U.S. Department
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United States
Coast Guard

Fall 2012

The Coast Guard Journal of Safety & Security at Sea
PROCEEDINGS
of the Marine Safety & Security Council

The Marine Casualty Investigation Process

Training

Absent Safety Culture

Distracted Operations

Complacency

Fatigue

Inadequate Maintenance

Connecting the Dots

Examining the causal factors that lead to marine casualties

PROCEEDINGS

Fall 2012 Vol. 69, Number 3

Investigate

Collaborate

Investigate

Collaborate

Communicate

Lessons Learned

Assistant Commandant's Perspective

by RDML Joseph A. Servidio
U.S. Coast Guard Assistant Commandant for Prevention Policy

The United States Coast Guard is this nation's premier marine safety organization. It has broad, multifaceted jurisdictional authorities, and in executing its marine safety and environmental protection responsibilities, the Coast Guard relies on the information it gleans from detailed marine incident investigations to assess mission effectiveness and formulate appropriate responses to the ever-changing marine industry. Investigations and the resultant data, analysis, conclusions, and safety recommendations are key parts of the Prevention program and lay the foundation to develop new or improved safety standards.

Following the old adage "an ounce of prevention is worth a pound of cure," the Coast Guard Prevention program has invested a lot of time and effort developing standards for ships, equipment, and personnel to ensure they operate safely. The Coast Guard reviews and approves plans for ship construction, repair, and alteration to ensure their designs comply with those standards. Coast Guard field personnel then inspect vessels, mobile offshore drilling units, and marine facilities for operational compliance safety. A final component of the Coast Guard's Prevention program is to test and license mariners to ensure they are qualified to operate within the scope of their assigned responsibilities.

Sadly, despite all of these precautions, marine casualties continue. However, great strides are being made to improve maritime safety, based on the findings and recommendations from marine investigations as well as improvements in our awareness of safety issues and our ability to interact with our many private and governmental partners to address those issues.

For the past 20 years, for example, the Coast Guard has helped achieve continual improvements to commercial fishing industry safety. With the 1991 implementation of the Commercial Fishing Industry Safety Act of 1988 (enacted largely based on historical Coast Guard casualty data) and during the period 1982 to 1991, fishing vessel-related fatalities averaged 105 per year. As a result of Coast Guard safety rules and the launch of the Coast Guard's Fishing Vessel Safety Program in 1991, the fatality rate dropped to an average of 78 per year, from 1992 to 1999.

Then in 1999, there was an unusual increase in fishing vessel losses and deaths in the Northeast clamming industry, sparking in-depth Coast Guard investigations. The result: The Coast Guard established the Fishing Vessel Safety Task Force and developed new efforts to improve safety. As a result, from 2000 to 2010, the average fatality rate for this industry dropped to 41 per year. As we consider even one death unacceptable, the Coast Guard continues efforts to improve safety in the fishing vessel industry and throughout the marine industry.

The Coast Guard will continue to rely on marine casualty investigations for quantifiable feedback to further its marine safety mission. The reiterative feedback system it provides is in constant motion to offer long-term dividends to help the program maintain its prevention course and speed.

Champion's Point of View

by CAPT David S. Fish
Chief of the U.S. Coast Guard Office of Investigations and Casualty Analysis

Looking back at the U.S. Coast Guard's long history, assuring safety in the marine environment has been, in my opinion, our most traditional mission, and the personnel of the Coast Guard are very proud of this legacy. Much of our effort is directed at prevention. The strategic goal of the Maritime Prevention program is to minimize, if not eliminate, the risk of marine casualties and security incidents as well as the deaths, injuries, property losses, environmental damage, disruptions to commerce, economic loss, and other adverse consequences that may arise.

To this end, the Coast Guard conducts nearly 14,000 marine incident investigations per year involving vessels, oil and hazardous materials spills, and maritime personnel actions. Results of these investigations form our standards development and compliance activities. Additionally, investigation activities may also result in suspension and revocation proceedings as well as civil or criminal prosecution.

The Coast Guard's analysis, conclusions, and recommendations are made available to the public and government entities and are used to develop new standards to prevent accidents. In this edition of *Proceedings,* we will take a close look at the Coast Guard's prevention efforts by focusing on marine casualty investigations and the challenges our investigating officers face while working on casualties such as salvage or underwater surveys of sunken vessels. We will also explore the plethora of tools and resources available to our marine investigators, including an introduction to our centers of expertise.

People are the heart of the Maritime Prevention program. The Coast Guard's ability to maintain awareness of the rapidly growing and evolving maritime environment is fundamentally linked to the competency, capacity, and readiness of our personnel. We foster a culture that promotes the development and retention of an experienced cadre of technically savvy professionals who provide excellence in mission execution, and the personnel assigned to our centers of expertise are the best of the best.

I hope you find this edition of *Proceedings* useful and informative. It is our intention to publicize the lessons learned from each of these incidents to educate the maritime community. In so doing, we hope to prevent similar incidents.

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No Stone Left Unturned

Searching for answers after a trawler sinking.

by LT Christina Sullivan
Chief, Investigations Division
U.S. Coast Guard Sector Boston

U.S. Coast Guard Marine Casualty Investigators reconstruct events to:

- **uncover the cause of the incident,**
- **document the events,**
- **initiate the necessary corrective actions to prevent casualties.**

On Jan. 3, 2009, at approximately 1:17 a.m., the F/V *Patriot,* a 62-foot steel hull stern trawler, suddenly went silent then disappeared approximately 14 nautical miles east of Gloucester, Mass.

Coast Guard investigators determined that the vessel had most likely sunk, but had no solid evidence to determine how this incident occurred. With no eyewitnesses to interview, no distress calls to evaluate, and no vessel activities happening nearby, investigators had little information to begin their investigation.

Starting with nothing more than a few pieces of debris from the sunken vessel, the marine casualty investigators faced a daunting pursuit to determine what caused the loss of the 12-year-old fishing vessel.

The Casualty

Jan. 2, 2009, was a typical day off the New England coast. The weather was clear, the air frigid, and the only people plying the wintry waters of the Gulf of Maine were avid fishermen, the hardiest of souls.

The F/V *Patriot* sliced through the salty waves of the Atlantic Ocean like a blade. Aboard were the master and his deckhand father-in-law, underway on a routine fishing voyage. At approximately 10:15 p.m., the master received a phone call from his wife (also the vessel's co-owner). He told her they were preparing to haul back their last catch of the day before heading home. Sadly, this was the last time she would ever speak to him.

On Jan. 3, 2009, at approximately 1:35 a.m., the master's wife contacted Coast Guard Station Gloucester to report that the vessel's alarm service received a fire alarm on the *Patriot.* Unable to contact the vessel, Station Gloucester personnel searched Gloucester fishing piers for the vessel then requested vessel-monitoring system (VMS) data.[1]

Wireless phone calls, emails, and VHF radio calls to the fishing vessel went unanswered. District 1 Command Center confirmed that the *Patriot* was the only boat not updating on the VMS. At that point, personnel at Coast Guard Air Station Cape Cod launched a helicopter and sent the Coast Guard Cutter *Flyingfish* to the vessel's last known position.

Picture of the F/V *Patriot* as the F/V *Danielle Marie*, prior to sale and name change. Photo courtesy of the former owner.

F/V *Patriot's* resting orientation. USCG photo.

Tragically, these assets would locate and recover the bodies of the vessel's crew. Since the Coast Guard did not receive any distress calls from the vessel, and neither crewmember was wearing a survival suit or lifejacket when recovered, investigators could safely assume that the vessel sank suddenly. With the recovery effort complete, the Coast Guard marine casualty investigation began.

Investigators Explore Possible Scenarios

Investigators examined several scenarios to determine the cause of the sinking, including collision, fire, capsize/loss of stability, or flooding.

The investigation began with the most time-critical scenario: collision. With a collision, it is crucial to collect evidence before it disappears. It is also imperative to interview any witnesses before they depart or become unreachable.

Therefore, investigators quickly gathered automated information system (AIS) and VMS data to identify all vessels that were near the F/V *Patriot* during its voyage. AIS data showed that the closest vessel was a tugboat, towing a tank barge approximately 1,300 feet astern, which had transited through the immediate area then passed within two nautical miles of the fishing vessel's last VMS position.

Sector Baltimore investigators boarded the tug and barge as it entered port, and interviewed the crewmembers. Additionally, investigators obtained a copy of the tug's digital video recorder hard drive, inspected the hull of the tug and barge for any indication of a collision, and issued a subpoena for the tugboat's towline.

Sector Boston investigators teamed with a National Transportation Safety Board metallurgist to inspect and analyze the tug's towline for evidence of a collision. Coast Guard Investigative Service computer forensic analysts reviewed the tug's camera data.

Concurrent to this effort, a remotely operated vehicle underwater survey confirmed the vessel was in approximately 100 feet of water, and revealed the vessel was lying on its starboard side with its fishing nets in a retrieved position. There was no evidence of a fire nor any visible damage to the hull or superstructure.

Evidence gathered from the tug and barge, the metallurgical and computer forensic analysis, and the remotely operated vehicle (ROV) video footage did not support the scenario that the tug and barge had struck the fishing vessel. Therefore, the collision theory was eliminated.

Investigators immediately shifted their focus to other scenarios. The challenges were daunting, and investigators had no ability to examine the lost vessel. In addition, the F/V *Patriot* did not have a sister ship for comparison, nor did vessel plans exist for investigators to review.

Stability

Stability testing is not required for commercial fishing vessels less than 79 feet in length. A stability test was never conducted on the vessel, therefore the stability of the vessel on the morning of Jan. 3, 2009, is unknown.

Evidence gathered from interviews on scene and from two nearby weather buoys show that icing was also not a contributing factor in the sinking. Weather recorded on scene shows the vessel would have experienced 17-knot winds with two- to three-foot waves.

Two previous owners and the current owner/master had implemented significant modifications to the vessel. Specifically, investigators discovered the owners had applied concrete to the bilge from the forepeak to the lazarette, indicating stability had been a concern in the past. This alteration could have affected stability characteristics of the vessel, but it is impossible to know to what extent without a stability test, inclining experiment, or deadweight survey.

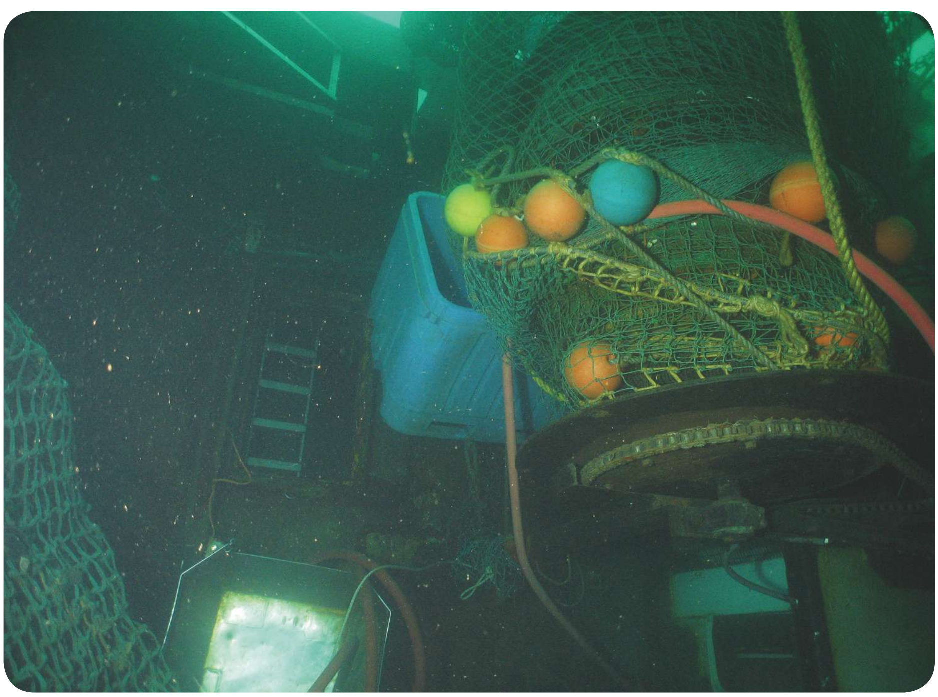
The F/V *Patriot* was fishing the night of the incident, and the weight of the haul may have contributed to the capsizing. However, we do not know the amount of fish on the vessel when the casualty occurred. ROV footage of the wreckage revealed the cod end of the net was high. According to NOAA's National Marine Fisheries Service, the *Patriot* could have legally caught as much as 2,800 lbs. of fish.

The fishing vessel's third crew member/engineer, who did not get underway that night due to a family obligation, revealed that the vessel had approximately six tons of ice in the fish hold upon departure from Gloucester.

The vessel also had as much as 6,400 gallons of diesel onboard that was distributed between two tanks: one to port, one to starboard. If the crew had not balanced these two tanks properly, it is possible that one tank was holding as much as 600 gallons, or 4,290 pounds, more than the other tank.

Considering all this information, Coast Guard Marine Safety Center (MSC) personnel attempted to create a computer model of the fishing vessel to assess the vessel's stability.

Despite the lack of any stability, inclining, or deadweight survey data, MSC staffers were able to acquire American Bureau of Shipping tonnage measurements and gathered critical information from the family, crewmembers, and former owners to create a rough computer model of the vessel.



The vessel's wash-down hose was found entangled in the forward net reel. USCG photo.

Via this model, the MSC team assessed different loading scenarios for possible catastrophic changes to stability and determined that a combination of uneven fuel load, a raised cod end, and water on deck could have brought the vessel close to capsize. Again, this was a rough analysis based on best estimates gathered during the investigation and cannot be considered a conclusive cause of the sinking.

The Investigation Continues

With flooding a likely scenario, Sector Boston marine casualty investigators moved to determine if this had caused the vessel to sink so quickly.

MSC evaluated flooding scenarios as part of its analysis and determined that unrestricted flooding into the fish hold would have resulted in down flooding into the engine room and inevitable sinking. Similarly, a flooded engine room would have resulted in down flooding into the fish hold. Staffers also analyzed the effect of flooding into the lazarette space and found that this flooding by itself would not sink the vessel. Regardless, the MSC concluded that complete flooding of the fish hold or engine room would cause the vessel to sink.

Trouble on Deck?

Additionally, with the help of the National Oceanic and Atmospheric Administration, marine casualty investigators were able to use acoustic buoys designed to record whale communications to uncover the most tangible evidence of what might have happened the final moments before the F/V *Patriot* sank (see “Audio Evidence” sidebar).

The vessel’s engine speed that night and the condition of the vessel’s deck gear, as revealed by the visual underwater survey of the vessel, indicates that the crew may have had trouble while retrieving the vessel’s fishing gear.

According to the engine speeds in the audio files, the vessel probably began hauling back her fishing gear at 12:29 a.m. Interviews with the vessel’s engineer and family members establish that a typical haul-back took approximately 20 minutes from start to finish.

However, the frequent engine speed changes from 12:29 a.m. onward indicate the engaging and disengaging of the vessel’s hydraulic system. This means it took the fishing vessel approximately 42 minutes to haul back her gear that night.

Additionally, video footage of the wreck site reveals other signs of difficulty with the haul back: There is a quantity of net that had come off the forward reel, presumably, while the net was hauled in.

Also, the net is wrapped tightly around the axle outside the port flange of the forward reel, possibly jamming the net reel. The underwater footage also showed the wash-down hose entangled in this same net reel.

This entangled wash-down hose may explain the speed decrease noted in the auxiliary motor at 1:06 a.m., and its increase at 1:09 a.m. Interviews with a former owner and vessel crew members established that the auxiliary motor the analysts heard is likely the vessel’s wash-down pump.

This hose entanglement would have increased the wash-down pump’s flow resistance and caused the motor’s speed to decrease. The diesel engine speed decreases at 1:08 a.m. and at 1:09 a.m., the auxiliary motor speed begins to increase again. This 1:09 a.m. increase may have been the crew diverting system’s flow or a hose/connection bursting, relieving pressure and resistance on the wash-down pump. This loss of resistance would cause the motor speed to increase from 1:09 a.m. to when the auxiliary motor noise was lost at 1:12 a.m.

Underwater footage also revealed a haul-back problem with both trawl doors.[2] The port trawl door’s wire had pulled the door tight to its block by the winch, and the starboard trawl door’s wire was parted and frayed and its 10-ton block bent. Neither trawl door was clipped to the gallows frame, allowing each 1,200-lb. door to swing on its block.

It is important to note that these haul-back abnormalities could not have solely caused the sinking; however, they may have distracted the crew from a developing dangerous situation.

Investigation Conclusions

While the exact cause of the sinking is not determined, as there are no survivors and no eyewitnesses, a preponderance of the evidence indicates that the vessel capsized resulting from a loss of stability and flooding.

The vessel likely capsized at 1:12 a.m., on January 3, 2009, leading to rapid down flooding through her open fish hold and engine room hatches, leaving the crew no time to respond or access lifesaving gear. The

Audio Evidence

Investigators knew that Cornell University's Laboratory of Ornithology had been collecting and researching the migration of right whales using National Oceanic and Atmospheric Administration's (NOAA) acoustic buoys. These acoustic buoys are located throughout Massachusetts Bay to record and track the underwater vocal sounds of the marine mammals, so the investigators requested audio recordings for the night of Jan. 2 to 3, 2009.

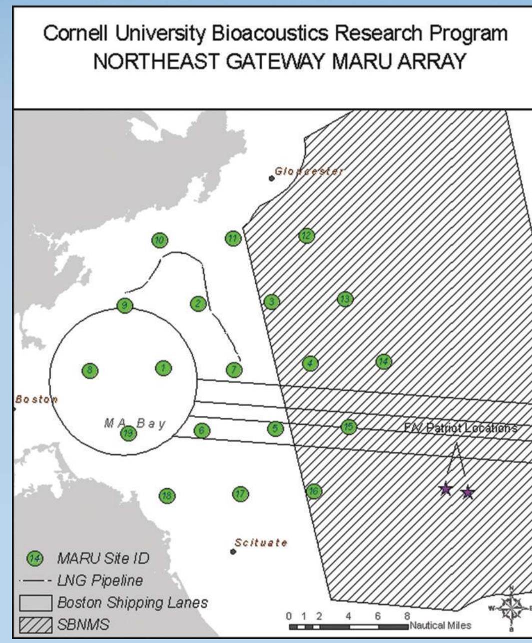
U.S. Navy Undersea Surveillance Analysis

The 19 marine autonomous recording units (MARUs) deployed underwater in a hexagonal pattern in the bay gave investigators a wide range of information for analysis.

Analysis of the closest buoys to the wreck location revealed several sounds of interest. Buoy 4 first detects a loud sound, designated as aural transient event (ATE) 1, lasting 2.5 seconds at 12:07:12 a.m.; every other buoy records this, too. A second, moderately loud sound (ATE 2), lasting less than one second, is first recorded by buoy 4 at 1:12:33 a.m. and then is recorded by buoys 5, 12, and 13. Only buoy 4 detects a third, faint sound (ATE 3), lasting less than 3 seconds, at 1:20:20 a.m.

Sector Boston Investigators provided the NOAA audio files to U.S. Navy Commander Undersea Surveillance (CUS) intelligence analysts. The CUS analyzed the audio files from Jan. 2 to 3, 2009 as well as 161 hours of audio files from eight periods in December 2008, when the F/V *Patriot* had operated in the same general area of Stellwagen Bank.

According to the CUS, every engine's revolutions per minute (rpm) create a unique underwater sound signature, much like a fingerprint.



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The CUS performed an analysis of the audio files and was able to conclusively identify the acoustic signature of the F/V *Patriot* and the tugboat (under investigation due to its close proximity to the *Patriot* during its transit).

Additionally, the CUS was able to determine the fishing vessel's typical operating profile during fishing evolutions. Most significantly, the CUS created a detailed timeline of the F/V *Patriot's* final voyage based on the measured engine rpm of her main propulsion diesel engine.

The Navy analysis detected an alternating current auxiliary motor from the *Patriot* starting at 8:53 p.m. on January 2, 2009. This motor runs at approximately 3,400 rpm until 1:06:11 a.m. on January 3, 2009, when it slows by 18 rpm over the next

cause of the vessel capsize was possibly a stability failure created by a combination of factors and initiated by the lifting of the cod end of the net off the deck.

Unfortunately, the loss of stability has been identified as the root cause of many commercial fishing vessel casualties. It is apparent that as fishermen make modifications to increase the efficiency of their vessels, most are unaware that their improvements may have drastically altered the vessel's center of gravity, displacement and stability characteristics.

After years of undocumented vessel modifications without a stability analysis, many vessels may be one "perfect storm" of shifting weight away from a catastrophic event.

three minutes and 29 seconds. Starting at 1:09:40 a.m., this auxiliary motor increases by 41 rpm until its acoustics are lost simultaneously with ATE 2 at 1:12:31 a.m.

ATE 1

Analysis of ATE 1 found that the event was made up of a series of individual sounds. The first sound in this series had the aural characteristics of a metal-on-metal impact. At least 12 short pulses follow this sound in groups of three at regular interval of 9.60 pulses per second, which matches the rotational rate of the tugboat's propeller. ATE 1 could not be definitively explained, but it is most likely propeller cavitation or an object striking the tugboat's propeller.

