time ○ Alertness/ SA ○ Disengagement • Consequences ○ Unpredictability ○ Distance/ Remoteness ○ Extreme Conditions			
Lack of experience			
Learn from local arctic & polar expeditions on how to survive in the arctic.			

Brown, R. (2013). Evacuation, survival and rescue in cold regions - goals, gaps and solutions. Arctic Oil& Gas conference 2013.

Oppdragsgiver:

Dokument:

Presentation

Nøkkelord:

human factors, evacuation, Arctic

Setting the scene

- For evacuation, survival and rescue in cold, remote harsh environments, need to consider:
 - Expected air and water temperatures
 - Wind and blowing snow
 - Potentially rough seas
 - Vessel/installation icing and presence of sea/level/iceberg ice/snow accumulation
 - Remoteness, reduced daylight, possible fog
- Helicopter response/rescue cannot be fully relied on
- Regular, relevant and high quality training is important
- Designing to overcome one issue may create other, unforeseen problems
- The human element is extremely important!

Summary

- Much research effort has been focused on better understanding issues in Arctic Evacuation-Survival-Rescue
- Solutions are not simply engineering based – we must consider the human element (behaviour, physiology, psychology)
- Where possible, research should be leading to updates to regulations, training, procedures and design for the Arctic (e.g. ISO TC67 SC8)
- To better understand Arctic survival requirements, we need to measure thermal protection of available and proposed equipment, determine maximum long-term sustainable metabolic rate, identify minimum thermal protection required and improve survival times until rescue can take place
- We must have an increased research focus on means of rescue; helicopters cannot cover all circumstances

Ergopro (2012). Arbeid i kaldt klima. Personlig beskyttelse mot varmetap i kalde omgivelser.

Oppdragsgiver:	Olf	Dokument:	Informasjonsfolder
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Nøkkelord:	kaldt klima, personlig beskyttelsesutstyr
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Bakgrunn

Informasjonsfolderen har som mål å gi personell som kan eksponeres for kaldt klima et bedre kunnskapsgrunnlag for gjennom egne aksjoner å kunne bidra til at det personlige beskyttelsesutstyret som er tilgjengelig blir anvendt på en optimal måte og at arbeidernes egen funksjonsdyktighet opprettholdes.

Innhold

- Kroppens varmebalanse
- Vindeffekt
- Endringer i kroppsfunksjoner ved varmetap
- Mental påvirkning
- Farer og skaderisiko (i kulde), inkludert langsiktig helserisiko
- Personlig beskyttelse
 - Personlig bekledning
 - Andre bekledningselementer
 - Praktisk tips
- Ulykker i sjøen
 - Beskyttelsesutstyr ved ulykker til havs
 - Avkjøling av menneskekroppen i kaldt vann
 - Beskyttelse mot varmetap i vannet
 - Etterberging

THELMA AS (2010). Kalde utfordringer. Helse og arbeidsmiljø på innretning i nordområdene.

Oppdragsgiver: Petroleumstilsynet

Dokument:

Rapport10-31.
ISBN 978-82-8032-024-7.

Nøkkelord: klimafaktorer, arbeidsmiljø, nordområdene

Bakgrunn

Oppdatering av rapporten "Health Aspects of Work in Extreme Climates within the E&P Industry" (International Exploration and Production Forum, 1998), med fokus rettet spesifikt mot arbeid på innretning i nordområdene på norsk sokkel.

Rapporten inkluderer ny kunnskap om vindavkjølingsindeksen, samt standarder/retningslinjer som er kommet i den senere tid.

Sammendrag

En rekke klimafaktorer vil skape utfordringer for arbeid i petroleumsindustrien i nordområdene, slik som temperatur, vindforhold, ising, polare lavtrykk, usikre værvarsel og mørketid. Faktorer som påvirker kroppens temperaturregulering er foruten klima; aktivitet, tekniske klimabeskyttende tiltak/systemer og bekledning.

De kritiske klimatiske faktorene for personellet er *lufttemperatur, stråletemperatur, vind og fuktighet*.

Vind øker bevegelsen av luften rundt kroppen og varmetapet øker derfor når vindstyrken øker.

Avkjølingseffekten som oppstar ved kombinasjonen temperatur og vind beregnes i vindavkjølingsindeksen (Wind Chill Index) som brukes for estimering av risiko for kulderelaterte skader. I 2001 ble en ny vindavkjølingsindeks innført. Formelen er basert på testing av varmetap fra eksponert hud på mennesker. Sykdom eller skader kan oppstå som direkte følge av kuldeeksponering. Kulde kan gi nye eller forverre eksisterende symptomer hos personer som allerede er syke, men kan også gi plager og symptomer hos friske individer.

Arbeidsrelaterte ulykker er høyere for arbeidere som i perioder gjennom året arbeider under kuldeeksponerte forhold, enn for arbeidere som ikke er eksponert for slike klimabelastinger. Forekomsten av frostskafer viser en sterk økning under forhold med omgivelsestemperaturer lavere enn -10 °C.

Sykdommer som kan relateres til kuldeeksponering er hjerte- og karsykdommer, Raynaulds syndrom, kuldeallergi, muskel- og skjelettsykdommer og respirasjonssykdommer.

Eksponering for ekstreme situasjoner kan ha negativ innvirkning på individets kognitive, emosjonelle og/eller fysiske ytelse. Nedsatt ytelse hos personell vil i tillegg til nedsatt arbeidseffektivitet, kunne føre til økt risiko for ulykker. Avkjøling påvirker alle enkeltelementer i den muskulære ytelsen, som utholdenhet, styrke, kraft, hastighet og koordinering. Motorisk ferdighet bestemmes av bevegelsesevnen og muligheten til å manøvrere objekter for arm, hand og fingre.

Mange studier viser at det er en klar sammenheng mellom hudtemperatur og motoriske ferdigheter. Kuldeeksponering kan i tillegg til redusert fingerferdighet innvirke på fysisk ytelse gjennom kraftig skjelving, sammentrekn timer av øvre deler av luftveiene og reduksjon i muskelens elastiske egenskap.

Kuldeeksponering vil ikke utelukkende forringe kognitiv ytelse. Nyere systematisk oversikt over forskningsresultater på området viser at lett kuldeeksponering øker kognitiv ytelse mens ekstrem kuldeeksponering over tid, avhengig av innvirkende faktorer i tillegg, gir kraftig reduksjon i kognitiv ytelse.

Operatørselskaper som har vært kontaktet informerer om at kulderelaterte utfordringer oppleves minst like store på Haltenbanken som utenfor kysten av Finnmark og norsk petroleumsindustri har lang erfaring i håndtering av slike klimatiske utfordringer i forhold til helse og arbeidsmiljø i Nordsjøen. Arbeid i nordområdene vil også inkludere utfordringer som mørketid, polare lavtrykk, lang avstand til infrastruktur, lavere temperaturer og mer ising. Kombinasjoner av flere krevende klimafaktorer vil gjøre utfordringene ved arbeid i nordområdene mer ekstreme.

Hverken operatører eller entreprenører som har operert i nordområdene, informerer om store problemer med gjennomføring av arbeid på grunn av kuldeproblematikk for de ansatte per i dag. Gode rutiner, vinterisering av innretning og tilstrekkelig med personell som kan bytte på arbeidsøkter utendørs om

nødvendig, er viktige faktorer for gode arbeidsforhold i kalde omgivelser.

Boreentreprenører melder at dekkspersonell som laster og loss er de som til daglig, og over lengre tid er mest eksponert for vær og kuldeproblematikk. I nordområdene vil fjerning av is som legger seg på eksponerte områder bli en større arbeidsoppgave enn det oljeindustrien på norsk sokkel har erfaring med i dag. Det er satt klare grenser for akseptabel kuldeeksponering for personell som jobber på disse områdene. En plan for håndtering av kuldeproblematikk bør inneholde elementer som: Identifisering av kulderelaterte utfordringer ved design av innretning, kartlegging og vurdering av risiko/tilrettelegging av arbeidsoppgaver, teknisk forbyggende tiltak/vinterisering, beskyttende bekledning, personlig vernebekledning og annet utstyr, informasjon og opplæring, medisinsk utvelgelse og oppfølging av personell, medisinsk beredskap samt organisering av HMS for arbeid i kulde.

Vanntemperatur og kuldeeksponering i en immersjonssituasjon (nedsenking i vann) kan være livstruende og er en direkte årsak til mange dødsulykker. Ulykkessituasjon ved immersjon består av fire livstruende faser - kuldesjokk, hemmet muskelfunksjon/koordinering, hypotermi og postimmersjon.

Kuldesjokk kan i ekstreme tilfeller føre til hjertestans. Kuldesjokket vil også kunne føre til hyperventilering som igjen kan føre til innånding av vann og drukning. Bruk av nødpuستهutstyr ved helikopterflyvninger på norsk sokkel er koblet til risikoen for kuldesjokk ved en nødlanding.

Nedkjøling av muskulaturen kan føre til utmattethet og nedsatt muskelkoordinering, noe som kan føre til drukning, dersom ikke nødvendige flytemiddel er tilgjengelig. Nedkjølingshastigheten av kroppen bestemmes av vanntemperatur, bølger og strømminger i vannet, bekledningens isolasjonsevne og vanninntregning. Sprutbeskytter vil kunne hindre vanninntregning i bekledningen. I tillegg kan den hindre innånding av vann og gjøre personen i stand til å medvirke i selve evakueringen. Overlevelsestid bestemmes av individuelle forskjeller, beskyttelsesutstyr benyttet i ulykkessituasjonen, vanninntregning, vanntemperatur, vanntilstand og mental tilstand til vedkommende.

20 % av dødsfall ved immersjon forekommer i forbindelse bergingsfasen. Dette skyldes blant annet at redusert blodstrøm til hjertemuskelen i en hypoterm tilstand sammen med en økt hjertemuskelaktivitet grunnet forventning om berging kan resultere i manglende oksygenforsyning til hjertet. Den hyppigste årsak til dødsfall etter berging av personer ut av vannet er mangel på oksygen i blodet, som følge av innånding av vann. Dersom gjenoppvarmingen foregår for intensivt vil en utvidelse av blodårene i hud og ytre vev kunne gi redusert tilbakestrømming til hjertet og føre til et fall i blodtrykket. Et blodtrykksfall kan i verste fall føre til hjertestans.

Norsk petroleumsaktivitet flytter seg stadig lenger nord og øst. Mer helårig aktivitet i disse kalde områdene byr på klimatiske og lokalitetsmessige utfordringer som petroleumsindustrien har mangelfull erfaring med. Arbeid i de nordligste områdene innebærer ekstreme kuldeeksponeringer. Kombinasjoner av krevende klimafaktorer gjør problemstillingene relevant også for områder noe lenger sør selv om kuldeeksponeringen her ikke er like ekstrem som i nordområdene. Mye av informasjonen i rapporten har derfor like stor betydning for havområdene utenfor kysten av Haltenbanken.

6 RISIKOSTYRING OG DRIFT, INKLUDERT DESIGN

Bos, R.W., Huisman, T.J., Obers, M.P.W., Schaap, T., van der Zalm, M. (2013). Servicing the Arctic. Report 1: Design requirements and operational profile of an Arctic Offshore Support Vessel (AOSV). Literature Survey.

Oppdragsgiver: Dutch maritime industry

Dokument:

Report

Nøkkelord: Arctic, Arctic offshore support vessel

Background

The Dutch maritime industry has only limited knowledge about Arctic engineering, in spite of a growing market and interest by the oil and gas industry. This literature survey is the first in a series of three reports to develop a concept design of an Arctic Offshore Support Vessel (AOSV). The purpose is to give a perspective on Arctic shipping with a specific focus on offshore platform support and to provide a design framework for AOSVs. The information in this report is based on technical papers from the Internet, contact with different companies and Arctic courses from the Aalto University in Espoo, Finland.

Content

Part I gives an overview of Arctic offshore issues:

- market overview
- overview of Arctic shipping
 - technologies
 - human factors -> causes and solutions for human failures
 - risks of and for the Arctic
- supplying the Arctic
 - requirements of an AOSV
 - challenges and solutions

Part II gives an overview of important factors for Arctic offshore support

- ice regimes
- geographical areas (maps, weather, ports)
- Arctic risks
- crew conditions
- laws and regulations
- ship types and solutions
- market research
- economic feasibility
- operations in the Arctic

Results

In general oil companies have a rising interest in the natural resource in the Arctic region. Next to their spending in Research and Development (R&D), also shipyards, suppliers and operators are eager to increase development for the harsh environments. This study shows, that every region in the Arctic has different weather and infrastructure conditions as well as different national laws and regulations. Next to that, operations in the harsh environment have high impact on the performance of the ship and its crew.

This report gives an overview on technology available for operating in the Arctic, such as double acting hull, azimuth thrusting and other ice breaking technologies. Increasing research in Arctic engineering results in new, more reliable technologies and opens the possibility to design more advanced Arctic vessels. A big challenge in Arctic engineering is to have a optimal compromise between open water and ice behavior.

Due to higher costs for among others R&D, material and equipment an AOSV will be more expensive. Operators, on the other hand, are also willing to pay more for them, because of the high amount of natural resources in the Arctic region.

The expected focus of the industry is on Baffin Bay, Barents Sea and Beaufort Sea. This study discusses the estimated oil reserves, existing infrastructure and environmental impact. Also the operations an AOSV is likely to perform are given.

Conclusions

The main question of this report was stated as: "What are the design requirements and operational profile of an Arctic Offshore Support Vessel?" The answer is given a broad overview of the topics that should be taken into account when operating in and designing for the Arctic. For the development of an AOSV this conclusion gives the initial design requirements and operational profile. The operational profile of the AOSV will be fully determined in the third stage of this research.

The discussion in section 12-1 suggest to focus on three areas to design the AOSV: the Barents Sea, Beaufort Sea and the Baffin Bay. Current projects are going on for these areas and is to be expected that there will be a need for AOSVs in about five years. Other regions as for instance the Chukchi Sea are still in an earlier stage development. Therefore the design areas of the AOSV is set to the South of the Barents Sea (Norway and Russian EEZ), shore region in the Beaufort Sea (Canada and USA EEZ) and the Baffin Bay (Greenland EEZ).

Season: the most interesting scenario to choose would be an extended season operation. Offshore platforms will be designed to operate as long as possible in a certain area.

The design requirements will be set according to the heaviest conditions of each of the areas according to the operating time window. When the ice conditions in a certain area become too harsh and dangerous, the ship has to leave the area. The estimated time windows are given below. They are based on the ice conditions and open water seasons for each area.

1. Barents Sea: March - January
2. Beaufort Sea: April - November
3. Baffin Bay: May - December

The time windows depend naturally on the location in the areas and the specific weather conditions of a year and are only meant to give a global indication.

The ice class has to be sufficient to operate in those three areas. The ship will be designed for the Barents Sea because it is expected that the operations will start in the near future. Because she is also sufficient for the Baffin Bay, she will also be able to operate there when the operations start. The following ice classes are chosen and will be used for further development:

- PC4 of the PC-rules: "Year-round operation in thick first-year ice which may include old ice inclusions", see section 8-3. This ice class is comparable to the ICE-15 class of DNV which is intended for ice breaking with a nominal ice thickness of 1.5 m.
- Icebreaker of DNV: Ramming requirements for ice ridges and other ice features.

An overview of class notations the vessel should have is given. The class notation is not complete or specified. There are more operations that the vessel can perform, if sufficiently equipped. AHTS and emergency operations will set the main design requirements. In the design process more classes will probably be given to the ship. The mentioned classes give, however, a good indication of the operations and requirements of the vessel. Also, in a next stage of the research the design requirements and class notations will be defined further as more insight is gained by a in depth study of existing OSVs.

The vessel will be designed for world wide operations in areas where offshore platforms are located, in open, preferably in ice infested waters, but excluding multi year ice areas with ice thicknesses higher than what the vessel is designed for.

Main conclusions

This report gives a wide overview on Arctic shipping. For most of its subjects more in depth research is needed to get a better understanding of the effects and specific demands of the Arctic. Nevertheless it is possible to develop AOSV that can operate in Baffin Bay, Barents Sea and Beaufort Sea. But in the end a perfect AOSV cannot be made, it can only be optimized for some of the predefined requirements as stated in the operational profile.

Crome, T. (Technip) (2013). The Arctic subsea landscape. Arctic Oil& Gas conference 2013.			
Oppdragsgiver:		Dokument:	Presentation
Nøkkelord:	operations, Arctic		
Main challenges • Geographical variations • Subsea projects • Technical and environmental challenges • Logistics, legislation and local content			
Project challenges in the Barents Sea • Far from North Sea Bases ○ Logistics • Focus on Safety ○ Distances from infrastructure • Focus on Environment ○ Extreme focus on use of chemicals • Weather ○ Short Summer Season with 24hr daylight ○ Long Winter Season with 24hr night ○ Severity & unpredictability of Polar Lows			
Conclusions • Subarctic developments are the best stepping stones to build competence for Arctic Projects • Must be in the forefront of the technological development - Engineering, Vessels, Equipment • Logistics can't be under emphasised - the Arctic challenge is more than just technology • Project delays • Need to get in and out quickly and do the job right first time !			

Ehlers, S. (NTNU) (2013). Technological frontiers in the high north. Ocean Technological Summit, Conference.

Oppdragsgiver:

Dokument:

Presentation

Nøkkelord:

Arctic, technology, design

Design considerations

- A ship in ice will be designed to the required performance in ice (technical, economical and safety), thus, it may be required to maneuver around unfavorable ice-features
- A local offshore structure placed in ice-covered waters can not be designed to withstand all possible ice-induced loads and thus a different approach to design loads compared to open water is required (design for a 1000 year return period in OW versus ice management and disconnect)
- Individual design approaches are needed

Knowledge gaps

- Error and uncertainty estimates for design ice data (subjective analysis of ice charts)
- High quality full-scale observations
- Identification of the risk and safety level
- Highly non-linear material behaviour must be described
- No agreed standards exist

Conclusion

- Structural design for arctic regions should consist of a holistic treatment of the design relevant actions and their identification to ensure safe arctic operations and transport

Gordeeva, T.S. (2013). Identification of Criteria for Selection of Arctic Offshore Field Development Concept.			
Oppdragsgiver:	Univ. Stavanger	Dokument:	Master thesis
Nøkkelord:	Concept development, Concept selection, Arctic development, Concept selection criteria		

Background

The result of the master thesis is a methodological tool for the concept selection in the Arctic area. It includes all stages of the project’s concept phase with necessary to know parameters, their effect on the concept selection and a ranked list of the criteria influencing the concept selection.

Conclusions

The study accounts for the specificity of a field located in the Arctic, whether it is located in ice-covered waters or in ice-free waters.

The research provides a comprehensive analysis of each stage of an offshore project’s concept phase with respect to the Arctic continental shelf. It gives a list of factors that should drive the concept screening stage and conceptual engineering stage. Effect of each factor is considered and shown in the research.

Thereafter, an elaborating study of the concept selection stage of an Arctic offshore project is performed. The list of comparison criteria that should contribute to the concept selection stage is prepared on the basis of a wide literature survey. This list consists of the main issues that should be considered during the concept selection.

The conclusion that is made after the analysis of the criteria is that it is possible to distinguish them into several groups: comparison criteria, established limitations and necessary requirements.

The comparison criterion evaluates the characteristic of the project (e.g. is it easy to start and shut-down or not, is there capability of well control or not, what is the quality of the end product etc.).

The established limitations for the use of the criteria are supposed to exclude improper development concepts that do not meet requirements established by the Operator Company (e.g. NPV, CAPEX, technical safety, schedule, etc.).

