Equipment and training considerations for a mass abandonment in Canadian Arctic waters

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Equipment and Training Considerations for A Mass Abandonment in Canadian Arctic Waters

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SUMMARY

The sinking of the MV Explorer in 2008 raised many questions about a marine disaster involving the sinking of a passenger ship in frigid waters far from search and rescue assets. One of these questions was whether or not crew on board vessels operating in remote inhospitable locations such as the Arctic are sufficiently trained for the unique challenges that exist. This report examines the challenges that crew and passengers may experience if a marine disaster was to occur in the Arctic and provides recommendations for training considerations to address them.

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Final Report

EQUIPMENT AND TRAINING CONSIDERATIONS FOR A MASS ABANDONMENT IN CANADIAN ARCTIC WATERS

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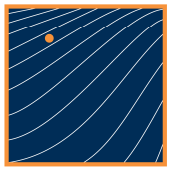
Submitted: 2 March 2012

Survival Systems Training



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ABREVIATIONS

DNV	Det Norse Veritas
EPIRB	Emergency Position Indicating Radio Buoy
GMDSS	Global Maritime Distress and Safety System
GSK	Group Survival Kit
IMO	International Maritime Organization
LSA	Life Saving Appliances
MV	Motor Vessel
PSK	Personal Survival Kit
SAR Tech	Search and Rescue Technician
SART	Search and Rescue Transponder
SOLAS	Safety of Life at Sea
STCW	Standards of Training, Certification and Watchkeeping
TPA	Thermal Protective Aid
VHF	Very High Frequency radio

SECTION 1

Topics raised by the sinking of the MV EXPLORER in the Antarctic area.

The sinking of the MV EXPLORER in 2008 raised many questions about a marine disaster involving the sinking of a passenger ship in frigid Antarctic waters. Some of the questions can be listed as follows:-

1. Poor crew training and coordination
2. No one in charge of lifeboats
3. No instruction on thermal protective aids given to passengers
4. Accident occurred on 12th day of the voyage and the only briefing provided to the passengers was on the 2nd day
5. Use of open lifeboats
6. Rusted zippers found on thermal protective aids (TPAs) when the plastic bags were opened
7. Many passengers were denied thermal protective aids
8. 35 people in a 59 person lifeboat appeared to fill it

Let us consider each of these in turn as they have relevance to the problems of Arctic abandonment and survival in general.

1. Poor crew training and coordination

The survival craft crew in the lifeboats would have had to complete the Standards or Training, Certification and Watchkeeping convention's Proficiency in Personal Survival and also the Proficiency in Survival Craft and Rescue Boats other than Fast Rescue Boats training courses. These courses should have provided them with the ability to operate the lifeboats and / or liferafts they were given.

There are problems where the assigned crew are not given time during drills to operate the boats themselves so they get to know its characteristics and they can develop the skills and team work to not only operate the boat but be confident doing so.

Drills are frequently a matter of ‘get the boat in the water, do a loop and hook on again.’ There is no requirement to take another boat (simulated raft) in tow, do a man-over-board recovery or other such practical activities so no skills are developed and, possibly, no idea that the fitting and or equipment provided are inadequate, inappropriate or lacking.

2. No one in charge of lifeboats

The muster list has to list someone as the person in charge of the boat, the coxswain. This is a SOLAS requirement. There should also be an alternate designated on the muster list in case the coxswain is incapacitated or is not present. At a practical lifeboat drill an officer may take control of the boat to prevent it being damaged so the coxswain and his team do not get the hands on experience they need. The designated coxswain or the alternate should be required to operate the boat at such drills. In some ships a coxswain is designated but the Master or a navigating officer is also put on the muster list as being ‘in charge’ of the boat. A nucleus for confusion has been put in place before the alarm bells have even been rung!

3. No instruction on thermal protective aids given to passengers

Thermal protective aids (TPA) are simple items that are coverall shape or sleeping bag shape garments made out of space blanket type materials. The donning of a TPA is more intuitive than donning, for instance, a Canadian SOLAS lifejacket which has 15 incorrect ways of donning it. People who say they need instruction to don a TPA would be in such a physical and mental condition they would need continuous monitoring of their daily lives, or they are looking to sue someone.

Figure 1: Sleeping bag TPA with plastic zipper

Figure 2: Coverall TPA in vacuum packed bag with instructions

4. Accident occurred on 12th day of the voyage and the only passenger briefing provided was on the 2nd day.

The Requirements of the SOLAS Convention says that, 'On a ship on a voyage where passengers are scheduled to be on board for more than 24 hours, musters of passengers shall take place within 24 hours after their embarkation.' It makes little sense to brief passengers 23 hours and 59 minutes after they have boarded if the ship docks a few minutes afterwards. SOLAS also states, 'Whenever new passengers embark, a passenger safety briefing shall be given immediately before sailing.'

Regulation 30 says, 'On passenger ships, an abandon ship drill and fire drill shall be held weekly. The entire crew need not be involved in every drill, but crew members

must participate in an abandon ship drill and a fire drill each month as required in regulation 19.3.2. Passengers shall be strongly encouraged to attend these drills.'

The passengers attended a briefing, apparently within 24 hours of departure, so the letter of the law was complied with. Did the crew attend a full or a weekly team drill after the vessel sailed and were the passengers encouraged to attend these drills?
It would appear the letter of the law was complied with in this case with regard to the passengers being briefed.

Following the grounding and sinking of the cruise lines COSTA CONCORDIA in January 2012 the members of the Cruise Line International Association has introduced a requirement that the passenger briefing be conducted BEFORE the ship leaves the dock. This association is had asked, before the COSTA CONCIODIA incident, for IMO to look at and improve the level of safety training required by the cabin and catering staff. It is not expected there will be any change in SOLAS or STCW requirements before 2013 despite the public's present concern on these matters.

5. Use of open lifeboats

The MV EXPLORER was built in 1972 with open lifeboats that were common to that era. It was not until 1986 that enclosed lifeboats were required on cargo vessels and partially enclosed lifeboats on passenger vessels. "Existing ship" built before 1986 were 'grand fathered' with the equipment from the previous requirements. The open boats were therefore legal on the MV EXPLORER when she sank. If the vessel had undergone a major rebuilding the lifeboats would have had to have been replaced with the latest equipment.

Figure 3: Open lifeboat in pack ice, crew without immersion suits or thermal protection

Figure 4: Totally enclosed lifeboat

Figure 5: Partially enclosed lifeboat with fitted cover at bow and stern and canvas cover amidships. Note the canvas cover is secured down to gunwale

Open lifeboats in the 1970s were required to carry exposure covers with a system to keep them erect. Metal hoops were generally slotted into the rowlock holes and the canvas cover with battens sewn into it to keep it erect was placed on top of the hoops. The sides of the cover were lashed down outboard of the gunwale and the shaped bow section lashed down around the outside of the bow. The exposure cover provided environmental protection from the wind, rain, snow and spray and made keeping warm and dry much easier. The cover did not cover the entire boat so the steering oar could be operated. A flap hanging down to the bottom boards over the opening provided even

more warmth retention. A double ply canopy with spacers between the canvas sheets also increased its insulation properties. For some reason the exposure cover has not been required in open boats for some time. If exposure covers had been carried in the MV EXPLORER's lifeboats, and the crew had known how to erect them, it would have made a great difference in the comfort and survival of those on board the boats.

Exposure covers do not provide the level of environmental protection of a partially enclosed lifeboat nor an enclosed lifeboat. An inflatable liferaft would also provide better environmental protection than an open boat with an exposure cover erected over it.

Figure 6: Open lifeboat with canvas exposure cover over hoops, note battens in cover to give it shape

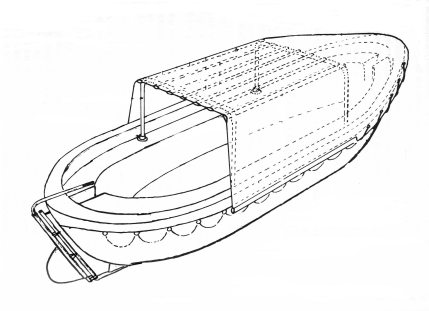
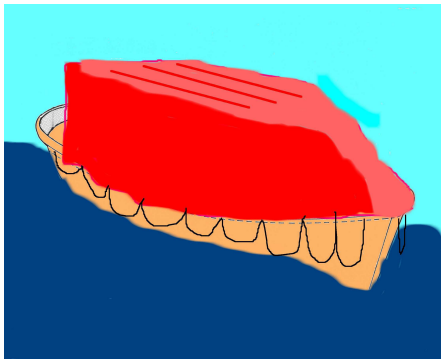


Figure 7: Shaped bow section of exposure cover



The Baltic icebreaker NJORD was built in Finland in 1969 for the Swedish icebreaking service but was sold and remodeled aft in 2000 to carry 105 passengers on Arctic and Antarctic cruises and was renamed the POLAR STAR. Its classification society, DNV, required enclosed lifeboats be fitted because of the harsh environment

they could be used in. Immersion suits were not required by the flag state or the classification society but floater coveralls or floater coats were provided for the excursion trips in the large Zodiac inflatable boats.

6. Zippers rusted on thermal protective aids when plastic bags were opened

The plastic bag must have been punctured long before the incident to allow moisture to enter the bag and damage the zipper. Most zippers on floater coats and coveralls are made of plastic, those on immersion suits are of a non-rusting metal. It is unusual to find zippers on thermal protective aids although those that do have zippers appear to have plastic zippers.

