Suitable drilling facilities

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The Petroleum Safety Authority Norway (PSA) has initiated a number of projects associated with knowledge development for the High North

Background for the projects:

• Increasing activity in the High North, linked to opening of new areas, more exploration drilling further north and the qualification of discoveries, has placed the High North in the spotlight in recent years

• Some discussion about whether the industry has adequate knowledge of the HSE challenges in this region

• 15 projects have been defined and initiated by the PSA to date, some will run until 2019.
Wells drilled in the Barents Sea

Source: NPD
Projects initiated and funded through PSA

- Simultaneous operations, undertaking activities in the High North (Logistics)
- Alternative personnel transport and evacuation solutions in the High North
- Winterization of facilities
- **Suitable drilling facilities**
  - Challenges linked to ice and snow in the High North
  - Human performance when working in the High North
  - Structural safety in the High North
  - Shallow reservoirs in the High North
  - Drilling in karstified formations
  - Directional drilling in the High North
  - Enclosed modules, design and explosion pressure
  - Effect of cold on the working environment in the High North
  - Risk of acute spills in the High North
  - Winterization
  - Operational challenges for process facilities and extinguishing systems in severe cold (planned for 2018)

*Reports from completed projects can be downloaded from [www.Ptil.no](http://www.Ptil.no)*
Study: Suitable drilling facilities

A research question we asked ourselves: What risk factors and corresponding selection criteria are important for selecting suitable drilling facilities for safe drilling and well operations in the newly opened south-eastern part of the Barents Sea, both for summer-season and year-round drilling activities?
Suitable Drilling Facilities

Summary of scope of the study:

- Identify risk factors associated with cold climate and arctic drilling operations and in potentially ice-infected waters
- Access suitability of winterization methods
- Look into experience from other offshore cold-climate drilling operations
- Access the suitability of different types of drilling facilities and risk-mitigating measures for drilling operations in the Barents Sea south-east
- Discuss requirements for summer and winter/year-round operations
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The study was led by Ramboll, in close cooperation with MH Wirth, assembling a project team covering the different aspects of the scope.

The methodology used was primarily gathering of data from:
- Reports published by the industry and relevant authorities
- National and international research institutions
- Suppliers data and specifications
- Internal experience in the project team

Several workgroup meetings and project status sessions with the PSA during the course of the study, from 2016 through 2017.
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This study is primarily related to the newly opened areas in the south-eastern part of the Barents Sea. Map shows the area lined in red and the expanded part of the map show license areas awarded in the 23rd license round on the NCS in 2016.

Source: NPD
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Some of the identified met-ocean challenges related to the area:

• Often heavy fog during the summer season
• Strong, fast and somewhat unpredictable Polar lows during the winter season
• Risk of heavy snowfalls, severe icing and possibility of fragments of sea ice or glacier ice/Icebergs drifting in the water during the winter and spring seasons
• Possibly extreme low temperatures (–34 °C) during the winter season

Source: «Værvarslingsutfordringer i Barentshavet». Meteorologisk Institutt, 2014
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Polar lows
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Origin of Icebergs
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Types of Icebergs

(a) Growler

(b) Bergy bit

(c) Glacier iceberg

(d) Dome-shaped iceberg

(e) Tabular iceberg
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Ice edge of Sea ice

Meld. St. 41, 2012-2013:

~ Drilling in oil-bearing formations is not allowed in areas closer than 50 km from the observed Ice-edge during the timeframe December 15. to June 15.

source: Haakon Hop, Norsk Polarinstittut
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Extreme low temperatures
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Key operational challenges identified for the area:
• Temperatures below what equipment and materials are normally rated for
• Drifting ice fragments in the sea may harm riser, “Kill”- and “Choke”- lines and BOP control system hydraulic and electric conduits
• Long supply chains and low visibility/darkness during mid winter season
• Stabilization and compensation equipment at risk of freezing by icing events
• Icing may affect critical operations and equipment, such as cranes, winches, hose-reels and emergency/evacuation equipment
- **more operational challenges identified:**
  - Polar lows require procedures for fast securing of operations and quick disconnect
  - Icing may damage or impede communication equipment
  - Icing on elevated structures may become dropping objects
  - How to recover safely from icing events
  - How to prevent firewater systems from freezing up
  - How to prevent pneumatic and hydraulic systems from freezing up
  - How to transfer fluids from supply boats during very low temperatures, like drilling fluids and chemicals
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Icing on a semi-submersible drilling rig

Icing på den halvt nedsenkbare boreinnretningen «Ocean Bounty» i Cook Inlet, Alaska.

Source: US Army Corps of Engineers, Engineer Research and Development, 2009
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Icing on ships

Ising på forskningsskipene «Miller Freeman» i Bering havet (t.v.) og «Knorr» i Labrador havet (t.h.)

Source: http://www.vos.noaa.gov/
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Icing on different types of vital equipment

Frozen anchorwinch
Winterization measures, deicing and removal of ice:

• Sufficient winterization and deicing measures to cover local conditions and facility layout can be very challenging

• Success of chemical winterization and deicing measures can be temperature dependent

• Manual removal of snow and ice may pose risk to personnel and be damaging to vital equipment

Source: Offshore Vessel Operations in Ice and/or Severe Sub-Zero Temperatures In Arctic and SubArctic Regions, OCIMF, First edition 2014
Summary of conclusions regarding summer operations:

• Summer operations may be performed by many modern and winterized drilling facilities (like 6th generation units), assuming winterization solutions for operations down to $-15^\circ$C to be sufficient for most locations

• Considerations should be made for drilling or well control problems that may require the drilling facility to stay on location towards the beginning of the winter season
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Summary of conclusions regarding winter/year-round operations:
• Winter or year-round operations in the coldest parts of the Barents Sea south-east area will require the implementation of new technology and solutions, enhanced winterization measures and operational procedures adapted to the location specific requirements
• New drilling facility designs are probably required to handle severe icing events and drifting ice-fragments in the sea, as well as suitable material selection and equipment specifications for the extreme low temperatures that may occur on some locations
• Emergency equipment, lifesaving and evacuation means, must be operationally qualified and usable under the harshest conditions anticipated
Thank you for your attention