

Ice Endangers Offshore Arctic Operations



Sea ice is a constant hazard in high latitude operations

Endeavor Management Company

2700 Post Oak Blvd.
Suite 1400
Houston, Texas 77056

P + 713.877.8130
F + 713.877.1823
www.endeavormgmt.com

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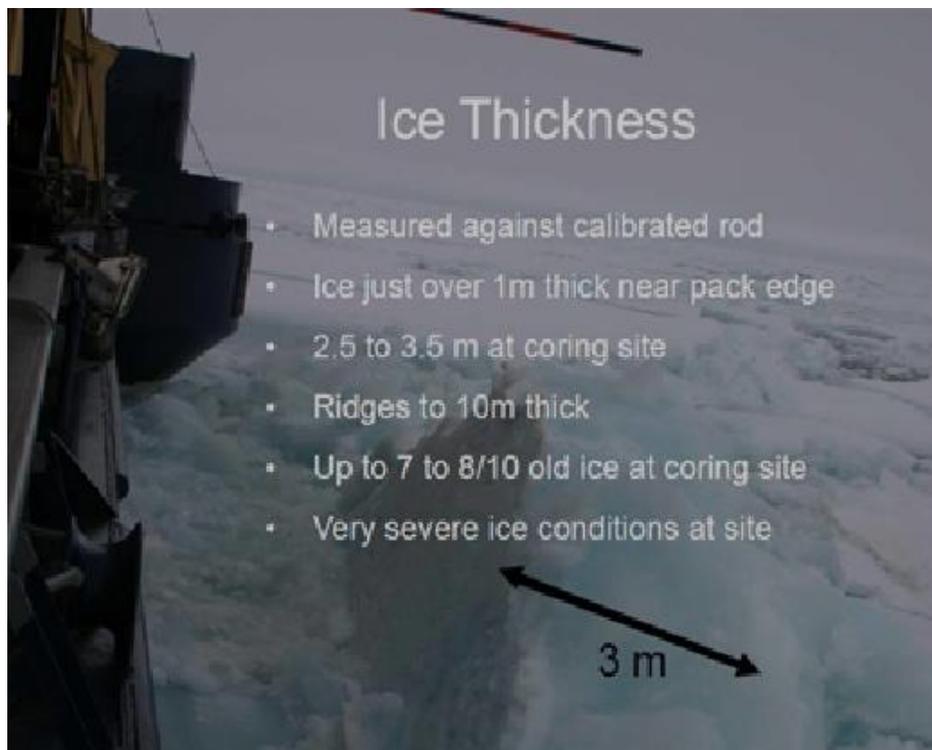
Dealing with the ever-changing ice cover in Arctic waters is one of the most challenging issues for any human activity there. Whether the task is moving vessels through the ice to their destinations or keeping ice clear of drilling vessels or production facilities, ice management requires the right resources (both physical and informational), sufficient expertise, and the right plan.

GETTING THE JOB DONE

An effective ice management program must have a clearly defined purpose with specific goals. The location or region to be serviced must be identified, based on the activity to be protected, whether it is a stationary drilling operation, production facility, or maintaining access for a regular supply or support vessels.

Ice management vessels protecting a target location must have the specific capabilities

