THE COLD FACTS:
Special Safety Considerations of High Latitude Voyaging

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“By failing to prepare, you are preparing to fail.” Ben Franklin

It is not the intent here to attempt a comprehensive treatise on all matters of safety pertaining to off-shore, or even near-shore cruising. Instead, the focus is on very specific hazards imposed by voyaging in an environment of extremely cold water, with significant possibility of the presence of ice, a much lower probability of timely assistance, and challenging communications.

No such voyage should be undertaken without a thorough understanding of these hazards. Intentionally entering the water for any purpose, including dive operations, requires special equipment and training, and that ice, particularly fresh-water glacial ice, is essentially a floating rock that poses significant risk to hull and machinery.

Anyone intending to undertake any high-latitude voyage in a cold water environment must have gained both significant experience, as well as structured safety training commensurate with the conditions and challenges to be anticipated prior to disembarking.

The purpose of this paper is to consider the specialized equipment, training, practice, drills, and leadership essential to safely prosecuting a high-latitude voyage. General matters of safety at sea, from medical emergencies, fire, damage control, crew-overboard retrieval, etc. will only be considered as to how the response must differ from that demanded in more temperate waters, with one overriding exception: in this environment, the appropriate response must be carried out surely and even more promptly.

The **POLAR YACHT GUIDE for non-SOLAS Pleasure Yachts in Polar Waters,** published by World Sailing and the Royal Cruising Club Pilotage Foundation, hereafter referred to as **PYG,** will be relied upon a great deal, and is incorporated here by reference.

Preparation and training are essential to safely undertaking a voyage in any high-latitude region. The PYG puts it succinctly, “The remoteness and climate of the Arctic poses particular demands on the vessels operating there. In many of these areas, there are no, or minimal, facilities for supplies, repairs, medical aid or crew changes. SAR resources may be minimal or non-existent. It is imperative that vessels visiting these areas are crewed, prepared, and equipped to be self-reliant.”

The PYG immediately follows the above introductory statement in Section I. Safety of Navigation in the Arctic, with the declaration that, “Vessels should be appropriately built and equipped, and crews should be appropriately trained and experienced for the intended areas of navigation.” This admonition well defines the purpose of this paper.

FORMAL TRAINING

Unless one has had a military background or a career as a mariner and undergone formal safety at sea training, it is strongly recommended that they get such training as a predicate to any high-latitude cruise.

The **Cruising Club of America** offers excellent, but very basic, safety training that includes such essentials as launching, righting, and boarding a life raft, emergency communications, recovering crew gone overboard and a host of other critical skills. These training sessions, or similar offerings, typically are a full day long, and should be attended by every member of the crew, not just the master.

Additional training for at least the skipper, if not others on the crew, should be very strongly considered. The best of these either comply directly with, or are modeled after, the **STCW.** (International Convention on **Standards of Training, Certification and Watchkeeping** for Seafarers) Standards for compliance have been set by the International Maritime Organization (**IMO**).

The STCW Basic course consists of a five-day series of training modules including Medical Emergencies at Sea, Fire Prevention and Fire Fighting, Personal Survival Techniques, and Personal Safety and Social Responsibility. In 2010 a Security component was added. Thus, the STCW Basic safety training focuses on the essential safety skills and knowledge to provide a framework for safe working practices, emergency procedures, and the critical teamwork required in the marine environment.

This essential course is a minimum entry requirement for anyone who wishes to work on commercial charter yachts or in another commercial sector of the maritime industry. It is engaging, challenging, and even a great deal of fun. What you learn in an STCW Basic course could well save your life or that of a fellow crew mate. The STCW course is mandated for all commercial mariners by the MCA (UK Maritime and Coastguard Agency), the USCG, (United States Coast Guard), and nearly every leading maritime flag state in the world. Variations on its basic framework have been adapted as requirements for fishermen and other marine industries. Anyone contemplating an extensive high-latitude cruising voyage would be well served to take such a course or one of its derivatives.

These courses are available in virtually all coastal maritime centers and are often offered by community colleges as well as schools offering training leading to license certificates. A variant is offered in the USA as a “train-the-trainers” certification for fishing industry Drill Conductor regulatory compliance.

The standard of competency in the UK (and much of Europe) for yachts is the RYA Yacht master certificate which is recognized by the MCA. It is a training scheme which starts from a basic “competent crew” level and goes to “Ocean Yacht Master” level. There are many training schools offering the courses, one of which is: https://uksa.org/course/professional-training/deck/professional-yachtmaster/. The Yacht Master qualification includes training and certification for telecommunications, radar, first aid, engine maintenance, survival, firefighting etc.

Short of an STCW or Yacht Master certification, the one-day Safety at Sea training programs offered by the CCA and others are an excellent beginning. If complemented with a First Aid/CPR course, and an additional basic fire prevention and response class, both often available from local fire departments, one will have laid a very good foundation for mastery of the techniques and understanding demanded to safely conduct more ambitious passages.

In the USA many coastal communities offer a good one day “Drill Conductor” training required for compliance by commercial fishing vessels. These are open to others than fishermen as well, and are excellent short courses that include the donning of Immersion/Survival suits, launching, righting and boarding a life raft, emergency signaling, crew overboard retrieval, some basic damage control measures, etc. Their primary purpose is to train a single crew member of every fishing vessel to become competent to conduct legally required monthly safety drills. Frequent grumbling by fishermen about this requirement is often heard at the start of the training. By the end of the day, one commonly overhears, “That was the best thing we've ever done!”

If even these grizzled skeptical veterans can be persuaded of the value of such training in just one day, imagine the benefit to those who have not spent a career working in the cold water environment. Find a course offering that fits your needs, from the single day to the extensive STCW Basic certification, and you will be equally persuaded. You and your crew will be markedly more competent to conduct a safe passage, as well as respond in an emergency.

THIS WATER IS DAMNED COLD!

Most of the special safety considerations of any high-latitude voyaging, are driven by this one simple environmental fact. Average mid-summer sea water temperatures range from 42.8º F/6º C, recorded at Maniitsoq on the west side of Greenland, to 32.4º F/ 0.2ºC at Clavering Island on the north east coast. The Labrador coast, by virtue of the cold south-flowing Labrador Current, is just a bit colder than the west coast of Greenland, averaging 41-43º F/5-6º C. Water temperature in the Denmark Strait, separating Iceland and Greenland, averages 45ºF/7ºC and varies very little throughout the year.

Similar water temperatures are common throughput Patagonia, the Antarctic Peninsula, and Alaska.

Putting water temperature into context, consider that in its life jacket recommendations, to be considered below, the USCG considers cold water to be 70º F/21.1º C. The US Navy and PADI (Professional Association of Diving Instructors) consider water between 60º F/15.5º C and 45º F/7.2º C to be particularly cold and require special training, certification, and equipment for divers. At temperatures 37º F/ 2.8º C and below, training, certification, and equipment required is even more rigorous, and the prospect of air supply regulator freeze-up becomes a very real threat. Specific diving considerations will also be briefly further addressed below.