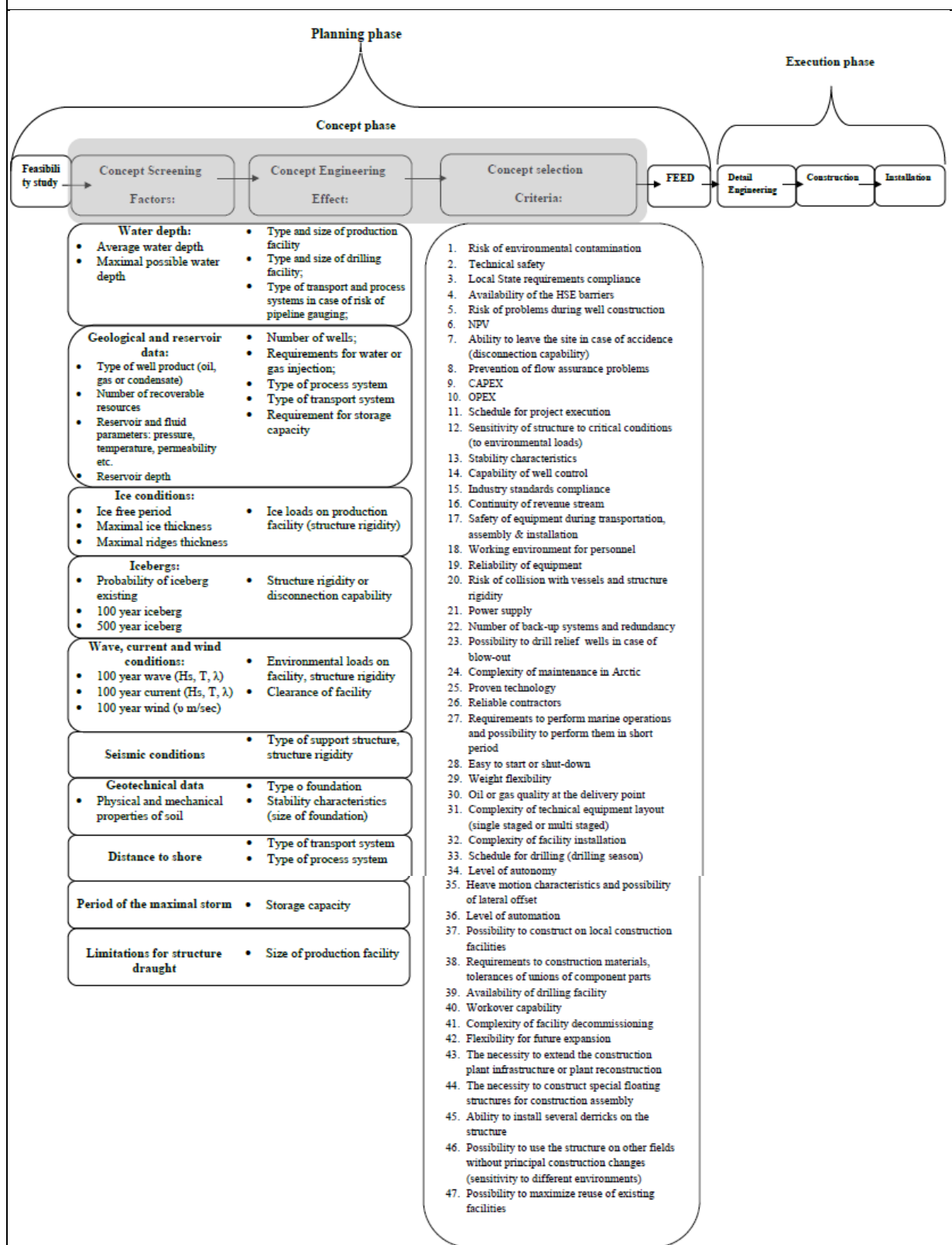
The necessary requirements also should exclude inappropriate development concepts set by government (e.g. industry standard compliance, local authority requirements, etc.).

Thus establishing criteria where it is possible to exclude inappropriate development concepts could significantly simplify the multi-criteria problem of the optimal concept selection.

The experts’ judgment method for ranking of criteria according to their importance in the concept selection process has been used. On-line questionnaire for criteria evaluation was prepared and sent to the experts. Unanimous opinion of people from the industry is that safety issues go before high profit. NPV or projects profit comes sixth after safety and regulations criteria. Of course it does not mean that unprofitable project would be more preferable than safe one, but it means that if a project has an average profit and high level of safety it would be more preferable for Arctic development than project with high profit and not sufficient level of safety. That is what experts’ opinion expresses in the project. And this result very much reflects the main Arctic challenge as being the high environmental risk.

We should, however, be aware to use the experts’ opinion in the thesis as the final authority of the truth due to the fact that few responses are obtained. The limited number of experts in the Arctic area and the short time available for the research did not allow making a wider observation of industry people’s opinion. But the results from the experts’ judgment about which criteria are the most important in the concept selection process could be a useful identification of what should be considered first and what aspects are obligated to be taken into account in the concept selection process of an Arctic offshore project.

Methodological tool for the selection of the development concept for the Arctic offshore field



Henningsgård, S. (2013). Operational Risk in the Norwegian Barents Sea.			
Oppdragsgiver:	NTNU	Dokument:	Master thesis
Nøkkelord:	Barents Sea, operations, risks		
The thesis focuses on areas that are currently open for petroleum activities in the Norwegian Barents Sea, considering two operational scenarios and two emergency preparedness scenarios. 1. Operation scenarios a. Off-loading by shuttle tanker b. Flotel connected to rig 2. Emergency preparedness scenarios a. Emergency landing with helicopter on water (Ditching) b. Man over board (MOB) The overall question to be answered was whether the Norwegian Barents Sea is significantly rougher than the North Sea and thus if it is possible to carry out the selected scenarios? This was split into three parts: 1. What is required and/or needed for these operations to be performed with a satisfactory level of risk? 2. How will this influence the availability? 3. Is it possible to conduct operations in the Norwegian Barents Sea at this point, without unreasonably high cost? By satisfactory it is meant as good as the North Sea. Background material regarding Barents Sea conditions and the operations investigated was thoroughly studied before a qualitative risk analysis was performed. The Bow Tie method was selected for this analysis, based on scenarios created for the particular operation or emergency preparedness cases; focusing on the differences between the Norwegian Barents Sea and the rest of the Norwegian Continental Shelf. The main differences found for the area of interest were; rapid weather changes, icing, polar night, lower temperatures and underdevelopment. The analysis has revealed that the selected operations in the area of interest can be carried out with a satisfactory risk level, with extra attention paid to operational planning and some minor adjustments to requirements. The Norwegian Barents Sea stands out as an Arctic area that will allow for petroleum activity without unreasonable added costs. The analysis and research has found that the conditions in the Norwegian Barents Sea are not significantly different from what the industry faces in other areas of the Norwegian Continental Shelf. The main issue found was the underdevelopment of the area and no area emergency preparedness. Uncertainties with weather forecasts are also an issue; however these are expected to improve as more observations are made. The forecast models for polar lows need to be improved. With gradual development and improved infrastructure, the investigated scenarios will not represent any greater risk in the Norwegian Barents Sea than other areas on the Norwegian Continental Shelf. Communicating the risk level to the public is a challenge for the industry. Industry partners seem to agree on the challenges and risks, and that they are not significantly different or worse than in the North Sea. The analysis' performed in this thesis do not challenge this view. Public opinion seems to be that the Norwegian Barents Sea is something completely new and different from the rest of the Norwegian Continental Shelf. At least for the cases studied in this thesis, this simply is not true.			

Oppdragsgiver:

Dokument:

Presentation

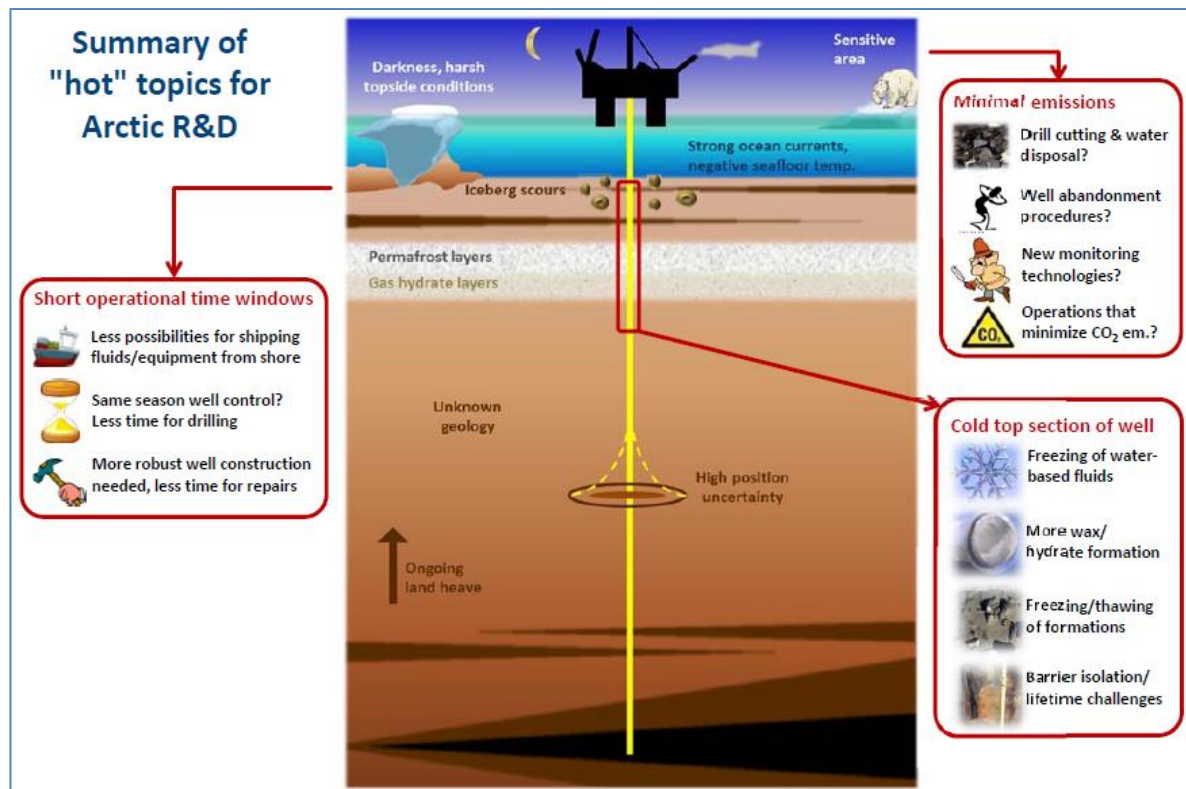
Nøkkelord:

operations, wells, Arctic

Understanding the Arctic environment

- Harsh topside conditions
 - Short operational windows
 - Speed up operations
 - Less frequent repairs
 - On/off production
 - Cannot rely on shipping in fluids/equipment from shore
 - Often necessary to protect top section of the well
 - Iceberg scours down to 400m water depth
- Challenging subsurface conditions
 - Up to 9% volume reduction:
 - Hole enlargement and caving
 - Subsidence in near-well region
 - Complex loads on casing and cement
 - Poor primary cementing
 - Thawing of gas hydrates:
 - Pressure build-up
 - Mud/cement gasification
- Cold "tophole"
 - Difficulties during on/off operations
 - Freezing of water-based well fluids
 - Strong thermal cycling of well
 - Flow assurance issues
 - Wax/hydrate formation in well
 - Plugging of BOP/safety valves
 - Well barrier material issues
 - New and unknown lifetimes
 - Poor isolation, materials weakened(1)
 - Substitutions?
 - Example: Arctic testing of well barriers
 - Temperature cycling <> expansion/contraction
 - Continuous monitoring of cement integrity during the experiment
 - When/where/how do leak paths form? How much flow? Optimal prevention/repair?
- Close to the north pole
 - Wellbore position accuracy
 - Wellbore trajectory defined by depth, inclination and azimuth.
 - Magnetic instruments: azimuth uncertainty dep. on horizontal component of geomagnetic field.
 - Gyroscopic instruments: azimuth uncertainty dep. on horizontal component of the earth rotation.
 - Important for:
 - well collision avoidance
 - safety margins with respect to e.g. faults
 - 4planning/drilling relief wells
 - required size of a target
- Ground in motion
- Remote and sensitive

Summary of "hot" topics for Arctic R&D:



Concluding remarks:

- **Well integrity:** one of many Arctic "show stoppers"
- **Still many unsolved issues** related to well integrity in "normal" locations
- **Additional well integrity risks** are present in Arctic environments.
- **How can we safely cross the "final frontier"?**
 - Know the environment, understand risks
 - Build robust wells – smart materials choice
 - Life-cycle design: Begin with the end in mind!

US Dep. of the Interior (2013). Review of Shell's 2012 Alaska offshore oil and gas exploration program.

Oppdragsgiver:

Dokument:

Report

Nøkkelord:

Shell, Alaska, drilling program, governmental review

Background

Shell experienced major problems with its 2012 program in Alaska. The difficulties raised serious questions regarding its ability to operate safely and responsibly in the challenging and unpredictable conditions offshore Alaska. As a result, Secretary of the Interior ordered a review of Shell's 2012 Alaska offshore drilling program in the Beaufort and Chukchi Seas. The purpose of the review was to assess, at a high level, Shell's performance across all aspects of its 2012 Alaska offshore exploration program, identify key lessons to be learned from Shell's experience, and make recommendations applicable to any future exploration drilling operations that may be proposed for the Arctic Outer Continental Shelf (OCS).

Director of the Bureau of Ocean Energy Management (BOEM) and Principal Deputy Assistant Secretary for Lands and Minerals Management at the Department of the Interior (DOI), lead the review.

Findings and recommendations

The review identified seven key principles and prerequisites for safe and responsible offshore exploration drilling in the Alaskan Arctic – five applying to industry and two relevant to government oversight. As discussed in detail in this report, in 2012 Shell fell short of successfully addressing all but the last of these principles.

1. All phases of an offshore Arctic program – including preparations, drilling, maritime and emergency response operations – must be integrated and subject to strong operator management and government oversight.

Arctic offshore operations are extremely complex, and there are substantial environmental challenges and operational risks throughout every phase of the endeavor, including preparations, mobilization, in-theater drilling operations, emergency response and preparedness, and de-mobilization.

As discussed below, Shell experienced significant problems during phases of the operation that were outside of the core drilling-related competencies devoted to the project, including during the fabrication of critical systems such as the ACS and maritime operations such as the Kulluk tow. Thus, although Shell generally performed safely while in-theater conducting drilling operations, and while subject to intense regulatory oversight, it is clear that all phases of an offshore exploration operation in Alaska must be managed and overseen as an integrated endeavor and subject to robust and direct operator management and government oversight.

2. Arctic offshore operations must be well-planned, fully ready and have clear objectives in advance of the drilling season.

Because of the inherent geographic, logistical and environmental challenges associated with working on the Arctic OCS, the operating plan and objectives of any offshore Arctic program must be well-planned and designed to provide operational clarity, while also allowing for ample flexibility in light of variable and changing conditions and the need for safe demobilization.

In contrast, Shell entered the 2012 drilling season with substantial uncertainty about the readiness of critical systems such as the ACS and air emission controls, as well as its timelines and operational objectives for the open water drilling window. These uncertainties, and the resulting delays, led to pressure on safety-related deadlines at the end of the season, and contributed to Shell's request to extend, by up to nearly three weeks, the period in which it would be allowed to drill in hydrocarbon-bearing zones beyond the original September 24 cessation date set by BOEM. There should be no loose ends or unnecessary improvisation with critical equipment, assets or drilling plans once operations are scheduled to begin.

3. Operators must maintain strong, direct management and oversight of their contractors.

Arctic offshore operations are complex and require operators to bring to bear equipment, systems and personnel with capacity across a broad set of specializations and competencies, some of which must be

supplied by contractors. Rigorous and effective operational management is extremely important to establishing sound oversight and internal process management. Moreover, operators must tailor their management and oversight programs to Arctic conditions, and the programs must cover preparations in advance of the drilling season and maritime operations as well in-theater drilling operations.

A recurring theme from Shell's 2012 experience is that there were significant problems with contractors on which Shell relied for critical aspects of its program – including development of the ACS, the air emission mitigation technology applied to the rigs' engines, the condition of the Noble Discoverer, and the Kulluk towing operation.

4. *Operators must understand and plan for the variability and challenges of Alaskan conditions.*

Reliable weather and ice forecasting play a significant role in ensuring safe operations offshore Alaska, including but not limited to the Arctic. Robust forecasting and tracking technology, information sharing among industry and government, and local experience are essential to managing the substantial challenges and risks that Alaskan conditions pose for all offshore operations.

The weather forecasting and ice management systems Shell employed daily during drilling operations in the Arctic were one of the strengths of its program. As experienced during the Kulluk tow incident, however, Alaska's weather changes quickly and produces hurricane force winds and extremely dangerous sea conditions.

5. *Respect for and coordination with local communities.*

Alaska Native communities on the North Slope are closely connected to the Arctic Ocean culturally, socially and economically. It is commonly said in Alaska Native communities that "the ocean is our garden," which illustrates the importance of subsistence hunting and fishing, including whaling, to North Slope villages. At the same time, many on the North Slope recognize, and hope to benefit from, the economic and employment opportunities that offshore oil and gas exploration may offer. Accordingly, it is imperative that offshore exploration in the Arctic be harmonized with the needs of North Slope communities, including traditional subsistence use. Moreover, it is an operator's safety and environmental performance that is the ultimate measure of how well and responsibly the company works with North Slope communities and Alaska Natives.

As discussed below, Shell performed well in many aspects of coordinating with Alaska Native and local communities, including abiding by the company's Conflict Avoidance Agreement (CAA) with the AEWC under challenging operational circumstances.

Recommended Undertakings by Shell

Based on these findings, the review team identified two specific undertakings that Shell should complete before the company proceeds with additional offshore exploratory drilling activity in future seasons. (1) Shell should develop, and submit to DOI, a comprehensive and integrated operational plan describing in detail its future drilling program. (2) Shell should commission and complete a full third-party audit of its management systems.

Government oversight

This report also defines important principles for government oversight of offshore drilling activity in the Arctic that must be carried forward and further developed. These include, in particular, (1) the importance of continued close coordination among government agencies in the permitting and oversight process, and (2) the need to continue to develop and refine standards and practices that are specific to the unique and challenging conditions associated with offshore oil and gas exploration on the Alaskan OCS.

Wassing, A., van der List, R. (2013). Development of solutions for Arctic offshore drilling. SPE Arctic and Extreme Environments Conference, Moscow, Russia, 15.17 October, 2013.

Oppdragsgiver:		Dokument:	Conference proceeding
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Nøkkelord:	Arctic, offshore drilling units, design
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Background

The paper discusses the origins and development of a portfolio of Arctic mobile offshore drilling unit designs, comprising both jack-up type and drillship type solutions. These designs are developed to address the specific challenges of exploratory and development drilling in the Arctic, and are developed to cover the full extent of the Arctic, from the very shallow to the deep water. The paper describes both challenges and proposed solutions, as well as providing an outline of the designs.