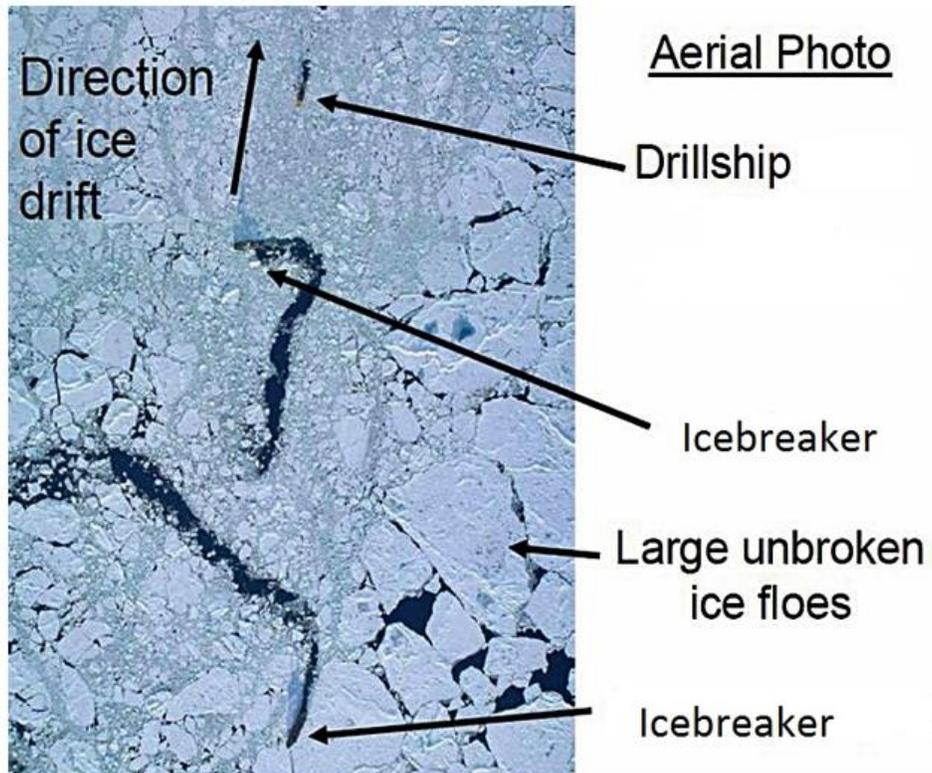
needed to deal with the likely ice conditions within the region, whether first-year sea ice in varying concentrations, more challenging multi-year ice, ridges, or icebergs. The vessel(s) to be utilized must have the ability to not only detect ice by radar and visual observation, but to operate safely in close proximity to identify ice concentration and thickness, and to break up large floes that might threaten operations whether they be drilling, production, or supporting functions.



Thick sea ice can severely hamper offshore operations without a plan to manage intrusive ice flows into manageable sizes or harmless rubble

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Ice forecasting is a critical task involving information gathering and monitoring of sea and wind conditions, as well as general weather conditions for any ice management program to be developed. These activities are necessary to determine the movement, direction, and speed of ice concentrations or floes, so that their threat level to a stationary structure can be evaluated and a mitigation plan initiated in a timely manner.



Two icebreakers work to break large ice floes into non-threatening sizes and keep the broken pieces from coalescing as they move past, in this case a protected drillship performing a coring operation

If the protected structure is to be safe, large ice floes must be broken into smaller pieces and those pieces managed so they do not threaten the structure. In some cases, large ice pieces may need to be diverted away from the endangered structure. Ice alert procedures must be established for the protected structure and the

crews on the ice management vessels, and coordination between ice advisers and vessel masters must be clearly established. The chain of command for decision-making responsibilities and criteria for terminating operations and moving off the site must be thought out, in place, understood, and agreed to by all participants.

