A lifeboat is lowered into the Arctic water for the exercise

RESEARCH SAVING LIVES IN ARCTIC SEAS

Arctic research provides clarification for Polar Code requirements.
***Katie Aylward* of ABS shares recent findings from lifeboat and life raft survivability studies**

How long can a person survive in the Arctic in a lifeboat or life raft? Will survival equipment function as needed in polar conditions? How will the Arctic environment impact search and rescue (SAR) operations?

In an attempt to answer these questions, American Bureau of Shipping (ABS) joined the University of Stavanger and other participants in an SAR research exercise near Svalbard, Norway, in April 2016 as part of a joint effort among Norwegian and Canadian academic institutions, Norwegian industry, Norwegian Armed Forces, the Norwegian Coast Guard and lifesaving equipment manufacturers. The goal was to advance the understanding of and evaluate the risks associated with increased vessel activity in Arctic waters and how typical SAR operations could be impacted.

Interpreting the Polar Code

The International Maritime Organisation's (IMO's) *International Code for Ships Operating in Polar Waters* (Polar Code) enters into force January 1, 2017, bringing with it a broad spectrum of binding regulations. Among these are elements of ship safety, equipment, design and construction, and operations and manning for vessels operating in polar waters. Of particular interest to those involved in the Svalbard exercise is Chapter 8 of the Polar Code, which provides regulations for lifesaving appliances and arrangements providing for safe escape, evacuation and survival.

Industry has raised questions about the correct interpretation and application of these new requirements. Because the IMO Polar Code is new, there is no historical experience to draw on for answers to questions that become particularly challenging in an exacting operational environment.

One of the requirements states that passengers and crew shall be equipped to enable survival for a minimum of five days while waiting for rescue. Another requirement indicates that 'adequate' thermal protection shall be provided for all persons on board. The goal of the research carried out in Svalbard was to study and interpret the Polar Code requirements and to determine the industry's state of readiness to comply.

While the research comprised three phases that examined all aspects of SAR operations in the Arctic, the findings shared here are confined to lifeboat and life raft survivability.

Real-life scenarios

Participants in this exercise included research team members and Norwegian Coast Guard personnel, representing a relatively healthy and fit study population, who entered into real-life scenarios to test their ability to survive in a lifeboat and life raft in polar waters for up to 24 hours. The group of 22 participants in a 55-person lifeboat and 20 participants in a 25-person life raft were randomly assigned to wear different levels of thermal protection, including insulated and uninsulated immersion suits, neoprene immersion suits and thermal life jackets. The goal was to determine how long the protective equipment was effective. A level of ineffectiveness was determined to be reached when:

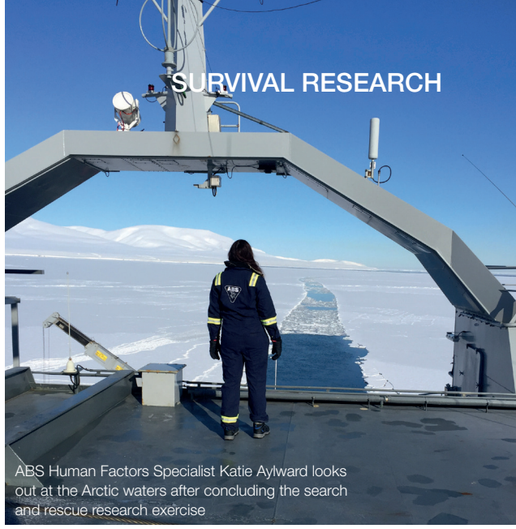
- Hands and feet were numb, or the participant experienced shivering
- The participant was unable to complete a simple physical test (unscrewing a bolt)
- Other participants noticed changes in physical appearance.

When any of these criteria were met, the ship's doctor carried out wellness checks as each participant left the survival craft.

Weather conditions were nearly perfect during the test, with sunny skies, virtually no wind or waves, an average air temperature of -13°C (8.6°F) and a water temperature of -1°C (30.2°F).

Photos: University of Stavanger, ABS


Research participants in the life raft paddle to the ice edge



ABS Human Factors Specialist Katie Aylward looks out at the Arctic waters after concluding the search and rescue research exercise

Thermal protection research outcomes

The type of thermal protection significantly impacted the length of time participants were able to remain in the survival craft. Participants wearing thermal life jackets were among the first to leave the study, followed by those wearing neoprene immersion suits and uninsulated immersion suits. The last to leave were those wearing immersion suits that were fully insulated.