IT'S NOT HYPOTHERMIA BUT DROWNING THAT'S MOST LIKELY TO KILL YOU!

It's known by many names---Gasp Reflex, Torso Reflex, Inhalation Response or Cold Water Shock. Regardless of what one chooses to call it, the phenomenon is the single greatest safety hazard, and the worst killer, of those who venture into the extremely cold waters of high latitudes.

When one is suddenly immersed in water below 70º F/21.1º C, an involuntary reflexive gasp results. This can immediately cause a person to aspirate a significant quantity of sea water into the airway and lungs. This leads to laryngospasm, disorientation, panic, and the loss of any physical ability to swim or even remain afloat. Compounding this reflex, as if things were not already bad enough, is that the body, in an involuntary effort to conserve vital core temperature, is simultaneously drawn into a tight fetal position, pulling the head down into the water.

This rapid and uncontrollable gasping can last from one to three minutes. The gasp reflex can continue while the victim is submerged, or his head drawn down, while cold water continues to be drawn in. Even if the victim is able to get the head above water, he still may be unable to clear water from the mouth and airway, preventing sufficient oxygen from entering the lungs. Drowning results long before the body's core temperature drops to the level of hypothermia.

If immersion continues, cold water also causes a sudden constriction of surface blood vessels that in turn causes an immediate jump in blood pressure and heart rate. If the heart is unable to handle this increase in blood pressure, sudden cardiac arrest can occur due to vasoconstriction. Although this seldom results in healthy and fit people, the danger is very real.

Because of this involuntary gasp reflex, it is critical to keep all on board and prevent anyone from going overboard in the first instance. Secondly, special consideration of the choice of PFD/Life Jacket is essential.

KEEP THE CREW ABOARD

Good design, installation and maintenance of safety lifelines is essential. Safety harnesses and PFD/Life jackets must be worn at all times by anyone on deck. Life jacket choices will be considered. below, but all efforts must be made to assure that no one goes overboard.

Typically, jacklines run down the deck, port and starboard, and serve to keep the tethered crew secured to the boat and more readily recovered should they go overboard. But even the brief immersion permitted by the length of the tether from the deck-level jackline may be sufficient to introduce a quantity of water into the lungs of the victim. As a consequence, consideration should be given to taking a page from the rudimentary safety measures employed by Grand Banks and Labrador fishing schooners of generations ago: chest-high jacklines.

Practical Sailor magazine outlines this alternative. See; https://www.practical-sailor.com/safety-seamanship/raising-the-bar-on-lifelines and https://www.practical-sailor.com/safety-seamanship/the-pros-and-cons-of-chest-high-jacklines

See also Cruising World magazine, https://www.cruisingworld.com/how/reader-tip-safety-lines/

Another alternative is to run a single jackline down the center-line of the boat, putting it a greater distance from the gunnels, and therefore the water.

See: https://www.morganscloud.com/2016/11/11/banishing-sidedeck-jacklines-forever/

The differing designs of each boat makes it impossible to lay out a single design for either alternative configuration. But the principle is simple. The chest-high jackline can be set up using a length of low-stretch line run from the bow to the stern by tying securely to the pulpit, running to the shrouds and securing to them with a clamp-on Aladdin cleat (flag cleat), rolling hitch, or special stainless steel guide made for such use, then to the other pulpit railing. Tension the line with a rigger's hitch (also called a trucker's hitch) or similar. Some skippers prefer to secure the ends of the low-stretch line to heavy pad-eyes at deck level, although the pulpit attachment raises the line to a more favorable height for even more of its total length. Working on deck, the crew can clip the tether directly to the chest-high jackline. Double tethers easily permit passing around the shrouds where the line has been secured, and shorter tethers than common on tropical voyages help prevent crew from ending up in the water.

The ketch, yawl or schooner rig offer extra shrouds to which the line can be made fast, making it even more useful over its entire length.

Obviously, the pulpit structure and attachment must be up to the additional loads to be expected. Additional backing pates may be required, as well as some structural reinforcement.

The advantages of the chest-high jackline are two-fold. First it also serves as a superb hand-hold and life line inside of which the crew can work, affording extra security. Secondly, unless the tether is excessively long, it will hold the crew at least partially above the water level should the crew fall

overboard. This can make the difference between life and death by keeping the head above water protecting against the effects of the involuntary gasp reflex.

The center-line jackline offers similar protection from going overboard far enough for immersion, but depending on how it is configured may not offer an additional hand-hold.

PFDs, LIFE JACKETS, FLOAT COATS and FLOAT SUITS

Here we will use the term PFD/Life Jackets to describe flotation devices. The nomenclature has recently been in flux, with the latest USCG standards reverting to use of the original term Life Jacket. Other regulators continue to use PFD. Both will be used together here for clarity.

Current conventional wisdom among many highly experienced offshore sailors prefers the use of inflatable PFD/Life Jackets that incorporate an integral safety harness. But the extreme cold water environment contemplated here, particularly the serious danger posed by the involuntary gasp reflex, requires consideration of better alternatives, even if somewhat unconventional.

The United States Coast Guard has weighed in definitively on the matter of life jackets better suited to the cold water environment. The USCG, Life Saving and Fire Safety Division (CG-ENG-4) has issued a very comprehensive ten-page official statement titled “PFD Selection, Use, Wear and Care” available as a .PDF file. Since the issue of this document the USCG has returned to the use of the term Life Jacket in its latest standards revision, rather than PFD.

On page 4 of the USCG document, under the heading “COLD WATER SURVIVAL, The Cold Facts”, the Coast Guard states, “Be aware that cold water (less than 70º F/21º C) can lower your body temperature. This is called hypothermia....Even if you're wearing a PFD/Life Jacket, your body can cool down 25 times faster in cold water than in air.”

This is also the policy behind US law at 46 USC Sec.3102, and the SOLAS Convention international requirement that all commercial mariners be provided Immersion/Survival suits at all times when operating beyond 32º latitude in the Atlantic, and 35º in the Pacific. Remember, these regulatory agencies consider cold water to be anything below 70º F/21º, considerably warmer than the waters contemplated by a cruise that is the subject of this paper. Even at this warmer temperature the water is markedly lower than the human body's core temperature, and will draw heat from the body with remarkable speed.

It is precisely for this reason that the USCG document declares definitively in the same “The Cold Facts” section, “When you boat in cold water, use a flotation coat or deck-suit style PFD. In cold water they're better than vests because they cover more of your body.” With the exception of recommendations of suitable PFD/Life Jackets for small children, this is the only specific recommendation of a particular type of PFD/Life Jacket found in the USCG document. They also point out that a tight-fitting device, even if only a foam vest, offers somewhat better protection because it reduces the free flow of cold water surrounding the torso, slowing down to at least some extent the cooling of the body.