Cornell University's analysis placed ATE 1's location at 42° 25' 1.2" N by 70° 31' 1.9" W, approximately 0.3 nautical miles from the tug's AIS position at 12:07 a.m. The tug's and F/V *Patriot's* engines remain at a constant speed throughout this event; this provided evidence that a collision between the tugboat and the F/V *Patriot* did not occur.

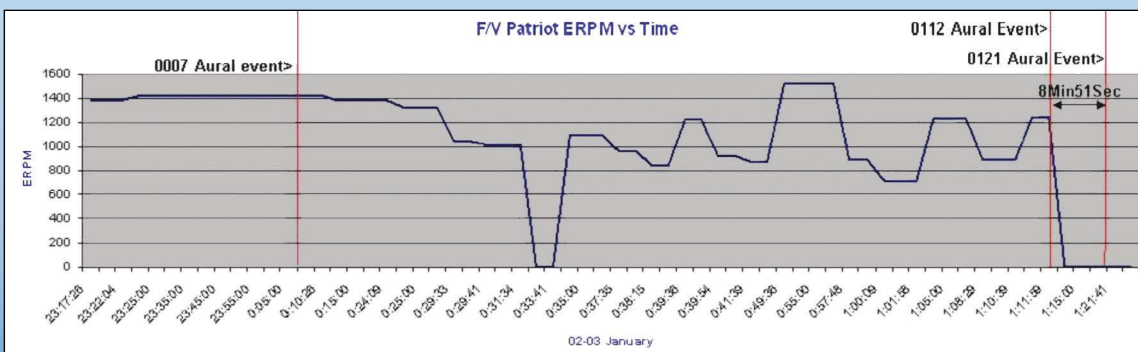
ATE 2

Navy analysis of ATE 2 describes this event as a metallic thud, lasting less than one second, originating from the fishing vessel. No other vessels were in the immediate vicinity at this time. Cornell analysis placed ATE 2's location at 42° 25' 20.6" N by 70° 28' 16.0" W, approximately one nautical mile northwest of the vessel's wreck location.

Immediately after ATE 2, Navy analysts detected a noise with an irregularly increasing frequency throughout the event, consistent with a void filling up with water. This is heard from 1:12:34 a.m. to 1:15:39 a.m. and ATE 3 occurs approximately 6 minutes after this sound ends.

ATE 3

Analysts described ATE 3 a series of seven irregular, quiet sounds lasting two seconds total with the final and loudest sound having a hollow metallic quality. Because ATE 3 is only heard on buoy 4, Cornell location analysis was not possible. No further sounds associated with the F/V *Patriot* are heard after this point; ATE 3 is most likely the sound of the vessel hitting the ocean floor.



F/V *Patriot* engine rpm vs. time, with a red line corresponding to each aural transient event. Notes: On this chart, an rpm reading of 0 means engine noises quieted to an undetectable level, not necessarily that the engine was shut down; analysis has a one- to five-nautical mile error radius. Chart courtesy of U.S. Navy CUS.

About the author:
LT Christina Sullivan is the chief of the Investigations Division of Sector Boston, and was a marine casualty investigator on this case. Her previous assignments include tours at Sector St. Petersburg as a vessel inspector, and at U.S. Coast Guard headquarters in the Environmental Standards Division. LT Sullivan holds a B.A. in communication, specializing in public relations at George Mason University.

Endnote:

1. Vessel monitoring systems are used in commercial fishing to allow environmental and fisheries regulatory organizations to monitor the position, time at a position, and course and speed of fishing vessels. NOAA allows the Coast Guard to utilize VMS data in search and rescue missions.
2. The trawl doors are designed to flow through the water at an angle, causing them to spread away from each other, opening the net horizontally. The trawl doors are attached to the boat by trawl warps (cables). During haul-back operations, the trawl doors were clipped to the gallows frame in preparation for the next pay-out of fishing gear.

Slime and Punishment

Environmental crimes investigation.

by LT Eric Rivera
Investigations Division
U.S. Coast Guard Office of Investigations and Analysis

One of the unique aspects of the U.S. Coast Guard is that it functions as a military force as well as a law enforcement agency. With that in mind, the USCG has found itself in the forefront of the fight against maritime pollution.

The Coast Guard relies heavily on the assistance of its port state control program to identify environmental deficiencies and coordinate actions against those who commit maritime pollution acts. Port state control examiners perform a number of duties including vessel exams, which begin prior to a vessel's entry into port. These exams cover three aspects of the ship's operations: safety, security, and pollution prevention.

The Partnership for Clean Water

The USCG is the primary federal agency responsible for investigating marine environmental crimes; however, Congress has not granted the Coast Guard power to prosecute these cases. Therefore, the Coast Guard elicits help from other federal agencies such as the Department of Justice (DOJ) to pursue such cases aggressively, and hold all guilty parties responsible for their crimes.

This procedure starts when Coast Guard officials determine that a violation of an environmental regulation may be criminal. The Coast Guard issues a recommendation to the DOJ to file charges against the suspect. After investigating the case further, U.S. attorneys decide whether to proceed with the case.

To determine if an action is criminal, prosecutors examine various elements, including:

- the extent of the damages,
- whether intent is shown,
- if the violator is cooperative,
- whether there have been violations like this in the past.

If DOJ officials determine there is enough evidence of a crime and decide to file charges, the defendant has the same constitutional rights and protections that are afforded to private citizens in any criminal case. Although criminal proceedings may deter future misconduct by the alleged perpetrators, they also likely deter those who may be tempted to perform similar offenses.

The Burden of Proof

Environmental crimes happen all over the U.S. and its territories and may involve international, federal, or state law violations, which means DOJ representatives can bring charges at each of these levels. While international cases typically focus on violations of various treaties, those that are filed at the local level are usually based on violations of environmental regulations.

These environmental offenses usually involve introducing hazardous material or other pollutants into the water. To bring criminal charges, however, the government must be able to show that the discharge was intentional.[1]

The Rules

The Clean Water Act, as amended by the Oil Pollution Act, prohibits the discharge of oil or hazardous substances in such quantities as may be harmful, into or upon U.S. navigable waters, adjoining shorelines, or into or upon the waters of the contiguous zone or which may affect natural resources in the U.S. exclusive economic zone. Regulation 33 CFR 151.10 prohibits the discharge of oil within 12 nautical miles of shore, unless passed through a 15 parts-per-million oily water separator. Under 33 CFR 151.25, vessels are required to maintain an oil record book, which must record the disposal of oily residues and the discharge overboard, or disposal of bilge water produced in the engine space.[2]

The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. MARPOL contains six annexes, each of which is concerned with preventing pollution from various shipboard operations. For example, the fuel, oil, onboard spills, and waste water from engines and other machinery that accumulates in the bilges is meant to be discharged over board through the oily water separator. However, if the content of the bilge waste is more than 15 parts per million, it must be sent to a shore-side regulated facility capable of receiving this waste.[3]

Unfortunately, some operators elect to cut corners and discharge illegally overboard, bypassing oily discharge preventative equipment.

The Punishment

Those who violate MARPOL regulations with the knowledge of seriously endangering the environment may face high monetary penalties. Though MARPOL fines are based on the responsible party knowingly violating regulations established to protect the environment, in some of the environmental cases, the government has contended that corporate personnel are criminally liable because they are responsible corporate officials with an obligation to supervise an operation and to detect and prevent a particular criminal act from occurring.

Therefore, MARPOL regulations apply to corporations and individuals alike, and failure to follow them can result in severe criminal penalties. The federal government can fine the responsible party thousands of dollars per day for criminal violations, or even imprison those who negligently cause an oil spill.

Making the Punishment Fit the Slime

So how does this investigation and enforcement play out?

During one inspection in August 2010, Coast Guard examiners found evidence of illegal overboard discharges and false records in the oil record book of a company that operated from a terminal on the Miami River. Investigators also found that the company failed to submit reports to the National Ballast Information Clearinghouse in advance of the ship's arrival to the Port of Miami. All vessel masters, owners, operators, agents or persons in charge are required to conduct ballast water operations in accordance with 33 CFR 151.

Because of USCG and DOJ efforts to prosecute and prove these charges, on January 20, 2012, the company received a $1,000,000 fine.

With an eye toward appropriate restitution, USCG and DOJ officials recommended that the court order $500,000 of the fine paid to the South Florida National Parks Trust, and the court agreed. The company received a five-year term of probation, which includes implementing an environmental compliance plan covering all the vessels in its fleet.

An example of an installed bypass used for deliberate discharges.

Holding the Line

USCG port state control examiners continue to work closely with the Coast Guard Investigative Service to strengthen enforcement actions on substandard vessels. Environmental regulations are strictly enforced, and responsible parties will incur fines and penalties for violating them.

USCG officials will also continue to enforce pertinent laws on vessels, and may hold crew members

A motor vessel simulates an oil spill by applying a non-hazardous, green dye into the water. U.S. Coast Guard photo by Petty Officer Allyson E.T. Conroy.

as material witnesses long after the ship is allowed to sail, with obviously serious financial implications to all parties involved. Additionally, criminal convictions, and even plea agreements can bring with them substantial fines, and possible prison terms and may cause personnel to be banned from entering the United States or serving on vessels calling on U.S. ports, thus impacting companies conducting business in the U.S. and the companies that use their freight services.

About the author:

LT Eric Rivera is a program analyst in the USCG Office of Investigation and Analysis. He has served in the Coast Guard for 17 years at two air stations as an aviation maintenance technician, and at two sectors as a prevention officer.

Endnotes:

1. In criminal cases, the burden of proof is the legal obligation of the state, which must show that the defendant satisfied each element of the statutory definition of a crime by his or her action/participation or failure to act. *Beyond a Reasonable Doubt.* More information is available at the USLegal.com website: http://courts.uslegal.com/burden-of-proof/beyond-a-reasonable-doubt/.
2. Soil Spills, Clean Water Act § 311, and the Oil Pollution Act. National Science & Technology Center: www.blm.gov/nstc/WaterLaws/Chap8.html#Anchor-6785.
3. International Maritime Organization. Available at www.imo.org/about/conventions/listofconventions/pages/international-convention-for-the-prevention-of-pollution-from-ships-(marpol).aspx.

The Congressman James Sener Award for Excellence in Marine Investigations

by LT Eric Rivera
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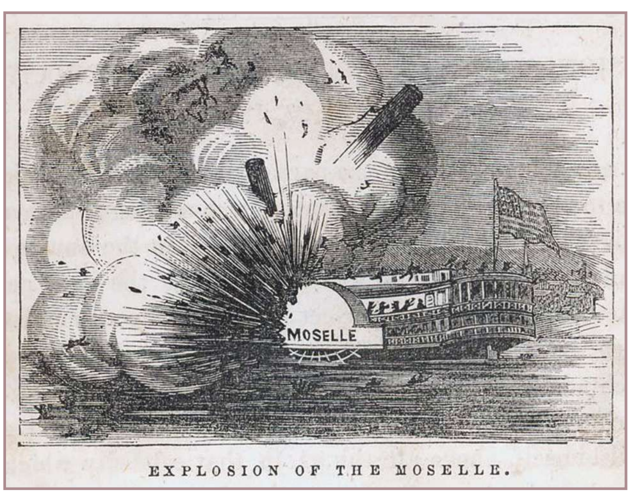
U.S. Coast Guard Office of Investigations and Analysis

The marine investigation program has been a vital arm of marine safety activities since 1838, when the program's predecessor, the Steamboat Inspection Service, was established.

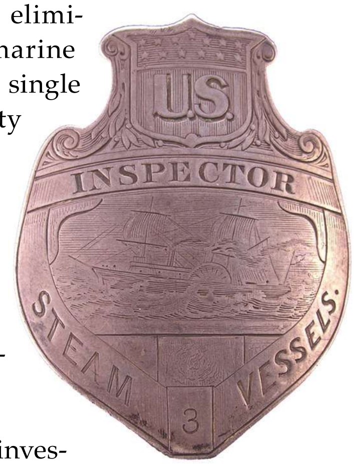
In 1838, about 14 percent of the steam vessels in operation were destroyed by explosions, which occurred largely because there were no inspection laws or rules of navigation. In some cases, the incompetence, negligence, and/or misconduct of a mariner was a causal factor contributing to the casualty.



On April 25, 1838, a boiler exploded on the *Moselle* during the vessel's voyage near Cincinnati, Ohio. More than half (160) the passengers aboard were killed. Photo courtesy of USCG Historian's Office.

As a result, Congress established vessel inspection laws and created the Steamboat Inspection Service.

On June 20, 1874, James Sener, then representative of Virginia, sponsored the legislation that created the modern marine investigations program. Congressman Sener's bill initiated the world's most effective system for identifying and eliminating unsafe conditions in the marine transportation system, perhaps the single greatest step forward in marine safety in the U.S.

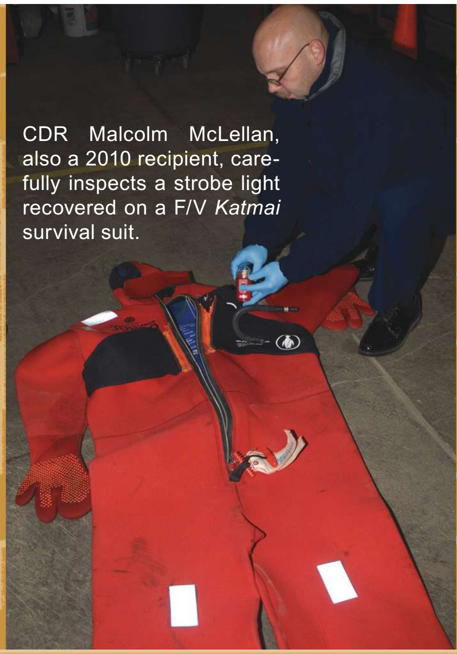


On Nov. 18, 2005, the United States Coast Guard's Office of Investigations and Analysis established the Congressman James Sener Award for excellence in marine investigations.

This award recognizes Coast Guard investigators who have demonstrated exceptional leadership, teamwork, technical acumen, and investigative skills, while positively influencing marine safety.

Furthermore, this award serves to educate Coast Guard personnel on the meaning and value of the marine investigation program and encourage shar-

Pictured from left to right is CDR Mike Farrell, LCDR Radiah Jones, and CAPT John S. Kenyon, who were presented with the 2009 James Sener Award for Excellence in Marine Investigations in August 2010. USCG photo by LTJG Morgan Evans.



CDR Malcolm McLellan, also a 2010 recipient, carefully inspects a strobe light recovered on a F/V *Katmai* survival suit.

CDR Brian K. Penoyer, deputy commander, and CAPT Mark P. O'Malley, commander, of Sector Baltimore, accept the 2007 James Sener Award for Excellence in Marine Investigations on behalf of Sector Baltimore for their efforts in the *Montrose* incident. USCG photo by Petty Officer Robert Brazzell.

James Sener Award Recipients

2010	**CDR Malcolm McLellan**, USCG headquarters: Sinking of the vessel *Katmai*.
2010	**MSTC Peter Gollnick**, Sector Boston: Sinking of vessel *Patriot*.
2009	**Mr. Phillip Wolf**, Sector Southeast New England: Sinking of the vessel *Costa and Corvo*.
2009	**LCDR Radiah Jones**, Sector Honolulu: Demasting of the vessel *Nahoku II*.
2008	**MSSE4 Michael Fincham**, Sector Southeast New England: Sinking of the fishing vessel *Lady of Grace*.
2008	**LCDR Charles Barbee**, Marine Safety Unit Savannah: Sinking of the towing vessel *Valor*.
2007	**LCDR Michael Kelly**, CG District 8: Sinking of the vessel *Elizabeth M*.
2007	**MSSD2 Peter Hackett**, Sector Baltimore: Grounding of the vessel *Montrose*.
2006	**MSSD3 John Nay**, Sector Delaware Bay: Grounding of the tank vessel *Athos I*.
2005	**Mr. Jerome Crooks**, Sector Hampton Roads: Explosion of vessel *Bow Mariner*.
2005	**CDR Richard Raksnis**, CG District 5: Explosion of vessel *Edward A. Carter*.
2005	**CAPT William Drelling**, Marine Safety Unit Morgan City: death on vessel *Mr. Fred*.

ing best marine investigation practices. Recognizing that many investigations are a team effort, the unit and the investigation team members are recognized along with the lead investigating officer.

The award does not replace the existing formal awards program, and individuals may receive both the Congressman James Sener Award and a formal military or civilian award, if appropriate, for the same outstanding effort.

About the author:
LT Eric Rivera has served in the Coast Guard for the past 17 years. He served at two air stations as an aviation maintenance technician, and at two sectors as a prevention officer. He is currently a program analyst in the Office of Investigation and Analysis.

Captain Domenic A. Calicchio Award

Acknowledging selfless contributions at Training Center Yorktown.

by Mr. James P. Fink
National Technical Advisor
Coast Guard Suspension and Revocation National Center of Expertise

CDR Robert Helton
Supervisor
Coast Guard Marine Safety Detachment Nashville

"When I turned around there was nobody there. I think we got separated by the seas.

Finally, after some time in the water, I came across a life ring, and there were five other people hanging on …

It was the chief engineer [Richard Powers]; the third mate, Richard Roberts; one of the ordinary seamen, his first name is Harold—I don't know his last name; the day man, Joe, I don't know his last name; and it was the radio operator [Sparks Lane], and myself.

We were on the life ring.

We sounded off so we could find out who was there. We sounded off by number and came out with six.

And then it was just talking, giving each other encouragement, that we thought daylight was coming pretty quick.

The only lights I could see around me were the strobe lights of the life rings, the water lights, and I could hear people calling all the time, but I couldn't see anybody else …

And I don't know when I started to notice that people weren't on the life ring.

I noticed that Harold wasn't there at one time.

And then I turned around and the day man wasn't there.

Right after that, I called out to Rich Roberts and I asked him how he was doing. He responded that he was okay; that he was cold, he was okay. I don't know how long it was on the life ring before I noticed that the only ones there were the chief engineer and the radio operator.

He was stiffening up. He kept saying, "I'm cold. I'm cold. Help me."

At that point, I noticed that the chief—the chief—when we went into the water, had his spotlight and he had been shining it up into the air all this time.

I noticed that he wasn't shining it any more. I thought he might have lost it. So I whacked him on the back of his life jacket, and there was no response from the chief.

I never looked at my watch in the water because I was afraid that I would lose my grip on the ring. So I wasn't concerned with the time element. I kept talking to Sparks. Sparks was the last one on the ring with me.

The helicopters arrived, and it seemed like I could see them passing over me two or three times before they spotted us.

When they lowered the basket, I turned to tell Sparks that the basket was here, and Sparks wasn't on the life ring anymore.

It was just myself."

The above citation from Robert Frump's book *Until the Sea Shall Free Them* may appear to be a story penned from some gripping novel of fiction. But what some of you may not know is that this passage is actually a description from a real-life event.[1]

In truth, those words were also the testimony given to the U.S. Coast Guard's Marine Board of Investigation by one of only three mariners to survive out of a crew of 34 from sinking of the S/S *Marine Electric* on Feb. 12, 1983.

The *Marine Electric*

The *Marine Electric,* a 605-foot-long, U.S.-flagged bulk cargo vessel, tragically capsized and sank about 30 miles east of the coast of Chincoteague, Va., during a winter storm. The vessel was a World War II-era modified tank ship that had finished a Good Samaritan assist for the Coast Guard. While back on course for Massachusetts, the vessel plowed through massive seas, then ironically, the crew aboard the *Marine Electric* found they were in the very same predicament as the vessel they helped, but with terrifying results.[2]

The Coast Guard convened a formal Marine Board of Investigation a few days after the loss of the *Marine Electric* to determine the cause of the casualty. Marine boards are not a common occurrence, but are even less so when the Coast Guard Commandant orders the precept. After a nearly two-year course, the final investigative report from the board triggered massive changes, affecting a wide swath of the maritime industry and influencing changes within Coast Guard operations.

District Commander RADM Edwin J. Roland, on right, swears in Domenic Calicchio at First District Headquarters in Boston. In 1948, Public Law 80-219 allowed licensed merchant marine officers, like Calicchio, to be commissioned into the Coast Guard. USCG photo.

Among the membership of this formal marine board was Captain Domenic A. Calicchio, a 23-year veteran merchant mariner with vast experience as a master of large, deep-draft vessels.[3] In 1957, Calicchio joined the Coast Guard as part of the "219 Program," which brought experienced licensed mariners to fill voids within the Coast Guard. He came aboard with a full-time commission in 1968. His ensuing Coast Guard marine safety career tasked him to fill key positions in Europe, New York, Miami, and New Orleans.

CAPT Calicchio was unquestionably a critical part of the process to piece together a complete casualty scenario, including needed recommendations intended to prevent future occurrences. However, there was yet another ingrained component of this master mariner-turned-Guardian that proved to be instrumental in initiating the resultant massive reforms: CAPT Calicchio was one of three brothers.

