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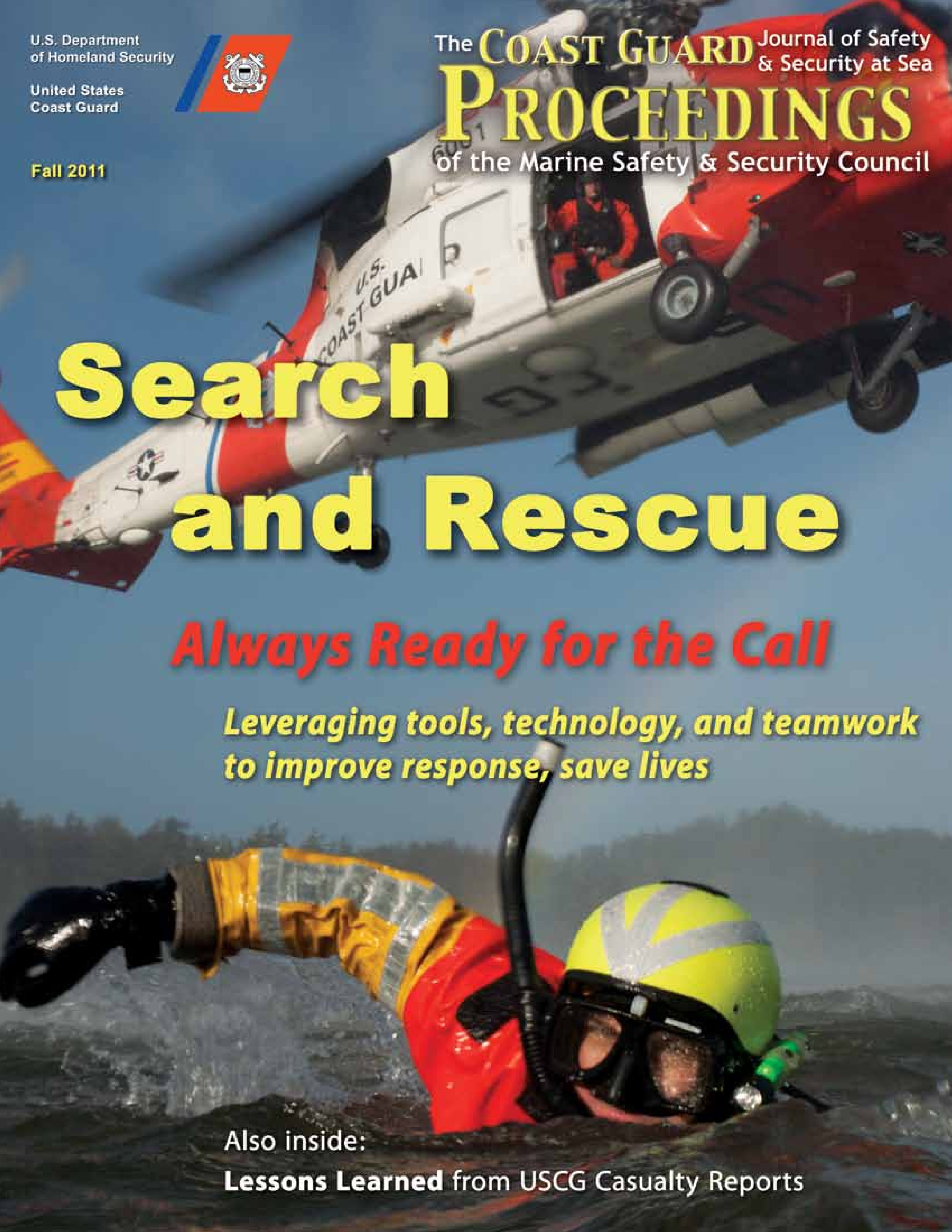

Search and Rescue

Always Ready for the Call

Leveraging tools, technology, and teamwork to improve response, save lives

Also inside:

Lessons Learned from USCG Casualty Reports

PROCEEDINGS

Fall 2011

Vol. 68, Number 3

International

National

Coast Guard

International

National

Coast Guard

Teamwork

Lessons Learned from USCG Casualty Investigations

On Deck

Pictured on the cover: Petty Officer Eric Young, a Coast Guard rescue swimmer from Air Station Astoria, Ore. Coast Guard photo by Petty Officer 1st Class Luke Pinneo.

Assistant Commandant's Perspective

by RDML Cari B. Thomas
Director, U.S. Coast Guard Response Policy

Search and rescue is a time-honored mission, dating back to the Revenue Cutter Service, which was strengthened by the addition of the Lifesaving Service in 1915 to form the modern-day U.S. Coast Guard. Lives are saved every day in the performance of this critical mission. The numbers speak for themselves: 26,000 Coast Guard search and rescue cases conducted annually, saving over 5,000 persons, assisting over 35,000 persons, and saving over $1.5 billion in property. The Coast Guard continues to serve as the nation's premier maritime search and rescue organization.

But it is not just the Coast Guard. We work daily with other dedicated volunteer, local, state, federal, and international partners who are just as committed to saving the lives of those in distress. As chair of the National Search and Rescue Committee, I have the privilege of meeting and working with numerous other agencies and volunteers who are dedicated to improving how the search and rescue community works together to save lives. Sharing lessons learned from difficult search and rescue operations and knowing each other's capabilities, strengths, and limitations helps to improve the United States' search and rescue system.

This issue of *Proceedings* has articles from Coast Guard authors and others representing unique aspects of search and rescue that many may not be familiar with. All of the authors provide valuable information concerning search and rescue. Whether discussing the Coast Guard's engagement with international search and rescue partners, the United States Northern Command's role in search and rescue, the Air Force's conduct of search and rescue operations in the United States, mass rescue operations, or the latest information concerning the International Cospas-Sarsat Programme, the reader will find this issue of *Proceedings* well worth reading.

Finally, I would like to remind our readers that April 15, 2012, is the 100th anniversary of the sinking of RMS *Titanic*. Tragically, of more than 2,000 people aboard, only about 700 were rescued. By comparison, on October 11, 2012, we will mark the 32nd anniversary of the sinking of the luxury liner *Prinsendam* in the Gulf of Alaska with more than 500 passengers and crew aboard. Considered one of the greatest Coast Guard rescues of all time, the heroic story of the *Prinsendam* turned out much differently, with no loss of life.

The rescue of the survivors of the *Prinsendam* is a reminder to all in the search and rescue community that what you do is important.

This issue of *Proceedings* is dedicated to those who risk their lives to save others—not just our Coast Guard professionals on call every day, but to all who are dedicated to saving the lives of those in distress.

Thank you and congratulations on a job well done!

Champion's Point of View

by CAPT David McBride
Chief, Office of Search and Rescue

Historically, the United States Coast Guard has been known for its heroic rescues; countless journals and news stories have documented those successes. Coast Guard air crews, boat crews, and cuttermen are considered some of the best trained and most proficient in the business. In addition, we continue to coordinate with and learn from our national and international search and rescue partners.

This issue of *Proceedings* provides a small look into the growth of those partnerships, within and external to the Coast Guard. It also highlights some of our challenges, especially with regard to long-range search and rescue, mass rescue at sea, and domestic disaster response.

Despite the best efforts of the Coast Guard and our partners, approximately 500 persons per year remain unaccounted for. Another 500 are recovered deceased. Preventing these accidents and deaths is a team effort for the Coast Guard response and prevention communities.

Therefore, one of the major objectives for the Office of Search and Rescue is improving our technology. For example, efforts to replace the aging Search and Rescue Satellite Tracking System with the new SAR/GPS system are underway. SAR/GPS will greatly reduce the time it takes to receive notification of a 406 MHz distress beacon alert and increase location accuracy. This, along with other improvements to distress beacons as well as the addition of new, commercially available notification devices, will improve the Coast Guard's ability to receive early notification of a distress situation.

As you read these articles, understand that there are many organizations, teams, and individuals involved in the search and rescue system. It is crucial that we continue to work with these partners to improve our plans and find new ways to leverage each other's talents.

Semper Paratus.

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Search and Rescue International Engagement

Positive relationships leverage SAR power.

by Mr. David L. Edwards
U.S. Coast Guard Office of Search and Rescue

A crafty U.S. politician once said, "All politics is local." This can hold true for modern-day search and rescue, as well—depending on how one defines "local." For example, the U.S. Coast Guard search and rescue (or SAR) system serves millions of recreational boaters, hundreds of thousands of general aviation pilots, thousands of fishing vessels, and tens of thousands of merchant vessels on or over our waters.

Additionally, millions of U.S. citizens travel around the globe on business or vacation. While we have an excellent SAR system in the United States—a safety net that our citizens may take for granted—many countries do not provide adequate SAR response.

SAR is an indicator of a developed country. Many countries continue to seek out the U.S. Coast Guard to provide advice and assistance on how to better provide SAR services. This does not mean we have to do all the work. Actually, most countries want to learn how to provide search and rescue services as part of a wider SAR community effort. So our "local" SAR subject matter expertise can have an effect far from our shores.

International Engagement as Soft Power

The Coast Guard is recognized as a unique instrument of U.S. foreign policy by virtue of its law enforcement, military, maritime, and multi-mission character as well as its broad statutory authorities, decentralized command and control structure, and more than 200 years of operational sea-going experience.

Sharing our SAR expertise allows us to interact very positively with our global neighbors. In this manner, "soft" power (as opposed to military or "hard" power) can win friends abroad as well as sustain support at home.

SAR discussions often illustrate the need to have a whole-of-government effort, as compared to the sometimes rough inner workings among civil and military authorities or maritime and aeronautical authorities.

SAR engagement is a blend of tactical (operational) and strategic expertise, which should be customized to meet the need of the other state. For example, even though our primary guidance comes from the International Convention on Maritime Search and Rescue, we often make use of the Convention on International Civil Aviation, since many more countries are obligated to follow the civil aviation convention, and it covers land and sea.

Also, depending on how agencies within that foreign country view international law, we often use the SAR cites within the International Convention for the Safety of Life at Sea and the United Nations Convention on the Law of the Sea. If nothing else, discussion on these conventions sets a tone and understanding of the rule of law. In addition, Coast Guard SAR discussions typically advance international adoption of U.S. principles, policies, and practices.

On the "local" level, Coast Guard joint rescue coordination centers live this every day through their interactions with neighboring countries as well as remote regions where no one else may be coordinating a basic SAR response.[1] We certainly also gain from international awareness in that our multi-mission craft are competent in search and rescue and can quickly divert to SAR from other tasks.

From a management perspective, SAR experts can provide advice and examples of government processes to establish and conduct SAR services—matters such as laws, regulations, agreements, national committees, communications capability, performance standards, measures for determining type and location of response craft, search planning tools, and the many other details needed to enable an operational response on a sustained basis.

SAR Engagement in Action

United Arab Emirates Conferences

In 2010, the United Arab Emirates hosted a global SAR forum and a regional Gulf SAR seminar in 2011 to develop regional solutions. The U.S. Coast Guard was one of many international SAR experts invited to the global session and one of the very few invited back to the Gulf SAR seminar from outside the Middle East.

Such invitations are a direct result of the reputation of experienced watchstanders at our joint rescue coordination centers as well as the dedicated effort of Coast Guard managers and experts to conduct face-to-face contact with other governments and organizations. The Coast Guard can and should be the leader or provide the quality expertise to support the efforts of others to advance SAR interests.

Mr. David Edwards speaks at a recent SAR forum. Photo courtesy of the International Civil Aviation Organization.

Attendees at the Gulf Region SAR seminar in March 2011. Photo courtesy of the United Arab Emirates Gulf Civil Aviation Authority.

In the Middle of Nowhere

On June 10, 2010, a lone sailor on a dismasted sailboat in the remote reaches of the Indian Ocean was in distress. Fortunately she carried the 406 MHz distress beacon. The alert was picked up by the Cospas-Sarsat system and routed to the rescue coordination centers (RCCs) in Australia and the French island of Reunion.

The positive outcome in this event was a direct result of the sustained efforts between the U.S. Coast Guard and Australian SAR agencies and shows how international "engagement" can grow and provide mutual benefits. RCC Australia adroitly handled the incident above, making full use of all available resources—including our Amver ship reporting system—while keeping concerned parties well advised during the prolonged rescue effort. Because RCC Australia knew of U.S. concerns and the U.S. knew about Australia's highly competent SAR system, both the distressed sailor and people back in the U.S. had good peace of mind.

Back to the Beginning

So, as we stand back and see how our local SAR response serves our home waters, we must also see how the benefit of SAR international engagement serves our citizens and many others abroad.

The Coast Guard's SAR reputation precedes us, and our capability is known around the world. Various entities around the globe seek our SAR talents, which in turn advances U.S. government and Coast Guard missions and interests around the world. All SAR is local *and* international.

About the author:

Mr. David Edwards served in the U.S. Coast Guard for 23 years in a variety of at-sea and ashore assignments. He has worked in the Office of Search and Rescue at Coast Guard headquarters since 1998, handling national and international SAR matters. Mr. Edwards serves as chairman of the International Civil Aviation Organization/International Maritime Organization Joint Working Group on SAR.

Endnote:

1. "Joint" means the rescue coordination center handles aeronautical and maritime SAR responsibilities.

A sailor is rescued in a remote part of the Indian Ocean. Photo courtesy of Mr. Grant Pipe of Western Australia's Fire and Emergency Services Authority State Emergency Service.

Amver in Action

Extending the SAR safety blanket.

by Mr. Benjamin M. Strong
Director of Marketing
Amver Maritime Relations
United States Coast Guard

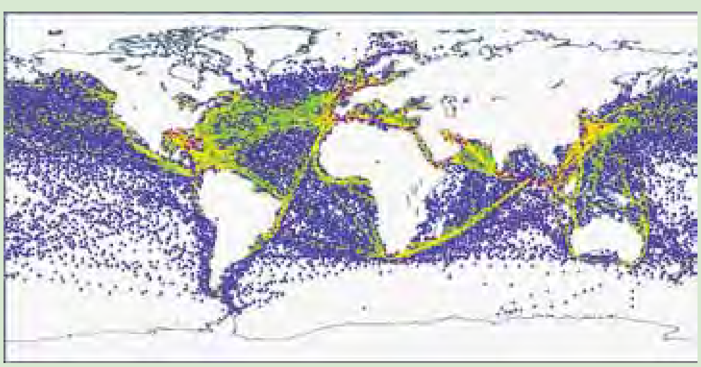
The Automated Mutual Assistance Vessel Rescue System (Amver) is a voluntary system used worldwide to assist persons in distress at sea.

Prior to voyage, participating ships send their sail plans to the Amver computer center, which are then displayed in a surface picture or SURPIC. Rescue coordination centers can request this SURPIC to find Amver ships near the distress location and divert the best suited to respond.

Amver is a force multiplier, offering a unique ability to ensure a blanket of safety that stretches across the far reaches of our search and rescue region. It doesn't matter where in the world you are—we can likely find a ship to save you.

Then and Now

According to a December 1959 Amver bulletin, there were an average of 614 vessels available to divert and assist in maritime emergencies. Amver reached an all-time high in April 2011 with an average of 4,600 ships available.[1] There has been similar growth in the number of messages received. For example, in November 1960, there were 9,460 messages; in November 2010, there were 321,572.[2]



An Amver density plot. Each colored dot displayed approximates a one-degree cell (60 minutes of latitude by 60 minutes of longitude).

Monthly Density Plot Totals

- Red Cells . . . . .50 vessels or more
- Orange Cells. . . 15-49 vessels
- Green Cells. . . .5-14 vessels
- Blue Cells . . . . .4 or fewer vessels
- Empty Cells. . . .0 vessels

The Automated Mutual Assistance Vessel Rescue System center can receive Morse code, Telex messages, fax messages, e-mails, Amver/Shipboard Environmental Acquisition System reports, and automated messages generated from a variety of commercial vessel monitoring systems. Amver can also combine Automatic Indentification System position reports and Long-Range Identification and Tracking messages to provide a comprehensive surface picture for search and rescue.

Better, Stronger, Faster

Amver went through a transformation in 2010, when the team installed new hardware capable of handling the increase in message traffic. The new technology, coupled with extensible markup language, makes processing message traffic and documents faster, requiring less manual involvement.

continued on page 11

Recent Stats

In 2010, Amver saved 265 people, assisted an additional 20, and responded to 330 calls for help.

Some of the more notable rescues of 2010 include:

- Crewmembers from Amver rescue ships *Hokuetsu Delight* and *Crystal Pioneer* rescued 64 Canadian students from the training ship *Concordia,* which capsized approximately 344 miles off the coast of Brazil.
- The Amver tanker *Alpine Maya* rescued one Canadian and three Americans after their sailboat became disabled and was adrift 720 nautical miles northeast of Oahu, Hawaii.
- Four French sailors were rescued by the Amver participating container ship *CMA CGM La Scala* 1,000 miles southeast of Bermuda.

Photo courtesy of the M/V *Alpine Maya* crew.

Crewmembers from an Amver rescue ship embark students from training ship *Concordia* life rafts. Photo courtesy of Mitsui O.S.K Lines, Ltd.

CMA CGM La Scala rescue. Photo courtesy of the M/V *CMA CGM La Scala* crew.

Amver closely aligns with the Commandant's guiding principles

- For more than 50 years, Amver has provided a steady foundation in international search and rescue.
- Amver strengthens partnerships among the Coast Guard, the commercial maritime community, and our international search and rescue partners.
- We honor our extended shipmates and their profession through the Amver awards program. In 2010, more than 5,500 vessels earned Amver participation awards.

Leveraging Partnerships, Saving Money

Imagine a vessel in distress 1,000 miles north of Bermuda. The likelihood of finding a Coast Guard cutter in the area is low. What's certain, however, is that our SAR professionals will quickly turn to Amver and see what commercial ships may be in the area.

So how does that save the Coast Guard money?

First, let's look at the Standard Rates Commandant Instruction.[1] A 378 WHEC or 270 WMEC costs between $6,000 and $12,000 an hour to operate. Add the $14,000 an hour for a C-130, $10,000 an hour for an HU-25 Falcon, or $8,000 an hour for an embarked H-65 helicopter, and you can see the costs to carry out a search and rescue mission are high. If this "typical" SAR case takes 14 hours to complete and does not use any Coast Guard surface or air assets, the savings to the Coast Guard is incredible.

It's also important to note that Amver assistance saves the Coast Guard more than just money. Using Amver vessels for SAR cases allows underway cutters to continue to protect the sea and our homeland.

Endnote:

1. COMMANDANT INSTRUCTION 7310.1M—Coast Guard Reimbursable Standard Rates, Feb. 28, 2011.

A new spatially infused database processes the calculations necessary to produce more accurate vessel positions, providing higher-quality surface pictures. What does all that mean? More lives can be saved more quickly.

The Future

The Automated Mutual Assistance Vessel Rescue System remains flexible enough to incorporate changes in emerging technologies and vessel reporting systems. As shipping routes and trends change, Amver will adapt as well, ensuring resources are available for search and rescue in areas such as the Arctic.

Additionally, as the shipping community evolves and fleets grow, Amver will work to include these new ships in saving lives at sea, and will continue to be a leader in search and rescue.

About the author:
Mr. Strong is the director of Amver maritime relations in New York, N.Y. His office is responsible for marketing, recruitment, and retention of commercial ships in the U.S. Coast Guard Amver system. Prior to leading the Amver office, he was the project manager for the U.S. Coast Guard Mass Rescue Operations Program in the Office of Search and Rescue.

Endnotes:

1. The most recent statistic available at the time this article was written.
2. www.amver.com

The International Cospas-Sarsat Programme

Taking the "search" out of search and rescue.

by Mr. Ajay Mehta
Deputy Director
Office of Satellite and Product Operations
National Oceanic and Atmospheric Administration

The International Cospas-Sarsat Programme (Cospas-Sarsat) is an intergovernmental organization established to coordinate satellite-aided search and rescue activities. It comprises two satellite-based systems that relay distress signals from mariners, aviators, and land-based users.

Russian satellites and instruments comprise the COSPAS system, which is a Russian acronym for Cosmicheskaya Sistema Poiska Avariynyh Sudov, or "space system for the search of vessels in distress." The search and rescue satellite-aided tracking system, or SARSAT, is the name of a payload on the National Oceanic and Atmospheric Administration's polar-orbiting operational environmental satellites and geostationary operational environmental satellites.[1] The system also includes emergency beacons used to initiate a distress call and ground equipment used to track satellites, retrieve the signals, locate the source of the signal, and transmit the distress alerts to search and rescue organizations. Together, they form Cospas-Sarsat.

In Action

Emergency beacons trigger the system and are activated either manually or automatically, depending on their use. The beacon digitally transmits information about the beacon, the user, specific information about the vessel or aircraft, its position (if equipped with navigation input), and a link to a national registry that can provide more information.

The signal is detected by Cospas-Sarsat satellites and relayed to a satellite ground station or local user terminal, which tracks the satellite, retrieves the beacon signal, and—if retrieved from a polar-orbiting satellite—calculates the beacon's position. The beacon position is then relayed to a mission control center (MCC), which collates the information with that from other sources, appends registration information, and transmits it to the appropriate search and rescue authority, or to another MCC. All this happens within minutes.

Rooted in Tragedy

The origins of the system and the organization can be traced to several high-profile incidents in the United States.

In 1967, a 16-year-old girl survived a light aircraft crash in California. Tragically, even as responders searched for her, she starved to death after being stranded for many days.

In 1972, U.S. Representative Hale Boggs (the House majority leader at that time) and U.S. Representative Nick Begich were lost while flying from Anchorage to Juneau, Alaska. U.S. Coast Guard, U.S. Navy, and U.S. Air Force planes searched for the plane with no success.

Bibliography:
www.time.com/
http://artandhistory.house.gov/

What Makes Cospas-Sarsat Successful

Cospas-Sarsat has contributed to the rescue of more than 30,000 people worldwide since its inception.[2]

Cospas-Sarsat participating nations in green.
Courtesy Cospas-Sarsat Programme.

One of the key reasons for this success is its narrow focus and goal shared by all participating nations. Unlike other international organizations where the scope of cooperation can be broad, leading to differing goals and introducing politics as a means to achieve those goals, the nations participating in Cospas-Sarsat all embrace its singular focus and the humanitarian nature of the program. The apolitical nature of the program drives its policies, which are readily accepted by the member nations, even in sensitive areas such as geographical search and rescue boundaries between nations. The goals of Cospas-Sarsat are also supported by other organizations such as the International Civil Aviation Organization (ICAO), International Maritime Organization (IMO), and Committee on Peaceful Uses of Outer Space.

In addition to assisting in the rescue of individuals in distress, the nations that participate in Cospas-Sarsat derive other benefits: They receive stature from participating in an international space program, and they avail themselves of the Cospas-Sarsat specifications for emergency beacons and ground equipment. The use of emergency beacons conforming to an international standard and tested in the same manner has allowed nations to have confidence that when they mandate carriage of emergency beacons, they will be detected reliably anywhere in the world. This also relieves member nations from implementing duplicative standards and testing programs.

Finally, Cospas-Sarsat has implemented organizational practices to help ensure the success of the program. Its data distribution plan establishes common procedures for all nations to ensure timely delivery of distress notifications and allow for contingency operations while minimizing the flow of redundant data. Cospas-Sarsat has also developed standard training materials and partnered with the United Nation’s Office of Outer Space Affairs to institute regional training programs to improve communications and assist search and rescue responders and developing nations to better use the system.

One of the more challenging undertakings has been implementing a quality management system (QMS). Many international organizations implement a QMS at the “headquarters” level or require such a system for member nations. For example, the ICAO requires its members to implement a quality management system for activities such as the provision of meteorological services. However, the implementation of a multinational QMS that monitors, evaluates, and—more importantly—reports on the performance of a global system and its individual elements is unique.

The scope of the Cospas-Sarsat QMS includes:

- commissioning,
- ground segment operation and monitoring,
- communications,
- emergency beacon approval,
- 406 MHz spectrum management,
- on-orbit operation of the satellites.

continued on page 15

Overview: Cospas-Sarsat

History
In the early 1970s, the U.S. Congress mandated that the Federal Aviation Administration adopt new regulations for emergency beacon carriage. However, at that time, emergency beacons could only be detected by over-flying aircraft, introducing significant delays and leaving large parts of the country without coverage. The ability to detect emergency beacons from space would help overcome these shortcomings.