The USCG document also clearly asserts, on page 7, that “Inflatable PFDs have a number of limitations as explained in the “Think Safe” pamphlet supplied with the device, and in some cases clearly marked directly on them. They are not recommended for non-swimmers.”

The specific reason inflatable devices are poorly suited for use in cold water environments is due in part to the free flow of water around the torso permitted by them, but more critically because of the very dangerous gasp reflex. Inflation requires considerable time, even with the best of the inflatables

(Mustang says 5 seconds). In this time, the gasp reflex has quite likely drawn a significant quantity of seawater into the victim's lungs and pulled the body into a head-down fetal position. Should it be necessary to trigger the inflatable device manually, or worse yet to have to inflate it by the back-up oral inflation tube, the victim will be unable to do so while literally fighting for life combating these extreme conditions. For non-swimmers this inflation time can be fatal.

The USCG document sums it all up on page 6 when it declares that “The perfect life preserver, or PFD, has not yet been designed. All the designs in existence today have some limitations.” As to inflatable devices, they go on to conclude that they, “are comfortable to wear, but they lack the reliability and low maintenance characteristics, and cost, of inherently buoyant PFD's.”

The USCG's concern about reliability is not unfounded. A formal study in the UK disclosed an approximate 8% failure to inflate of new inflatable vests right out of the package, and one of the preeminent CCA Safety at Sea moderators, conducting an informal survey, noted approximately a 10% failure to inflate as attendees entered the pool.

So, what's to be done? The full deck-suit style flotation devices are clearly the best solution for the cold water environment and offer greater protection. But they can be rejected by many who consider them too cumbersome, too restrictive. Donning a harness over the suit can also be difficult. While the recommendation here is to use these suits, even with their inherent awkwardness, there are some creative, less conventional solutions available.

A very good alternative is what are now being called Hybrid PFD/Life Jackets. One of the primary leaders in the market is Mustang Survival, headquartered near the cold waters in British Columbia, Canada. Long a leader in cold water Immersion/Survival suits, coverall-style flotation deck-suits, as well as their popular inflatable PFD/Life Jackets, Mustang has introduced what they call the “Khimera 22 Hybrid Vest”.

The Khimera Hybrid is a very closely fitting vest composed of closed cell foam that offers at least a modicum of inherent flotation (8 lbs/ 3.62 Kg buoyancy) which offers some immediate protection from the danger of the gasp reflex, but then is supplemented by its integral inflatable suspenders. When inflated, the Khimera 22 Hybrid Vest provides a total of 22 lbs/9.98 Kg buoyancy. In Mustang's promotional words, “Lightweight low-profile design offers greater comfort and range of motion.”

Lacking on the Khimera, at the present time at least, is an integral sailing safety harness like that offered on some of Mustang's purely inflatable PFD/Life Jackets. But the combination of a snug fit that helps reduce the flow of cold water around the torso with the initial inherent buoyancy, followed up with the high buoyancy inflatable makes the Mustang Khimera 22 Hybrid an attractive alternative for those interested in a less cumbersome flotation device.

See: http://www.mustangsurvival.com

Another creative solution to the desire for a non-burdensome PFD/Life Jacket is the snug, form-fitting foam “Rogue Fishing Vest” offered by Kent Safety Products. This non-approved all foam vest provides 12 lbs/5.44 Kg of inherent buoyancy, but no additional inflatable buoyancy. However, the very snug form-fitting Kent vest is so well tailored that it is easy to don a conventional approved inflatable with integral safety harness over top, resulting in a very practical and effective flotation device.

Very popular with much of the Pacific Northwest and Alaska fishing fleet, the Kent “Rogue Fishing Vest” lends itself very well to yet another creative solution for cold water protection. When combined with one of the thin neoprene-foam insulated foul weather jackets offered by a company called Stormr, the combination of the inherent buoyancy of the Kent vest and the insulated foul weather jacket give a

modicum of protection from cold water as well as adequate inherent buoyancy to prevent immersion resulting in aspiration of seawater from the involuntary gasp reflex. However, neither the Kent vest nor the Stormr jacket are approved PFD/Life Jackets. Alone or in concert they will not meet regulatory requirements. But the combination is widely used by commercial fishermen wishing a high degree of protection while being able to work easily. Combined with a harness, the combination may offer an alternative to cruisers wanting the same.

See: https://www.kentsafetyproducts.com and https://www.stormrusa.com/

Both the Mustang Khimera and the Kent Rogue Vest are sufficiently compact and form-fitted that they easily fit beneath conventional foul weather clothing. This makes them a very attracttive alternative, as they also give exta warmth, and permit a safety harness to be donned outside all.

By far the best protection, however, is a full cover-all style deck-suit. Mustang, Kent, Sterns, Firstwatch, and other manufacturers offer well made, fully insulated, highly buoyant anti-exposure suits as well as jackets. If one becomes familiar with the restrictions in movement imposed by these protective garments, it is not too difficult to perform all necessary tasks on deck. In addition, they offer superior protection in the dinghy as well as ashore in inclement conditions. Such suits and jackets are the overwhelming choice of professional ship's pilots working the many ports of North America beyond 35º north latitude where climbing a ship's boarding ladder is no simple task.

Regardless of which PFD/Life Jacket and harness combination is chosen, the one inviolable mandatory rule must be that the tether and flotation be worn at all times on deck. Period. No exceptions, no excuses.

HYPOTHERMIA AND RELATED COLD WATER EFFECTS

Myths have long abounded about the effects of extremely cold water. Stories about how the cold water will kill in seconds and so on are in fact true, but it is usually the cold water gasp reflex that results in such rapid death, not hypothermia. But the effects of hypothermia are indeed a very real threat to life in this environment.

Dr Gordon Giesbrecht, a leading Canadian expert on the effects of cold water immersion, coined the phrase “1-10-1” to describe the three critical phases of exposure to cold water. Over many years, Dr. Giesbrecht has researched the effects of cold water immersion on hundreds of subjects and has personally experienced those effects himself over 30 times.

See : http://www.coldwaterbootcamp.com/pages/home

The 1-10-1 Rule

1-10-1 is a simple way to remember the three phases of cold water immersion and the approximate time duration of each phase..

1 - Cold Shock. An initial deep and sudden gasp reflex followed by hyperventilation that can be at a rate as much as 600-1000% greater than normal breathing. You must keep your airway clear or run the risk of drowning. Cold Shock will pass in about **1 minute.** During that time concentrate on avoiding panic and getting control of your breathing. Wearing a life jacket during this phase is critically important to keep you afloat and breathing.

10 - Cold Incapacitation. Over approximately the next **10 minutes** you will lose the effective control of your fingers, arms, and legs for any meaningful movement. Concentrate on self-rescue initially, and if that isn’t possible, prepare to have a way to keep your airway clear to wait for rescue. Swim failure

will occur within these critical minutes and if you are in the water without a life jacket, drowning will likely occur.

1 – Hypothermia. Even in ice water it could take approximately **1 hour** before becoming unconscious due to hypothermia. If you understand the aspects of hypothermia, techniques of how to delay it, self-rescue, and calling for help, your chances of survival and rescue will be dramatically increased.