One of the limitations of the thermal life jackets is that they provide thermal protection only to the core and upper body and offer no protection to the feet, legs, or hands. While the neoprene immersion suit appeared to function well in the lifeboat, it met with less success in the life raft, where some participants were damp from opening the entranceways. Once the neoprene suit got wet, it failed to provide sufficient protection.

Not surprisingly, the insulated immersion suits performed best because they provide whole-body thermal protection. Participants wearing the insulated suits lasted the longest time, but only three were able to complete 24 hours in the lifeboat. Two of the people wearing insulated immersion suits remained in the life raft for approximately 18 hours. Preliminary conclusions suggest insulated immersion suits should be a requirement for vessels operating in Arctic environments because they provide the best thermal protection for this type of environment.

Survival craft capacity

Another interesting finding that came out of this study is the posted persons on board (POB) capacity on survival craft. Because there were only 22 people assigned to the 55-person lifeboat, the boat was not near capacity. However, 20 participants could barely fit in the 25-person life raft. Findings from lifeboat capacity studies in both the Gulf of Mexico and Atlantic Canada show that it is not unusual for the posted maximum capacity to be an overestimation.

In the case of the Arctic study, participants were wearing bulky personal protective equipment (i.e., immersion suits, life jacket, boots, gloves, etc.), which increased the space needed for each person on the life raft. Because the life raft was provisioned with a large bag of survival supplies (food, water, flares, etc.), the entire middle section of the life raft was not available for use by personnel. Even with a healthy group of participants, there was not enough room for 20 people.

In reality, in Arctic conditions, there could be even more safety equipment in the life raft, including survival kits such as tents, warm clothes, flashlights and cooking equipment, all of which would require additional space. Based on existing research including the recent Svalbard study, the POB capacity for survival craft, including both lifeboats and life rafts, should be re-evaluated.

Carbon dioxide level concerns

Another important issue identified in the study was the poor air quality in both the life raft and lifeboat. Previous research identified carbon dioxide (CO_2) levels as a concern in lifeboats. For safety reasons, portable oxygen (O_2) metres were used in each craft. Every 20 to 30 minutes, the O_2 meter alarm sounded in both crafts, indicating required ventilation, which took the form of opening entranceways or hatches. Each time a craft was vented the temperature within the survival craft dropped noticeably.

Today, survival craft are not required to have an O_2 or CO_2 alarm. Without an alarm occupants may not be aware of the need to periodically circulate fresh air through the survival craft. Since many of the initial symptoms of overexposure to CO_2 – including increased respiration, headache, sweating, increased heart rate and blood pressure and hyperventilation – are difficult to distinguish from shock and stress, it would be possible for a potentially deadly situation to develop in a relatively short span of time. Existing research and conclusions from this study indicate that all survival craft should be equipped with a way to measure air quality, or alternatively that ventilation options should be explored.

Recommendations and remaining work

While a number of questions cannot be answered with certainty at this point, results indicate that even with a healthy group of participants and excellent weather conditions, the risks during SAR operations are very serious. If conditions had been more severe, the results could have been considerably different particularly for the life raft due to the possibility of seasickness, water entering the life raft and a colder environment. Primary findings suggest industry may find it difficult to meet Polar Code requirements for surviving for at least five days in polar waters.

The results of the Svalbard study indicate further research is needed in the following areas:

- Lifeboat and life raft performance in harsher weather conditions for longer periods of time
- The adequacy of thermal protection after exposure to water
- Testing of additional life-saving equipment in ice and polar waters
- Air quality and ventilation of lifeboats and life rafts
- POB capacity for lifeboats and life rafts
- Similar study in controlled conditions (lab setting) FE

A full report on this research exercise, available to the public in the fall of 2016, will contain detailed results with input from all of the research team members. The results will help industry meet Polar Code requirements for escape, evacuation and survival.

Participating and contributing to this world-class Arctic research has provided the opportunity for ABS to support research efforts on human element considerations in the Arctic and will provide input for future updates to the existing *ABS Guide for Vessels Operating in Low Temperature Environments*.