The "Old Man's Code"

They were all career master mariners who contributed much to this country by sailing with the merchant marine. Like Domenic Calicchio, Alfred "Fred" Calicchio, the youngest of the three, along with his oldest brother, Michael, were rooted firmly by family tradition. An unfailing belief in the "Old Man's Code" was implanted deeply in them by their father. That code has often been summed up by Fred Calicchio with four simple words: "Never compromise the truth."

The Captain Domenic A. Calicchio Award plaque on display at Coast Guard Training Center Yorktown, Va., contains a somewhat more elaborate recitation from Mr. Frump's outstanding work:

> *"You did what you knew was right, not what anyone told you. You thought for yourself*
>
> *and did the right thing. You listened to people, but in the end, you were your own person,*
>
> *and any compromise with something you knew was wrong violated the Old Man's Code."*[4]

The *Marine Electric* Report

CAPT Calicchio used this code as he pursued his professional career with the merchant marine. He abided by the Old Man's Code, while in Coast Guard uniform, as he gained understanding of the service's missions. He transcribed his belief in the code into the final 137-page, painstakingly prepared marine casualty report provided to Coast Guard headquarters in late July 1984, including its 14 far-reaching recommendations. But, it was CAPT Calicchio's unfailing faith

Calicchio Award perpetual plaque on display at the Marine Inspection and Investigation School, CG Training Center Yorktown, Va. Photo by Mr. James Fink.

At the 2011 Coast Guard Marine Inspector/Investigator graduation ceremony, U.S. Coast Guard Vice Admiral Brian Salerno honored two marine safety legends, Rear Admiral William M. Benkert and Captain Dominic A. Calicchio. While each of these men have Coast Guard awards named for them, it was only recently that they themselves were rewarded, albeit posthumously.

"If my signature looks like my hand was shaking when I signed the certificates awarding the Marine Safety Pin to Rear Admiral Benkert and Captain Calicchio, it probably was," Vice Admiral Salerno said. "These are two icons of marine safety, and I have been in awe of them throughout my marine safety career."

From left, Rear Admiral Benkert's son, Mr. Alan Benkert; and Captain Calicchio's brother, Master Mariner Captain Fred Calicchio; receive the accolade from Vice Admiral Salerno. USCG photo.

RADM Mary Landry provides poignant remarks during the dedication ceremony for the Calicchio Award at CG Training Center Yorktown, Va., Nov. 7, 2007. USCG photo.

in the code, while facing heavy pressure to amend the report, that allowed him to forge ahead when others would have buckled.

On February 16, 1983, the investigation convened in Portsmouth, Va. The report had resulted in more than 2,000 pages of testimony, including testimony from *Marine Electric's* Third Mate Eugene Kelly, which is reflected at the beginning of this article. CAPT Calicchio stood steadfast upon the code and the report's proclamation for change.

On January 11, 1985, after review, the Coast Guard Commandant approved and concurred with the report (subject to comments), including a majority of the proposed recommendations. CAPT Calicchio's unwavering dedication to the Old Man's Code brought about incredible reforms for the maritime industry intended to protect the lives of mariners at sea.

As a result of the Coast Guard investigation and report, Mr. Frump wrote:

> *"The impact of inspections on the Merchant Marine fleet of the United States—on any post-war merchant fleet of any flag in peacetime – seems unparalleled. More than half of the large bulk carriers of the American merchant fleet were junked virtually overnight. Even more followed in subsequent years. The losses to owners were estimated at more than $1 billion."*[5]

American Merchant Marine Veterans Memory Publication page submitted for Domenic Calicchio from info/photos as provided by Mr. Fred Calicchio.

The Legacy

In 2006, the authors' desire to resurrect the importance and impact of Coast Guard investigating officer efforts began to solidify within the school. There was already a LCDR William B. Turek Award for distinguished marine inspector graduates. So, a decision had to be made to determine what type of award would best symbolize the personal qualities and professional traits of the marine casualty investigating officer that could be used to honor a marine investigator graduate.

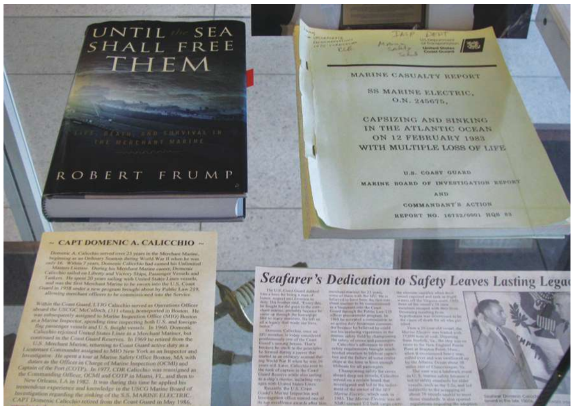
From initial consideration to final realization, patience and perseverance were watchwords. In 2001, Random House publishers released Frump's *Until the Sea Shall Free Them,* and it captured the outstanding attributes of Coast Guard CAPT Domenic Calicchio.

Yorktown training school staffers read the book and became captivated by its focus on the highest order of marine casualty investigation; it empowered their core beliefs of honor, respect, and devotion to duty. They unanimously agreed that CAPT Calicchio was the ideal beacon for inspiring these newly minted investigating officers; and, with just a touch of the same perseverance shown by CAPT Calicchio, the Calicchio family was contacted. The family granted approval to honor their loved one by naming a perpetual award after him.

Like many things, while the report's impact was still obvious, the efforts and personal sacrifices of CAPT Calicchio have faded with time. The report of the *Marine Electric* disaster had joined company on the shelf with so many other marine casualty reports. The Marine Inspection and Investigation School at Coast Guard Training Center Yorktown Va., did include it within their course teachings in the 1980s, but it eventually lost significance and was displaced when training functions expanded.

The Award

CAPT Calicchio may have passed over the bar in 2003, but the qualities he showed in life—the Old Man's Code—could now live on to lead others. The Captain Domenic A. Calicchio Award was dedicated in early November 2007 at Coast Guard Training Center Yorktown, Va. Those in attendance included members of the Calicchio family (including both Fred and Michael), Mr. Robert Frump, and a wide variety of Coast Guard personnel.



A few items on display within the Calicchio memorial at Yorktown, Va. Photo by Mr. James Fink.

Fred (left) and Michael Calicchio (right), brothers of Captain Domenic Calicchio, donated artifacts and awards to support the Calicchio memorial at Hamilton Hall, Training Center Yorktown, Va. Photo by Mr. Dennis Crawford.

After the dedication, the Calicchio family kindly allowed the Training Center to establish a permanent display of numerous donated artifacts and highly prized memorabilia from the captain. Guests can visit the display in Hamilton Hall at Yorktown Training Center.

Since its inception, the Calicchio Award has been presented to 19 course graduates who are charged with carrying out duties, while keeping with the personal and professional traits exhibited by CAPT Calicchio during his lifetime.

About the authors:
Mr. James Fink is a marine investigator serving as the national technical advisor at Coast Guard's Suspension and Revocation National Center of Expertise in Martinsburg, W.Va. He served at the investigations school while on active duty and as a civilian.

CDR Robert Helton enlisted in active duty Coast Guard in 1982. He is a marine inspector and investigator serving as supervisor of the marine safety detachment in Nashville, Tenn. His previous tour included an assignment at Training Center Yorktown serving as assistant chief at the Marine Inspection and Investigation School, also school chief and assistant marine safety branch chief respectively. He graduated from officer candidate school in 1995.

Endnotes:

1. Frump, Robert. *Until the Sea Shall Free Them: Life, Death, and Survival in the Merchant Marine.* New York, NY: Random House, 2001.

2. *Capsizing and Sinking in the Atlantic Ocean on 12 February 1983 With Multiple Loss of Life.* Marine Casualty Report: The SS *Marine Electric* O.N. 245675. Washington, DC: U.S. Coast Guard Marine Board of Investigation Report and Commandant Action. Also available at www.uscg.mil/hq/cg5/docs/boards/marineelectric.pdf.

3. Thiesen, William H. *Captain Domenic Calicchio: The Coast Guard's Champion on Marine Safety Regulations.* Available at www.uscg.mil/history/people/CalicchioDomenicA.pdf.

4. Ibid, p. 149.

5. Ibid, p. 317.

Coast Guard Petty Officer Nicholas L. Adams scoops an oil sample from the Mississippi River. The sample of oil is used as evidence in the investigation of the oil spill that occurred July 23, 2008. U.S. Coast Guard photo by Petty Officer Adam Baylor.

Investigations National Center of Expertise

Committed to improving marine casualty investigations.

by CDR Joshua McTaggart
Supervisor
Investigations National Center of Expertise

The Coast Guard established the Investigations National Center of Expertise (INCOE) in 2009 to familiarize marine investigators with vessel systems and operations, and to help them develop a high degree of skill in the investigative craft, which is crucial to our mission of preventing marine casualties.

INCOE's overall goals include developing advanced training, tactics, and procedures within the investigative program, providing direct and immediate assistance to formal or high-profile investigations, and establishing and strengthening relationships across the investigative community.

Personnel

INCOE staff have Coast Guard and merchant marine experience, possess an array of licenses and certifications, and are subject-matter experts in topics such as bridge resource management, commercial diving, towing vessels, and electronic evidence collection. They also assist with many complex investigative efforts when necessary.

Additionally, INCOE staff also researches and develops replies to hundreds of inquiries from investigators in the field, often addressing technical, complex, or unique issues.

They keep their skills honed by attending advanced training courses offered by the National Transportation Safety Board, the National Association of State Boating Law Administrators, and other leading organizations in the investigative community.

INCOE staff members also work closely with the Coast Guard Investigations and Analysis Office and the Training Center Yorktown Investigations School to develop, disseminate, and implement tools and techniques that enhance the knowledge and skills of investigating officers across the Coast Guard.

Initiatives

To this end, one of the first initiatives of the INCOE was to develop an online investigating officer exchange forum, which allows for improved collaboration within the Coast Guard community—directly linking those in the field with training and policy makers at every level of the organization.

While the forum has become a repository for training, tactics, and procedures information; best practices; and new policy documents, perhaps its greatest function is to offer immediate peer-to-peer communications, which is critical to improving skills.

Other efforts include quality assurance reviews of our investigative casework, tactics, and procedures to address training shortfalls. We pay particular attention to best practices and lessons learned, as these are often not included as part of traditional qualification

Mr. Patrick Cuty, INCOE senior marine investigator, examines engine room damage following a fire onboard the cruise ship *Carnival Splendor.* He also aided in the forensic examination of the failed engine components. All photos USCG.

framework. Once identified, we develop products (including written and video presentations) to inform the investigative community and improve competencies.

Large Scale Casualty Assistance

When major marine casualties occur, sectors may request INCOE staff assistance, including on-scene investigative support. We are staffed to provide all manner of support, and have assisted in many recent high-profile cases, including serving on the investigation team tasked with investigating the *Deepwater Horizon* casualty. Other notable responses include those to the *Delta Mariner* bridge collision[1] and the *Costa Concordia* sinking.[2]

Building Relationships

The INCOE places priority in providing support to Coast Guard sector staff elements, developing personal and professional relationships with the individuals who conduct daily investigative work. We have the unique ability to offer direct support to those units or sub-units, outside the typical chain of command, and through this relationship, we can better understand the complexities the typical investigator encounters.

We cannot hope to accomplish our mission on our own, however. We must continue to build relationships with the National Transportation Safety Board, the United Kingdom's Marine Accident Investigation

Crew of the INCOE pictured from left to right, Mr. Keith Fawcett, Mr. Kerry Duke, LT Nick Parham, Mr. Patrick Cuty, Mr. Marc Dejesus, LCDR Teresa Hatfield, CDR Josh McTaggart, and Mr. Les Ledet.

- Mr. Keith Fawcett is a marine investigator and licensed mariner who specializes in human factors and interview techniques.
- Mr. Kerry Duke is a marine investigator, specializing in electronic forensic analysis, evidence collection, and commercial fishing vessels.
- LT Nick Parham is a marine investigator who specializes in environmental crimes and general investigative matters.
- Mr. Patrick Cuty is a marine investigator and licensed mariner who is a specialist in diving, sailing, tankship, and mechanical casualties.
- Mr. Marc Dejesus is a marine investigator who specializes in offshore supply vessel, passenger vessel, and engineering casualties.
- LCDR Teresa Hatfield is a marine investigator and provides logistical oversight of INCOE activities.
- CDR Josh McTaggart is a marine investigator and INCOE supervisor.
- Mr. Les Ledet is a marine investigator and licensed inland towboat pilot who specializes in bridge team management, towing vessel casualties, and navigation rules.

Branch, and with other investigative bodies to build our expertise. The INCOE will continue to conduct frequent outreach within this community.

Moving Forward

Moving ahead, the INCOE is well positioned to provide critical mission support to the Coast Guard investigative community. Most staff members have obtained designation as national verification officers, which allows them to test and validate the skill sets of investigating officers across the country.

We will continually add instructor training, develop exportable training modules, and leverage technology to deliver training to personnel throughout the Coast Guard efficiently and effectively, improving consistency of effort. We will also continue to provide direct investigative support to field personnel and respond routinely to larger scale marine casualties.

About the author:

CDR Joshua McTaggert has served in inspections and investigations-related marine safety positions over his 18-year Coast Guard career, including duties at marine safety detachments/units, sector offices, and Coast Guard headquarters.

Endnote:

1. Carroll, Tina. *Ship carrying rocket parts hits Kentucky bridge.* The Associated Press, 2012. Reprinted by USA Today, Gannett Inc., January 2012. Available at www.usatoday.com/news/nation/story/2012-01-27/kentucky-bridge-collapse/52813592/1.
2. *The Costa Concordia Disaster.* Available at www.cruisecritic.com/reviews/review.cfm?ShipID=371.

Collaborate

Ship Simulation

A versatile marine safety tool.

by Mr. Keith Fawcett
Marine Casualty Investigator
USCG Investigations National Center of Expertise

A mariner in training navigates a large tanker into the port of Valdez, Alaska. Waterway, landscape, and facilities pass by the bow of the ship. The pilot in training issues helm and rudder commands as members of the student bridge team carry out her orders. Everything is going according to plan.

As the giant ship approaches the last few hundred meters to the dock, orders are given and carried out smoothly in the darkened bridge under threatening skies, as snow flurries build into heavier snow. The pilot orders slow astern then half astern, while looking at the ship's rpm indicators on the overhead of the bridge.

Startled to see no response from the ship's massive engine and no reduction in speed, the pilot turns to the vessel's captain. The instructor calls out from the simulator control room: "Stop the exercise." The overhead lights come on in full brightness. This exercise is finished for now.

Experienced instructors and members of the bridge team analyze their actions, and a technical support team resets the complex simulator for the next trainee.

Today's Simulators

Modern state-of-the-art ship simulators provide an extremely realistic experience for mariners undergoing training and certification. These systems can range from desktop-sized simulators to multi-million dollar systems that incorporate a vessel's heave, pitch, sway, roll, and yaw motions, and other realistic effects such as rain, snow, fog, and other simulated environments. These simulators are used in maritime training centers, training academies, and military marine training centers worldwide.

While it is very expensive to model the marine environment, the results are amazing. Every conceivable aspect of the maritime world is possible to model: The effects of ship design, propulsion characteristics, weather, bottom contours, tugboat assistance, and marine traffic are all integrated with the vessel controls to simulate a real-life experience.

Most simulators are programed to model a number of vessels, such as tankers, cargo ships, car carriers, tugs, pleasure craft, wing-in-ground craft, pilot boats, and a host of other watercraft. Designers of the simulation software create complex programs that go to great lengths to create a challenging and realistic virtual marine world.

Occupational Functions

Our nation's waterways are becoming more complex and congested, and simulators provide a way for the Coast Guard and the marine industry to plan, analyze, and achieve the goal of reducing marine casualties.

Course instructors at the control console for the MITAGS simulator. The personnel in the center maneuver the vessel and respond to the simulation, while the instructors control the scenario. Photos courtesy of the Maritime Institute of Technology and Graduate Studies.

Also, when marine casualty investigators report to a new field unit, they are normally unfamiliar with the local area, the practice of navigation unique to the area, and other unique waterway issues.

Simulators can serve a valuable purpose in these cases. Sometimes, investigators will contact training instructors at schools and ask to sit in on a simulator-training course, which gives them the opportunity to gain valuable insight to the operational challenges of a local waterway.

In addition, new investigators can gain a sharpened insight to the industry they serve. If investigators spend time inside the simulator or inside the classroom, they may understand the complex challenges of the local marine industry.

Local Insight

Investigators who take advantage of company training offered by marine operators often enhance their credibility with the marine industry and strengthen those important relationships. Fortunately, local marine operators are usually willing to allocate seats in training classes for Coast Guard personnel. Sector investigators who take advantage of these opportunities get time to share one-on-one training experiences, and follow up conversations with port captains, pilots, masters, mates, and other key industry personnel.

Bridge resource management also comes alive, as instructors at the training facility coach the mariners to develop the effective teamwork necessary to navigate a large ship or tow through the nation's busy harbors.

After-action critiques are spirited and interesting discussions about what would have been the best maneuver in these complex scenarios. For investigating officers, this provides an opportunity to learn about vessels and the waterway where they work. It also allows them to engage in discussions and form relationships with mariners that can help to broaden their understanding of marine operations unique to their team's investigation.

A Catastrophic Allision is Moments Away

LT Chris Jones, investigating officer, USCG Sector Houston-Galveston, is in the simulator wheelhouse in a tense port-to-port meeting situation with a container ship in a busy and congested waterway. Photos courtesy of Mr. Matthew Hyner, SCI's Center for Maritime Education in Houston, Texas.

LT Chris Jones, marine casualty investigating officer at Sector Houston-Galveston, has never touched the tiller arms of a towboat. Now, LT Jones grimly grips those steering controls as he maneuvers the 20-barge tow in heavy down-bound current.

As he prepares to "flank" a bridge in New Orleans (a tricky maneuver, using the river current and the maneuvering characteristics of the heavy tow to steer), he will have to meet a speeding container ship head on before reaching that bridge. Judging by the look of intense concentration on his face, things do not look good. A horrendous and catastrophic allision with the bridge pier could be moments away, with this "rookie" at the helm.

Luckily, this all took place inside a simulator at the Center for Marine Education, Seamen's Church Institute (SCI) in Houston, Texas. The center is ideally located at the Port of Houston and comprises four independent simulators that can be interlinked to provide an ideal training environment.

In one year, investigating officers from throughout the USCG Eighth District were given the unique opportunity to participate in realistic training on America's western rivers at SCI facilities in Houston, Texas, and Paducah, Ky.

Working with the staff at SCI, Mr. Tim Farley, division chief of the USCG Investigations Division, created a week-long course that would allow the trainers to put the investigators through a series of unique challenges. Using sophisticated simulation, the investigators navigated through bridges as well as in congested waterways, unusual hydrology, and congested marine traffic situations.

From left, LT Jones and instructor Captain Stephen Polk of the Seamen's Church Institute in Houston critique a maneuvering situation on a critical point on the waterway.

Using Simulators for Forensic Cases

In some instances, such as in high-profile marine casualty cases, it may be necessary to consider using a simulator as a forensic tool. Simulators can aid investigators in determining certain factors such as how the various vessels may have interacted with one another in the events leading up to the casualty.

Some marine casualty investigators develop a timeline following their initial investigation to verify and analyze statements from interviews to determine a likely sequence of events. This method can help clarify complicated information from multiple sources. In addition, electronic data—such as communications tapes, or voyage data recording audio—when coupled with simulation can clarify the casualty events, conditions, and individual actions before, during, or after a marine casualty.

Normally, investigators do not have the luxury of using the vessels involved in a marine casualty to replay the events leading up to a casualty. Usually, they are far at sea or in shipyards for repair. Under these circumstances, simulators can give an investigator an idea of the dynamic forces in play.

Using Simulators for Instant Replays

The investigations team at USCG Sector Houston-Galveston is using simulation to help in the investigation of a high-profile collision that occurred in one of their major waterways. According to Mr. Steve Stokely, chief of the Sector Investigations Division, Coast Guard Eighth District Prevention has contracted and funded SCI Houston to provide simulation modeling for the vessels involved as well as the waterway at the collision location. When this modeling is complete, the investigator can stand on the bridge of one vessel and have the benefit of "instant replays" of the events leading up to the collision.

Simulators as Waterway Management Tools

Ship simulators can also be used as waterway management tools. For example, they can help determine whether a vessel can transit safely through a particular waterway.

Additionally, the Coast Guard's vessel traffic service community uses simulation as the basis of training at the National Certification Course at the Maritime Institute of Training and Graduate Studies, in Maryland. The vessel traffic service watchstanders use the simulation to understand the elements

LT Chris Jones is at the tiller sticks in the simulator towboat wheelhouse. CAPT Stephen Polk, SCI Houston, coaches him on the unique maneuvering characteristics of the vessel. Photo courtesy of Mr. Matthew Hyner, SCI's Center for Maritime Education in Houston, Texas.

of ship handling, bridge resource management, and effective communications.

Satisfying the "What If"

Investigators sometimes use simulators to determine the effect of current or wind on a casualty. In addition, examining blind sectors, sight lines, stopping distances, and turning radiuses may help with understanding any complex forces at play during the incident.