The work of Dr. Giesbrecht and others, including the USCG, has involved carefully overseen volunteers who deliberately entered very cold water in order to learn more about its immediate effects.

What is evident from this work is that a PFD/Life Jacket, as discussed above, is critical to survival. Without flotation the victim most likely will not survive past the first minute.

Then comes the critical next ten minutes. This is most likely the entire time that the victim will be able to do anything at all to assist in his own rescue. For a sailor overboard this includes signaling for help by whatever means possible and distinguishing himself from his surroundings in order that he can be quickly located and recovered. The adage that you must become," Bigger, Brighter, Different" from your surroundings applies in this situation as well as it does in the discussion of life rafts and abandoning the vessel to be discussed below.

However, when immersed in cold water the victim must be certain to avoid doing anything that increases the rate at which the body core loses heat. Thus, frantic waving, splashing, or other activity calculated to gain attention must be very limited and confined only to the very brief time when it is certain to be seen by rescuers. Instead, it is essential to keep the head covered by foul weather clothing if possible, control breathing, and keep the body in the Heat Escape Lessening Position known by the acronym HELP. See: www.boatus.org/cold-water-boating/help/

HELP protects the body's three major areas of heat loss---the groin, head and neck, and the rib cage and armpits. By drawing the knees to the chest, and the upper arms down and forearms crossed across the chest, contact with the cold water and these areas is minimized. Better yet of course is a full deck-suit style PFD/Life Jacket that helps keep heat loss down to the minimum possible short of a special Immersion/Survival suit.

Research with willing volunteers at Cold Water Boot Camp and similar projects has shown that, during this ten-minute period, muscle and nerve cell response deteriorates very rapidly. Even trained USCG personnel soon become unable to even change channels on water-proof handheld VHF radios, and speech soon becomes slurred.

Within an hour – the final 1 in the "1-10-1" scheme – unconsciousness is likely for most individuals. Death may soon follow without rescue and very careful medical treatment.

CREW OVERBOARD RETRIEVAL

The anticipated onset of hypothermia complicates even very efficient and rapid recovery of a crew member who has fallen overboard. An individual with significant hypothermia must be physically hanlded very gently and with great care. When brought back aboard with the use of the LifeSling or similar device, the victim cannot simply be yarded aboard and flopped down on the deck like a hooked halibut. As essential as it is to respond and rescue expeditiously, the victim must be lifted aboard very carefully – not an easy task when lifting by a halyard while the boat is rolling about in the trough of a running sea.

The basics of crew overboard retrieval absolutely must have been mastered by skipper and crew as part of the essential safety training long before attempting any high latitude passage. As set out in the

introduction, it is impossible here to address all the essential basic safety at sea and seamanship skills that are demanded before any significant offshore passage. The STCW Basic text alone runs more than 160 pages. Suffice it to say that it is critical to master the intricacies of crew recovery early in one's cruising career.

The acronym MOB (Man OverBoard) will be used here for purposes of discussion. This is not due to any reticence to adopt a more current gender-neutral pronoun, but solely to prevent any dangerous confusion. Virtually all GPS units, chart plotters, PC based chart systems and other electronic aids continue to use “MOB” as the designation on their emergency position recording function. Until the industry agrees upon and adopts a newer designation, that presently in use must control for purposes of absolute clarity in an emergency.

Locating the position of the person in the water as quickly as possible is essential. Anyone observing the man overboard event must immediately sound an alarm, throw ring buoy, MOB pole, boat cushion, fenders, buoys or whatever floats into the water to mark the location and provide a debris trail back to that spot, and above all else keep his eye on the victim and any references to fix that location in the mind. Another crew member must immediately press the MOB function button on any electronic navigational device. The helmsman must immediately begin the necessary maneuver to return the boat to the victim, and the remaining crew perform any required tasks on deck to facilitate the maneuver.

Because of the added time criticality of retrieving the victim in the extreme cold water environment, crew AIS beacons and other similar electronic devices should be strongly considered, every PFD/Life jacket should be equipped with lights, whistles, and even smaller personal signal flares.

There are at least a half dozen commonly taught and used man over board recovery vessel maneuvers. Learn what works best for your boat and crew in certain specific conditions, and practice until it can be performed expertly. For any method, to create a protective lee, the desired final position is beam-to-the-wind, slightly to windward of the victim, all way taken off the boat.

Cross-train by having alternate crew members take the helm in these drills, as it might well be the captain who has gone overboard. Use a buoy, MOB training dummy, or some other floating device to simulate the victim. It will give you a good understanding immediately that this process requires a skilled helmsman and a high degree of ship-handling skill. All crew must thoroughly practice their individual roles in the maneuver. Insist that the crew actually recover the floating marker. When you and your crew have mastered these vital skills, exchange roles with each other and do it over again until each has mastered their new job.

Then practice it all over again sometime when weather conditions are much less favorable. It is far more probable that a crew member goes overboard in bad weather than good, and having practiced on a beautiful sunny day is not an adequate simulation to assure success in an actual event.

Use of the LifeSling or a similar device is essential. The integral lifting collar of the LifeSling is the only sure way to get the victim back aboard. As discussed above, the physiological effects described by the “1-10-1 Rule” make it clear that the victim will have only about one minute during which to do much to help himself. He most certainly will not be able to firmly grasp a ring buoy or any other such device; it will be all he can do to simply pull the LifeSling collar overhead.

The crew in the water must be recovered in the shortest time possible. As we've seen, these waters will incapacitate or kill in a very brief time. The LifeSling facilitates speedy recovery, as it simplifies the critical vessel maneuvering required, bringing the device to the victim without having first perfectly

positioned the boat at the ideal position relative to the person in the water. As long as the victim is able to lift the sling overhead and beneath the arms, he will now be prepared for lifting aboard.

A halyard must have been previously designated and properly rigged for lifting the victim. On a power boat, some crane or lifting rig must be incorporated into the fitting out of the boat.

An unfortunately all-too-often mistake by many users of the LifeSling is the failure to tie a loop into the long painter of the device. Per LifeSling's instructions, the user must tie a loop into this line at a place far enough above the lifting collar that the deck crew may easily shackle the lifting halyard to the line at that point, then begin hoisting aboard. The balance of the sling's painter can then also be used by the crew as a “tag line” to help dampen swing and to assist in bringing the victim inboard.

As we've seen in the discussion above detailing the Gasp Reflex and other immediate effects of cold water immersion well before onset of hypothermia, it is critical that the victim be handled as carefully as possible. Hypothermia compounds this even further.

Without a detailed discussion of the physiological responses of the human body, suffice it to say that immediate shock and even cardiac arrest can result as changes in the physical position of the person undergo rapid changes. This is known as “Post Rescue Collapse.” Blood that had been retained in the body's core to help retain warmth will rush back to the extremities, being replaced in turn in the heart by cold blood that had been in the limbs. Even minor jostling of the victim can induce cardiac arrest.

