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Arctic Potential: Realizing the Promise of U.S. Arctic Oil and Gas Resources
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OVERVIEW AND BACKGROUND OF ESCAPE, EVACUATION, AND RESCUE OF OFFSHORE PERSONNEL IN THE ARCTIC

Prepared for the
Technology & Operations Subgroup

On March 27, 2015, the National Petroleum Council (NPC) in approving its report, *Arctic Potential: Realizing the Promise of U.S. Arctic Oil and Gas Resources*, also approved the making available of certain materials used in the study process, including detailed, specific subject matter papers prepared or used by the study's Technology & Operations Subgroup. These Topic Papers were working documents that were part of the analyses that led to development of the summary results presented in the report's Executive Summary and Chapters.

These Topic Papers represent the views and conclusions of the authors. The National Petroleum Council has not endorsed or approved the statements and conclusions contained in these documents, but approved the publication of these materials as part of the study process.

The NPC believes that these papers will be of interest to the readers of the report and will help them better understand the results. These materials are being made available in the interest of transparency.

The attached paper is one of 46 such working documents used in the study analyses. Appendix D of the final NPC report provides a complete list of the 46 Topic Papers. The full papers can be viewed and downloaded from the report section of the NPC website (www.npc.org).

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Topic Paper

(Prepared for the National Petroleum Council Study on Research to Facilitate Prudent Arctic Development)

7-13	**Overview and Background of Escape, Evacuation, and Rescue of Offshore Personnel in the Arctic**
Author(s)	**Jim Poplin (ExxonMobil)** **Brian Wright (Chevron Canada)** **David Dickins (Chevron)**
Reviewers	**Peter Velez (Shell)**
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SUMMARY

Escape, evacuation and rescue (EER) of offshore personnel in Arctic environments is challenged by ice conditions that vary considerably from location to location and during different times of the year. Rescue systems may be required to contend with open water, full ice coverage, mobile ice, ice rubble piles around fixed shallow water platforms and exposure of personnel to extremely cold temperatures. To date, no single EER system has been developed that can be uniformly applied for all Arctic platform and vessel conditions; hence, multiple modes of EER are often used to cover all environmental contingencies, which can lead to very high operating costs for Arctic platforms. With resurgence of interest in arctic oil and gas resources, new research efforts are underway to improve EER systems for the harsh arctic environment. This topic paper describes EER system requirements and design standards applicable to Arctic EER. It also describes the functional shortcomings of current EER systems for some arctic environments and the research efforts underway to address the shortcomings as well as future opportunities for further enhancement of EER technologies for platforms and vessels operating in an arctic environment.

A. Overview and Background

Worker safety is the number one priority in the oil and gas industry. Because the probability of having to abandon a manned offshore structure or vessel due to a major incident cannot be reduced to zero, a robust escape, evacuation and rescue (EER) system is of paramount importance to protect personnel. The terms escape, evacuation and rescue as used in this study are defined below since these definitions are not used consistently throughout the world (ISO 19906, 2010).

Escape	Act of personnel moving away from a hazardous event to a place on the installation where its effects are reduced or removed
Evacuation	Planned precautionary and emergency method of moving personnel from the installation (muster station or Temporary Refuge – TR) to a safe distance beyond the immediate or potential hazard zone, usually off the installation

Rescue	Process by which persons entering the sea or reaching the ice surface, directly to a standby vessel, in an evacuation craft or by other means, are subsequently retrieved to a place where medical assistance is typically available. Includes survival and recovery components.

Improvements to EER in open water areas have been made over the past several decades, driven largely in response to major loss of life and/or asset incidents e.g. Ocean Ranger (Royal Commission on the Ocean Ranger Marine Disaster, 1984), Piper Alpha (Cullen, 1990), Petrobras 36 Inquiry Commission, 2001 and National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling Deepwater Horizon, 2011). In contrast, much less effort went into improving EER systems and procedures suitable for offshore environments where sea ice persists for at least a portion of the year (Bercha, 2010). With the recent resurgence of commercial shipping and oil and gas industry interest in the Arctic offshore, arctic EER is now receiving more attention. However, the relatively limited commercial market reduces the manufacturers' incentive to develop highly specialized arctic EER systems as compared to ongoing research and development (R&D) initiatives aimed at improving open water systems.

The Arctic environment can profoundly influence the design, operation, maintenance, and success of any EER system, necessitating that the full range of physical environment conditions be accounted for when developing and implementing an EER plan (Barker et al., 2006; Bercha, 2010; Polomoshnov, 1998; Spencer et al., 2007). Consequently, the full range of physical environmental conditions possible at the offshore installation, as well as between the shore base and the installation need to be taken into account when developing and implementing the EER plan (Poplin et al., 1998a; Timco and Dickins, 2005). Ice-related factors affecting the types of EER systems that could be used in different Arctic offshore settings include; ice concentration, ice drift speed and direction, ice thickness, ice floe size, ice roughness, ice pressure occurrence, joint ice and wave conditions, and fall freeze-up and spring break-up conditions. The nature of the interactions expected between the ambient ice cover and any arctic offshore installation is another important aspect that must be accounted for in EER system design. The range of ice-structure interaction factors affecting the type of EER system best suited to a fixed or floating offshore installation include: ice conditions immediately adjacent to the installation such as the presence of grounded or floating ice rubble, ice failure processes around the platform in moving ice and the possible presence of a down-drift wake (Wright et al., 2002; Wright, 2010; Poplin and Timco, 2003; Timco et al., 2006).