One of the goals of marine casualty investigations is to determine if safety alerts or recommendations are necessary. Simulation allows investigators to explore the "what if" part of the investigation, helping the investigations team to improve all aspects of maritime safety.

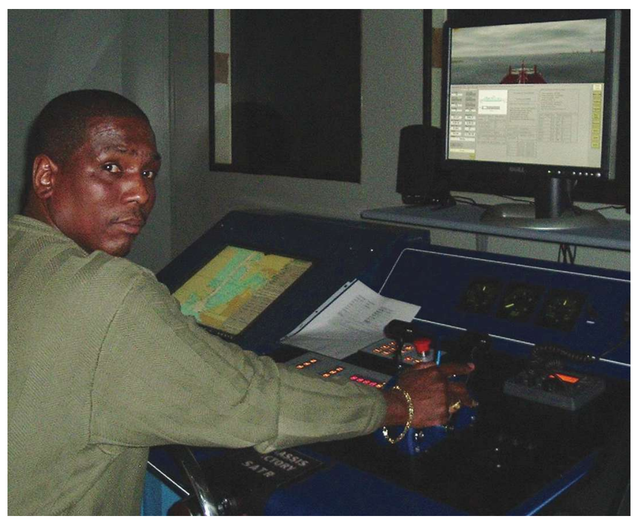
Simulation on a Cost-Effective Basis

Modeling for simulation is an expensive proposition. However, an investigator may be able to use the simulator on a cost-effective basis by using a simulation environment and vessel type that has already been developed. While it may not exactly duplicate the interaction, it may give insight into the factors that may have contributed to an incident.

Additionally, using the simulator in this manner may engender dialogue with the simulator staff and allow the investigator to better understand how the incident occurred and how it might have been prevented. It would take a short time for the technical staff to load modeled vessels into an existing environment and run a couple of quick scenarios.

The simulator drives improvements in marine operations, safety, and training worldwide, and its applications and uses are as diverse as the safety goals the prevention team are working to achieve each day.

About the author:
Mr. Keith Fawcett is a licensed mariner and member of the staff at the USCG Investigations National Center of Expertise. He worked in the marine industry for more than 20 years, and is the INCOE's subject matter expert in human factors, vessel traffic service operations, and interviewing techniques.



Mr. Fred Siddall, a watchstander from Vessel Traffic Service Lower Mississippi River, New Orleans, in the MITAGS all-weather simulator. The simulators allow VTS personnel to experience handling vessels and interacting with the other VTS trainees in a simulated VTS environment. USCG photo by Mr. Keith Fawcett

USCG investigators examine a commercial fishing vessel that caught fire while moored. U.S. Coast Guard photo.

Marine Inspection and Investigation School

Providing world-class marine casualty investigating officer training.

by LCDR Jacob Hobson
LT Michelle Schopp
LT Matthew Meskun
Instructors at USCG Marine Inspection and Investigation School

School Staff and Investigating Officer Course Instructor Credentials

The Marine Inspection and Investigation School (TMII), located at Training Center Yorktown, Va., is staffed by 16 officers and civilian personnel who provide marine inspection and investigation training in seven distinct disciplines to more than 650 officers and petty officers a year.

Among the staff members are five marine casualty investigators with more than 50 years of combined marine inspection and investigation experience. Their backgrounds include training in criminal, civil, and judicial concentrations, coupled with additional training in instruction techniques, course curriculum development, and human performance technologies.

Course Information

The Marine Inspection and Investigation School holds four investigation officer courses each fiscal year, with a throughput of 100-plus students. As there are approximately 200 investigating officer billets throughout the Coast Guard assigned to conduct the marine investigation mission, and our workforce is typically reassigned to a new duty station every three or four years, we work to ensure that we are capable of instructing each new investigating officer who is assigned those duties. The course is based upon tasks that come from a job task analysis, conducted at least every five years by polling subject matter experts (those who have been part of the marine casualty program for years) along with accomplished performers—the best of the best currently performing the job.

The combined results are used to update or re-write the course curriculum. This year, we have just completed the investigating officer course analysis and will begin taking the course to production, with the goal of redeveloping the course based upon what is actually happening in the field today.

The investigating officer course instructs marine casualty investigators on the investigative processes along with human factors. It's akin to the graduate level of study, as the students are generally junior officers and chief warrant officers.

The established course prerequisites require that all of our students be assigned to an investigating officer billet, and are performing casualty investigations; have received a formal letter of designation from their commanding officer as an investigating officer (this provides them the legal authorities to conduct the mission in a particular zone); have attended one of the marine inspector courses or the port state control

This new barge is fully outfitted with all types of valves, gauging, and pollution prevention equipment, and can be towed to different areas for display training opportunities. All photos USCG.

officer course; be a qualified port state control officer holding one of five foreign vessel examiner qualifications; or be a marine inspector holding a qualification that includes navigation and engineering.

Course Content Improvement

Following the training system standard operating procedures, we have taken advantage of newly funded training aids and local commercial contractor resources that have allowed us to get our students out of the classroom and into the field to visit facilities and perform practical investigation exercises.

The course starts off with classroom lectures outlining juridical authorities under marine casualty investigation laws, regulations, and policies. The staff performs role-play exercises with the students to demonstrate examples of how to properly execute those responsibilities in certain investigations-based scenarios.

Once satisfied that the students are comfortable with the overall course expectations, they are then given the opportunity to practice performing multiple tasks before being evaluated during a practical exercise, which includes a list of tasks that each student must perform to the high standard that would be expected of a qualified marine investigator in the field. A typical standard task may include drafting and serving a subpoena, collecting and documenting physical evidence, securing a casualty scene, or conducting witness interviews and statement writing.

After three weeks of practice, the course culminates with students being divided into small groups and presenting a comprehensive investigation brief of a highly complex and multifaceted marine casualty, requiring them to employ all of the skills and processes they have learned.

All groups work independently, and must brief their findings to Coast Guard officers who have experience as sector commanders, prevention department chiefs, or senior investigating officers. Students make their cases and justify why they have made the conclusions and recommendations presented.

Course Review and Update Process

The Coast Guard uses a performance-based training system similar to what you would find at Department of Defense training commands and civilian training institutions.

TMII employs the accomplished-based curriculum development and the analysis, design, development, implementation, and evaluation methods. Both are very systematic approaches to creating a course, and are based upon formal analyses of our different missions to determine what job is being conducted, and what tasks are performed to complete the job. A continuous loop of course review ensures we are teaching the most current and accurate information.

The investigating officer course specifically undergoes a comprehensive triennial review, along with our own course assessment process, both of which ensure we are teaching the latest and greatest material with respect to laws, regulations, and policy. It ensures the instructor notes match the student guides, training media reflects accurate performance needs, and that nothing has deviated from the program approved curriculum outline.

Evaluations

An important part of our training process is feedback from students and supervisors. Incorporated in the instructional design process is a four-level tiered course evaluation system. This includes a level I “reaction” survey, a level II “learning” evaluation, a level III “behavior” survey, and a level IV “results” assessment.

The level I reaction survey allows the students to provide immediate and timely feedback as to how they felt about the course and whether it met the training objectives. This evaluation is taken at the end of the course and before graduating, and is the student’s opportunity to give feedback to the staff on their ideas for making the course better. The level II behavior survey is sent out to the student and their supervisor approximately six months after the completion of the training to determine the effectiveness of the training. In other words, did the student come back to the unit fully capable of performing a task or the mission? This survey can help identify topics that should be added or removed from the training based on their experiences.

The level II learning evaluations are the tools the school uses to assess the student's ability to comprehend and perform tasks such as tests, quizzes, homework assignments, and performance assessments from the lab exercises. TMII has spent a great deal of effort over the past year to improve its learning assessments to make certain that students get the attention they need and deserve.

Our staff works closely with Yorktown's Performance Systems Branch on criterion reference test development to create valid and reliable questions that properly assess the student's retention of the material.

In addition to the four levels of evaluations, a well-maintained training system evaluates instructors on their performance and proficiency. This ensures that the students are receiving the highest quality of instruction needed to understand and retain the material. To accomplish this task, a qualified master training specialist, who has completed a rigorous evaluation and qualification process in the Coast Guard training system disciplines, observes every instructor on a semi-annual basis. A written evaluation provides feedback to instructors on all aspects of instruction with a goal of improving their instructional skills.

Increased Capabilities in the Training Environment

The Coast Guard's marine safety program has gone through unprecedented development and improvement to match the recent growth within the maritime industry. The renewed emphasis on marine safety follows some significant casualties and other congressional insight into how we execute our mission, and it starts with how we train our workforce.

This new focus on the marine safety program has brought us much-needed training resources and capabilities, such as specially designed training aids and instructional teaching material that provide students a realistic depiction of what they will find in the field. These training aids have allowed us to modify our training techniques, and place our marine casualty investigators in realistic scenarios, providing them

A fixed barge platform ties to a simulated waterfront facility for bulk liquid cargo transfers.

with exposure to the types of casualties and the challenges that they may find themselves investigating in the field.

About the authors:

LCDR Jacob Hobson is a 2001 graduate of Officer Candidate School. Prior to attending OCS, he enlisted and attained the rate of MST1. He completed two marine inspection tours as an officer, as well as an investigations tour at Sector NY, prior to being assigned as an instructor at Yorktown. LCDR Hobson has a B.A. in business management and a M.A. in occupational health, safety and environmental management.

LT Michelle Schopp is a 2004 graduate of Officer Candidate School. Prior to attending OCS, she was enlisted and attained the rate of MST2. She has completed two marine safety tours as an officer as well as investigations industry training, prior to her assignment as an instructor. LT Schopp holds a B.A. in environmental management, and an A.A.S. in legal studies.

LT Matthew Meskun is an instructor at Training Center Yorktown, Va., with more than 10 years of experience in the maritime industry. He served aboard several merchant vessels and tours at two Coast Guard marine safety units. He is a 2000 graduate of Maine Maritime Academy, and holds a B.A. in marine transportation operations, an M.B.A., and several professional maritime licenses and certificates.

The 65-foot-long small passenger vessel *Yorktown Lady* is routinely used for lessons and courses. It was in inspected passenger vessel service prior to our acquisition.

Leveraging Investigative Partnerships

Joint efforts foster a safer maritime domain.

by LCDR Randy Waddington
Marine Casualty Program Manager
U.S. Coast Guard Office of Investigations and Analysis

The U.S. Coast Guard's marine safety mission has played a key role in enhancing the safe transportation of people and goods since the 1830s. This effort contributes to the nation's overall economic vitality and promotes sound environmental stewardship. The USCG maintains broad, multifaceted jurisdictional authority and responsibility in executing this mission. At the heart of this mission, the USCG relies upon marine casualty investigations to determine what caused the incidents and initiate corrective measures to assist in preventing reoccurrences. This effort provides an important safety net to protect national waterways, crew, the marine environment, and the public interest.

The USCG is not alone in pursuit of this admirable goal. Since 1967, the National Transportation Safety Board (NTSB), an independent federal accident investigation agency, has also worked to determine the probable cause of transportation accidents, including maritime incidents, and to formulate safety recommendations to improve transportation safety ashore and afloat. The NTSB also conducts comprehensive safety studies and utilizes public forums to raise awareness of important safety issues across all transportation modes.[1]

Investigative Efforts, Focus

The USCG investigation program focuses on a broad range of maritime activities, ranging from small vessel to complex deep-draft vessel operations. Integral to this process is analyzing casualty data, sharing lessons learned through safety alerts, promoting safety recommendations, recommending new regulations, and taking appropriate remedial enforcement actions.

Similarly, the NTSB's investigation program focuses on big-picture marine safety systems and analyzes high-visibility marine casualties to help develop safety recommendations. The USCG and NTSB maintain joint authority and jurisdiction for major marine casualties.

This overlap of roles and responsibilities creates a unique opportunity for each agency to leverage a team-oriented partnership toward the goal of a safer maritime domain. The basis of this partnership is embedded within federal regulations and interagency cooperation, promoted through memorandums of understanding. Further bolstering interagency cooperation, the Commandant of the Coast Guard and the National Transportation Safety Board Chair meet annually to monitor progress and promote a continuous working relationship.

Agency Roles and Responsibilities

Federal regulation 46 CFR 4.40 outlines joint USCG and NTSB responsibilities for major marine casualties on navigable waters of the United States, U.S. merchant vessels in international waters as well as collisions involving U.S. vessels.

Under joint regulations, the USCG conducts the preliminary investigations of marine incidents then

Coast Guard and National Safety Transportation Board members participate in a joint investigations hearing. From left, LT Cheeks, USCG; Rob Jones, NTSB; CDR Moore, USCG; others unidentified. All photos USCG.

notifies the NTSB if there is a major marine casualty, defined as:

- the loss of six or more lives;
- loss of a self-propelled vessel of 100 or more gross tons or property damage estimated at more than $500,000; or
- involving a serious threat from hazardous materials.

In addition, the National Transportation Safety Board investigates selected marine casualty investigations that involve public vessels or those of a recurring nature. The Coast Guard and NTSB may respond by conducting independent investigations, participating in joint investigations, or by having the Coast Guard conduct an investigation on behalf of the NTSB.[2]

Following these investigations, NTSB issues safety recommendations to agencies such as the USCG, the U.S. Army Corps of Engineers, shipping firms, and other maritime organizations.

Additionally, recognizing the unique roles and responsibilities each agency plays toward the public welfare, each organization enters into memorandums of understanding, which detail interagency cooperation and mutually beneficial assistance.

On most occasions, a lead investigative agency is chosen and a mutually coordinated investigation ensues. Each agency will then issue a separate report per their respective investigative processes, or will defer to the other for an official report on the incident.

Critical Resources

The NTSB also provides the USCG with investigative support for casualty investigations, such as voyage data recorder information retrieval, and materials properties analysis typically conducted by the National Transportation Safety Board laboratory staff.

The Coast Guard provides the NTSB with logistical support at the scene of a casualty, such as air or water transportation and office facilities. The NTSB and USCG have also agreed to establish, sponsor, and conduct joint training opportunities for their investigators, with each encouraged to make courses and training facilities available on a reciprocal, no-cost basis. Recognizing the importance of developing an understanding of each agency's role, both NTSB and Coast Guard representatives regularly speak at each other's training sessions.

International Impact

In the event either agency is notified of a marine incident, and the United States is deemed a "substantially interested state" under the International Maritime Organization (IMO) *Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident,* each agency will immediately notify the other of all information received regarding the casualty. Then, NTSB and USCG will coordinate an appropriate investigative

Coast Guard and National Safety Transportation Board personnel tour an engine room. From left to right: CAPT Rand, USCG; CDR Hawkins, USCG; Liam Larue, NTSB; and CAPT Nadeau, USCG.

response. When the United States is asked to participate, or decides to conduct an independent casualty investigation, USCG and NTSB may each participate in the investigation.

In addition, the USCG regularly invites the NTSB to participate as a member of the U.S. delegation to IMO meetings where marine safety issues of interest may arise, and consults with the NTSB in developing the U.S. position at IMO, regarding matters related to marine casualty investigation.

Differences in Procedures

There are distinct differences in how each agency conducts an investigation. National Transportation Safety Board investigations are open public dockets with parties in the investigation, which may include the support and participation of technically knowledgeable industry and labor representatives who have special information or capabilities. This relationship is known as "the party system." Through this system, under the direction of the NTSB, much of the background technical information is gathered for use in the factual reports.

NTSB investigator Brian Curtis and U.S. Coast Guard CDR Hawkins inspect immersion suits.

Unlike NTSB protocols, the USCG investigations include parties in interest, which include entities whose conduct is under investigation. Unlike NTSB-led investigations, legal counsel may represent parties in interest. Additionally, the USCG is statutorily required to determine if there was any misconduct by any government or industry personnel during the course of the investigation. In these instances, enforcement actions are recommended for further consideration, unlike NTSB protocols. Coast Guard investigations, while public record, are subject to Privacy Act disclosure protections.

The Overall Goal

Wherever marine casualties occur, the U.S. Coast Guard and the National Transportation Safety Board are ready and willing to respond. Developing lessons learned from investigations in an effort to prevent casualties from occurring again is a time-proven process. Additionally, to ensure the highest quality investigations, the Coast Guard and National Transportation Safety Board will continue to cooperate and coordinate efforts to ensure they are leveraging beneficial partnerships in the public interest.

About the author:

LCDR Randy Waddington has served in multiple capacities during his 23-year Coast Guard career, most recently as chief of Investigations Division at Sector Los Angeles/Long Beach, and as chief of vessel inspections and senior investigating officer at Sector Juneau.

Endnotes:

1. National Transportation Safety Board (NTSB/SPC-05/02). *What is the National Transportation Safety Board?* NTSB Office of Public Affairs, 2002.
2. Ibid.

Coast Guard Cutter *Washington* returns home after conducting search and rescue exercises. U.S. Coast Guard photo by LTJG Justin Valentino.

Marine Casualty

HOMEPORT

To access marine casualty and pollution data files, visit: http://homeport.uscg.mil. On the left side of the screen, click "Investigations." Scroll toward the bottom and click "Marine Casualty/ Pollution Investigations."

Marine Casualty and Pollution Data

Provides details that can be used to analyze marine accidents and pollution incidents by a variety of factors, including vessel or facility type, injuries, fatalities, pollutant details, location, and date.

Merchant Vessels of the United States

A data file of merchant and recreational vessels.

Notable Oil Spills in U.S. Water 1989 to 2009

Each year, the Coast Guard investigates several thousand polluting incidents. In any given year, more than 70 percent of the annual spill volume can be attributed to fewer than 20 incidents. This report describes the most significant of those incidents.

Oil Spill Compendium 1973 to 2009

Pollution-related data and graphics from 1973 to 2009.

National Response Center

Available at www.nrc.uscg.mil/foia.html. The National Response Center provides an online query system of all reported oil and chemical spill data.

- There is a significant difference between a spill reported to the National Response Center and a spill investigated by the Coast Guard.
- Not all spills reported to the National Response Center occur under the jurisdiction of the Coast Guard.
- It is common for a spill to be reported by several parties. Each report generates a National Response Center report.

and Vessel Data

United States Coast Guard
Maritime Information eXchange

Coast Guard Maritime Information Exchange

Located at http://cgmix.uscg.mil, the Coast Guard Maritime Information Exchange, or CGMIX, provides Coast Guard maritime information on the Internet in the form of searchable databases.

CGMIX Constraints and Caveats

- Open investigations are not released.
- Incident severity determines the amount of data.
- Per the Privacy Act, some information cannot be released.

The CGMIX database search engines include:

Port State Information Exchange

Vessel-specific information representing a weekly snapshot of Freedom of Information Act data on U.S.-flagged vessels and foreign vessels operating in U.S. waters, and Coast Guard contacts with those vessels. Information on open cases or cases pending further action is considered privileged and is precluded from the system.

Incident Investigation Reports

Information regarding reportable maritime incidents investigated by the U.S. Coast Guard that were closed after October 2002.

MARPOL Certificates of Adequacy

A list of U.S. ports and terminals holding valid MARPOL Certificates of Adequacy, issued as evidence that their facilities meet the requirements of Annexes I, II, and V of the 1978 Protocol to the International Convention for the Prevention of Pollution from Ships.

Vessel Identification System

Registration and ownership data from participating Vessel Identification System states and the USCG National Vessel Documentation Center. Data is accessible to registration and law enforcement personnel of participating states and federal agencies.

Collaborate

I Identify You Loud and Clear

How modern electronics influence the marine industry.

by Mr. Kerry L. Duke
Marine Casualty Investigator
U.S. Coast Guard Investigations National Center of Expertise

Imagine you are the captain of the uninspected towing vessel (UTV) *Stanley Gene.*[1] It is 5:30 a.m., on a warm winter morning, with heavy fog drifting over the region. Your tow boat is pushing nine loaded red-flagged barges downbound from Baton Rouge, La., on the lower Mississippi River, en route to the Gulf of Mexico. You receive a radio call from the pilot aboard the motor vessel (M/V) *Short Boxer,* an approaching deep-draft bulk carrier en route up the Mississippi River on to its anchorage location to wait the vessel's turn at her final destination to offload cargo. The tanker is foreign-flagged, consisting entirely of a foreign crew with one state pilot, who has recently boarded the vessel.

Meeting Arrangement

At a distance of approximately three miles, you commence radio communications with the pilot of the M/V *Short Boxer.* The pilot requests a two-whistle meeting (starboard to starboard). You acknowledge his request by stating, "M/V *Short Boxer* requests a two-whistle meeting. UTV *Stanley Gene* agrees to a two-whistle meeting with the M/V *Short Boxer.*"

Another radio call comes in from the *Short Boxer* around 5:50 a.m. Once again, you confirm the two-whistle meeting. As you turn out of a rather sharp bend in the river, you identify the open-range lights on the M/V *Short Boxer* indicating a two-whistle meeting. A few minutes later, you receive a radio call from the pilot of the M/V *Short Boxer* requesting you to turn more to port. A few minutes later, you hear via radio the pilot of the vessel make a statement that he is tired of looking at your green light, indicating the M/V *Short Boxer* was setting up for a two-whistle pass.

One-Whistle or Two?