Technology
Canada and the United States began investigating the use of satellites in low-Earth orbit to detect and locate emergency beacons operating at 121.5/243 MHz.

The Communications Research Centre of the Department of Communications Canada led the effort to develop the processing technique for 121.5/243 MHz emergency beacons and combined their efforts with the National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA) in the United States.

The Centre National d'Etudes Spatiales in France was also cooperating with NOAA and NASA on developing the Argos system, which used NOAA's polar-orbiting satellites to collect environmental data. The junction of these two efforts set the foundation for the SARSAT system. However, additional satellites were needed to complete the space segment. Enter the USSR.

Reaching Through the Curtain
The United States and USSR had successfully cooperated on the Apollo-Soyuz mission in 1975 by launching two spacecraft within hours of each other and conducting joint experiments after rendezvousing in orbit. Both nations were eager to find other ways to cooperate, especially in a peaceful and beneficial use of space technology.

Cooperation on Cospas-Sarsat was attractive, as it was a humanitarian mission and required no transfer of funds or technology. The USSR's participation involved its Ministry of Merchant Marine, Morsviazsputnik (the organization responsible for mobile satellites communications), and the Russian Institute for Space Device Engineering. Their collective efforts resulted in the COSPAS project.


Launch of NOAA's GOES-P satellite in June 2009 carrying a search and rescue instrument. Photo courtesy of the Boeing Company.

The two projects, SARSAT and COSPAS, came together in 1979. The result was an interoperable system that could track and receive data from member satellites and instruments and locate emergency beacons anywhere in the world.

In 1982, the first satellite carrying a Cospas-Sarsat instrument (Cospas-1) was launched. Shortly afterward, the rescue of three survivors of a light airplane crash in Canada was the first attributed to the system.[1] As the program grew, the four-partner governance structure was quickly becoming inadequate to manage the global program.

United Efforts
The partners recognized the need for a permanent organization to provide continuity, governance, funding, and international recognition, and developed the International Cospas-Sarsat Programme Agreement (ICSPA) in 1988. This agreement between Canada, the Republic of France, the USSR, and the United States carried the full force of a treaty, ensured the continuation of the system and its availability on a non-discriminatory basis, established the governance structure, and defined the means by which other nations could join.

Expansion of the space segment and technological advances followed. Search and rescue instruments on geostationary satellites were introduced into the system in 1995. Unlike the polar-orbiting satellites, the geostationary satellites orbit the Earth at approximately 36,000 kilometers, which allows them to continuously view approximately one-third of the globe. This new capability allows almost instantaneous alerting and locating.

Governance
Nations can join the organization as ground segment providers or user states. A council oversees management and is supported by a permanent secretariat based in Montreal, Canada. A joint committee and various task groups meet to address technical and operational matters.

Each national administration develops, implements, and operates its own ground system, and authorizes the use of beacons that meet Cospas-Sarsat specifications. Distress information is passed to any nation on a non-discriminatory basis, free of charge to the end user in distress.

In addition to the nations and organizations that are part of Cospas-Sarsat, the International Civil Aviation Organization and the International Maritime Organization coordinate on international search and rescue issues and mandate the use of emergency beacons on aircraft and vessels that fall under their purview. The International Telecommunications Union coordinates on international frequency issues, including the frequencies used by Cospas-Sarsat beacons and satellites.

Endnote:
1. Jim V. King, "Overview of the Cospas-Sarsat Satellite System for Search and Rescue," Communications Research Centre.

Mission Control Center in Suitland, Maryland. Photos courtesy NOAA.

Cospas-Sarsat system overview. Diagram courtesy of U.S. SARSAT program.

Given the importance of the mission, the member nations readily approved implementation of a QMS, and now report on their performance within Cospas-Sarsat as well as externally to key stakeholders such as ICAO and IMO.[3]

The Future

There are many opportunities for Cospas-Sarsat in the coming years, such as a growing and global demand for distress alerting services, as the user community continues to expand and expectations for safety increase. In this regard, Cospas-Sarsat has expanded its services to include an international registration database where nations and individuals can register their beacons if a national administration does not provide those services.

Rescues involving recreational mariners are on the rise. However, this growth is also driving the commercial entry of distress alert services such as those offered by Spot LLC, which offers a commercial, fee-for-service alternative to the government-based Cospas-Sarsat system.

Finally, Cospas-Sarsat is implementing a medium-Earth orbiting search and rescue (MEOSAR) system, which will significantly improve its detection and location services. (See article on page 19.) The MEOSAR system will use satellites, such as those that provide Global Positioning System services, to relay distress signals. This new space segment will allow quicker detection and location of emergency beacons, and will ensure a stable and reliable space segment for many years to come.

About the author:

Mr. Mehta is the deputy director of the Office of Satellite and Product Operations within the National Oceanic and Atmospheric Administration. He also serves as the U.S. representative to the Cospas-Sarsat council, which is responsible for overseeing the management and operation of the International Cospas-Sarsat Programme.

Endnotes:

1. The United States, through NOAA, supplies the satellites, while Canada and France provide the actual instruments that comprise SARSAT. Russia supplies its own satellites and instruments.
2. http://www.cospas-sarsat.org
3. C/S P.015, Cospas-Sarsat Quality Manual, October 2010.

For more INFORMATION:

For more information, visit
http://www.cospas-sarsat.org

Maritime Distress Radio Beacon

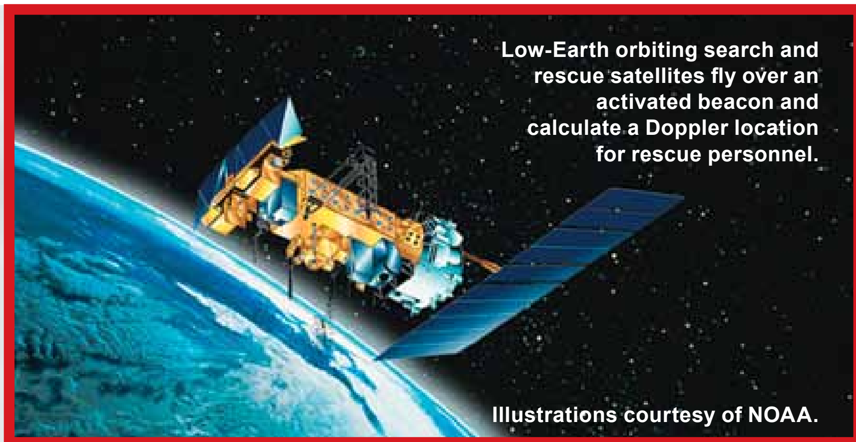
The silent communicator.

by CDR Mark Turner
SARSAT Liaison Officer
U.S. Coast Guard Office of Search and Rescue

A Sudden Capsize

The roar of hurricane-force winds and crashing waves drown out the survivors' voices. Wave after wave tumbles the small survival raft. All four boaters were just able to climb into it before their sailboat sank.

The only way search and rescue authorities know someone is in trouble is a cell phone-sized 406 megahertz (MHz) distress beacon that silently sends a distress alert to the International Cospas-Sarsat Programme satellites. The distress alert is, in turn, routed to the closest rescue coordination center.



Low-Earth orbiting search and rescue satellites fly over an activated beacon and calculate a Doppler location for rescue personnel.

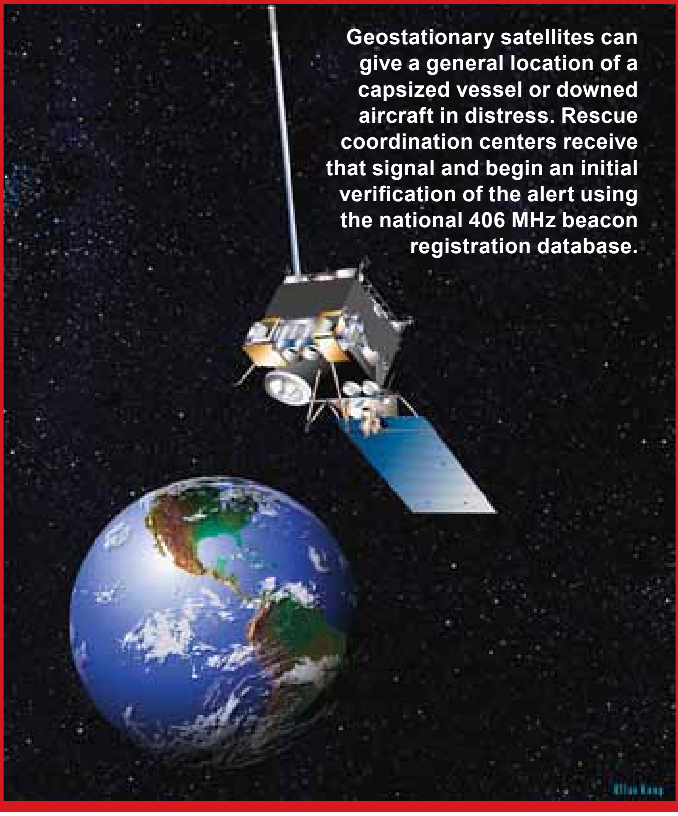
Illustrations courtesy of NOAA.

Sending the Signal

Modern distress beacons transmit a digital signal on 406 MHz that is fast, reliable, and accurate. Two separate satellite systems—low-Earth orbiting satellites flying 530 miles overhead and geostationary satellites that "hover" 22,500 miles overhead—receive the signal from the emergency beacons and send the information to a ground station.

The ground station decodes the information and sends it to the United States Mission Control Center, where computers sort the information by the geographic location of the distress beacon and send the position and data to the rescue coordination center (RCC) closest to the alert. The RCC launches search and rescue (SAR) resources to save the boaters in distress.

Properly registered and updated beacons regularly aid in rescue missions. U.S. Coast Guard photo.



Geostationary satellites can give a general location of a capsized vessel or downed aircraft in distress. Rescue coordination centers receive that signal and begin an initial verification of the alert using the national 406 MHz beacon registration database.

Emergency position indicating radio beacon, up close. U.S. Coast Guard photo by Petty Officer 3rd Class Robert Brazzell.

Aboard the Life Raft

"Do you think they know we need help? How long will it be until help arrives?"

The four survivors take inventory. The only items that made it to the raft were in their pockets when the sailboat was pulled under by a rogue wave: two wallets, a pocket knife, a tube of suntan lotion, and a roll of partially eaten breath mints.

All of the survivors had been wearing life jackets. Fortunately, one had clipped the 406 MHz emergency personal location device to his life jacket. The device was now actively sending a signal to the International Cospas-Sarsat system satellite.

Cospas-Sarsat

The International Cospas-Sarsat Programme is an intergovernmental organization established to provide distress alert and location data to help SAR authorities assist persons in distress worldwide.

The Cospas-Sarsat system is available to maritime users, aviation users, and persons in distress situations anywhere in the world. It is free of charge for the end user in distress. On average, about five persons are rescued every day with the assistance of Cospas-Sarsat alert and location data.

Waiting for Rescue

One of the survivors watches the LED strobe light on the distress beacon illuminate everyone's faces every few seconds. The light indicates the distress beacon is working and will be used by the helicopter rescue crew to locate the survivors in the dark night.

The survivors have given the distress beacon a clear view of the sky so the built-in Global Positioning System (GPS) chip embedded in the beacon can calculate and send its position to SAR authorities. The small distress beacon is designed to withstand conditions that far exceed what the survivors are facing this evening.

Narrowing the Search Area

As well as helping rescuers find your position, 406 MHz distress beacons transmit a unique identification code, hexadecimal identification (HEX ID), which uniquely identifies each 406 MHz distress beacon with a combination of 15 alpha-numeric hexadecimal characters.

While a non-GPS-equipped distress beacon gives rescuers a search area of approximately eight square miles in 60 to 120 minutes, a GPS-equipped distress beacon can reduce the search area to only a few square meters within minutes of activation.

At the Rescue Coordination Center

Minutes after the 406 MHz distress beacon is activated, a SAR controller at a Coast Guard RCC is alerted to the unfolding distress situation. He immediately queries the National Oceanic and Atmospheric Administration (NOAA) distress beacon database and quickly realizes this is an actual distress.

How? The owner of the distress beacon had entered his planned trip for the day in the comments section, and the distress beacon position correlates with the entered route. The SAR controller requests a Coast Guard C-130 aircraft and H-60 helicopter be launched to the distress beacon's position.

In the last few years, approximately nine percent of beacon activations were for genuine emergencies. However, every alert received by the Coast Guard is treated as a genuine emergency until proven otherwise, so all alerts are cross-referenced against a database of registered owners. This confidential database includes phone numbers, points of contact, vessel type, and other vital information so the right response to the emergency can be deployed.

Because the distress beacon is registered in NOAA's distress beacon database, when a false alarm does occur, the RCC is then able to call the registered distress beacon owner to determine if there is an actual

During a rescue like the one described here, a Jayhawk helicopter arrives on scene to rescue a person in distress. U.S. Coast Guard photo by Petty Officer 1st Class Sara Francis.

distress situation. This saves time and resources and allows SAR authorities to use limited assets for real emergencies. There is no penalty for accidentally activating a distress beacon, but if it was activated accidently, the Coast Guard needs to be notified as soon as possible.

It is critically important to be sure the NOAA distress beacon database remains updated with your current contact information. Having this information improves rescuers' ability to help in an emergency.

The Search

More than 100 miles from the distress beacon, a Coast Guard C-130 is receiving the 406 MHz signal from the activated distress beacon and begins homing in on the survivors in the water. As the aircrew receives the distress signal, they are able to decode the digital message embedded in it and display the GPS information in the cockpit of the aircraft.

It takes the C-130 less than 30 minutes to cover the distance and arrive on scene. During this time, the C-130 crew passes the information to the Coast Guard H-60 helicopter crew that is still one hour out.

When used correctly, the distress beacon will provide timely notification of an emergency. Distress beacons are not the only safety equipment that should be used in outdoor recreation and are not intended to replace essential safety equipment such as radios or life jackets; rather, they should be used in addition to these devices.

The 406 MHz distress beacon is the international standard, as it is the only frequency monitored globally by international satellites. As such, these distress beacons will remain a critical notification tool people can use to notify the Coast Guard of a distress situation.

The Rescue

Three hours after activating their distress beacon, the four sailors are out of their raft and on their way home. The distress beacon has been turned off and no longer broadcasts an alert signal. For less than $300, the silent communicator summoned help for four people in distress.

Four lives saved.

We Are SAR

The oldest United States Coast Guard mission is the successful search and rescue of persons in distress. The 406 MHz distress beacon is the international standard for distress beacons, and, when activated, receives the full attention of the U.S. SAR system.

No safety device is a substitute for exercising good judgment and following sensible safety procedures, but a 406 MHz distress beacon will let search and rescue authorities know when you need help.

About the author:
CDR Mark Turner has served in the U.S. Coast Guard for 16 years in many capacities, most notably as a rescue helicopter pilot. He has been recognized as the Coast Guard Exceptional Pilot of the Year by the Order of the Daedalians, and has also received an air medal, two Coast Guard commendation medals, a Coast Guard achievement medal, and two Coast Guard letters of commendation for various search and rescue cases.

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Space-Based Search and Rescue

by Mr. Allan Knox
Chief, Isolated Personnel Requirements
U.S. Air Force Air Combat Command

For almost 30 years, search and rescue responders and people in distress worldwide have benefited from the Cospas-Sarsat space-based distress alert system. This system uses a combination of geostationary and low-Earth orbiting weather satellites to detect and locate a variety of emergency beacons.

The satellites relay the distress signals to a network of ground stations and ultimately to a mission control center, which then alerts the appropriate search and rescue authorities to who is in distress and, more importantly, where they are located.

This alert is frequently the first indication that a distress situation exists. Since the first "save" in 1982 the system has saved nearly 30,000 people worldwide.[1]

Although the Cospas-Sarsat system is very successful, there are some limitations. For example, one element, GEOSAR, the geo-stationary search and rescue system, allows near-instantaneous beacon alert detection but, because it remains in a fixed orbit in relation to the Earth, cannot independently provide beacon location, nor can it detect distress alerts above or below 70 degrees latitude.

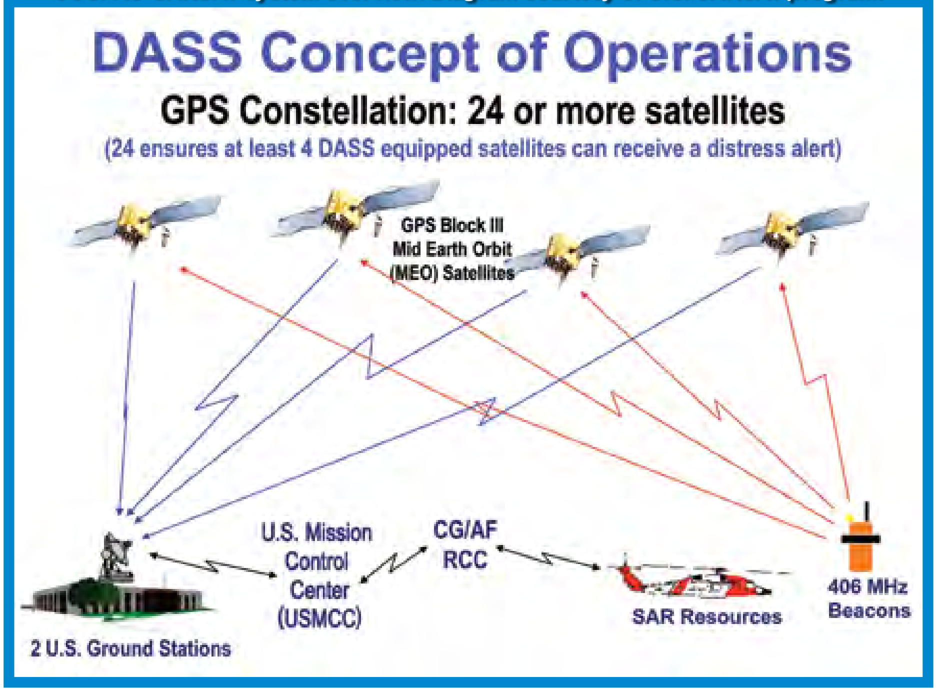
Most of these shortfalls are overcome by the low-Earth orbiting search and rescue (LEOSAR) system. These satellites circle the Earth around the poles, and their orbital planes remain fixed while the Earth rotates underneath, allowing coverage for the areas that are not visible to the GEOSAR system. While recent indications suggest this will provide Arctic coverage, there is one drawback: The coverage is not continuous because these polar-orbiting satellites can only view a small portion of the Earth at any given time. Additionally, the system cannot produce distress alerts until the satellite is in a position where it can "see" the distress beacon and download the information to a satellite ground station.

Via this interaction, unlocated alerts detected by the GEOSAR system can be resolved (located) when they are subsequently detected by the LEOSAR system.

Can We Develop a Better System?

In the 1990s, several members of the Cospas-Sarsat program participated in various research studies to determine what system would best serve as a LEO/GEO follow-on. The determination: The most cost-effective method would be to install search and rescue

COSPAS-SARSAT system overview. Diagram courtesy of U.S. SARSAT program.



The distress alerting satellite system concept of operations.

repeaters on a mid-Earth orbiting system such as the U.S. Global Positioning System (GPS) or other international global navigation system satellites (GNSS).

In 2000, the United States, Canada, the European Commission, and Russia began discussions within Cospas-Sarsat regarding the feasibility of installing 406 MHz repeaters on their respective GNSS constellations to develop a mid-Earth orbiting search and rescue (MEOSAR) capability for Cospas-Sarsat. One of the intended discussion outcomes was to ensure that all MEOSAR space segments would be totally interoperable and would function with the appropriate satellite ground stations regardless of national administration. It was also about this time that the U.S. Sarsat program began its efforts to develop the U.S. MEOSAR system.

The U.S. Sarsat program is managed under an interagency memorandum of agreement among the National Oceanic and Atmospheric Administration, National Aviation and Space Administration (NASA), U.S. Coast Guard, and U.S. Air Force. These agencies are responsible for the planning, programming, budgeting, and execution of our national space-based distress alerting system, ensuring accurate, timely, and reliable distress alert and location data is delivered to search and rescue authorities.

Concurrent Efforts

NASA led the initial U.S. efforts to develop a national MEOSAR capability, and its search and rescue mission management office completed a proof-of-concept that demonstrated reliable beacon detection within five minutes of activation. It also showed that accurate locations could be produced after a single burst of a newly activated beacon.

Though using only eight of the planned 21 distress alerting satellite system-equipped GPS satellites, performance was better than the existing Cospas-Sarsat systems, and projections indicated that significant improvement would occur when a full constellation of satellites became available.[2]

While NASA was conducting the proof of concept, other interagency partners were developing the programmatic documents and operational requirements and beginning the budgetary processes to ensure a transition to an operational system.

The resultant analysis of alternatives evaluated six viable options:

1. Continue existing Cospas-Sarsat LEOSAR space segment.
2. Integrate SARSAT capability on the Argos data collection system space segment.
3. Implement U.S. MEOSAR space segment with Canadian-provided SAR repeater.
4. Implement U.S. MEOSAR space segment with U.S.-provided SAR repeater.
5. Place 406 MHz repeater and processor on satellites of a commercial system.
6. Rely on SAR/Galileo and SAR/GLONASS for space segment.[3]

At the conclusion of the analysis, option three—implementing a U.S. MEOSAR space segment by putting a Canadian-provided payload on the U.S. GPS system—was determined the most cost-effective, low-risk option.

Concurrent to this analysis, the interagency partners, led by the Coast Guard, were working though the process by which civilian payloads are approved as secondary payloads on the GPS system. On September 21, 2009, the distress alerting satellite system (DASS) was formally approved as a secondary payload on GPS III.[4] Subsequent to that decision, the program nomenclature was changed to SAR/GPS, which better aligned our U.S. MEOSAR program nomenclature with those of our international partners.

Where Do We Go From Here?

The interagency Sarsat partners are currently working a number of different issues to ensure we can transition to an operational SAR/GPS system. U.S. Air Force members are putting the final pieces in place to approve a memorandum of understanding under which the Canadian government will provide the 406 MHz SAR/GPS repeaters for integration onto the GPS III system.

U.S. Coast Guard and U.S. Air Force senior leaders have agreed to a 50/50 sharing of the costs associated with that integration, and the respective organizations are busy planning, programming, and budgeting to ensure that budget authority exists to cover those costs starting in the 2012 fiscal year.

How Will MEOSAR Be Different from GEOSAR and LEOSAR?

A completed system will give the U.S. 24 satellites capable of detecting, locating, and relaying distress alerts. If the other international MEOSAR programs are able to launch their planned full constellations, we may well have more than 70 satellites able to detect distress alerts worldwide.

Like the GEOSAR system, MEOSAR will allow "first-burst" detection. Unlike the GEOSAR system, we will also get first-burst location whether or not the beacon has ascertained its position. MEOSAR is able to accomplish this due to the number of satellites that will be in view of the distress beacon, similar to the way a GPS unit fixes its position on the earth. SAR/GPS just reverses the process.

SAR/GPS system operation.

The large number of MEOSAR satellites should also eliminate terrain-masking issues that sometimes occur with the LEOSAR system. The increased number of satellites also eliminates what can be long intervals between satellite passes associated with the LEOSAR system.

Additionally, at an altitude of 12,000 miles, the MEOSAR system allows each satellite to see a larger portion of the globe than the LEOSAR system, which operates at an altitude of approximately 550 miles. The altitude increase coupled with the increase in the number of satellites provides global coverage by one system.

The system will be backwards-compatible with existing beacons and will allow us to incorporate the next-generation beacons currently in development.

U.S. Air Force, NOAA, and NASA technical experts are working with their counterparts in the Canadian Department of National Defence to ensure a seamless integration.

The U.S. delegation to Cospas-Sarsat continues to work with our international partners to ensure interoperability among the three MEOSAR programs. Cospas-Sarsat hopes to begin the demonstration and evaluation phase of MEOSAR development very shortly using the existing NASA proof of concept system along with planned launches of the initial SAR/Galileo and SAR GLONASS constellations.

It is the fervent hope of the U.S. interagency Sarsat partners that we complete our work and transition to a fully operational system as soon as possible. Like the search and rescue responders we support, we do these things that others may live.

