photo: ABS

Enormous oil and gas reserves estimates for offshore areas in the Arctic have been reported in many publications. These numbers are driving the increased activity aimed at confirming and ultimately extracting these resources. The science and technologies employed are under continuous development and refinement. And these efforts are closely monitored by the regulatory agencies that carry the responsibility for approval of exploration and development plans. Ultimately, the challenge for all involved – to increase Arctic activity safely – is significant and encompasses a broad range of considerations.

BY JAMES BOND

Industry Rises to the Arctic Challenge

Winterisation

Extreme temperatures are an obvious Arctic challenge. This is being addressed in terms of equipment readiness under the umbrella of "winterisation", which for the offshore industry, means protecting fluids (kept warm and moving), equipment (special materials and possibly simpler big button controls for use by gloved hands), and personnel (special clothing and training to understand the effects of cold on the human body) for drilling, safety, aviation, and habitability systems to provide effective and reliable functionality.

New winterised rig designs will incorporate more enclosed spaces, which brings about the need for air quality monitoring for personnel safety and explosive gas detection that exceeds what is needed for a rig intended for use in a more temperate climate. In addition to climate and quality control, air humidity levels need to be maintained in a range that keep the human body comfortable without resulting in frost on cold surfaces.

Logistics

Rig designers also must be conscious of the great distances that must be travelled for resupply in the Arctic. Unlike North Sea and Gulf of Mexico operations, developments in the Arctic frontier will not have a vast resupply chain close at hand. Designs will have to incorporate larger tank capacities, stores capacity and room to carry more spares to reduce supply demands and frequencies.

Downtime for repair or parts replacement for a drilling program is always costly, but that cost is compounded if the supply line is long. This consideration could lead to equipment redesign that will increase robustness, extending operation time between scheduled maintenance.

Human Factors

All companies know that their most important asset is their people. Meeting the needs of the Arctic workforce will be expensive because of the long-distance crew changes and supply lines. An additional challenge is to reduce the number of people required for individual operations, ultimately resulting in a lower number of persons on board (POB) count.

Because weather unpredictability is a factor, it is likely that onboard personnel could be caught with a landing helicopter unable to return with the off-duty crew; so the ability to house an extra 30 people will be necessary in Arctic rig designs. And the distance involved to transport injured personnel could mean the need for extra medical capability on board. To provide the necessary accommodations for personnel, it is likely that new Arctic rigs will be larger than those used in temperate climates.

Ice Management

The industry as a whole has a relatively good understanding of local ice loads on structures (peak pressures and design structure of sufficient strength). Global ice loads, however, are not understood as well. At the September 2012 ICETECH conference, organised by the Society of Naval Architects and Marine Engineers, it was noted that for the Moliqpak production platform, the original global design loads used would be reduced by a factor of ten today, and this would still be conservative because it would take into to account today's understanding of the unknowns. Industry, including ABS, is involved in several projects to simulate and quantify global ice loads on both fixed and floating offshore structures partially as validation of ISO Standard 19906 and in general to further understanding.

Ice management is understood by many to be an integral element for controlling and reducing the global loads to which a structure could be subjected. The challenging issue is the reliability of the overall process, which includes ice detec-

tion – understanding the ice that is moving toward the structure and the ability of physical ice-management vessels to perform reliably.

Collaborating Expedites Progress

Classification Societies like ABS are uniquely positioned between the regulators and the energy industry. Developed without bias, Class Rules, Guides and Guidance Notes act as a framework for design of assets and processes that help protect the environment from the asset and the asset from the environment while promoting personnel safety. To that end, Class works with regulatory agencies and industry to identify knowledge gaps and to create research initiatives that will help to close them. In an effort to make sure its research efforts are aligned with industry needs, ABS has hosted several Arctic workshops in St. John's, Newfoundland, and Houston focusing on such subjects as winterisation, corrosion, and mooring systems for Arctic drilling and production operations. These workshops provide a forum where industry representatives from energy majors, drilling contractors, offshore engineering firms, equipment manufacturers and regulatory bodies can present their views, share their expertise, and discuss how R&D efforts can best answer present needs. At a corrosion workshop held in St. John's in March 2012, experts tackled the subject of coatings requirements, including current IMO (SOLAS) Regulations on the Performance Standard for Protective Coatings (PSPS) and the potential need for additional guidance, and how coatings could help reduce maintenance costs to increase uptime on offshore assets operating in Arctic conditions.