You then begin to see the M/V *Short Boxer's* red light, indicating that she is turning more to starboard, which means that the pilot either wants to do a one-whistle pass (though that was never agreed upon), or the vessel is moving more to the left descending bank side of the channel. Either way things are not looking good.

Judgment call: Do you continue to prepare for the two-whistle passing that both vessels originally agreed upon, or do you prepare for what appears to be a one-whistle meeting?

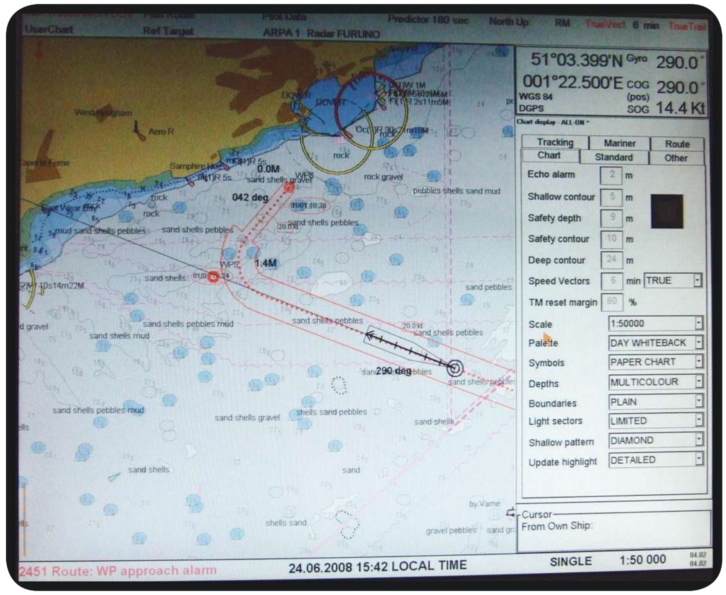
The pilot stated via radio that he identifies your vessel and used the bow floodlights to identify your position. Suddenly, and without warning the *Short Boxer* makes a hard starboard turn. Now, you re-take control of the *Stanley Gene* from your watch relief and specifically request the pilot "Do not turn on us."

The M/V *Short Boxer* collides with the lead port barge of your tow—resulting in your tow breaking loose and your lead port barge sustaining damage and spilling ammonium nitrate into the river. Accordingly, river traffic is impeded and ultimately forces the closure of the Mississippi River.

What Happens Now?

A marine casualty, as defined by 46 C.F.R. § 4.03-1 has occurred, triggering a U.S. Coast Guard investigation. Although you think the investigation will be simple, the pilot aboard the *Short Boxer* now denies a two-whistle agreement had taken place, and denies turning starboard. He claims your actions triggered the marine casualty.

Fortunately, you are not alone. Electronic evidence exists to support your position. The marine industry has several electronic devices normally found on vessels: Automatic Identification System, voyage data recorder, and Global Positioning System to name a few. Also, vessel traffic services, the electronic chart display and information system, an electronic chart system, engine control logs, course recorders, closed circuit television, and witness video and pictures are also found on vessels. Information that is stored on these systems is not only retrievable under most circumstances and conditions, but, due to the existence of electronic technology onboard vessels today, the Coast Guard can review the data to determine the causal factor(s) of the marine casualty.



Screen capture taken from an electronic chart display and information system unit depicting an intended passage plan of a vessel. Photos on this page courtesy of Richard North, technical manager, UK Marine Accident Investigation Branch.


Two recovered GPS units and a satellite compass recovered from a sunken fishing vessel off the coast of the UK.

Why Are They There?

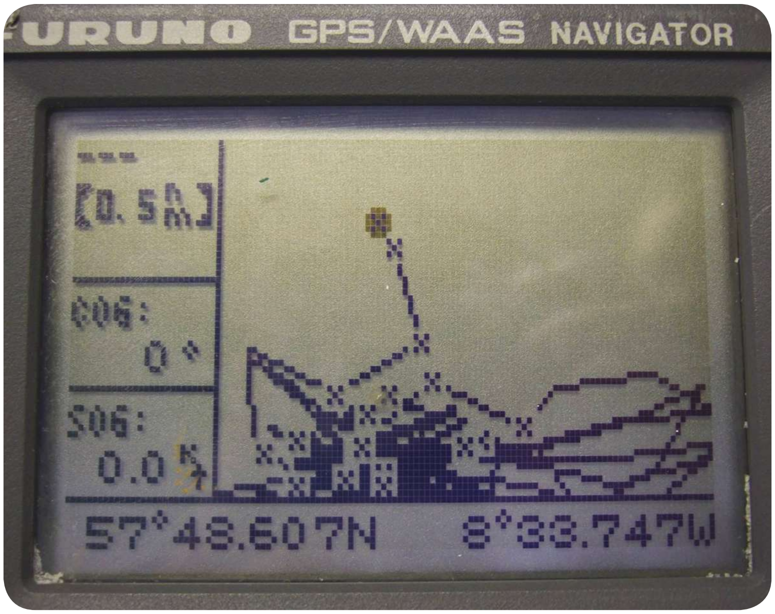
International and federal regulations dictate the requirements for electronics to be installed on all vessels.[2] Moreover, a company may require installation of electronics that are not necessarily required by the government or any governing bodies to help enforce safety of life at sea, and create a trail of evidence for a subsequent investigation, should it be necessary.

Much like aviation's flight data recorder, or "black box," the marine industry's voyage data recorder has very similar capabilities. For example, data can be retrievable even after the unit takes on water.

Who Deciphers This Data?

Many consider the United Kingdom's Marine Accident Investigation Branch (MAIB) the seminal leader in electronic evidence collection. The MAIB, equipped with a modern laboratory, has developed a systematic approach to data extraction. Within the MAIB laboratory, technicians can retrieve and play back data from all electronics kept onboard vessels regardless of the device's manufacturer.


Image of an installed voyage recorder.



Screen of early GPS/Wide Area Augmentation System Navigator. Photo courtesy of Richard North, technical manager, UK Marine Accident Investigation Branch.

The MAIB hosts an annual international conference comprised of the world's brightest technical agents to discuss electronic evidence retrieval, share experiences and lessons learned, demonstrate new technology as well as receive hands on training. This assures that participants throughout the marine investigations world are communicating and collaborating to help ensure safety of life at sea.

The Coast Guard Role

In 2011, personnel from U.S. Coast Guard headquarters, along with members of the Investigation National Center of Expertise (INCOE), attended the MAIB conference and returned with the recognition that the Coast Guard needs such capabilities.

In December 2011, the INCOE spearheaded a training workshop in Washington, D.C., consisting of key personnel from the INCOE, Coast Guard headquarters, the MAIB, and the National Transportation Safety Board (NTSB). MAIB's Mr. Richard North provided critical technical training, allowing attendees to better understand electronic retrieval capability as well as its efficiency and effectiveness.

Traditional Global Positioning System equipment. Photo courtesy of the UK Marine Accident Investigation Branch.

One of the Coast Guard's goals is to build a laboratory similar to that of the MAIB. Presently, the INCOE is working diligently to obtain funding to build such a facility. Once the Coast Guard fulfills this goal, it will be possible to extract electronic evidence without having to rely upon MAIB or NTSB assistance.

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Electronic Crime Scene Investigation: A Guide for First Responders. Second Edition, Washington, DC: U.S. Department of Justice, Office of Justice Programs, National Institute of Justice, April 2008. Available at https://www.ncjrs.gov/pdffiles1/nij/219941.pdf.

46 C.F.R. pt. 4 (2010) Web, May 17, 2012. Available at http://cfr.regstoday.com/19cfr4.aspx.

About the author:
Mr. Kerry L. Duke is an INCOE marine investigator and INCOE's subject matter expert on electronic records, email recovery, document retrieval, AIS data, evidence collection/chain of custody, records retention, and commercial fishing vessels. He serves as a lieutenant in the U.S. Coast Guard Reserve after previously serving on active-duty. Mr. Duke has more than 12 years of Coast Guard experience. He received his bachelor's degree in 1999, from the University of Tennessee in Chattanooga, and his master's degree from the National Graduate School in 2009.

Endnotes:

1. All vessel names are fictional.
2. International regulations are governed by the International Maritime Organization rules, and federal regulations are governed under the Code of Federal Regulations.

U.S. Coast Guard's Marine Investigations Program

A world-wide impact.

by Mr. Timothy J. Farley
Chief
U.S. Coast Guard Investigation Division

> *"There are things about the sea which man can never know and can never change. Those who describe the sea as angry, gentle, or ferocious do not know the sea. The sea just doesn't know you're there—you take it as you find it, or it takes you."*
>
> **R.M. Snyder, an early oceanographer.**

U.S. Coast Guard marine casualty investigations continue to affect worldwide marine safety and environmental protection in myriad positive ways, from the U.S. Coast Guard's engagement with the United Nations International Maritime Organization (IMO) to many cooperative marine casualty investigations. Coast Guard investigating officers aim to learn the truth, make valuable safety recommendations to prevent recurrence, and share lessons learned to ultimately improve the complex marine transportation system.

International Maritime Organization

In 1945, representatives from 50 countries met in San Francisco to develop the United Nations Charter. It was envisioned that a series of many different international organizations would be created under the U.N. umbrella to focus on a variety of worldwide concerns. In 1948, attendees at a follow-up conference considered establishing a new organization to specifically deal with marine shipping and safety. At the conclusion of that conference the Convention for the Establishment of an Inter-Governmental Maritime Consultative Organization (later changed to the IMO) was adopted. Ten years later, that convention entered into force. Delegates from member states subsequently met as a formal group for the first time in 1959, and members were elected to the Marine Safety Committee (MSC).

The stated purposes of the IMO from Article 1(a) of the convention are:

> "to provide machinery for cooperation among Governments in the field of governmental regulation and practices relating to technical matters of all kinds affecting shipping engaged in international trade; to encourage and facilitate the general adoption of the highest practicable standards in matters concerning maritime safety, efficiency of navigation and prevention and control of marine pollution from ships."

Soon after, the IMO was sanctioned to deal with all related administrative and legal matters, including

Pictured is CAPT Paul Thomas, head of the U.S. delegation to IMO's Flag State Implementation Subcommittee. U.S. Coast Guard photos by Mr. Tim Farley.

CAPT Paul Thomas, on left, and Mr. John Hannon, right, review technical papers in the IMO Plenary Session of the FSI Subcommittee meeting.

CAPT Paul Thomas is pictured on the IMO's large screen monitor in the main assembly room as he makes a formal statement on behalf of the United States. Assisting him is legal counsel CDR Jason Hamilton, to his right, and Mr. Larry Bowling, NTSB, in back.

international agreements aimed at addressing existing, or emerging worldwide marine safety, pollution, and security issues. IMO's body of work includes such instruments as an update of the International Convention for the Safety of Life at Sea; development of the Global Maritime Distress and Safety System; the International Safety Management Code; and the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers.

To address pollution issues following an epidemic of ship casualty-related pollution events such as the *Tory Canyon*,[1] the IMO adopted the International Convention for the Prevention of Pollution from Ships. This convention, along with other types of conventions, addressed such topics as antifouling systems and ballast water management to prevent the invasion of alien species. The IMO has also addressed emerging ship security issues through the International Ship and Port Facility Security Code and the Convention (and Protocols) for the Suppression of Unlawful Acts Against the Safety of Maritime Navigation.

As technology and worldwide shipping evolves, new safety, security, and environmental protection challenges emerge. Existing IMO instruments are reviewed, updated, amended or proposed, oftentimes based on lessons learned from marine accidents or incidents. Piracy, greenhouse gas emissions, and the influence of the human element on safety of life at sea are some of the latest issues IMO is working to address.

Historically, the United States, through the U.S. Coast Guard, along with its partners from the National Transportation Safety Board and the Department of Transportation's Maritime Administration, provides overarching macro-level casualty statistics to the IMO Secretariat as well as information regarding specific U.S. casualty investigations meeting a designated IMO threshold, or those having possible worldwide interest. Casualty data is channeled to the MSC by way of the IMO Secretariat and through a casualty analysis working group established and answerable to the MSC's Flag State Implementation Subcommittee. Working group members share analysis of specific casualties of interest, consider casualty data trends or emerging issues, develop lessons learned for seafarers, and help develop investigative protocols and tools to promote worldwide cooperation in casualty investigations.

International Maritime Safety Security Environment Academy

In 1988, the Italian government and the IMO signed a bilateral agreement for cooperation to provide professional training and education in appropriate maritime topics to promote marine safety among developing countries. Under that agreement, the International Maritime Academy in Trieste, Italy, was formed. In 2005, the IMA was dissolved and subsequently the International Maritime Safety Security Environment Academy was identified as the entity to provide this needed training and education.

The U.S. Coast Guard has historically supported the academies by providing instructors, materials, and resources. In that way, the U.S. Coast Guard has had a hand on the tiller with respect to helping guide fledgling flag and port state administrations with creating investigative bodies and training investigators.

Marine Accident Investigators International Forum

The U.S. Coast Guard is one of the original "plank holders" of the Marine Accident Investigators International Forum (MAIIF) and was instrumental in its development. The MAIIF parent organization has several regional subgroups such as EMAIF (Europe), AMAIF (Americas), and MAIIFA (Asia). IMO formally recognizes MAIIF as an intergovernmental organization and it participates in appropriate IMO functions. It currently consists of members representing 39 countries, 16 honorary member countries, and maintains relationships with 20 non-member countries.

MAIIF membership is open to any individual appointed as a marine accident investigator, or employed in the process of marine accident investigation (other than a person representing commercial or private interests outside an administration).

MAIIF objectives are:

- to foster, develop and sustain a cooperative relationship among national marine investigators for the purpose of improving and sharing of knowledge in an international forum;
- to improve maritime safety and the prevention of pollution through disseminating information gained in the investigative process;
- to encourage cooperation to develop, implement, and improve appropriate international instruments.

The U.S. delegation to IMO's 20th Session of the Flag State Implementation Subcommittee on the IMO building balcony overlooking the River Thames, London, UK. From left: CAPT Jennifer Williams; CAPT Paul Thomas, head of the U.S. delegation; Mr. Emanuel Terminella; Mr. Larry Bowling, NTSB Office of Marine Safety; Mr. Timothy Farley; Mr. Pradeep Nayyar, U.S. Maritime Administration; Mr. John Hannon; and CDR Jason Hamilton.

Members of the FSI Casualty Working Group gather on the IMO building balcony overlooking London. From left: Mr. Pradeep Nayyar (MARAD); U.S. Merchant Captain Mr. Timothy Farley (USCG), head of the working group delegation; and Mr. Larry Bowling (NTSB).

Routine U.S. Coast Guard Marine Casualty Investigations

Approximately 4,500 marine casualties are reported to the U.S. Coast Guard annually. Since the U.S. is primarily considered a port state in the world of maritime shipping, you can imagine a portion of these casualties involve foreign-flagged vessels and crewmembers. Furthermore, U.S. vessels sail internationally. Therefore, it is critically important to maintain close ties with our international marine accident investigating partners. On average, the Office of Investigation and Analysis (CG-INV) is in contact with our foreign investigator counterparts regarding significant incidents about once every other week. Additionally, CG-INV is contacted or reaches out to our international investigation community almost daily with respect to numerous other investigative or marine safety-related issues.

The Coast Guard's Office of Investigations and Analysis and its investigation program is the United States' primary feedback mechanism to the shipping world through the IMO. It provides the necessary evaluation and analysis of the marine system regarding the effectiveness of existing international safety standards, emerging marine safety issues, the development of international strategies, and interventions aimed at helping reduce risk to the marine industry, those that are innocently transported upon the sea, and the marine environment itself. Additionally, our international partnerships and engagement strengthens the worldwide feedback mechanism and goes a long way to furthering our common goals of protecting men from the sea and the sea from men.

About the author:

Mr. Timothy J. Farley is the chief of the U.S. Coast Guard Investigations Division Office of Investigations and Casualty Analysis. He is the program manager responsible for administering marine casualty, environmental crimes, marine pollution, and personnel action investigations for the Commandant as well as implementing the drug and alcohol program inspection rules. Mr. Farley holds and maintains an active U.S. Coast Guard License as master, any gross tons, oceans. He has a B.S. of business management, marine transportation from SUNY Maritime College.

Endnote:

1. The *Torrey Canyon* was shipwrecked off the western coast of Cornwall, England, on March 18, 1967, causing an environmental disaster. Also available at www.guardian.co.uk/environment/2010/jun/24/torrey-canyon-oil-spill-deepwater-bp.

CSI New London

U.S. Coast Guard forensic oil spill analysis.

by Dr. Wayne R. Gronlund
Manager
U.S. Coast Guard Marine Safety Laboratory

A casual perusal of the prime time television schedule quickly reveals that crime scene investigations and forensic evidence evaluation are very popular themes for viewers. Often, the storyline involves a careful and perceptive investigation at the scene of the crime where investigators collect and catalog various items of evidence. Back at the crime lab, high-tech analytical instruments quickly identify the source of the trace substance, or a DNA analysis identifies the perpetrator.

In the real world, U.S. Coast Guard pollution investigators frequently respond to "mystery spills" (oil in the environment from no obvious source) to protect the environment from further harm and to identify the source of the spilled oil. Their physical investigation of the scene is crucial to solving the case. Investigators obtain samples of the spill as well as samples from potential sources, which then undergo forensic chemical analysis to identify the responsible party.

Sometimes the pollution investigation involves an identifiable source. For many months following the *Deepwater Horizon* explosion and fire, millions of barrels of crude oil bubbled up from the wellhead a mile below the surface.[1] As the world watched video coverage of the escaping oil and gas, the U.S. Coast Guard oversaw a great effort to stop the release, contain the spilled oil, and minimize the environmental consequences. During and after the spill, National Oceanographic and Atmospheric Agency personnel, along with Coast Guard pollution investigators, collected oil samples for forensic analysis from shorelines and marshes as well as from impacted wildlife.

Solving the Mystery of "Mystery Spills"

The Marine Safety Laboratory (MSL) is the Coast Guard's forensic laboratory for oil spill source identification, or "oil fingerprinting," a term adopted in

The Marine Safety Lab

The Marine Safety Lab provides:

- **consultation with field investigators, district offices, hearing officers, as well as National Pollution Funds Center, Department of Justice, and other federal agency personnel concerning the oil identification system and MSL analysis reports;**
- **expert opinions and testimony at legal proceedings;**
- **a system of quality controls to assure the integrity of the Oil Identification System;**
- **evaluation of new methods and advancements in technology that may increase the accuracy, reliability, and efficiency of the Oil Identification System;**
- **long-term secure storage of oil samples (evidence) that MSL has received from field units in support of oil pollution cases.**

Analytical Techniques

Gas Chromatography

Gas chromatography separates the components of oil, primarily on the basis of their boiling points. The separation is carried out under controlled conditions such that the same component will be eluted (removed by dissolving) from the gas chromatographic column at the same relative time for all samples.

The separated components are sensed by a flame ionization detector and simultaneously recorded electronically. Interpretation of evaporative weathering is relatively straightforward, because it affects components in the same sequence as they are displayed graphically.

Gas Chromatography-Mass Spectrometry

Gas chromatography-mass spectrometry uses a mass selective detector to continuously collect the mass spectrum for the components eluting from the gas chromatograph.

The mass spectrum, reflecting the ion fragments present, can be used to conclusively identify individual components. For oil identification, selected target ions representing biomarkers in the oil are selected. These biomarkers are components unique to petroleum oils; their ratios are used to characterize individual oils.

Because some are highly resistant to biodegradation and other types of weathering, severely weathered oils that cannot be identified by other means can often be matched through this technique.

Fourier Transform Infrared Spectroscopy

Fourier transform infrared spectroscopy uses the absorption of infrared energy over a spectral region that corresponds to the bond stretches and vibrations of the molecules that form the oil.

A number of absorptions are common to all petroleum oils, which allows the analyst to identify the sample as a petroleum product. Other absorptions are used for uniquely identifying specific oil samples.

Comparison of the infrared spectra, taking into account weathering differences, is sometimes used to eliminate dissimilar sources from further analysis. Fourier transform infrared spectroscopy is particularly sensitive to the presence of water and can be used to screen samples to reduce prep time, especially in cases containing a very large number of samples from cargo or fuel tanks that are likely to be free of water.

the mid-1970s when the Coast Guard Research and Development Center developed the oil spill identification methodology.[2] The primary mission of MSL is to conduct the chemical analyses necessary to identify the source of an oil spill in conjunction with Coast Guard field investigations.

The Marine Safety Lab supports pollution investigators and various federal, state, and local agencies by providing forensic analysis of spilled oil samples and suspected source samples. Additionally, MSL works closely with the National Pollution Funds Center and the Department of Justice to prosecute responsible parties. The Marine Safety Laboratory's analytical evidence provides law enforcement and cost recovery benefits, as MSL's forensic chemist provides expert witness testimony for hearings and court proceedings, as necessary.

The lab uses several complementary chemical tests that exploit the unique intrinsic properties of petroleum oil and make it possible to match spilled oil with its chemical source. MSL provides the means to fix oil pollution responsibility, assess penalties, and help recover federal pollution cleanup funds expended during an incident. The lab's work also serves as a deterrent to deliberate oil pollution discharges and encourages reporting and acceptance of responsibility for accidental spills.