The presence of sea ice at the installation (and icebergs if applicable) can significantly influence the reliability and performance of different evacuation and rescue systems. Survivability of systems in open water and waves, in various ice-wave combinations, between floes in pack ice, on a solid ice surface and in the presence of ice rubble should be taken into account for any design options that deal with abandonment and rescue. Other factors associated with the Arctic include, but are not limited to: sea spray and atmospheric icing, low air temperatures, high winds and wind chill, poor visibility, prolonged darkness, the effects of blowing snow and fog. Moreover, related factors such the deck layout, operational hazards, substructure geometry and deck height, proximity to support, manning levels, the operating environment, and the presence of contaminated hydrocarbons (e.g. hydrogen sulfide) all need to be considered.

Figure 1 is a generalized schematic of the overall EER basic logic. Note that not all of the components shown under the escape, evacuation and rescue headers may actually be used in the EER strategy. For the most part, issues associated with the Arctic escape component of the logic (e.g. escape routes and the temporary refuge or TR) are largely the same as for open water. Exceptions include mitigations required for the impacts of sea spray and atmospheric icing, snow, and below-freezing air temperatures. Additionally, specialized arctic TR design considerations (incorporating for example, the need for longer impairment time and off-platform real time monitoring systems, and even whether a TR will be used at all) could all be impacted by the severity and dynamics of the ice environment.

However, the Arctic offshore environment poses significantly greater challenges to both evacuation and rescue. An ideal evacuation system for ice covered waters is one that allows installation personnel to abandon the facility in an orderly manner in response to an emergency under all anticipated ice and sea conditions, and to proceed to a safe distance from the disabled facility to await rescue (Bercha, 2010). Most conventional evacuation methods employed in open water elsewhere in the world would have serious limitations in the presence of ice and simply may not be viable. For example, while survivability in the winter Arctic environment may demand a faster recovery of evacuees, the most effective open water rescue methods may be adversely impacted by ice, darkness and extreme temperatures. The effects of cold air and water temperatures on survival time, require a greater reliance on dry evacuation systems whereby evacuees transfer from the mode of evacuation directly to the mode of rescue without entering the sea.