Challenges in Arctic offshore drilling

The challenges for Arctic offshore drilling are numerous, and include the usual challenges associated with offshore drilling but added to these are a number of challenges more specific to the Arctic:

- (Periodic) presence of sea ice
 - High loads on the structure and station keeping systems, whose magnitude is less predictable and may increase dramatically in a short timeframe
 - Damage to operational equipment, including underwater equipment such as thrusters, riser string and subsea equipment
 - Restricted maneuverability, requiring icebreaker assistance for transits
 - Availability and suitability of escape, evacuation and rescue means
- Extreme weather conditions
- Shallow water
 - Becomes a challenge when combined with sea ice conditions, as there is less choice in rig types and solutions such as jack-ups are subject to water depth limitations
- Remoteness
 - Little or no existing infrastructure and supply routes are very long.
- Pristine and vulnerable environment

Solutions for meeting the Arctic challenge

Principles

Exploration in the Arctic needs bespoke solutions, which adhere to high standards to ensure that drilling can be done in a safe and responsible manner. In the development of these solutions, a number of principles have been established which are applied consistently across all designs:

- Compliance with all applicable rules and regulations
- Robust and reliable
 - Use proven solutions where available
 - Use innovation where necessary
 - Make level of innovation manageable -> Technology qualification to be embedded in the development
- Working environment driven
 - Protect the people and equipment, allow them to operate in the extreme conditions
 - Protect the environment
- Shallow water capable
 - Enhance economic feasibility by extending the area of potential application through increasing the range of operational water depths
 - Open water is equally important as sea ice conditions, as critical operations are expected to occur in open water conditions and the unit should perform optimally in those conditions
 - Transit to and from the areas of operation shall be accounted for, as mobilization to remote areas is a comparatively large part of the operations
- High autonomy
 - High variable load (VDL) to reduce need for re-supply in remote areas

- High holding capacity for station keeping system to allow extended operations under heavy conditions, keep loads low by design of the unit to allow the same station keeping system to operate in heavier conditions
- Transit speed shall be sufficient to economize mobilization and to allow the unit to mobilize to and from the areas of operation under safe circumstances
- High standards of environmental protection

Choosing the solution

Rig type selection (major unit types):

<i>Area</i>	<i>Jack-up</i>	<i>Semi-submersible</i>	<i>Ship-shaped</i>
High Arctic (Beaufort, Chuckci, Northern Greenland, Kara, East Siberian)	+	-	++
Sub Arctic (Seasonal high arctic and periodic ice infested such as southern Greenland, Barents)	+	+	++
Winterized / Harsh environment	+	++	+

* Limitations in water depth apply

The paper gives recommendations on rig selection based on water depths.

An Arctic portfolio of designs

- Jack-ups:

The main challenges that needed to be addressed and the principle solutions for these challenges applicable to the development of jack-up series are [briefly summarized]:

- Leg design.
- Overturning moment.
- Sliding resistance.
- Re-entry in sea ice conditions.
- Drill string protection in exploration mode.

The paper gives recommendations on sea ice jack-up series.

- Drillship solutions:

For water depths exceeding 50 to 80 meters, monohull drillships based solutions have been identified as the optimum solution. The main challenges to be met by drill ship design are related to the station keeping system are assigned. With respect to operating in sea ice conditions, the following considerations apply [headlines only]:

- Dynamic positioning
- Spread mooring
- Turret mooring

Berg, T.E., Berge, B.O. (2012). Arctic intervention vessels - design considerations and verification studies.
 Berg, T.E., Berge, B.O. (2012). Arctic Technology Conference, Texas, USA, 3-5 December, 2012.

Oppdragsgiver:		Dokument:	Conference proceeding
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Nøkkelord:	Arctic, subsea production equipment, ice
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Abstract

The paper discusses how to extend access to subsea production equipment in regions with seasonal ice. Important factors such as long distances to shore-based infrastructure, harsh environmental conditions including ice, icing and polar lows, low quality of communication system services and lack of workers with experience of working under Arctic conditions will have to be investigated and analysed as inputs to the development of safe operational procedures.

Part 1: Design configurations

There is need for an improved metocean and ice design basis when specifying the operational characteristics of intervention vessels capable of working on an all-year basis in Arctic regions with seasonal ice. The paper describes the challenges involved in designing such a vessel, which will operate [in the Olga basin east of Svalbard], far from shore-base infrastructure.

Current climate changes mean that it will be necessary to acquire new information about actual meteorological, oceanographic and ice conditions in the vessel's operational area.

Part 2: Construction and intervention vessel for Arctic operations

The second part of the paper describes a case study for a vessel design for specific area of operation, the Norwegian part of the Eastern Barents Sea in a sector with significant seasonal ice. The design guide can be summarized as follows:

- Calm water performance
 - To achieve a design with low resistance, experience with hull lines and knowledge of which details are important make all the difference between a good and bad design. Sharp corners are generally something to avoid, focus needs to be maintained on good design of appendages such as brackets and headboxes. A bulb bow

- design is essential to minimize resistance. This is very different from a traditional ice-breaker bow, but a compromise design, with bow-down trimming in ice-breaking mode can compensate for this to a certain extent.
- Optimizing **propulsion** characteristics is a compromise between the actual aft ship hull design and the propeller design. Good clearance between hull and propeller and the avoidance of vortices are important, as is designing the propeller to closely match the purposes of the vessel.
 - **Seakeeping performance**
 - **Main dimensions** are important for good seakeeping performance. Important parameters are:
 - Displacement, B/L-ratio, T/L-ratio, C_{WF} – forward water plane area coefficient and GM_T – Transverse metacentric height.
 - **Roll-damping devices** are important to reduce roll motions and thereby roll-induced motions and accelerations.
 - **Added resistance** in waves is dependent on good bow design for short waves, while vessel length sets the limit for how to define long waves, i.e. in the range of the length of the vessel. For longer waves, the added resistance tends asymptotically to zero.
 - **Slamming** is typically detail design-dependent. The most important parameter is the water entrance angle to the hull.
 - **Ice performance – important parameters**
 - Bow form (stem and waterline angle).
 - Bulb bow.
 - Beam.
 - Waterline area and frame angles at waterline.
 - Appendages' roll-damping effect.
 - Bollard pull versus design speed propeller optimisation.
 - Bollard pull/Beam ratio.
 - Displacement.
 - **Environmental considerations**
 - The Life Cycle Assessment (LCA) method was employed to estimate emissions to air.
 - The results are case-specific and should not be generalized to other diesel and dual-fuel option comparisons.
 - In general, the way of operating the engines should be readjusted closer to optimum to decrease fuel consumption while also reducing emissions.
 - Water emissions and volumes of oily bilge water, waste water and ballast were estimated.
 - Considerations for oil-spill response options in the project vessel have also been discussed.

Part 3: Ice management and dynamic positioning in ice

Dynamic positioning in ice and the need for ice-management support when the vessel is required to perform intervention tasks (inspection, maintenance and repair) on a subsea oil/gas production system. The focus on ice-management is expected to be on sea ice (not icebergs).

For winter operations it is suggested that the ice management system should provide capabilities for:

- Ice detection, tracking and forecast
- Threat evaluation
- Physical ice management
- Ice-alert procedure
- Provisions for disconnection of subsea working tools launched from the vessel
- Training needs and training resources

Part 4: Other operational challenges

There are challenges for communication systems in the Arctic (see figure below):

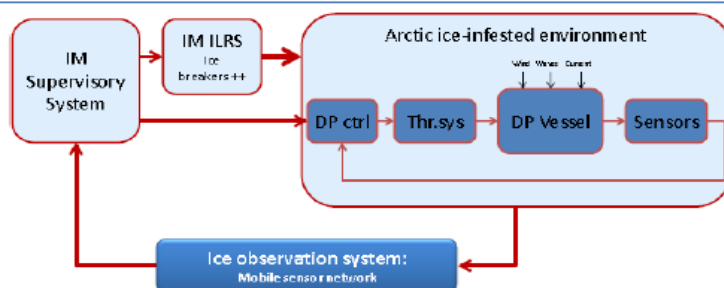


Figure 5 Top-level feedback system for ice management for an Arctic intervention vessel (courtesy Roger Skjetne, NTNU)

Challenge	Cause	Consequence
Low elevation angles	Geostationary orbit satellites	Signal loss due to shadowing, low signal strengths. Signal loss when combined with heavy roll, pitch and heave of vessels.
Additional signal transit distance	Geostationary orbit satellites	Signal attenuation and degraded quality due to atmospheric (for frequencies > 10 Gz) and ionospheric disturbances (for frequencies < 1GHz).
Icing on antennas	Ice accumulation from sea spray and air humidity	Signal attenuation and degraded signal quality.
Signal delay and latency variations	Lack of earth stations/gate ways	Real time requirements are difficult to achieve

Figure 6 Challenges for Arctic communication systems

Recommendations

To obtain a satisfactory risk level, the following is recommended:

- Specifying and developing a data-acquisitioning system for meteorology, oceanography and ice data for the Norwegian part of the Eastern Barents Sea.
- Starting acquisition meteorology, oceanography and ice data for the Norwegian part of the Eastern Barents Sea.
- Employing the data gathered to improve existing weather and ice forecast models for the actual area.
- Employ the data to improve existing hindcast databases.
- Design and test a vessel concept for critical intervention tasks to be performed on a subsea production system located in the Olga Basin east of Svalbard based on site-specific metocean and ice data.

Masterson, D.M. (Chevron, Canada) (2012). The Arctic Islands Adventure and Panarctic Oils Ltd. Cold Regions Science and Technology 85 (2013) 1–14.

Oppdragsgiver:

Dokument:

Paper

Nøkkelord:

Arctic, Arctic Islands, Oil and gas exploration, Ice, Ice structures, Drilling

Abstract

Panarctic Oils Limited was an industry/government consortium established to explore for oil and gas in the Canadian Arctic Islands with up to 37 participating companies. Panarctic drilled 150 wells over an area measuring some 850 by 1200 km. The most northerly well was located approximately 80°45' N on Ellesmere Island and the most southerly well was at 72°40' N on Prince of Wales Island. 38 of these wells were drilled offshore from floating ice platforms in water depths of up to 550 m. 500 km³ of natural gas reserves was discovered over this period and small oil reserves were discovered at Bent Horn. All of the offshore wells attempted were drilled, logged and tested as planned, a proof of the viability of using ice as a support for drilling. In spite of large distances, extreme weather and permafrost, the operations were successful and had no lasting effect on the environment.

The paper summarizes the significant achievements over Panarctic's history from inception to 1986 when operations ceased, discussing

- Seismic operation
- Sealift
- Onshore wells
- Airstrip preparations
- Onshore rig move
- Air support
- Offshore wells
- Ice movement
- Airstrip construction
- Airstrip and ice platform
- Rig mobilization and storage
- Rig design
- Ice platform drilling
- Moonpools (drilling from a ship)
- Ice platform
- Monitoring during drilling
- Drake offshore trial gas production
- Bent Horn oil production

Conclusions

Exploring for oil and gas in the Canadian Arctic Islands presents enormous physical, logistical and organizational challenges. Exploration began in 1961 and continued until 1986.

Panarctic drilled 150 wells, 38 of them being offshore from floating ice platforms thickened to between 5 and 6 m. Conventional land rigs were used to drill both the onshore and offshore wells. Rig design was modularized to improve efficiency.

Panarctic collected 35,000 km of seismic line data during the time it operated, 16,000 km of this being from the offshore ice pack. Ice thickness was measured at shot holes drilled through the ice and 83,606 thickness measurements were obtained between 1971 and 1980.

Transportation over large distances under hostile weather conditions was effected using aircraft and overland and over ice vehicles, both standard trucks and all terrain vehicles. Supply of rigs, equipment and bulk material from the south occurred using sealift and Hercules C-130 transport. Crew changes were accomplished by Lockheed Electra and 727/737 aircraft. These aircraft landed on land strips or offshore on strips prepared on the sea ice. Hercules aircraft brought rigs and supplies to the remote locations. 253 loads were required. Helicopters, such as the Sigorsky S61, ferried construction equipment and camps to sites at

start-up.

Communications and reporting via HF radio to the south was often challenging and intermittent. In 1975 a satellite link from the Rea Point base camp was established which provided a much more reliable flow of information. Radio communication between Rea Point and the rig sites was often interrupted by magnetic storms in the spring.

Well costs were relatively low for a frontier area. An onshore well could be drilled to a depth of 3000 m for \$11 to \$12 million. An offshore well of similar depth would cost \$22 to \$23 million. Early wells were drilled for \$2 to \$4 million. Later wells cost more because of several factors, including increased depth of the wells necessitating larger and more sophisticated rigs and because the operation included more stringent health and safety measures and more sophisticated and costly camps and related support.

Drilling offshore from ice platforms required continuous quality assurance during construction and performance monitoring during drilling. Basic information was relayed south and to NRC in Ottawa as part of the daily construction and drilling reporting.

A trial gas production was completed at Drake F-76 in 1978. An offshore well was drilled from a floating ice platform and a pipeline was connected from shore to the well using the sea ice as a support. Two 152 mm flowlines, both heat traced, one insulated and one not insulated in a bundle were installed. Maximum flow of 10 m³/s at 10 MPa pressure was achieved during the flow test. The well was shut in in November 1978 and was plugged and abandoned in 1995.

Panarctic discovered a small oil field at Bent Horn on Cameron Island in 1974, and between 1985 and 1997 2.8 million barrels of oil were tankered south during the late summer/early fall period.

Oljedirektoratet (2012). Teknologiutvikling. Konsekvensutredning for Barentshavet sørøst.

Oppdragsgiver:

OED

Dokument:

Rapport

Nøkkelord:

teknologibehov, utbyggingsløsninger, Barentshavet

Bakgrunn

Rapporten vurderer teknologibehov knyttet til petroleumsaktivitet i Barentshavet sørøst området. Det er blant annet tatt utgangspunkt i en rapport fra Meteorologisk Institutt som beskriver de meteorologiske og oceanografiske forholdene i området.

Klimatiske forhold i området

De statistiske dataene med hensyn på vindstyrke og bølgehøyde viser lavere verdier i Barentshavet sørøst enn i Norskehavet (Heidrun feltet) og nordlige Nordsjø (Statfjord feltet).

Den gjennomsnittlige minimumstemperaturen er 2 – 12 °C lavere enn for Goliat området.

- Sterk ising kan forekomme (1,3 % på årsbasis) i den nordlige delen og det er risiko for polare lavtrykk i hele området.
- I den nordlige delen av området kan det forekomme havis.

Faktorer vurdert om de må tas særskilt hensyn til ved valg av utbyggingsløsninger i Barentshavet sørøst

1. Metocean data
2. Lave lufttemperaturer
3. Lave sjøtemperaturer
4. Havis
5. Polare lavtrykk

Sammendrag

Rapporten viser at forholdene i Barentshavet Sørøst ikke skiller seg ut for flere av de klimatiske faktorene sammenlignet med andre områder på Norsk kontinentalsokkel (NKS) der det allerede er petroleumsaktivitet. Både med hensyn til bølgehøyder og vindhastighet vil det være andre steder på sokkelen der det foregår petroleumsaktivitet som har høyere verdier.

Dimensjonering av innretningene for å ta høyde for bølge- og vindkrefter anses derfor ikke å være et område det må ta særskilte hensyn til ut over det som allerede er kjent i petroleumsvirksomheten på NKS. Også flere av de forholdene som angis å representere noe nytt i forhold til øvrige deler av sokkelen, vil utbyggingsteknisk kunne ivaretas med de løsningene som er kjent fra andre deler av sokkelen. Av de forhold som her er gjennomgått gjelder det faktorer som lavere lufttemperaturer, lavere sjøtemperaturer, lengre periode med mørketid og polare lavtrykk.

De forholdene som vil kunne sette nye rammer for teknisk løsning i Barentshavet sørøst området er i første rekke mulighet for havis i den nordlige delen. Selv om dette representerer noe nytt forhold i forhold til øvrig petroleumsvirksomhet på norsk sokkel, vil det være betydelig erfaring fra andre petroleumsprovinser i verden der disse forholdene er tatt høyde for.

Lubbad, L.K. (2011). Some Aspects of Arctic Offshore Floating Structures.			
Oppdragsgiver:	NTNU	Dokument:	Dr. thesis
Nøkkelord:	Arctic, offshore, floating structures		
Abstract			
The work highlights some aspects related to the analyses of Arctic offshore floating structures. This thesis consists of five papers, which can be divided into two main categories. One category deals with the dynamics of slender structures with an emphasis on the prediction and suppression of vortex induced vibrations (VIV), and the other category examines the process of interaction between sloping structures and sea ice with focus on developing a numerical model to simulate this process in real time. Slender structures, such as mooring lines and marine risers, are very important for the offshore petroleum industry, which is currently approaching deeper waters. Increasingly, attention has been focused on predicting the susceptibility of these structures to VIV. In this thesis, two asymptotic techniques namely, the local analysis and the WKB methods, were used to derive closed-form solutions for the natural frequencies and mode shapes of slender line-like structures. Both the top-tensioned nearly-vertical configuration and the catenary configuration were considered. The accuracy of the solutions derived was established through comparison with other analytic solution techniques and with results of numerical finite element solutions. The effects of the bending stiffness and the effects of approximating the tension variation as a linear function were discussed. Experimental data on the multi-modal in-line and cross-flow response behaviour of a towed catenary model were analysed to examine the usefulness of the solutions for predicting the response frequencies and envelopes due to VIV. Helical strakes are often used as a mitigating measure to suppress the VIV of slender structures. This thesis presented an innovative method to fit ropes helically to a riser in the installation phase. Such a procedure will help to overcome the handling problem associated with the use of conventional sharp-edged strakes. Experimental investigations were then performed to verify the efficiency of these ropes (round-sectioned helical strakes) in suppressing VIV. Systematic experimental investigations including twenty-eight configurations of round-sectioned helical strakes were tested in an attempt to find the most suitable strake configuration. The effects of varying pitch, the surface roughness and the ratio between the cross-flow and in-line natural frequencies on the efficiency of the proposed configuration of round-sectioned helical strakes were also investigated. The process of interaction between sea ice and offshore sloping structures (e.g., conical structures and ship-shaped structures) is quite complex. Modelling this process is very demanding and often computationally expensive, which typically hinders the chances for realtime simulations. This kind of simulation can be very useful for training personnel for Arctic offshore operations and procedures, for analysing the efficiency of various ice management concepts and as a part of the onboard support systems for station keeping. The challenge of meeting the real-time criterion was overcome in the present work. This thesis developed a numerical model to simulate the process of interaction between sea ice and sloping structures in real time. In this model, only level- and broken-ice features were studied. New analytical closed-form solutions were established and used to represent the ice breaking process. PhysX was used for the first time to solve the equations of rigid body motions with six degrees of freedom for all ice floes in the calculation domain. The results of the simulator were validated against experimental data from model-scale and full-scale tests. Accurate predictions of ice actions are also vital to optimise the design of the structures in the Arctic regions. A good understanding of the role of seawater in the process of interaction between the sloping structures and level ice will help to establish reliable models to estimate the ice forces. This work formulated both the static and dynamic bending problems for a floating wedge-shaped ice beam interacting with an offshore sloping structure. For the dynamic interaction, the effects of the water foundation on the bending failure of the ice were studied by comparing the results of an elastohydrodynamic approach with a model of a Winkler foundation. The thesis also investigated the breaking lengths of the ice wedges (i.e., the frequency of the ice loads) as a function of the ice thickness, the compression in the ice and the acceleration of the interaction.			

Zhang, D., Yue, Q. (2011). Major challenges of offshore platforms design for shallow water oil and gas field in moderate ice conditions.

Oppdragsgiver:

Dokument:

Paper

Nøkkelord:

Ice-resistant structure, Ice-induced vibration, Structural failure modes, Conceptual design

Abstract

Offshore engineers and scientists face fascinating economical and technical challenges in designing offshore platforms for shallow water oil and gas fields in moderate ice conditions. Petroleum production systems in these sea ice infested areas such as the Bohai Bay of China, Cook Inlet, Barents Sea, and Caspian Sea must be designed to accommodate the harsh environmental conditions, among which the first-year sea ice is one of the major design consideration. Extreme ice loads and ice-induced vibrations still remain an area of uncertainty in offshore platforms. This paper demonstrates the main technical aspects on the use of jackets in the Bohai Bay, with particular focus on ice loads and the failure modes of slender ice-resistant structures, which are the two key issues in design considerations. A design proposal and some considerations for economical ice-resistant structures for safe development in the cold region are also conceptually discussed.

Content

The report briefly reviews

- sea ice conditions and oil exploitation in the Bohai Bay
- ice loads and ice-induced vibrations
- structural performance of ice-resistant platforms

- and discusses

- proposal and considerations of ice-resistant design

Conclusions

The safety reserves of ice-resistant jacket platforms are greater under the extreme static ice loads. However, ice-induced structure vibrations may raise two kinds of risks. The intensive shaking of the deck may endanger the facilities on the platform and cause discomfort of the crew members. Additionally, cyclical stresses on tubular nodes of the jacket structures may reduce the structure's fatigue life. We have further discussed various ice-resistant design aspects for shallow water oil and gas fields in moderate ice conditions:

- better geometry to prevent ice pile-up
- ice-breaking cones should be adopted
- vibration mitigation and control device may be applied
- dynamic failure mode of slender ice-resistant structures should be considered

Arctic conditions and the presence of ice have significant influence on the development schemes and platform designs. The challenge for offshore engineers and scientists is to advance technologies so that field developments become economically justified. From the economical point of view of a project, slender jacket structures are suitable in ice marginal oil fields if the structural failure modes is induced by ice vibrations meet their performance requirements.