The ideal device to retrieve the victim from cold water, like life jackets themselves, has not yet been invented – at least in the practical sense as to a cruising boat. The LifeSling and similar retrieval systems lift the victim from the water in a vertical position. This facilitates blood rushing to the legs. The ideal would be to lift the person horizontally. Some Pacific Northwest pilot boats have been refitted with hydraulically elevating basket-like devices on their stern. Easily entered when in the down position, they can then be raised to pick up the victim in a reclining position.

IMMEDIATE TREATMENT OF HYPOTHERMIA

It is impossible here to consider all first aid and medical emergencies at sea. Those vital skills must have first been mastered early in the training necessary for an ambitious offshore passage. But in keeping with the determination to consider here the special considerations of safety germane to passage-making in the cold water environment, hypothermia must be specifically considered.

Severe Hypothermia: If the patient has any of the following symptoms, he is considered to have severe hypothermia:

1. Body temperature of 90ºF/32.2ºC or less
2. Depressed vital signs, such as slow pulse and /or slow respiration
3. Altered level of consciousness, including slurred speech, staggering gait, decreased mental skills, or lack of response to verbal or painful stimuli
4. No shivering in spite of being very cold (Note: This sign is potentially unreliable and may be altered by alcohol consumption)

Mild Hypothermia: If the patient is cold and does not exhibit any of the above signs and symptoms, he is considered to have mild hypothermia

Treatment for Severe Hypothermia

1. Prevent further heat loss. Insulate from the deck or ground, protect from the wind, eliminate evaporative heat loss by removing wet clothing or by covering with a vapor barrier such as a plastic bag or sheeting, cover the head and neck and carefully move the patient to a warm environment. Consider covering patient's mouth and nose with a light fabric to reduce heat loss through respiration. Once moved to a warm environment, carefully remove wet clothing, cutting away if necessary. Cover victim with warm sleeping bag or quilts.
2. Get medical assistance, whether by shore-based advisors or rescue services.
3. Do not give alcohol
4. Do not put severely hypothermic patients into a shower or bath
5. Do not give patient oral fluids unless he or she is swallowing easily and protecting their airway
6. Treat patient very gently; do not rub or manipulate extremities
7. Gently and very gradually apply warmed (body temperature) objects like warm water bottles wrapped in towels or similar to the head, neck, chest, groin and armpits. Re-warming must be very slow to avoid shock
8. Treat for shock, do not leave the victim alone.

Treatment for Severe Hypothermia with no Signs of Life

1. Treat as above
2. If no pulse (after checking for 45 seconds) and no respiration, start CPR
3. Reassess patient's physical status periodically
4. Transfer to a medical facility as soon as possible

Treatment for Mild Hypothermia

1. Treat as outlined above for Severe Hypothermia
2. Increase heat production through exercise and calorie/fluid replacement. This method of generating heat is particularly important when emergency care is not readily available
3. Consider warm showers or bath if the patient remains fully alert

DIVE OPERATIONS

Diving is a highly regulated activity and it will not be considered in detail here, other than to point out that any diver deliberately entering waters of the ambient temperature anticipated must know full well the inherent risk. In North America, dive training and certification is commonly conducted by PADI (Professional Association of Diving Instructors). In Europe the ISO (International Organization of Standardization) and the EUO (European Underwater Organizational) control training and certification.

PADI first requires the Open Water Diver Certification as a predicate to its specialty Dry Suit certification. PADI defines “cold water” as any between 45ºF/7.2ºC and 60ºF/15.5ºF. The United States Navy uses the same classification.

The USN in its *Navy Diving Manual* Volume 2 declares at section 11-2.9, “**Suit Selection.** Custom wet suits designed for cold water diving, variable volume dry suits, and hot water suits have all been used

effectively for diving in extremely cold water. Each has advantages and disadvantages that must be considered when planning a particular dive mission. All suits must be inspected before use to ensure they are in good condition with no seam separations or fabric cuts."

The *Manual* adds: "Custom wet suits have the advantages of wide availability, simplicity and less danger of catastrophic failure than dry suits. Although the wet suit is not the equipment of choice, if used the following should be considered:

- The wet suit should be maintained in the best possible condition to reduce water flushing in and out of the suit.
- Wearing heavy insulating socks under the boots in a wet suit will help keep feet warm"

The Navy manual continues: "CAUTION In very cold water, the wet suit is only a marginally effective thermal protective measure, and its use exposes the diver to hypothermia and restricts available bottom time. The use of alternative thermal protective equipment should be considered in these circumstances." Emphasis in the original.

The use of dry suits is specially regulated by both PADI and the Navy. The Navy volume sums it up: "CAUTION Prior to the use of variable volume dry suits .... divers must be trained in their use and be thoroughly familiar with the operations of these suits." Emphasis in the original.

Dry suits, offering far superior thermal protection for the diver, pose significant problems of buoyancy control. It is for this reason that both PADI and the Navy require specialized training and certification.

Anyone intending to do even brief shallow dives, for vessel maintenance or any other purpose in the waters contemplated here must be assumed to understand the hazards and have undergone the relevant training and certification. No advice can be given or implied here regarding dive operations. All prospective divers must comply with relevant training and certification requirements.

IMMERSION SUITS

Although cold water thermal protective suits have long been referred to as "Survival Suits" the proper term, recognized by all regulatory agencies, is "Immersion Suits." However, in the continuing effort to prevent confusion resulting from commonly used nomenclature, the conjunctive term Immersion/Survival suit will be used here.

However, it must be noted that once the wearer has successfully boarded the life raft, even without having been immersed in cold water in the process, these protective suits do indeed become "survival suits." Without the critical thermal protection afforded by the suit, survival, even in the raft, is in no way assured. The suit provides that essential protection.

US law at 46 USC Sec.3102, and the SOLAS Convention recognize the extreme danger presented by cold water. As a consequence, these agencies and nearly all maritime regulatory agencies require that all commercial mariners be provided Immersion/Survival suits at all times when operating beyond 32º latitude in the Atlantic, and 35º in the Pacific, not simply when operating at very high latitudes.

Remember, these regulatory agencies consider cold water to be anything below 70º F/21ºC, considerably warmer than the waters contemplated by a typical high latitude cruise.

Even at this warmer temperature the water is markedly colder than the human body's core temperature, and will draw heat from the body with remarkable speed. The Immersion/Survival suit is designed to protect against this danger not only in the case that the wearer is immersed in cold water, but also while aboard a life raft or life boat.

These suits are not a recent innovation. They have been in use for many decades, not only by ocean-going ship's crews, but also by high-latitude fishing vessel crews. This writer has personally utilized these suits since 1978. They are widely considered the single most important piece of safety equipment aboard. Yet, unfortunately, few yachts have been equipped with Immersion/Survival Suits.