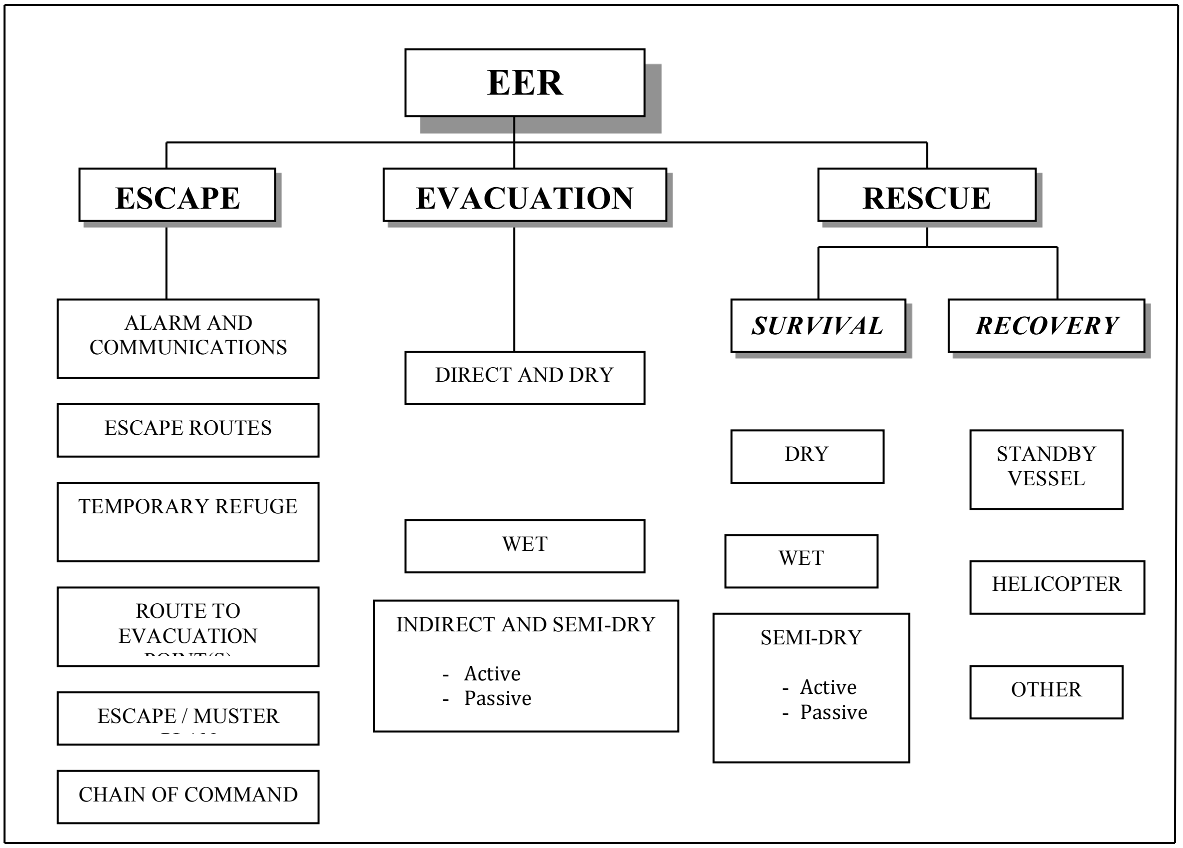

Figure 1. Generalized logic of an example escape, evacuation and rescue (EER) approach for an offshore platform or vessel (Modified from Wright et al., 2002).

The harsh Arctic offshore environment poses formidable challenges to EER system performance. Currently, there is no single evacuation method available that is suitable for abandonment in the full spectrum of environmental, metocean and ice conditions under all credible incident scenarios (Poplin and Bercha, 2010). Moreover, rescue approaches may be adversely affected by environmental conditions as well as the type of incident. Although various operational EER systems have been developed and applied in different ice-covered regions of the world, there are a number of serious limitations that remain when using them in different ice environments. As a result, there is an ongoing need for future research, development and demonstration initiatives to improve primarily evacuation and rescue capabilities in the Arctic offshore.

B. Standards and Technological Constraints

In the early to mid-1980s, bottom founded exploration drilling structures were first deployed in the Alaskan and Canadian Beaufort Sea, where dynamic pack ice conditions were experienced throughout the year. More recently, offshore petroleum operations have moved into regions like the Sea of Okhotsk offshore Sakhalin Island and the Kara and North Caspian Seas where dynamic sea ice conditions also occur. Future Alaskan offshore exploration and development is planned for the US Chukchi and Beaufort Seas where highly mobile pack ice is a common occurrence for much of the year.

Acceptable EER practice typically requires the provision for multiple means of platform abandonment to help ensure that at least one method is available under the full range of environmental conditions and incident scenarios. In cold regions, the EER strategy for the open water season can rely heavily on the use of existing technology. However, for the most part, these conventional open water EER systems and strategies, even in modified form, can only cope with a relatively limited range of sea ice regimes. Moreover, the effectiveness of available EER systems in ice-covered waters has not been fully assessed under emergency conditions.

The EER strategy developed will need to account for the site-specific environmental conditions that persist in the particular region of interest (Spencer et al., 2007). For example, rudimentary EER measures can be used for low freeboard structures in stable winter sea ice conditions. In some instances, the EER strategy under such relatively predictable winter conditions could look similar to that for land based drilling operations and may potentially include a provision to evacuate to the surrounding ice cover along a prepared path over the ice to an intermediate place of safety beyond the hazard zone (Barker et al., 2013; Barker et al., 2009; Barker et al., 2007; Barker et al., 2006). In contrast, an effective winter EER strategy for a platform operating in an area of dynamic pack ice may look very different. Even in a landfast ice environment, evacuation across the ice during the shoulder seasons with thin or melting ice may not be safe or practical.

The few systems specifically designed for applications in a limited number of ice-cover scenarios include the ARKTOS survival craft (Seligman and Berchga, 2012), the Ice Breaking Emergency Evacuation Vessel (IBEEV) and the full-scale prototype Seascape System of evacuation TEMPSC with a conceptual articulated deployment arm (see Figs. 2-4). The limited availability of arctic evacuation systems reflects in part the relatively limited market, but more importantly the significant challenge in designing an evacuation system suited for a diverse range of ice and open water conditions.

The capabilities of evacuation systems for use in ice-covered waters have been reviewed in a number of recent studies (e.g. Poplin et al., 1998b; Wright et al., 2003; Timco and Dickins, 2005; Poplin et al., 2010; Wright, 2012; Poplin et al., 2011). While acknowledging that advancements have been made, the authors also identify a number of key gaps and current technological constraints related to EER systems especially with regard to applying the strategy to dynamic ice environments. These limitations are largely associated with evacuating during the Arctic shoulder seasons (i.e. during the freeze-up and break-up periods) when nilas, and melting floes predominate, and from high freeboard structures in dynamic pack ice.

Ongoing design concepts, developments and research may overcome these challenges in the future. However, in the interim, multiple, diverse means of abandonment, including modifications of open water systems for use in ice are required to form a safe and credible EER system. Limited platform deck space, interior stowage and deck loadings provide further constraints on deploying multiple evacuation systems to cover all eventualities. Additionally, the relatively short period available to develop and test new concepts or modify existing systems during Front End Engineering and Design creates additional challenges.