Eik, K.J. (2010). Ice Management in Arctic Offshore Operations and Field Developments.			
Oppdragsgiver:	NTNU	Dokument:	Dr. Thesis
Nøkkelord:	ice management, offshore operations, Arctic		
Abstract			
The subject ice management has been studied with the main objective to deduce a methodology that incorporates the effect of ice management on the structural reliability of offshore installations. This was done by first studying Arctic projects in the past and summarizes the learning's. All available reports were unanimous and highlighted ice management as a key for the successes in the projects. Based on the reported experiences, an unambiguous definition of ice management was made: "Ice management is the sum of all activities where the objective is to reduce or avoid actions from any kind of ice features" Despite the number of similarities between sea ice management and iceberg management, it was decided to study each of the fields individually. The motivation for doing so was that iceberg management in general focus on reducing the frequency of impacts between icebergs and installations while sea ice management generally focus on reducing the sizes in the ice floe distributions and thereby reduces the severity of the ice actions. <i>One methodology for including iceberg management and one for including sea ice management in the offshore installation design process has been proposed.</i> In order to develop the models for ice management efficiency a number of studies of the various elements were conducted. Individual papers regarding subsurface ice intelligence, iceberg drift modelling, iceberg deterioration, iceberg deflection in ice and ice load variability has been published and are included in this thesis. Each of these papers is of importance for the proposed models for ice management efficiency. The possibility to disconnect an installation and escape the site has been considered both in the methodologies for iceberg management and sea ice management. When considering the number and magnitude of uncertainties both with respect to load calculations from icebergs and sea ice, it is <i>concluded that disconnection capabilities should be considered in all Arctic projects</i>. It was shown that icebreakers not necessarily are sufficient to reduce extreme or abnormal loads on a structure. However, there may still be a number of reasons for why icebreakers also should be considered in Arctic projects. The methodologies presented in this work provide adequate tools for evaluating the effect of various icebreaker fleets and iceberg management systems. However, the approaches rely on a number of tools and formulations with inherent weaknesses and advantages. The weaknesses are discussed and recommendations for further work in order to improve the models have been proposed.			
Summary and conclusions			
Iceberg management			
With respect to iceberg management, the proposed methodology considers the operations of the offshore installation as a system with certain reliability. In order to increase the reliability, various safety functions may be incorporated in the system. The occurrence of icebergs is considered as an accidental event and actions such as iceberg detection, iceberg deflection and disconnection of the installation are considered as safety functions. This is modelled as an event tree. In order to demonstrate the methodology, an iceberg drift model has been combined with statistical distributions describing the efficiency of iceberg detection and iceberg deflection. As the ability to calculate iceberg drift is one of the main elements in the model for calculation of iceberg management efficiency, separate studies were performed within this subject. First, a model for systematic evaluation of the skills of an iceberg drift model was presented. The ability to create reliable oceanographic models was identified as a key element required to provide reliable iceberg drift models. Further, in open waters, the iceberg drift caused by waves was considered to be of significant importance for the iceberg drift. Both physical tank model tests and numerical calculations were conducted and improved formulations for iceberg wave drift were performed. The ability to forecast iceberg deterioration was considered to be of			

important for the iceberg risk assessment. Due to this, a study of iceberg deterioration in the Barents Sea was performed. Existing models for deterioration calculations were used together with an iceberg drift model and the significance of iceberg deterioration in the Eastern Barents Sea was quantified. A factorial design study was conducted in order to identify the importance of environmental variables contributing to iceberg deterioration.

With respect to iceberg deflection operations, the efficiency of open water operations was well documented through records from Canadian operations. With respect to iceberg towing in ice covered waters however, there were no documentation on how it should be done or how efficient it can be. Due to this, physical tank model tests were performed by making iceberg models of fresh water ice and tow them through different sea ice conditions. It was found that the ice resistance increases significantly as the ice concentrations increases. Only iceberg towing in concentrations up to around 30% can be considered as feasible while towing in 50% ice or higher is not considered feasible due to the high ice resistance. Extensive use of icebreakers could evidently increase the feasibility. Independent on concentrations, significant wear on the towing equipment must be expected.

Sea ice management

With respect to sea ice management, the proposed methodology focuses on the icebreaker's ability to change the load effect distributions. In order to do so, environmental data from a probabilistic type of analysis is required. In the presented study, a 1000-year long synthetic dataset was applied. Prior to the ice load calculations, the various ice conditions are transformed into an equivalent ice thickness parameter. The reason for doing so is to be able to use formulations for icebreaker resistance and icebreaker efficiency. When using the principles of ice equivalency one may consider i.e. ice of 1.1 m thickness in 90% ice concentration to cause equal icebreaker/vessel resistance as 1 m thick ice in 100% ice conditions. Also other parameters such as ice floe size, ridge intensity, ice strength, temperature etc. are included in the calculations of equivalent ice.

By first calculating equivalent ice thickness at all time steps in the 1000-year long synthetic dataset and thereafter the ice resistance on a structure, the ice load distribution without any ice management system could be derived. By reducing the equivalent ice thicknesses depending on what type of icebreaker fleets would be used, corresponding distributions for different ice management systems could be developed. It was found that icebreakers in general may contribute to significant reductions in horizontal ice loads on a moored structure. However, if the icebreakers do not have the sufficient power, they may still not be able to affect the tail in the load distributions. If it cannot be documented that the icebreakers reduce the severity of extreme and abnormal ice conditions, the robustness of the structure needs to be as without the icebreakers.

One of the key elements in the approach for calculation of horizontal loads on a moored vessel is the use of empirical formulations for icebreaker resistance in ice. When considering the required strength of mooring lines for a floating installation, it is the peak loads that are of importance and not the average loads. Due to this, the variability in ice loads in physical tank model tests was studied. By considering the ratio between peak loads and average loads for a floating system with different mooring configurations and in different ice drift speeds, distributions describing the variability in the ice loads were presented. These distributions were used in the model for efficiency of sea ice management as the calculated ice resistance was transformed to a peak load by using the variability distributions.

The reduction in ice loads due to icebreakers was demonstrated through a Structural Reliability Analysis (SRA), i.e. the probability of the loads being larger than the structural resistance was calculated. However, when considering ice management, there are a number of factors of importance not included in the SRA. Examples are the probability of failure in ice forecasting, the probability of human errors, the probability of failure in icebreaker equipment etc. In order to also take such factors into account, an approach for including the results from an SRA into a Qualitative Reliability Analysis (QRA) was proposed. Basically, this approach use a fault tree and both the events "Dangerous ice" and "Ice management failure" need to occur at the same time in order to get an accident. By doing so, the probability of an accidental event may be quantified.

Disconnection

The possibility to disconnect an installation and escape the site has been considered both in the methodologies for iceberg management and sea ice management. Details on how to physically disconnect offshore installations have not been studied in this work. However, when considering the number and magnitude of uncertainties both with respect to load calculations from icebergs and sea ice, disconnection capabilities should be considered in all Arctic projects. In this respect, it should be noted that both distributions for kinetic energy from iceberg impacts and from sea ice loads on a moored structure shows

extremely “fat tails”. This means that once in a while, there will be events that are significantly more severe than the main bulk of ice events. The possibility to disconnect an installation will contribute to an increased level of safety and to some extent compensate the uncertainties in ice load calculations.

Recommendations for further work

Both the approaches for iceberg management and sea ice management efficiency calculations require that a number of tools are used. With respect to icebergs, the lack of reliable oceanographic models has been highlighted and thus focus on further development and validations of such models such be given priority. When considering operational use of iceberg drift models, the ability to quantify the uncertainty in the drift forecasts will be crucial. Due to this, existing drift models should be used operationally for testing simultaneously with data-logging of all relevant metocean parameters such as winds, waves and currents.

Regarding sea ice management, the lack of reliable load models for unmanaged ice in general and managed ice in particular has been highlighted. It is important that the transformations the icebreakers do with the ice also are captured in the models used for calculations of ice loads. Continuous focus on numerical approaches, physical tank model tests and full scale tests will be required in order to achieve better load models.

The presented model for sea ice management do not take into account scenarios were ship-shaped installations are subjected to ice approaching perpendicular to the hull. There are reasons to expect that icebreakers will be extremely important in order to assist such installations to vane and reduce the severity of such events. Priority should be given to studies on this subject as ship-shaped installations may be preferred in a number of Arctic projects.

Hauge, M. (2012). Arctic Offshore Materials and Platform Winterisation. Proceedings of the Twenty-second (2012) International Offshore and Polar Engineering Conference Rhodes, Greece, June 17–22, 2012.

Oppdragsgiver:		Dokument:	Conference proceeding
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Nøkkelord:	Barents Sea, offshore, SAR, personnel,
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Abstract

Materials for fixed and floating structures in arctic environment must be designed for low ambient temperature. The offshore operating environment is also including sea ice, marine ice accretion and snow. The materials strength, ductility and wear resistance are challenged. Structural steels and steel for piping and pressure vessels for operating temperatures down to -60°C are needed, and the steel industry has a challenge to meet such requirements. At the same time the testing and qualification procedures should be improved to open for utilisation of new materials and welding procedures.

As operation in many cases is located in remote areas, the cost of maintenance and repair is more expensive, and the need for replacements, repair and maintenance should be minimised. Of particular importance is the corrosion protection by painting and cathodic protection.

The integrity and performance of the process system depends upon a good control of the temperature in the production and utility fluids. Therefore, insulation and electrical heat tracing of piping and process equipment is essential. The material selection must therefore take into account that large temperature variations can take place and that the maximum temperature associated with localised heating can be higher than normal process temperature.

Operation of gas production systems includes strict requirements to ventilation. Natural ventilation is not compatible with enclosed process systems unless very large ventilation systems are installed. Material selection for advanced heating, ventilation and air conditioning (HVAC) systems and combinations of natural and mechanical ventilation systems need to be developed for systems operating in arctic marine environment where sea spray, ice accretion and snow can cause problems. Ice repellent materials are attractive, but the long term performance of the materials is questioned.

Conclusions

Development of arctic offshore oil and gas fields should combine the comprehensive experience from arctic onshore developments and from offshore projects in harsh seas.

Long distance to established infrastructure leads to long transport of equipment and personnel. This suggests that solutions with less maintenance and repair should be even more important.

Use of fracture mechanics to demonstrate structural integrity in the presence of cracks or defects is well established in the offshore industry. However, the low temperatures to be expected in the arctic regions are outside the scope of the current standards. Continued R&D efforts resulting in optimised qualification procedures as well as optimised steel grades are required to ensure cost-effective structures for cold climate.

The harsh marine environment in combination with low temperatures makes stainless steel grades, titanium and aluminium and GRP more favourable compared with carbon steel and compensate partly for the difference in cost.

Coating and cathodic protection systems need to take into account the impact of sea ice, ice accretion and heavy snow. The qualification of coating systems need to consider these conditions to ensure sufficient durability and robustness of the corrosion protection system.

As heat conservation is essential for many systems, the heat tracing and thermal insulation materials need particular attention. Flexible elastomeric foam and aerogels are promising candidates for efficient insulation. GRP piping with integrated insulation and heat tracing is also developed for water containing systems.

Sheltering and ventilation represent a major challenge for production facilities, in particular for gas production. Many solutions have been proposed and more will come before an industry standard is settled. Increased operational experience will also contribute to this development.

Horn, A.M., Østby, E., Hauge, M., Aubert, J.-M. (2012). Robust Material Qualification for Arctic Applications. Proceedings of the Twenty-second (2012) International Offshore and Polar Engineering Conference Rhodes, Greece, June 17–22, 2012.

Oppdragsgiver:		Dokument:	Conference proceeding
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Nøkkelord:	arctic material, brittle fracture, toughness
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Abstract

Oil and gas exploration and production is moving into arctic areas. The reduction in ice-covered areas has rendered northern routes more advantages and in addition it is anticipated that as much as 25% of the undiscovered oil and gas resources can be found in the Arctic.

There is a lack of rules and standards that provide guidelines for material selection and qualification of materials for offshore and onshore structures in Arctic areas. Some actions have been taken to develop new standards e.g. ISO19906 Arctic Structure, however the guideline does not specify material requirements except for the statement that material shall have adequate toughness in order to behave ductile at low temperature.

Material related standards like EN10225, API 2W and Norsok are not developed for low temperature applications and are generally applied for service temperatures down to -10°C (Norsok covers down to -14°C). For lower temperature, it is up to the designer to show fit for purpose of the selected material. Hence, one major challenge for designers is to specify adequate toughness requirements at an early stage of the design process for low temperature applications. This paper will discuss factors that influence the required CTOD toughness value at an early stage of a design process by discussing the following topics: required qualification and testing, utilization/robustness of a structure, weld defect size, residual stress, constraint effect and tensile properties.

Conclusions

In order to ensure safe and reliable exploration and exploitation of oil and gas in the Arctic areas, it is highly important to ensure robust material selection. This challenge the designer in order to ensure a safe design that works functionally for all environmental cases, due to limited field experience in Arctic regions. More knowledge has been gained for vessels operating in harsh and cold climate, and it is reported by Zhang, Bridges and Tong (2011) that 57% of ice-class ships have cracks or fractures at an average age of 13.0 years. Hence, it is becoming increasingly important that the industry develops a good understanding of brittle fracture and fatigue acceptance criteria's for structures under ice loading.

In order to ensure the total safety of a structure in the Arctic, uncertainties related to material properties and environmental loading such as wave, wind, ice loads in combination with low temperature should be documented in order to ensure a probability of failure according to recommendations in e.g. ISO 19906 or local operates or authority's requirements. This requires designers to specify a comprehensive material qualification program in order to ensure adequate and robust material properties that ensure a safe construction until more experience is gained by the offshore industry. It is important that the material selected meet the environmental loading both seen at LAST and at e.g. 0°C.

The outcome of the of the 5 years Arctic Material project run by SINTEF (2008-2012) will be a project guideline with the objective to provide recommendations for a systematic approach to material selection and qualification for low temperature applications.

7 BEREDSKAP

Ims, B. (2013). Emergency preparedness in Arctic oil and gas exploration.			
Oppdragsgiver:	NTNU	Dokument:	Master thesis
Nøkkelord:	Barents Sea, offshore, SAR, personnel,		

Objective

The objective of the thesis is to examine conditions relevant to the evacuation and rescue of personnel from facilities operating in the Barents Sea. The report considers the Norwegian sector of the Barents Sea north of the Norwegian mainland, south of Bjørnøya, and extends towards the Norwegian/Russian border that came into effect in 2011.

Study outline

A specific case was made to analyze the following three Defined situations of hazard and accident (DSHA):

- Personnel in the sea as a result of a helicopter accident (DSHA 2)
- Personnel in the sea during emergency evacuation (DSHA 3)
- Personnel injury/sickness requiring external assistance (DSHA 7)

Two scenarios were given: Scenario 1 and Scenario 2. The first scenario should have a SAR helicopter stationed on a production facility, while the other scenario should have the SAR helicopter stationed on a floating base (for instance a standby vessel).

Results

The case study showed that land-based SAR helicopters would not fulfill the performance requirements regarding the three DSHAs mentioned above because the distances out to the actual facilities were too long. Having stationed a SAR helicopter offshore in a hangar is therefore a necessity, and placing the helicopter on a production facility is a better alternative than to station it on a floating base such as a standby vessel.

A SAR helicopter, with an operational speed of 140 knot and a 15 min. mobilization time, could in the event of a helicopter accident (DSHA 2) manage to cover 82 Nm. while rescuing 21 persons from the sea. In the event of a DSHA 7, time of response in emergency medicine, the range could be 100 Nm.

Long distances and a lack of infrastructure combined with the climatic conditions in the Barents Sea, lead to challenges that require special attention and management. Insufficient communication coverage around 70-75°N and further north cause an extra challenge in achieving a safe emergency preparedness. The poor communication coverage also has an influence on the quality of weather forecasts. A good reliable weather forecast is essential to maintain a safe and secure operation. This is however difficult to achieve today due to few measuring points in the area. An increased activity in the Barents Sea will therefore improve the situation.

Ice accretion is an issue that requires attention particularly for standby vessels, lifeboats, MOB boats and facilities. Drifting sea ice and icebergs is also something that has to be taken into consideration when operating north in the Barents Sea.

Special attention has to be given to the use of free-fall lifeboats. If there is sea ice in the area around a facility, the drop of free-fall lifeboats cannot be carried through. Compensating measures then have to be taken into account.

The challenges related to oil and gas exploration in the Barents Sea are manageable, but they require attention and the provision of suitable resources in the area. No single secondary evacuation method is currently available for year-round operation when sea ice is present. Before all-year round petroleum activity can be possible everywhere in the Barents Sea, emergency preparedness must be given sufficient attention so that some critical challenges can be solved.

It seems to be a reasonable requirement that all producing fields in the Barents Sea, including exploration drilling, have an emergency preparedness standard that corresponds to the areabased emergency preparedness.

Basharat, S. (2012). Proactive Emergency Preparedness in the Barents Sea.			
Oppdragsgiver:	NTNU	Dokument:	Master thesis
Nøkkelord:	offshore, Arctic, emergency preparedness, NORSOK Z-013		
Objective			
The objective of the thesis is to provide an overview of offshore petroleum activity in arctic and sub-arctic areas as well as the accidents which took place in these areas. Furthermore, the accidents are analyzed with respect to the emergency preparedness handling of accidents using the NORSOK Z-013 standard as one basis. The thesis also discusses the anticipated emergency preparedness challenges for arctic and sub-arctic areas.			
NORSOK Z-013			
The NORSOK Z-013 standard refers to alert, danger limitation, rescue, evacuation, and normalization as the five emergency preparedness phases and their detailed description is available in the Activities Regulation by the Petroleum Safety Authority in Norway (PSAN). It is stated in the NORSOK Z-013 standard that a set of Defined Situation of Hazard and Accident (DSHA) needs to be defined as part of the risk and emergency preparedness analysis. The set of DSHAs provided in the “Trends in risk level” project is used in this thesis for the classification and analysis of the accidents in the Arctic Sea.			
Results			
The analysis of the accidents in the Arctic Sea shows that all the emergency operations went through the phases of alert and normalization while the oil spill related accidents did not pass through escape and evacuate operations as there were no personnel involved in these accidents. All the emergency operations were affected by bad and tough weather conditions. Advanced emergency preparedness tools, equipment and technology are needed for effective emergency operations under such conditions. Due to scarcity of accidents in the Arctic Sea, only four DSHAs (out of 12) have been experienced, or at least reported. It may be that some of the remaining DSHAs are not reported due to minor consequences.			
In addition to the lessons learned from the emergency response operations for the accidents experienced in the Arctic Sea, there are also some emergency preparedness challenges which can be anticipated. The challenging weather conditions due to sudden polar lows, strong winds, spray icing, snowstorms and severe fog can hamper the emergency operations. Furthermore, long distances and lack of infrastructure can create communication and logistic problems and can result in delay of rescue and evacuation operations. Robust and reliable ice and weather data is a challenge due to global warming and may become a limiting factor for the adequate design of offshore equipment. The use and maintenance of emergency response equipment is also a challenge in sometimes dark, snowy and foggy areas of the Arctic Sea and the Barents Sea.			

Jacobsen, S.R., Gudmestad, O.T. (2012). Evacuation from Petroleum Facilities Operating in the Barents Sea. Proceedings of the ASME 2011 31st International Conference on Ocean, Offshore and Arctic Engineering OMAE2012 July 1-6, 2012, Rio de Janeiro, Brazil.