The zippers on immersion suits need lubricating with candle or bees wax to keep them sliding easily and to better keep the zipper water tight. The zippers on floaters also work more easily when given a rub with wax.

7. Many passengers were denied thermal protective aids

The requirements are for thermal protective aids to be carried in open lifeboats for 100% of the personnel if immersion suits are not provided. This raises a number of questions as to why the TPAs were not distributed. Did the crew not know they were there? Did the crew not know where they were stowed in the boat? Did the survival craft crew in fact say, “You cannot have one?”

The survival craft crews are not generally the ones who look after the boat they are assigned to operate so they may not have known exactly where each item of equipment was stowed in their boat. The crew may not have known, or remembered if told, what equipment must be in the boat. There is no legal requirement for the equipment to be stowed in the same place in each boat (except for the bow painter and the releasing painter) and there is no need for logic to be involved in the stowage of the equipment. The fishing kit could be the last thing put into a water tight locker with the food and water packs in beyond it and the flashlight being the first thing that was placed in the locker. In other words the item most likely to be needed first is buried behind things that may not

be needed for a day or two. (Logic is not required nor mandated). The contents of the locker must be marked on it but how up to date is the marking?

8. 35 People in a 59 person lifeboat filled it

When the 1913 Safety of Life at Sea (SOLAS) convention was developed the average size of mariner (male and of Northwest European origin) was 165 pounds in weight, 74.84 kilograms. This weight, revised to 75 kilograms, and a buttock / hip measurement of 430 millimeters (16.93 inches) was used as the 'standard' for seating and weights in lifeboats and rafts. A presentation was made by a Canadian delegation to the IMO in 2003 regarding the increase in size prospective lifeboat users of Northwestern European origin and the detrimental effect this was having on the seating space in lifeboats. A study conducted in 2003 in Canada provided some data on the size of offshore workers in the Nova Scotia and Newfoundland oil and gas industry. The study also looked at the way immersion suits added to the girth of people and the comparative compressibility of different makes (materials) of immersion suits. Amongst other things the study was concluded that shoulder width, not hip width be used as the measurement regarding seating space as this is the widest part of the body. The size and width of those in the work force studied were as follows:

Table 1: Size and Width

	MEAN	MEDIAN	MINIMUM	MAXIMUM
Mass (kg)	86.3	85.5	46.8	145.5

Measurements were taken of the breadth of the study group and the table shows these results. The subjects were wearing normal work clothing then different makes of immersion suits, as can be seen there was a difference in the space required depending on the suit provided on the ship.

Table 2: Measurements of Breadth (mm)

BREADTH (mm)	WORK CLOTHES	IMMERSION SUIT 1	IMMERSION SUIT 2	IMMERSION SUIT 3
SHOULDER	515	592	595	604
HIP	383	424	425	427

STANDING				
HIP SITTING	419	464	459	452

In November 2010 the ‘standard’ mariner was revised upwards to a weight of 82 .5 kilograms but the seat width remained the same at 430 millimeters. An oil industry ‘Gulf of Mexico’ standard for hip width is being accepted at 530mm which is near the shoulder width measurement in the above table.

Let us multiply the number of people the lifeboat on the MV EXPLORER was approved to seat, 59, by the seat width according to the SOLAS LSA Code, 430 mm, so 59 X 430 equals 25,370 millimeters.

If we multiply the ‘Gulf of Mexico’ standard, 530 mm, by the number of people in the boat, 35, we get 18,550 millimeters of seat space occupied. The boat, under the new (realistic) conditions was at 73% of its capacity and not the 60% but ‘appeared nearly full’ the regulators would have us believe.

Before the LSA code was changed lifeboat manufacturers were advertising lifeboats with a ‘North American – Northwest European’ capacity and a greater ‘international’ capacity, the seat belts having different centers to accommodate the different body sizes. No one appeared to have a multinational arrangement where there was a mixture of seat belt spacing.

It is noted in the tables that there is a difference in shoulder width of 17 millimeters between immersion suits. At the LSA code standard of 430mm seat spacing this could mean a loss of 1 in 25 seats depending on the type of suit provided or one in 31 for the ‘Gulf of Mexico’ standard. Should IMO use the bulkiest suite for the seating test or some arbitrary figure?

It is hoped the new standards will alleviate the seating problems in lifeboats but existing vessels will be grandfathered until the vessel undergoes a major restructuring (unlikely) or it is scrapped.

It is assumed a floater coverall would add about the same breadth to an individual as an immersion suit so the figures in the study noted above can be used when determining seating space wearing either device.

The bigger body mass of passengers of Northwest European origin in immersion suits or floater coveralls trying to get through the (small) doors of enclosed lifeboats needs to be considered. This will slow down the boarding rate considerably. Arctic lifeboats must be considered with passengers in immersion suits boarding under abandonment conditions and exiting the boat under rescue conditions. Should there be standards for door sizes, boarding times, rescue equipment etc. established for these boats?

SECTION 2

Considerations on survival equipment needed for mass survival in Arctic conditions where rescue or support may be five days away

IMO Resolution A.1024 (26) adopted in December 2009 contains much the same information as MSC 1056 of 2002, Guidelines for Ships Operating in Polar Waters. Chapter 11, Life-saving Appliances and Survival Arrangements, of these Guidelines provides some equipment specific to Polar voyage vessels.

Let us consider some of the guidelines as they pertain to personal survival situations;
11.1.1 Adequate supplies of protective clothing and thermal insulating materials should be provided, taking into account the intended voyage.

11.2.2 Personal survival kits (PSKs) as described in section 11.3 should be carried whenever a voyage is anticipated to encounter mean daily temperatures below 0°C.

11.2.3 Group survival kits (GSPs) as described in section 11.4 should be carried whenever a voyage is anticipated to encounter ice conditions which may prevent the lowering and operation of survival craft.

11.2.4 Sufficient PSKs and GSKs (as applicable) should be carried to cover at least 110% of the persons on board the ship.

11.2.5 Personal survival kits should be stored so that they may be easily retrieved in an emergency. Arrangements such as storage in dedicated lockers near the assembly stations may be considered.

11.2.6 Group survival kits should be stored so that they may be easily retrieved and deployed in an emergency situation. Any containers should be located adjacent to the

survival craft and liferafts. Containers should be designed so that they may be easily moved over the ice and be floatable.

PERSONAL SURVIVAL KIT (PSK)

Table 3: Content of the personal survival kit

Equipment	Quantity		Equipment	Quantity
Clothing			**Other**	
Head protection (VP)	1		Hand warmers	240 hours
Neck and face protection (VP)	1		Sunglasses	1 pair
Hand protection – mitts (VP)	1 pair		Survival candle	1
Hand protection – gloves (VP)	1 pair		Matches	2 boxes
Foot protection – socks (VP)	1 pair		Whistle	1
Foot protection - boots	1 pair		Drinking mug	1
Insulated suit (VP)	1		Pen knife	1
Approved immersion suit	1		Handbook (Polar survival	1
Thermal underwear (VP)	1 SET		Carrying bag	1

Note: (VP) = vacuum packed.

A PSK therefore provides a complete set of thermal clothing, including an immersion suit as well as some items for comfort and other survival needs.

Should all these items be stored in a person's cabin or in a 'changing room' type location adjacent to the survival craft and GSKs? The underwear and socks could be kept in the individual's cabin while the immersion suit could be kept in a locker by the survival craft. The candles, matches and other small items could be in the bag by the immersion suit.

New ships can have a locker large enough built in for this purpose (being excluded from tonnage measurements) adjacent to the survival craft location. Immersion suits could be on hangers in rows of different sizes of suits for easy identification. An immersion suit that is too big is as much a problem as one that is too small to get into, especially if one has to move or work in it.

Thermal clothing specifications

There is a need for detailed specifications on the thermal protection provided by the clothing, a requirement that it must be of the appropriate size and such things as the matches being wind proof in a water tight container and how many matches there must be in a box etc. The boots must be of the right size or people will have trouble walking in them if they are too big or will have their circulation cut off if they are too small, increasing the cold foot problems.

Immersion suit for Arctic use

An immersion suit protects the body from cold shock and swimming failure by keeping it dry on immersion in cold water. A full immersion suit is tested so that a person's core temperature will not fall more than two degrees Celsius in water of two degrees Celsius in six hours of immersion; it therefore only delays the onset of hypothermia. In Arctic conditions with no wind break or other protection an immersion suit will delay the onset of hypothermia for more than six hours because the suit is dry on the outside.

The immersion suit for Arctic conditions must have insulated boots suitable for walking on ice and snow. The knees, elbows and rump areas must be provided with chaffing patches to ensure they are not worn through by contact with the snow and ice. The suit should also meet the normal standards for immersion suits but be streamlined so it is suited to working and walking on a solid surface. People in immersion suits are almost unrecognizable with the hood up so there should be identifiable jackets or ponchos for those in authority to wear over their suit so they can be identified. Should colour coding be provided so crew can be identified from officers?

Should consideration be given to having a long under crotch zipper for men and a horizontal zipper on the buttocks for women? Wearing an immersion suit for days will make the inside damp if not wet because the sweat and normal vapor release from the skin cannot evaporate through the water tight covering of the immersion suit. Will this be a problem over time out of the water in sub-zero temperatures with a wind?

The hoods on immersion suits cut off hearing which could be a problem during the abandonment and survival phase on ice.

Figure 8: SOLAS immersion suits vary in design, bulk and restriction to movement.