Oil Spill Identification Methodology

The Oil Identification System (OIS) uses the unique, intrinsic properties of petroleum oil that make it possible to match spilled oil to the correct chemical source. The system supports multiple analytical methods. Of the original four techniques developed and evaluated for the OIS, two of them used today have undergone marked technological refinements: gas chromatography and infrared spectroscopy.

Additionally, gas chromatography-mass spectrometry has been added as the most powerful analytical technique available for oil fingerprinting. As a consequence of more definitive results made possible by these improved methods, the lab no longer uses the other two original techniques: fluorescence spectroscopy and thin layer chromatography.

These modern analytical methods measure different chemical properties of an oil sample. If two oils are chemically similar, they are said to derive from a common source. In nearly every case, oils from other possible sources are simultaneously eliminated from consideration as the pollutant source because they are chemically different as determined by the test methods.

How Is a Typical Oil Spill Case Processed?

When a pollution incident occurs, a local Coast Guard unit will collect samples of the spill and obtain samples from possible sources (vessels and shore facilities) in accordance with MSL's Sample Handling and Transmittal Guide.[3] Most oil spill cases arrive at the lab by overnight shipping.

The sealed boxes are opened and all samples are accounted for by checking them against the enclosed chain of custody. Any discrepancies are noted and will be resolved by MSL personnel through consultation with the investigating unit. Also enclosed with the samples is a letter of request. This document tells personnel what the investigators need the lab to do

A Marine Safety Lab forensic chemist and technician work to extract a sample from a hose suspected of being used to bypass an oily water separator. USCG photo.

The Marine Safety Lab

History

The Federal Water Pollution Control Amendments of 1972 assigned general responsibilities to the Coast Guard for the protection of the marine environment, including enforcement of the nation's antipollution discharge laws and regulations.

To carry out these responsibilities, in 1973 the Coast Guard Research and Development (R&D) Center began to develop a system to identify pollutant sources. In four years, many analytical tests and procedures were evaluated for their ability to distinguish all types of petroleum oil. In 1977, the R&D Center published its final report detailing the Coast Guard's Oil Spill Identification System. The Central Oil Identification Laboratory (COIL), established in November 1977, applied the system and was located within the R&D Center facilities in Groton, Conn.

Legal Precedent

One of the first steps for COIL and the new Oil Identification System was obtaining legal precedent for its "oil fingerprinting" technique. This occurred in December 1978 at a federal criminal jury trial, under the Federal Water Pollution Control Act, involving spilled oil. In *U.S. v. Distler,* Judge Charles M. Allen ruled that "chemical evidence" would be admissible, thereby establishing the necessary legal precedent.[1]

In 1979, administrative control of the Central Oil Identification Laboratory transferred to the Coast Guard Oceanographic Unit in Washington, D.C. However, COIL operations under the Oceanographic Unit were to be short lived when the "O Unit" closed in April 1982. At that time, COIL became a branch of the Port and Environmental Safety Division, Office of Marine Environment and Systems.

The Central Oil Identification Laboratory then moved to the Avery Point campus of the University of Connecticut in Groton, Conn., in 1986. In 1988, COIL and the Marine Fire and Safety Research Staff merged to form the Coast Guard Marine Safety Laboratories. During 1991, control of the Marine Fire and Safety Research program returned to the Coast Guard R&D Center and COIL became the Marine Safety Laboratory.

The Evolution

As part of the Coast Guard's streamlining initiatives in 1996, the laboratory's top leadership position was converted from a commanding officer to a Coast Guard civilian supervisory chemist with the title of manager.

In January 2006, as part of the Coast Guard's continued modernization efforts, MSL divested as a subunit of the National Maritime Center and became a headquarters unit under the Coast Guard's Office of Investigations and Analysis. Shortly thereafter, the Marine Safety Lab underwent an A-76 streamlined competition study. MSL's proposed most efficient organization won the competitive bid and began its first year of contract performance on January 31, 2007.

In February 2009, the Marine Safety Lab, along with the R&D Center and International Ice Patrol, relocated from Avery Point, Groton, to the Fort Trumbull area in New London.

Endnote:

1. United States v. Distler, 9 ENVTL. L. REP. (ENVTL. L. INST.) 20,700 (W.D. Ky. 1979).

with the samples (compare or ID only) and in what time frame (regular, priority, or RUSH).

After the samples are checked in on paper and electronically, staffers move to the sample preparation stage. While most of us think of oil as an environmental pollutant, from our perspective, the environment is polluting our oil sample. At the prep station all the water, sand, seaweed, and such is removed, leaving a "neat" (unadulterated) oil sample. The neat is then diluted with cyclohexane solvent for injection into the gas chromatograph (GC). It takes about an hour for the GC to analyze each sample. Fortunately, once the prepared vials are placed into the sample tray, an automated sample handler allows the instrument to run 24/7 without an operator.

After the lab technician and the forensic chemist review the GC data, the samples are analyzed via gas chromatography-mass spectrometry, which provides even more detailed information about the composition.

Interpreting the analytical test results is usually not straightforward because of increased analytical complexity brought about by weathering or contamination of the spilled oil. "Weathering," for example, includes such processes as evaporation, dissolution, biodegradation, oxidation, and other chemical, physical, and biological environmental changes that alter the makeup of the spilled oil, significantly complicating the analyst's job.

MSL prepares a written analysis report for each case and maintains a complete case file that includes:

- the expert opinion of a trained forensic chemist;
- a forwarding letter;
- laboratory report with results and conclusions;
- sample check-in log;
- case documentation (such as the analysis request and chain of custody);
- quality assurance sheet;
- cost-recovery documentation;
- worksheets;
- the original test data.

How Can We Improve the Process?

MSL provides on-call assistance to Coast Guard field investigators, district personnel, and hearing officers as well as the National Pollution Funds Center, Department of Justice, and other government agencies, on all aspects of the Oil Identification System. This assistance includes:

- answering questions and explaining the significance of test results,
- evaluating test data from other laboratories,
- providing expert witness support,
- planning sampling strategies in complex cases.

An effective Oil Identification System depends upon good communication and understanding among the various users of the system and Marine Safety Lab personnel. Please give us a call. We are eager to help!

About the author:
Dr. Wayne Gronlund has 43 years of service with the Coast Guard, and is currently the manager of the U.S. Coast Guard Marine Safety Lab. He has a bachelor's degree from the USCG Academy, an MALS in physical science, and a PhD in chemistry. He is a retired Coast Guard captain and professor emeritus from the Coast Guard Academy.

Endnotes:

1. *Deepwater Horizon* Oil Spill. Available at www.uscg.mil/foia/docs/DWH/BPDWH.pdf.
2. *Oil Spill Identification System.* USCG R&D Center Report No. CG-D-52-77 (NTIS #ADA044750), 1977.
3. *Sample Handling and Transmittal Guide,* Version 7.0. U. S. Coast Guard Marine Safety Laboratory, October 2010.

Ensuring Competence

The Coast Guard's Suspension and Revocation National Center of Expertise.

by CDR Scott Budka
Detachment Chief
U.S. Coast Guard Suspension and Revocation National Center of Expertise

The Coast Guard recognizes that merchant mariners spend a great deal of time and effort to receive and to maintain their merchant mariner's credential (MMC), which provides them a livelihood. Nevertheless, it is the Coast Guard's responsibility to ensure that the 200,000-plus credentialed merchant mariners operating in the nation's waterways are not only competent, but also that their conduct promotes marine safety, security, and protection of the marine environment.

In October 2008, the U.S. Coast Guard established its Suspension and Revocation (S&R) National Center of Expertise (NCOE) to ensure the safe operation of the marine transportation system and to protect the lives and safety of those at sea.

The significant implications that result from the suspension or revocation of a merchant mariner's credential demand that Coast Guard investigating officers be properly trained and proficient in the suspension and revocation process and administrative hearing procedures. Therefore, NCOE hires Coast Guard civilian attorneys and highly experienced marine safety personnel to work along with Coast Guard Training Center Yorktown to formally train investigating officers in the suspension and revocation process and hearing procedures.

The S&R NCOE also serves as a resource for investigating officers to review and provide assistance with the completion of various suspension and revocation

Suspension and Revocation National Center of Expertise

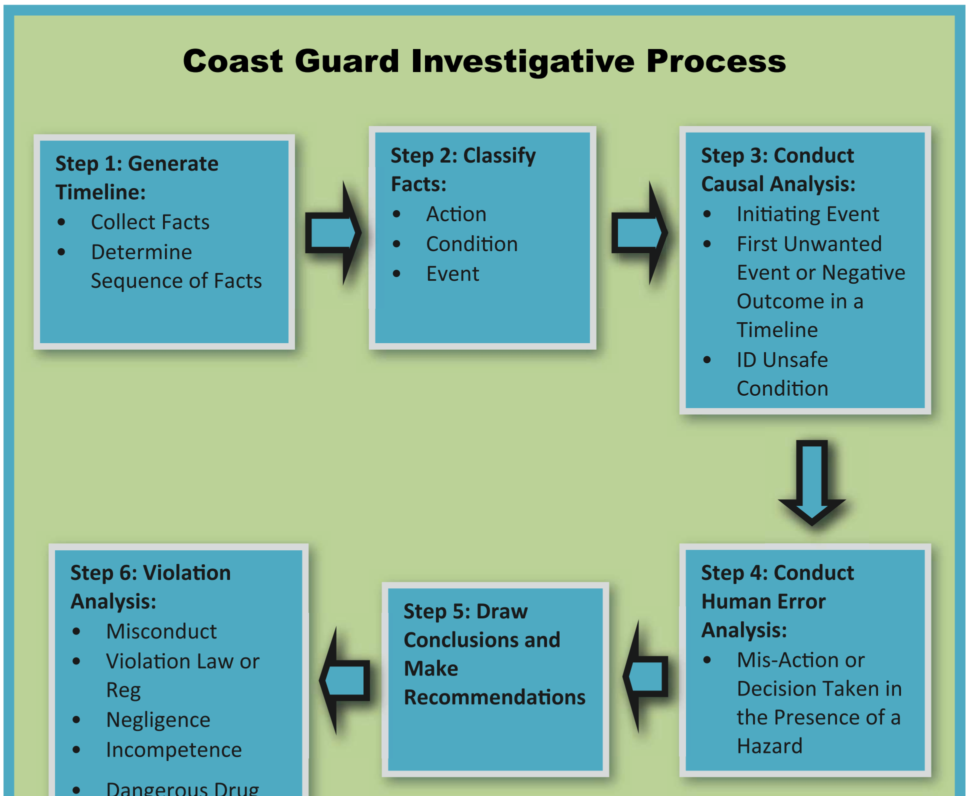
Functions:

- maintaining and developing programmatic expertise in the suspension and revocation process and administrative hearing procedures;
- liaising with the National Maritime Center on S&R implications from TWIC denials and medical and professional incompetence issues;
- providing onsite training opportunities for investigators from other Coast Guard units on the suspension and revocation process and hearing procedures;
- assisting with suspension and revocation hearing preparation and representation at hearings;
- providing advice to sector commanders on the S&R process and hearing procedures and to the Commandant during policy development;
- providing a resource for field investigative officers for review/assistance with S&R filings and general advice on S&R case management.

filings such as motions, complaints, settlement agreements, and briefs. Officers also receive specialized advice on suspension and revocation procedures and assistance in preparing for administrative hearings.

The Process

The S&R mechanism is an integral part of the Coast Guard's marine casualty investigation process, as Title 46, United States Code, Section 6301, mandates that the Coast Guard determine if a credentialed mariner's actions or inactions contributed to a casualty or incident. When a Coast Guard marine casualty investigation reveals credible and sufficient evidence of negligence, incompetence, misconduct, a threat to maritime security, or violations of laws or regulations intended to promote marine safety, investigating officers issue complaints to begin suspension and revocation proceedings that can ultimately result in the suspension or revocation of a mariner's MMC.



(Source: U. S. Coast Guard Training Center Yorktown, Marine Inspection and Investigation School.)

The proceedings are remedial and not penal by nature and suspension and revocation actions minimize damage to property, the environment, and the U.S. economy by ensuring that mariners continue to possess the necessary skills, experience, and character to safely operate in the maritime transportation system.

The complaint will state under what authority (Title 46, United States Code, Section 7703 or 7704) the Coast Guard is initiating the S&R action and will allege pertinent facts the investigating officer intends to prove at the subsequent administrative hearing to establish that the offense occurred. S&R proceedings afford an opportunity for an oral, fact-finding hearing before an administrative law judge. The applicable regulations containing the guidelines concerning suspension and revocation proceedings are located in Title 33, Code of Federal Regulations, Part 20. At a hearing, a merchant mariner has the right to representation by another person such as an attorney, and to obtain witnesses, records, and other evidence by subpoena.

The S&R process is intertwined within all steps of the investigative process (see graphic); and, in the final step, the investigating officer will evaluate the facts, causal factors, and actions or inactions to determine if an offense occurred. Although the S&R NCOE assists investigating officers during several steps in the investigative process, their location with the National Maritime Center has proven extremely valuable during the violation analysis step. The S&R NCOE staff utilizes their marine safety experience working with the investigating officer and the National Maritime Center's Medical Evaluation Division to determine if any involved merchant mariner's fitness, use of over-the-counter or prescription medication, or medical condition may have been a factor in the casualty.

When a casualty investigation reveals that a merchant mariner who holds a Coast Guard-issued MMC may be physically incompetent, the investigating officer may issue a complaint alleging incompetence. This initiates the suspension and revocation administrative process, which can ultimately conclude with the Coast Guard presenting its evidence of incompetence before an administrative law judge at a fact-finding administrative hearing.

If the administrative law judge finds that the merchant mariner is physically incompetent, regulations in Title 46, Code of Federal Regulations, Part 5, require the merchant mariner's credential be revoked.

Alternatives to Administrative Hearings

In keeping with the remedial nature of S&R proceedings, the Coast Guard has implemented several options that a merchant mariner can employ in preference to appearing at an administrative hearing, such as:

A merchant mariner may elect to enter into a voluntary deposit agreement with the investigating officer (see 46 CFR 5.201), which specifies the conditions upon which the Coast Guard will return the MMC. Once the conditions of the agreement are satisfied and verified by the Coast Guard, the merchant mariner's credential is returned and the merchant mariner may serve under the authority of the MMC. This is a viable option when the merchant mariner's physical incompetence is temporary in nature and the medical condition, or fitness may improve to a point where the mariner would once again be deemed fit to hold a merchant mariner's credential.

A merchant mariner may elect to enter into a voluntary surrender agreement with the investigating officer (see 46 CFR 5.203). This agreement requires all rights to the merchant mariner's credential be surrendered and permanently relinquished. A merchant mariner who voluntarily surrenders his or her merchant mariner's credential may only be issued a new one after applying for a new credential through the administrative clemency process, which is administered by the Office of Casualty Investigations and Analysis at Coast Guard headquarters. Guidance on the administrative clemency process can be found in 46 CFR Part 5, Subpart L (5.901 – 5.905).

A merchant mariner may elect to apply for a document of continuity (see 46 CFR 10.227(e)), which does not allow an individual to serve as a merchant mariner. These documents have no expiration date and they are issued solely to maintain an individual's eligibility for renewal. This is a viable option when the merchant mariner's physical incompetence is temporary and any medical condition may improve to a point where the person would once again be deemed fit to hold a merchant mariner's credential. Once issued a document of continuity, an individual may obtain a properly endorsed MMC at any time by applying for and meeting all applicable requirements for renewal of his or her previous MMC.

About the author:
CDR Scott Budka has served in the U.S. Coast Guard for 24 years, including 22 years in the marine safety program. His marine safety experience includes tours at the Marine Safety Unit Lake Charles, La., Sector Delaware Bay, and several years as the suspension and revocation program manager at Coast Guard headquarters.

Communicate

The Investigations Feedback Loop

Safety alerts, recommendations, and lessons learned.

by LCDR Michael Simbulan
Enforcement Program Manager
U.S Coast Guard Office of Investigations and Analysis

The purpose of any marine casualty investigation is to determine the cause of the incident and to make recommendations to improve marine safety. That is why safety alerts, safety recommendations, and lessons learned are all key components of the marine investigations process.

These mechanisms allow investigating officers to communicate with industry and the public, and improve marine safety in the U.S. and around the world.

Safety Alerts

Safety alerts are created to advise the general public of conditions that may pose urgent threats to safety, in fleets of vessels, or particular types of operations, and propose voluntary actions for elimination or mitigation of those threats.

Safety alerts originate primarily from marine casualty investigations completed by Coast Guard Marine Boards and investigating officers. However, a safety alert may be issued based upon its merits, regardless of its source.

Safety Recommendations

Safety recommendations propose corrective actions for identified unsafe conditions to prevent those conditions from contributing to future incidents. These corrective actions may include changes to policy, law, or regulation.

Although similar, safety alerts and safety recommendations differ in several ways.

Safety Alerts:

- are only based upon conditions identified in the investigation report findings of fact;
- are issued to the public in general, or may be focused on a segment of the maritime community;
- recommend voluntary actions;
- primarily involve immediate actions intended as short-term solutions.

Safety Recommendations:

- are based upon and flow logically from the findings of fact and conclusions drawn through causal analysis;
- are issued to a specific person, unit, or organization;

continued on page 56

Safety Alerts Issued Since 2010

Advisory—GPS Enhanced EPIRBs
This advisory strongly urges owners and operators to replace and upgrade existing EPIRBs to GPS enhanced EPIRBs. Issued May 20, 2011.

Air Receivers and Relief Valves
Compressed air systems can present hidden dangers if not properly protected by safety devices. Issued Feb. 28, 2011.

AIS Messaging Issues
This safety alert addresses various concerns associated with AIS messaging. Issued July 28, 2011.

Caution to AIS Users
Important information for AIS users in the Northeast and Mid-Atlantic Regions. Issued Sept. 30, 2010.

CO_2 System Safety Alerts
These alerts present a number of concerns related to a CO_2 system. Issued Dec. 21, 2010.

Dangers Associated with Automatic Channel Switching
This document addresses concerns regarding VHF radios equipped with automatic channel switching. Issued August 26, 2010.

Dangers of Moving and Rotating Machinery
This alert reminds all maritime personnel of the dangers associated with working near moving machinery. Issued Dec. 15, 2011.

Deepwater Horizon Explosion
A MMS/USCG reminder to industry to re-examine a variety of practices associated with drilling. Issued August 26, 2010.

Explosives Safety Guide
Information/warning about what to do when munitions are caught in fishing gear. Issued August 28, 2010.

Fuel Oil Quick Closing Valves
This alert reminds owners and operators of the importance of quick closing valves. Issued Feb. 28, 2011.

High Velocity Vent Valves, Vacuum Valves, P/V Valves
This safety alert reminds owner operators of the importance of maintaining high velocity vent valves, vacuum valves, and P/V valves onboard tank vessels. Issued May 20, 2011.

Marine Safety Advisory—Distracted Operations
Throughout the United States and across all transportation modes, safety initiatives are being established to address issues related to distracted operations. The Coast Guard recognizes the importance of this issue, understands the potential consequences caused by increased operational risk in marine operations, and is supportive of the goals and objectives of the U.S. Department of Transportation and other distracted driving safety initiatives. Issued Feb. 28, 2011.

Mustang Survival PFD Recall
Provides recall information pertaining to several models of Mustang Survival personal flotation devices. Issued Dec. 2, 2011.

VHS (DSC)/GPS Setup
This alert reminds mariners of the importance of properly setting up VHF DSC equipped radio and GPS equipment to ensure prompt and effective rescue. Issued Sept. 1, 2011.

Parasail Industry Reminder
This alert reminds parasail operators of a few key operational issues to be aware of, to minimize risk. Issued Sept. 20, 2011.

Personal Flotation Devise Strap Check
This alert reminds vessel owners and operators to check the routing of personal flotation device straps to ensure availability during an emergency. Issued Jan. 11, 2011.