Figure 2. ARKTOS evacuation craft (Photo: W. Spring)

Figure 3. Ice Breaking Emergency Evacuation Vessel (Photo: Remontowa Shiprepair Yard)

Figure 4. Articulated Seascape System of Evacuation Concept (Courtesy: Seascape 2000)

In addition to recent technology advances, a major initiative to address arctic offshore EER involved the development of the new ISO 19906 Design Standard (ISO 19906, 2010). This Standard provides the oil and gas industry with a coherent and consistent definition of methodologies to design, analyze and assess arctic offshore structures worldwide, and is expected to replace existing standards and guidelines. ISO 19906 emphasizes that the EER strategy be an integral part of the platform design and operations. The Standard's objective is to ensure that offshore structures, deployed where arctic conditions prevail, provide an appropriate level of reliability (Bercha and Gudmestad, 2008) with respect to personnel safety, environmental protection and the asset. The Standard addresses EER design requirements that are largely performance-based and also provides background and guidance on the use of the document. For evacuation, in particular, the ISO Standard instructs that the same level of safety and reliability be achieved for personnel evacuations (and EER systems) on offshore platforms year round.

Potential scenarios based on varying environmental conditions that could exist when abandoning a platform in a region containing sea ice at least a portion of the year include:

- Open water abandonment with little or no sea ice present;
- Abandonment to a newly formed ice cover;
- Abandonment to a solid, non-moving ice cover (including grounded ice rubble);
- Abandonment to a partial sea ice cover less than about 4/10ths – 6/10ths); and
- Abandonment to a high sea ice concentration (more than about 4/10ths – 6/10ths)

Abandonment to open water with little or no sea ice can utilize conventional open water technology. Abandonment to a newly formed ice cover presents challenges to evacuation craft attempting to transit through ice and for personnel transiting across the ice. Abandonment to a solid, non-moving ice cover is relatively straight forward except for crossing ice rubble and ridges. Abandonment to dynamic sea ice can pose significant challenges to EER because the ice concentration can vary widely and the ice can limit the effectiveness of the evacuation craft. On the other hand, a dynamic sea ice environment may actually be beneficial for example, in a sour gas release scenario whereby a marine evacuation craft (if used), would be carried away from the installation if deployed onto the ice in the down drift direction. A partial sea ice cover condition could range from isolated floes to 4/10ths – 6/10ths ice concentration with the ice cover that is present potentially able to support personnel and equipment depending on the ice thickness. Abandonment in a high concentration of ice has both advantages and disadvantages depending on the evacuation strategy followed.

When selecting and positioning lifesaving appliances on the offshore installation, consideration of both the environmental conditions and hazardous areas on the installation as well as the suite of credible incident scenarios specific to the facility need to be taken into account. Ice rubble may have a major impact on the winter EER strategy. As an ice floe or an ice sheet impacts a structure, it is broken into smaller fragments referred to as ice rubble shown as blocks in the upper left diagram in Figure 5. Early in the ice loading event, ice rubble drifts past the structure. The distance from the structure to the ice that was deformed as a result of its interaction with the structure (see

Figures 6a and 6b) is referred to as the Ice Damage Zone (Poplin and Timco, 2003; Timco et al., 2006).

The ice damage zone width varies in response to factors including the ice thickness, ice failure mode and ice drift velocity. Additionally, the authors (referenced above) reported that the ice damage zone widths can vary depending on structure type as shown in Figure 7 and that 10-20 m widths of were not uncommon.

An example grounded ice rubble field is shown in Figure 8. Such ice rubble fields can be hundreds of meters in extent, with sail heights in the range of 10m to 20m in places, and can pose significant challenges to evacuation (and to rescue) systems.

The side(s) of a platform undergoing active interactions with drifting pack ice would not provide safe access from an EER perspective (Figure 9). For gravity-based installations, the side facing the predominant direction of ice drift will usually be unsuitable for evacuation. The lee of the platform on the opposite side could remain an open water wake or could be clogged with brash ice and ice rubble clearing around the platform. Even if an open water wake does exist, it may not be suitable for evacuation due, for example, to smoke or unignited gas. In many cases, the preferred sides for platform abandonment in ice may be the long-sides paralleling the ice drift direction.