They do keep you dry and warm for a while in the water

Figure 9: SOLAS immersion suit with boots, additional covering on the knees, bottom and elbows, streamlined legs

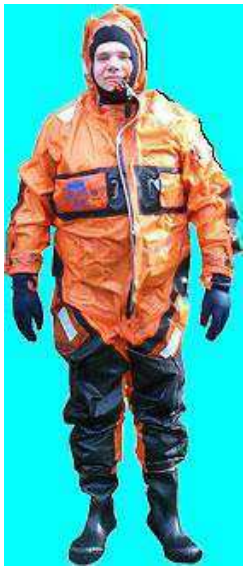
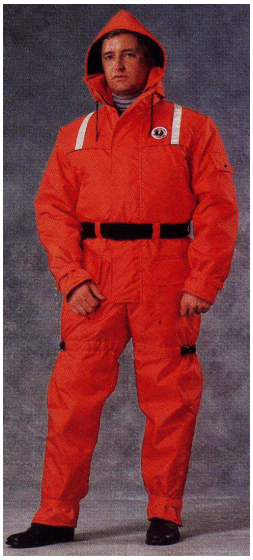


Figure 10: 'Floater coveralls' do not meet the standards for an anti-exposure suit



Is the SOLAS immersion suit the right clothing for survival on ice or a beach? It is if water immersion is a possibility the immersion suit is the right clothing but is it suited as it is now manufactured and tested for on ice or beach use? What alternatives are there? The Canadian 'floater coverall' is a possibility but it does not keep the wearer dry if they enter the water so cold shock will occur almost immediately it enters the water. Out of the water the floater coverall may be more practical than an immersion suit. Is there a hybrid suit (available or yet to be developed) that is better than either and that meets the needs of wet and dry use?

Handbook

The handbook on Polar survival must be specific to the equipment provided, it makes no sense to have instructions that you do not have the equipment for. The type of information required in the hand book must also be specified so all handbooks are of nearly equal use.

Other considerations

- Would a butane lighter be better than wind proof matches? Why two boxes of matches for one candle, more candles should be provided if that many matches are required.

- As mitts are liable to be lost unless on a string through the jacket would it be better two have two sets of mitts in place of one?
- Should the mitts be of different types, one for warmth and the other that allows for more dexterity than warmth?
- The long days and glare off the ice as well as wind could cause sun burn so sun screen and lip balm should be included in the PSK.

GROUP SURVIVAKL KIT (GSK)

Table 4: Contents of the group survival kit

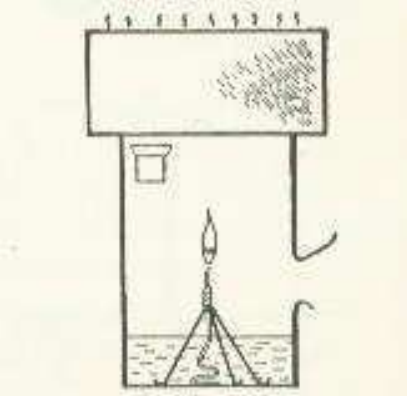
Equipment	Quantity		Equipment	Quantity
Group equipment	-----		**Spare personal equipment** (1 set per GSK container, which may be considered as part of the 110% as specified in paragraph 11.2.4)	
Tents	1 per 6 persons			
Air mattresses	1 per 2 persons			
Sleeping bags	1 per 2 persons (VP)			
Stove	1 per tent			
Stove fuel	0.5 liters per person			
Fuel paste	2 tubes per stove		Head protection (VP)	1
Matches	2 boxes per tent		Neck and face protection (VP)	1
Pan (with sealing lid)	1 per stove		Hand protection – mitts (VP)	1 pair
Fortified health drinks	5 packets per person		Hand protection – gloves (VP)	1 pair
Flashlight	1 per tent		Foot protection – socks (VP)	1 pair
Candles and holders	5 per tent		Insulated suit (VP)	1
Snow shovel	1 per tent		Thermal underwear	1pair
Snow saw and snow knife	1 per tent		Hand warmers	1 set
Tarpaulin	1 per tent		Sunglasses	1
Foot protection – booties	1 per person		Whistle	1
GSK container	1		Drinking mug	1

There is a need for specifications for the GSK ‘containers,’ what size and weight limits are there on them to allow for their movement over ice. How are they to be ‘launched’ or lowered? Is a crane needed to lift them over the side and how many

containers can one crane handle in an emergency? Can a GSK container be lowered by rope and if so how and how many GSK containers can one rope handle? How is the container to be moved over the ice, does it have to have drag ropes fitted to it or do the people work that out for themselves? Does the container have to have skies on it so it can be moved over ice and snow?

How large is the tarpaulin required to be and what material or thickness must it be made of? Does the tarpaulin need to have grommets around its perimeter and if so how many and where, should they be and what size, should the tarpaulin be orange or red in colour? How long and what diameter should the candles be? Should there be a kudlik the candles can be fitted in for safety and to provide a place for melting ice or snow to produce drinking water?

Figure 11: Metal kudlik with vent holes and a tin on top for melting ice and snow over a candle



Hand cranked flashlights need to be tested in below freezing temperatures to see if they function adequately as normal battery flashlights do not work well if they have been stored in subfreezing temperatures for even a brief period of time. Once the battery is dead you have a dead flashlight. If hand cranked flashlights do work in the Polar environment they should be specified as preferable to battery powered units as they can be recharged as often as required.

The size and capacity of snow shovels, length of handle etc. must be specified, as must dimensions and teeth size for the saws and knife. Specifications or a goal that

the equipment must meet must be provided or the cheapest, inappropriate piece of equipment is sure to be purchased by economy minded purchasing departments.

ADDITIONAL EQUIPMENT

Stakes and coloured rope or survey tape

There would be a hazard of people wandering away from the camp or getting lost between camps if there was not some form of perimeter fencing and guide lines set up. Persons going to use the wash room could also get disoriented and or lost if there was no marked route home.

Stakes about one and a half meter in length with a twist on the top to which a coloured line could be easily fixed would provide a guide line between camps and or to the wash room area. Two hundred meters of brightly coloured line with stakes for every eight meters should be provided per group survival kit. One set of stakes and coloured line could mark the perimeter and the other the path to an adjacent camp. One hammer per group survival kit to pound in the stakes should be provided.

Toilet paper

Passengers may be unhappy without the comforts of toilet paper, a situation which may not be an issue 36 hours after the ship has been abandoned. One roll per 6 persons could be considered sufficient. Shovels for burying bodily waste would also be required but could come from other sources.

Additional EPIRBs, SARTs and VHFs

A ship operating in Arctic waters would have high frequency and medium frequency communications equipment to cover A3 and A4 sea areas but this capability will be lost when the ship sinks. If rescue can be delayed for up to five or more days from the time of abandonment additional batteries and or EPIRB, SART and VHF units are required to ensure location and communications can be maintained until rescue has been completed. The required battery supply for these units is less than the expected wait for rescue.

Would a satellite cell phone, with sufficient batteries, be an option for communications between the castaway's leader and rescue authorities and units as they

approach? The long delay in rescue would cause consternation amongst passengers (as well as officers and crew) if there was no communication to say rescue was on its way and when to expect it.

If four EPIRBs and four SARTs were provided numbers 1 and 2 could be turned on for the first 24 hours, then numbers 1 and 3 for the next 24 hours then numbers 2 and 4 for the next 24 hours, followed by numbers 3 and 4 for the next 24 hours, then the cycle is repeated. This would provide back up and reasonable power to cover for up to eight day period.

Tarps and ground pegs

Tarpaulins, with eyelets in the corner and along the edge, with ground pegs and some line to tie them down would provide additional overhead cover, wind breaks or underlay for liferafts on the ice. The size of the tarpaulins should be at least (check on 25 person liferaft size + 10%) with 16 metal ground pegs.

The hammer for the stakes for the stakes for the coloured rope would be available to pound in these ground pegs.

Protection from wild animals

When people are on pack ice or on the beach polar bears and other wild animals are threats to life in the Arctic region. There is therefore a need for protection from these predators so rifles with suitable ammunition should be available.

One rifle per 50 people would provide suitable protection if there are three trained and qualified firearms operators per rifle so a continuous watch can be maintained over a group of persons. The coloured perimeter rope would also provide a mark for the hunters to fire at an approaching polar bear or other threatening animal.

Hunter and spotters must be assigned to look out for each group. The hunter should kneel to fire and the most effective killing range is said to be only 10 to 15 meters. Head shots are ineffective but shots to the low center neck area if the animal is head on or low neck if it is broad side to the hunter. Polar bears are the main threat to humans in the Arctic area. The “AECO’S Guidelines for Expedition Cruise Operations in

the Arctic" has some good information on the use and protection of fire arms and protection from polar bears.

Figure 12: Road sign on Svalbard Island

Figure 13: Polar bear near cruise ship

TP number 13670, “Guidelines for the Operation of Passenger Vessels in Canadian Arctic Waters” has a section on Defensive Firearms. It notes that the firearm must be reported to the Customs Agent and that hunting is not permitted. At this time the need to register the fire arm is unclear even for a Canadian flag vessel.

Other considerations

- A day light signaling mirror only needs sunlight to operate and there is lots of day light hours in the Arctic in the summer months. The daylight signaling mirror takes up almost no space and is light so could be added to the group survival kit without diminishing the GSK maneuverability.
- Survival rations, as required in a lifeboat or liferaft should be included in the GSK. The volume should be for a minimum of five days at twice the amount in a liferaft, i.e., 40,000 kilojoules per person.
- The first aid kits in a lifeboat or liferaft do not provide much equipment for more than a scrape of minor cut. The GSK should have a first aid kit with more long term supplies and for a more serious condition.
- The sleeping bag and inflatable t require a bag for protection

SECTION 3

Consider if a tent, lifeboat or liferaft would make a better survival capsule in pack ice conditions with regard to their ability to be moved on ice, provide shelter and or used if the pack ice breaks up.