About the author:
Mr. Allan Knox is a retired U.S. Air Force command and control officer, having served more than 25 years as an active and reserve officer. He has served in many capacities, most notably as an ICBM launch officer, Rescue Coordination Center controller, National Search and Rescue School instructor, USAF SARSAT liaison, and USCG mass rescue operations program manager.

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Mass Rescue Operations

Optimizing success.

by Mr. Paul Culver
Passenger Vessel Safety Specialist
United States Coast Guard

The International Maritime Organization defines a mass rescue operation as search and rescue services characterized by the need for immediate response to large numbers of persons in distress, such that the capabilities normally available to search and rescue authorities are inadequate. This may occur following a natural disaster or a vessel, aircraft, rail, or roadway incident. Since no single organization is fully equipped to mount an effective mass rescue response, success is contingent upon effective plans and the efforts of the many people and agencies that implement them.

Success Begins with Planning

The key is preparing for a worst-case scenario—an event that may rarely occur, but puts many lives in peril. This is referred to as a "high-consequence/low-probability" event, and is the sort of incident that typically engenders mass rescue operations.

One way to begin to plan is to gather your partners in your area of operations and review past catastrophic events. The steps to success are based on decades of lessons learned from such disasters. For example, nearly every safety regulation and guidance in the maritime world can trace its roots back to the International Convention for the Safety of Life at Sea, which was implemented in response to the *Titanic* sinking.

I'm not sure who said it, but the adage "exchange business cards with your partners *before* an incident" is critical in mass rescue. Your first meeting should include responders, owners/representatives from industry that transport large numbers of people, and your area's Good Samaritans.

One means to reduce the risk of an incident is through analyzing the "causal chain." This method looks at the whole system and/or processes and identifies intervening events that can break the chain of errors that lead to an incident or accident. With respect to a mass rescue operation plan, there are several elements that implement these interventions.

The Response Chain

Initial Notification. The person(s) in charge of a vessel or aircraft must notify authorities of any accident. In this initial notification, the person verifies the location and nature of the condition, and that information is passed on to the rescue agencies, company/owners, agents, local community's emergency responders, and Good Samaritans in the area.

The initial notification allows rescuers to prepare their equipment and management teams for the disaster. Mutual aid agreements are activated, passenger manifests are identified, and medical facilities are placed on standby to receive injured persons.

Coordination. A search and rescue mission coordinator is designated to manage each mission and organize resources. This may be a person within a rescue coordination center or one designated by the center who is given lead responsibility to coordinate the search and rescue response.

Communication. Responders will communicate via special working frequencies assigned by the national communications commission to ensure clear communications. For marine response, the Global Maritime Distress and Safety System (GMDSS) has established "sea areas" for communications and multiple distress alerting and communications networks and methods.

GMDSS equipment is mandatory on vessels subject to the Safety of Life at Sea (SOLAS) convention. Aircraft are also required to carry an emergency locator communicator, which is part of the GMDSS system.

Command. In any mass rescue operation, a unified command will establish objectives to maximize efforts to save lives and ensure the safety of the responders.

During your initial meetings with local response partners, you will have a chance to pre-determine some decisions and priorities, including:

- organizations that will be represented in the unified command;
- integrating other supporting and cooperating organizations or Good Samaritans;
- support facilities and locations, including the incident command post, base, and joint information center;
- primary position staffing;
- restoration of the transportation infrastructure/maritime or aviation commerce.

In Practice

These key elements, especially the decision to staff primary positions and identifying appropriate response agencies, can assist you in creating a mass rescue operation plan and frame how the response will be organized.

The established command membership should be documented in the mass rescue operation plan and cemented by each agency with a memorandum of agreement. This provides the necessary organizational commitment in the participation and acceptance of the plan. Specifically, recognizing unified command members and agreeing to their authority will allow them to command the incident response efficiently and effectively.

Contentious issues may arise, but the unified command framework provides a forum and a process to resolve problems and find the solutions.

Response Organizations

Response organizations are really not that difficult to design. All response organizations have pre-established branches, divisions, groups, and technical specialists. The difference in design with mass rescue operations is you must also think about the initial response agencies and Good Samaritans as well as the actions from the initial notification through the clean-up and closure of the incident.

Are the organizations able to communicate? Hopefully that was addressed in the communication plan developed in the mass rescue plan and has been validated by exercising the plan.

The Unified Command in Action

As mentioned, one of the decisions you can predetermine is staffing of key positions for the unified command. Using the Incident Command System, you can pre-design an initial response organization using your known agencies, organizations, and Good Samaritans. That said, the operation section chief should come from the agency with the primary jurisdiction for the incident, and must be able to build a response organization using established incident management processes. This organization is the tactical element of the response.

Assign the agency with the primary jurisdiction as the initial incident command. From there, build your response structure. As an example, in a water rescue incident for a plane crash, the U.S. Coast Guard is the designated search and rescue mission coordinator for water rescue. The nearest Coast Guard unit(s) will provide the initial incident command (will become a member of the unified command), operation section chief, and rescue resources.

In this example, the local State Fish and Wildlife Conservation Commission officer is the closest jurisdictional officer near the crash site. Therefore, he or she is designated as the on-scene coordinator and water rescue branch director.

The local fire rescue battalion chief is designated the land branch director. He or she sets up the landing site for victim triage, treatment, and transportation. The airport where the plane either departed or was arriving has a designated airport branch director who will manage the family assistance process.

The operation section chief oversees the branch directors and ensures they all have the necessary resources to achieve the unified command objectives.

Success

In a proper planning process, the organization is pre-scripted and allows the designated persons

The Keys to Success

- Effectively use limited resources to save lives through a mass rescue operation plan that embraces a standardized incident command system.
- Embrace a pre-identified response organization using the most likely agencies as the initial command that can transition from crisis management to a managed response.
- Identify common communication channels and incorporate them into the mass rescue operation plan.
- Develop and coordinate training exercises and conduct joint drills.
- Develop and implement lessons learned from the training exercises into updated mass response plans.

to achieve the objectives set to save lives and mitigate the incident efficiently and effectively with the resources available. It also allows the responders to change positions as the mission evolves from rescue, to triage and medical aid, to a salvage and recovery incident.

When all is said and done, creating and implementing your plan to save lives begins with that initial meeting and business card exchange. Exercising the mass rescue operation plans with your partners and stakeholders will benefit everyday operations, as well, through knowledge of the capabilities and procedures of your mutual aid partners and stakeholders.

Successful mass rescue operations require numerous agency heads, organization leaders, and Good Samaritans to work together for the common goal of saving lives.

About the author:
Mr. Paul Culver is a United States Coast Guard passenger vessel safety specialist.

Raising the Ante

Mass rescue operations in the Arctic.

by Mr. Harold Hunt
Mass Rescue Operations Program Manager
U.S. Coast Guard Office of Search and Rescue

The decline of Arctic sea ice at rates faster than climate scientists initially predicted may soon open the Arctic to shipping and development. In fact, a recent study indicates that we could see an ice-free Arctic before 2050.[1] This could mean, in addition to the thrill-seekers, adventurers, hunters, and individual explorers that currently trek to this area, we could see a rise in nature, cultural, and cruise tourism in the region, as well.

According to Dr. John Snyder of Strategic Studies, Inc., in Centennial, Colo., Arctic tourism development is the goal for Greenland, Nunavut, Manitoba, Yukon, Sami, the Russian Federation, and Native Alaskan economies. Additionally, the Arctic Marine Shipping Assessment (AMSA) report notes that passenger and cruise vessel activity represents a significant proportion of vessel activity in the Arctic, and that such activity is growing. The AMSA report also emphasizes the significant management challenges posed by the continued increase in this traffic, including those pertaining to passenger safety needs and protection of the Arctic marine environment from sinkings, groundings, and pollution.[2]

What This Means for Search and Rescue

Today, mass rescue operations are low-probability/high-consequence events. With an ice-free Arctic, they have the potential of becoming high-probability (common occurrence)/high-consequence (with very serious outcome) events. To make matters worse, there may be confusion on how best to respond to an incident in the Arctic, who should respond, how we communicate, and who is in charge, which will further amplify the ensuing calamity.

Communications are essential for mariners for routine operations and safety purposes. Past experience and repeated lessons learned have shown that the issue is and always has been a problem. As you go farther from the shore, more equipment will be required. The VHF radio has a range of 25 to 50 miles, depending on antenna height and atmospheric conditions. Coastal vessels, for example, only have to carry minimal equipment if they do not operate beyond the range of shore-based VHF radio stations. But there is no hard-and-fast rule for where "offshore" begins, particularly in the Polar regions. In some areas you may have trouble calling for assistance beyond approximately 30 miles from shore.

Marine Incidents Involving Polar Cruise Ships

Marine Incidents	Total Events	Events Since 2000	Percent Since 2000
Polar Cruise Ships Sunk, 1979–2007	8	5	63%
Polar Cruise Ships Running Aground, 1972–2007	27	16	59%
Pollution and Environmental Violations, 1992–2007	40	18	45%
Disabling by Collisions, Fires, Propulsion Loss, 1979–2007	28	22	79%

Sources: Public Media Sources, Ross A. Klein, PhD, and www.cruisejunkie.com

All ships that transit Arctic waters have to carry HF, MF, and VHF equipment. But even current satellite equipment will only help you so much. Geostationary satellites, which are positioned above the equator, can't receive information from the distant sea around the North Pole. Again, with 2011 communication technology, we have long-range communications equipment, survival gear, and the 406 MHz EPIRB, but all this communication equipment will be old technology in 2050.

An Arctic Action Plan

We must work to create a plan that includes and identifies:

- sheltering operations, emergency first aid, bulk distribution of emergency items, and collecting and providing information on individuals and victims beyond the scope of traditional mass rescue operation services.
- individuals in need of additional response assistance, such as those who have disabilities, the elderly or the very young, or those who are transportation disadvantaged.
- customized charts that provide annotations of track lines, danger bearings, and distances from hazards as well as other information important to future national and international mariners.

Additionally, we may consider requiring all those visiting the region to have an Arctic-specific license, just like researchers are required to have a license to work in the Arctic.

Finally, we must be sure to coordinate any future requirements with local, tribal, and voluntary agencies; other federal agencies; and international agencies and other nations.

What Are the Chances?

If we perceive the likelihood of a disaster to be below some arbitrary threshold, it is a natural human tendency to assume "It won't happen—at least not on my watch." Many times we seek evidence that confirms this and ignore conflicting data. Also, there is a tendency to focus on a disaster or mass rescue operation only after it occurs (but not long afterward), and we avoid preparing for or preventing future catastrophes because the event is not salient to us anymore.

Despite these assumptions, we know that preparing for the unexpected becomes more important as the world becomes more unpredictable. We and our community partners now face special challenges with respect to low-probability/high-consequence events; by definition, they occur rarely and are especially difficult to predict. Therefore, preparing in advance of catastrophes is an essential step for prevailing over them. One of the first obligations is to recognize our shortcomings and create means of reducing their impact.

Calling the Bet

In the high-stakes game of passenger vessel safety, we must focus on identifying risk, developing new partnerships, planning, and exercising. From now until the year 2050, in cooperation with industry, the Coast Guard's Passenger Vessel Safety Program will be devising new policy and safety standards for maximizing passenger survivability in the event of a low-probability/high-consequence event. We plan to accomplish this by partnering with experts in the international community on naval architecture, marine engineering, and analysis support to achieve shared operational goals and objectives.

By 2050, we hope to be assisted by a much stronger support structure that can expand and contract assets and resources depending on the severity of the incident, and in which cold weather resources and supplies will be obtained, tracked, and utilized efficiently.

By adhering to these few simple steps, we can eliminate confusion through effective command and control. We can begin by rigorously testing response plans by holding realistic training and challenging exercises in conjunction with other nations in the region and with local response agencies. We can work with these partners so that all become proficient with a common, universal, and international incident command system that will allow us to save more lives.

About the author:

Mr. Harold Hunt, MS, MEP has 20 years of civil service experience in emergency management coupled with 30 years of military service in the U.S. Army. He has served as an emergency management specialist, as co-program manager for the U.S. Coast Guard Passenger Vessel Safety Program, and has received numerous citations and service awards. He is currently the program manager for mass rescue operations in the U.S. Coast Guard Office of Search and Rescue.

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10 Mass Rescue Operation Realities

by Mr. George "Rob" Lee
Passenger Vessel Safety Specialist
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Mr. Rick Janelle
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U.S. Coast Guard Seventeenth District

Adventure cruises now sail to the Arctic, Antarctic, and other remote corners of the seas. In 2010, the cruise ship *Clipper Adventurer* grounded in the high Arctic with approximately 200 passengers and crew. It took two days for the nearest Canadian Coast Guard rescue vessel to arrive on scene.[1] Ferry vessels, day tour operations, dinner cruises, offshore gaming vessels, commercial freighters, and fishing industry vessels have also grown in number, size, and geographic area of operation. This may result in a greater number of mass rescue operations in ever-more isolated regions.

The International Maritime Organization defines a mass rescue operation as "a civil search and rescue activity characterized by the need for immediate assistance to a large number of persons in distress, such that the capabilities normally available to search and rescue authorities are inadequate."

Each mass rescue operation (or MRO) is unique, depending on the type of craft or structure involved, number and condition of victims, location, weather, available response assets, capabilities of the crew and ownership, and other contributing factors. Although all MROs share common "operational realities," for our purposes, we will focus on mass rescue operations that involve vessels or that occur in water.

10 Operational Realities

1 ***Mass rescue operations are not confined to a single organization, or to strictly search and rescue functions.***

By their very nature, mass rescue operations involve many partners—local, state, regional, or international responders must work together, beginning with the search and rescue (SAR) operation, and for support functions including:

- medical attention,
- victim shelter and support,
- transportation,
- security,
- pollution mitigation,
- salvage,
- investigation.

Agencies involved may include the lead SAR agency, ship personnel, ship owners, "Good Samaritan" vessels, port community officials, agents, the National Transportation Safety Board, Customs and Border Protection, local fire and police departments, public health officials, hospitals, media, transportation companies, and various non-government organizations. To avoid duplication of effort or conflicts, mass rescue operation plans must dovetail with the emergency plans of each significant response partner.

Practical Tip

Develop an incident briefing document that includes an organization chart and identifies key facility locations including command post, landing sites, and reception centers.

Resource

The Coast Guard "Multi-Agency Quick Start Guide for Passenger Vessel Emergencies" (see next page) lists unified command response objects in an easy-to-follow format, which aids overall plan compatibility.

The next two operational realities are closely related and will be discussed jointly.

2 ***Accounting for passengers and crew will be difficult.***

3 ***There will be delay between rescuing and officially accounting for people. Rushing the process lowers the accuracy.***

If you're lucky, there will be an official manifest to compare with the names of rescued survivors, but manifests may not include the regular crew, short-term technicians, marine pilots, or other individuals. On many commuter ferry operations there is no manifest—just a head count. In any event, accounting for all evacuees will take time.

Tips

Buses are very useful. Survivors can be loaded on buses where they can be warmed and provided with basic food, drink, and first aid. This can also help break survivors into manageable groups so that individuals can be identified, recorded, and verified.

Get local bus companies involved in MRO plans, training, and exercises. Identify those who will be responsible for each busload, such as ship hotel staff or local volunteers who understand the accountability process and are familiar with directing large groups of people.

Resources

The Canadian Coast Guard is refining an initiative, "Casualty Tracking System for Multiple Casualty Incidents," which tracks all casualties involved in a major marine incident. The intent is for the system to be adaptable and useful to other response agencies.

The USCG "Six-Step Process for Evacuee Accountability, Care, and Processing" guide (see online resources sidebar) can be amended for local conditions.

4 ***The demand for information will be overwhelming unless a process is implemented early to manage communication content and flow.***

This is a huge topic that requires deliberate planning with response partners. Planning should involve:

- hardware compatibility,
- frequency use,
- content and format agreement,
- release authority,
- information security,
- social media concerns,
- public information policy.

Internal Communications. The SAR mission coordinator must actively push internal communications (those intended solely for the response organization), including:

- numbers and conditions of victims,
- port arrival times,
- rescue vessel names and docking requirements,
- safety concerns.

Tip

Dispatch liaison officers to collect and share critical information.

External communications. In addition to potentially non-stop media requests for information, the families will be desperate for news of their loved ones. The sheer volume of these requests can overwhelm the joint information center, potentially diverting other resources from the response.

Your external communications response plan must outline a process for establishing a call center for relatives and friends, as well as a media strategy that includes a joint media center and methodology for unified command press releases and media briefs.

Tips

The more public information officers, the better.

Identify which response partners have media specialists and conduct joint planning and training.

Resource

USCG "Communications Best Practices"

5 ***Dedicated SAR resources will be limited, so "Good Samaritan" vessels will be critical.***

"Good Samaritan" vessels will often be the first rescue resources to arrive. However, most Good Sams have no formal training in search and rescue operations and will need a higher level of support and direction

continued on page 32

Plan and Prepare Today To Pr

Multi-Agency Quick Response Guide for Passenger Vessels

USCG Rescue Coordination Center

- Verify information and location. Complete notifications.
- Reduce comms to ship to extent possible. Contact owners, agents for info to permit master to address emergency.
- Coordinate with company on response plans.
- Assume SMC. Initiate checklist.
- Issue UMIB/AMVER.
- Launch/divert assets.
- Designate On Scene Commander (OSC).
- Determine status: numbers, injuries, missing, etc.
- Assign dedicated communicator and maintain open line with company/agents as required for rapid info.
- As needed, establish satellite comms w/vessel.
- Notify sector/COTP and request safety, security zone.
- Request SAR Plan of Cooperation (large cruise ships).
- Support master requests assistance.
- Request PAX/crew list from agents, NOA/SANS.
- Initiate passenger accountability procedures.
- Coordinate w/owner and agents for commercial resources.
- Alert local communities resources.
- Dispatch USCG liaison officer to company EOC.
- Contact FAA for temporary airspace restriction.
- Coordinate with UC for staging and landing areas.
- Alert Public Affairs and CBPS.
- Complete ICS 201 form for situation brief.

Vessel Owner

- Activate Crisis Action Team.
- Establish comms with ship and USCG RCC. Maintain open line as needed.
- Request local USCG liaison officer at EOC.
- Share status information regularly.
- Assist master with stability analysis and supplement decision support system. Share info.
- Commence logistics for possible passenger evacuation.
- Initiate passenger accountability process. Share information.
- Coordinate actions/information with Unified Command.
- Contact Flag State, class, underwriters.
- Initiate spill and security plans.
- Ensure required state and local notification made.
- Activate JIC process w/USCG–release initial media statement.
- Establish 800 number.
- If no agent, initiate actions below.

State

- Activate pollution, medical, and law enforcement actions/support as needed.
- Provide SOSC for UC.

USCG Sector Command

- Form and dispatch Away Team as needed.
- Prepare ICP and initiate Unified Command process as needed.
- Distribute contact info.
- Liaison to RCC/SMC and agents.
- Execute applicable provisions of Area Maritime Security Plan.
- Establish and direct enforcement of safety/security zones.
- Direct shore/waterside MHLS patrols.
- Evaluate for security threat.
- Coordinate terrorism investigation with FBI (if appropriate). Increase MARSEC level (if appropriate).
- Coordinate NOAA SSC.
- Initiate pollution response.
- Investigation initiation.
- Comms with ship thru RCC or company EOC conference type calling.
- ACP checklists reviewed.

Vessel suffers disabling casualty.

IMMEDIATE

WITHIN TWO TO FOUR HOURS

Ship

- Contact CG and company EOC at earliest time.
- Assess damage to vessel/stability.
- Extinguish/contain fire.
- Initiate damage control.
- Treat injured personnel. Report to USCG.
- Request MEDVACs as required.
- Determine need for evacuation.
- Evaluate cause of casualty for security threat.
- Mitigate possible release of fuel.
- Keep passengers informed of situation.
- Provide dedicated communicator for reports to EOC and USCG.
- Provide regular updates of status and changes.
- To extent possible, ensure pax. and crew have identification prior to evacuation.
- Maintain communications with SAR OSC.

Agents

- Establish comms with EOC (owner) and USCG.
- Arrange for any immediate requests from vessel's master/owner.
- Send liaison to RCC and sector.
- Update resources dispatched.
- Identify and contact all other available commercial assets in region for potential use.
- Souls on Board list to EOC, RCC, and reception center.
- Logistics for evacuation. Find reception center.
- Initiate process to activate reception center.
- Alert Red Cross/Salvation Army.
- Locate interpreters.

Port Community

- City manager notified.
- Activate shore-side emergency plans.
- Hospital(s) recall available staff.
- Harbormaster prepares city-owned port facilities. Assist with landing site ops.
- Assist w/establishment of reception center(s).
- Provide triage, medical treatment, patient transport for injured persons landed ashore.
- Provide reps for UC.

- **SAR OSC**: Support master, direct rescue resources on scene, serve as single POC for master, recover PIW, establish check in/out for resources, track evacuee numbers and destinations, provide status updates to SMC/sector.

event and Respond Tomorrow

Unified Command

- Assume command.
- Set organization and objectives. Distribute.
- Initiate IAP development. "Planning P."
- Manage on-scene info flow. Ensure effective information sharing.
- Establish effective communications on scene. Complete comms plan and distribute.
- Coordinate with law enforcement for investigative and security support.
- Stand up JIC w/industry. Issue joint release at earliest time.
- Maintain comms link to industry EOC for current info and plans.
- Assign tasks and responsibilities.
- Coordinate Customs Border Protection Service for evacuee clearance.
- Establish and maintain effective liaison with key stakeholders.
- Support passenger accountability process.
- Establish secure landing sites: decon, triage, medical transport, pax. transport, crowd control.
- Monitor/assist evacuee transport.
- Set security for reception center.
- Coordinate/supervise special teams support (EOD, Strike Team, CSST, NOAA, FEMA, etc.)
- Coordinate marine firefighting support.
- Supervise spill response (source control, containment, recovery, protection of sensitive areas, disposal, and decontamination).
- Evaluate damage survey/approve salvage plan/supervise salvage operation.
- Implement law enforcement requirements for pax. control.
- Coordinate requirements for damaged ship transit, port entry.
- Locate interpreters.

Unified Command General Objectives

1. Address safety of passengers, crew, and responders.

Identify hazards and risks.

Provide coordinated response.

Stabilize the vessel.

Account for all personnel.

Evaluate and treat injuries.

Determine need for evacuation.

2. Respond to potential and actual security threats.

Evaluate cause of casualty.

Make timely notifications.

Mobilize outside security as needed.

3. Mitigate threat of pollution.

Control source—minimize amount spilled.

Arrange for response contractor to protect sensitive areas and recover and dispose of pollutant.

4. Manage information.

Internal communications—Establish effective flow of information to and from scene, and between command post and response partners.

External communications—Joint media coordination to provide "best" information source.

5. Restore maritime operations.

Coast Guard Response Expectations

- Notification at earliest time. Maintain an open line to USCG as needed to share information.
- Accurate reports of situation damage, injuries, pollution, cause if known.
- Immediate update of significant events and timely information sharing.
- Local participation and representation with authority to act on behalf of owner/operator.
- Timely arrangements for pollution and salvage response.
- Accountability of all passengers and crew.
- Establish shore side management and support for evacuees.
- Participation in joint information center for media relations.
- Understanding of NIMS ICS.

from the on-scene coordinator or SAR mission coordinator.

Additionally, these vessels are not designed for victim recovery, especially deep-draft commercial freight ships or tank ships.

Tips

Provide basic SAR training to potential Good Samaritan vessels in your region. Explain the role of the on-scene coordinator and review communications requirements, safety considerations, and other concerns.

Logistically, helicopters can lift survivors from lifeboats to the deck of a Good Samaritan ship.

Resource

"Guidance for Good Samaritan Vessels Assisting in Maritime Search and Rescue" provides basic information.

6 ***Coast Guard SAR mission coordinators and on-scene coordinators receive minimal training in managing MRO activities.***

In mass rescue operations, the coordinators must track dozens of rescue boats, manage extreme communication demands, and oversee thousands of survivors, many of whom may be gravely injured. They will need extra help.

Explain how the SAR organization fits into the unified command and ensure your management team is well trained in Incident Command System (ICS) principles. For this support to work and not add to the frustration and confusion of the event, the staff must regularly train and practice as a team.