The EER strategy generally needs to provide multiple (typically preferred, primary, secondary and tertiary) means for platform abandonment under the full range of ice and open water (or any combination thereof) of

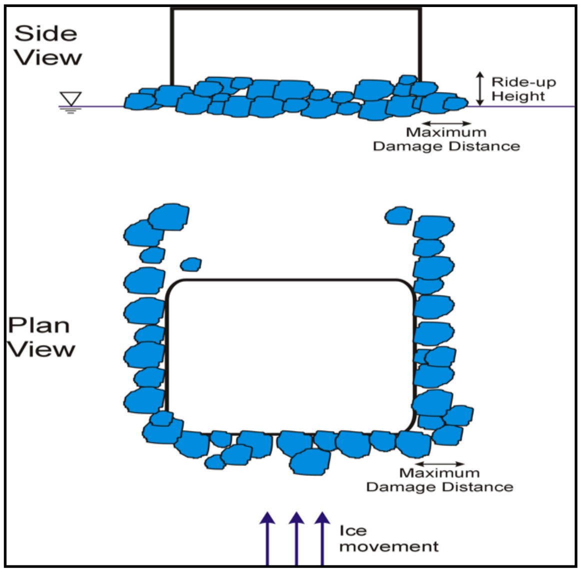

Figure 5. Schematic of ice rubble near a platform

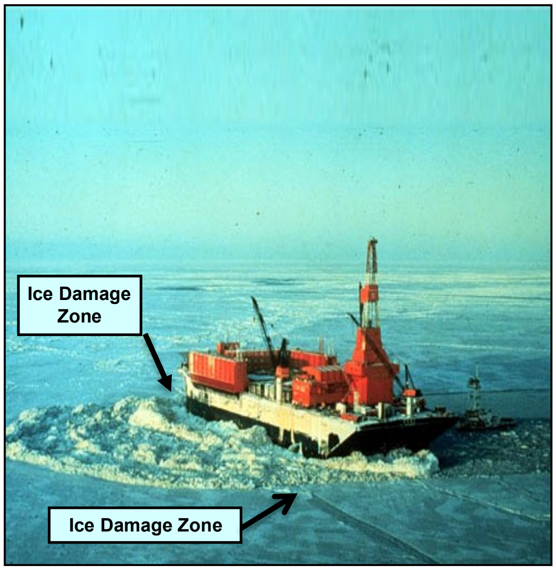

Figure 6a. Example ice damage zone at the SSDC

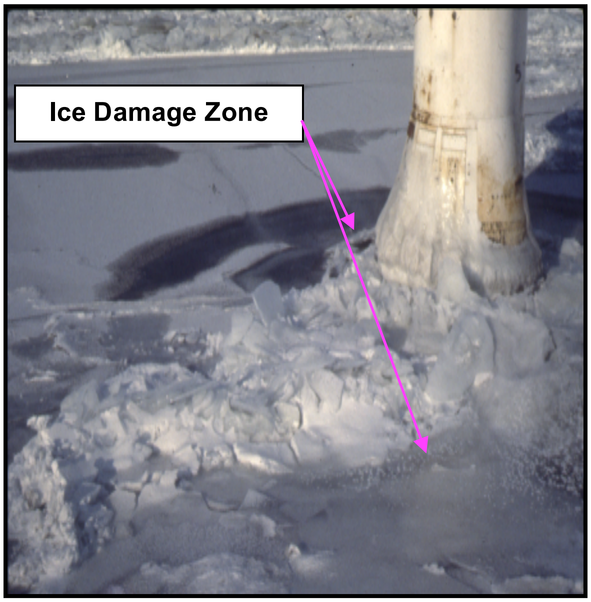

Figure 6b. Conical structure ice damage zone

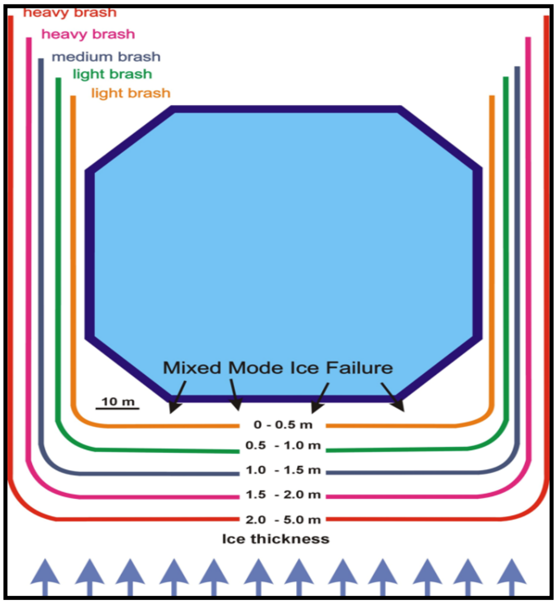

Figure 7. Ice damage zone around *Molikpaq* structure (after Timco et al., 2006)

(Figures 5,6,7 after Timco and Morin, 1997)

Figure 8. Example ice rubble field around the *Molikpaq* platform. (Photo: Canmar via Beaudril)

environmental conditions anticipated. In many cases, this could necessitate that a greater number of lifesaving appliances be available both on and potentially off the installation for orderly and emergency evacuation year round.