LIFEBOAT IN ICE

Shackleton and Franklin, amongst others, found that boats are of no use in heavy pack ice. Modern lifeboats will also be of no use when launched in to ice covered waters from today's vessels when surrounded by ice. The lifeboats will be lowered onto the ice alongside the ship, and there they will sit with a list alongside the thing the occupants are trying to get away from.

SOLAS lifeboats are not powerful enough to push heavy ice floes aside and are not strong enough structurally to break sheet ice, nor are they designed to ride up on the ice to break it with their weight. The construction of SOLAS lifeboats does not require any structural strength to resist the pressure exerted by ice or for contact with ice when trying to force a way through.

Figure 14: National Research Council enclosed lifeboat with instrumentation package operating in pack ice

Figure 15: Lifeboat operating in 7/10th pack ice coverage, the higher the coxswain the better the view around

Lifeboats can work their way through pack ice of less than seven tenths coverage but this requires skill, patience and experience. Easing off on the throttle and gently placing the bow between ice floes then applying some power and wiggling the stern so the bow can push the floes apart allowing the boat to slip through. Ramming the floes or charging into the gap with full power is not the way to make progress; this is the way to damage the lifeboat.

Figure 16: Enclosed lifeboat with occupants wearing immersion suits, note cramped conditions

Figure 17: Boarding problems with older, larger people in an immersion suit

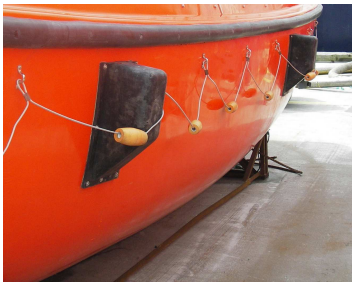
An enclosed lifeboat is built without thermal insulation. Should an Arctic lifeboat be required to have thermal insulation built in? A partially enclosed lifeboat has a double ply canopy which does provide some thermal insulation but the interior of the partially enclosed lifeboat would be draftier and most likely colder than an enclosed lifeboat. Fortunately open boats, with or without an exposure cover, are no longer being provided on new vessels. Should enclosed lifeboats be a requirement on Arctic voyage passenger vessels?

Figure 18: Metal rubbing plate on bow should be all around the hull

Figure 19: Protection around rudder and propeller

Figure 20: Keel cooling pipes need protecting from mice damage

Figure 21: There should be no obstructions on the hull that could get caught on the ice



The hull of a lifeboat intended for operation in ice infested waters should have a metal hull or a fiber glass hull with a metal ice belt all-round the hull in order to protect the hull from the abrasive ice. The metal belt should cover as much of the hull as possible as the ice can extend from below the keel to above the gunwale.

Lifeboats for Arctic class vessels must be built to withstand ice pressure, contact with ice and also be provided with thermal insulation. Doors and hatches should also have gaskets to reduce drafts and snow entry. Means of ventilation that spreads the cool air throughout the boat must also be fitted. Drafts around a door may provide

ventilation but those seated next to that door will suffer more than those seated further from the doors.

The hull of a lifeboat intended for use in ice should be subjected to a crush test to ensure it can resist a certain amount of nipping by ice. Would it be unreasonable to expect the hull to ride up if nipped?

The propeller and rudder need a guard system to protect them from ice damage going ahead as well as astern. The guard must be strong enough to take the impact as well as full enough to fend off small floes.

The engine in enclosed lifeboats are cooled in one of two ways, by pipes with the hot water and anti-freeze mixture running under the hull through pipes or by cold sea water cooling being pumped through a heat exchanger then being injected into the exhaust pipe. The keel pipes could be damaged by the ice and the intake for the wet exhaust system could become clogged by slush or ice. Because enclosed lifeboats must be self-righting air cooled engines are not practical. Engine cooling is therefore an issue in lifeboats to be operated in ice infested waters.

The keel cooling pipes also need protection from damage by ice floes as the boat moves through the ice fields. Engines that use a heat exchanger to cool the engine may need a sea bay so there is sufficient seawater available for cooling the engine as the small intake hole on existing lifeboats would soon be blocked by ice and slush. Could the warm water cooling pipes be fitted with a by-pass valve so a certain amount of the heat could be released into the interior of the boat for the comfort of the passengers?

Lifeboat engines must be fitted with block heaters and glow plugs, or other means of heating the oil and or cooling water in the engine. A lifeboat built for use in pack ice needs more power, not speed, than a standard lifeboat if it is to force its way through the floes.

Thought should be given to increasing the volume of fuel to a minimum of 48 hours at full throttle. Under normal abandonment the castaways that have got clear of the vessel sit and wait for rescue to come to them. In pack ice the castaways may have to make their way towards rescue or move to avoid other hazards around them or coming at them so engine use can be expected to be greater than in open water.

The ice flows passing down the side of the boat can catch on any obstruction on the side of the boat. This may hinder the progress of the boat, or even bring it to a stop or even damage the hull of the boat. There should be no obstructions, such as skates or bolts or fittings for skates etc. on the side of the boat. The becketed grab line should either not be fitted or be held up by a line to keep the beckets from being caught in the ice.

The doors of the boat should be increased in size compared to those fitted in enclosed boats for cargo vessels. Aged and over size passengers in bulky immersion suits would find it difficult to enter the boat via these doors and the time to load the boat would be extended. The track for sliding doors should be heated to prevent ice forming in and blocking the track.

The interior of a lifeboat on a vessel operating in cold climates should be heated while it is sitting waiting for an emergency to occur. This will prevent condensation forming and possibly freezing doors, hatches, hinges and other moving parts. A warm interior will reduce condensation and frost on the boat's interior. A warm interior will also prevent the water supply freezing as well as making the engine easier to start.

The coxswain's windows need heaters to prevent them steaming up with the warm moist air on the inside and ice and frost on the outside of the window.

The higher the boat operator is above the ice surface the better the view of leads through the ice so a hatch over the coxswain's position is needed for a clear all-round view as the boat advances through the ice. The coxswain's seat should be adjustable in height so the coxswain can operate the boat when his or her head is out of the hatch. The steering and throttle / gearbox controls must also be located where they are within easy reach of someone operating the boat when the hatch is shut as well as open. This flexibility should be tested with persons with a height range from 1.5 to 2 meters? The coxswain's seat and controls of lifeboats do not appear to be tested for comfort or the ability to reach and comfortably operate the controls. There are some lifeboats where the coxswain sits facing one side of the boat while the steering wheel is tucked under one arm pit!

INFLATABLE LIFERAFT = INSTANT IGLOO

Let us consider the use of an inflatable liferaft when the ship is surrounded by ice. The normal launching of a liferaft, letting it fall onto the ice floe, is not recommended in this situation. The landing impact may shatter the fiber glass shell which could puncture the fabric of the liferaft inside before it even starts to inflate. The shell must be lowered in a controlled manner to the surface of an ice floe. This could be by crane and a sling or by using a rope tied round the raft and belay the rope around something to control the descent of the heavy raft to the ice surface

Figure 22: Cutting the retaining bands so the shell can be opened on the ice

Figure 23: Persons in floater coveralls carrying an inflatable liferaft in its shell

Once on the ice surface the liferaft in its shell can be carried clear of the sinking, burning vessel. Rope, such as the liferaft painter, can be used to make a sling so the shell can be lifted on a pole which two or four people can carry on their shoulders, the raft being suspended between them. One readily available and strong pole for this task

is an oar from the lifeboat. When in a suitable place on an ice floe the shell can be placed on a tarpaulin of suitable size before the shell is opened. The smoothest piece of ice is preferred. Before opening the raft remove ice ridges and sharp points of ice would make things safer for the raft over time. The shell can be opened by cutting the retaining bands holding the two halves of the shell together. A pair of wire cutters or a knife is required for cutting the retaining bands. The raft can be removed from the shell and rolled out right side up on the tarpaulin, care being taken NOT to pull on the painter as we do not want to activate the gas cylinder at this time. With the raft laid flat on the tarpaulin the equipment bags can be removed and placed in one half of the shell. The air pump intended to top-up the inflatable tubes can now be used to pump up the lower tube. This can be achieved in about 10 to 15 minutes even with a 25 person raft. As the tube inflates the raft can be lifted off the tarpaulin every minute so the raft expands without dragging itself over the ice under the tarpaulin. This will reduce the chances of puncturing the raft fabric. Once the lower tube is inflated the raft is not likely to creep on the ice when the upper tube is inflated.

The upper tube is now inflated using the air pump. The roof support(s) bleed air from the upper tube so it takes a little longer to inflate the upper tube and roof supports. With the roof up the raft is ready for occupancy. People could in fact burrow get under the roof as the upper tube and roof are inflated if the weather is very hostile.

Now the ‘instant igloo’ is occupied the doors can be closed and adjusted as necessary for warmth and ventilation, the waterproof outer canopy is reasonably air tight so the occupants will soon consume the oxygen inside the space and gas themselves if adequate ventilation is not established. Larger rafts have two ‘ventilation / look out sleeves’ built into the roof. These are fabric tubes that hang from holes in the roof. If one of these tubes is rolled up and the other is left hanging down the body warmed air will flow upwards out of the shorter (high) tube and this will draw cooler air in down the longer tube. There are draw-string tie lines or Velcro strips on the open end of the tubes so the size of the opening can be adjusted.