Oppdragsgiver:		Dokument:	Paper
Nøkkelord:	evacuation, rescue, personnel, ice accretion, Barents Sea		

Objective

The purpose of this paper is to examine conditions relevant to evacuation and rescue of personnel from facilities operating in the Barents Sea. The paper considers the area from the Norwegian coast to Bjørnøya (Bear Island) in the north and the new border with Russia in the east. This corresponds roughly to the area that is open for exploration and exploitation of petroleum resources in the Norwegian sector of the Barents Sea.

Method

Pertinent meteorological observation data is collected from the Norwegian Meteorological Institute. The data is used to evaluate evacuation and rescue under the observed conditions. The probability and effect of ice accretion on vessels, in particular lifeboats, is considered. Ice accretion on lifeboats is possible and could threaten stability if the lifeboat has to ride off a storm while waiting for a weather window that allows rescue of the passengers.

Conclusions and recommendations

The analyses of the meteorological data for stations around the Barents Sea coincide with what can be expected from literature and norms for the area. The meteorological data and the stability calculations indicate that stability of lifeboats could be impaired due to ice accretion. This is an issue that the designers and producers of lifeboats are aware of, but it has not been investigated in detail. The effect of ice accretion should be investigated for each lifeboat model that may be used on facilities operating in the Barents Sea.

Access to reliable weather forecasts is paramount for operating in the Barents Sea. Responsible personnel onboard facilities operating in the Barents Sea should be competent in the interpretation and understanding of weather forecasts and the implications the conditions may have in an evacuation and rescue situation.

Equipment available for evacuation can encounter conditions that render them inappropriate. The limitations of existing evacuation and rescue systems are generally understood.

Third generation rapid response rescue vessels are recommended as standby vessels in the Barents Sea. Their rescue capacity and ability is by far the best that is currently available.

Norwegian regulations are functional and risk based. They are considered sufficient to regulate safe evacuation and rescue in the Barents Sea. The guidelines to the regulations should be complemented with references to standards like ISO-19906.

All year operation in the Norwegian sector of the Barents Sea is thus considered possible when appropriate risk analysis and risk reduction measures are put in place.

Jacobsen, S. (2012). Evacuation and Rescue in the Barents Sea, Critical issues for safe petroleum activity.			
Oppdragsgiver:		Dokument:	Master thesis
Nøkkelord:	Emergency preparedness, evacuation, rescue, helicopter, lifeboat, emergency response vessel, barriers, bow tie, risk analysis		
Objective Norwegian petroleum regulations require that personnel on a facility can be evacuated quickly and efficiently to a safe area at all times, Activity Regulation § 77 d), and in all weather conditions, Facilities Regulation § 44. The objective of this thesis is to examine limitations and critical issues for emergency preparedness in the Barents Sea.			
The most important results Every effort should be made to prevent the need for emergency preparedness resources and if required, evacuation, survival and rescue equipment should perform satisfactorily in order to eliminate or reduce injury and loss of life. • Weather conditions in the Barents Sea are such that certain critical technical solutions may not be appropriate in some circumstances. • Immersions suits are critical to survival of persons in the sea and should be used with caution outside of the design envelope. • Helicopters are equipped with floatation systems that may be insufficient in sea states that are currently accepted for transport flights. • It can be difficult to rescue persons from lifeboats in harsh weather and this may pose an extra threat to survival if ice accretion threatens the stability of the vessels. • The useful operational window of equipment and a person’s ability to use the equipment should be known and activities should be planned within this envelope.			
Major findings and conclusions The lack of infrastructure and long distances combined with the climatic conditions of the Barents Sea lead to challenges that require special consideration and management. Performance requirements related to medical evacuation of ill or injured persons will be challenged as activity moves further north and away from mainland Norway. Compensating measures will need to be implemented to ensure that the need for emergency preparedness resources is reduced at the same time as improving access to these resources as the need cannot be eliminated. As work has progressed on this thesis, it has become increasingly clear that it is insufficient to only consider the traditional regimes of emergency preparedness within the area of evacuation and rescue. In the case of an accident involving many injured persons, there is a challenge with regard to the capacity of the public health services in Northern Norway. This is further aggravated by large distances and limited resources for transportation. In order to prevent the loss of life, the availability of emergency health services onshore must be considered when evaluating the total acceptability of petroleum operations in the Barents Sea. Increased awareness of the physical and psychological limitations of a person and the limitations of evacuation, survival and rescue equipment is required combined with improved planning of activities based on this knowledge. Departure criteria for helicopter transport should be developed to ensure a reasonable prospect of rescue under the prevailing conditions during the flight. Ice accretion remains an issue that requires attention particularly for emergency response vessels, lifeboats, fast recovery daughter craft and man overboard boats. Emergency response vessels should be designed to retrieve lifeboats from the sea in a broad range of sea conditions and as far as reasonably practicable be able to perform this operation close to the limit of the conditions that can be anticipated. Improved access to medical assistance onboard the facility is required due to distance and unpredictable weather conditions. Improved health requirements and screening of personnel who will work on facilities in			

the Barents Sea is recommended.

All year activity everywhere in the Barents Sea is only possible if comprehensive risk analysis is performed, the ALARP process applied and necessary measures are put in place to compensate for the specific challenges of the area.

Recommendations for further work

- Research helicopter ditching and accidents in the sea to identify critical issues related to escape and survival in order to improve helicopter underwater escape training.
- Research voluntary safety training involving developing tolerance to cold water and dealing with a stressful environment during escape from a helicopter and subsequent survival in the sea. Evaluate the benefits compared to current helicopter underwater escape training.
- Develop a decision support tool based on a comprehensive set of departure criteria for helicopter flights.
- Develop a civilian helicopter in flight refuelling system (HIFR) suited for use in the Arctic.
- Develop suitable methods for evacuation in cold climates where sea conditions can vary from calm to violent storm or even hurricane in open water conditions to many varieties of ice types and cover.

NOROG (2012). 064 Anbefalte retningslinjer for etablering av områdeberedskap.			
Oppdragsgiver:	NOROG	Dokument:	Retningslinje
Nøkkelord:	områdeberedskap, retningslinje		
Formål			
Formålet med retningslinjene er å uttrykke en norm for beredskap, spesielt i forhold til marine og luftbårne ressurser. Retningslinjen er en revidert versjon av dokumentet Norsk olje og gass 064:2000.			
Faktorer med særlig relevans for nordområdene			
3.8 Bruk der det ikke er etablerte områder			
Retningslinjene setter ikke krav til beredskap for innretninger som ikke inngår i etablerte områder.			
3.9 Bruk i Barentshavet og tilsvarende områder			
Klimatiske forhold og miljømessig sårbarhet i nordområdene (Barentshavet og tilsvarende områder) har berettiget en særskilt oppmerksomhet på effektivitetskravene ved områdeberedskapsløsninger som etableres der. <i>Det er likevel ikke funnet faglig grunnlag for å etablere særskilte effektivitetskrav i disse områdene.</i>			
Det er særlig kravene til DFU2, DFU3 og DFU7 som det er sentralt å oppfylle, eventuelt i kombinasjon med kompenserende tiltak og/eller tiltak i samarbeid med andre aktører, eksempelvis sjøforsvaret.			
• DFU2: Personell i sjøen som følge av helikopterulykke • DFU3: Personell i sjøen ved nødevakuering • DFU7: Personskade/sykdom med behov for ekstern assistanse			

Preventor as (2012). Områdeberedskap på norsk sokkel. Underlagsrapport med dokumentasjon av forutsetninger og faglige vurderinger i Norsk olje og gass 064: Anbefalte retningslinjer for etablering av områdeberedskap. Rev. li , 12.9.2012.

Oppdragsgiver: NOROG

Dokument:

Rapport

Nøkkelord: områdeberedskap, retningslinje, underlagsrapport

Innhold som adresserer nordområdene: DFU 7 - Personskade/sykdom med behov for ekstern assistanse

Når virksomhetene utvides til nord i Barentshavet er akuttmedisin ett av de to temaer som må vurderes nøye. *(Temaet helikopterredning diskuteres ikke ytterligere i rapporten).*

Vedrørende tidskrav - transport til sykehus:

Tidskravet til transporttid i revidert retningslinje 064 er 3 timer. Helikopter i Hammerfest kan *ikke* gi akuttmedisinsk responstid ihht dette kravet. Av kompenserende tiltak foreslås:

1. Øke medisinsk kompetanse om bord (lege på innretning, to sykepleiere om bord)
2. Ekstra utstyr om bord (overvåkningsutstyr, medikamentutvlag, intensivmedisisk utstyr) kombinasjon med økt kompetanse
3. Utnyttelse av mulighetene knyttet til telemedisin
4. SAR helikopter i området, på innretning eller fartøy (fullverdig tiltak, ikke kompenserende)

Rapporten anser at gjennom ENI sin boring av produksjonsbrønner på Goliat og etterfølgende produksjonsfase setter en standard om at alle felt med permanent bemannede innretninger i Barentshavet skal ha en beredskapsstandard minst tilsvarende områdeberedskap.

Proactima (2012). Beredskap og støttefunksjoner. Underlag for konsekvensutredning Barentshavet sørøst.			
Oppdragsgiver:	Olje og Energidepartementet	Dokument: 1070696-RE-02	Rapport
Nøkkelord:	Beredskap, rømning, evakuering, redning, Barentshavet		
I forbindelse med konsekvensutredningene av virkninger av petroleumsvirksomhet i sørøstlige Barentshavet og Jan Mayen, ble Proactima tildelt oppdraget ”analyse av beredskaps- og støttefunksjoner for petroleumsvirksomhet” i disse områdene. Det ble laget en rapport for hver av havområdene. Her er kun rapporten for Barentshavet Sørøst sammenfattet. Utredningen er basert på scenarioer for utvikling av aktivitet i havområdet definert av Oljedirektoratet (OD). På bakgrunn av scenarioene kan det ikke utelukkes at det kun vil være én enkelt innretning tilstede i utredningsområdet fram mot 2030. Dette innebærer i så fall at det ikke vil være nærliggende innretninger som kan brukes for evakuering av personell i denne perioden. Det vil være en beredskapsmessig fordel om man gjennom tildeling av tillatelser sørger for samtidighet i operasjoner i de nordligste delene av utredningsområdet. Utredningen dekker beredskapsmessige forhold relatert til HMS-forskriftene og omfatter beredskap for personell når de befinner seg om bord på petroleumsinnretninger, samt under transport til og fra disse. Det er gitt en beskrivelse av dagens beredskapsnivå på norsk sokkel, basert på informasjon og krav gitt i Stortingsmeldinger, Petroleumsregelverket og retningslinjer fra Norsk olje og gass (tidligere Oljeindustriens landsforening, OLF). Videre er det beskrevet utfordringer relatert til klima, aktivitet og infrastruktur som kan påvirke beredskapen og det er vurdert om dagens etablerte beredskap kan opprettholdes ved petroleumsvirksomhet i Barentshavet sørøst eller om alternative løsninger er påkrevd. De beredskapsmessige utfordringene er gjennomgående er størst i de nordlige delene av utredningsområdet, det vil si i området nord for om lag 73 grader nord. Sør for denne grensen er de beredskapsmessige utfordringene ikke ansett å være vesentlig forskjellig fra i de områder som i Barentshavet sør som i dag er åpnet for petroleumsvirksomhet . Spesielle utfordringer relatert til klima og avstander, egnethet av dagens benyttede beredskapsløsninger og anbefalinger for nye løsninger vurdert i forhold til disse utfordringene er gjengitt i det følgende.			
Havis Havis (varierende fra issørpe til fast havis) kan forekomme i nordlige deler av området i månedene januar til juni. Maksimal utbredelse varierer fra år til år og det forekommer sykliske svingninger. Meteorologisk institutt har de senere årene registrert en trend med redusert isutbredelse, men det forventes en ny økning i isutbredelse i perioden 2014-2016. Nyere data viser imidlertid at isutbredelsen (minimum) i september 2012 var den minste som er registrert. Havis kan gjøre det vanskelig å oppdage personer (mann over bord) som har havnet i sjøen og kan føre til at beredskapsfartøy (eller annen redningsbåt), ikke kan nå fram til skadelidte personer. Muligheter for evakuering av personell vil i stor bli påvirket av havis, og sikker bruk av fritt fall livbåter og utsetting av flåter kan bli forhindret. Båtene eller flåtene kan skades av sammenstøt med drivende is, og personell som havner i sjøen vil kunne bli skadet av isen. Havis kan videre begrense mulighet for manøvrering og framdrift av livbåter. Det må påregnes at evakueringsbehovet i områder med sannsynlighet for havis ikke utelukkende kan løses ved bruk av livbåter eller flåter. På denne bakgrunn gis følgende anbefalinger: 1. Problemstillinger forbundet med forekomst av havis må adresseres i relevante prosedyrer knyttet til arbeid over sjø. 2. Metoder og utstyr for evakuering i isfylt farvann bør videreutvikles. Eksempler på mulige løsninger vil være gangbroer montert på fartøy som kan ta seg fram i vann, i issørpe og på fast is. 3. Eksplisitte krav i regelverket til bruk av fritt fall livbåter bør modereres, og åpning for alternative livbåtløsninger bør gis.			
Ising Ising må påregnes i området og i de nordlige deler av området vil sterk ising (2 - 4 cm tilvekst i timen) være sannsynlig i korte perioder. Det er større sannsynlighet for ising i de nordlige delene av utredningsområdet enn i andre deler av Barentshavet. Ising anses som et større problem for fartøyer og evakueringsmidler enn for innretninger. Ising kan forhindre rømning om bord på innretningen dersom dører/luker i rømningsveier fryser til.			

Rømningsveier kan dermed blokkeres og gjøres utilgjengelige.

Ising kan føre til at beredskapsressurser får en redusert effektivitet eller ikke kan benyttes. Helikopter som ikke er spesielt tilpasset flyging under ising kan få tap av flygeevne. Muligheter for å bruke MOB båt som ikke er innebygget på kan bli redusert. Ising kan påvirke stabilitet for livbåter som er sjøsatt. Disse forholdene vil påvirke muligheter for redning. Følgende anbefalinger er gitt relatert til ising:

4. Innebygging og skjerming av rømningsveier og eventuelle utvendige mønstringsområder bør utføres som del av vinterisering av innretninger.
5. Design av livbåtenes utsettingsarrangement må sikre tilgjengelighet og funksjon under forhold der ising forekommer. Hel eller delvis innebygging bør vurderes.
6. Sterk ising og effekt på livbåters stabilitet må hensyntas i design av livbåter.

Vind og bølger

Maksimale vindhastigheter og bølgehøyder er lavere enn ved Goliat, Heidrun og Statfjord feltene. Det er ikke spesielle beredskapsmessige utfordringer knyttet til dette i Barentshavet sørøst.

Polare lavtrykk

Polare lavtrykk er små, men intense lavtrykk som dannes i de arktiske havområdene i vintersesongen fra oktober til april. Polare lavtrykk kjennetegnes ved raske skiftninger hvor vinden kan øke fra bris til storm på bare få minutter og bølgehøyden kan øke med opptil 5m på under en time. De følges også av tett snøfall med dårlig sikt, og særlig nær iskanten ofte med sterk ising. Polare lavtrykk er vanskelige å varsle. Evnen til å gi værprognoser og dermed også varsle polare lavtrykk er i dag begrenset av observasjonsgrunnlaget i Barentshavet sørøst.

Polare lavtrykk vil gi beredskapsmessige utfordringer ved at værforholdene forverres raskt ut over det som er normale operative begrensninger for helikopter. Dette kan påvirke tilgjengelighet av helikopter som evakueringsmiddel i større grad enn ellers på norsk sokkel. Sjøforholdene som oppstår vil også kunne være et problem for redningsflåter, livbåter og personell i sjøen. Begrensninger ved bølgehøyde for redning av personell fra livbåt og redningsflåte kan medføre at personellet må oppholde seg i disse over lengre tid.

Følgende anbefalinger er gitt:

7. Evakueringsmidler som kan fungere under ekstreme værforhold, som alternativ til helikopter, bør inkluderes på innretninger som skal operere i områder med sannsynlighet for polare lavtrykk.
8. Det bør iverksettes arbeid for å bedre de meteorologiske observasjonene i området for dermed å etablere et grunnlag for tidligere og mer presis varsling av polare lavtrykk.

Luft og sjøtemperatur

Luft- og sjøtemperatur i området ligger tildels betydelig under det som er observert for Goliat-feltet, med beregnede minimumstemperaturer ned mot -25° (i februar) for de nordligste delene av området.

Sjøtemperaturen kan også perioder ligge under null grader.

Lave temperaturer vil påvirke overlevelsestid for ubeskyttet personell, personell i sjø, samt i flåter og livbåter uten oppvarming. Kombinasjonen vind og minusgrader kan føre stor kuldepåkjenning for personell.

Følgende anbefalinger gis:

9. En videreutvikling av krav til overlevningsdrakters isolasjonsevne, samt eventuell underbekledning bør vurderes.
10. Behov for, og eventuell løsning for oppvarming av luft i livbåter etter sjøssetting bør utredes.

Sikt og lysforhold

For Bjørnøya og Hopen er forekomsten av tåke vesentlig hyppigere enn på stasjonene på Svalbard og på Finnmarkskysten. Det foreligger ikke observasjonsdata for sikt i utredningsområdet, men dette antas å være tilsvarende som for Bjørnøya og Hopen i nordlige deler av området og noe gunstigere i de sørlige delene. Området har "Mørketid" i om lag 3 måneder av året, lengst i de nordlige delene. Snødrev i kombinasjon med tåke og mørke vil redusere sikt ytterligere.

Dette skiller seg ikke vesentlig fra områder på norsk sokkel som er åpnet for petroleumsvirksomhet, men høyere frekvens av situasjoner med dårlig sikt vil forstreke utfordringer knyttet til dårlig sikt. Muligheten for landing av helikopter på helidekk og søk etter og redning av personell i sjøen kan bli redusert.

Redningsdrakter med god termisk isolasjonsevne gir redusert mulighet for å detektere personell ved hjelp av varmesøkende kamera.

Følgende anbefaling gis:

11. Overlevningsdrakter må utstyres med, i tillegg til personlige nødpeilesendere og lys, egnet teknologi som øker synligheten av personell i sjøen ved bruk av varmesøkende kamera.
12. Det bør vurderes om operasjonelle begrensninger for flyging med helikopter må revideres.

Nordlys og Geomagnetiske stormer

Nordområdene er spesielt påvirket av geomagnetiske stormer som reduserer mulighet for kommunikasjon i flere frekvensområder og også gi misvisninger eller bortfall av GPS signaler. Kommunikasjon over radio og satellitt har vist seg upålitelig og det er klare "hull" i dekningen i områder nord for 70 grader nord. Slike fenomen vil kunne vanskeliggjøre kommunikasjon mellom ulike beredskapsressurser, og redusere muligheten til å bruke GPS til navigasjon eller gjenfinning av personell som har evakuert til sjø. Følgende anbefaling gis:

13. Robuste kommunikasjonsmuligheter for nordområdene må etableres, for eksempel gjennom bruk av polare høyelliptiske systemer for satellittkommunikasjon.

Avstander og infrastruktur

Det er store avstander fra fastlandet til de nordligste delene av utredningsområdet, og det er heller ikke utbygget noen form for infrastruktur i dette området. Analysen har vist at meste av utredningsområdet er utenfor dekning av dagens SAR-helikopter stasjonert i Hammerfest. Operasjonsgrensen for dette helikopteret er 340 km fra land, mens det er minst 450 km til den nordligste utredningslokasjonen.

Dagens løsning med SAR-helikopter stasjonert i Hammerfest vil ikke gi en tilfredsstillende løsning for redning av skadet personell i Barentshavet sørøst. Stasjonering av SAR helikopter i Øst-Finnmark vil forbedre situasjonen, men vil ikke gi tilfredsstillende løsning i de nordlige delene av utredningsområdet.