At the Arctic mooring workshop held in Houston mid-year 2012, participants identified three topics of special interest: the role of ice management in mooring system design; disconnection and reconnection devices; and practical guidance on global ice load prediction. These observations will help ABS focus its research program so that guidelines can be developed not only to protect the environment, but also the crews and vessels that will work in this extreme environment.

A winterisation workshop held in St. John's in October examined the issues of environmental criteria, existing experience, training and human issues, and how the industry can move forward. ABS engineers used this event to present a risk-based approach to winterisation to elicit industry response and guidance.

At the final workshop in 2012, which was held in Houston held during the SPE-ATCE Arctic Technology Conference in December, the ABS team shared ideas for research and explained where the organisation is headed with its Arctic project plan for 2013. Attendees were encouraged to provide input to help direct R&D efforts by answering a basic question: "What needs to be done to meet the short-term and long-term demands from the industry?"

The answers to that question identified research needs not only for

Frigid conditions introduce technical challenges for nearly every aspect of Arctic operations

An icebreaker makes its way through ice-infested water. *(photo: ABS)*

ABS, but for the entire industry: the need for a global ice load model and full-scale measurement capability, improvements in mooring systems, advancement in ice management technology, and global harmonisation of regulations.

Identifying Critical Safely Needs

While these workshops have not provided specific solutions, they have been invaluable in identifying the critical needs for safely developing Arctic reserves. ABS has recognised the value in working with industry to break the technology barriers that will facilitate safe Arctic drilling and production activities and plans to play a leadership role in meeting the industry's needs for good guidance in this frontier area. ■

Defining a global ice load model and full-scale measurement capability, improving mooring systems, advancing ice management technology, and working toward global harmonisation of regulations will help move the oil and gas industry safely into Arctic waters *(photo: ABS)*

Arctic Research Targets

ABS has contributed to the advancement of Arctic research through its R&D efforts at the ABS Singapore Offshore Technology Center (SOTC), established in conjunction with the National University of Singapore.

Researchers at SOTC have applied Cohesive Zone Modelling, a technology that is useful in determining structural response and local ice force evaluations, to ice fracture and failure simulation. Additional efforts are being invested in developing analysis and design methodologies for ice-resistant jacket and jack-up structures. And a project being carried out via a joint industry project with the University of Delft is investigating ice-induced vibration for offshore structures. The addition of a Virtual Model Basin early in 2012 has added even more local capabilities.

Meanwhile, ice-management simulation work is taking place at the ABS Harsh Environment Technology Center (HETC) in St. John's, Newfoundland, where high-end General Purpose Graphical Processing Unit (GPGPU) technology is being used to simulate ice management scenarios. Researchers at the centre, which was established in partnership with Memorial University, are modelling realistic ice collision scenarios to capture the specific capability of an icebreaker while at the same time calculating the interaction among the resulting broken ice pieces. Plans are in place for these simulations to be extended to include a "fixed" position rig with mooring system flexibility and limits. Ice loads on the icebreakers and eventually the rig and mooring systems will be extracted from the modelling.

An underlying difficulty with ice management is that some regulatory bodies are not comfortable relying on it. For this reason, at this point some agencies are considering requiring the rig to be able to take the full load from unmanaged ice. The *Kulluk* drill barge, recently moved off station in Alaska, operates with a mooring release system. Industry is working on new designs with the same principle.

Ice-load simulation is a cost-effective means of advancing knowledge. At present, the biggest concern is that process validation requires measured data. While ice-tank testing adds significantly to the industry's understanding of ice behaviour, new full-scale ice-load measurement programs are sorely needed to supplement the too few data points that industry has from past programs from the limited number of true Arctic assets.

The Author:

Based in Houston, James Bond is Director, Shared Technology in the American Bureau of Shipping Corporate Technology group. He is responsible for guiding ABS research, ABS rule development and industry guidance. Bond has worked in the marine and offshore industries for more than 25 years.