Newer rafts have a space blanket floor which will provide insulation between the occupant’s bottoms and the cold ice surface under the raft. Older rafts have an inflatable floor which, when inflated by using the air pump, will also provide insulation.

The roof of all SOLAS liferafts are double-ply, the outer ply being water proof to keep out rain, hail, snow and spray, the inner canopy is a mesh or close weave net so there is dead or still air trapped between the two layers . This air gap provides insulation. The fabric doors on the raft are doubly-ply, like the roof.

People can shelter in side this igloo where their body heat will soon warm the interior. Tests conducted in the 1960s by the British Royal Navy with seamen wearing only normal work clothing showed that 20 persons in a 20 person raft with the doors closed in 0° C temperatures on near 0° C waters cou ld warm the inside temperature of the raft to 30° C. With proper ventilation the bod ies could maintain a 20° C temperature inside the raft. Ten persons sleeping in a 20 person raft in the above mentioned environmental conditions kept the inside temperature above 10° C during the night.

If snow is packed around the base of the raft it will provide some more insulation and also prevent wind getting between the floor and the ice which could chafe the fabric or cool those inside. If the tarpaulin is cut to shape to fit the raft and is a little larger than the largest circumference of the lower tube the tarpaulin could be lashed to the becketed grab line around the raft to protect the sides of the lower tube before the snow is packed around the raft.

Snow blocks can be cut and used to build a wind break around the raft which would, again, improve the environmental protection provided by the raft.

If the pack ice starts to break up and there is a threat that people may be cast into the frigid waters the liferaft is already inflated and ready to provide floatation. If the need to launch the raft is there it can be vacated by the people and the raft carefully lifted and moved to the ice edge and slid, again carefully, into the water. The people and the equipment packs in the raft shell can be taken into the raft and the raft left to drift or be moved as required. There are paddles in a SOLAS raft kit which can be used to try and move the raft or to fend off ice floes.

If there is a need to move the encampment across the ice the raft can be deflated (take good care not to lose the deflation plugs), folded and rolled up into the other half of the shell. The shell half with the equipment can be carried slung from the oar or a pole and the shell half with the deflated raft can be similarly carried suspended from an oar or

pole. When the new location has been reached the raft can again be rolled out on its tarpaulin and inflated as noted above.

While the raft is deflated and on the move the gas cylinder is still secured in its pocket, attached to the tubes and ready to inflate the raft if the painter is pulled. If the pack ice opens up quickly the raft can be dumped into the water and the painter pulled so the raft inflates and is ready for boarding in less than two minutes.

Inflatable liferafts are reported to be susceptible to puncture by significant contact with ice. Any sharp edge dragged against the fabric or a sharp point driven into the fabric of the inflatable tubes is likely to puncture it. If a raft is inflated from the gas cylinder while resting on an ice floe the fabric creeping uncontrollably across the ice surface could puncture the floor and or the tubes.

Would it make sense to require inflatable liferafts intended for use in the Arctic and Antarctic waters (and or ice infested waters in the Gulf St. Lawrence, Baltic and other cold climate locations) be made of thicker or stronger materials? Could the upper half of the shell be manufactured with skies and a towing bridle so it can be pulled over an ice surface. The lower half of the shell must be suitable for launching into the water so remains as other raft shells are today.

Arctic inflatable liferafts could be improved if a thicker, more chafe resistant floor and lower tube were required. Would an outer bottom be more effective?

Would inflatable pillows for use when sitting on the floor of the raft on ice be more comfortable than sitting with the legs out in front of you? The insulation would also keep the bottom warmer than sitting on the ice.

The light inside a liferaft is good for at least 12 hours then the illumination can start to diminish. Keys or plugs are provided to turn off the light during the day light hours. Open water rescue is considered to be no more than 24 hours away with modern distress and navigation systems but five days may be expected in the Arctic. Should additional batteries be required on Arctic voyages or should hand cranked lanterns be required if they can withstand Arctic conditions?

TENTING IN THE ARCTIC

The Guidelines for ships operating in Arctic Ice-covered waters, MSC 1056, requires tents be provided for each six persons. Special Arctic environment tents must be provided, not something picked up from a camping store in temperate climates. The tent must be simple to erect, come with as few lose pieces as possible so there is less chance of anything being lost. Inflatable roof supports might be one way to make the tent simple and without parts except for the pump, which could be permanently attached to the tent. Why not a triple skin inflatable structure for support and double still air insulation? The floor should be part of the structure which must also provide thermal insulation as well as wind and snow penetration protection. Floor space and head height must also be included in the specifications. An approval process which tests the equipment in a realistic environment must be developed.

'Idiot testing' of the tent must also be part of the approval process; can the average person put the tent up in a certain amount of time, and does the tent remain erect?

A snow block wall built around the tent would provide a wind break. If a tarpaulin could be stretched over the snow blocks this could help keep snow off the tent.

Tents may provide adequate protection on the ice but provide no floatation if the pack ice breaks up or the people have to move across open water.

REVIEW

The lifeboat on Arctic class or ships that voyage into ice infested waters must be legislated and be specially designed and tested for the environment involved. An Arctic lifeboat may not be suitable to open waters, however, so would two different types of lifeboat be required?

The inflatable liferaft provides portable shelter and floatation but Arctic liferafts may need to be made from tougher materials than standard liferafts and may require a larger gas cylinder or heated cylinder to cope with the low temperatures. Viking Marine already has a liferaft in a shell heated by the ship's electric supply on the market so this is doable.

Tents may be effective on sheet ice and on land but do not provide floatation. There is therefore a need to provide some form of floatation for the group or for individuals if tents are to be used as the principal means of environmental protection.

SECTION 4

Determine what training or information is provided in the STCW safety courses that relate to the abandonment of a vessel and survival in Arctic waters

The topics listed in IMO Model Course 1.19; Proficiency in Personal Survival Techniques is listed with the time allocated to them in the following table:-

Table 5: Knowledge, understanding and proficiency

#	Knowledge, understanding and proficiency	Approximate time (hrs)
1	Introduction, safety and survival	0.75
2	Emergency situations	1.5
3	Evacuation	0.75
4	Survival craft and rescue boats	2.0
5	Personal life-saving appliances	0.75
6	Personal life-saving appliances (demonstrations)	3.75
7	Survival at sea	0.75
8	Emergency radio equipment	1.5
9	Helicopter assistance (optional)	1.5
	TOTAL	**13.25**

The detailed requirements for each topic in the model course outline are generic in nature and would apply equally to vessels operating in the tropical, temperate as well as cold water areas.

Table 6: sub topics are of greater relevance to the cold climate conditions under consideration in this report

SECTION	TOPIC
2.1.1	Lists emergencies leading to fires or the foundering of ships as – hull failure [ice damage is not mentioned, however]
2.8.1	Lists extra equipment which is to be taken from the ship to the survival craft if time permits
3.7.1	Means of survival; describes as essential for survival after the ship has been abandoned: a means of keeping warm, drinking water and food
5.3	Immersion suits / anti-exposure suits (AES)
5.3.1	Describes an immersion suit
5.3.2	States that an immersion suit / AES should be available to every person assigned to crew the rescue boat
5.3.3	States that for passenger and cargo ships with non-enclosed lifeboats at

	least three immersion suits / AES shall be carried for each lifeboat
5.4	Thermal protective aids
5.4.1	States the main purpose of a thermal protective aid
5.4.2	States that for passenger and cargo ships with non-enclosed lifeboats a thermal protective aid must be provided for persons not provided with an immersion suit
6.4	Immersion suits
6.4.1	Unpacks and dons an immersion suite without assistance within 2 minutes
6.4.2	While wearing an immersion suite and lifejacket: - climbs up and down a vertical ladder at least 5 meters in length – jumps from a height of not less than 4.5 meters into the water – swims a short distance and boards a survival craft
6.5	Thermal protective aids
6.5.1	Unpacks and dons a thermal protective aid without assistance whilst in a survival craft or rescue boat while wearing a lifejacket
6.5.2	Removes a thermal protective aid which impedes swimming in not more than two minutes
6.5.3	Puts a thermal protective aid on a person simulating unconsciousness in a liferaft
7.1	Dangers to survivors
7.1.1	Describes dangers as; - heat stroke, sun stroke, exposure to cold and hypothermia
7.2	Best use of survival craft facilities
7.2.2	Explains protective measures against heat stroke, sun stroke, exposure and hypothermia
7.2.4	Explains prudent use of fresh water and food and the need to avoid dehydration
7.2.10	Lists means of maintaining morale

The topics listed in IMO Model Course 1.23

Table 7: Proficiency in Survival Craft and Rescue Boats other than Fast Rescue Boats are listed with the time allocated to them

#	Knowledge, understanding and proficiency	Approximate time (hrs)
1	Introduction and safety	0.5
2	General	1.5
3	Abandon ship	0.5
4	Survival craft and rescue boats	0.75
5	Launching arrangements	1.25
6	Evacuation and recovery of survival craft and rescue boats	1.25
7	Actions to take when clear of the ship	0.25
8	Lifeboat engine and accessories	1.5
9	Rescue boat outboard engine	1.0
10	Handling survival craft and rescue boats in rough weather	0.75

11	Actions to take when aboard a survival craft	1.5
12	Methods of helicopter rescue	1.25
13	Hypothermia	1.0
14	Radio equipment	1.5
15	First aid	2.0
16	Drills in launching and recovering boats	3.0
17	Drills in launching liferafts	3.0
18	Drills in launching and recovering rescue boats	3.0
19	Practical exercises and evaluation	6.0
	TOTAL	**31.5**

The detailed requirements for each topic in the model course outline are generic in nature and would apply equally to ships operating in the tropical, temperate as well as cold water areas.