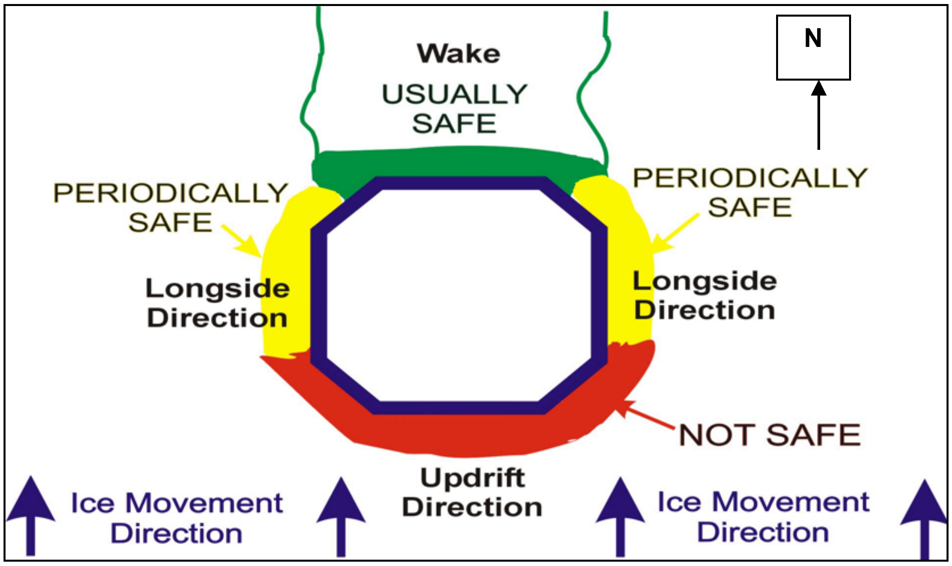

Figure 9. Potential evacuation directions

C. Recent and Ongoing Research

A number of recommendations for improvements to EER systems were made in the Cullen Report (Cullen, 1990) and by the Royal Commission (1984) in response to loss of life incidents on the Piper Alpha and Ocean Ranger respectively, which have led to improvements in open water EER capability. Contrastingly, few new evacuation systems have been designed and "purpose built" for in-ice applications or systematically evaluated and tested in different sea ice conditions. Even so, some recent and ongoing, noteworthy research and development initiatives include:

- A Canadian Panel for Energy Research Development (PERD) funded effort to pursue and evaluate viable EER systems for use in the Canadian Beaufort Sea (Barker et al., 2013);
- A Newfoundland, Canada R&D effort (via PRNL) to design, construct and test an ice strengthened lifeboat (ISL) in a wide range of sea ice conditions;
- A Canadian PERD-funded initiative to assess the use and limitations of direct support vessel applications for personnel evacuations from platforms operating in ice environments;
- A Joint Industry Study to assess the capabilities of a conventional lifeboat with the aim of ultimately designing a TEMPSC with a 'Fram-shaped' hull designed to resist high ice forces by rising out of the ice (see Fig. 10);
- A Joint Industry Study with Seascape to design an articulated lifeboat launching arm (and an 'ice enhanced TEMPSC) designed to place a TEMPSC on an ice cover or in the sea beyond the hazard zone (Fig. 4);
- The development and implementation of EER systems in the northern Caspian Sea including the IBEEV and ARKTOS evacuation crafts (Figs. 2 and 3);
- Refinements to the ARKTOS evacuation craft as part of its use at Northstar Island in the Alaskan Beaufort Sea, particularly during the freeze-up period;
- A Joint Industry Study to modify the design of the Viking chute to allow deployment onto the deck of a standby icebreaker and/or onto the ice;
- A Joint Industry Study to assess the performance of aviation and marine exposure suits; and
- Field measurements of local ice impact loads on a full-scale TEMPSC moving through an ice choked channel in a fresh water pond in Newfoundland.

In addition to the aforementioned studies, industry has undertaken R&D initiatives aimed at modifying conventional open water EER appliances to extend their capabilities in sea ice. Examples include:

- Ice characterization and risk studies carried out to identify and verify the power and station keeping requirements for the Orlan Platform standby icebreaker, offshore Sakhalin Island. The icebreaker proactively maintains a clear path through the ice rubble collar to the platform to enable launch of the TEMPSCs and a chute system directly to the vessel deck.
- Studies performed on the flat-bottom keel Survival Systems Inc. TEMPSCs to evaluate design modifications that enabled launch directly to a standby

icebreaker vessel deck and to the ice, employing a 'cushion mat' and slower winch descent speed. Additionally, winterization enhancement studies were carried out resulting in the design of shelters placed over the TEMPSC winch and canopy to reduce the amount of sea-spray and atmospheric icing and snow buildup, the use of low temperature lubricants and provision for fuel additives and the addition of cabin heaters and a coxswain window fan.

- The Viking SES-2 Arctic chute underwent design modifications employing a slower winch descent rate, a rail launch system to store the system behind the wave deflector when not in use and other enhancements allowing launch to a vessel deck and/or the ice

a. b.