Discuss coordination with shore-side agencies and the importance of sharing information quickly.

Tip

Be sure to determine the maximum number of recovered survivors who can be loaded onto rescue boats and still maintain stability in the on-scene conditions.

7 ***The physical or emotional condition of survivors may prevent them from helping themselves.***

Cold water, poor health, injuries, or emotional stress may prevent many victims from swimming to and climbing into a life raft, or climbing out of a life raft to a rescue vessel. Additionally, their support needs will not end once they are aboard a rescue vessel or when they reach shore.

Many of the survivors will be too tired to walk up a ramp or even climb aboard a bus. Survivors may be cold, wet, and their clothes may be contaminated with spilled fuel or other hazardous substances necessitating decontamination and emergency clothing.

Tips

Rescue swimmers will be needed on scene, often for extended periods.

The response organization must anticipate the demands and plan for survivor support along the entire continuum of care.

8 ***Local communities are vital partners in providing shoreside MRO response actions, but most have minimal guidance or training on the functions expected of them.***

9 ***Once delivered to shore, accountability, emergency medical care, human health, shelter, food, and other survivor support needs must be continued and coordinated.***

Some of the most complicated MRO work starts once the survivors hit the beach, especially if the beach is a remote village with limited infrastructure.

Establishing shore landing sites and sheltering facilities, arranging transportation, and providing medical care, food, clothing, and other support all involve the local community. In fact, this portion of the response may last much longer than the on-scene rescue.

Unfortunately, many Coast Guard MRO plans stop at the beach. That may work for a few dozen survivors, but with several hundred or thousands of survivors, it's unacceptable. It is critical to know your partners and their responsibilities, capabilities, and expectations.

Encourage and assist your port partners in creating community mass rescue operation plans that incorporate existing local emergency response procedures and facilities while addressing MRO-specific differences.

Tip

This port-level planning is especially important for large ports where MRO coordination involves multiple community jurisdictions, several potential landing sites, mass media outlets, and the potential for survivors to easily find their own way home before final accountability.

Resources

Available online: A sample small community MRO plan for Kodiak, Alaska, as well as the brochures "Mass Rescue Landing Site" and "Mass Rescue Center Job Aid."

10 *Past success does not guarantee future results.*

Transfers, promotions, and retirements result in high turnover for Coast Guard personnel, so a continual training and exercising program is paramount.

This training and practicing cannot be conducted in a vacuum. To be a successful multi-agency response organization, partners need to develop, train, and practice jointly and regularly.

Go back and critically evaluate your plans. Ask questions like:

- Are they useful?
- Do they include all your response partners?
- Is a command organization identified?
- Does everyone have clear expectations and directions?
- Can you efficiently exchange information?
- Do you know what information to exchange?
- Is the command post identified?
- Do you have an accountability process, and does everyone know it?
- How will survivors be managed ashore, and who is responsible?

Once the plan is complete, conduct joint training to educate everyone on the plan and then exercise regularly. After each exercise or actual event, improve the plan.

Tips

Carry through on the necessary improvements. Each successive exercise should test new solutions and not simply identify old problems.

Resource

Additional information can be found in "Mass Rescue Operations Planning Guidance."

About the authors:

Mr. George "Rob" Lee is a U.S. Coast Guard passenger vessel safety specialist, and has served as a USCG commercial fishing vessel safety coordinator and fishing vessel safety examiner. His active duty Coast Guard service included marine safety and incident response. He also worked for the California Department of Fish and Game and the University of California, Davis.

Mr. Rick Janelle, U.S. Coast Guard passenger vessel safety specialist, has 30 years of active, reserve, and civilian emergency response and planning experience with the U.S. Coast Guard. Since 2002, he has been actively involved in maritime mass rescue response planning, especially the critically important shore-side component.

Endnote:

1. http://www.cbc.ca/news/canada/north/story/2010/08/29/north-cruise-ship-stranded.html

Online Resources

Available at http://www.uscg.mil/pvs/Handouts.asp

- Six-Step Process for Evacuee Accountability, Care, and Processing
- Communications Best Practices
- Emergency Radio Procedures
- Evacuee Handling—Landing Site Job Aid
- Evacuee Handling—Reception Center Job Aid
- Getting to Grips with the Human Factor
- GMDSS Chart
- Guidance for "Good Samaritan" vessel assisting in maritime search and rescue
- Guidance for "Good Samaritan" vessel assisting in maritime search and rescue—Alaska
- Helo Medivac Checklist
- ICS 201 - Sample. Mass Rescue Operations Ashore
- Maritime Mass Rescue Planning—A Quick Reference Guide
- Mass Rescue Landing Site—Shore Side Job Aid for agencies
- Mass Rescue Planning Guidance
- Mass Rescue Plan Example—Joint USCG Maritime/Community Plan, Kodiak, Alaska. Includes ICS-201 example.
- Mass Rescue Reception Center Job Aid—Shore Side Job Aid to Receive Survivors
- Multi-Agency Quick Start Guide for Passenger Vessel Emergencies
- Multi-Agency Quick Start Guide for Passenger Vessel Emergencies—Alaska
- Unified Command Recommended Response Priorities, Objectives, and Tasks
- Voyage Plan

Mass Rescue Operations

Passenger vessel safety specialists prepare ferry and cruise industries for catastrophe.

by LCDR Chaning Burgess
Port State Control Manager
U.S. Coast Guard Office of Vessel Activities

Coast Guard passenger vessel safety specialists examine passenger vessels and port infrastructures domestically and abroad and work to ensure the safety of American and international communities. They are responsible for keeping America prepared to respond to major waterborne catastrophes, such as those seen during Hurricane Katrina and the U.S. Airways flight 1549 emergency landing in the Hudson River.

Today, there are cruise ships that can carry thousands of people on voyages that circle the globe. What would happen if all these people needed rescue? Preparing for a mass rescue of this magnitude takes comprehensive planning and some savvy organization.

Admiral Thad Allen (USCG, retired) alluded to this during a recent radio interview while in New Zealand helping with U.S. relief efforts in response to the aftermath from Japan's earthquake. He was asked, "How do you go about managing expectations during a crisis management situation?" He said, "I focus on clearly, accurately, and concisely identifying the problem, and then creating a unity of effort by managing collaborative networks to respond."[1] This is also the mission our passenger vessel safety specialists work to accomplish.

Exercises with Industry

To accomplish their missions, passenger vessel safety specialists are joined at the hip with contingency planners, marine inspectors, and search and rescue response personnel. Their primary focus is to prepare any given area for a response that would otherwise inundate normal available resources. This preparation is four-tier, involving prevention, protection, response, and recovery forces throughout the Coast Guard and local communities.

Training with Industry

Passenger vessel safety specialists help the passenger vessel industry by working with a variety of domestic and international maritime organizations and interacting with national and international maritime response communities. They also work with state and federal agencies to help promote, establish, and maintain effective standards for passenger and crew evacuation that include:

- lifesaving,
- fire prevention,
- fire fighting,
- vessel construction,
- inspection,
- vessel security,
- vessel movement control,
- crew training.

These specialists also assist industry by providing training to Coast Guard personnel to ensure boarding officers, marine inspectors, and industry liaison personnel meet the public's and industry's expectations of high-quality service.

Research and Development

For the most part, USCG rescues involve a limited number of persons aboard a single vessel, aircraft, or facility. However, we occasionally encounter rescue missions—referred to as mass rescue operations (MROs)—that involve large numbers of people in distress, and may overwhelm conventional SAR resources. Rapid growth in the cruise ship industry

Notable Rescues

- **1897: Overland.** In this incident, 265 lives were saved after eight whaling ships were trapped in the Arctic near Point Barrow, Alaska. President McKinley sent a relief expedition to rescue the trapped crews.
- **1937: Mississippi River Flood.** Hundreds of Coast Guard personnel using 128 vessels responded in this disastrous flood. The scope of operations actually eclipsed that of the Hurricane Katrina rescue, responding to people and property across 12 states. CG personnel saved 43,853 lives.
- **1943: *Dorchester.*** After the transport vessel *Dorchester* was torpedoed off the coast of Greenland, CGCs *Escanaba* and *Comanche* responded, saving hundreds. Due to the frigid water and the size of the rescue, the crew on the *Escanaba* employed a new rescue technique called the "retriever," in which swimmers dressed in wet suits would swim to victims and secure them on a line to be pulled back to the ship.
- **1947: *Bermuda Sky Queen* Rescue.** The American-owned flying boat *Bermuda Sky Queen* was traveling from Ireland to Newfoundland when it ran into gale-force winds that threw it off course. When it ran out of fuel over the North Atlantic, the pilot decided to land the plane in 30-foot seas in proximity of the cutter *Bibb*. Worsening weather conditions made the transfer of passengers difficult, but all lives were saved.
- **1952: SS *Pendleton.*** In this double shipwreck, the tankers SS *Fort Mercer* and SS *Pendleton* broke in half while caught in a "nor'easter" off the New England coast. USCG vessels, aircraft, and lifeboat stations worked in severe weather conditions during this rescue, where all but five lives were saved.
- **1980: *Prinsendam.*** A fire broke out in the engine room on the Dutch cruise vessel *Prinsendam* as it sailed the Gulf of Alaska. The captain ordered the ship abandoned and the passengers, including many elderly, filled the lifeboats. U.S. Coast Guard and Canadian helicopters and ships responded in concert with other vessels in the area. All passengers and crew were rescued without any loss of life or serious injury.
- **2005: Hurricane Katrina.** After Hurricane Katrina struck the Gulf Coast, the Coast Guard responded by moving hundreds of small boats and many helicopters from all over the U.S. to assist in the rescue operation. The Coast Guard rescued or evacuated more than 33,500 people.
- **2009: Miracle on the Hudson.** The U.S. Coast Guard was part of an armada of boats that sped to the rescue when the commercial airliner made a splash landing in the Hudson River with 155 people on board. Rescuers successfully extracted all the passengers and crew.
- **2010: *Deep Water Horizon.*** The Mobile Offshore Drilling Unit *Deep Water Horizon* was engulfed in flames, forcing the crew to abandon the rig in survival craft. An offshore supply vessel was on scene and rescued many of those crewmembers. Several Coast Guard helicopters also assisted in the search for missing crewmembers. Out of the 126 persons aboard, 115 were evacuated or rescued.

and the role of the USCG in large-scale rescue and evacuation incidents, such as the 9/11 terrorist attacks and Hurricane Katrina, have created increased interest in the USCG's capability to conduct MROs.

In keeping with the Commandant's vision of the Coast Guard's role as "all threats, all hazards, always ready," the USCG's Research and Development Center has identified 13 mass rescue operations scenarios for which the USCG could have a major response role and ranked them on the basis of risk.

This effort included a historical review of MRO incidents and provided data on the frequency and consequences of these incidents, as well as on the effectiveness of USCG response efforts. We also held an assessment and analysis workshop for safety, response, and transportation professionals. The workshop participants discussed MRO incidents in detail, ranked them by category according to risk, and identified specific response needs and areas of concern associated with each category or scenario.

These scenarios were validated in a follow-up project that then examined response activities (including response gaps), defined functional requirements of potential response interventions, and determined the potential availability of intervention equipment.

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Mass Rescue Operations Exercise

In April 2009, the U.S. Coast Guard, Canadian Coast Guard, and other federal, state, and local agencies held a mass rescue exercise to test operational capabilities.

The Scenario

A cruise ship with 1,800 passengers and 700 crewmembers has grounded 28 miles northwest of Ketchikan, Alaska.

The ship's hull has breached and the vessel is taking on water. Additionally, there is a switchboard room fire, which hampers the response.

The Numbers

The three-day event was the second mass rescue operation of this level. It incorporated lessons learned from the 2007 Caribbean MRO exercise, and featured classroom training, a table-top exercise, and a full-scale shore side response exercise.

During this simulated response to the 2,500-person maritime mass evacuation, 600 volunteers simulated passengers and portrayed various types of "victims." In addition, the exercise included five phases of activity that took place across three geographical areas: Seattle, Wash.; and Ketchikan and Juneau, Alaska.

The Response

The joint response community tested the GMDSS notification system and coordinated and established the landing sites, passenger accountability process, rescue transport, and reception center operations.

Mass Rescue Operations Exercise

Participants included:

- **Industry stakeholders.** Cruise Lines International Association, Holland America Cruise Lines, Alaska Bus Tour Lines.
- **Foreign government participants.** Canadian Coast Guard, Canadian Consulate.
- **U.S. federal agencies.** U.S. Coast Guard, Customs and Border Protection, Federal Bureau of Investigation, National Transportation Safety Board, Transportation Security Administration, Department of Interior, National Oceanic and Atmospheric Administration.
- **State entities.** State police and public health department.
- **Municipal first responders.**

A volunteer poses as a passenger stricken with injury, being rushed by stretcher to receive emergency care. All photos USCG.

Volunteer "evacuees" from the cruise ship are transferred to a Canadian Coast Guard vessel.

Mass Rescue Operations Exercise

Objectives achieved include:

- Exercise provided realistic events that challenged the response capabilities of all stakeholders.
- Identified key logistical issues.
- Improved response coordination among industry, local, state, federal, and Canadian SAR agencies and personnel.
- Evaluated the effectiveness of information exchange among participants.
- Evaluated joint response planning and execution of shore side support.
- Tested the exchange of critical information throughout the command structure.
- Evaluated the crew/passenger accountability process.
- Coordinated and evaluated security procedures.
- Tested local emergency medical services triage and transport capabilities.
- Activated and evaluated southeast Alaska's metropolitan medical response system.
- Tested unified command's ability to handle an elevated public affairs incident.
- Identified problems and solutions during Coast Guard/industry follow-on hotwash meetings.

Hundreds of people participated. The goal was to create a plan, exercise it, and perfect it so that in the event of an actual emergency, responders would be well prepared.

The U.S. Coast Guard and the Holland America Line organized the exercise in conjunction with the Canadian Coast Guard and several other federal, state, and local agencies. The Incident Command Center was set in Seattle, Wash., the staging area for the Unified Command Center took place in Ketchikan, and the USCG Rescue Command Center was set in Juneau, Alaska.

Exercise staff at the staging area for the unified command center in Ketchikan, Alaska, coordinate rescue, transportation, and medical care.

MRO Scenarios Ranked By Risk

Scenario	Ranking
Domestic passenger vessel requires evacuation	1 (tie)
Large vessel sinks, passengers and crew must be located and rescued	1 (tie)
Natural disaster requiring air, land, sea rescue	3
Major casualty aboard cruise ship requires evacuation	4 (tie)
Rescue and interdiction of large number of refugees/illegal immigrants	4 (tie)
Airliner crash requiring passenger extrication and water rescue	6
Rescue of people from collapsed or burning waterfront building or facility	7
Rescue of individuals necessitated by bridge collapse or train derailment	8 (tie)
Small MRO (above local capability)	8 (tie)
Rig sinks; crew must be located and rescued	10
Waterborne evacuation necessitated by large-scale terrorist action, industrial accident, natural disaster, or nuclear/biological incident	11
Rescue of individuals stranded on an ice floe or on a ship beset in ice	12
Rescue of large number of people from flooded (or flooding) tunnel or other need for rescue	13

The project then revalidated intervention requirements and made conclusions and recommendations to address the ability of the Coast Guard or third parties to assist in maritime mass rescue response.

Program Leadership

America counts on the expertise and services that passenger vessel safety specialists provide, especially in a world where transport vessels are becoming larger and more complex, voyages more expansive and remote, natural disasters more frequent, and populations more dense.

The mass rescue operations program is led by the U.S. Coast Guard Office of Search and Rescue, which provides the program management, policy development, and oversight for the passenger vessel safety specialists. The office coordinates their funding and industry and interagency partnerships, as well as sponsoring the National Search and Rescue Committee and other SAR organizations. The office also works hand-in-hand with the Office of Vessel Activities to help ensure commercial vessel safety, security, and environmental protection compliance programs are being implemented correctly throughout the field.

About the author:

LCDR Chaning Burgess serves as a port state control oversight manager for the U.S. Coast Guard Office of Vessel Activities. During his service, he has served as a salvage and marine firefighting coordinator, senior marine inspector training coordinator, chief of waterways/aids to navigation division, and has managed the passenger vessel safety specialist program.

Endnote:

1. ASQ Weekly Radio Broadcast 2011.

International Search and Rescue

An air perspective.

by Lt. Col. Charles A. Tomko
Commander, Air Force Rescue Coordination Center
U.S. Air Force

ALERT

ALERFA: N644AP

Light Civilian Aircraft

Departure: Montreal, Canada (YUL)

Intended Arrival: Boston, Massachusetts (BOS)

Route of Flight: YUL YJN BTV LEB BHT BOS

Persons on board: Pilot, three passengers

Last known position: Radar 3 NM south of YJN heading south, descending out of 10,000 feet

This fictitious scenario of an “alert phase,” or ALERFA, is an example of the start of the process to search for a missing aircraft that has crossed the border between two nations.

There are myriad issues that could hamper a rescue response across an international border, such as security concerns, language and terminology differences, mismatched technology, and differing communication methods.

For example, a ground search and rescue team typically uses latitude and longitude references to aid search efforts, rather than the airfield codes noted in the alert.

Fortunately there are dedicated agencies constantly evolving the global search and rescue network to embrace these issues, respect sovereignty, and save lives.

Those who travel abroad via commercial aviation often look out the airplane window to view the expanse of an ocean or untouched, remote forestland. Hopefully the vast majority of these passengers will never hear the term ALERFA, much less be the subject of one. The air and maritime environment can be extremely unforgiving, however.

What would happen in the event of a crash landing in that remote wilderness? Who would search for those aboard? How would the responders know where to look?

Rescue Coordination Centers

In America, U.S. Air Force and U.S. Coast Guard duty officers and watch standers man federal rescue coordination centers (RCCs). They are supported by many other equivalent federal, state, local, and tribal agencies to report, search, locate, and find overdue or missing aircraft. But where does it end?

The answer: It doesn’t! The global search and rescue (SAR) network is integrated worldwide. Under the auspices of the International Civil Aviation Organization and the International Maritime Organization, signatory countries such as the United States agree to foster and field SAR capabilities in their airspace, over land and water.

You may ask, “How does that help me in a mishap? Who is looking out for me as a U.S. citizen, or a visitor to the U.S.?”

It begins and ends with the relationships that improve SAR capability worldwide. In the United States, the primary civil rescue response is coordinated by the

Air Force Rescue Coordination Center, Alaska Rescue Coordination Center, and the nine U.S. Coast Guard joint rescue coordination centers as well as two joint rescue sub-centers that stand watch 24 hours a day, seven days a week, 365 days per year. Many other federal, state, local, and tribal agencies have similar 24-hour integrated centers that provide rescue response for missing aircraft, missing vessels, missing persons, medical evacuation, and many other aspects of emergency response.

> As noted in its annual report, in 2010 the Air Force Rescue Coordination Center responded to more than 5,000 distress alerts.
>
> Of these, 550 were some form of distress alert outside the United States.

International Coordination

At the international level, the aeronautical search and rescue response is built upon the International Civil Aviation Organization (ICAO) Annex 12, which advises SAR services within its territories and over those portions of the high seas or areas of undetermined sovereignty.[1] States (in this case "states" refers to sovereign nations) that are party to the convention promulgate a framework in which the aviation traffic between nations is afforded a common search and rescue response. States maintain their sovereign borders, but agree to coordinate effective search and rescue services. In the same way air traffic services are coordinated to allow for cross-border air traffic, SAR services are likewise provided for.

States recommend common search and rescue plans and procedures to facilitate coordination of search and rescue operations with those of neighboring states. To affect this expeditious coordination, states should request assistance from other rescue coordination centers, including aircraft, vessels, personnel, or equipment, and grant necessary permission for the entry of such aircraft, vessels, personnel, or equipment into its territory.

To affect this, the world is divided into search and rescue regions, each with a rescue coordination center and associated SAR services that assign responsibility and delineate search and rescue missions. There are two important benefits that result from this method of organizing the global SAR network.

- It allows participating states with a defined SAR responsibility to concentrate resources in that area.
- It establishes the ability to coordinate with an adjacent region, as states agree to publish the contact information, coordinating procedures, and plan for SAR in their areas and adjacent areas.

A memorandum of understanding between the rescue agencies of the United States and Canada allows search and rescue personnel, aircraft, and vessels to coordinate, synchronize, and respond in a timely and effective manner.[2] This agreement respects the sovereignty of the two nations and allows for mutual support of search and rescue operations.

For example, along the United States and Canadian border, search and rescue aircraft in receipt of a distress alert or beacon can respond to the crash site and use the RCC and air traffic services to affect an immediate "state" entry for the purpose of lifesaving. The rescue coordination centers on both sides of the border conduct the necessary coordination to deconflict these actions and allow rescue forces to transit the boundary uninhibited by the routine process.

It May Be a Race, But It's Not a Competition

A key link in the air domain is the relationship and coordination between the aviation traffic service agency and the rescue coordination center. In the U.S., the Federal Aviation Administration air route traffic control centers and the RCCs are linked by phone and through the aeronautical fixed telecommunication network. This worldwide air traffic network receives alerts regarding missing aircraft in the form of INCERFA (when there is concern about the safety of an aircraft), ALERFA (alerts), and DETRESFA (reasonable certainty that an aircraft is in grave and imminent danger) notifications.[3]

In the example at the beginning of this article, an ALERFA notice issued to a rescue coordination center includes the information necessary to start the SAR process. A similar function would be provided from any air traffic service to its RCCs, with local variances based on each state's implementation process.

Another link is direct coordination between rescue coordination centers. While in many cases there are diplomatic and procedural guidelines to define coordination and contact between states, participating states have the framework to allow RCCs to maintain vital, immediate contact.

U.S. SAR Framework

Inside the United States, the SAR framework is developed under the National Search and Rescue Plan, which provides for a common federal response. Similar plans and capabilities at the state, local, and tribal level, when synchronized with the federal response, provide the holistic SAR framework for the United States.

To align the efforts of the federal agencies, which include the rescue coordination centers, there are memorandums of understanding among state search and rescue or emergency management agencies and the rescue coordination center in the applicable search and rescue region. These documents provide the basis of the framework, but it is the constant coordination and partnership building among the different agencies that serve to continue the process into an effective networked response.

It should be noted that inside the United States, the primary disaster response guidelines follow the National Incident Management System, which includes descriptions of the incident command system structure published by the Federal Emergency Management Agency. However, the International Aeronautical and Maritime Search and Rescue manuals and NIMS/ICS do not always coincide with each other. Therefore, the RCCs must "translate" between the two structural concepts.

For example, a state SAR team responding to a rescue mission involving an international aircraft in the U.S. would likely call the leader of the element the "incident commander," or IC. However, in the international lexicon this individual would be referred to as the "on-scene coordinator," or OSC. While this may seem like an insignificant issue, the subtlest or smallest confusion or misunderstanding can result in lost minutes, and in all rescue events, minutes matter.

For example, recently the Air Force Rescue Coordination Center received a call from the Japanese RCC regarding a U.S.-coded distress beacon just prior to the Air Force Rescue Coordination Center receiving the alert. This is an indication of the speed at which distress beacon alerts can be processed and the immediate link between RCCs. Information on the distress beacon, the owner, and the situation was shared between rescue coordination centers, and thankfully it was resolved as a non-distress situation.

ICAO/IMO Joint Working Group
All this coordination and effort is constantly evolving. It takes dedicated representatives at the international level to continue the process of planning between states. The International Civil Aviation Organization and International Maritime Organization have met this need by developing the ICAO and IMO joint working group on search and rescue. This international forum discusses coordination, tactics, techniques, and develops guidance to the international community to best promote effective search and rescue across the globe.

The United States is represented by members of the Air Force and the Coast Guard. The harmonization of the aeronautical and maritime environments is important to ensure an effective response regardless of the domain in which an aircraft or vessel finds itself. The product of this harmonization is the International Aeronautical and Maritime Search and Rescue Manual, which contains three volumes that provide guidelines for international search and rescue.

While not directive in nature, the signatories to the ICAO and IMO agreements utilize these guidelines in building their national search and rescue framework. How each state responds internally to its country is a sovereign issue; however, an effective SAR effort in coordination with another country is best developed following this guidance.

You Can Find a Friend in Emergency, but You Can't Make a Friend in an Emergency
The true power in this harmonization is the ability for nations to understand the response of the other nation and synchronize rescue capabilities, communication, and coordination.