Table 8: Sub topics are of greater relevance to the cold climate conditions under consideration

SECTION	TOPIC
2.3.3	States that the person in command of each survival craft should check that all crew are present and that crew and passengers are suitably dressed and have correctly donned lifejackets
3.2.2	States that an immersion suit, thermal protective aid or anti-exposure suit should be worn if available
3.2.4	Explains that a person in the water will cool and suffer from exposure very quickly, even in temperate areas, unless wearing an immersion suit, thermal protective aid or anti-exposure suit.
11.4.2	Explains how to ration and issue water and emergency food
15.2.3	Describes the cause and signs of frostbite
15.2.4	Describes the treatment of frostbite
15.2.5	Describes the cause of non-freezing cold injury (immersion foot)
15.2.6	Explains how to prevent immersion foot
15.2.7	Describes the treatment of immersion foot

Table 9: The main topic, Hypothermia, topic 13, contains the following sub topics

#	TOPIC
13.1	State the cause of hypothermia
13.2	Describe the precautions to be taken to prevent hypothermia
13.3	Describe the use of immersion suits, thermal protective aids and anti-exposure suits
13.4	Describe the symptoms of hypothermia
13.5	Explains that the heartbeat and breathing may be very feeble and difficult to detect in severe cases, but heart compressions and artificial respiration will do more harm than good

13.6	Describe how to treat a person suffering from hypothermia in a survival craft

The topics listed in IMO Model Course 1.28;

Table 10: Crowd Management, Passenger Safety and Safety Training for Personnel Providing Direct Service to Passengers in Passenger Spaces are listed with the time allocated to them

#	Knowledge, understanding and proficiency	Approximate time (hrs)
1	Introduction to STCW 95	2.5
2	Crowd management training	4
3	Familiarization training	1.25
4	Safety training for personnel providing direct service to passengers in passenger spaces	
5	Review and assessment	-
	TOTAL	**7.75**

These topics are aimed at the control of passengers on the ship before abandonment takes place. Some of these topics may be of assistance to survival craft team members during a long wait for rescue. The cabin and catering staff must have undergone the crowd management training if they are assigned to deal directly with passengers during an emergency situation. The deck crew, who usually form the survival craft team, may not have had such training because they are not directly involved with passengers in an emergency. The coxswain can delegate the task of crowd management to one or more of the trained cabin or catering crew available who have had such training.

As can be seen from the above detailed teaching points in the two STCW safety courses dealing with survival and the use of survival craft there is no real directive to cover the unique needs of survival craft operation, and survival techniques in frigid and ice infested waters.

The problem of rescue by ship in ice infested waters is another subject that needs study and development. Rescue in general needs study and development for open water situations as there is no IMO specified equipment required on ships for rescue work. Climbing the pilot ladder is not an acceptable means of rescue on today's high sided ships.

SECTION 5

Determine what training or information is required by officers and crew of vessels that operate in Arctic waters to prepare them for abandonment and survival situations

CREW TRAINING REQUIREMENTS

Those mariners who are responsible for the safety, survival and rescue of persons in Arctic waters need additional safety training to that provided in the STCW basic safety suit of courses.

Cold environment; its impact on health, protection from and treatment for

This topic is sparsely covered in the STCW basic safety suite of courses so requires more in depth coverage here. Topics that need covering include:-

- Cold environment and its impact on the body
- Cold shock and swimming failure
- Hypothermia, wet and dry
- Frost bite
- Wind chill factor
- Prevention of cold shock and hypothermia
- Treatment for hypothermia and frost bite in the field

Making ice block wind breaks

This is needed to provide additional wind protection for a prolonged stay of more than a few hours on the ice. Suggested topics that need covering include:-

- Recognizing ice suitable for making ice blocks
- A video on how to cut and erect snow blocks into a wall

Figure 24: Building a ice block wind break

Operation of the cooking stove

Miss-use or unsafe operation of a gaseous or liquid fueled stove could cause injury and even death so simple and practical instructions on the safe fueling and operation of the stove are required. Suggested topics that need covering include:-

- Safe filling and refueling of the stove (practical)
- Safe location of the stove for cooking and heating (practical)
- Use of an insulated mat under the stove for safety and efficiency (practical)
- How to fuel, light and operate a stove (practical)
- The efficient melting of ice or snow to make water (practical)

Operating a Kudlik

A kudlik is not a common piece of equipment ashore or afloat so some simple explanation of its use and operation is required. Suggested topics that need covering include:-

- Safe location of the kudlik for lighting, heating and melting snow (practical)
- Safe location of the kudlik for light and heat (practical)
- Use of an insulated mat under the kudlik for safety and efficiency (practical)

Set up and use of inflatable liferaft on ice

Cracking open the shell of a liferaft and taking out the raft and rolling it out on a hard surface is not covered in the Proficiency in Personal Survival course nor in the Proficiency in Survival Craft and Rescue Boat course. If the raft is not to be damaged

mariners need to develop the skills and knowledge to perform this task. Suggested topics that need covering include:-

- Opening liferaft shell and removing liferaft (practical)
- Making inflation gas cylinder operating mechanism safe (practical)
- Rolling out the liferaft on tarpaulin and inflating it with pump (practical)
- Deflating and rolling up liferaft (practical)
- Make carrying sling from liferaft painter or other rope and use sling and poles to move raft and equipment in shell halves (practical)

Operating a lifeboat in ice infested waters

The operation of a lifeboat in ice infested waters is a skill that is not covered in the Proficiency in Survival Craft and Rescue Boat course. Driving a lifeboat full speed into an ice floe is unlikely to be effective in breaking ice and could be damaging to the boat. Operating a vessel in ice is a skill that takes some basic knowledge and time to develop. The best way to learn it is to do it but this is not practical unless some form of simulation is available as an alternative to going into ice infested waters in a lifeboat. This topic could be covered by video presentations. Suggested topics that need covering include:-

- Recognition of ice flows and leads
- Throttle control and steering control when operating in pack ice

Group management

Crew members on a passenger vessel may have to the leader of a group of passengers and crew if the decision is made for the full complement of people to spread out on ice flows. Team leaders must therefore have the knowledge and skills to lead and control those in their charge on the ice. Suggested topics that need covering include:-

- Mental impact of long term (5 days) survival on ice
- Group dynamics and conflict resolution
- Group organization and control
- Delegation of duties and ensuring tasks assigned are performed

- Setting priorities and getting them done

Immersion suits and thermal protective aids

Most mariners do not travel in ships that ply cold waters so immersion suits and thermal protective aids are not items of equipment that they are familiar with. Those who do their marine safety training in tropical and semi tropical climates may not have worn an immersion suit, if at all, for more than a few moments. Now the immersion suit is a primary means of survival. Mariners must be fully familiar with the way to don an immersion suit quickly and effectively as well as direct, assist and check on others doing this. Thermal protective aids are an item of equipment not used by mariners except in an emergency so practical familiarization is needed. Suggested topics that need covering include:-

- Size and fit of an immersion suit
- Don an immersion suit (practical)
- Function in an immersion suit in and out of the water, as well as getting from the water onto the ice (practical)
- Operate a lifeboat while wearing an immersion suit (practical)
- Open and don a coverall type TPA (Practical)
- Put an unconscious body into a sleeping bag type TPA (practical)
- Don and function in floater coveralls (practical)

Arctic group survival kit

Group survival kits are required to be carried on vessels making Arctic voyages, the use of the kit's contents and how to move the container are skills not covered in other STCW safety courses. If officers, crew and passengers are to use the kits effectively the mariner must be trained in how to use and move the kits. Suggested topics that need covering include:-

- Group kit content and its stowage container
- GSK container location and lowering arrangements
- How to lower kit to surface and free it (practical)
- How to move the container on the ice (practical)

- Effective and efficient use of the container contents (practical)
- How to set up the tent quickly and efficiently (practical)

Arctic survival; heat, fluid and energy balance

The survival topics in the Proficiency in Personal Survival and Proficiency in Survival Craft courses do not cover the needs of survival in cold climates so additional education and training is needed for those who will be exposed to this potential hazard for extended periods. Suggested topics that need covering include:-

- The effects of cold water immersion on the human body; cold shock, swimming failure and hypothermia
- The effects of prolonged cold on the human body; hypothermia and frost bite
- Wind chill factor
- Protection against cold shock and hypothermia
- Treatment for cold shock, hypothermia and frostbite in survival conditions
- Problems of sweating and over exertion in freezing conditions
- Need for additional fluid intake in dry air conditions
- Need for greater calorific intake in cold condition for body heat generation

Rescue processes and hazards

The possibility of outside assistance and or rescue being delayed for days rather than hours needs to be considered. The possibility of rescue to a large community setting may take a number of days and different forms of transport and staging to accomplish. Small local communities are not equipped to handle the number of people even a small tour ship can carry so even after rescue has commenced persons are still under a 'survival' condition. Suggested topics that need covering include:-

- Possible staging to get air assistance to location
- Air drops and safety involved
- Type of equipment that may be dropped
- Personnel that may be brought to area (medical, SAR Techs etc.)
- Portable medical facilities
- Triage and staged evacuation to city locations

- Intermediate trans-shipment and small community air strips
- Aircraft and helicopter ground safety

OFFICER TRAINING REQUIREMENTS

The ships navigation officers need more education and training than the crew in the management of an abandonment situation in ice covered waters. The officers would have covered the crew requirements earlier in their career so this would be a follow up at a later date.