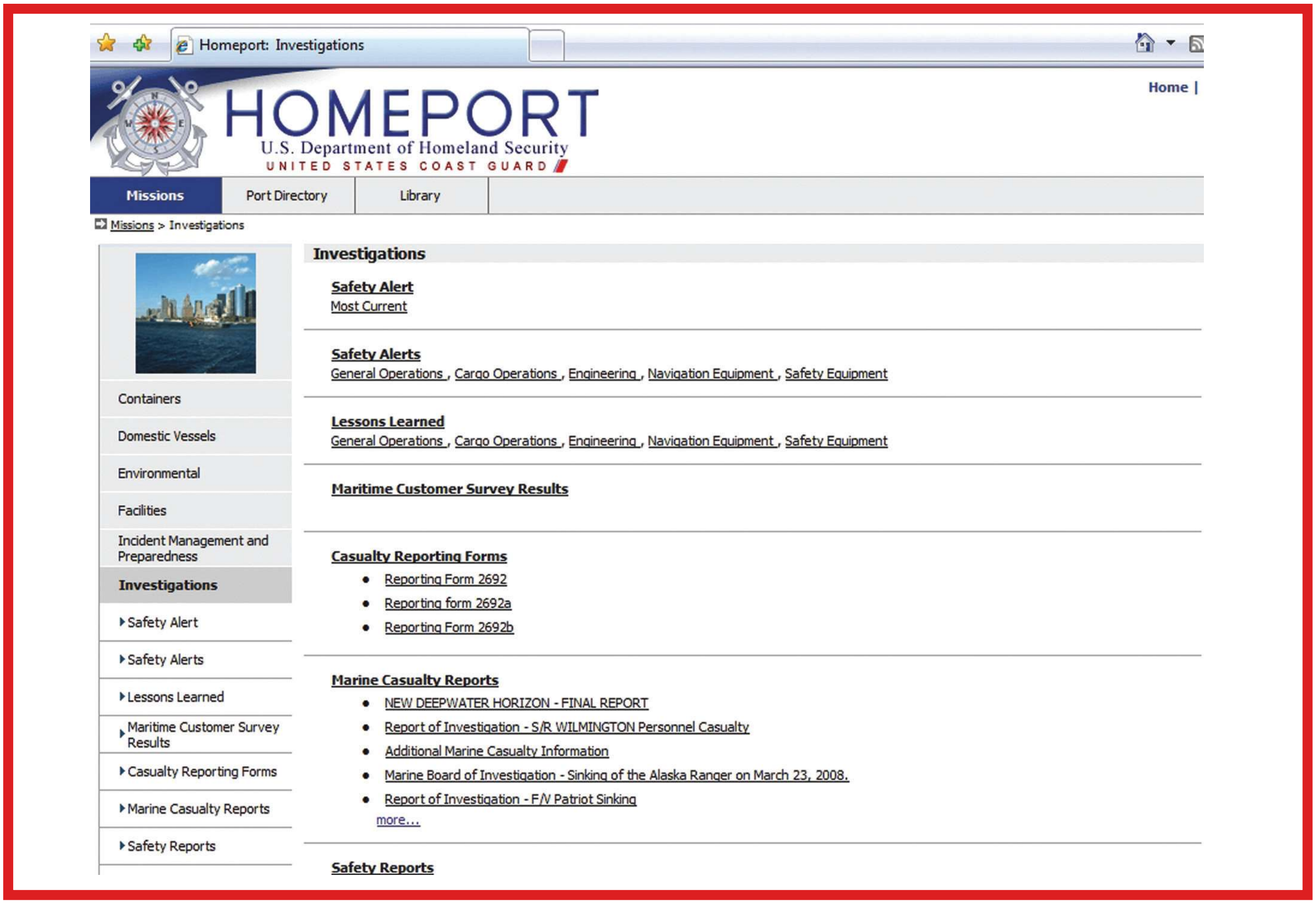
Providing CPR—No Time to Waste
This safety alert serves as a reminder to the international maritime community that when it is necessary to provide a patient CPR there is simply no time to waste. Every second that passes affects the patient's chance of survival. Issued May 12, 2011.

Ship Security Alert System
A reminder to vessel operators to ensure their ship security alert system is maintained in a fully functional condition. Issued Oct. 29, 2010.

Use of Portable Generators on Recreational Houseboats
This document reminds boaters of the dangers of carbon monoxide. Issued August 26, 2010.

Watertight Doors—Close Them Dog Them!
Another reminder for industry to close watertight doors while underway. Issued August 26, 2010.

Safety Alerts 2008–2009
A document containing 24 safety alerts from 2010 to 2008. Includes also one Lessons Learned document. Issued August 26, 2010.



- may result in mandatory requirements and procedures;
- may involve actions taken over an extended period of time to provide a long-term solution.

Lessons Learned

Lessons learned is another method used to advise the public of unsafe conditions as well as a way to suggest actions to help mitigate or eliminate them.

However, unlike safety alerts, lessons learned are not urgent and are normally published upon completion of an incident investigation as a means of emphasizing the need to prevent unsafe conditions from arising. Except for the urgency of the process, the drafting, approval, and release of lessons learned is the same as a safety alert.

About the author:
LCDR Michael Simbulan is the enforcement program manager in the Office of Investigations and Analysis at Coast Guard headquarters. He has 17 years of marine safety experience, and has served as a marine investigator in San Juan and Honolulu. He was awarded the Coast Guard Meritorious Service Medal for his efforts in support of the joint investigation into the loss of the Deepwater Horizon. *LCDR Simbulan holds a bachelor's degree in civil engineering from the U.S. Coast Guard Academy, and a master's degree in ocean engineering from Virginia Tech.*

For more INFORMATION:

Safety Alerts

Safety alerts are located on the Homeport Web page, under the investigations link in the left margin.

For questions regarding safety alerts, or to be added to the email distribution list for future safety alerts, please contact Mr. Ken Olsen at the Office of Investigations and Analysis at Coast Guard headquarters at Kenneth.W.Olsen@uscg.mil.

Safety Recommendations

Safety recommendations are included in the investigations case file. In cases where safety recommendations address national issues, or for questions regarding safety recommendations, contact Mr. David Deaver of the Office of Investigations and Analysis at Coast Guard headquarters at David.W.Deaver@uscg.mil.

Communicate

Top Ten Most Severe Marine Casualties

by Mrs. Kristin Williams
Operations Research Analyst
U.S. Coast Guard Office of Investigations and Analysis

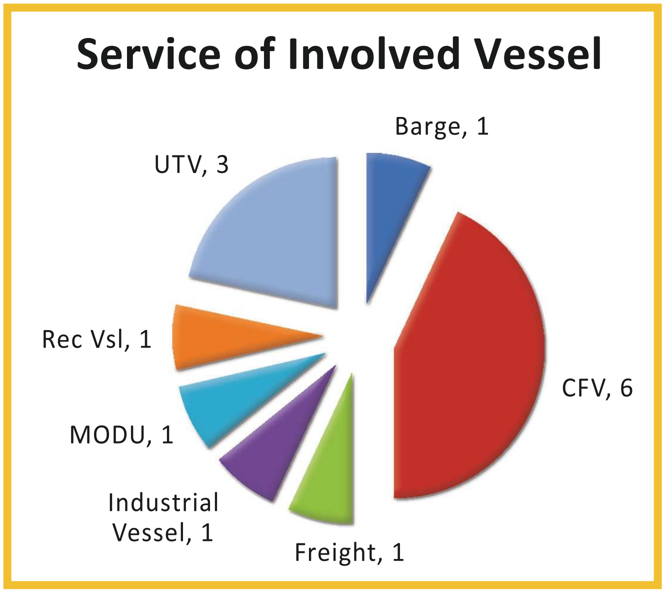
The Coast Guard is vested with the authority to conduct investigations of marine casualties, oil discharges, and hazardous material releases. The purpose of these investigations is to determine the cause of the incident, document the events and their causes, and to initiate the necessary corrective actions.

We limited this list to recent marine casualties, with complete, closed investigations. As such, going back to 2006, there were more than 50,000 incidents investigated by the Coast Guard. These incidents range from small discharges of oil to the catastrophic loss of life. Some of these incidents resulted in fatalities from explosions or fires, such as the incident that occurred to the Mobile Offshore Drilling Unit *Deepwater Horizon,* referenced later in this report.

Determining Severity

The first step in determining the most severe casualties is to extract data from the Coast Guard's Marine Information for Safety and Law Enforcement database. The initial data extracted for this report focused on marine casualties meeting at least one of the following five criteria:

- at least one person listed as deceased or missing;
- total damages exceed $100,000;
- the release of a hazardous material in the navigable waters of the U.S., equal to or exceeding the reportable quantity;
- the discharge of oil in the navigable waters of the U.S. classified under Title 40 CFR 300.5 as either a medium discharge or major discharge;



- the loss of any commercial vessel, Coast Guard inspected vessel, or any vessel greater than 100 gross tons.

Out of the 50,000 records pulled in this initial data extract, approximately 2,300 incidents met at least one of the criteria.

The second step is to create a point scale for each of the five criteria. Using a combination of various definitions found in Title 46 CFR as well as a scale approved by the Coast Guard/American Waterways Operators safety partnership, we created a "severity scale."

Incidents involving a loss of a vessel are awarded the highest point value for each vessel lost, for example

The Top Ten Most Severe Incidents from 2006 to 2010				
Activity	**Total Property Damage**	**Total Fatalities**	**Vessels Lost**	**Total Gallons Oil Spilled**
Explosion, fire and sinking of the MODU *Deepwater Horizon* with multiple loss of life	$350,000,000	11	1	206,980,200
CFV *Katmai*—sinking with multiple loss of life	$5,000,000	7	1	0
Explosion, fire and sinking of the *Athena 106* Barge with multiple loss of life	$1,606,800	6	3	0.2
CFV *Lady Mary*—sinking with multiple loss of life	0	6	1	0
CFV *Alaska Ranger*—sinking with multiple loss of life	$4,000,000	5	1	0
CFV *Lady of Grace*—sinking with multiple loss of life	$500,000	4	1	100
Allision with UTV *Little Man II* and sinking of the PC *FL8258MN* with multiple loss of life	$49,500	5	0	0
CFV *Ash*—capsize with multiple loss of life	$400,000	4	1	0
UTV *Valour*—sinking with multiple loss of life	$4,000,000	3	1	15,000
M/V *Seacor Madison* collision with CFV with multiple loss of life	0	4	1	0
TOTALS	**$365,556,300**	**55**	**11**	**206,995,300**

the loss of a commercial vessel greater than 100 gross tons receives 2.0 points. The severity of an incident is then determined by adding the points for each criterion. The higher the points, the more severe the incident.

Severity Point Scale	
Loss of life	3.0 points (each)
Damage > $100,000	1.0 point
Damage > $500,000	1.5 point
Damage > $1,000,000	2.0 points
Release > Reportable Quantity	1.0 point
Medium discharge of oil	1.0 point
Major discharge of oil	2.0 points
Loss of any commercial vessel*	1.0 point (each)
Loss of any GC inspected vessel*	1.5 points (each)
Loss of any vessel > 100 GT*	2.0 points (each)
* Note: Incidents involving a loss of a vessel are awarded the highest point value for each vessel lost.	

1. Explosion, Fire, and Sinking of MODU *Deepwater Horizon* with Multiple Loss of Life and Major Oil Spill (39.0 points)

On the evening of April 20, 2010, the Ultra-Deepwater Semi-Submersible Mobile Offshore Drilling Unit (MODU) *Deepwater Horizon* was dynamically positioned in Mississippi Canyon Block 252, performing drilling operations on the Macondo Well when a well integrity failure occurred, allowing hydrocarbons to escape onto the *Deepwater Horizon.* The hydrocarbons ignited, resulting in explosions and a continuous fire until the vessel sank two days later. Eleven of the men working on the vessel lost their lives and 17 others were injured. Hydrocarbons continued to flow through the wellbore and the blowout preventer for 87 days, causing a discharge of 4,928,100 barrels of crude oil. Estimated damages: $350 million.

The probable causes:

- Failure to prevent a well blowout.
- Poor maintenance of the electrical equipment that may have ignited the explosion.
- Lack of personnel training in the protocols of when and how to shut down engines and disconnect the MODU from the well to avoid a gas explosion.

2. Sinking of the CFV *Katmai* with Multiple Loss of Life (25.0 points)

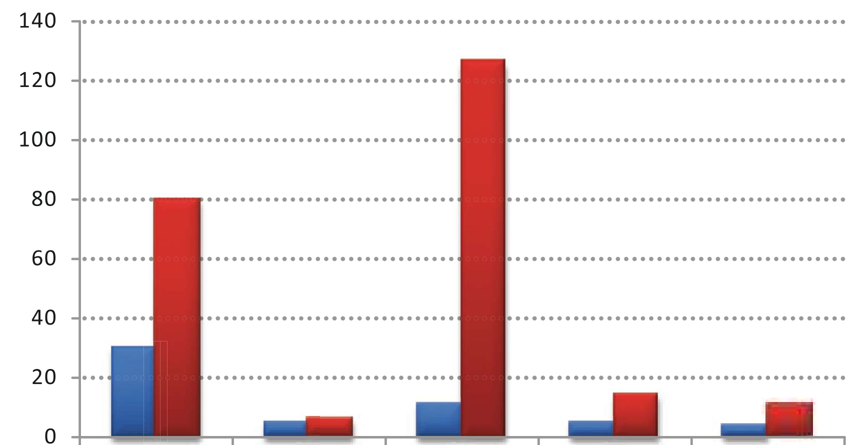
On Oct. 21, 2008, the commercial fishing vessel (CFV) *Katmai* was making way toward Dutch Harbor, Alaska, to offload approximately 120,000 lbs of cod. Just after midnight, the vessel lost steering and reported the lazarette was flooded. As the flooding progressed, the vessel took on a starboard list and was down by the stern. The *Katmai* sank in the vicinity of Adak Island, Alaska. Of the 11 crewmembers

The *Deepwater Horizon* fire. U.S. Coast Guard photo.

onboard, four were rescued, five were recovered deceased, and two remain missing and are presumed dead. The vessel was lost. Estimated damages: $5 million.

The probable causes:

- Lack of watertight integrity.
- Decreased stability due to excessive loading of cargo (the *Katmai* was carrying almost twice the amount of cargo referenced in the most current stability report).
- Failure to maintain watertight boundaries.
- Insufficient drainage of the shelter deck allowed water to accumulate in rough seas.



	CFV	Industrial Vessel	MODU	Rec Boat	UTV
Fatalities	30	5	11	5	4
On Board	80	6	126	14	11

3. Explosion, Fire, and Sinking of the *Athena 106* Barge with Multiple Loss of Life (24.0 points)

On Oct. 12, 2006, the uninspected towing vessel (UTV) *Miss Megan* was pushing barge *IBR-234* and spud barge *Athena 106* in West Cote Blanche Bay, La., when the five-ton aft spud of the *Athena 106* released from its fully raised position, dropped into the water, and pierced a submerged buried high-pressure natural gas pipeline. The gas ignited and created a fireball that engulfed all three vessels. The tug's master and three crewmembers lost their lives, and two crewmembers are missing and presumed dead. Estimated damages: $1,606,800.

The probable causes:

- Failure to pin the spuds securely in place on the barge *Athena 106*.
- Poor decision making and failure to ensure the barge spuds were securely pinned before getting under way.

4. Sinking of the CFV *Lady Mary* with Multiple Loss of Life (20.0 points)

On March 24, 2009, the commercial fishing vessel *Lady Mary* completed dragging operations (loaded with 10,500 pounds of shucked scallops) and was adrift off the coast of Delaware Bay, with a crew of seven aboard. After hauling the loaded scallop dredge onboard and setting it on the main deck, the crew opened the hatch cover to the steering lazarette and rigged the space for dewatering. The vessel was in a state of progressive flooding and had a 30-degree port list with one third of the main deck awash. The EPIRB activated but could not be correlated with the *Lady Mary*. Of the seven crewmembers aboard, one survived, four were recovered deceased, and two remain missing and are presumed dead.

The probable causes:

- Loss of buoyancy due to the flooding lazarette.
- Loss of buoyancy from the inability to rapidly shed water from the main deck due to partially blocked freeing ports.
- Lack of watertight integrity and ineffective internal subdivision.
- Poor emergency response.

5. Sinking of the CFV *Alaska Ranger* with Multiple Loss of Life (19.0 points)

On March 23, 2008, the commercial long-trawler *Alaska Ranger* was underway, approximately 130 miles due west of Dutch Harbor, Alaska, with 47 people aboard when the high-level bilge alarm in the rudder room sounded. The vessel flooded rapidly and progressively into the engine room and adjacent spaces. As the crew donned survival suits, the vessel suddenly rolled to a 45-degree starboard list. The crew abandoned ship. Twenty-two people managed to board one of the two life rafts and were rescued. Of the 25 people who did not board a life raft, 20 were rescued, four died, and one remains missing and is presumed dead. Estimated damages: $4 million.

The probable causes:

- Breach in watertight integrity and progressive flooding in the engine room and adjacent spaces at the stern of the vessel.
- Poor material condition of the vessel, possibly related to the Kort nozzle struts, which are believed to have experience excessive stresses where they were attached to the hull.

6. Sinking of the CFV *Lady of Grace* with Multiple Loss of Life (15.5 points)

On Jan. 26, 2007, the commercial fishing vessel *Lady of Grace* sank in the Nantucket Sound during severe winter weather conditions, while transiting to New Bedford, Mass. The vessel was located submerged in approximately 56 feet of water, resting on its port side. Of the four crewmembers aboard, two were recovered

CFV *Lady of Grace* undergoing salvage. USCG investigation photo.

from the submerged vessel and two remain missing and are presumed dead. Estimated damages: $500,000.

The probable cause:

- Significantly reduced stability due to added weight from a significant accumulation of ice.

7. Allision with the UTV *Little Man II* and Sinking of the PC *FL8258MN* with Multiple Loss of Life (15.0 points)

On April 12, 2009, the pleasure craft *FL8258MN* was northbound on the Intercoastal Waterway with 14 people aboard. Travelling at approximately 20 to 30 knots outside the east side of the designated channel, the *FL8258MN* allided with the unmanned push boat *Little Man II* moored near Ponte Vedra Beach, Fla. Five of the 14 persons aboard the *FL8258MN* died and nine were seriously injured as a result of the allision. Estimated damages: $49,500.

The probable causes:

- Inattention of the boat operators.
- Inexperience on the part of the designated operator.

8. Sinking of the CFV *Ash* with Multiple Loss of Life (14.0 points)

On Dec. 16, 2006, the commercial fishing vessel *Ash* capsized, broke apart, and sank near the Rogue River Bar in Gold Beach, Ore., with four crewmembers aboard. The vessel was loaded with 96 crab pots for its maiden voyage, when the crew attempted to transit outbound across the Rogue River Bar on an ebb tide. After the vessel successfully crossed the bar, it hit a large wave and rolled. As a second wave struck the side of the vessel, it flipped over and was destroyed. Two of the crewmembers were recovered deceased, and the other two remain missing and are presumed dead.

The probable causes:

- Significantly reduced stability due to increased ballast, addition of 96 crab pots, and structural and mechanical modifications completed without revised stability calculations.
- Maiden voyage as fully loaded crabbing vessel without prior sea trials.
- Transiting the Rogue River Bar during dangerous conditions.

Above: PC *FL8258MN*. Right: *Little Man II*. USCG investigation photos.

9. Sinking of UTV *Valour* with Multiple Loss of Life (14.0 points)

On Jan. 17, 2006, the towing vessel *Valour* was towing the fully loaded cargo barge *M-192* astern, off the coast of Wilmington, N.C. The wind was gusting up to 70 knots and seas were 15 to 20 feet when the vessel took on a significant port list and sank. In the process of ballasting the vessel, the chief mate fell down the stairs and possibly broke both his legs. Of the nine crewmembers aboard, two are missing and presumed dead (including the chief mate), and six were rescued; however, one of the crewmembers rescued later died due to shock brought on by hypothermia. Approximately 15,000 gallons of diesel oil was discharged. Estimated damages: $4 million.

The probable causes:

- Severe weather caused significant heel and synchronous rolling of the vessel.
- Vessel design shortcomings (starboard list was consistent with stability letter).
- Poor communications between the master and chief engineer regarding ballasting.
- Lack of established ballasting procedures.
- Loss of stability due to reduced reserve buoyancy and increased free surface effect.

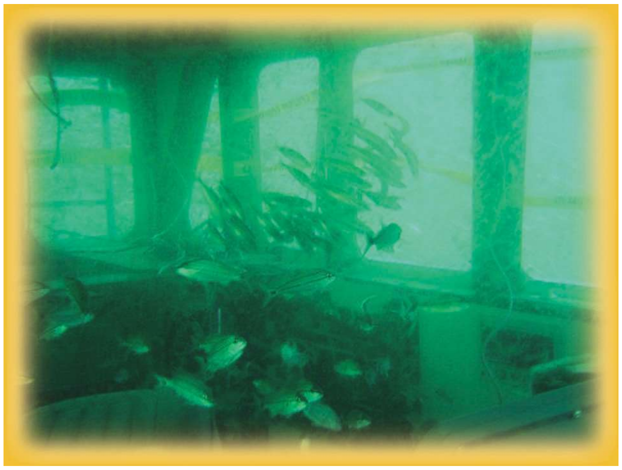
10. M/V *Seacor Madison* Collision with Ghanaian Canoe with Multiple Loss of Life (13.0 points)

At July 5, 2007, at 10 p.m., the offshore supply vessel *Seacor Madison* collided with a dugout Ghanaian commercial fishing canoe approximately 30 nautical miles off the coast of Ghana. The canoe posed a low profile and was not equipped with radios, sound-producing devices, navigational lights, radar reflectors, or lifesaving equipment. The vessel could not detect the canoe by sight or sound until the vessels were already in extremis. Of the seven people aboard the canoe, four were lost at sea and are presumed dead. The vessel recovered three survivors and returned them to Ghana. The canoe was lost at sea.

The probable cause:

- Failure of the fishing vessel to comply with International COLREGs

About the author:
Mrs. Kristin Williams is an operations research analyst in the U.S. Coast Guard Office of Investigations and Analysis.



The UTV *Valour* rests underwater, prior to salvage. USCG photo.