Within many nations there are requirements for aircraft and maritime vessels to carry distress beacons based on the search and rescue satellite-aided system. There are three main types:

- emergency locator transmitters (ELTs) for aviation use,
- emergency position indicating radio beacons (EPIRBs) for maritime use,
- personal locator beacons (PLBs).

When activated, each of these beacons provide a distress alert to the country in which they activated and the country in which they are registered. However, all distress beacon alerts that are U.S. coded and located outside of U.S. SAR regions will be routed to a U.S. rescue coordination center. ELTs and PLBs alert to the U.S. Air Force rescue coordination center, and EPIRBs alert via the U.S. Coast Guard Atlantic Area.

So the next time you book a flight, board an aircraft, or visit friends and family overseas, take a moment to consider that there are many others involved in that flight other than the flight crew and ground teams. Countless unseen others in states and nations around the world are active in the SAR infrastructure as a virtual bubble around that aircraft you are flying on, ready to respond in an effective and timely manner to bring rescue forces on scene.

Just as you can call "911" to get fire, police, and emergency services, in the air traffic environment are there call centers, the RCCs, and many other agencies partnered globally for a networked response.

About the author:
Lt. Col. Charles Tomko has served in the U.S. Air Force for 20 years as a fixed wing rescue and special operations pilot, with combat deployments to numerous overseas areas and assignments ranging from squadron command to the joint staff at the Pentagon.

Endnotes:

1. Convention on Civil Aviation (Chicago Convention), Annex 12 — Search and Rescue, original convention signed by United States August 9, 1946.
2. Memorandum of Understanding for Co-operation Between Canada, the United States and the United Kingdom Concerning Search and Rescue, 1999.
3. Federal Aviation Administration, "Subject: Flight Services, Section 3. Alerting Service," JO 7110.10U, February 11, 2010.

121.5 MHz Not Monitored

It is important to note that in the aviation community, while many are converting to the digital 406 MHz SARSAT-compatible beacons, many still retain and install the older 121.5 MHz beacons.

However, in February 2009, the space-based system terminated monitoring the 121.5 MHz signal.

While many 406 MHz beacons retain a 121.5 MHz signal that ground rescue teams might use, the space system does not detect it. In fact, unless an aircraft flies nearby, that signal may never be heard.

Catastrophic Event Search and Rescue

NORTHCOM coordinates and standardizes SAR efforts.

by Mr. Joseph Sokol, Jr.
Col. U.S. Air Force (Ret.)

The Katrina Experience

As the sun was rising over New Orleans on September 3, 2005, I was among team members from United States Northern Command (USNORTHCOM) who arrived to support the response to Hurricane Katrina. The Superdome evacuation was in its final stages, but there were still many search and rescue (SAR) missions going on throughout the greater New Orleans area.

As our USNORTHCOM team became more involved in the SAR effort, we discovered there was little operational-level coordination or synchronization, and there was no standardized method to link the air, ground, and boat searches. The only coordination was at the local level, with the ground teams and pilots coordinating before they departed and after they returned from flights.

In short, there was no national plan that addressed these issues during a large-scale catastrophic event, and by the time there was a reasonable level of coordination among the state, local, federal, and military agencies, response to the hurricane was in the recovery phase.

USNORTHCOM and SAR

After the Hurricane Katrina experience, we were invited to participate in the National Guard aviation and safety after-action review. As issues were raised and we looked for the appropriate organization to provide leadership, the standing question was: "If not NORTHCOM, then who?" So began the USNORTHCOM involvement in search and rescue.

In March 2006, USNORTHCOM hosted an interagency catastrophic incident rapid response planning conference to work on SAR operational planning. Also, during the summer of 2006, the Federal Emergency Management Agency asked USNORTHCOM to assist Louisiana and the city of New Orleans in preparing for the hurricane season.

The team set to work, coordinating with the U.S. Coast Guard, Louisiana Department of Wildlife and Fisheries, Louisiana National Guard, New Orleans Police Department, and other partners to build an interagency plan based on concepts of inland civil, maritime, and urban SAR; close air support; and mass rescue operations. The result: A plan that was synchronized, integrated, and supported the survivor all the way to a place of safety.[1]

A National Plan

Using the Louisiana planning effort as a springboard, USNORTHCOM elevated operational concepts to the Coast Guard and the National SAR committee. USCG Office of Search and Rescue staffer Rick Button then coordinated a catastrophic incident search and rescue addendum for the National SAR Supplement that compiles doctrine from various SAR disciplines to standardize how federal responders will conduct SAR.[2]

By 2007, emergency support function (ESF) # 9—search and rescue—had been significantly revised and improved from the Hurricane Katrina experience, but collaborative planning identified more room for improvement. The post-Katrina revision expanded ESF #9 from urban search and rescue, which was primarily focused on collapsed structures, to encompass all search and rescue in any environment.

Of particular significance to USNORTHCOM, the revision elevated the Department of Defense to one of four agencies having primary responsibility for ESF #9 in partnership with FEMA, the USCG, and the National Park Service. Harnessing collective experiences, the primary agencies held a series of workshops to evolve and improve ESF #9 based on lessons and best practices from numerous planning activities and operations. The revised ESF #9, approved in February 2011, further defines roles, responsibilities, and expectations of the federal partners.

SAR Coordinator

Throughout this period, some at USNORTHCOM asked, "Now that USNORTHCOM is the geographic combatant command for North America, why is the Air Force still the SAR coordinator in the inland region?"

For more than 50 years, the U.S. Air Force has provided exemplary service to the nation in support of civil SAR. However, since USNORTHCOM has homeland defense and civil support responsibilities, it seemed logical that the role should shift to the combatant command. In November 2009, the Secretary of Defense designated the commander of USNORTHCOM as inland SAR coordinator for the contiguous 48 states.[3]

This designation triggered a review of SAR coordinator responsibilities and mission analysis, resulting in a comprehensive SAR mission statement and concept of operations.

Some key SAR coordinator tasks include:

- arranging or providing for SAR services,
- supporting civil authority requests for assistance,
- developing and promulgating SAR policies and supporting documents,
- coordinating joint and interagency SAR training and exercises.

In summary, the commander of USNORTHCOM and headquarters staff would be responsible for strategic duties while the commander of Air Forces Northern would provide operational and tactical SAR mission coordination.[4]

USNORTHCOM Rescue Coordination Center

Our experiences with catastrophic incident SAR planning and operations informed us that there are not nearly enough specialized personnel to assist with planning and operations for catastrophic events. Therefore, the commander of USNORTHCOM and the commander of Air Forces Northern worked to establish a joint personnel recovery center located at Tyndall Air Force Base, Fla., alongside the Air Force rescue coordination center. These two organizations now work together in mutual SAR support.

Military Support to Urban Search and Rescue

As a part of continuing review and improvement efforts, in 2010 FEMA identified a potential shortfall of urban search and rescue capability in catastrophic incident SAR response. It requested a concept of operation for the military to augment urban search and rescue task forces.

So in collaboration with FEMA, the National Guard Bureau, and other stakeholders, USNORTHCOM developed a concept that includes the option for a trained and skilled response from state National Guard and active military search and extraction elements and flexible enabling support provided by troops that are not specialized in search and rescue. It also includes a training syllabus to provide just-in-time, onsite training in the basics of SAR support and safety to non-SAR responders. This entire military support initiative was exercised during the recent FEMA-led national-level exercise, and lessons will be used to increase our national capability.

To carry collaborative efforts forward, USNORTHCOM has directed military responders to use civil SAR standards, terminology, and procedures unless supported SAR authorities direct otherwise, and has directed the military to use the Catastrophic Incident Search and Rescue addendum for planning and operations. Likewise, USNORTHCOM uses incident command system forms and terminology.

The Future of USNORTHCOM and SAR

USNORTHCOM continues to strengthen relationships at the local, state, and federal level. We work closely with the USCG Office of Search and Rescue to ensure that USNORTHCOM fulfills its responsibilities as SAR coordinator, and we work with FEMA and our partners to ensure that there is no gap in operational coordination and tactical execution. We also look for innovative ways to increase capability and shorten the response timeline to support the lifesaving mission. To that end, we are working very closely with states and the National Guard bureau to coordinate National Guard SAR response.

Recognition for Ike Response

USNORTHCOM was awarded the National Eagle Trophy for Valor from the National Institute for Urban Search and Rescue in recognition of joint operational support during Hurricane Ike, throughout which military personnel flew nearly 900 hours in dangerous conditions to save over 400 lives.

Recent Successes

USNORTHCOM's CDR Pat Merrigan was integrated into collaborative planning and operations to prepare for flooding in North Dakota. In these efforts, a multi-agency, federal state unified air operations branch/SAR branch serves under the North Dakota Department of Emergency Services as part of an all-domain SAR team in support of the state of North Dakota and FEMA Region VIII.

In other advancements, a recent FEMA initiative captures best practices for planning and operations via a deployable federal SAR coordination group. This group of experts from the primary agencies will deploy in support of a requesting agency to assist in SAR planning and operations and to help build the linkage to federal SAR partners.

To take this initiative to the next level, USNORTHCOM is examining the concept of a deployable rescue sub-center to assist local SAR authorities in managing large-scale SAR response.

As we build capability, we are applying the lessons we learned with the USCG, FEMA, and our SAR partners in Louisiana, Texas, and most recently in North Dakota. We are working toward catastrophic incident search and rescue agreements with all states to plan and specify what level of operational support will be requested of USNORTHCOM, the USCG, and other federal partners to assist any search and rescue coordination request and ensure rapid SAR response.

About the author:
Mr. Sokol has been the chief of Search and Rescue and Personnel Recovery at USNORTHCOM since September of 2009. While on active duty, he served as a USNORTHCOM team chief deployed to support Hurricane Katrina response, and led Department of Defense planning in support of FEMA and Louisiana in 2006. He has three combat tours, has more than 3,300 hours of flight time, and commanded at the flight, squadron, and group levels in the Air Force.

Endnotes:

1. "Improved Search and Rescue Operations for the Hurricane Season," The Air Land Sea bulletin, September 2006. Lt Col Jim Zietlow and Mr. Tim Sutlief, ALSB 2006-3.
2. Catastrophic Incident Search and Rescue Addendum to the National Search and Rescue Supplement, version 2.0, November 2009.
3. Memorandum for Commander, U.S. Northern Command, Designation as Inland Search and Rescue Coordinator, November 4, 2009.
4. The concept of the operation is that the commander of USNORTHCOM (CDR USNORTHCOM) retains the title and role of inland SAR coordinator and all attendant policy governance responsibilities. CDR USNORTHCOM delegates to CDRAFNORTH the Federal Routine Aeronautical SAR Coordination Authority for the Langley search and rescue region and the authority to coordinate and execute catastrophic incident SAR. SAR coordinator duties that are strategic in nature will be accomplished by HQ USNORTHCOM, while operational duties and authorities are delegated to CDRAFNORTH/Joint Forces Air Component Commander. USNORTHCOM will assume the role of an ESF #9 primary agency and will be prepared to assume overall primary agency responsibilities if so designated.

A Smartphone to the Rescue

Only one thing was clear: "Call the Coast Guard!"

by LT Scott Farr
Operations Unit Controller
U.S. Coast Guard Fifth District
Rescue Coordination Center Norfolk

Just months after reporting aboard as a recently qualified operations unit controller from the National Search and Rescue School, LT Scott Farr and his watch team would need all their training, abilities, and resourcefulness to save three lives on a fall evening in 2009.

This is his account of the events as they unfolded.

In June 2009, Ken Kell and Ashley Acheson of Ontario purchased a 48-foot sailboat and renamed it the *Element Quest*. They planned to take the sailboat on a 35,000-mile journey around the world. On November 2, 2009, at 1:30 p.m., the *Element Quest* and its third crewmember Daniel Simec set out on the initial leg from New York to Bermuda.

Ashley Acheson and Ken Kell aboard the *Element Quest*. Photo by Geoff Cunningham, Jr., courtesy of Fosters Daily Democrat.

At 4:31 p.m. on November 6, 2009, Rescue Coordination Center (RCC) Halifax, Nova Scotia, provided the U.S. Coast Guard Fifth District command center with a relay from Canada—Brian McGraw, a friend of the crew on the *Element Quest*. McGraw explained that he had just returned from work and heard a voice mail from Ashley Acheson, recorded at 7:21 that morning.

Brian Neilan and I took the initial call from Halifax and listened to the voice mail McGraw played over the phone. Although the audio quality was not very clear due to howling wind and rain, it was apparent that Ashley was screaming into the satellite phone, trying to provide their current position. Out of the entire recording, there was only one thing at the end of the voice mail that was crystal clear: "Call the Coast Guard!"

The Response

All on the watch floor agreed that this was a vessel in distress somewhere between New York and Bermuda—a track line of at least 630 nautical miles. That's a lot of water to search, and the limited information didn't provide an initial position. We discussed deploying a U.S. Coast Guard C-130 Hercules to search for the vessel and worked to determine the best search area.

At 5:12 p.m. we queried RCC Bermuda, but it had no amplifying information. District Five then sent out an enhanced group call covering the sailboat's intended track line. The enhanced group call allows broadcast messages to selected groups of ship stations located anywhere within a satellite's coverage.

While the watch continued prosecuting the case, other personnel calculated a cold exposure survivability model. The results were grim. Ashley's voicemail was left at around 7 that morning. If the three crewmembers were in the water with no survival gear, the report showed only seven hours of functional time and approximately 11 hours of survival time. With survival gear factored in, the results were only slightly better—just over nine hours of functional time and 13.8 hours of survival time.

Narrowing the Search Area

After talking with family members, the watch learned that the sailboat had a satellite phone, SPOT device,[1] an emergency position indicating radio beacon (EPIRB), signaling devices, dingy, and a VHF radio. No EPIRB notifications had been received from the sailboat, so we contacted the SPOT command center personnel for any positional data that they might have and learned that the last position of the *Element Quest* as of November 3 was 60 nautical miles from New York.

From the time the initial phone call came in from Halifax, the watch floor became a flurry of activity, with three watch turnovers occurring within an hour and a half. LT Mark Briggs relieved Brian Neilan, and at 6:15 p.m., LTJG Michelle Foster relieved me. But I wasn't satisfied with the largely estimated positions that Brian and I had come up with and I wanted to try and continue narrowing down the search area.

Technology and Perseverance to the Rescue

I remembered that McGraw had the same model of smart phone that I did, so I asked him to e-mail the audio file of the voice mail to me, in the hope that it could be improved. Of course, that's easier said than done. McGraw e-mailed the file with no problem, but when I forwarded it to the command center the file couldn't be accessed on a Coast Guard workstation.

We had to convert the file into a usable format before it could be manipulated with our digital audio editing software. I used a stand-alone computer to convert the file from the audio file format used in the cell phone into a Waveform (.wav) audio file format. From there personnel could manipulate the file to help clear up the position provided in the beginning of the voice mail.

New Information Guides the Search

Operations Specialist Senior Chief Carla Harsch and LT Jon Parker repeatedly listened to the edited file and pieced together a position that best correlated to the sailboat's track line. The updated estimated position was 63 nautical miles southeast from the first estimated position. LT Briggs and LTJG Foster entered this updated information into the Search and Rescue Optimal Planning System (SAROPS)[2] as the new probable last-known position. The new position was given to the now-airborne C-130 out of Air Station Elizabeth City, which was tasked to fly directly to that position before commencing an initial track-line search.

LT Briggs, LTJG Foster, and OSCS Harsch continued to formulate search plans in case the airborne C-130's initial search produced negative results. Fortunately, "Plan B" wasn't necessary. As the C-130 flew toward the estimated position that had been determined with the help of the improved audio file, onboard personnel were able to raise the *Element Quest* on a VHF radio. Pilot LCDR Brian Eckley stated, "We heard a Mayday call, established communications, and determined the call was from the sailboat we were looking for."

The Rescue

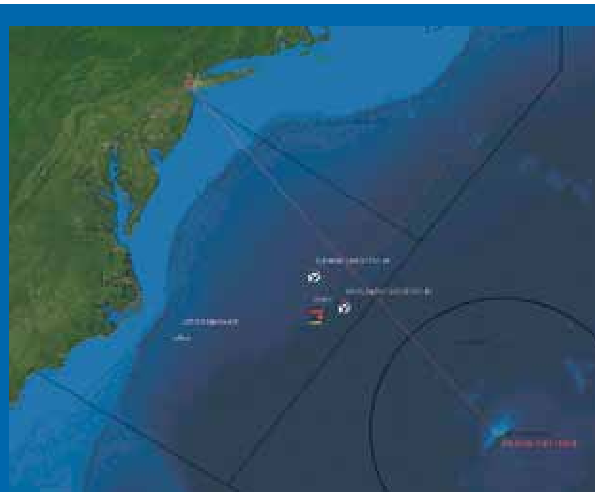
The *Element Quest* was located only 47 nautical miles southwest of the second estimated position. While the C-130 remained overhead to provide hope to those below and act as a communications relay, an MH-60 Jayhawk launched from Air Station Elizabeth City.

The MH-60 crew reported weather of 10-foot seas, 30-knot winds, heavy rain, and minimal visibility.

In this SAROPS screen shot, the dotted black lines represent the areas of responsibility for U.S. Coast Guard District 5 in Portsmouth, Va., and District 1 in Boston, Mass., and the black boundary around Bermuda is its EPIRB area of responsibility. The red line illustrates the most direct voyage from where vessel originated to its destination port.

This SAROPS view also shows the location of the USS *Eisenhower*, which was available to refuel the rescue helicopter.

The amplifying information from the voicemail allowed us to plot an updated position for the vessel, labeled "S/V Element Quest Est #2." Due to the severe conditions, the vessel drifted about 50 nautical miles from this position.



Social Media Effort

Sharing voice mail via smart phones wasn't the only unconventional method used to gather information for this case.

Personnel put a message on Ashley's Facebook page in the hope that a friend tracking the sailboat's progress might have heard from them and could provide a better position.

Ken and Ashley were in good shape, but Daniel had sustained a back injury. All three were hoisted safely and later treated at the Albemarle Hospital in North Carolina.

The Aftermath

The *Element Quest* had sustained damage to its main sail from rough weather. Ken would later describe 60-knot winds and a wave height that ranged between 60 to 100 feet. The sailboat was hit abeam by a rogue wave that rolled it, tossing out their EPIRB and SPOT device, leaving them only with a satellite phone and VHF radio. When the sailboat rolled, they were 400 nautical miles offshore.

This case still stands out at the Fifth District. Although it was prosecuted with all standard search and rescue protocols, the actions and investigative work done at the Fifth District Command Center were unconventional. Add the distance offshore and the logistics it took to coordinate this mission, and the rescue becomes near miraculous. "This was a particularly proud moment, as this was the first time I had a chance to really apply SAROPS and what I had been taught at SAR school, which resulted in a real find and saving lives," said LT Briggs.

The survivors from this incident also realize they are extremely lucky to be alive. After this rescue at sea, the Fifth District Command Center received a Christmas card from Ken's mom. She was thankful that, through their determined efforts, Ken was able to be with family and friends during the holidays.

"This is all that we need," said Senior Chief Harsch, "To know that our actions positively affected the lives of those that we have never met."

About the author:

LT Farr has served in the U.S. Coast Guard for seven years. He holds a bachelor's degree in computer science and graduated from Officer Candidate School in 2004. Before being assigned to the Fifth District, LT Farr was the executive officer at Station Seattle. He is currently pursuing a master's degree in homeland security.

Endnotes:

1. A SPOT device is part of a product family that uses the GPS satellite network to determine a customer's location and the Globalstar network to transmit messages and GPS coordinates to others, including an international rescue coordination center.
2. SAROPS is a Monte Carlo-based system that uses thousands of simulated particles generated by user input in a wizard-based graphical user interface. This software can handle multiple scenarios and search object types, model pre-distress motion and hazards, and account for the effects of previous searches. SAROPS also uses the latest drift algorithms to project the drift of the survivors and craft.

Rescue Crew Honored

The crew of CG-6034, the rescue helicopter that hoisted the sailors to safety, pose with their spouses in Times Square, New York, after being awarded the Coast Guard Foundation's Award of the Year.

Crew pictured from left are flight mechanic AET2 Brandon Critchfield, rescue swimmer AST1 Edwin Hannah, aircraft commander LT Anthony DeWinter, and co-pilot LT Thomas Huntley. Photo courtesy of LT Thomas Huntley.

Helping You Safely Help

Good Samaritan search and rescue support.

by Mr. Rick Janelle
Passenger Vessel Safety Specialist
U.S. Coast Guard District 17

Mr. Paul Webb
Senior Controller
RCC Juneau

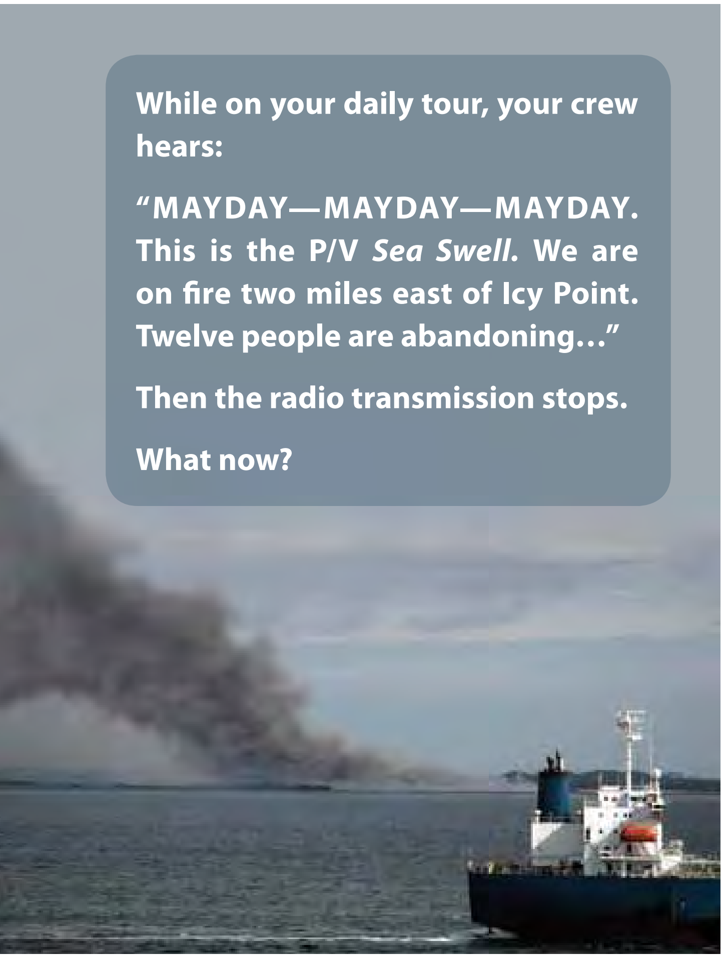
LT Byron Hayes
Senior Controller
Sector Houston-Galveston

While on your daily tour, your crew hears:

"MAYDAY—MAYDAY—MAYDAY. This is the P/V *Sea Swell.* We are on fire two miles east of Icy Point. Twelve people are abandoning…"

Then the radio transmission stops.

What now?



The Coast Guard surpassed the 1 million-person-saved milestone several years ago. Some of you may be included in the million-saved total, but it's more likely that many of you were on the other side of the rescue operation and contributed to our rescue efforts.

We appreciate your help and will continue to rely on it, as our assets are spread too thin to ensure we're always the first to arrive on scene. The odds are good that one day your vessel may find itself as the first rescue resource for an incident. To ensure the safety of your vessel and its crew, you must understand the search and rescue organization, critical communication requirements, and the duties and responsibilities of the first vessel on scene.

Search and Rescue Organization

Worldwide aeronautical and maritime search and rescue is well organized and highly coordinated. There are international, national, and agency-specific search and rescue plans and procedural manuals. For example, U.S. Coast Guard search and rescue (SAR) plans divide the oceans of the world into search and rescue regions, each of which is the responsibility of a dedicated rescue coordination center (RCC). In the U.S., an RCC may be further subdivided into smaller areas managed by sector command centers.

There are two positions critical to this SAR organization:

SMC The SAR mission coordinator (SMC) is the person at the rescue coordination center who is in charge of planning and directing a specific operation. For maritime incidents in the U.S., Coast Guard personnel serve as SMCs.