Overall management of groups

An abandonment of the ship onto ice floes presents a very different command and control situation than for abandonment in to open water. The people involved may be in close but isolated proximity to the master but weather conditions may make physical contact hazardous if not impossible. The senior officers must be able to plan ahead and develop strategies for the possibility of being stranded on ice floes or in pack ice for a number of days. Suggested topics that need covering include:-

- Stay or move to another location, logistics of moving personnel and equipment
- Keep groups in one location or spread them over a number of floes to distribute weight and minimize possible conflicts
- Keeping control of separated groups
- Weather forecasting and safety control of groups and individuals

Use of resources, human & equipment

There may be specialized knowledge and ability amongst the officers, crew and passengers. There may be a person with 'local knowledge,' such as a guide or speaker to the passengers, and the ability to live off the land could be a valuable resource for the leader and those involved. Medical ability may be needed in more than one location. Manpower may also be in demand when wind breaks or equipment moves are necessary. The ability to recognize that the leader needs assistance and also needs to delegate and take advantage of whatever support is available is a leadership skill some need to develop.

Suggested topics that need covering include:-

- Determine what assistance is necessary and when it may be needed
- Identify individuals (medical, local knowledge, language interpreters, fire arms users) who may be of assistance at different times
- Call for volunteers for tasks (movement of equipment, assistance with persons when moving groups, cooking and wind break building)
- Pooling of equipment that may be of assistance to the overall needs, such as satellite cell phone, additional clothing etc.

Internal communications with groups

If tents or rafts are set up a little distance from the leader's location how is communication between the leader and outlying camps or individual raft / tent to be maintained, especially during bad weather? Are there sufficient walki-talkies available for all rafts / tents or just for a local leader raft / tent in control of other outlying camps? Can a messenger follow a coloured rope laid out from the master's raft /tent to the outlying camps to deliver a message or to gather information? Suggested topics that need covering include:-

- Discussion on distribution of tents / rafts into outlying clusters or individual satellite locations or keep them all in a tightly compact city arrangement.
- Communication needs and how to communicate
- Team leader briefings and information gathering

External communications with rescue authorities

The extended wait for rescue without two way communications would cause considerable stress amongst the passengers who are used to instant and continuous communications via text and talk means. Passengers would not realize the isolation of the Arctic region as far as personal and emergency communications links are concerned. What type of two way communication can be provided for use in an Arctic emergency? Could it be left on at all times or be turned off until a pre-arranged time for an update and information exchange on the situation at both ends? If information is provided on the progress of getting aid and or rescue to the area it will go a long way to

easing the anxiety and tension amongst those involved. Suggested topics that need covering include:-

- Types of two way communication and their advantages and disadvantages in the Arctic
- Scheduled communications or continuous stand-by
- Information required by authorities
- Information required by castaways
- Providing additional EPIRBs, SART,s, VHFs or additional batteries
- Provision of solar and or hand cranked battery powered portable Iridium HF radio equipment and antenna system or other appropriate radio or satellite cell phone with additional batteries or solar / hand cranked batteries

Groups together or separated and how far

Should a large number of people stay in close proximity to each other or should they be spread out as individual raft / tent around a central command post or be set up as a number of clusters of camps of rafts / tents around the command post camp? Suggested topics that need covering include:-

- Individual or clustering may depend on the number of tents / rafts involved, the size or strength of an ice floe or some other local situation
- Discussion on how to manage clusters or satellite tents / rafts in good or poor weather
- Discussion on merits or demerits of clustering or individual camps

Group leadership

The senior officers need to understand that survival on ice or a coast line in a remote location will require a different type of leadership than that needed in open waters where it is a matter of awaiting rescue / air support arriving in a few hours. The senior officers need to develop a pre-plan for their initial actions if abandonment is necessary so decisions are not based on scant information or lack of forethought. Suggested topics that need covering include:-

- Setting goals and dissemination information and directives to outlaying camp leaders
- Getting information from group leaders of outlying groups
- Encouraging, developing and nurturing subordinate leaders
- Delegating authority and tasks to group leaders and ensuring they are carried out; no freelancing!
- Communicating needs so group leaders understand the intent of the instruction
- The way the subordinates have been trained is the way they will react in an emergency

How to conduct polar safety drills

The normal safety drills required under SOLAS does not cover the specific needs of the high latitude situation which is additional to the normal SOLAS activity. Suggested topics that need covering include:-

- What is required during team and group training sessions
- How simulation can be used during team drills
- How can passengers be involved in the drill
- Can the drills involve passengers in a meaningful way?
- Can the drills or briefings be used as part of the passenger briefings on their activity in small boats away from the ship?
- If drills are conducted so they are practical and discussion follows the drill the equipment and personnel will develop together as will procedures. If an emergency occurs then the master has an easier time controlling it as his subordinates know what to do and when to do it, there is no need for micro-management.

DELIVERY OF TRAINING

When the scope, type and duration of training has been determined how is it to be administrated and delivered?

It will take a few years before there is an international, IMO, requirement, remember changes to the lifeboat seating took seven years to get through the IMO process. Could Canada require passenger vessels or all vessels traversing Canadian Arctic waters to have crew trained for Arctic survival and abandonment conditions?

Assuming Canada and IMO are onboard with the concept that Arctic abandonment and survival require additional training and education how is best delivered?

Add on courses already exist, the Proficiency on Fast Rescue Boat course is an add on to the Proficiency in Survival Craft and Rescue Boat other than Fast Rescue Boat course which, in turn, is an add on to the Proficiency in Personal Survival course. Proficiency in Arctic Abandonment and Survival could therefore be an add-on to the Proficiency in Personal Survival and Proficiency in Survival Craft and Rescue Boat course.

Who would require the training in Arctic Abandonment and Survival? The training should be required by all the deck / navigating officers, deck crew and those who are assigned as crew of survival craft. The number required to be qualified could be related to the number of rafts and or tents, whichever is the greater number, or to the group survival kits. This would provide someone trained and skilled to use and lead each group on the ice or beach if they are not kept as a very compact camp.

Where should the Proficiency in Arctic Survival course be delivered? It makes no sense to provide Arctic training where the temperature is above 15° C. Some topics could be provided by using video taken in the Arctic situation, such as selecting suitable ice and cutting blocks and building a wind break. Operating a lifeboat in ice could also be provided by using video although there is nothing better than actually driving a lifeboat in ice. Some imagination and ingenuity can be used such as using plywood to simulate ice floes for getting out of the water onto an ice floe.

SECTION 6

Determine what information and or training is required for passengers on ships operating in Arctic waters and how such information and or training can be provided.

As noted previously, passengers 'shall be instructed in the use of the lifejacket and the actions to be taken in an emergency.'

In 2009 Carnival Cruise Line reduced what had been termed a "Boat Drill" to what they then called a "Safety Briefing." A drill implies that those involved do something while a briefing implies they just need to listen. Carnival also did away with the passengers taking their lifejackets with them to their muster station and trying them on. The passengers will now be shown how the jackets are worn during the briefing. The decision not requiring passengers to collect their lifejacket and return them to their cabin may have been made after a passenger tripped over the tapes on the lifejacket and sued the company. It should be noted the instructions for the 'actions to be taken in an emergency' can be as brief as, 'come here when the alarm sounds!'

The vast majority of passengers on air craft pay little or no attention to the safety briefing, most have their ears plugged by music or their eyes closed or have their nose in a book. If the safety briefing was given before boarding and only those who answered some questions correctly could board the air craft people might pay more attention.

Ship passengers want to get to the fun stuff, open the bar, start the meal service, sail etc. Attending even a muster to show them how to put on a lifejacket and that when the alarm sounds this is where to come is too much trouble for many passengers. "I have done it before," or "nothing will happen," or "the crew will look after me" are many reasons why people do not want to attend a safety briefing let alone a comprehensive muster and briefing.

The majority of 'crew' on a passenger ship are not seamen; they are waiters, catering staff, bar people, room attendants or entertainers who happen to work on a ship. These people may have no marine safety training and be little more than passengers themselves. There are requirements for trained and qualified (but are they

competent?) firefighters and lifeboat operators but how often do they get to practice these skills with the equipment provided? This, and safety briefing, or lack thereof, has been brought to the fore by the sinking of the COASTA CONCORD off the Italian coast in January, 2012.

SOLAS is quite clear in regulation 50; the signal to go to your muster station is 'SEVEN OR MORE SHORT BLASTS FOLLOWED BY ONE LONG BLAST ON THE SHIP'S WHISTLE OR SIREN AND ADDITIONALLY ON AN ELECTRICALLY OPERATED BELL OR CLAXON OR OTHER EQUIVALENT WARNING SYSTEM.' SOLAS goes on to say the signal to abandon ship is as posted on the muster list.

Unfortunately the wording in the Canadian Hull Construction Regulations is different, it states in section 96 that the 'EMERGENCY SIGNALS; ABANDON SHIP (OR MUSTER STATIONS) is MORE THAN SIX SHORT BLASTS AND ONE LONG BLAST OF THE WHISTLE SUPPLEMENTED BY THE SAME SIGNAL ON THE GENERAL ALARM BELLS.' Does this mean that this is the signal to abandon ship or for passengers to muster while the crew deal with an emergency? (This is the nucleus for confusion before the incident starts). The Canadian Fire and Boat Drill Regulations do not give an emergency signal nor does it give the abandon ship signal.