Suits are now offered in the original neoprene-foam version, as well as a later design more akin to a diver's dry suit with a welded-seam nylon outer material. Although these later designs are less bulky and more easily moved around in than the original neoprene-foam suit, they are more than three times as expensive. Some users have reported these suits more difficult to don in very cold weather.

Objections range from “too expensive” to “just too bulky.” Neither objection is well-founded. The neoprene-foam suits can commonly be purchased for $275-300 US at commercial fishing chandleries, making them much less expensive than foul weather clothing worn by many yacht crews. Their bulk, when properly rolled and stowed in the special storage bag provided, is about the same as a sleeping bag.

The Polar Yacht Guide (PYG) puts it succinctly at Section 4. High Latitude Equipment, 4.12 when it declares, “In addition to survival suits, a flotation suit or similar for every person aboard,” be provided. The PYG thus recognizes the value of the flotation suits as an alternative PFD/Life Jacket, as well as the essential requirement of the Immersion/Survival suits.

Immersion/Survival suits are marketed by numerous companies:

See: https://mustangsurvival.com/collections/immersion-dry-suits

See: https://survitecgroup.com/survitecproducts/4779/ImperialImmersionSuit

See: https://www.kentsafetyproducts.com

See https://www.datrex.com/product/stearns-universal-uscgsolasmed/

Donning the suits, while very simple, should be practiced until mastered and able to be done in less than one minute. See the USCG instructional video,
https://www.youtube.com/watch?v=doRLksdmYCE

An excellent technique, commonly taught to Pacific Northwest and Alaska fishing vessel crews, is to team up with another crew member when donning the suit. After sitting down to place the legs into the suit, then standing to put the arms into the suit, both crew members can then assist each other pulling the suits fully up over the shoulders and the hood over the head, as well as getting the lapels of the suit in proper position for closing the special water-proof zipper. When pulling up the zipper, although counter-intuitive, it is helpful to thrust out the stomach. This pulls the clothing tight at the midriff which inhibits clothing from getting fouled in the zipper. To help prevent ingestion of water, and conserve additional heat, be certain to properly fasten the face covering flap of the hood.

Some suits are offered with pre-installed and cleverly stowed tethers, complete with snap shackles. This feature is very valuable. It permits the entire crew to be closely linked together should they end up in the water. This allows them to form a circle, arms linked, facing outward. By kicking their legs to stir up the water such that a white foam is generated, the group is distinguished from the environment as a signal to over-head rescue aircraft. Remember the manta mentioned above to make yourself, “Bigger, Brighter, Different” to facilitate your rescue.

The tether is also critically useful in safely entering the life raft. Only in unusually calm conditions is it possible to easily board the raft directly from the boat. (Launching and boarding the raft will be

discussed more fully below). It may well be necessary to enter the water to get to the raft, as well as to properly re-invert the raft should it inflate upside-down. This is where the tether becomes critical as it can be clipped to the raft's painter, assuring that the swimmer is not carried away from the raft.

Purchasing Immersion/Survival suits equipped with an integral tether is very strongly recommended.

The suits must be properly stowed and maintained. Instructions accompanying the suits detail proper folding before bagging. A special wax, either supplied with the suit or purchased separately, should periodically be applied to the special water-tight zipper. If the suit is ever used in salt water, or in a chlorinated swimming pool for training purposes, it must be carefully rinsed in clear fresh water, then fully dried before bagging.

Seam integrity should periodically be inspected. This can easily be accomplished by inserting a small hard-foam buoy commonly used for lobster or crab traps into the face opening with the suit fully zipped up. Place the hose from a dinghy inflation pump or similar air supply into the hole through the center of the buoy and put a bit of low-pressure air into the suit. Any seam leaks or other damage will immediately be apparent or can be easily detected by spraying a small quantity of slightly soapy water onto the seams.

Any seam failure or other damage should immediately be repaired by a competent dive shop or the original supplier. If in doubt, replace the suit. However, experience has shown that if properly cleaned and stowed, such failure is not common and that the suits are quite durable. They can and should be used for occasional practice sessions, then inspected, rinsed, dried, and stowed.

The buoyancy of these suits is very high, and they are indeed somewhat bulky as they are intended to be worn over other clothing. Swimming in the suit is quite difficult. But there is a technique that can be employed by the crew as a unit should significant swimming become necessary.

With the crew taking a position on their backs, have them hook their legs over the mid-section of the next crew member in turn. This strings together two or even several individuals into a longer chain.

We know that “hull speed” through the water is in large part a function of waterline length of the boat. By linking the crew together in this manner, a longer “waterline length” has been created and efficiency through the water enhanced. At the tail end of the chain, one crew member should take up a position belly down, face forward, in order to see ahead, but still linked into the legs of the crew in front. This crew-member is effectively the “coxswain”, commanding and steering the chain by instructing the group to back-stroke with their arms, calling steering commands for extra strokes on one side or the other. A remarkable speed can be attained with this effective group approach, and it is possible to reach even a fairly distant objective.

All suits should also be equipped with lights and whistles. Small personal-sized flares as well as Personal Locator Beacons (PLB) should be given careful consideration as well.

LIFE RAFTS

The PYB, incorporated here by reference, does not mince words. Section 4.9 makes very clear that any life raft to be used at these latitudes, “comply with SOLAS LSA 1997 Chapter IV or later, or comply with World Sailing Offshore Special Regulations requirements or with ISO 9650 when an insulated floor is included. In addition, insulation can be included in a grab bag designed to be taken into the raft.”

This declaration is the definitive statement on rafts, and compliance must be absolute. Even wearing an Immersion/Survival suit, it does not take long for the cold water beneath the raft to draw critical heat from the human body if the raft is inadequate.

It is assumed that the crew has been trained and drilled in necessary distress signaling procedures, that a 'Mayday' call has been made, and the EPIRB activated before abandoning ship, unless time is so critical that it cannot be done until the raft has been boarded. In this case bringing the EPIRB into the raft becomes even more critical.

All efforts at any damage control must have been fully exhausted, and all efforts made to save the boat. Only then is it time to abandon ship.

The boat itself is always preferable if it is possible to keep it afloat. A couple of simple phrases are commonly used to train high-latitude fishing vessel crews, and would be well remembered here:

“Don't give up on the boat until its given up on you!” and “Never board the raft until you have to step up!” These expressions fairly well sum it up.

If it does become necessary to launch the life raft, there are a few things to keep in mind. When the raft has first been installed, ensure that the painter has been properly attached to the boat. Follow all manufacturer's mounting instructions assiduously. If a hydro-static release device is used, be certain to comply with the special installation instructions and periodic replacement requirements.

The raft must be deployed over the lee side of the boat. To inflate the raft, pull the painter out to its full length, then give a sharp tug. Some painters are quite long, and no inflation will occur until reaching the very end.

If the raft properly inflates in the upright position, pull it as close to the boat as sea conditions permit. It should be boarded from the boat if conditions allow.

If the raft inflates inverted, it will be necessary to re-right it. Practicing this technique in the pool is very strongly recommended.