OSC The on-scene coordinator (OSC) is the person or unit designated by the SAR mission coordinator to coordinate operations on scene and implement the mission coordinator's SAR plans.

Important Recommendations

People come first, boats and equipment later. Those in the water without personal flotation devices are a top priority.

Only the on-scene coordinator should attempt to contact the distressed vessel. The master has an emergency on board, and therefore does not have time to respond to multiple requests for similar information.

Check and double-check the number of people recovered on each rescue vessel.

Do not attempt a rescue that exceeds the limits of your capabilities, your training, or your vessel.

Do not place your vessel, crew, or passengers in serious danger.

Have a plan prior to action. Communicate the plan as well as your expectations to your crew and, if possible, to the distressed vessel.

Keep the Coast Guard informed of your actions.

Know how you will recover survivors onto your vessel. This is especially important for high-sided vessels.

Ensure all crewmembers are wearing safety gear required for the rescue.

The Role of the Good Samaritan

For centuries, maritime tradition—the old "law of the sea"—compelled mariners to help fellow sailors in trouble. This tradition is still very much alive. Additionally, federal statute also requires a master to render assistance if the master can do so without serious damage to the vessel or individuals aboard.

The standard of care for a Good Samaritan vessel is to exercise reasonable care to avoid negligent conduct that worsens the position of the victims and also to avoid reckless and wanton conduct in performing the rescue actions.

Good Samaritans are vessels that render voluntary aid without compensation to a person or vessel in distress.

Good Samaritans are often the first vessels to arrive on the scene of a casualty. If you find yourself in this position, alert the Coast Guard that you are prepared to assist. Depending on what other assets are responding and their arrival time, the SAR mission coordinator may designate you as the on-scene coordinator. You can expect to retain this role until a Coast Guard cutter or other more capable vessel can relieve you. The SMC will broadcast this information and direct all assisting vessels to report to you upon arrival and departure.

Functional OSC actions that you should be prepared to assume normally include:

- ☑ Conducting tasks assigned by the SAR mission coordinator.
- ☑ Directing immediate rescue operations.
- ☑ Providing direction and tasking to arriving rescue vessels.
- ☑ Serving as the sole communicator to the distressed vessel.
- ☑ Providing the SMC with information such as:
  - ☐ Weather, wind, and sea state and their effect on the situation.
  - ☐ Drift rate of vessel and potential to drift aground.
  - ☐ Vessel description: draft readings, visual damage, list, fire or smoke observations, location of passengers or crew, what passengers or crew are wearing, number and condition of people recovered.

- On-scene search actions, resources on scene, recommendations, and potential problems.
- Significant events and changes to the distressed vessel.
- Name of each rescue vessel on scene.

Most importantly, if you are the on-scene coordinator, you must track the number and location of survivors. Do not let vessels depart with survivors until their contact information, vessel names, destination, and number and condition of survivors is known and recorded. Relay this information to the SMC as soon as practical. If you are not the OSC but have survivors aboard, make sure this information is communicated to the OSC before departing.

The Response Process

To illustrate how this all fits together, let's revisit the incident at the beginning of this article.

Your vessel heard the Mayday call from the pleasure vessel *Sea Swell*, but since the transmission was cut short, did anyone else? Your crew should write down the Mayday information—especially the location. You should then listen closely for a Coast Guard response, and follow those instructions.

If a Coast Guard reply is not immediate, radio the Coast Guard while traveling toward the distressed vessel, relay the Mayday information, and follow any direction. Then attempt to alert the distressed master that you heard his call and are proceeding to the scene.

En Route

Begin your rescue planning and risk assessment so you're prepared to safely execute a rescue when you arrive.

- Inform your crewmembers and passengers of the situation, provide clear directions for their safety, and evaluate crowd-control measures that may be required to keep your passengers from interfering.
- Develop a plan for a safe approach to the scene, accounting for weather and sea conditions.
- Prepare equipment to recover people from the water or survival craft.
- Clear a work area on your vessel.
- Determine if any passengers have medical skills to treat the injured (such as burn victims in the case of this vessel fire).
- Maintain contact with the Coast Guard and, if possible, with the distressed vessel master. Communications will be critical. If possible, bring additional personnel to the bridge to assist.
- Coordinate to ensure that the radio frequencies used on scene can be monitored by the command center. We recommend you use a separate frequency, cell phone, or satellite telephone for rescue vessel-to-shore communications.

Once On Scene

As you approach the distressed vessel, contact the SAR mission coordinator to report your initial observations.

Continue your risk assessment. Ask yourself questions such as:

- Does the location and condition of distressed passengers and crew permit safe rescue?
- Does the planned rescue exceed the limits of your training, vessel, or crew experience?
- Does the rescue place your vessel, crew, or passengers in serious harm?
- Is additional or better-trained assistance needed?
- How will the wind, waves, current, tide, and/or water temperature impact the rescue?
- What is the condition of the distressed vessel? Will it sink or drift ashore? Can it be safely approached given the current conditions?
- Is safety equipment needed to complete the rescue available?
- Are you trained and equipped to tow the vessel to safety?
- Do you have a means to recover people from the water or a survival craft?
- Are there serious injuries, and are you prepared to provide first aid?
- Is your crew properly equipped? Are rescue crews wearing PFDs and other required safety gear?

Gather Important Information

If the distressed master remains aboard and his radio equipment is operational, maintain communications with him. Confirm the number and condition of people that are aboard, in rafts, or in the water.

Review his priorities and recommendations and brief him on your intentions and plan of action. This communication will increase his confidence in you and your actions.

Update the SMC, jointly identifying the best available landing site for evacuees to be offloaded, and finalize your rescue plan.

Brief the Plan

Before conducting any action, brief your crew so everyone understands who does what, why, where, when, and how. It's very important that all understand the plan and their roles in it; otherwise you may cause more problems than you solve.

Work the Plan

Once on scene, take control and activate your plan. Manage other arriving rescue vessels and provide directions or tasking according to your plan. People come first, boats and equipment later. Recover those in the water without personal flotation devices first, especially in cold water regions.

Assign a crewmember to begin a written log to track all rescue resources as they arrive or depart and record the recovery of people from the distressed vessel. Double-check the number of people recovered on each rescue vessel. Accuracy is critical. If possible, re-confirm with the distressed master the number of people aboard. Do the math to determine if everyone is rescued or some are still missing.

Continue to stress safety to everyone, and caution other rescue vessels not to exceed their capabilities. Most important, keep the SAR mission coordinator updated on the situation, especially the number of people recovered.

Rescue efforts continue until everyone is accounted for or until the Coast Guard cancels operations.

Closing Recommendation

Discuss with your crew their level of comfort if asked to assume the functions of an OSC, and determine what additional training or skills are required for their success. If needed, develop a company basic rescue assistance plan or policies, and make it part of your training program.

As required, request basic SAR support training from the local sector command, and investigate opportunities to conduct joint training with the Coast Guard or other SAR organizations.

About the authors:

Mr. Rick Janelle, U.S. Coast Guard passenger vessel safety specialist, has 30 years of active, reserve, and civilian emergency response and planning experience with the U.S. Coast Guard. Since 2002, he has been actively involved in maritime mass rescue response planning, especially the critically important shore-side component.

Mr. Paul Webb is a U.S. Coast Guard Search and Rescue specialist, with 21 years of active duty experience. For the past nine years, during his civilian service, he has been responsible for planning and coordinating active search and rescue cases, planning search and rescue exercises, and developing policies for responding to search and rescue emergencies.

LT Byron Hayes has served in the Coast Guard for 10 years, six of which have been spent working in command centers. LT Hayes has been stationed in Portsmouth, Va.; assigned to the Coast Guard's Atlantic Area Command Center; and assigned to Sector Juneau, coordinating search and rescue response efforts in Juneau, Alaska.

Accident Prevention: Best Practices

Safety the way it ought to be done.

by Mr. Rick Janelle
Passenger Vessel Program Coordinator
U.S. Coast Guard District 17

All professionals have a duty to provide their services in a manner consistent with their profession. But what does that mean?

The most basic explanation as it relates to safety: generally accepted standards for how to accomplish missions safely, effectively, and efficiently. A lawyer might say something like, "The degree of care or prudence that practitioners of the same specialty would utilize under similar conditions." In my opinion, this leaves room for discussion, personal interpretation, and an opportunity for billable hours.

The Way it Ought to be Done
The best workable definition of best practices I recall came from Clarence, my supervisor when I worked for a central Maine roofing company back in the 1970s. Clarence didn't talk about best practices, but he did know the way roofing ought to be done.

He showed me the proper use of a shovel and broom, how to push a wheelbarrow, hold a hammer, position a nail, set a shingle, and a variety of other functional skills that some supervisors would take for granted that I already knew. But Clarence took the time to explain what he expected, train new crew, and enforce his standards.

I can testify that Clarence had no problem with enforcement. If he saw any violations of his practices, sharp words and spit started flying. And it worked. His crews got the work done, on time, under budget, with no injuries. Customers were satisfied and referred new business our way.

So there you have it. Best practices are ways "it ought to be done." It is your daily practice of excellent safe operations. Thanks, Clarence.

If he saw any violations of his practices, sharp words and spit started flying.

Who Establishes Best Practices?
Best practices may be established by statute, common practice, specialty boards or organizations, or individual companies. In most cases, maritime best practices established by statute and regulation should be considered the minimum level.

Note: Best practices established by "common practice" need your careful attention and evaluation. Just because that's the way it's always been done does not mean it's still the best or safest method. Changes in the natural environment, vessel traffic patterns, vessel design, navigation equipment, regulations, and customer expectations make some common practices dangerous.

Investigate and make sure that common practices remain valid. It may only be by luck that something has not gone wrong.

Area-specific Practices
Best practices that go beyond the existing regulations or address specific situations or waterways may be established by either professional organizations or by agreement of individual users of the resource. These practices are usually more specific than regulatory

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Developing Best Practices

At a minimum, you should address the following topics to develop best practices.

Area Familiarity

- Define your area familiarity qualification process. For example, how many pre-transits of the areas with an experienced mariner are required? As a minimum, ensure your requirements meet any legal requirements for vessel and class of service.
- Define how operators will demonstrate their knowledge of the waters, navigation aids, hazards, vessel traffic patterns, rules, and protocols.
- Define your refresher trainer requirements.

Bridge Resource Management

- Define the company process for bridge management. Who does what? Clarify expectations, training requirements, procedures, and policies.
- Are exceptions permitted? Under what situations?
- Make sure all crewmembers know how they mesh and how important this is.
- How will electronic charts be utilized? What position fixes are required?
- As required, identify specific procedures for difficult navigation areas.

Restricting Passengers from Bridge

- Define conditions, locations, and other situations where passengers will not be permitted on the bridge.
- Make sure passengers are aware of the standards beforehand to avoid problems.

Communications

This can be viewed from both the hardware and procedural perspective.

- Does the company have the equipment available to communicate with the home office and emergency responders everywhere along its route? If not, what is the acceptable level for "no communication" capability? If 100% communication capability is the desired standard, then additional equipment may be required.
- From a procedural view, define where, when, what, and how vessels are to report.
- Detail your practices for keeping passengers informed of the situation during an emergency.

Safe Distance from Known Navigation Hazards

Specify company policy for safe distances to maintain from navigation hazards. You can keep this a general standard or make it hazard-specific. As required, prohibit transit of certain areas at all times, on specific tides, or depending on current or other weather conditions.

Reduce Speed in Hazardous Situations

This may seem like common sense, but don't bet the farm that it will automatically happen.

- Define company-specific practices during voyages with heavy seas, restricted visibility, ice conditions, or other hazardous conditions.

Charts

Electronic charts versus paper charts.

- For paper charts, what is the standard for updating or replacing? Who is responsible for developing customized charts? How will information be shared between crews?
- For electronic charts, what program is utilized? What skill(s)/level of training is required? What navigation limitations or concerns are affected by electronic chart use? How will your electronic charts be corrected and updated?

Emergency Preparedness

Develop, train, and keep readily accessible emergency checklists specific to your company that outline actions the crew should take in the event of sinking, grounding, fire, medical evacuation, taking on water, or other emergency situations.

- Conduct training to the checklists and exercise the checklists using various scenarios.
- Provide best practices for having passengers don personal flotation devices.

Situational Awareness

Define company standards and procedures for knowing what is happening at all times on and around the vessel. This may include procedures for deteriorating weather, policy of donning PFDs, procedures for monitoring seasick passengers, identifying and enforcing areas on board where passengers may view wildlife from, monitoring radio communications and radar traffic, awareness of conflicting traffic, the presence of smaller vessels in the area that may be impacted by the vessel's wake, the positions of the deck crew during heavy weather or when embarking passengers, etc.

Equipment

Document the capabilities and limitations of your vessel's navigation and safety equipment, including but not limited to the vessel's charting programs, GPS, fathometer, radios, and autopilot. With respect to communications, operators should know where they have good communications and where communications are poor or non-existent. Crews need to be familiar with the vessel's lifesaving equipment and operation.

Training

Define training requirements including frequency, general topics, and requirements or expectations for professional development. Set a minimum requirement of company training for various levels of employees.

Pre-Voyage Planning

- Define what actions crews should take before every voyage.
- Include actions to ensure the safety of passengers from the time they enter the property, get out of their car or bus, and are seated aboard the vessel.

Go/No Go

Provide guidance on parameters for go/no-go voyage determinations.

Exercising

State company policy for type and frequency of exercises.

- For each contingency exercise, develop an evaluation checklist of critical points to evaluate during the drill.
- Identify actions to target your training and make improvements.

Just because that's the way it's always been done does not mean it's still the best or safest method.

standards and are implemented to improve operational safety for all users.

For example, users of a congested waterway, port, or difficult navigation area may jointly develop best practices and user guidelines when navigating in those waters.

Company Practices

Most companies already have standard procedures, but refer to them as operating procedures, safety management systems, standing orders, or other terminology. But remember, to be effective, best practices by any name must be known and understood by all employees. Practices should be in writing and training should be conducted and tested periodically to ensure their meaning is clear.

Like anything else, best practices shouldn't just be developed and left alone. Equipment is replaced, vessels go faster, regulations change, traffic patterns change, and passenger expectations and demands change. As your operating environment changes, so too must your practices. To continue to be effective, your practices must be reviewed regularly, updated as required, enforced, and infused into current day-to-day operations.

As your operating environment changes, so too must your best practices.

Link to Accident Prevention

At the deck-plate level, practices communicate how to make your operations safer, more effective, and provide a better value to your customers. But if you leave them on the shelf in the company office, they will have minimal impact on operations or accident prevention. To be truly useful, there must be a "link" for communicating the practices to front-line operators. This link will require a combination of training, documentation, and enforcement.

Training lets everyone know the company standards as well as the details of the program. After the initial training, you can post a succinct summary of your company practices at strategic locations. Including a review as part of other training will keep the topic current and visible.

Equally important is an audit program to validate that the practices are known and followed. Although the audit can be an internal function, an independent external auditor will provide a fresh set of eyes on the situation, and may be better positioned to identify safety improvements.

The Final Word

Maritime operations are high-stakes activities, and when things go wrong, they can go wrong big-time—often garnering national media attention that many times leads to additional regulations. The risk is real. There have been examples of things going wrong in all regions of the world in the past few years.

Best practices are your daily practices of excellent, safe marine operations to keep the big-time problems away. They are all about safe, efficient operations. So make the old roofer Clarence proud, and let your practices establish the way it ought to be done, and don't be shy about making sure everyone on your team follows them.

About the author:
Mr. Rick Janelle, U.S. Coast Guard passenger vessel safety specialist, has 30 years of active, reserve, and civilian emergency response and planning experience with the U.S. Coast Guard. Since 2002, he has been actively involved in maritime mass rescue response planning, especially the critically important shore-side component.

Lessons Learned

from USCG Casualty Investigations

Lady of Grace

London Express

A regular feature in Proceedings: "Lessons Learned From USCG Casualty Investigations."

In this ongoing feature, we take a close look at recent marine casualties. We explore how these incidents occurred, including any environmental, vessel design, or human error factors that contributed to each event.

We outline the U.S. Coast Guard marine casualty investigations that followed, describe in detail the lessons learned through them, and indicate any changes in maritime regulations that occurred as a result of those investigations.

Unless otherwise noted, all information, statistics, graphics, and quotes come from the investigative report. All conclusions are based on information in the report.

Lessons Learned from USCG Casualty Investigations

Instant Instability

A sturdy dragger succumbs to deadly ice build-up.

by Ms. Daisy R. Khalifa
Technical Writer

At 9 a.m. on January 23, 2007, the F/V *Lady of Grace* departed for a routine ground fishing trip to Cultivator Shoal in the western area of Georges Bank, a fishing area roughly 60 miles off the coast of Cape Cod, Mass. After a day and half of fishing, and with approximately 15,000 lbs. of fresh fish aboard the vessel, the master decided to cut the trip short late in the day on Jan. 26, alerting the ship's owner by satellite phone that the fishing trawler would be returning to her homeport of New Bedford due to deteriorating weather conditions and excessive ice build-up.

That evening, as midnight approached and a winter storm ensued, the vessel suddenly capsized and sank in 50 feet of water in Nantucket Sound. The casualty resulted in the deaths of all four crewmembers. Dive teams recovered the bodies of the ship's master and one crewmember several days later, while two crewmembers remain missing and are presumed dead.

The primary cause of the sinking was the accumulation of ice on the vessel's exterior, estimated at about .75 inches per hour at the time she sank. Findings following the investigation determined that the vessel was significantly destabilized by significant ice accretion, aggravated by severe weather conditions, including high winds, and low air and water temperature combined with the wind direction relative to the vessel's heading during the voyage. Together these conditions contributed to what was most likely several inches, if not more, of heavy icing.[1]

Ice accumulation tends to increase the closer a vessel gets to land, and the icing on this vessel occurred during the evening hours, creating a false sense of stability due to a slower, more comfortable roll period of the vessel. Additionally, the accumulation of ice eliminated the inherent righting effects of the vessel, causing it to capsize with little to no warning.

The two missing crew members were presumably on deck attempting to break and remove excess ice when the vessel suddenly sank, thus, allowing them little to no time to don survival suits or utilize flares or life rings. Similarly, findings indicate that the master and deckhand were not fully aware of the serious impact that the increasing ice accumulation had on the vessel's stability. When their bodies were recovered, both individuals were wearing light clothing, and they had not used the survival suits, which were found stowed on the vessel.

Exacerbating the inherent danger of ice accumulation is that ice build-up, if not carefully removed, inhibits automatic deployment of the life raft and emergency position indicating radio beacon (EPIRB), both of which did not automatically deploy as designed, based on the investigation into the sinking.

The Voyage

After two bountiful days on the fishing grounds of Georges Bank, the vessel's master had contacted the ship's owner twice by satellite phone: once early in the morning on Jan. 25 to advise him that they had arrived at their destination and were fishing; and, in his last phone call at around 6 p.m. on Friday, Jan. 26, to advise the vessel owner that they would be returning to New Bedford early because of bad weather. He said they planned to arrive in New Bedford by about 5 a.m. January 27. The master told his employer that with the ice build-up on the vessel, his crew had already been breaking ice and he specifically mentioned the removal of ice from the radar antenna.

In early hours of the morning of January 27, Boatracs, a vessel monitoring system used for reporting fishing vessel position and activity, discovered it was having trouble locating the vessel. The monitoring system recorded its last contact position for the vessel at about 11 p.m. on January 26, and when personnel did not receive the next automated 30-minute "ping" from the vessel, the staff initiated an automated countdown for a two-hour position alarm. When the vessel appeared on the position alarm, Boatracs' network operations center requested a manual ping to the ship from the satellite provider, which was unsuccessful.

Boatracs personnel then sent a standard positioning message to the vessel and, after 45 minutes, saw that the positioning message for the ship had failed. This prompted them to send messages to three vessels within the vicinity of the last known position of the vessel, the *Megan Marie*, *Fitz Sea*, and *Lisa Ann II*, requesting that any of these nearby vessels contact the missing fishing boat. By 5 a.m. and after several failed attempts, the master of the F/V *Lisa Ann II* contacted Coast Guard Sector Boston Command Center to report that the *Lady of Grace* was not responding to VHF-FM radio calls.

Search and Preliminary Investigation

From 5 a.m. and throughout the morning on Saturday, January 27, federal and local maritime officials initiated a search for the vessel. The Coast Guard's First District Command Center requested that Sector Southeastern New England Command Center make callouts for the vessel, which were negative, as were attempted cell phone calls.

Sector Southeastern New England requested that New Bedford police check all docks to see if the vessel was in port. Still unable to locate the vessel, Boatracs advised the vessel's owner that the vessel had not positioned. By 10 a.m. that morning, a Coast Guard Jay Hawk helicopter had left Air Station Cape Cod to conduct a track line search for the vessel from her last known position through Vineyard Sound to New Bedford. Within half an hour, the helicopter discovered oil sheen in the vicinity of the vessel's last known position.

A search and rescue effort ensued after Coast Guard Station Brant Point rescue boat divers discovered debris in that position. At 2 p.m., the Massachusetts Law Enforcement Council dive team discovered the vessel submerged in approximately 56 feet of water

Lady of Grace in 2006.

12 miles from Wood's Hole in Nantucket Sound. At this point, the Coast Guard suspended its active search, turning over responsibility for salvaging the vessel to its owners, the vessel's insurance underwriters, and local authorities.

On January 29, Massachusetts State police and commercial divers dove on the vessel and recovered the body of the master of the vessel. The following day, the divers, hired by the vessel's insurers, dove again on the vessel and plugged the vessel's fuel oil service tank vents to reduce the risk of leakage the vessel presented.

About one month later, commercial divers dove on the vessel and recovered the body of the cook (also a deckhand), who was found in his stateroom on the vessel. Autopsies found the cause of death for both the master and deckhand was drowning.

In late April 2007, a salvage company hired by the ship's insurance underwriters, raised the vessel. She was transported to a deck barge, where Massachusetts State police and Coast Guard personnel searched for the two missing crewmembers, and conducted a preliminary assessment to examine the vessel for any possible mechanical failures. The two missing crewmembers, an engineer and another deckhand, were not found and are presumed deceased.

The ship's mechanical and physical condition was determined to be good—the hull appeared to have no obvious structural failures, nor was there any indication of mechanical failures. Investigators found four survival suits still in their stowage bags, distress flares in place in the pilothouse, and they found two ring life buoys. Divers had found the third life buoy in the initial search in January.

The vessel was finally scrapped in the middle of May, shortly after workers were able to remove 7,000 gallons of diesel fuel from the vessel's fuel tanks. As stated in the investigation report, "the initial action to plug the fuel vents by divers and precautions taken during the salvage of the vessel from the seabed reduced the environmental risk the incident presented." As it turned out, only about 25 gallons of diesel and hydraulic oil were released before the divers plugged the fuel vents.

Findings and Contributing Factors

The sinking of the of the 29-year-old fishing boat resulted in a considerable amount of debate among Coast Guard investigators and maritime officials as to stability requirements for commercial fishing vessels when subjected to major ice accumulation in severe cold weather conditions. Central to potential regulatory changes that would arise from the vessel casualty were recommendations relating to sections of Title 46 of the Code of Federal Regulations, Part 28, Requirements for Commercial Fishing Industry Vessels, and, specifically, Subpart E, Section 28.550 on stability and icing.

And, while ice accumulation was indeed the overarching cause of the vessel's sinking, giving cause for officials to re-evaluate, in a regulatory context, the dangers of ice accretion, there were many factors with this particular fishing vessel that needed to be taken into consideration during the investigation.

The vessel's owner had made modifications to the vessel only a few months earlier to outfit it for day-boat scallop dragging in addition to its service as a fishing trawler, including the addition of a 27-foot scallop boom and bulwarks to accommodate scallop fishing.

The report stated these additions were most likely not direct causes of the sinking, however, the modifications did create more surface area that, according to the report, undoubtedly increased accumulation of ice on the vessel. Moreover, the master, while a veteran fisherman familiar with the vessel and the weather conditions, was not aware of the effects the poor weather and icing would have on the modified vessel.