Figure 10. Lifeboat hull-ice interaction study (a) craft deployment and recovery icebreaker and (b) lifeboat. (Photos: Fleet Technologies)

D. Observations & Recommendations for Future Research and Development

A number of Arctic offshore EER systems have been developed and are currently employed in a range of ice and metocean environments around the world. These EER systems have been designed to account for the sea ice, metocean and major credible incident scenarios specific to the region deployed and to the installation. Whereas recent and ongoing R&D initiatives are expected to lead to improvements in EER capabilities, additional work is needed. In this section, additional EER R&D initiatives are proposed that if successful, would extend Arctic EER effectiveness to more challenging ice environments.

EER R&D initiatives being proposed are summarized here in Table 1, followed by further descriptions of the main items. Given that the greatest challenges to EER are associated with limitations in the evacuation and rescue areas, the focus of the R&D initiatives is on these two components. However, two of the recommended initiatives are expected to impact all three EER components.

Table 1. NPC Arctic Research Study - Proposed Arctic EER R & D Initiatives

No.	EER Component	Research Topic Area	R & D Thrust	Comments
1.	Evacuation	**Ice Capable Arctic Evacuation Craft** Arctic survival craft (an ice-capable "Fram-type" TEMPSC) designed to perform in a wider range of ice conditions than current technology	Design, construction and evaluation of a full-scale prototype craft capable of surviving evacuation in a greater range of sea ice conditions than current TEMPSCs with ice management vessel support	– Possible collaboration with current industry funded Petroleum Research Newfoundland & Labrador (PRNL) Joint Industry Project (ISL JIP) related to an ice strengthened TEMPSC development, provided the technology intellectual property transfer is not restricted and that the prototype design is scalable to wide range of manning levels (i.e.: TEMPSC sizes) – Full-scale prototype testing & demonstration in a wide range of ice conditions – Trials should be performed over a full range of ice conditions
2.	Evacuation	**Mobile Evacuation Craft with Enhanced Deployment System** Arctic survival craft having mobility over a large range of ice conditions without ice management support	Evacuation craft capable of moving out of the hazard zone without icebreaker support to an intermediate point of safety (e.g. onto an ice floe) over a range of stationary and dynamic sea ice conditions	– Mobility over range of anticipated ice conditions near the installation and beyond the hazard zone – Ability for craft to move onto a substantive ice floe or ice cover if needed, to await rescue support – Depending on craft mobility limitations may need to include a deployment system to place the craft beyond the installation hazard and ice damage zones
3.	Evacuation & Rescue	**Direct Transfer Methods for Personnel between Installations and Standby Vessel** Dry evacuation directly between the installation and a standby vessel	Dry evacuation system such as telescoping gangway, chute, etc. deployed from vessel to installation (or vice versa)	– Vessel-based system capable of reaching multiple evacuation muster points on the installation; alternatively installation-based system is an option, versus a platform deployed system – Eliminates the ice/water transition for evacuees – System needs to be scalable to range of deck heights (installation freeboard) and vessels, including their station-keeping performance capabilities in ice
4.	Escape, Evacuation & Rescue	**Education and Training** Training Simulator	Develop training simulator to promote EER success in offshore locations where actual training with actual lifesaving appliances and rescue equipment is difficult or poses undue risk due to the presence of ice	– Aim is to provide ongoing training opportunities – Possible collaboration with arctic marine shipping companies, the USCG, etc.
5.	EER	**Situational Awareness** Extended life temporary refuge (TR) designed with situational awareness to increase the probability of evacuation and rescue success	Design extended life TR with capability to monitor the sea ice and hazards to evacuation and rescue caused by the incident from within the TR	– Aim is to remain on installation for longer period with ability to monitor ice conditions and hazards to evacuation/ rescue caused by the incident to select more favorable time to undertake evacuation when ice conditions are less onerous – An example is the use of drones (or other technologies) to monitor ice conditions at distance from the installation for the maximum life of the TR and also to monitor evacuation routes to aid abandonment decision making – Need for real time downlink of imagery to survivors in the TR to maintain situational awareness

1. Ice Capable Arctic Evacuation Craft

Egg-shaped or rounded-shaped keels are more effective at resisting ice forces than are conventional ship-shaped keels because they tend to rise up when subjected to high ice loads versus being crushed by the ice. The ice capable arctic evacuation craft R&D initiative would build on this observation by evaluating the performance of a hybrid totally enclosed motor propelled survival craft (TEMPSC) designed with a "Fram-type" hull to minimize the potential for damage due to ice forces. A TEMPSC so designed is expected to be suitable for use in a wider range of ice conditions than TEMPSCs that are currently available. Ice management support could be a key component of this evacuation strategy in certain situations as the hybrid TEMPSC would not be capable of transiting through ice rubble fields and large solid ice floes on its own.

This R&D initiative includes the design, construction and evaluation of a full-scale prototype craft capable of successful evacuation in a greater range of sea ice conditions than current TEMPSCs. It also includes an assessment of the requirements of ice management support of the craft, in scenarios where this type of support is needed.