På grunn av lange avstander til nordlige deler av Barentshavet sørøst bør man ikke basere beredskapen på beredskapsfartøy eller SAR-helikopter alene, men på løsninger som kombinerer flere beredskapsalternativer. Følgende anbefalinger gis:

14. Ved tildeling av tillatelse for gjennomføring av boreoperasjoner i de mest fjerntliggende områdene bør samtidighet i operasjoner tilstrebes slik at man på denne måte har mulighet til å benytte nærliggende enheter som framskutte baser i en beredskapssituasjon.
15. Dedikerte innretninger og / eller fartøyer utplassert som mellomstasjoner for evakuering og beredskap i perioder med aktivitet og som kan betjene flere felt / operasjoner bør vurderes.
16. Mulighet for å ha permanent stasjonerte helikoptre på innretninger anbefales vurdert, spesielt innretninger som ligger i de mest fjerntliggende områdene, men også på innretninger som etableres som mellomstasjoner for evakuering.
17. Mulighet for bruk av helikopter med høyere hastighet og lenger rekkevidde enn de som normalt benyttes i dag bør undersøkes.
18. Etablering av en helikopterbase i de nordlige delene av Øst-Finnmark bør utredes.

Beredskapsfartøy

Følgende anbefalinger gis med henblikk på å sikre at beredskapsfartøy kan utøve sin tiltenkte rolle i en beredskapssituasjon:

19. Det bør etableres krav til bruk av "tredje-generasjon" (eller bedre) beredskapsfartøy ved operasjoner i Barentshavet sørøst. Spesielt gjelder dette i de nordlige områdene.
20. Løsninger som gjør det mulig å trekke livbåter direkte inn i beredskapsfartøyet også ved høy sjø bør utvikles.
21. Beredskapsfartøy bør designes for å møte utfordringer ved ising. Innebygging av kritisk utstyr bør vurderes også for beredskapsfartøy.
22. Sivile løsninger for fylling av drivstoff på helikopter fra beredskapsfartøy uten at landing gjennomføres ("in flight fuelling") bør utvikles.

Akuttmedisinsk beredskap

Store avstander til land og klimatiske forhold innebærer at dagens beredskap for Barentshavet sør ikke kan betraktes som tilfredsstillende for utredningsområdet, og da spesielt nordlige deler av dette.

Det vil være vanskelig å tilfredsstillende kravet om å kunne evakuere skadet personell til sykehus på land i løpet av 3 timer med landbaserte helikoptre. Operasjoner under forhold som dem man finner i nordlige deler av Barentshavet sørøst er utfordrende, og vil påvirke ulike skadetyper, behandlingsmuligheter og -opplegg.

Dette vil stille nye krav til både kompetanse og organisering.

Følgende anbefalinger gis:

23. Det bør vurderes om kravet om å starte medisinsk behandling på innretningen innen 60 minutter er tilstrekkelig også i situasjoner med personskaade kombiner med sterk kulde kombinert og vind.
24. Den akuttmedisinske beredskapen i Øst-Finnmark bør styrkes uten samtidig å forlenge flytiden vesentlig. Løsninger hvor akutt medisinsk utstyr er tilgjengelig på helikopterbasen og medisinsk personell bringes dit, alternativt en fremskutt akutt medisinsk enhet i Øst-Finnmark med kampanjespesifikk bemanning, bør vurderes.
25. Muligheter for bruk av telemedisin for akutt medisinsk assistanse til innretninger og beredskapsfartøy bør utvikles videre.

Anbefalinger gitt andre steder

I tillegg til anbefalinger gitt over som resultatet av dette arbeidet er det i utredningen gjengitt en rekke anbefalinger gitt av operatører og andre basert på erfaringer med oljevirksomhet i nordområdene. Disse anbefalingene bør også vurderes og hensyntas som del av konsekvensutredningen for Barentshavet sørøst. Det er også beskrevet en rekke alternative løsninger, både i denne utredningen og i andre arbeider som bør vurderes forut for etablering av ny petroleumsvirksomhet i nordområdene.

Konklusjon

Arbeidet dokumentert i denne rapporten har vist at man ved petroleumsvirksomhet i Barentshavet sør-øst vil møte enkelte utfordringer. Disse er beskrevet i rapporten.

Proactimas konklusjon er at det å håndtere disse på vil kreve videre utvikling av regelverk, infrastruktur og teknologi, men at ingen av utfordringene isolert sett synes å være uoverkommelige. Anbefalingene gitt i rapporten vil, hvis hensyntatt, bidra til å sikre at man kan etablere en beredskap også i disse områdene som vil være forsvarlig og tilsvarende den som er etablert i områder som allerede er åpnet for petroleumsvirksomhet.

Oppdragsgiver: Norges Fiskarlag / Ett hav

Dokument:

Rapport

Nøkkelord: beredskap; SAR (søk og rednings)-ressurser; nordområdene

Bakgrunn

Utredningen har sett på tilgangen på søk- og redningsressurser (SAR-ressurser) i nord, forventet regional utvikling frem mot 2020, og potensielle synergieffekter mellom fiskeri- og oljenæringen som vil bidra til en bedre utnyttelse av SAR-ressurser.

Sammendrag

SAR-kapasiteten er lavere i nord enn i den sørlige delen av den norske SAR-regionen. Dette er delvis et resultat av store geografiske forskjeller. I nord er det et betydelig større havområde som skal dekkes med færre SAR-ressurser. Det er også et resultat av forskjeller i petroleumsnæringens tilstedeværelse. I nord er det få petroleumsinstallasjoner, og tilgangen på SAR-ressurser tilknyttet denne næringen er derfor mer begrenset enn i sør.

Utredningen har vist at SAR-kapasiteten i nord vil øke frem mot 2020. Dette skyldes en kombinasjon av økte offentlige investeringer, og at petroleumsnæringens aktivitet i regionen vil øke. Tre sentrale elementer som vil bidra til å øke SAR-kapasiteten i nord er:

- Anskaffelse av nye redningshelikopter med utvidet rekkevidde
- Utplassering av permanente plattformer med tilhørende SAR-kapasiteter/egenberedskap
- Gjennomføring av leteboring med tilhørende SAR-kapasiteter/egenberedskap

Nye redningshelikopter er prosjektert anskaffet før 2020. Redningshelikoptrene vil forbli stasjonert i Bodø og på Banak. De nye helikoptrene vil kunne operere i dårligere vær, holde høyere hastighet og ha langt bedre rekkevidde enn dagens Sea King.

Utredningen har vist at etablering av nye permanente petroleumsinstallasjoner i nord, som Goliat, Skrugard og Havis, vil bidra positivt til den regionale beredskapen. Petroleumsnæringens krav til egenberedskap betyr at disse vil ha SAR-kapasiteter, både i form av tilgang på AWSAR-helikopter (*All Weather Search and Rescue*), beredskapsfartøy, medic og etablerte prosedyrer for syketransport. Frem mot 2020 kan det ikke utelukkes at det vil komme strengere krav til egenberedskap i nord, noe som ytterligere vil forsterke disse installasjonenes SAR-beredskap.

Det kan forventes relativt høy leteboringsaktivitet i nord frem mot 2020. Det betyr at det i perioder vil være økt SAR-kapasitet i deler av Barentshavet, inkludert mot øst og nordøst. Dette er områder der SAR-beredskapen i dag er lav, og der det generelt sett er lite skipstrafikk. I disse områdene drives det blant annet fiske med not og line. For fiskerinæringen vil leteboring bidra til økt tilgang på SAR-ressurser for fartøyer i området.

Offentlige myndigheter har signalisert at de ønsker å styrke SAR-beredskapen i nord. Økt aktivitet fra petroleumsnæringen vil komme som et supplement til dette. Erfaringene fra Nordsjøen og Norskehavet viser at petroleumsnæringens SAR-ressurser er viktige for hovedredningssentralen, da ressursene bidrar regelmessig også i sivile redningsaksjoner. I takt med at petroleumsnæringens fotfeste i nord øker vil deres mulighet til å bidra i sivile SAR-operasjoner tilta. Dette vil bidra til bedre SAR-beredskap i nord frem mot 2020.

Ly, J.M., Bjerkemo, O.K. (2011). Prevention, preparedness, and response to shipping incidents in the Barents Sea. 2011 International Oil Spill Conference.

Oppdragsgiver:

Dokument:

Conference proceeding

Nøkkelord:

Barents Sea, shipping incidents, preparedness

Abstract

A number of preventive measures related to maritime safety and oil spill response have been implemented in the Norwegian part of the Barents Sea. The background for these measures is to reduce the risk for shipping incidents in a clean and rich marine area of great significance for Norway. Preventive measures within surveillance, monitoring, the maritime infrastructure and the maritime services are established and being implemented. Preparedness issues with development of oil spill response equipment, enhancement of the governmental emergency response system for acute pollution are being further developed and improved. This paper will give an overview of these preventive and preparedness measures.

The Barents Sea risk picture

The weather conditions off the Norwegian coast mean that oil spill response measures only provide effective damage limitation for about 60 per cent of the year (ref Whitepaper to the Norwegian Parliament - St.meld. 14 2004-2005). In the northern part of the Barents Sea and the Svalbard area effective oil spill response operations pose special problems due to logistic difficulties, winter darkness and cold climate with ice.

Risk reducing factors (preventive measures)

Risk reducing factors and preventive measures in the Barents Sea include a number of services aiming at improving the safety for vessels navigating these waters. New technologies have paved the way for improved surveillance over larger sea areas. Monitored by large area VTS (Vessel Traffic Services Centre) and combined with other services such as ETV (Emergency Towing Vessels), sea routing and offshore traffic separation system and pre-planned places of refuge the overall level of security has improved over the last decade. On the environmental side improvements in vessel design and international rules have limited the use of single hull tankers in the area. In addition Norway has implemented restrictions on use of heavy fuel oil on the east coast of Svalbard. This will reduce the possible impact following a spill.

Surveillance

The maritime civilian surveillance in the Norwegian part of the Barents Sea is maintained by the Norwegian Coastal Administration (NCA). The sources are AIS (Automatic Identification System) both land based and by satellite, LRIT (Long Range Identification and Tracking) and radar systems. For environmental surveillance, primarily for oil spills, Norway use aerial surveillance by satellite and by fixed wing aircraft on routine patrol.

Conclusions

1. Risk reducing measures as VTS services, ETV service, Traffic separation schemes and other risk reducing measures are important to avoid incidents.
2. Surveillance with AIS, LRIT, AIS by satellite and surveillance aircraft is important to reduce the number of incident, but they are also important when an incident should occur.
3. Well trained available resources (ETV, booms and skimmers) are important when an incident should occur to reduce the consequences of a spill.
4. The contingency plans should always be updated and regularly tested through training and exercises
5. Bi- and multilateral agreements on oil and HNS response is very important if the incident exceeds the national limitation. These agreements should regularly be tested through exercises.
6. An accidental release Oil and/or HNS in cold and Arctic climate is a challenge.

Forsvarets Forskningsinstitutt (FFI) (2010). Kystvaktens oppgaver. FFI-rapport 2010/01312**Oppdragsgiver:****Dokument:**

Rapport

Nøkkelord:

Kystvakten, Kystvaktloven, Suverenitetshevdelse, Myndighetsutøvelse, Ressurskontroll

Organisering

Kystvakten er organisert som en av tre hovedavdelinger under Sjøforsvaret, og ledes av Sjef Kystvakten (Sj KV). I 1997 vedtok Stortinget *Kystvaktloven* som omhandler Kystvaktens organisasjon, oppgaver, myndighet og virksomhet. Kystvakten er delt i Indre-(IKV) og Ytre Kystvakt (YKV).

Kystvaktens operative enheter er organisert i to skvadroner, KV Nord og KV Sør, med tilholdssted i henholdsvis Sortland og Haakonssvern i Bergen. KV Nord disponerer 9 fartøyer, hvorav 7 i YKV. KV Sør har 5 fartøyer, hvorav 2 tilhører YKV.

Kystvakten disponerer 6 helikopter organisert i Luftforsvarets 337 skvadron, stasjonert på Bardufoss. I tillegg gjennomføres ukentlige patruljeflyvninger med P3 Orion fra 333 skvadronen. Kystvakten benytter også innleide fly i noe utstrekning.

Operativt er Kystvakten underlagt Forsvarets operative hovedkvarter (FOH), som ivaretar kommando, kontroll, koordinering av virksomheten for helårlig og døgntkontinuerlig patrulje for overvåkning, kontroll og aksjon.

Oppgaver

Kystvaktloven angir i stor grad hva Kystvakten både skal og kan gjøre innenfor det fredsoperative spekter. Områder der Kystvakten er primærmyndighet er:

- Suverenitetshevdelse m.v
- Anløpskontroll
- Fiskerioppsyn, fangstoppsyn, ressurskontroll m.v.
- Rapportering om og uskadeliggjøring av drivende gjenstander
- Opprettholdelse av ro og orden (fiskefelt)

Oppgaver der Kystvakten har komplementær eller subsidiær myndighet

- Bistand til politi
- Schengen-kontroll
- Tolloppsyn
- Miljøoppsyn
- Andre oppsynsoppgaver (bistand til statlige institusjoner og organer iht. Kystvaktlovens intensjoner. F. eks. ved aksjonsledelse og beredskap i norske kyst og havområder)
- Søk og redning
- Kontroll i forbindelse med vitenskapelige undersøkelser m.v.

Operasjonsområde

Det norske jurisdiksjonsområde til havs, som består av Norges økonomisk sone (NØS) og fiskerivernsonene rundt Svalbard og Jan Mayen, er ca 7 ganger større enn det norske fastlandet. Operasjonsområdet er delt mellom KV Nord og KV Sør ved 65. breddegrad.

Mer om oppgaven søk og redning (SAR-operasjoner)

Med søk- og redningsaksjoner menes organisert virksomhet i forbindelse med øyeblikkelig innsats for å redde mennesker fra død eller skade som følge av akutte ulykkesituasjoner. Man skiller altså mellom SAR-operasjoner og andre operasjoner som tar sikte på for eksempel berging av fartøyer og andre verdier. For Kystvaktens del er SAR-operasjoner avgrenset til sjøredning og til strandsonen.

Det er Forsvarets operative hovedkvarter (FOH) som leder Forsvarets operasjoner, og øverstkommanderende utøver operativ kommando. I Sjøforsvaret utgjør alle fartøyer under kommando en redningsressurs. I tillegg har Sjøforsvaret spesialressurser slik som for eksempel dykkere og fjernstyrte undervannsfarkoster som kan benyttes til søk etter omkomne. I tillegg til Redningshelikoptrene og Kystvaktens egne helikoptre utgjør alle

Luftforsvarets fly en søkeressurs.

Med redningstjeneste forstås vanligvis den offentlig organiserte virksomhet som utøves i forbindelse med øyeblikkelig innsats for å redde mennesker fra død eller skade som følge av akutte ulykkessituasjoner. For at det skal være en oppgave for redningstjenesten, må ulykken ha et slikt omfang at det er behov for å samordne de ressurser som er tilgjengelige for redningstjenesten. Redningstjenesten i Norge har alltid basert seg på et samvirke mellom en rekke offentlige etater, private selskaper og ikke minst de frivillige hjelpeorganisasjonene. Redningstjenesten omfatter alle typer redningsaksjoner uavhengig om de skjer på sjøen, på land eller om det er en flyredningsaksjon, såkalt integrert redningstjeneste.

Justisdepartementet har ansvaret for den administrative samordningen av redningstjenesten. Dette gjøres gjennom de to hovedredningssentralene (HRS) i henholdsvis Bodø og Stavanger, og de i dag 27 lokale redningssentraler som har ansvaret for operativt å lede og koordinere søk- og redningsaksjoner. De lokale redningssentralene tilsvarer antall politidistrikter i Norge. Sjøredningsaksjoner ledes normalt fra HRS dersom det ikke dreier seg om mindre aksjoner i nære kystfarvann.

Gjennom International Civil Aviation Organization (ICAO) og International Maritime Organization (IMO) er det inngått internasjonale konvensjoner som danner grunnlaget for dette samarbeidet. Norge har ratifisert begge. Men Norge har også inngått bilaterale avtaler om redningssamarbeid av forskjellig art med Storbritannia, Danmark, Sverige, Finland og Russland.

Følgende plattformer inngår i en redningsoperasjon:

- Kystvakt fartøy
 - Havgående fartøy med god utholdningsevne. Kompetanse på organisering/ledelse av SAR-operasjoner
- Hovedredningssentralen
 - Overordnet ansvar for SAR-operasjoner
- Helikopter
 - Svært mobil enhet der enkelte modeller har spesielt egnede sensorer til søk (IR-kamera, radar, nattkikkert).
- SAR-enhet (større)(komersiell)
 - Komersiell fartøy som iht gjeldende lover er forpliktet til å stille seg til disposisjon ved SAR-operasjoner, men som ikke har dette som hovedoppgave. F. eks laste, passasjer el fiskefartøy av havgående type.
- Redningsskøyte
 - Redningsselskapets (NSSR) største fartøyer. Havgående. Hovedoppgave å utføre SAR.
- Redningskrysser
 - Redningsselskapets minste fartøyklasse. Hurtiggående fartøy som er spesielt godt egnet til innenskjærs operasjoner
- Politibåt
 - Mindre hurtiggående fartøy som egner seg til søk innenskjærs.
- SAR-enhet (mindre)(fritidsbåt)
 - Privateide lystbåter av mindre størrelse
- Forsvarets operative hovedkvarter
 - Operativ kommando over Forsvarets fartøyer og døgntkontinuerlig overvåkning av havområdene

Funksjon og rolle til de større kystvaktfartøyene gjør at de naturlig utpekes som "On Scene Coordinator" ved større redningsaksjoner. Dette stiller store krav til mannskapets kompetanse, men også til den tekniske utrustningen om bord for å kunne kommunisere med de øvrige aktørene, og å holde en god og oppdatert oversikt over situasjonen under hele operasjonen.

8 LOGISTIKK

Analyse&Strategi, Multiconsult, DNV, Perpetuum as (2012). Infrastruktur og logistikk ved petroleumsvirksomhet i Barentshavet sørøst. Konsekvensutredning for Barentshavet sørøst.			
Oppdragsgiver:	OED	Dokument:	Rapport
Nøkkelord:	helikopterbaser, Barentshavet		
Innhold			
Rapporten presenterer infrastruktur og logistiktjenester relevant for petroleumsvirksomhet i Barentshavet sørøst. Rapporten har en tredeling:			
1. Status for infrastruktur og logistikk knyttet til pågående offshore olje- og gassvirksomhet. 2. Behov for infrastruktur til petroleumsvirksomhet basert på Oljedirektoratets scenario 1 og scenario 2. 3. For scenariene vurderes til slutt helhetlige løsninger for logistikk.			
Sammendrag			
Vurderingene av utfordringer og infrastrukturbehov på land, tar utgangspunkt i - og dimensjoneres etter - hvor den maritime trafikken anløper landanlegg og havner/baser. Kriteriene er:			
• Avstand fra felt til land • Maritim egnethet og egnet havn • Øvrig transportinfrastruktur • Bunkring, service og næringsmiljø			
Havn, base og basekapasitet			
Scenario 1 i Barentshavet sørøst innebærer mulig nytt LNG-anlegg i Finnmark. Det stiller krav til dyptgående for LNG-skipene. Egnethet for aktuelle lokasjoner er basert på prosjektgruppens faglige vurdering av fysiske parametere som forhold ved inn- seiling, dybder ved kaianlegg, oppankringsmuligheter og manøvrering. Basert på disse parameterne og vår kunnskap om hva oljeselskapene vil se etter ved valg lokasjon synes følgende fire lokasjoner å peke seg ut som best egnet: Melkøya (Tog 2, Hammerfest), Sarnes i Nordkapp kommune, Porsangerfjorden og Kirkenes i Sør-Varanger. Vi understreker at også andre lokaliteter kan være aktuelle, men at vi i dette arbeidet ikke har gjort nødvendige lokalitetsstudier.			
Scenario 2 i Barentshavet sørøst legger til grunn utbygging med FPSO for olje. Base- og forsyningstjenester til både lete-, utbyggings- og driftsfasene kan her betjene feltene fra både Øst- og Vest-Finnmark. Nærhet til transport- og samfunnsmessig infrastruktur vil være viktig ved valg av lokalisering.			
Transportinfrastruktur			
I vurderingen av transportinfrastruktur for logistikkoperasjoner tilknyttet petroleumsvirksomhet i Barentshavet sørøst, er det her tatt utgangspunkt i mulige lokasjoner for landanlegg/forsyningsbaser for scenario 1 og 2.			
Analysen for scenario 1 viser at det genereres mest logistikk i årene 2023-2026 i snitt 1950 havneanløp pr år fordelt på 21 skip. I denne perioden vil det foregå 3 parallelle utbygginger av felt samtidig med leteaktiviteter frem til 2025. Utbyggingsfasen vil samtidig generere stor helikoptertrafikk som følge av gjennomsnittlig 1250 flygninger og 23700 passasjerer pr år.			
Analysen for scenario 2 viser at det genereres mest logistikk i årene 2023-2028 i gjennomsnitt 1400 havneanløp pr år fordelt på i snitt 13 skip. I denne perioden vil det være et stort behov for mannskapsrotasjon i forbindelse utbygging av gass og olje felter. Dette vil igjen generere høy passasjertrafikk med helikopter gjennomsnittlig 13800 passasjerer pr år fordelt på 730 flyvninger.			
God transportforbindelse mellom flyplass, veg og forsyningsbase vil være av stor betydning for valg av baselokasjon. Kirkenes lufthavn er stamlufthavn nær E6. Dersom man legger til grunn et økt behov for mannskapsrotasjoner under utbyggingsfasen i scenario 1, vil Kirkenes lufthavn ha kapasitet til å motta den økningen i antall passasjerer det her kan være snakk om. Hammerfest har kortbaneflyplass. Alta lufthavn er stamlufthavn og ble benyttet som hovedflyplass under utbyggingen av Snøhvit. Dette kan også være en			

aktuell mulighet for scenario 1. Honningsvåg har kortbaneflyplass, men en aktuell mulighet ved valg av Sarnes som lokasjon vil kunne være å benytte nærliggende stamlufthavner for å motta større passasjerfly i utbyggingsfasen. Nærmeste stamlufthavn er her Lakselv. For Porsangerfjorden som lokasjon, vil også Lakselv lufthavn være nærmeste stamlufthavn.