Modification Background

When the vessel owner decided in mid-2006 to outfit the vessel for day-boat scalloping, which it would do alternately to drag fishing, the vessel was required by its insurance underwriters to meet stability requirements and undergo an inclining stability test. The vessel's insurers, who considered it good marine practice, imposed the stability requirement on the vessel for its new service as a day scallop fishing boat. However, the insurers did not require a stability test for the vessel to operate in its usual mode as a fishing trawler, even though it was undergoing major modifications. When operating as a stern trawling ground fishing boat, the vessel had never been required to meet Coast Guard stability requirements because her official length of 75.8 feet put her just a few feet shy of the 79-foot regulatory requirement in effect at that time.[2]

In June 2006, the naval architect evaluated the vessel to allow for equipment modifications for day scallop fishing. The naval architect performed a hold survey and provided oversight for stability modifications to the vessel. The vessel was then re-floated in mid-June, and in late June, it was hauled and measured again for a stability analysis test. At that time, the vessel was examined by naval architects who performed an inclining stability test. While the vessel did not initially pass the intact stability criterion for the conversion to scallop dragger, subsequent analysis by the naval architect outlined a plan, including modifications and restrictions that the naval architect stated would meet Coast Guard intact stability criteria when configured for day-boat scallop operations.

Subsequently, and in accordance with stability evaluations, the vessel underwent modifications over a three-week period in July to operate as a day scallop dragger when not engaged in ground fish dragging operations. The modifications included a new steel ballast tank with a capacity of 2,342 gallons, built on the vessel centerline in front of the engine room and beneath the storeroom.

New hinged watertight doors were installed on the main deck, on the port and starboard sides. The vessel's bulwarks were raised in such a way that the main deck bulwarks were 36 inches high and extended the entire periphery of the main deck transom, while the shelter deck bulwarks were extended to run aft from the foredeck to just forward of the gallows. A 27-foot boom and 1.1 long ton, 10-foot scallop dredge were also installed. The boom, which was attached to the main

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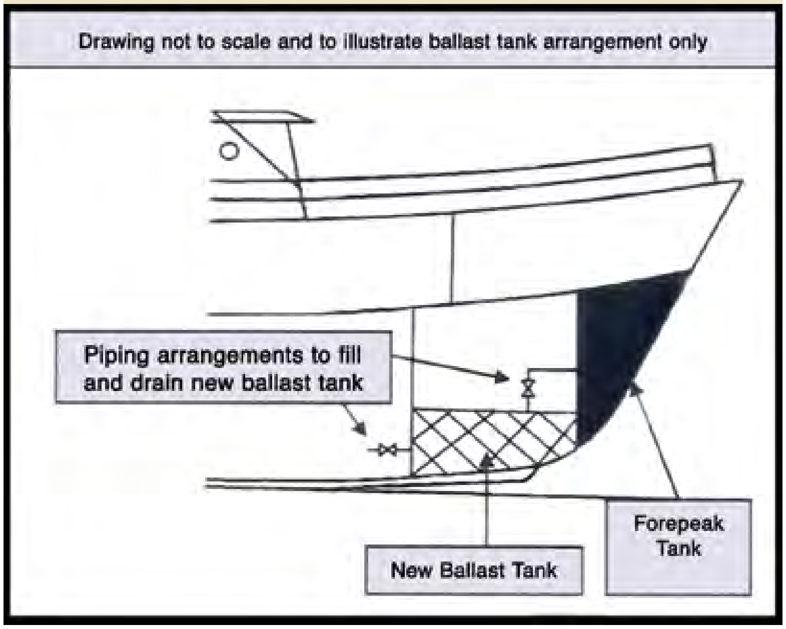
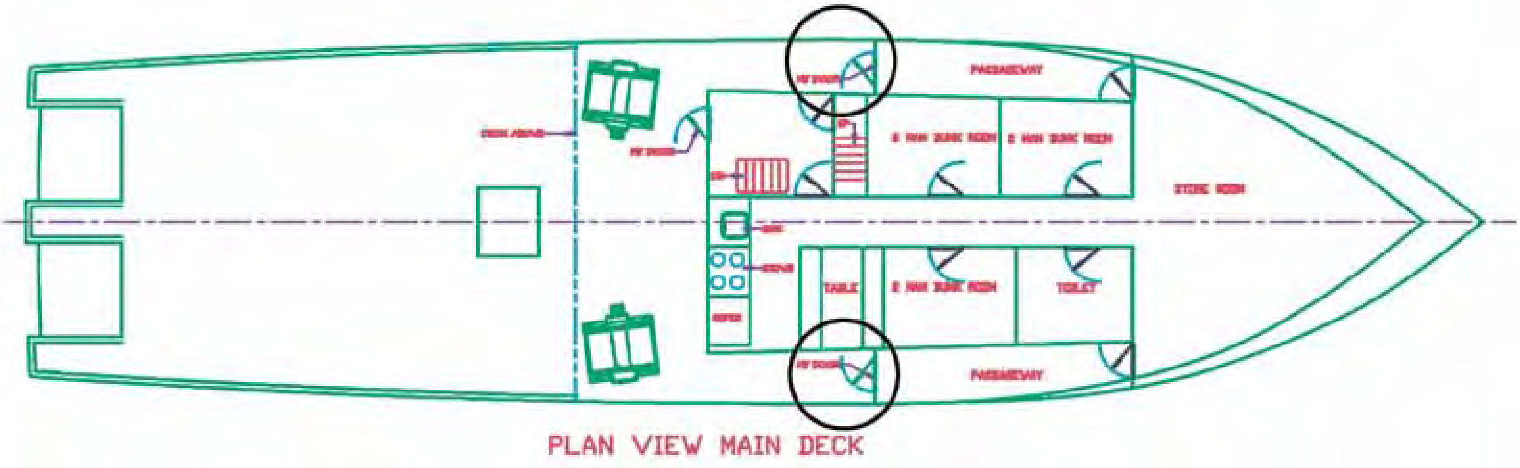
New ballast tank.



27-foot boom modification.



Hinged watertight doors were installed on the main deck, port and starboard side of the house in July 2006.

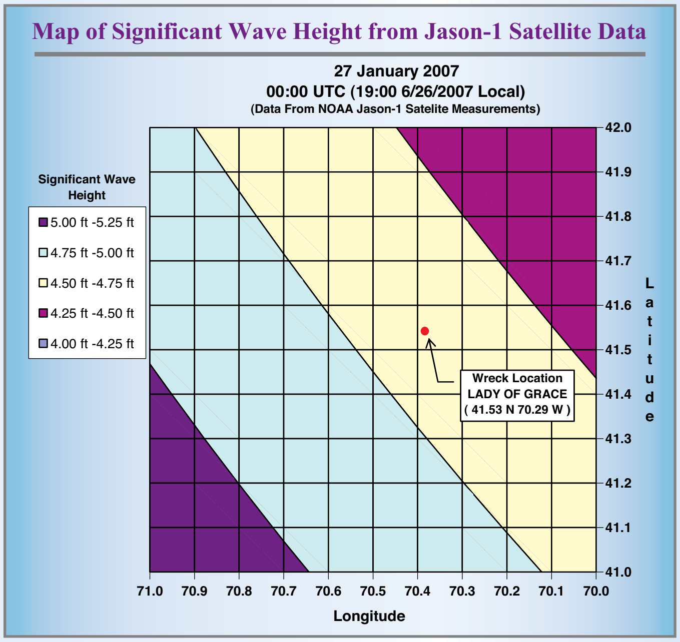
Icing a Dominant Factor in Vessel Casualty

According to the testimony of the master of the F/V *Debbie Sue,* a 74-foot scallop fishing vessel that had also transited Nantucket Sound earlier that day, his crew had to break ice on four occasions. The master described how the vessel's hand rails were covered in 10 inches of solid ice, that the top of the pilothouse had a solid six inches of ice covering the entire surface except the exhaust stack, and everything on deck from the waist down to the deck was covered in ice.

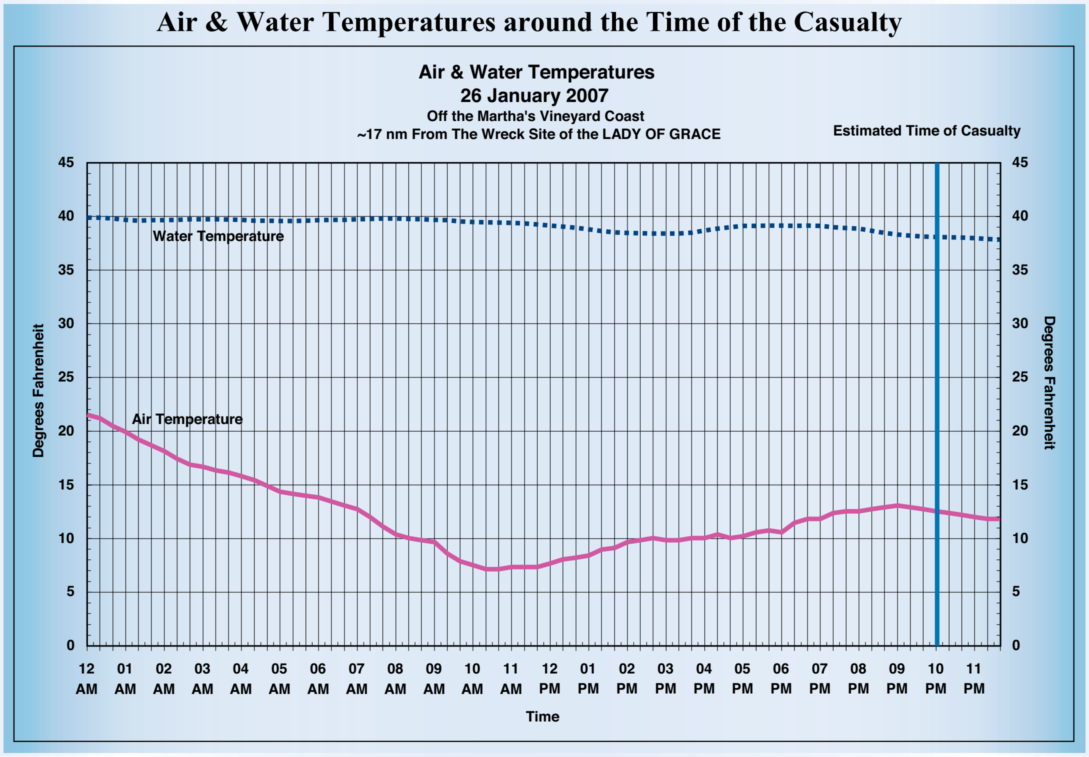
He said the vessel's outriggers, made of three to five-inch tube steel, had accumulated 10 to 12 inches of ice and that the port outrigger bent under the weight of ice. Finally, he said when parts of the upper deck on the starboard side to the waterline of the outer hull of the vessel were broken loose of ice, "the vessel actually bobbed back to port."

Underscoring what investigators, the vessel owner, and authorities would learn, the conditions on the night of January 26, 2007, could not have been worse for the F/V *Lady of Grace*. The air temperature plummeted in the course of the trip from 20 degrees when the fishermen set out on January 25 to seven degrees at noon on January 26. Wave height averaged between at least four and seven feet, wind speeds were roughly 20 knots, and water temperature did not get above 38 degrees.

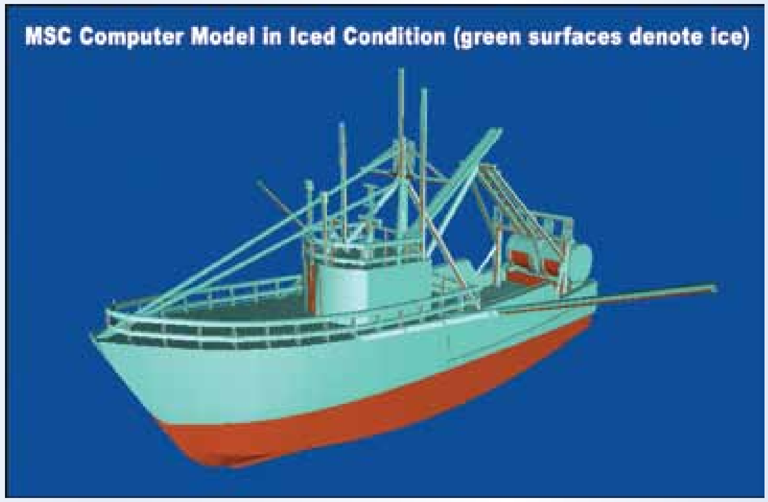
The plotted position of the wreck is shown by the red dot, which is almost at the middle of the 4.5 foot to 4.75 foot band for significant wave heights. All graphics by USCG.



The temperatures over time for January 26, 2007.



In a July 2007, USCG Marine Safety Center memorandum, investigators took into account a wide range of factors to analyze the effect of ice on the vessel's stability to better understand how the vessel capsized so rapidly. The technical evaluation arrived at a relatively straightforward conclusion based on environmental conditions, vessel geometry, and vessel loading.



Marine Safety Center computer model in iced condition (green surfaces denote ice).

The evaluation stated that the vessel, in its assumed loading condition "would only have been able to sustain a maximum of 2.25 inches of ice uniformly distributed about [its] surfaces and still remain upright."[1] The evaluation found that the vessel was likely experiencing heavy icing at the rate of .75 inches per hour, and that these icing conditions exceeded the amounts of ice that the vessel was required to be evaluated to by the Code of Federal Regulations.

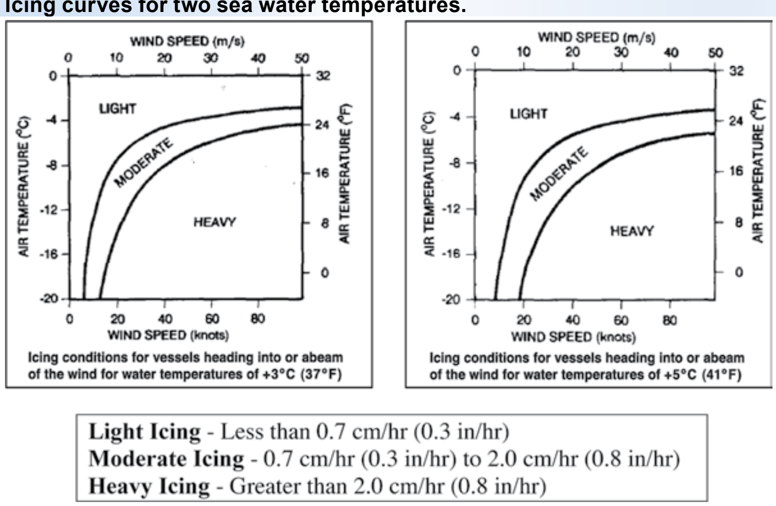
According to the analysis, the critical air temperature for icing is between zero and 32 degrees, and studies indicated that the vessel would begin to accumulate ice in wave heights of 3.9 feet with winds of about 14 knots. Furthermore, the effects of sea spray in icing were a key factor. Sea spray increases ice accumulation on a vessel, and is generated mainly by wind and spray blown from wave caps. Sea spray also occurs in others ways—from various aspects of severe cold weather conditions to the different characteristics of a vessel—all of which affected the ill-fated ship.

Sea spray can also become more intense if the dominant sea state wavelength approaches the vessel's length. Additionally, as stated in the memorandum, "ice already formed increases the effective cross-sectional area of exposed rigging, mast, rails, and antennae." Put simply: Ice accumulation increases the rate of ice accumulation.

The naval architect who was hired in July 2006 to make stability calculations in order for the vessel to be outfitted as day-scallop fishing boat was able to provide computer models of the vessel as well as a report of inclining and stability calculations. The vessel was carrying several tons of newly added scalloping equipment aboard, in addition to an approximated 15,000 lbs. of fish and 13,000 lbs. of ice in its hold that night. It was also outfitted with a roll-dampening system consisting of two 40-foot pin-connected masts, one port and one starboard, mounted outboard and aft of the pilothouse.

The vessel's assorted surface areas and added weight provided a range of metrics and called for a variety of calculations and model analyses before investigators arrived at the conclusion that the vessel could only have handled 2.25 inches of ice before it would capsize. It was evident based on eye-witness accounts and environmental conditions that there were most likely far heavier amounts of ice on certain portions of the vessel. The report went on to conclude that: "When compared with the required icing loads used in the naval architect's calculations, this number represents a case that is nearly 12 times more severe than the anticipated amount of icing required by 46 CFR 28.550."[2]

Icing curves for two sea water temperatures.



Endnotes:

1. United States Coast Guard Memorandum, "Subj: Request for Stability Evaluation of the Sinking of the F/V *Lady of Grace,* O.N. 599517," From: S.P. McGee, To: L.W. Clayborne, LCDR, July 18, 2007.
2. Ibid.

mast, was constructed of six-inch square steel pipe of 3/8-inch wall thickness, and was fitted with a ladder and safety hoops. When the vessel sank six months later, it carried nearly all of its newly installed apparatus except for the scallop dredge.

In short, the vessel's modifications for scallop dredging were significant. Clearly, the modifications added a considerable amount of surface area as well as additional weight to the vessel.

Stability Requirements

The investigation grew somewhat more complicated around the issue of the requirement of stability letters for commercial fishing vessels, as the vessel's sinking—as well as data on the ship's significant physical modifications the previous summer—inadvertently shed light on the possible need to amend portions of 46 CFR Part 28.550, which calls for commercial fishing vessels built after 1991 and 79 feet and greater in length to perform stability tests and provide a letter of verification prior to operating.

As described in the investigation report: "While the vessel did undergo a stability evaluation in accordance with Coast Guard regulations as a requirement of the vessel's insurance underwriters, the evaluation was only for day scalloping. The vessel initially failed the intact stability criteria, but passed for day scalloping operations only if the vessel was configured and operated in accordance with the naval architect's restrictions." The naval architect revealed that in stability test calculations performed prior to the vessel modifications, "the vessel would not meet current intact stability standards if they were applicable."

The naval architect advised the vessel owner that the vessel would meet stability criteria for operating as a day scalloper, provided the vessel made certain modifications and abided by certain operating restrictions. On July 29, 2006, the naval architect issued a stability letter applicable only while the vessel was in service as a day boat scallop dragger.

Recommendations

There were five official recommendations as a result of the investigation into the sinking of the fishing vessel. The first dealt with the relatively urgent matter of stability requirements, while three other recommendations dealt with gaining a better understanding of ice accretion, providing for additional allowances from a geographical standpoint, and addressing fundamental threats that ice accretion poses to the safety of mariners in terms of access to safety equipment aboard a vessel. The final recommendation, while not a factor in the sinking of the vessel, was a recommendation to review stability formulas in 46 CFR, Part 28 for accuracy.

The first recommendation by investigators called for the Coast Guard to re-evaluate the need to amend applicability requirements in 46CFR 28.550 to lower the stability requirements for commercial fishing vessels from 79 feet and greater in length to 50 feet and greater in length. The Coast Guard concurred with the recommendation, stating:

"We have indicated our intention to establish stability standards for commercial fishing vessels less than 79 feet in length in the Federal Register on several occasions leading up to our current regulatory project…"

The next two recommendations were more technical in nature, and dealt with calls to re-evaluate the weight of assumed ice as well as to re-evaluate latitude as factors in stability calculations, which ultimately impact regulatory and stability restrictions in severe weather. In short, the case being made by investigators involved assumptions about ice accumulation, and that extreme icing—or higher figures in height and weight for ice—occurs slightly farther south than previously believed. The second recommendation included the following:

"…that the Coast Guard re-evaluate the weight of assumed ice on each surface above the waterline for all fishing vessels as specified in 46CFR 28.550(b). Additionally, recommend that the Coast Guard re-evaluate the weight of assumed ice on each surface above the waterline for fishing vessels operating north of 42 degrees but south of 66 degrees 30' North latitude or south of 42 degrees but north of 66 degrees South latitude as specified in 46CFR 28.550 (c)."

Similarly, the investigator's third recommendation stated that:

"…the Coast Guard re-evaluate latitudes specified in 46 CFR 28.550 that state the weight of assumed ice has to be a factor in stability calculations when a fishing vessel operates north of 42 degrees North latitude. The case highlights the fact that significant ice accumulation occurs south of 42 degrees North latitude."

The Coast Guard concurred with both recommendations. With regard to the value used for weight of assumed ice, the Commandant's action said they are consistent with those used for all vessel types internationally, however, in light of this case, the Coast Guard "will undertake a study to determine if the current values are the most appropriate for commercial fishing industry vessels." Likewise, in response to the third recommendation on latitudes used within ice accumulation calculations, the Coast Guard said the calculations are in keeping with domestic and international standards, but that the agency will undertake a study to see if current values are appropriate.

The investigator's fourth recommendation addressed the direct hazards of ice accumulation, given the fact that the vessel's life saving equipment, including its inflatable life raft and EPIRB, failed to deploy and function as designed when the vessel sank on that freezing January night in Nantucket Sound. The investigation recommended that the Coast Guard evaluate the need to study alternatives and create guidance that advises commercial fishing vessel operators on ways to ensure that such emergency equipment works properly.

However, the Coast Guard did not concur, stating that adequate direction already exists to vessel operators for the proper stowage and readiness of inflatable life rafts and other lifesaving items. Stated in the Commandant's action:

"Icing is not new to the commercial fishing industry in New England and Alaska. Those responsible for crew safety, when operating in the conditions like those experienced by [the fishing vessel], should understand the risks and mitigating factors. An operator has both the responsibility for ensuring safety aboard the vessel and the only realistic opportunity to take actions to ensure equipment is ready for use in an emergency."

Lessons Learned

Tragically, the lessons learned from this incident came at the expense of the lives of four seasoned mariners. However, the casualty may result in at least one significant regulatory change.

This change in stability requirements for commercial fishing vessels so that they apply to vessels 50 feet and larger will surely have an impact on the industry. Given the vivid picture of the dangers of icing as illustrated by this casualty, the requirement will very likely save more lives.

Acknowledgments:

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About the author:

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Endnotes:

1. United States Coast Guard Memorandum, "Subj: Request for Stability Evaluation of the Sinking of the F/V Lady of Grace, O.N. 599517," From: S.P. McGee, To: L.W. Clayborne, LCDR, July 18, 2007, p.13.
2. 46 CFR Part 28.550.

Vessel being loaded onto barge during salvage phase.

Lessons Learned *from* USCG Casualty Investigations

No Way Out

A mariner perishes while trapped inside a confined space.

by Ms. Carolyn Steele
Technical Writer

When a man inexplicably vanishes aboard a 964-foot container ship, finding him is a daunting task. Such a challenge faced crewmembers aboard the M/V *London Express,* a German-flagged vessel moored in Savannah, Ga., on October 24, 2003.

Two days and two nights would pass before his body was found. The circumstances surrounding his disappearance were mysterious, and the condition in which he was found only raised more questions.

Was this an accident or foul play?

Timeline

On the afternoon of October 24, while the vessel was moored in Savannah for cargo operations, the engineering department was overhauling the number six cylinder on the main engine in preparation for the voyage to Norfolk, Va.

By 5:20 p.m., the crew had finished work and cleaned the engine room. The crewmembers requested permission from the second engineer to go to dinner and headed to the changing room. The second engineer and the relief second engineer remained to close up the scavenge air receiver and finish a few odd jobs.

At 5:30 p.m., the relief second engineer closed the door on the aft end of the scavenge air receiver and saw the second engineer close the forward door. The relief second engineer then left the engine room alone to change for dinner. He did not see if the second engineer left the engine room.

Missing Crewmember

At 6:20 p.m., while the crew was having dinner, the ship's steward told the chief engineer that the second engineer was absent for the meal. Unconcerned, the chief engineer said he guessed the second engineer had decided to skip dinner and rest up before departure that evening.

At 8:30 p.m., the chief engineer was preparing the engine room for departure when he realized that the second engineer had not reported to the engine control room as required. He telephoned the man's stateroom and got no answer. He then telephoned the bridge and informed the chief officer that the second engineer had not shown up.

The chief officer told him to search the engine room while he checked the second engineer's stateroom and the rest of the ship's superstructure. At this point neither man was concerned; they still thought the engineer had probably overslept.

Search

At 8:40 p.m., the chief officer checked the second engineer's stateroom. It was empty. The bed was made. He then contacted the forward and after mooring stations and told them to check and see if the second engineer was in the area. The chief officer then searched the ship's superstructure from the bridge down, deck by deck.

The chief mate and the second relief engineer walked through the engine room looking for the missing man. They opened the aft door to the scavenge air receiver and briefly shone a flashlight into the space to see if he was inside.