2. Mobile Arctic Evacuation Craft with an Enhanced Deployment System

Strategies that can provide a successful means of evacuation independent of off-installation support are generally preferred as the primary means of evacuation compared to an evacuation strategy that relies for example, on the assistance of a standby vessel. This is because there may be instances associated with the environment and/or incident that may preclude the vessel from approaching the installation due to the elevated risk (e.g. gas plume, projectiles, etc.). Moreover, the cost of a dedicated standby vessel over the facility life results in a large component of the operating expenditure and potentially capital expenditure depending on how icebreaker standby vessel services are procured. A mobile arctic evacuation craft with an enhanced deployment system R&D initiative would be to develop an evacuation craft with mobility sufficient to transit beyond the hazard zone to an intermediate point of safety (e.g. onto an ice floe) without the need for icebreaker assistance over/through a range of stationary and dynamic sea ice and metocean conditions, including rough ice, ice rubble and water.

This R&D initiative includes the design, construction and evaluation of a full-scale prototype craft capable of successful evacuation from low and high freeboard offshore installations in a greater range of sea ice and open water conditions than current technology e.g. the ARKTOS). Craft mobility would need to be such that it could transit through all combinations of ice and water that might exist near an installation to reach a point beyond which the installation hazards pose no threat. The need for a deployment system capable of launching the craft beyond the ice damage zone from low and high freeboard offshore installations would also be evaluated as part of this effort in the event mobility across ice and/or water was impaired to the extent that evacuation success criteria were not met.

3. Direct Transfer Methods for Personnel Between Installation and Standby Vessel

Simple, relatively low-tech EER strategies utilizing systems in which installation personnel are already generally familiar with are preferred, as they reduce the training requirements and ultimately the success of EER under an actual incident scenario. Moreover, evacuation systems that transition directly to the means of rescue without crossing over or transiting through the sea ice or having to first enter the sea are desirable because rescue is achieved without evacuees having to survive for a period of time outside the hazard zone. This R&D initiative involving direct transfer methods for personnel between the installation and a support vessel would improve upon any direct transfer methods currently available. Methods could include gangways, chutes or some combination thereof. These systems could originate either from the vessel or the installation.

This R&D initiative includes the design, construction and evaluation of a full-scale prototype direct personnel transfer system for use over a range of installation deck heights. Note that for this evacuation and rescue strategy to be viable, the attendant vessel would require station keeping capability in the range of sea ice and metocean conditions anticipated, over the anticipated duration of the transfer operation. A range of vertical and horizontal motion design criteria at the installation or on the vessel would need to be agreed to as part of the system design.

4. Education and Training Simulator

The winter Arctic environment poses challenges to deployment of evacuation and rescue systems for the purpose of training and drills required to maintain personnel competency in response to an emergency. Whereas damage to lifesaving appliances may be an acceptable outcome when deployed under emergency conditions (i.e. provided EER success is not compromised), damage to EER systems as a result of training exercises may compromise the operational readiness of these systems for use in an emergency. Additionally, replacement of lifesaving appliances damaged during drills or training exercises may have long lead times and be cost prohibitive. Finally, practical training may not be possible during the winter due to increased hazards that trainees are exposed to. The education and training simulator R&D initiative would allow installation personnel the ability to maintain competency in the use of EER equipment and procedures.

This R&D initiative entails the development of an EER simulator that can provide close to "real life" training without the risks involved in actual deployment of the lifesaving appliances onboard the installation and support vessel (if part of the EER strategy).

5. Situational Awareness

In some regions and/or at certain times of the year, ice conditions at an offshore installation can vary widely over relatively short periods of time. The success of the EER system may be challenged more so by certain ice environments than by others. This may include both the performance of the evacuation system(s) as well as the ability to rescue evacuees once they have abandoned the installation. Upon sounding of the emergency alarm, installation personnel generally head to the TR (if so equipped) which provides protection while the severity of the incident is assessed and the incident response managed. The TR is designed to withstand the effects of the incident for a prescribed period (i.e. the impairment time) until such time the incident is either brought under control or a decision to abandon the installation is made.

To address the potentially longer evacuation times in ice and advantages of selecting the optimum time to evacuate when ice conditions are less onerous, one EER strategy is to design a TR with a longer impairment time. To aid the evacuation decision making process, information regarding ice conditions at and updrift of the installation as well as an assessment of the evacuation route integrity is needed. The situational awareness R&D initiative would result in the incorporation of real-time situational awareness capability into the offshore installation’s extended life temporary refuge (TR) design, such that the optimum timing for evacuation (if needed) can be made as the environmental conditions and incident severity dictate.

This R&D initiative entails an assessment of on and off-installation monitoring techniques, including the provision for drones to provide information on existing and oncoming ice conditions (both local and far-field) that could impact evacuation and/or rescue success as well as the viability of evacuation routes to the evacuation points. Whereas an attendant vessel could provide some of this information, standby vessels may not be used in all EER strategies.

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