Ved scenario 2 kan stamlufthavnen ved Kirkenes være aktuell som hovedlufthavn, dersom Kirkenes velges som forsyningsbase. På samme måte vil Alta lufthavn kunne operere som hovedflyplass dersom Polarbase i Hammerfest er egnet som forsyningsbase.

Avfallshåndtering

Avfallslogistikk foregår uavhengig av hvor prosessanlegg og forsyningsbaser etableres. Mottaksanlegg vil bli etablert der oljeselskapene bestemmer at aktiviteten skal være. Etablering av sluttbehandlingsanlegg er ikke påkrevd, og kan eventuelt kompenseres med logistikk løsninger for avfall til sluttbehandlingsanlegg andre steder.

Dagens forsyningsbase i Hammerfest kan benyttes, men fullverdige baseetableringer er også aktuelt lengre øst, for eksempel i Kirkenes. Kirkenes har i dag noe infrastruktur, inkludert et lite tankanlegg. Tankanlegget i Kirkenes er klargjort for raskt utvides i størrelse, slik at det kan håndtere en boreaktivitet med base i Kirkenes.

Mengdene borekaks og slop for begge scenarioene kan generere et relativt stort behov for transport, men fordelt over hele perioden, vil mengdene bare utgjøre en mindre del av nødvendig grunnlag for sluttbehandlingsanlegg. Sammen med forventet aktivitet i resten av Barentshavet, og eventuelt tilgrensende områder som nordlig del av Norskehavet, er det imidlertid grunnlag for etablering av et anlegg for sluttbehandling av slop i Finnmark. Den relativt høye andelen vannbasert slop forsterker også behovet for et lokalt anlegg som er spesielt tilpasset

Beredskap

For Barentshavet sørøst er det en rekke tilleggs-risikoelementer som gjør at logistikk til/fra offshoreinstallasjoner, samt søk og redning (SAR) operasjoner blir utfordrende. Dette gjelder faktorer som Ising, lave temperaturer, lange avstander fra land, mørke, tåke og polare lavtrykk. Disse forholdene stiller krav til oljevernutstyr og operasjonstid. I det geografiske området er det i dag kun Hammerfest som har SAR helikopter dedikert for hendelser knyttet til offshore petroleumsaktiviteter. I tillegg har forsvarets 330-skvadron Sea King helikopter på Banak. Summen av de totale tilgjengelige beredskapsressurser både offentlige, kommunale og private aktører vil definere det totale beredskapsnivået for Barentshavet sørøst.

AVINOR (2012). Konsekvenser for luftfart. Konsekvensutredning for Barentshavet sørøst. Avinor rapportnr: 12/04416.

Oppdragsgiver:

OED

Dokument:

Rapport

Nøkkelord:

helikopterbaser, Barentshavet

Bakgrunn

Avinor har gjennomført en vurdering av mulighetene for å etablere helikopterbaser på kystnære lufthavner i området Barentshavet – Lofoten.

Generell del

Rapporten inneholder en generell beskrivelse av nasjonale og regionale lufthavner i området, og en nærmere beskrivelse av de enkelte nasjonale, regionale og lokale flyplassene i området.

Oppsummering

Grovt oppsummert kan det sies at Avinors lufthavner, i varierende grad, er egnet for etablering av eventuelle helikopterbaser i sammenheng med petroleumsaktivitet i området Barentshavet - Lofoten. Dersom det blir aktuelt med slike baser på et utvalg av plassene, må det påregnes behov for å vurdere mulige endringer i plassenes lufttrafikkledelse, herunder bemanning, samt prosedyrer for inn og utflyging. I tillegg må det vurderes nærmere eventuelt behov for å revidere dagens støysoner på de berørte plassene.

Svalbard lufthavn ligger innenfor et naturreservat, og det er ønskelig å begrense fremtidig arealbruk på plassen innenfor de avsatte områdene i lufthavnplanen. For øvrig er det ingen kjente, større konflikter av miljømessig karakter i nærområdet av noen av lufthavnene. Bortsett fra avrenningsproblematikk, knyttet til bruken av avisingskjemikalier på noen av plassene, er det kun Alta og Harstad/Narvik lufthavner som har miljøproblematikk, i form av et naturreservat eller forslag til reservat, i nærområdet av selve lufthavnen.

Vurderingene av de enkelte lufthavnene viser at de nasjonale og de regionale plassene i all hovedsak har tilgjengelige arealreserver som kan disponeres til mulige fremtidige baser for helikoptervirksomhet. Det foreligger langsiktige arealplaner (lufthavnplaner) for samtlige av disse plassene. Med få unntak, er det allerede avsatt arealer i disse som vil være egnet som baser for helikopter. Største arealbegrensninger gjelder Svalbard lufthavn og Alta lufthavn, mens Harstad/Narvik lufthavn, Evenes, Lakselv lufthavn, Banak og Kirkenes lufthavn, Høybuktnoen har meget gode arealreserver. I noe mer begrenset grad har Bodø og Tromsø lufthavner tilgjengelige arealreserver for slik virksomhet i dag.

Etter Forsvarets beslutning om å opprette nye kampflybase på Ørland, med fremskutt base på Evenes gjenstår det per september 2012 avklaringer for Forsvarets aktivitet på de militære lufthavnene. Lufthavnene dette gjelder er foruten Bodø og Evenes, Bardufoss og Andøya.

På de lokale lufthavnene er arealreservene gjennomgående langt mer begrenset, og dagens infrastruktur er bare i liten grad tilrettelagt for mulige nye utvidelser og aktiviteter. I stor grad dekker infrastrukturen på disse plassene kun dagens behov, mens det må påregnes behov for en rekke tilleggsinvesteringer dersom det blir aktuelt med helikopterbaser på disse plassene.

I dagens situasjon er det kun Brønnøysund lufthavn, og til en viss grad Båtsfjord lufthavn, av de lokale lufthavnene som har egne arealer avsatt til ulike typer helikopteraktivitet. Gode arealreserver finnes også på Sandnessjøen, Røst, Berlevåg og Vardø lufthavner. For tre av lufthavnene (Leknes, Stokmarknes og Vadsø) vil mulighet for omrokering og flytting av dagens ekspedisjonsområder, åpne for forbedret arealtilgang for eventuelle helikopterbaser.

Noen av de lokale lufthavnene er av flyoperative årsaker lite egnet for trafikk med helikopter. I tillegg er det meget begrensede arealreserver tilgjengelig på disse. Lufthavnene dette gjelder er Svolvær, Honningsvåg og til en viss grad Mehamn lufthavn. Begrenset arealtilgang er det også på Sørkjosen og Hasvik lufthavner.

9 REGELVERK, STANDARDER, RETNINGSLINJER

Eriksson, S. A. (2013). Standardization – cooperation for safety in the High North. Arctic safety conference.			
Oppdragsgiver:	PSA	Dokument:	Presentation
Nøkkelord:	Arctic, safety, Barents2020		

Value of standards

- Standards are the tools we use to organise our technical world
- Quality improvement
- Ensuring consistent and reliable engineering
- Compatibility and efficiency (cost and time reduction)
- Global trade (promotes trading, facilitates partnership and international operation)
- Sharing and dissemination of the knowledge and experience

Development of Arctic standards under Barents2020

- The overall aim of the project was to ensure that all oil and gas operations in the Barents Sea, both on the Norwegian or Russian continental shelf, should be carried out with an acceptable safety level
- The project included all aspects of offshore petroleum activity, i.e. exploration, drilling, production, transportation and support activities
- The project established a very good dialogue between Russian and Norwegian experts for recommendation of industry standards for use in the Barents Sea

130 standards identified by B2020; only 51 standards can be used for Arctic operations without modifications.

New subcommittee on Arctic Operations (ISO TC/67 SC8) established in 2011: scope is standardization of operations associated with exploration, production and processing of hydrocarbons in onshore and offshore arctic regions, and other locations characterized by low ambient temperatures and the presence of ice, snow and/or permafrost.

Working groups under SC8 are 1) working environment, 2) escape, evacuation and rescue, 3) environmental monitoring, 4) ice management, 5) arctic materials, 6) physical environment for Arctic operations, 7) man-made islands and land extension. It is not clear that winterisation is covered by ISO TC67/SC8.

Mosesyan, M., Mukhoryamov, M. (2013). Arctic Drilling Activities: Critical Review of the International Safety Standards, Technical Regulations and Regulatory Regimes. SPE Arctic and Extreme Environments Conference & Exhibition, Moscow, Russia, 15–17 October 2013.

Oppdragsgiver:

Dokument:

Conference proceeding

Nøkkelord:

Arctic, drilling, safety standards, technical regulations, regulatory regimes

Abstract

The last decade has seen an unprecedented and continuously growing interest to explore offshore Arctic. Major international energy companies are now mobilizing their resources, improving competence and knowledge, developing technology and internal regulations to prepare for a long lasting and challenging journey.

This paper is intended to provide a review and comparison of the most stringent international standards and regulations relevant for the Arctic region including but not limited to as follows:

- American Petroleum Institute (API)
- International Organization for Standardization (ISO)
- U.S. Code of Federal Regulations (U.S. CFR)
- Bureau of Safety and Environmental Enforcement (BSEE)
- UK Health and Safety Executive (UK HSE)
- Norsk Søkkel Konkurransesepisjon (NORSOK)
- Norwegian Petroleum Safety Authority (PSA)
- Norwegian Petroleum Directorate (NPD)

Each entity has its strong sides that are usually based on previous industry experience and accidents resulted in substantial downtime, harm to environment, equipment and not least the personnel. At the same time simultaneous compliance to divergent standards might compromise overall safety. Bearing in mind extreme environmental sensitivity of the Arctic region, scale of impact and possible environmental consequences, there is literally no room for failure.

Differences in safety philosophy and approach to well barrier elements to ensure well control and well integrity need to be thoroughly reviewed. Understanding these issues will improve safety in drilling operations, reduce cost of the exploration and mitigate potential operational and project risks.

Content

Deepwater Gulf of Mexico operating area and Norwegian Continental Shelf examples are used: a case study of a typical well abandonment operation in deepwater Gulf of Mexico with simultaneous compliance to both U.S. 30 CFR 250 and NORSOK D-010 is presented.

Conclusions

- The global oil and gas industry has been responsible for several disasters over the past decade, but few have heard of them. When Deepwater Horizon exploded in the Gulf of Mexico, safety in our business became a worldwide issue.
- Changes in the U.S. regulatory regime will result in the enhancement of safety for drilling operations in the US GoM, and these regulations can be adapted to other parts of the world to achieve the same goal.
- Relationship between standards and the consistencies and inconsistencies in their use is an important point of itself. In particular, focusing on the NORSOK standards and how they work together with the underlying business processes.
- NORSOK standards tend to be consistent with the underlying processes providing a chain of dependent actions covering entire well construction process.
- Different governmental bodies have different approach to safety philosophy and barrier philosophy which depends on past experience, good engineering practice, risk analysis, internal procedures and index of complexity.
- Level of transparency, collaboration and advanced technology use on the NCS could be exemplary for the industry.

- Operators entering offshore deepwater and/ or Arctic exploration areas should consider challenges encountered while well construction in the deepwater GoM and other related areas.
- Simultaneous compliance to divergent standards might compromise overall safety. Bearing in mind extreme environmental sensitivity of the Arctic region, scale of impact and possible environmental consequences, there is literally no room for failure.
- At the same time, to properly address well construction challenges in the Arctic region, existing international regulations should be reviewed and applied in such a way that all operations will still be as safe as cost efficient.
- Process of standardization and compliance within company's management systems will create a long-term value; reduce cost of operations and overall offshore safety. These management systems should be aligned with existing regulatory requirements mainly based on risk analysis and acceptance criteria.
- Regular and feedback-based dialogue between operators, contractors and governmental authorities will support industry's intention to explore Arctic regions in a safe and efficient manner.

Aronson, J.G, Raykin, V. (2012). Achieving international standards in the Arctic: the need for modern interdisciplinary technical and managamenet approaches. SPE/APPEA International conference on health, safety, and environment in oil and gas exploration and production, Perth, Australia, 11-13 September, 2012.

Oppdragsgiver:

Dokument:

Conference proceeding

Nøkkelord:

Arctic, international standards

Background

The paper explores the current status of Arctic exploration activities with a focus on northern Russia, and identifies specific emerging Arctic considerations which highlights the need for interdisciplinary approaches such as sea ice dynamics, navigation, undersea completion technologies, logistics, meteorology, satellite communication, permafrost, marine ecology, native people, application of international law, treaties and standards.

International standards

International standards derive from (among others):

- World Bank
- International Finance Corporation Performance Standards and the Equator Principles
- ASTM (American Society for Testing and Materials)
- IMO (International Maritime Organization)
- ICMM (International Council of Mining and Minerals)
- IPIECA (International Petroleum Industry Environmental Conservation Association)
- API (American Petroleum Institute)
- UN (United Nations)
- WHO (World Health Organisation)
- OPIC (Overseas Private Investment Corporation)
- EBRD (European Bank for Reconstruction and Development)

Russia has a very high evolved set of regulations, but Arctic specificity is lacking in many areas.

[The paper briefly reviews the physical environment (ice conditions), the chemical environment (air and water quality, geochemistry, pollution, waste disposal), the biological environment, the social environment, and engineering advances].

The interdisciplinary approach

It is the principal premise of the paper that there needs to be much more interdisciplinary thinking applied, addressing communication, cooperation and collaboration.

There are more organizations who are linking up, designing and creating new and more effective and transparent networks and collaborations, such as (among others)

- SAON (Sustaining Arctic Observing Networks)
- The Byrd Polar Center
- The Scott Polar Research Center (Univ. of Cambridge)
- The International Arctic Research Center (Univ. Alaska)
- The Institute for Arctic and Alpine Research
- Russian Institute for Hydrometeorology Research Center

Increased interdisciplinary technical and management approaches will be required to achieve international standards of quality and performance, and to cope with the many inherent challenges, impacts and risks associated with development of this valuable and important region.

Barents2020 (2012). 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 Phase 4.

Oppdragsgiver:	Norwegian Ministry of Foreign Affairs	Dokument:	Report
Nøkkelord:	Barents2020,		

Background

The Barents 2020 project was initially aimed at creating a dialog 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.

Phase 3 identified 130 standards for common use of which 64 can be applied “as is” and the remaining 66 can be applied provided special considerations are made for low temperatures and/or ice loading. The recommendations provided by the working groups 2, 4, 5, 6 and 7 were submitted to the relevant standardization body – primarily – ISO TC 67’s 19906 standard, and to the new TC67 Subcommittee 08, “Arctic Operations”. (Working group 3-risk management, did not recommend any new standards).

The phase 4 of the project brought forward from phase 3 those issues and topics in greatest need of completion, revision and detailed guidance. The project was funded by Russian and international companies with support from the Norwegian Government’s Barents 2020 program.

Working groups phase 4

RN01 Co-ordination of deliverables

RN02 Design of floating structures in ice

RN03 Risk Management of major hazards

RN04 Escape, evacuation and rescue of people

RN05 Working environment

RN06 Ice management – state of the art

RN07 Operational discharges to air and water

RN00 DNV Project Management and project support

Executive summaries of the working groups (phase 3 and 4)

RN02 Design of floating structures in ice

In Phase 3, RN02 recommended that the new standard ISO 19906:2010(E) Petroleum and Natural gas industries — Arctic offshore structures – should be adopted as the common standard but that the standard had some shortcomings regarding floating structures and that some additions and amendments would be necessary.

Suggested major amendments to ISO 19906:2010(E) include:

- Add definition for stationary floating structure
- Clarification of the term ice event as the current use of the term is ambiguous.
- Add and amend requirements and guidance regarding inclusion of ice management in design, requiring that physical ice management can only change the design ice actions if it can be documented that the physical ice management system can break/divert the ice features responsible for the design ice actions.
- Amend several clauses in the standard to make it more relevant for floating structures with the ability to disconnect as the action level for the disconnection criteria should influence the design ice action.

RN03 Risk management of major hazards

The result of the work after completion of phase 3 working groups was:

- Common agreed references to recognized 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.

RN04 Escape, evacuation and rescue of people

RN04 concluded that ISO19906 (Petroleum and natural gas industries – Arctic offshore structures), published in December 2010, is the only international standard which deals with Arctic EER issues and should therefore be used as a common basis for review, comments and subsequent recommendations. It was recognized and agreed that the relevant sections of ISO19906 (Chapter 18 and Appendix A18), provide appropriate normative requirements and informative guidance for EER operations in general Arctic conditions.

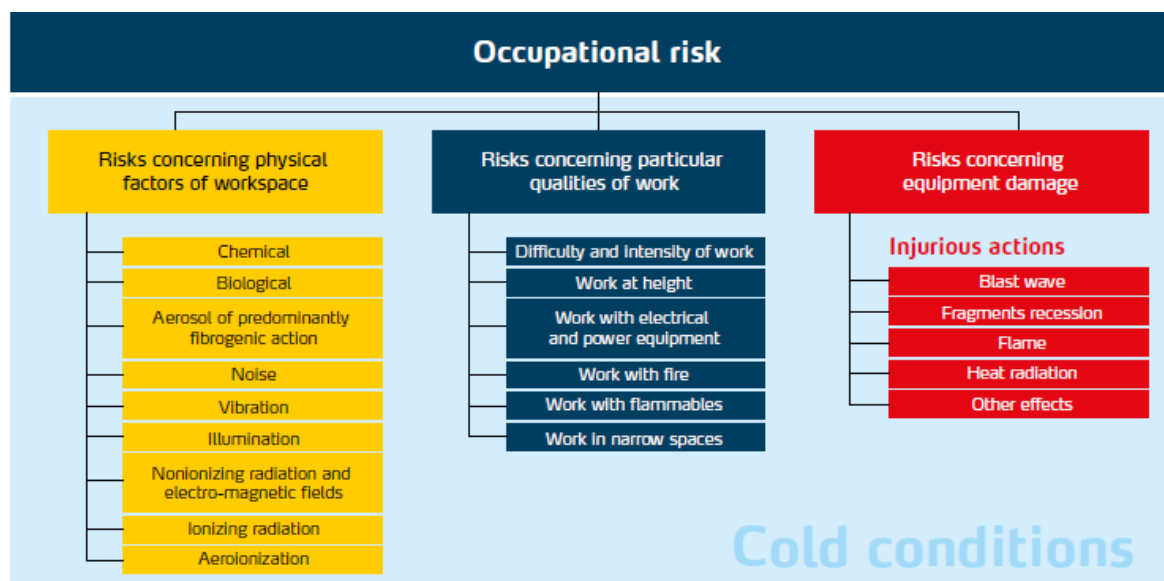
It was realised that the best way to address the findings of the group would be to propose a separate addendum or guidance document to ISO19906 specifically for the Barents Sea, and this became the primary focus of the work during Phase 4. While progress is being made in Arctic EER standards and guidelines, especially in research and development of new concepts, there is still no single secondary evacuation system available that can provide yearround availability under all Arctic conditions.