PASSENGER BRIEFING

Passengers need to do a muster at their muster station BEFORE the lines are let go at the port they boarded at. Passengers also need a briefing on the cold environment they are entering. There are other topics that they should be briefed about if the ship's Master is to have an easier time of it if there is an abandonment situation. The topics to be covered at the briefing are listed below in no particular order.

Cold environment

People entering the polar and cold water regions need to understand the cause and effect of cold shock, swimming failure and hypothermia. Suggested topics that need covering include:-

- Cold environment
- Impact of cold water immersion

- Cold shock
- Swimming failure
- Cold water hypothermia; its causes, results protection and prevention
- Dry hypothermia, causes, results prevention treatment
- Frostbite; causes, prevention, treatment

Clothing

People need to understand that clothing is critical to survival and comfort in a cold climate. Suggested topics that need covering include:-

Need to dress warmly, including sox, hat and gloves, especially if the alarm bells are ringing

Layered clothing preferable

Better to have it than wish you have it

Abandonment process in ice covered waters

Abandonment in open waters is something some passengers may think they know about after watching Hollywood movies but the process in ice infested waters will be something totally new to most passengers. For the passengers to be forewarned will make it easier to control them during the abandonment as well as make it less stressful on the passengers. Suggested topics that need covering include:-

- Vessel crushed or ice surrounding vessel
- Dress warmly
- Use of gangway, ladder or lowered in lifeboat to ice
- Stay alongside or move clear of vessel
- Items taken from ship

Time to rescue and reason for delay

The passengers may expect a helicopter will be overhead within the hour and they will most likely not realize rescue may take days before everyone is removed to a warmer climate. The staging to reach them, the stages to get them to warmer climates

and the possibility of a delay should be explained before it may become a problem. Suggested topics that need covering include:-

- Reason for delay in rescue
- Rescue may arrive in stages from the south by air or ships approaching from distant waters

Personal survival kit

As each person has a personal survival kit they should know where it is and what is in it, especially if the kit is not in one place (underwear in cabin, suit by lifeboat). Suggested topics that need covering include:-

- Location
- Contents and how to use it

Don immersion suit

Immersion suits need to be sized to fit the individual so now is the time to determine that there are enough suits of the right size available. This is also an opportunity to show passengers how to done the suit correctly, 'burp' it, get the hood on properly, don the gloves easily and effectively as well as point out its features and equipment.

- Immersion suit shown
- Immersion suit donning demonstration, including 'burping' the suit, locating the hood and pulling on the gloves
- Passengers don their immersion suit to show the suit fits and is operable
- Passengers don an immersion suit to determine that the suit fits the individual

Group survival kit

The location and contents of the group survival kit need explaining briefly. A picture of the kit and the way it is moved on the ice can provide the passengers with an idea of how they may assist when asked. Suggested topics that need covering include:-

- Location
- Contents and how to use it
- Need for assistance in moving group survival kit containers

Survival in Polar region

The time passengers may have to survive in an Arctic abandonment would indicate they need some pre-departure idea on how this will impact on them. Suggested topics that need covering include:-

- Need to follow instructions of team leader
- No freelancing or going it alone
- Close confines in a tent or liferaft
- Perimeter and guide rope
- Need to maintain heat, fluid and energy balance
- Polar bear hazard

Equipment drop from aircraft

Passengers need to be pre-warned of the hazards of an aircraft dropping equipment onto the ice. They will then understand why they may be confined in a safe location when this is to take place. Suggested topics that need covering include:-

- Hazards of an air drop
- Air drop of additional survival equipment, survival experts, water and food, medical team and equipment and the hazards involved
- Method of rescue by air, ship and possible groups rescued over a period of time

Communications in emergency situation in Polar region

Passengers may wonder how rescue can be contacted and what updates there may be during the wait for rescue to arrive. Suggested topics that need covering include:-

- EPIRB, SART VHF management
- EPIRB involved in notification and geographic location of emergency
- Lack of voice communication systems in Arctic
- Satellite cell phone

Survival on ice (Video)

Most if not all passengers will be unfamiliar with survival beyond a few hours without electricity so any information they can be given about this topic before they may spend

close to a week in isolation will make everyone's life easier. Any assistance the passengers can give, when asked, will also be of assistance to all concerned. Suggested topics that need covering include:-

- Building wind break with ice blocks
- Hazards of wild animals
- Use of inflatable liferafts as a shelter
- Guide ropes and reasons for guide ropes

Figure 25: Survival in the Canadian Arctic

SECTION 7

Review and Recommendations

There are few international and or Canadian requirements for the abandonment of a vessel in the Arctic or for the survival of a group of people following such abandonment. This may change as more vessels enter the Arctic waters with passengers. An incident greater than a grounding will focus the politicians' attention on this issue and speed up regulatory actions. Unfortunately a knee jerk rushed reaction may put the legislation in the wrong direction.

Before legislation is developed, be it international or Canadian, the hazards must be determined and assessed; the needs must be defined and the details established and then the legislation written.

The contents of this report are the opinion of one person made over a short period of time. It has most likely raised more questions than it answered because there is so little information available on the subject. There is a need for more study on the hazards, the equipment needed to mitigate the hazards and the standards the equipment must be tested against.

The training need is there because the existing courses, at best, deal with cold water, not ice infested waters or pack ice areas. The special and specific needs for abandonment and survival training need to be identified further and curriculum and skill development standards established. The type and amount of equipment required will impact on the training standards.

Briefly there is a need for the following research and development for Arctic survival equipment and training

<u>Lifeboat</u>

- Determine if an ice capable lifeboat is possible then determine what thermal and other requirements there are for sub zero survival conditions.

<u>Liferaft</u>

- Determine if an inflatable liferaft can be used as an igloo on ice floes

<u>Equipment</u>

- Determine how best to lower a group survival pack from a ship

- Determine how best to move a GSK on the ice and the number of people this requires
- Determine the materials and design of an immersion suit for use on ice floes and in polar waters
- Determine detailed standards for PSK and GSK equipment and other new polar survival equipment
- Determine what survival equipment is required for Arctic survival

Training

- Determine what knowledge and skills are required to move and operate the survival equipment required
- Determine how the Master and group leaders can control the group and groups for up to a week on ice floes or an Arctic beach
- Implement the training required in as practical a format as possible

In general this is an open field that needs developing before there is a loss of life in the Arctic waters that will push changes before the equipment has been developed to meet the challenges involved.

We have been lucky so far in the Antarctic with groundings by adventure cruises (one vessel has had four groundings each requiring dry docking to repair) which were mitigated by there being other vessels in the vicinity to carry out a quick rescue. Even when the MV EXPLORER sank after impacting ice rescue was relatively quickly by a nearby ship. The inappropriate and historic equipment on the EXPLORER highlights the problem of older adventure cruise vessels operating in these waters. The Canadian Arctic has had, so far, only a grounding by an adventure cruise vessels.

The longer we go without a major accident the closer we get to the next one. The loss of the COSTA CONCORDIA highlights the vulnerability of any vessel to loss of stability and sinking if they sustain major damage in unexpected situations.

It is too early to make hard and fast recommendations on these subjects because they are so little understood at this time. Once greater understanding of the needs and the technology has been identified and developed the training needs will become clearer.

Information on the Author

Tom Kearsey, Master Mariner

Tom is a Master Mariner with 12 years' experience working at sea in various ranks ranging from Cadet to Ship's Master. With his vast knowledge of the marine industry, Tom developed the first Marine Emergency Duties (MED) course in Nova Scotia (second in Canada) to receive Transport Canada approval.

Tom was instrumental in obtaining STCW recognition for the Fast Rescue Craft training program. Tom has been involved with marine training, especially the safety training aspects, since 1973.

BACKGROUND

- Born & educated in England
- Attended the HMS CONWAY Merchant Navy Cadet School 1959 to 1962.
- Went to sea on commercial deep-sea vessels as a Cadet in 1962.
- Served on pulp and paper carrying ships, general cargo and tramp ships, passenger vessels and scientific ships.
- Obtained British Second Mate Foreign Going Certificate of Competence in 1964, First Mate in 1966 and Master Foreign Going Certificate of Competency in 1971. Granted Canadian Master Mariner Certificate
- Served in all officer ranks from Cadet to Master (Captain) on British commercial vessels and Canadian government vessels.
- Immigrated to Canada in 1971.
- Became a Marine Safety and Navigation Instructor in 1973, mainly involved with safety subjects (MED) until 1985.
- Instructed Meteorology, Ship Management and assisted with other navigation subject courses for officer certification candidates.
- Principal of the Nova Scotia Nautical Institute from 1985 to 1998.
- Instructor with Survival Systems Training from 1998 to present.

- Involved with the development of the first syllabus for the Marine Emergency Duties program in 1975 and its subsequent revisions.
- Developed the Marine Emergency Duties program in Nova Scotia in 1973.
- Attended Vocational Instructor courses in 1974 & 1975.
- Remains active in the regulatory process and operational activity of the industry
- Served on various committees and development groups in industry and the Canadian Marine Advisory Council
- Presented various papers at marine safety conferences and authored 'advice to masters' on technically different ships and voyages to assist them in their adapting to a new work environment.
- Expert witness on the rescue efforts at a fatality inquiry.

INSTRUCTOR APPROVALS HELD

Currently hold main course instructor approval by Transport Canada for the following courses:

- Marine Emergency Duties courses: A1; A2; A3 and Small Vessel Operator Proficiency
- STCW Basis Safety
- STCW Proficiency in Survival Craft other than Fast Rescue Boat
- STCW Proficiency in Fast Rescue Boat

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