To get to the raft, use the integral tether of the Immersion/Survival suit recommended above to secure yourself to the raft painter. This assures that you are not separated from the raft or the boat. Remember it is very difficult to swim in the suit.

Next, place the feet on the CO2 inflation cylinder of the raft, reach as far across the bottom of the raft as possible and grab the righting straps provided or one of the water-ballast pockets if no strap is available. Then lean back pulling the raft along with you to flip it upright.

This can fast become a very dangerous maneuver and must be anticipated carefully, as it is possible for the raft to come down into the water atop the person performing this essential task. If this occurs, it is essential to immediately grasp one of the ballast pockets and quickly pull oneself from beneath the raft before any of the pockets begin to fill. The very great buoyancy of the Immersion/Survival suit will press the wearer up firmly against the bottom of the raft, making it very difficult to escape. As the ballast pockets fill, the individual can be trapped and drown.

Should water have entered the raft and been trapped by the canopy while inverted, it may prove very difficult or impossible to re-invert. If the raft is next to the boat, the remainder of the crew can assist by lifting the perimeter of the raft as the maneuver described above is performed. Should so much water have entered the raft that this combined effort not be sufficient, it may be necessary to cut a hole in the

canopy to permit re-righting. This must be done carefully so as not to damage any of the inflation tubes of the canopy structure.

If the raft is some distance from the boat, the crew should enter the raft using the same tether connection described above. In the absence of tethers, it is essential to maintain a hold on the raft painter in the crook of an elbow with the forearm then held firmly against the hip.

Contrary to centuries of tradition, board the biggest, strongest, most capable crew member first. It can be difficult to board the raft from the water, and by getting the strongest member in first, the others can quickly be assisted into the raft by the first aboard.

Any grab-bag or other supplemental equipment, provisions, water, thermal protection and signals can be handed in or sent down the painter to the raft with a pre-installed short tether and snap shackle on their bag. Section 4.1 of the PYB states that, “A portable GPS receiver which can be included in a grab bag,” should be considered. If the raft has not been pre-equipped with an EPIRB, the boat's EPIRB should also be taken into the raft, along with a hand-held VHF radio as it will permit communications with SAR aircraft and near-by vessels.

Always keep the raft attached to the boat by its painter as long as possible. Even partially submerged the boat assists SAR crews in spotting the location and serves as a very effective sea anchor. Always keep in mind, “Bigger, Brighter, Different.” When finally necessary to let go, a blunt-tipped knife is to be provided near the raft entrance for this purpose should any weak-link supplied fail. When the raft is inspected for periodic service and re-certification, assure that this knife has in fact been been included.

As soon as the crew has boarded, assign one to carefully inventory supplies and equipment pre-packed or brought aboard. Assign tasks to all aboard, such as bailing, adding supplemental inflation if necessary, stowing equipment safely to prevent loss, etc. Deploy the drogue included in the raft's equipment if no longer moored to the boat. Set a watch to look for other vessels or aircraft, but close the entry port as much as possible to conserve heat and exclude water. Do not use any pyrotechnic signaling devices until an aircraft or vessel is sighted, and then do so carefully, holding the device well out from the raft's lee side to prevent damage.

Huddle the crew closely together and use any supplemental thermal protective material to preserve heat.

It cannot be overstated how important it is to first have practiced these critical skills in a controlled setting in a pool. Many training programs retain outdated rafts for such purposes. Most commonly remove the ballast pockets for training, due to the danger referred to above. Only by mastering these essential techniques in a warm-water, controlled environment will it be ensured that the crew will be able to respond properly should a real emergency come to pass. You will note during such training that these rafts are quite small. This is deliberate, not only in order that they may be readily stowed and deployed, but also to more effectively retain internal warmth generated by the occupants.

Finally, find diversions to maintain crew moral. Many fishing vessels in the north add a deck of playing cards to their raft supplemental equipment bags.

Make certain that all manufacturer and regulatory inspection, service and repacking requirements are complied with. Ask your raft repacking service to allow you to watch part of this service and carefully inspect the raft in order to become familiar with it and its equipment.

EMERGENCY COMMUNICATIONS

The general subject of communications including equipment and techniques must be part of the underlying training essential before any high latitude cruise. But a few considerations of special concern are set out here.

Although the PYB makes no specific mention of an Emergency Position Indicating Beacon (**EPIRB**) it is most strenuously recommended here that the boat be so equipped. It is recommend that the life raft also be equipped with an EPIRB or that provision be made for transferring the boat's unit to the raft. The 406Mhz EPIRB, especially one with integral GPS to more precisely locate the raft, is without question the single most effective emergency signaling device.

EPIRBs are required by law on commercial vessels and fishing boats. Although not similarly required aboard yachts, no well-found yacht should fail to include an EPIRB in its safety equipment. It is not uncommon for yachts to conduct very lengthy voyages, well beyond shore-based communications systems, often for longer periods of time than many working vessels.

Widely popular with adventurers of all sorts, the InReach from Garmin has achieved very good acceptance in the marketplace.

See: www.garmin.com

With the Garmin device and an active satellite subscription, it is possible to stay in touch globally, send and receive messages, share your routing, and if necessary, trigger an emergency message to a staffed emergency response coordination center via the Iridium satellite network.

The PYG also recommends at Section 4.3 that, “a tracking device capable of automatically transmitting position, time and course overground at least twice a day .... Details of the tracking device and the vessel's email address should be given to the appropriate SAR authority or reporting authority.”

If you have chosen to install an Inmarsat system, distress alerts, calls and distress priority messages transmitted over the Inmarsat network are routed via its Land Earth Stations (LESs) or Shore Access Stations (SASs) to shore-based Maritime Rescue Co-ordination Centers (MRCCs) around the world.

Refer to https://www.inmarsat.com/en/solutions-services/maritime/solutions/safety/maritime-rescue-co-ordination-centres.html

If you elect an Iridium Satellite telephone be certain to become familiar with its use for distress signaling. See: https://www.iridium.com/services/gmdss/

You will note, when you familiarize yourself with the use of these satellite communications systems and your specific device, that international convention (IMO) designates responsibility for specific geographic regions to certain national SAR services. the Maritime Rescue Coordination Centers (MRCC) relevant to the region intended to be cruised.

If the device that you have chosen does not provide an automatic distress signal feature, linked directly to the appropriate SAR or MRCC agency, it is critical that the relevant telephone numbers be pre-programmed, as well as carefully recorded and predominantly displayed. In addition, although it is clearly the responsibility of the skipper to make or command a distress call to be issued, all must understand exactly how to do so. There have been a disconcerting number of tragic episodes in which satellite telephones were intended to be used for distress signaling, but failed in doing so due to unfamiliarity with the device or the proper number to call. On-board periodic safety drills must include a simulation of a proper distress call.

The primary distress call signaling system remains radio, both VHF and HF-SSB. A significant advantage of this century old technology is that the distress call can be immediately received by other vessels which may be in close proximity and which can quickly respond. Telephone systems require the relevant RCC to pass on such signals, and these signal relays may not be received by vessels, particularly fishing vessels, that might be working in the area, or which are not equipped with a GMDSS system.