Further assessment by RN04 identified the importance of developing performance standards for all EER system components. The scope of work for RN04 during Phase 4 was then expanded to also include guidance on preparing Performance Standards for secondary evacuation methods and emergency response vessels. This expands the guidance given in ISO19906 Appendix A18. This report also explains how Performance Standards can be utilised to align performance-based international standards with national rules and regulations.

RN05 Working environment

The objective of the group was to ensure the optimal health, safety, performance and decision-making of people working on vessels and installations in the Barents Sea.

The figure below shows the groups of occupational risks to which workers may be exposed while working on offshore facilities, including those located in the Arctic. Occupational risks are classified into three groups: (1) effects of physical factors of industrial environment; (2) danger (harm) connected to special kinds of work (characteristic for certain trades); and (3) potential danger of adverse factors from emergency situations at an offshore facility. Potential harmful effects of these occupational risk factors are increased at Arctic sites due to the extreme conditions of cold, polar night, etc.



Barents 2020 Group 5 prepared a proposal for an international standard on Working Environment for Arctic Offshore Operations to fill a gap in the current ISO profile, which lacks a working environment standard for offshore operations. It draws principally on the respected Norwegian Shelf standard for Working

Environment, NORSOK S-002. The proposal builds on aspects of the NORSOK S-002 philosophy, principally the use of risk assessments and its emphasis on design solutions to minimizing working environment risks. To this, the proposal adds the specific aspects of working environment risks related to the Arctic offshore environment found in the Barents Sea.

RN06 Ice management (IM) - state of the art

Main findings

- ISO 19906:2010(E) is currently the only document where IM is addressed, and suggestions for improvements are proposed by RN02
- IM (when relevant) should be considered and planned at all development stages: from feasibility studies to implementation into operations
- Role and function of IM should be clearly defined in the project and operations
- The recognition of the importance of IM team does not come across clearly in studies of earlier IM systems and activities, nor in ISO 19906:2010(E)
- Integration of the IM team into the Organization over the lifetime of a project is important
- The HAZID identified several risks that are related to human behaviour or error
- There is a need for continuous training and education of all personnel that will be or are involved in IM.

Recommendations

- The operator's role and involvement in IM throughout the project development and implementation should be highlighted in relevant standards and guidelines
- Projects should establish a core team of people who know and understand all aspects of IM and whom should be involved in all project phases
- For seasonal or new operations a period of time should be allowed for training and team consolidation before any critical operations start. The training should include use of field specific simulators and in-field exercises.
- Due to limited documented IM experience available today, future IM operations should be fully recorded and made publicly available

Summary of recommendations

	Deliverables	Recipients	Application
RN2	Guidance (amendment) Document to ISO 19906 on Ice Loads	National Standards Org. Russia/Norway	Regional amendment (identical) to ISO 19906 (until new edition)
		ISO TC67/SC7	Input to next revision of 19906
RN3	Seminar proceedings on Risk Management (including phase 3 conclusions)	Barents 2020 steering committee National Standards Organisation in Russia (TC23)	General industry use New GOST R standard on Risk Assessment
RN4	Technical report on Evacuation and Rescue	ISO TC67/SC8	Future possible NWIP
	Guide for Arctic Evacuation	ISO TC67/SC8	Future possible NWIP
	Guide for Emergency Response Vessel	GOST R TC23	New GOST R standards on EER
		ISO TC67/SC8	Future possible NWIP
RN5	Tech. report on Human Factors	National Std. Organisations Russia/	Regional annex (identical) to ISO

RN6	Tech. report on Ice Management	Norway	19906Input to NORSOK S-002 update
		ISO TC67/SC8 Russian/Norwegian Class Societies ISO TC67/SC8	Future NWIP Basis for Arctic rules Basis for future NWIP (5-6 proposed standards)

Arctic Council (2009). Arctic offshore oil and gas guidelines.			
Oppdragsgiver:	Arctic Council	Dokument:	Guideline
Nøkkelord:	Arctic, offshore, oil and gas, guidelines		
Goal The Guidelines are intended to be of use to the Arctic nations for offshore oil and gas activities during planning, exploration, development, production and decommissioning. The guideline covers environmental impact assessment, environmental monitoring, safety and environmental management, operating practices, emergencies, and decommissioning and site clearance. The guidelines give general (not detailed) guidance on how to address HSE and emergency, with emphasis on environmental management. Summary - operating practices This chapter covers waste management, use and discharge of chemicals, emissions to air, and design and operations, human health and safety, transportation, and training. Summary - emergencies This chapter covers preparedness, response (contingency planning, emergency response plans, oil spill response plans, exercise and drills, ice management plans, emergency preparedness maintenance.			

10 ANNET

Organisasjoner

i-Sea as (2013). A report on the Arctic Council.			
Oppdragsgiver:	NOROG	Dokument:	Report
Nøkkelord:	Arctic Council, organisation		

History

In 1996, the Ottawa Declaration <http://library.arcticportal.org/1270/> formally established the Arctic Council as a high-level intergovernmental forum to provide a means for promoting cooperation, coordination and interaction among the Arctic States, with the involvement of the Arctic Indigenous communities and other Arctic inhabitants on common Arctic issues; in particular, issues of sustainable development and environmental protection in the Arctic.

Chairmanship

The Chairmanship of the Arctic Council rotates between the eight Arctic States every two years. The Deputy Ministers Meeting takes place every second year. SAO (senior Arctic Officials) meetings takes place regularly.

Organisation

- **Member states** (8): Canada, Denmark, Finland, Norway, Russian Federation, Sweden, USA.
- **Permanent participants** (6): Arctic Athabaskan Council, Aleut International Association, Gwich'in Council International, Inuit Circumpolar Council, Russian Association of Indigenous Peoples of the North (RAIPON), Saami Council.
- **Observers - countries** (12): France, Germany, The Netherlands, Poland, Spain, United Kingdom, Italy, People's Republic of China, Japan, Republic of Korea, Singapore, India.
- **Observers - organizations** (9): International Federation of Red Cross & Red Crescent Societies (IFRC), International Union for the Conservation of Nature (IUCN), 3.rdic Council of Ministers (NCM), Nordic Environment Finance Corporation (NEFCO), North Atlantic Marine Mammal Commission (NAMMCO), Standing Committee of the Parliamentarians of the Arctic Region (SCPAR), United Nations Economic Commission for Europe (UN-ECE), United Nations Development Program (UNDP), United Nations Environment Program (UNEP).
- **Observers - NGOs** (11): Advisory Committee on Protection of the Seas (ACOPS), Arctic Cultural Gateway, Association of World Reindeer Herders (AWRH), Circumpolar Conservation Union (CCU), International Arctic Science Committee (IASC), International Arctic Social Sciences Association (IASSA), International Union for Circumpolar Health (IUCH), International Work Group for Indigenous Affairs (IWGIA), Northern Forum (NF), University of the Arctic (UArctic), World Wide Fund for Nature-Global Arctic Program (WWF).
- **Working groups** (6): Arctic Contaminants Action Program (ACAP), 2.Arctic Monitoring and Assessment Programme (AMAP), Conservation of Arctic Flora and Fauna (CAFF), Emergency Prevention, Preparedness and Response (EPPR), Protection of the Arctic Marine Environment (PAME), Sustainable Development Working Group (SDWG).

More about the working groups

It is the responsibility of the Working Groups to execute the programs and projects mandated by the Arctic Council Ministers for each group. These mandates are stated in the Ministerial Declarations, the official documents that result from Ministerial Meetings.

1. Arctic Contaminants Action Program (ACAP)
 - The goal of ACAP is to reduce emissions of pollutants into the environment in order to reduce the identified pollution risks.
2. Arctic Monitoring and Assessment Programme (AMAP)

- AMAP's current objective is to "provide reliable and sufficient information on the status of, and threats to, the Arctic environment, and providing scientific advice on actions to be taken in order to support Arctic governments in their efforts to take remedial and preventive actions relating to contaminants".
- 3. Conservation of Arctic Flora and Fauna (CAFF)
 - The Conservation of Arctic Flora and Fauna (CAFF) is the biodiversity working group of the Arctic Council, and its mandate is to address the conservation of Arctic biodiversity, and to communicate its findings to the governments and residents of the Arctic, helping to promote practices which ensure the sustainability of the Arctic's living resources.
- 4. Emergency Prevention, Preparedness and Response (EPPR)
 - EPPR address various aspects of prevention, preparedness and response to environmental emergencies in the Arctic.
- 5. Protection of the Arctic Marine Environment (PAME)
 - PAMEs activities are directed towards protection of the Arctic marine environment.
- 6. Sustainable Development Working Group (SDWG)
 - SDWGs objective is: (1) to propose and adopt steps to be taken by the Arctic States to advance sustainable development in the Arctic, including opportunities, (2) to protect and enhance the environment and the economies, culture and health of Indigenous Peoples and Arctic communities, as well as (3) to improve the environmental, economic and social conditions of Arctic communities as a whole.

Maritim21 (2012). En Helhetlig Maritim Forsknings- og Innovasjonssatsing. Innsatsområde: Maritim transport og operasjon i arktiske områder.

Oppdragsgiver:	Nærings- og Handelsdepartementet	Dokument:	Rapport
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Nøkkelord:	kaldklimateknområder, maritim transport, forskningsaktivitet
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Maritim21 - er en helhetlig maritim forsknings- og innovasjonsstrategi utviklet av næringen på oppdrag fra Nærings- og Handelsdepartementet.

Innsatsområde Maritim transport og operasjon i arktiske områder:

- mål for innsatsområdet

Mål #1 Gjenbruk og videreutvikling av offshoreteknologi/skipsteknologi for en sikker, miljøvennlig og kostnadseffektiv olje- og gassproduksjon i kaldklimateknområder.

Resultatet vil være relevant teknologi og design som tilfredsstiller de spesielle utfordringene en møter ved arktisk olje- og gassutvinning

Tiltak:

- Industrielle utviklingsprosjekt.
- Prioritet gis til kritiske områder hvor vi har forutsetninger og ønsker å oppnå et konkurransemessig fortrinn i forhold til internasjonale konkurrenter.
- Vinterisering av utstyr

Eksempel:

- multioperasjonsfartøy for kaldklimateknområder – utvikle nye løsninger/ vinterisere eksisterende løsninger for operasjoner i nordområder
- utvikle mer spesifikk design til aktuelle områder
- spesifikt utstyr for spesielle oppgaver, mindre volumer, dermed mindre interessant for andre konkurrenter
- komplekse prototyper bør testes ut av norske eiere for å få rask tilbakemelding til designere (samarbeide mellom utvikler og sluttbruker)

Resultatet vil være relevant teknologi og design som tilfredsstiller de spesielle utfordringene en møter ved arktisk olje- og gassutvinning.

Mål #2 Gjennomføre en nasjonal plan for bygging av sterke fagmiljø innenfor kaldklimateknologi og operasjon.

Bygge et virtuelt (desentralisert, men integrert) utdanningssystem som styrker samarbeid mellom aktuelle norske undervisnings- og forskningsmiljø. Kaldklimateknomiljøet i Norge skal fremstå som det mest kompetente (klynge) i verden og at aktører som vurderer kaldklimateknom operasjon derved vil oppsøke norske miljøer og bruke norsk kaldklimateknomologi

Mål #3 Forbedre designgrunnlag for kaldklimateknom skip og offshorekonstruksjoner

Systematisere eksisterende og innhente nye miljødata for bølger, strøm, vind og is. Forbedre prediksjonsmodeller,

Mål #4 Opparbeide verdens beste kompetanse på arktisk logistikk.

Kunnskap om logistikk er en forutsetning for utviklingen av bærekraftige kaldklimateknomprosjekt

Mål #5 Identifisere tiltak for å redusere tilleggsutfordringene i kaldt klimateknom, for å oppnå samme sjøsikkerhet som en har i andre deler av norsk farvann.

Norge skal ha verdens beste system for sjøsikkerhet Fokus vil være på arbeid med preventiv sjøsikkerhet og Norge skal være en pådriver i internasjonale organisasjoner (IMO, IHO, IALA, EMSA, Arktisk Råd,...).

Mål #6 Utvikle løsninger for rømning, evakuering og redning fra skip/rigger i kaldklimatefarvann (EER).

Utvikle metoder for å analysere og sette kriterier for en god løsning for rømning, evakuering og redning fra skip/rigger i havsnød i kaldklimatefarvann. Videre skal en i samarbeid med industrien utvikle løsninger som tilfredsstillende kriterier ut fra operasjonstyper og lokasjon

Mål #7 Utvikle, utprøve og implementere teknologi som gir en miljøvennlig operasjon i arktiske farvann.

Målet er minimale utslipp til luft og sjø samt forbedret hydroakustisk signatur

- konklusjoner og anbefalinger

Innsatsgruppen peker på at det er behov for en betydelig styrking av forskningsaktivitet og industriell virksomhet dersom Norge skal få en ledende rolle som premissleverandør for framtidig shipping og offshorevirksomhet i kaldklimateområder. En rekke nasjoner forbereder seg på et arktisk kappløp og det er nå en enestående mulighet for å påvirke framtidig sikkerhet for personell, miljø og eiendeler når aktivitetsnivået øker i nord.

Generelt er det en utfordring at det er gap i kunnskap når det gjelder fysiske og biologiske forhold i nordlige havområder. Dette gapet bør enette gjennom en nasjonal dugnad hvor en samtidig styrker internasjonale nettverk. Den norske maritime klyngen har en sterk kopling mellom shipping og offshorevirksomhet. Gjensidig kunnskaps- og erfaringsutveksling mellom disse to miljøene må styrkes på temaet kaldklimatedesign og operasjoner.

Av de 7 målene som er beskrevet av innsatsgruppen vil en anbefale umiddelbar oppstart av tiltak knyttet til målene:

- Forbedre designgrunnlag for kaldklimate skip og offshorekonstruksjoner
- Gjenbruk og videreutvikling av offshoreteknologi/skipsteknologi for en sikker, miljøvennlig og kostnadseffektiv olje- og gassproduksjon i kaldklimateområder
- Utvikle, utprøve og implementere teknologi som gir en miljøvennlig operasjon i arktiske farvann.

Taylor, R.S., Murrin, D.C., Kennedy, A.M., Randell, C.J. (2012). Arctic development roadmap: Prioritization of R&D. Offshore Technology Conference, Houston Texas, USA, 30 April - 3 May, 2012.

Oppdragsgiver:		Dokument:	Conference proceeding
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Nøkkelord:	Arctic, petroleum, research
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Background

The industry-funded Centre for Arctic Resource Development (CARD) is focused on addressing medium and long-term R&D needs for petroleum development in the Arctic and sub-Arctic regions, and has sponsored a broad industry consultation program with subject matter experts from Arctic oil and gas sector.

Prioritization of R&D

Prioritization was based on the following factors:

- Industry relevance
- Range of (geographical) applicability
- Expected impact of R&D (in terms of improving safety or reducing risk and cost)
- Time to implementation
- State of knowledge

Highest prioritized R&D (short summary)

1. Environmental protection
2. Ice management (IM)
 - Need to improve IM systems in operational and design. Most critical need identified was management of ice to support emergency response.
3. Ice mechanics and loading
 - Addressing structures and vessels designed for Arctic operations. Top priority is to address the need for full-scale ice load data for interaction with multi-year ice and icebergs involving large interaction areas (10-100 m²). In addition to collecting new data, it was recommended to re-assess full-scale data to improve the understanding and modeling of global, local and dynamic ice-loads (including ice-induced vibrations) for both design and operations.
4. Station-keeping in ice
 - To extend the operating season of drill ships and floating platforms, systems must be in place to enable vessels to maintain station in the presence of ice. To help maximize up-time and improve vessel station-keeping in ice, research needs were identified in several key areas.
5. Environmental characterization
6. Offshore safety and escape, evacuation and rescue (EER)
 - The need to design and validate performance of ice-capable evacuation systems was identified, and the need to improve personnel safety equipment. Safe working limits for work above sea need to be established and man-over-board rescue technology.
7. Dredging and trenching
 - Design and development is identified as a key issue of improved dredging and trenching technologies capable of operation in harsh Arctic marine, ice and geotechnical conditions. Another major issue is the high associated cost. An improved understanding of iceberg scour patterns, frequencies and loads was identified a main area of research that can help reduce burial depth requirements. Other issues include how to deal with sediment resulting from operations.
8. Simulation and training
 - Two main areas identified for application of simulation and training technology are in training of personnel for escape, evacuation and rescue scenarios, and also for training personnel for oil spill scenarios.
9. Hydrocarbon export technologies
 - FLNG (Floating liquefied natural gas) was identified as an export technology of high priority due to its potential for stranded gas exploitation in Arctic regions.

10. Arctic drilling

- Economic viability of drilling a sufficient number of wells is a particular challenge for deepwater, since year-round drilling from drill ships will be required. This is currently not possible. For floating platforms, same season relief well requirements dictate that a separate drilling vessel can be quickly made available in an emergency response scenario. To maximize up-time and ensure safe operations for drilling vessels, the need for technology to assist drilling vessels operators in deciding when disconnection is required was also identified.
- Identifying R&D opportunities to help reduce drilling costs and increase the number of wells that can be drilled in a season was a high priority.

Conclusions

Hydrocarbon development in Arctic region presents significant challenges. The top tier priority issues are

- Show-stopper issues: environmental protection
- Barriers to development: ice management; ice loads and mechanics; station-keeping in ice; environmental characterization
- Significant impact on future development: Offshore safety and EER; hydrocarbon export technologies; Arctic drilling; simulation and training; dredging and trenching.

University in Tromsø, University in Stavanger, IRIS, Norut, Akvaplan-niva. (2012). Roald Amundsen Petroleum Research.

Oppdragsgiver:

Dokument:

Presentation

Nøkkelord:

Arctic, petroleum, research

Organisation

- Established in December 2012 with a base in Tromsø.
- Initiative was triggered by *St. melding nr. 28 (2010-2011)* and increasing petroleum activity in the Arctic.
- Five national, partners are members of the Amundsen-Consortium: *University in Tromsø, University in Stavanger, IRIS, Norut and Akvaplan-niva.*
- Startup funding from Troms fylkeskommune and 6 industry-partners (Statoil, ENI, Aker Solutions, Det norske, Lundin and Dong).

Objective

- The main objective is to engage in petroleum research in Arctic, funded by NFR and EU in cooperation with industry.

Research programs and coordinator

- Petroleum Geology - UiT
- Petroleum Technology - IRIS
- Technology and Operations in Arctic - Norut
- Offshore Field Development, Operations and Maintenance - UiS
- Environmental Surveillance Technology – Norut
- Environmental Risk Control - APN
- Risk Management and Safety - UiS
- Society and Industry – UiT
- The first building block of this development is the establishment of the Arctic petroleum center, ARCEX (Research Centre for ARctic Petroleum Exploration). Focus is geological recourses.