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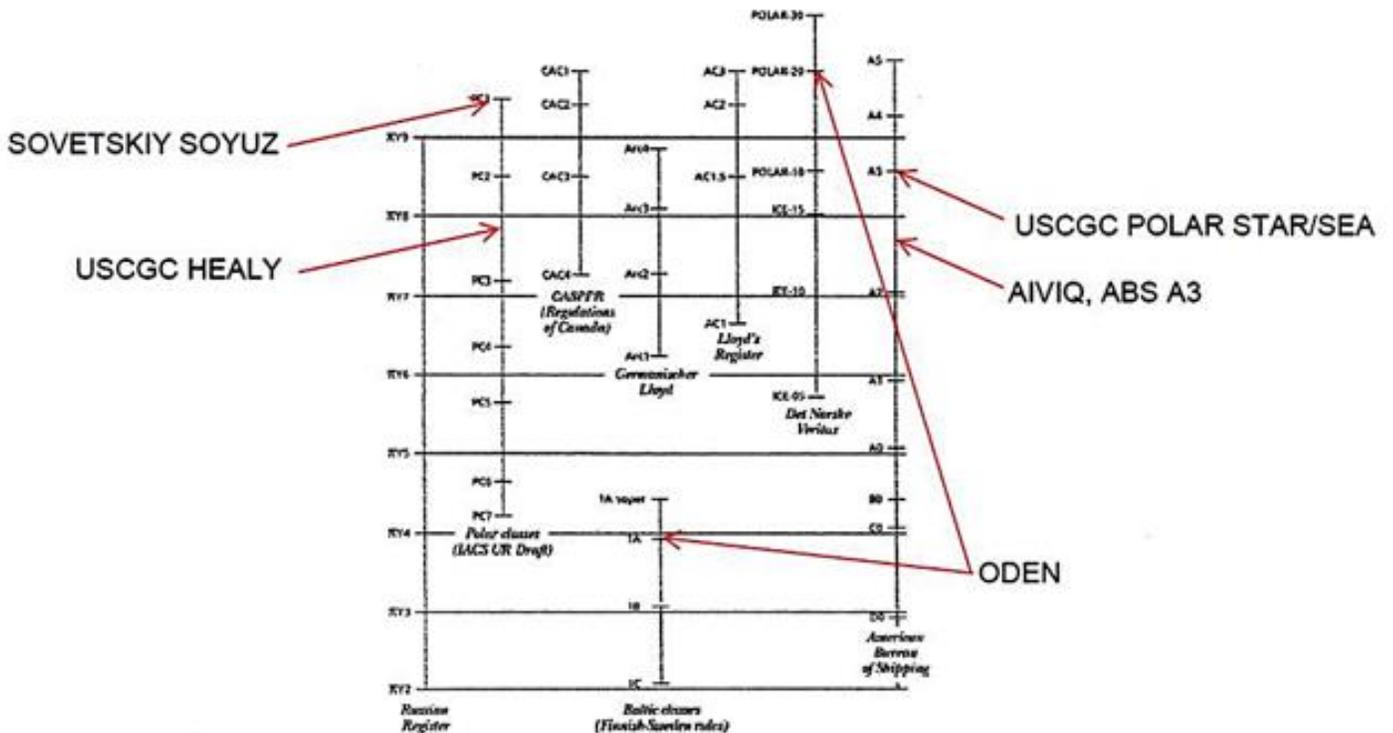
It is important to recognize that ice-class vessels have a wide range of capabilities and all are therefore not the same. They are built to different standards, depending on the country of operation and the classification standard to which they were

both designed and built, as well as their intended use and function. Determining the right mix of ice-capable vessels is thereby critical for any successful ice management program.

Comparison of different Ice Rules (scantlings)



Comparison between different rules for ice strengthening.
Carried out by Krylov Institute in St. Petersburg



Ice classification does not equate to icebreaker performance. Source DNV

In simple terms, ice classification reflects design requirements for safety and survivability, not performance in ice. The International Association of Classification Societies (IACS) Requirements for Polar Class states: "The IACS Unified

Requirements state that they apply to ships constructed of steel and intended for navigation in ice-infested waters. Icebreakers may have additional requirements and are to receive special consideration (see Sections 1.1 and 1.3)."

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In summary, ice management is a complex and critical component of any oil and gas program envisioned for Arctic OCS waters. A successful ice management program must be carefully constructed to reflect environmental conditions in the particular geographic location for the intended operation, and it must be developed in accordance with regulatory rules in effect for the specific geographic location of intended operations. Clearly, having the right expertise to develop and implement an ice management plan is as important as having the right assets to do the work intended, but ice management expertise is not widely available, particularly in the U.S. for U.S. Arctic OCS Territorial Waters.

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Joseph White is a member of Endeavor Management's Arctic Team. He has over 40 years of hands-on technical support for operations and engineering design experience, of which 25 plus years has been offshore Arctic related, obtained while serving on the technical staff of vessel owners and operators. Mr. White earned a degree in Naval Architecture and Marine Engineering from Mississippi State University.

This Endeavor Insight is brought to you by Endeavor Management, a management consulting firm that leads clients to achieve real value. Endeavor Management's Arctic Team can provide independent and unbiased oversight when tackling the challenges of the Offshore Arctic. For more information contact Bruce Crager, Executive Vice President at 713-459-1215 or bcrager@endeavormgmt.com.

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