A “Mayday” call placard must be prominently displayed close to the radio. Many of these plaques set out a script for the distress call. Unfortunately, too often the suggested script begins with phrases such as the boat name and radio call sign, but fail to get to the critical information, the boat's geographic position by Latitude and Longitude, until several steps later.

It is strongly recommended that the call be initiated with the internationally recognized “Mayday-Mayday-Mayday”, and then immediately the vessel's position stated clearly, then repeated clearly again. Only after having conveyed this most critical information should the other details like boat name, color, distinguishing features, call sign, number of crew aboard, and so on be communicated. Then again repeat the position. Finally, listen for any response and provide requested information. If there is no response, repeat the distress call over again as long as it is safe to do so.

CREATE A CULTURE OF SAFETY

Too often a great deal of attention, as well as money, is devoted to purchasing and equipping the boat with the latest and greatest equipment available in the marketplace. But the human element is most important to the conduct of a safe passage.

Team building among the crew is critical. The best way to build the team, as well as give all members of the crew the requisite skills, and the confidence to use them, is to train, practice, and drill. This is so even if the crew is comprised only of a cruising couple.

As was stated at the outset, there are numerous formal training programs available. The prudent skipper will add such training to all of the other skills required to prosecute a voyage as ambitious as that contemplated here by ensuring that his seamanship tradecraft has been rounded out by formal safety at sea training. The crew as well must have undergone at least the rudimentary one-day courses offered. If this has not been done, the master must conduct such training of the crew as a part of preparation for the voyage.

Once the basic skills have been learned by all involved, they must practice together as the team that we mariners have come to call a crew. Periodic drills of each of the various emergency responses demanded should be conducted. It is not necessary to drill every element of all possible emergency responses in the same session. Instead, each emergency response anticipated can be drilled as appropriate.

In the course of these drills, it will generally become apparent that changes in the procedure must be made, and that there may be a better way. Then the procedure can be discussed and suitably modified. What will happen in these drills, follow-up discussions, and quest for the better means of proceeding will be the beginning of real team building.

All aboard will have been invested into the design and implementation of the best response to any particular emergency. This is the essence of what we have more recently begun to refer to as the “Culture of Safety.”

When matters of safety have been given such obvious priority, conveyed by training, drills and practice, all concerned will have been imbued with the attitude that safety is paramount.

Commercial vessels, and regulated fishing vessels, must prominently display a "Station Bill." Plastic laminated forms for the Station Bill are readily available at all commercial fishing chandleries or available on-line. On the laminated form, under separate headings such as Fire, Flooding, Man Overboard, Abandon Ship, the name and duties of each crew member are entered in erasable marker. This sets out who is to report where, bring which equipment, and perform what duties in an emergency.

With the Station Bill prominently displayed at all times, the crew is constantly reminded to think about their job in an emergency response. They will inevitably discuss these matters, often leading to additional suitable revisions. At the next drill, these revisions can be tried out, and procedures changed as required. This further involves the entire crew in decision making and implementation. And by facilitating these discussions, rehearsals, and changes in procedures, the prudent skipper will have solidified the position of leadership that the title only nominally conveys.

The best leaders are not autocrats. They know that collaboration, with them serving as the facilitator, director, conductor, is the more effective leadership technique.

This approach, this Culture of Safety, has more recently become more concisely defined by the notion of Crew Resource Management.

While it is beyond the confines of this paper, Crew Resource Management (CRM) originally evolved as Cockpit Resource Management, first in the airline industry and the military. It has now been applied to the maritime environment, medical practices and other endeavors that rely on collaboration among numerous participants to effectively---and safely---carry out their responsibilities.

CRM builds the effective team by including both leadership and "follower-ship." It recognizes that the leader is not a supreme being, but prone to human failings and can be made more effective if he both leads and is open to helpful suggestions from the rest of the team.

The leader, in the CRM scheme, is granted that leadership authority through four main points:

- Ensuring mission safety---The leader is ultimately responsible for crew safety, although safety requires active participation by all members.
- Fostering respectful communication
- Establishing clearly defined goals
- Including crew input

The leader must **mentor** the crew to achieve a high degree of competence, as well as to build critical trust. The leader must implement a system of **conflict resolution,** as conflict can arise on any crew. If handled effectively, this can be healthy, and with effective listening and focus on the over-all goal, will enable the leader to resolve such conflict. The leader is responsible for fully understanding the **mission** and for developing plans to safely meet that objective.

Finally, the leader must develop "follower-ship" among the crew. This means that the leader must permit the crew to respectfully challenge when needed, but this right is conveyed to the crew with the full expectation that as followers they must act responsibly and continually develop their own skills.

Developing and implementing standard operating procedures (SOP) is essential to this process. Such standard procedures are enhanced by safety drills, as well as conducting all tasks on deck in a

standardized way. The Station Bill is a formalized, written declaration of such standardized operating procedures for emergency response.

Finally, it is essential to recognize hazardous attitudes. These include impulsivity, pandering, machismo, anti-authority, invulnerability, pressing for time and so on. Such emotional, non-logical human reactions pose the greatest impediment to safe operations.

The Culture of Safety is fostered by these management techniques, full participation by all, practice and drills, and standardized operating procedures. More than anything else, this culture leads to a safe passage.

Keep the crew aboard, keep the water out, keep the round side down. Sail Safely.

AUTHOR BIOGRAPHY

Mark Roye and his partner Nancy Krill have sailed their 44' Swedish steel ketch *Tamara* more than 60,000 miles, half of it at latitudes beyond 50º, both north and south. Following ten years of voyaging that included four transits of the Labrador coast to Hudson Strait, two circumnavigations of Newfoundland, three roundings of Cape Horn, an extensive Antarctic cruise, and several months in the Chilean Patagonia channels in both winter and summer, they returned home to Alaska where they continue their high-latitude cruising, including several trips to the Bering Sea from *Tamara's* home port of Cordova in Prince William Sound. Mark has also made a series of winter cruises in Prince William Sound in recent years.

Before finally able to begin cruising, Mark had a long career as an Alaskan fisherman. In the course of his career, he owned and skippered a succession of ever-larger vessels from the Gulf of Alaska to the Bering Sea. As his career advanced, he gained considerable experience, as well as extensive formal safety at sea training, including stability management, advanced first aid and handling medical emergencies at sea, firefighting, damage control, and abandon ship and survival techniques. Twice he was forced into the life raft, successfully fought a fully involved fire aboard while 100 miles from shore in the Bering Sea, recovered crew overboard, and attended to medical emergencies. Mark and Nancy continue to be involved in the professional maritime industry as part owners of a specialized emergency response, pollution control, and salvage tug based in Cordova. He holds STCW Basic and Advanced, Fishing Vessel Drill Instructor, and specialized oil industry and hazardous materials response certifications.