The chief officer told the chief engineer that the second engineer was still nowhere to be found. The chief engineer suggested that the missing man might have gone ashore earlier. He checked the deck log, but there was no record that the second engineer had logged out, and the gangway watchman reported he had not seen him go ashore.

At 8:50 p.m., the vessel's captain ordered the general alarm sounded, and the crew mustered. The second engineer did not appear. No crewmembers had seen him since before dinner; however, one of the oilers thought he had seen him come up out of the engine room at around 5:20, shortly after the rest of the engineers.

The chief officer then ordered the engine department crewmembers to search the vessel's deck, forward and aft machinery areas, and superstructure. By 9:10, most of the deck department personnel had completed a search and reported to their assigned mooring stations to make fast the tugs.

Minutes later, the engineer foreman briefly opened the aft door to the scavenge air receiver to check for the missing crewman. The engineer foreman did not have a flashlight, nor did he enter the space.

At 9:20 p.m., the chief officer used binoculars to check the telephone booths on the dock. They were unoccupied. By this time the crew had finished searching the vessel. They reported to the chief officer and chief engineer that they had not found the missing man.

Departure

Both the docking master and the state pilot were aboard and ready for departure, and tugs had been made fast. The captain contacted the vessel's agent to discuss the situation. They agreed that the second engineer had most likely gone ashore, and had simply not made it back in time for sailing. The captain decided to depart Savannah and continue the search during the outbound transit.

At 9:30 p.m., the lines were taken in and the vessel departed for Norfolk.

While continuing the search one hour later, several members of the engine department noticed an air leak from the forward door to the scavenge air receiver. They also saw what appeared to be a small piece of rag trapped in the door, and reported the problem to the relief second engineer.

He examined it and saw that the obstruction was actually a piece of gasket material. He also noticed that two of the handles were not properly latched, and tightened all three. This slowed but did not completely stop the air leak. He told the other engineers that they would fix the air leak once they arrived in Norfolk. He would later tell investigators that he thought the doors had been improperly dogged by other crewmembers, whom he guessed must have opened it earlier during the search.

Shocking Discovery

Another day passed with no sign of the missing crewman. At 11:15 a.m. on October 26, the vessel arrived in Norfolk. Ten minutes later, the chief engineer told the engineer foreman and an oiler to open the forward and aft doors to the scavenge air receiver so the crew could repair the air leak and inspect some piston rings.

When the engineer foreman opened the forward manhole, he was shocked to discover the second engineer's body lying just inside. He seized his crewmate, but immediately realized that the man was dead. He informed the captain, who contacted the vessel's agent in Norfolk. The agent in turn notified the Virginia Port Authority Police Department (VPAPD) and the U.S. Coast Guard.

Investigation

October 26

By 11:30 a.m., two VPAPD officers were met on the gangway by the captain, who explained the situation. One of the port authority officers secured the area around the scavenge air receiver as a potential crime scene, posted a watch at the gangway, and contacted the VPAPD director and Norfolk Fire and Rescue.

Investigators initially treated the area as a crime scene. All photos USCG.

An officer from Norfolk Fire and Rescue and a doctor from the Norfolk medical examiner's office arrived on the scene, and at 1:00 p.m., the second engineer was officially pronounced dead.

At 1:30 p.m., a USCG Marine Safety Office Hampton Roads maritime armed security team conducted a security sweep of the vessel. Crewmembers were mustered for a head count, then confined to the mess hall under watch during the security boarding. All staterooms were searched for weapons and contraband.

By 3:00 p.m., two special agents from the Virginia State Police, an investigator from Marine Safety Office Hampton Roads, and three Coast Guard Investigative Service special agents arrived on the scene. Because they deemed the second engineer's death suspicious, they initially treated it as a criminal investigation.

At 6:44 p.m., Virginia State Police crime scene technicians arrived and began to process the area around the scavenge air receiver, the second engineer's body, and his stateroom for evidence. A marine chemist declared the scavenge air receiver safe to enter.

At 7:45, the investigative team interviewed the captain, the chief engineer, the chief officer, the engineer foreman, the relief second engineer, and the oiler who thought he might have seen the victim last. Marine

Suspicion of Foul Play

When investigators arrived on the scene, their first impression was that they might be dealing with a murder because several things seemed out of the ordinary. Through re-enactments and interviewing crewmembers, they ultimately came to the conclusion that such was not the case.

Nevertheless, after considering all the events leading up to the tragedy, a number of questions remained—not all of which would have answers.

If this was an accident, why was the second engineer in the scavenge air receiver in the first place? This question remained unresolved. The second engineer's body was found with a partially melted plastic flashlight, a T-shirt, and a rag, but no tools.

How did the manhole get dogged shut with the second engineer inside? Onsite re-creation demonstrated that this could have happened accidently. The demonstration proved the door would easily swing open or closed depending on the vessel's trim. Simply allowing the door to close all the way would engage the upper left-hand dog, effectively locking the door closed.

There is no mechanism to open the door from the inside, and attempts to shake the door from the inside during the re-enactment only caused the dog to engage further.

If the scavenge air receiver was opened twice during the search, why wasn't the second engineer found? The air receiver was essentially a narrow, long cylinder filled with numerous obstacles such as support beams, so moving through it would have been difficult. Investigators determined that unless you were specifically looking for someone at the other end of the scavenge air receiver, you could not see a person near the forward door from the aft door.

Even if the second engineer had been conscious and seen his shipmates open the aft door, the space inside was so dark and cramped—and that area of the ship so noisy—that he would have been unable to reach them in time if he had tried to cross the space. Neither would they have seen or heard him in the short time they looked.

The second engineer's records revealed that he was meticulous and had been trained in the proper procedure to enter the scavenge air space, which required two people. Why didn't he follow protocol? During interviews, various crewmembers remembered occasions when the second engineer would skip safety protocols to save time. They did observe, however, that when doing so he usually risked his own safety rather than that of his shipmates.

Why did the crew assume the second engineer went ashore if the gangway watchman stated he never saw him leave the vessel? The crew had already searched most of the vessel, so the captain assumed that the gangway watch missed the second engineer going ashore.

Forward end of the scavenge air receiver.

noticed that the manhole was not properly dogged down and had dogged it down further, which slowed the leak.

During the interview, he admitted that his search of the scavenge air receiver had been cursory because he hadn't expected to find the second engineer inside.

At 4:00 a.m. on October 28, investigators agreed there was no probable cause to presume that a crime had been committed, and departed the vessel. The USCG Marine Safety Office Hampton Roads investigator remained behind to determine the cause of the accident.

Safety Office Hampton Roads issued an order requiring the vessel to remain moored in Norfolk until safety issues surrounding the suspicious death were resolved. The FBI Norfolk Field Office was briefed because the second engineer might have died in transit between Savannah and Norfolk. Coast Guard headquarters also briefed the German Consulate.

At 11:30 p.m., the Norfolk medical examiner's office removed the second engineer's body from the vessel. The following items were found near his body and were turned over to the VPAPD: a black t-shirt, a plastic container, four batteries, foam-style hearing protection, and a melted flashlight.

October 27

At 2:00 a.m., investigators stopped initial interviews. The vessel was granted captain of the port permission to shift to anchorage for the remainder of the investigation. At this point the second engineer's death was still being treated as a possible crime.

Investigators re-convened 12 hours later and interviewed various officers and crew until 1:00 the next morning, after which they examined the scavenge air receiver to try to piece together how the death might have occurred.

October 28

At 2:30 a.m., investigators requested a second interview with the relief second engineer, the last man who had been working with the casualty victim before he went missing. The relief second engineer recalled that he had become aware of the air leak from the forward door on the scavenge air receiver shortly after the ship got underway in Savannah. He

Coast Guard Findings

After conducting re-creations of the scene aboard the vessel, the Coast Guard outlined what most likely happened to the unfortunate mariner.

Trapped Inside

When the second engineer entered the scavenge air receiver alone, he violated written procedures for confined space entry. After he entered, the hinged, inward-opening door accidentally closed. Reconstructions demonstrated that the door could be easily moved if bumped. In each test, the upper-left dog engaged when the door was closed.

Once this dog engaged, it was not possible to open the door from inside the scavenge air receiver. There were hand and boot prints in the soot on the inside of the receiver, tragic evidence that the second engineer had been alive and conscious at some point while trapped inside.

Cause of Death

The medical examiner concluded that the second engineer died of hyperthermia. Not to be confused with hypothermia, hyperthermia occurs when a person is exposed to excessive heat. According to investigators, the ambient temperature inside the scavenge air receiver was 116.6°F when the ship's engine was running. To make matters worse, the space was encased in steel, which grew increasingly hot once the vessel got underway. Body temperatures exceeding 106°F are usually catastrophic.

The medical examiner's report specified the cause of death as accidental. The report noted the second engineer had a ¾-inch long, ¼-inch deep gash on his right temple, which the medical examiner described as possibly incapacitating. No crewmember remembered seeing the cut on the second engineer's forehead while he was alive, so the injury likely occurred while he was locked inside the scavenge air receiver.

Probable Scenario

Although it is impossible to know for sure, the second engineer most likely entered the scavenge air receiver either to retrieve something or to check on something. He leaned or fell against the sharp-edged, inward-opening door, perhaps injuring himself in the process, and caused it to close. He subsequently died from the high ambient temperatures inside the confined space while the vessel was underway.

The crew of the ship had conducted multiple searches of the vessel, including two separate checks of the scavenge air receiver. Both checks were made at the opposite end of where the second engineer had last been seen and was eventually found. A re-creation by investigators confirmed that searchers would not have been able to see him from the aft end.

There was no evidence that drugs or alcohol contributed to this casualty.

Assessment

This case was complicated by the fact that the mariner died en route between two jurisdictions—Georgia and Virginia. Several local U.S. agencies investigated the casualty, and because this was a foreign-flagged ship, the U.S. State Department, German Consulate, and Germany's Federal Criminal Police Office eventually became involved.

The conclusion was unanimous: There was no foul play. The mariner's death was an accident.

It is hoped that this tragic story will serve as a reminder for mariners to question assumptions, be wary of expedient practices, and—above all—remember the importance of safety protocols. Abide by them—they can save your life.

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About the author:

Ms. Carolyn Steele has more than 20 years of experience in the communications field. As a freelance writer/editor she has worked on numerous Coast Guard projects, including the USCG Marine Safety Manual, *the* USCG Maritime Law Enforcement Manual, *and* USCG Publication 1. *She is also the editor and designer of the* Crew Endurance Management *newsletter, and designs* VRP Review, *a newsletter published by the USCG vessel response team.*

Analysis and Lessons Learned

As with so many cases covered in this "Lessons Learned" series, this calamity was not the result of a single factor, but rather a series of poor decisions and various other causal factors.

Follow standardized procedures.

- It was policy to require two people for entry into the receiver. The second engineer should have had someone with him before entering.

  As this incident illustrates, even a one-time deviation from procedure may prove fatal.

Avoid complacency.

- The scavenge air receiver was checked twice during the search, but never more than a few seconds or at the forward end where the missing man had last been seen.

  Also, nobody checked inside a third time, soon after the transit to Norfolk began, when a problem was noticed with the dogs on the forward door.

  Asked later why they had never opened the forward door during the search, crewmembers had no explanation other than that they doubted the second engineer was inside.

- Despite the fact that the gangway watch reported that he had not seen the missing man go ashore, the captain assumed he had left the ship.

Communication is crucial.

- The second engineer should have told someone before entering the scavenge air receiver, and as noted, should not have entered it alone.
- Other crewmembers recalled seeing the second engineer cut safety corners, but never relayed this information to a superior officer.
- If the last man to see the second engineer alive had told anyone that he had last seen his crewmate by the *forward* manhole, it might have prompted a search starting at that end of the scavenge air receiver.

Maintain your focus.

- The second engineer may have been in a hurry or momentarily distracted, and forgotten his training about the dangers of confined spaces.

  A brief lapse in situational awareness may have cost him his life.

Chemical of the Quarter

Understanding Phenol

by LT Elizabeth Newton
U.S. Coast Guard Hazardous Materials Standards Division

What is it?
Phenol is used primarily in the production of phenolic resins, and is also used in the manufacturing of nylon and synthetic fibers. Phenolic resins are used to produce moldings and laminates, which are used in mass transit, marine, offshore, and construction areas where fire- and high temperature-resistant components are required.

Phenol also has medical uses. It is used as a disinfectant and antiseptic as well as in medicinal preparations such as mouthwash and throat lozenges.

Phenol has a distinct sickeningly sweet and tarry odor that can be detected at levels lower than those that would be considered harmful. It is both a natural substance and a manufactured chemical. In its pure state, phenol is made up of white or clear acicular (narrow, long, and pointed) crystals.

How is it shipped?
Phenol is shipped in its molten state at elevated temperatures or in its solid/crystalline form in 55-gallon steel drums, 5,000-gallon stainless tank trucks, and 20,000-gallon steel tank cars. The drums and tank cars are lined with phenolic resin.

Why should I care?
Shipping concerns.
The main concern with the shipment of phenol is that it should be stored in a cool, dry area, away from sparks and open flames. Phenol should also be stored away from oxidizers such as chlorine, bromine, and hypochlorite.

Health concerns.
Phenol is more likely to enter your bloodstream through inhalation or ingestion; only small amounts of the substance can enter the bloodstream by absorption through the skin. Short-term air exposure to phenol may cause respiratory irritation, headaches, and burning eyes. Skin exposure to large amounts of phenol may cause skin burns, liver damage, dark urine, irregular heartbeat, and even death. If ingested in high concentrations, phenol may cause internal burns, muscular weakness, and death.

Fire or explosion concerns.
Phenol has a flash point of 175 degrees Fahrenheit, which gives it a flammability rating of "two—moderate fire hazard." According to The National Fire Protection Association, the flammability scale ranges from the lowest value of zero (materials that will not burn) to the highest value of four (materials with a flash point of less than 73 degrees Fahrenheit). Phenol has a flammable vapor range from 1.7 to 8.6 percent by volume in air, which means it can be ignited by open fires, sparks, or glowing surfaces. Phenol is also flammable when mixed in solutions.

Fires involving phenol should be fought upwind at the furthest distance possible, with all unnecessary persons kept away since toxic gases such as carbon monoxide may be released. All emergency personnel and workers should avoid low areas and ventilate closed spaces before entering. The preferred methods used to extinguish a fire involving phenol are carbon dioxide, foam, or dry chemical. Water can be used to cool the fire, but flooding should be monitored so as not to spread the phenol or fire further. Containers of phenol should be removed from the fire, if possible, to avoid risk of explosion from the heat of the fire. If removal is not possible, the sides of the container need to be cooled using water until the fire is out.

What is the Coast Guard doing about it?
Phenol, as a bulk cargo, is carried in tank vessels which are required to be inspected by the Coast Guard in accordance with 46 CFR 153. When phenol is transported as a packaged hazmat on an oceangoing vessel it is shipped in accordance with 49 CFR 173.

In the event of a spill, the U.S. Coast Guard National Response Center can be reached toll-free at 800-424-8802.

About the author:
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Nautical Engineering Queries

Questions

Prepared by NMC Engineering Examination Team

1. If the intercooler relief valve lifts while an air compressor is operating under load, you should check for __________.

A. a defective pressure switch or pilot valve
B. a leak in the intercooler piping
C. leakage though the low pressure unloader control diaphragm
D. leaking high pressure discharge valves

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2. An insulation resistance reading is taken at 20°C and found to be 10 megohms. What would be you expect the resistance reading to be at 40°C?

A. 2.5 megohms
B. 10 megohms
C. 15 megohms
D. 20 megohms

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3. The principle effect of liquid free surface is dependent upon the volume of displacement of the vessel and the __________.

A. height of the liquid in the tank
B. amount of liquid in the tank
C. dimensions of the liquid surface
D. weight of the liquid in the tank

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4. The capacity of a particular ballast pump is 200 gallons per minute. Approximately how long will it take to ballast a tank with 68.5 long tons of seawater?

A. 1.5 hours
B. 2.0 hours
C. 2.5 hours
D. 3.0 hours

1. *Note: To reduce the temperature of the compressed air between each stage of compression, multi-stage air compressors are fitted with heat exchangers called intercoolers. Cooling of the compressed air between stages results in a dryer and denser air charge, thus improving the compressor's efficiency. Intercoolers can be either air- or water-cooled, and are fitted with a relief valve to protect them from the damaging effects of accidental over-pressurization.*

A. a defective pressure switch or pilot valve — Incorrect Answer. A defective pressure switch or pilot valve could allow the compressor to continue to run in a loaded state beyond normal parameters. The result would be the compressor discharge relief valve lifting. The intercooler relief valve, however, would remain seated.

B. a leak in the intercooler piping — Incorrect Answer. A leak in the intercooler piping would simply result in air escaping from the point of leakage. The intercooler relief valve would not lift in this situation.

C. leakage though the low pressure unloader control diaphragm — Incorrect Answer. Leakage through the low pressure unloader control diaphragm (if so equipped) would simply result in faulty unloader operation. As in answer "A" above, the intercooler relief valve would remain seated.

D. leaking high pressure discharge valves — Correct Answer. A leaking second stage (high-pressure) discharge valve would allow compressed air from the discharge of the second stage cylinder to leak back into the cylinder on the piston down-stroke. The leakage back into the second stage cylinder prevents some of the air being discharged from the first stage (low-pressure) cylinder from entering the second stage cylinder. This results in the intercooler pressure rising above normal parameters, causing the relief valve to lift.

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2. *Note: Insulating materials have a negative temperature characteristic, meaning that as the temperature of the insulation increases, the resistance of the insulation decreases, and vice versa. Resistance readings are normally corrected to 40°C. The corrected resistance may be calculated if the temperature correction factor is known.*

$$R_{40} = K_t \, X \, R_t$$

Where R_{40} = insulation resistance corrected to 40°C in megohms ◆ R_t = measured insulation resistance at t ° C in megohms ◆ K_t = temperature correction factor

A. 2.5 megohms — Correct Answer. Even though the actual resistance corrected for temperature cannot be calculated without knowing the temperature correction factor, this is the correct answer based on the fact that with a negative temperature characteristic, this is the only answer with a resistance of less than 10 megohms. In this case, the actual temperature correction factor must be 0.25.

B. 10 megohms — Incorrect Answer. Since resistance has a negative temperature characteristic, the corrected resistance cannot remain at 10 megohms, but must be less.

C. 15 megohms — Incorrect Answer. Since resistance has a negative temperature characteristic, the corrected resistance cannot be higher than the original 10 megohms, but must be less.

D. 20 megohms — Incorrect Answer. Again, since resistance has a negative temperature characteristic, the corrected resistance cannot be higher than the original 10 megohms, but must be less.

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3. *Note: Any time a vessel pitches or rolls, the vessel's stability is adversely affected by any virtual rise in the center of gravity. This is caused by movement of liquid contents within partially filled tanks. The virtual rise in the center of gravity is a function of what is known as the free surface effect. Free surface is the surface area of liquid in tanks not in contact with tank boundaries as a vessel pitches or rolls. Transverse stability may be adversely affected by rolling action and longitudinal stability by pitching action due to the free surface effect.*

A. height of the liquid in the tank — Incorrect Answer. A half-filled deep tank would have less free surface than a half-filled double bottom tank of equal volume; therefore, the height of liquid in the tank considered by itself is not the determiner of the free surface effect.

B. amount of liquid in the tank — Incorrect Answer. The free surface effect maximizes when a tank is half-filled. A virtually filled tank and a virtually empty tank have negligible free surface effect. There is no direct relationship between the amount of liquid in a tank and the free surface effect.

C. dimensions of the liquid surface — Correct Answer. As a vessel pitches or rolls, the greater the surface area of the liquid in a tank not in contact with tank boundaries, the greater the virtual rise in the center of gravity. The surface area is a function of the actual length and width dimensions of the liquid surface.

D. weight of the liquid in the tank — Incorrect Answer. The greater the density of a liquid, the greater the weight of a liquid for a given volume. As seen in an answer "B" above, there is no direct relationship between the amount of liquid in a tank and the free surface effect. By extension, there is no direct relationship between the weight of liquid in a tank and the free surface effect.

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4. A. 1.5 hours — Correct Answer.

B. 2.0 hours — Incorrect Answer.
C. 2.5 hours — Incorrect Answer.
D. 3.0 hours — Incorrect Answer.

Solution is as follows:

1 long ton = 2,240 pounds
68.5 long tons (2,240 lbs/long ton) = 153,440 pounds

1 gallon of water = 8.3456 pounds
153,440 pounds ÷ 8.3456 pounds/gallon = 18,385.7 gallons

pump capacity = 200 gals min = 200 gals/min(60 minutes/hour) =12,000 gals/hour
thus, 18,385.7 gallons ÷ 12,000 gallons/hour = 1.5 hours to ballast tank

Nautical Deck Queries

Questions

Prepared by NMC Deck Examination Team

1. **Inflatable life rafts shall be serviced at an approved servicing facility every 12 months or not later than the next vessel inspection for certification. However, the total elapsed time between servicing cannot exceed __________.**

A. 12 months
B. 15 months
C. 17 months
D. 18 months

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2. **Your vessel is required to have an impulse-projected line throwing appliance. The auxiliary line must __________.**

A. be of a light color
B. be 250 meters in length
C. have a breaking strength of 9,000 lbs
D. be made of synthetic material

---

3. **INLAND ONLY Which statement is TRUE concerning the fog signal of a canal boat 25 meters in length, anchored in a "special anchorage area" approved by the Secretary?**

A. The vessel is not required to sound a fog signal.
B. The vessel shall ring a bell for five seconds every minute.
C. The vessel shall sound one blast of the whistle every two minutes.
D. The vessel shall sound three blasts of the whistle every two minutes.

---

4. **A cargo of canned foodstuffs is packed in cartons. Each carton is 36 cubic feet and weighs 380 pounds. What is the stowage factor of the cargo?**

A. 9.5
B. 62
C. 212
D. 237

1. A. 12 months — Incorrect Answer.

B. 15 months — Incorrect Answer.

C. 17 months — Correct Answer. As per 46 CFR 199.190 (g) Servicing of inflatable lifesaving appliances, inflated rescue boats, and marine evacuation systems, (1) each inflatable lifesaving appliance and marine evacuation system must be serviced—

(i) Within 12 months of its initial packing; and

(ii) Within 12 months of each subsequent servicing, except when servicing is delayed until the next scheduled inspection of the vessel, provided the delay does not exceed 5 months.

D. 18 months — Incorrect Answer.

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2. A. be of a light color — Incorrect Answer.

B. be 250 meters in length — Incorrect Answer.

C. have a breaking strength of 9,000 lbs — Correct Answer. IAW 46 CFR 199.170 Line-throwing appliance.

(c) Additional equipment. Each vessel must carry the following equipment for the line-throwing appliance—

(1) The equipment on the list provided by the manufacturer with the approved appliance; and

(2) An auxiliary line that—

(i) Is at least 450 meters (1,500 feet) long;

(ii) Has a breaking strength of at least 40 kiloNewtons (9,000 pounds-force); and

(iii) Is, if synthetic, of a dark color or certified by the manufacturer to be resistant to deterioration from ultraviolet light.

D. be made of synthetic material — Incorrect Answer.

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3. A. The vessel is not required to sound a fog signal. — Correct Answer. Inland Rule 35(j) states: "The following vessels shall not be required to sound signals as prescribed in paragraph (f) of this Rule when anchored in a special anchorage area designated by the Secretary:

(i) a vessel of less than 20 meters in length; and

(ii) a barge canal boat, scow, or other nondescript craft."

B. The vessel shall ring a bell for five seconds every minute. — Incorrect Answer.

C. The vessel shall sound one blast of the whistle every two minutes. — Incorrect Answer.

D. The vessel shall sound three blasts of the whistle every two minutes. — Incorrect Answer.

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4. A. 9.5 — Incorrect Answer.

B. 62 — Incorrect Answer.

C. 212 — Correct Answer. The formula for stowage factor computation is cubic capacity/weight in long tons.

1 long ton is equal to 2,240 lbs.

The weight of the cargo is given in pounds and must be converted to long tons.

380 lbs / 2,240 lbs = .1696 long tons.

Stowage factor = 36 cubic feet / .1696 long tons = 212.26.

D. 237 — Incorrect Answer.


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