Marine Casualty Analysis

We keep history from repeating itself.

by Mr. James Law
Operations Research Analyst
U.S. Coast Guard Office of Investigations and Analysis

The U.S. Coast Guard Office of Investigations and Analysis oversees commercial vessel investigation processes within the marine safety program and conducts analyses of casualties and events to prevent recurrence. The office has three divisions: Investigations, Compliance and Analysis, and Data Administration and Freedom of Information Act. The Marine Safety Lab, in New London, Conn., is part of the Investigations Division.

Staffers manage, process, and document marine safety activities such as inspections, boardings, notifications of arrival, examinations, pollution incidents, and investigations to generate statistics measuring overall prevention program effectiveness.

Statistics Inform Analysis, Oversight

The office also regularly generates summary statistics for reports, regulatory analysis, and program oversight to inform partnerships, advisory committees, and the public. Trending topics in the past several years have included parasailing casualties, cruise vessel casualties, major marine casualties, commercial fishing losses, commercial diving casualties, waterways management studies, bridge allisions, fuel switching, and distracted mariners.

Other office activities and processes include:

- managing pollution violations,
- managing personnel action investigations,
- conducting administrative clemency boards,
- overseeing the drug and alcohol testing program,
- supporting field offices.

About the author:
Mr. James Law served in the U.S. Coast Guard on active duty and as a civilian employee for 39 years. He is a qualified marine inspector and investigator, and has participated in numerous Commandant's Quality and Benkert award review teams.

Marine Casualty Statistics

Overview of Reportable Marine Casualties, from 2006 to 2011

US Coast Guard	Calendar Year					
	2006	2007	2008	2009	2010	2011
Marine Casualties, Reportable	**4,596**	**4,696**	**4,769**	**4,477**	**5,271**	**5,884**
Level of Investigation						
Data Collection	3,946	2,905	2,688	2,471	2,794	2,968
Informal	648	1,791	2,076	1,999	2,473	2,911
Formal	2		5	7	4	5
U.S. Casualty Classification						
Routine	4,518	4,612	4,698	4,441	5,230	5,844
Significant Marine Casualty	40	48	31	12	21	14
Major Marine Casualty	38	36	40	24	20	26
Losses						
Vessels Constructive Total Loss	111	97	99	89	107	94
Vessels Actual Total Loss	46	53	33	51	28	31
Sum of Vessels Damaged	2,050	2,083	1,879	1,545	1,837	2,078
Vessel Property Damage (US $ Millions)	$129.7	$86.3	$140.5	$63.6	$433.7	$57.6
Vessel Casualty-Related Injuries						
Dead	49	55	57	43	33	26
Missing	15	8	5	3	16	
Injured	345	171	164	183	161	129

Top Initial Casualty Events for 2006 to 2011

Initial Casualty Events	Calendar Year					
	2006	2007	2008	2009	2010	2011
Material Failure (Vessels)	1,665	1,751	1,648	1,636	2,100	2,194
Grounding	685	699	816	591	779	745
Personnel Casualties	843	713	622	606	651	801
Allision	557	633	612	517	523	510
Vessel Maneuverability	153	185	311	341	397	451
Collision	163	133	128	132	128	126
Loss of Electrical Power	51	71	108	115	148	160
Flooding	80	102	98	92	96	99
Fire	96	95	85	108	103	79
Fouling	57	72	70	74	62	76
Not Specified	3	3	10	11	43	327
Evasive Maneuvers	30	38	44	35	45	70
Damage to the Environment	35	33	28	48	35	63
Material Failure (Non-vessels)	27	38	47	42	38	46
Set Adrift	26	32	48	38	40	48
Falls into Water	36	28	22	31	21	26
Sinking	42	30	25	16	19	17
Loss of Stability	11	11	19	16	18	14
Capsize	17	11	7	10	9	6
Explosion	5	7	3	5	6	6
Damage to Cargo	5	1	8	4	4	7
Emergency Response	3	2	6	7	1	7
Material Failure (Diving)	3	3	3	1	3	5
Abandonment	3	4	1	1	1	1
Implosion		1			1	
Annual Totals	**4,596**	**4,696**	**4,769**	**4,477**	**5,271**	**5,884**

Top initial casualty events for 2006 to 2011. Material failure (of systems, components, materials, and related equipment) is the most common initial event.

Injury Severity Scale

Minor The injury is minor or superficial. No professional medical treatment was required.

Examples: Minor/superficial scrapes (abrasions); minor bruises; minor cuts; digit sprain; first degree burn; minor head trauma with headache or dizziness; minor sprain/strain.

Moderate The injury exceeds the minor level, but did not result in broken bones (other than fingers, toes or nose), loss of limbs, severe hemorrhaging, muscle, nerve, tendon or internal organ damage. Professional medical treatment may have been required. If so, the person was not hospitalized for more than 48 hours within 5 days of the injury.

Examples: Broken fingers, toes or nose; amputated fingers or toes; degloving of fingers or toes; dislocated joint; severe sprain/strain; second/third degree burns covering 10% or less of body (if face included, move up one category); herniated disc.

Serious The injury exceeds the moderate level and requires significant medical/surgical management. The person was not hospitalized for more than 48 hours within 5 days of the injury.

Examples: Broken bones (other than fingers, toes or nose); partial loss of limb (amputation below elbow/knee); degloving of entire hand/arm or foot/leg; second/third degree burns covering 20-30% of body (if face included, move up one category); bruised organs.

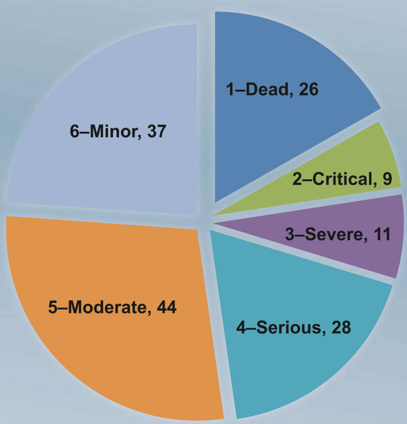
Severe The injury exceeds the moderate level and requires significant medical/surgical management. The person was hospitalized for more than 48 hours within 5 days of the injury and, if in intensive care, was in for less than 48 hours.

Examples: Internal hemorrhage; punctured organs; severed blood vessels; second/third degree burns covering 30-40% of body (if face included, move up one category); loss of limb (amputation of whole arm/leg).

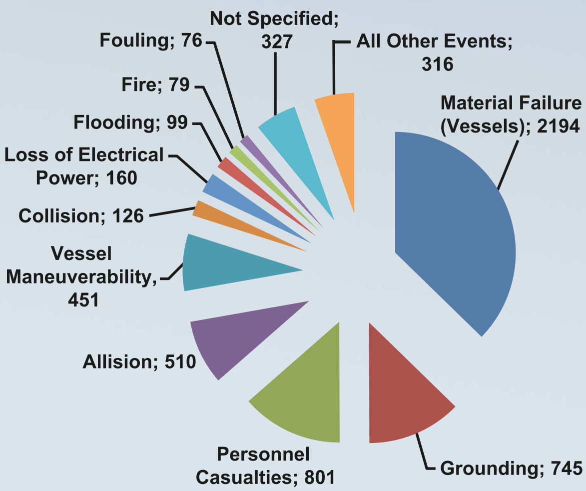
Critical The injury exceeds the severe level and requires significant medical/surgical management. The person was hospitalized and intensive care for more than 48 hours within 5 days of the injury.

Examples: Spinal cord injury; extensive second or third degree burns; concussion with severe neurological signs; severe crushing injury; internal hemorrhage; second/third degree burns covering 40% or more of body; severe/multiple organ damage.

Vessel Casualty-Related Statistics for 2011, by Severity of Injury



The Top 12 Initial Casualty Events in 2011



Pollution Statistics

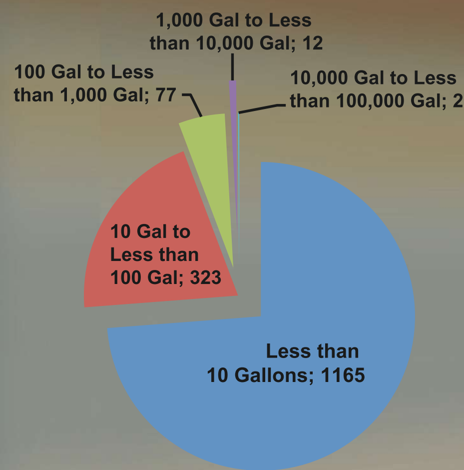
Summary Statistics for Vessel Pollution Incidents

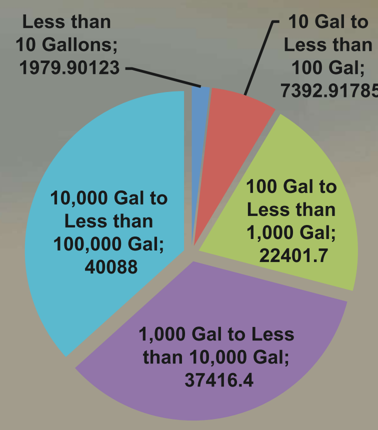
Oil and Petroleum Spills Vessel Sources	Calendar Year 2006	2007	2008	2009	2010	2011
Vessel Spills—Counts	**2,145**	**2,057**	**1,774**	**1,795**	**1,604**	**1,579**
Less than 10 Gallons	1,445	1,424	1,279	1,290	1,140	1,165
10 Gal to Less than 100 Gal	547	500	404	409	372	323
100 Gal to Less than 1,000 Gal	130	106	73	79	75	77
1,000 Gal to Less than 10,000 Gal	17	23	15	14	14	12
10,000 Gal to Less than 100,000 Gal	5	4	1	3	1	2
Greater than 100,000 Gal	1		2		2	
Vessel Spills—Quantity	**416,102**	**233,782**	**551,390**	**128,305**	**894,002**	**109,279**
Less than 10 Gallons	2,669	2,634	2,327	2,089	1,807	1,980
10 Gal to Less than 100 Gal	13,101	12,680	10,045	10,376	9,563	7,393
100 Gal to Less than 1,000 Gal	35,673	27,200	18,570	23,473	17,064	22,402
1,000 Gal to Less than 10,000 Gal	36,049	69,567	30,429	31,937	35,567	37,416
10,000 Gal to Less than 100,000 Gal	108,611	121,701	19,000	60,430	10,000	40,088
Greater than 100,000 Gal	220,000		471,018		820,000	

In 2010, two casualties released more than 100,000 gallons of oil in U.S. waters. On January 23, 2010, a tank vessel collided with a barge, resulting in a spill of 240,000 gallons of crude oil in the Sabine-Neches Channel in Port Arthur, Texas.

The second incident: the disastrous loss of the *Deepwater Horizon* in the Gulf of Mexico in April 2010. The spill quantity attributed to the vessel alone is 400,000 gallons—the capacity of the tanks.

Vessel Oil Spills by Count and Quantity, 2011





Fishing Vessel Casualties

Using investigations to improve safety.

by Mr. David Dickey
Management Analyst
U.S. Coast Guard Office of Investigations and Analysis

Within the maritime safety community, we work to ensure that investigations provide feedback to the preventive measures established to protect lives, property, and the environment. When casualties occur, investigators determine what happened and why; safety professionals evaluate any findings as well as the effectiveness of existing measures to determine if there is a need for changes in policies, procedures, laws, or regulations.

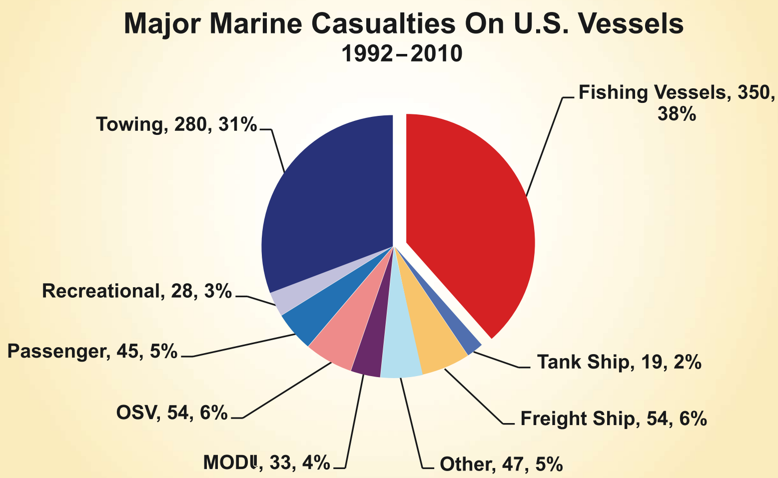
To show how Coast Guard investigators help identify and address safety issues on commercial vessels, we conducted an eight-year study of arguably the most dangerous type of vessel we encounter—the commercial fishing vessel.[1]

Fishing Industry Casualties in Perspective

Commercial fishing vessels are subject to the fewest safety regulations when compared to other vessels. The requirements for their design, construction or maintenance are minimal, and crewmembers are not required to possess a Coast Guard license. Current regulations focus primarily on lifesaving and firefighting equipment, for use after a vessel is in danger.[2]

To get an indication of relative safety, fishing vessel casualties are compared to those of other vessel types, as shown in figure 1. From 1992 to 2010, fishing vessels were involved in more "major marine" casualties[3] than any other vessel type. Further, commercial fishing vessels were involved in six of the 10 most severe casualties from 2006 to 2010 (see related article in this edition).

Figure 1: Fishing vessels account for 38 percent of the major marine casualties that occurred from 1992 to 2010. Graphics from *A Review of Lost Fishing Vessels and Crew Fatalities, 1992–2010,* Washington, D.C.: U.S. Coast Guard, Office of Investigations and Analysis.



The Bureau of Labor Statistics reported commercial fishing as the most dangerous occupation in the U.S., with 116 fatalities per 100,000 workers. That rate is 33 times the national average of 3.5 for all occupations.[4] It is likely that the high accident rate is related to the unregulated nature of fishing vessels.

Casualty Statistics

Investigators have seen some improvements in the casualty numbers since the Commercial Fishing Industry Vessel Safety Act of 1988.[5] However, the number of significant incidents is still quite high, with approximately 61 vessels lost and 39 fatalities per year.

Thus, safety professionals continue to look for ways to reduce the number of incidents. Additionally, casualty data has helped to identify the most significant factors involved in fishing vessel incidents and to track year-to-year trends.

Fortunately, the repository of casualty data is quite extensive. On Jan. 1, 1992, the Coast Guard began recording investigation reports directly into its Marine Safety Information System database. This was the first time decision makers and researchers were able to see the details in any investigation report. Prior to this, reports were prepared on paper, with a small number of items being transcribed into a database that was only available to researchers at headquarters.

From 1998 to 1999, a cluster of casualties in mid-Atlantic waters again raised awareness of safety issues on fishing vessels.[6] Shortly thereafter, a task force of government and industry representatives was chartered to study fishing vessel safety and make recommendations to help reduce loss of life and property. Among the many findings, it was apparent that some casualties could not be prevented with existing regulations. So, casualty data was used to prepare more detailed analyses of crew member fatalities and vessel losses in support of requests to Congress for additional authorities.

Crewmember Fatalities

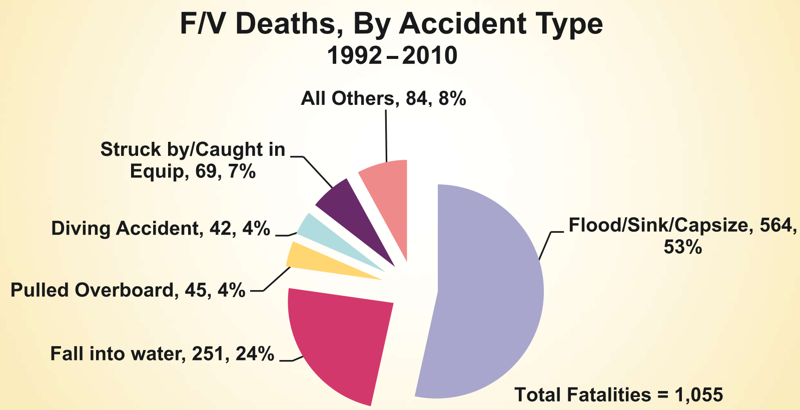
From 1992 to 2010, the Coast Guard investigated 757 incidents involving cases with loss of life. Those incidents resulted in 1,055 deaths, or an average of 56 per year.

The highest number of fatalities occurred in USCG District 17 (Alaska); District 8 (Gulf of Mexico); and District 1 (Northeast), for 57 percent of the total. Since the current regulations became effective in 1991, there has been a decrease in fatalities with a record low in 2010. However, the number of fatalities on fishing vessels remains significantly higher than that of commercial vessel types.

Fatalities by Accident Type

When crewmember fatalities are grouped by accident type, more than half (53 percent) are related to the flooding, sinking, or capsizing of a fishing vessel, i.e., vessel-related. Another 24 percent of the fatalities resulted from falling overboard. With three-quarters of all fatalities, water exposure is the most significant factor in personnel loss. Consequently, the vessel-related and man overboard fatalities were examined more extensively.

Figure 2: As water exposure was determined to be the most significant factor in personnel loss, investigators examined those casualties to determine prevention strategies.



For the group of 564 vessel-related deaths, the investigations showed:

- The number of fatalities was highest in the colder waters of the U.S. West and Northeast coasts, (69 percent of the total). In those regions, there were more deaths from October to January.
- Steel-hulled vessels appear to present a higher risk. Forty-four percent of all vessel-related fatalities occurred on steel vessels, but included only 25 percent of the vessel losses. Vessel population data showed that steel vessels are larger than other vessels, with the ability to operate farther offshore, with larger crews.
- Fishing vessels are getting older, which is another indicator of increased risk. In 1997, more than 55 percent of the U.S. documented fleet was less than 20 years of age.[7] In 2010, the percentage dropped to 23 percent.
- In the warmer waters of the Gulf of Mexico where survival times are much longer, factors other than water temperature became more significant.

Some vessels were lost suddenly, often in severe weather conditions. Such incidents occurred too quickly for use of lifesaving equipment, or crewmembers were trapped in the vessel.

Analysis of the vessel-related casualties also provided some indicators of the effectiveness of current lifesaving regulations:

- For incidents in the colder waters of the U.S. West and Northeast coasts, survival rates more than doubled when the required lifesaving equipment was available and was used properly.
- The incident reports confirmed that even in warmer waters, the use of lifesaving equipment is essential. In nearly half of the warm water fatalities, crewmembers entered the water without lifesaving equipment and died from either drowning or hypothermia. Conversely, most survivors were recovered in either a personal flotation device or a life raft.
- Coast Guard personnel conduct voluntary dockside examinations of fishing vessels to check for compliance with the current safety requirements. Vessels meeting all requirements are issued decals. Of the 564 vessel-related fatalities, 73 percent occurred on vessels with no decal or with a decal more than two years old (expired). This is an indication that safety equipment and the increased awareness gained through USCG interaction with crewmembers can save lives. However, it is estimated that less than 10 percent of the fishing fleet has successfully completed a dockside exam.
- Two incidents revealed the importance of training when crewmembers died because they did not know the proper procedures to deploy a life raft.
- When fishing vessels were lost, Good Samaritan vessels were on hand to rescue crewmembers in more than 29 percent of the incidents. There were very few fatalities during such incidents and, when fatalities did occur, the vessels were lost quickly due to flooding, capsizing, collision, or fire.

Falls overboard resulted in the second largest number of fatalities, with 24 percent of the total (251 of 1,055). Personal flotation device/survival suit usage was

A 38-foot fishing vessel sinks after running aground on rocks, while transiting near the north jetty at Barnegat Light, NJ. The six people who were aboard abandoned the boat and waited on a life raft for Coast Guard Station Barnegat Light crewmembers to rescue them. U.S. Coast Guard photo.

reported for only two of the 251 fatalities, although "unknown" was reported for 111 persons.

By far, the highest number of fatalities occurred in USCG District 8 (Gulf of Mexico), accounting for 35 percent of the total. Given that the District 8 has the warmest waters and the longest survival times, the number of falls overboard fatalities appear to be abnormally high. The data provides no reasons for this high number of fatalities. This appears to be a region where continued emphasis on safety equipment, drills, and training would be beneficial.

Taken together, the above findings indicate:

- Deaths can be avoided when the lifesaving equipment required by current regulations is available and properly used.
- Factors leading to vessel loss will have to be addressed to reduce fatalities below current levels, especially for incidents that occur suddenly, such as sinking and capsizing.

Congress Reacts

On April 20, 2007, the House Subcommittee on Coast Guard and Maritime Transportation conducted a hearing on fishing vessel safety. An earlier version of the report was provided to the subcommittee along with the testimony of fishing vessel safety experts. Ultimately, the Coast Guard Authorization Act of 2010[8] provided safety enhancements, including:

- a requirement to conduct dockside exams on all fishing vessels that operate outside of state waters, (the "three-mile limit");
- mandatory safety and operational training for each person in charge of a fishing vessel;
- after July 2012, new vessels larger than 50 feet in length must be examined by a classification society, and vessels more than 79 feet will require load lines;
- in 2020, new regulations are to begin for vessels more than 25 years of age requiring certification under an alternative safety program.

The Feedback Cycle Continues

Work is in progress to update fishing vessel safety regulations as specified in the 2010 Authorization Act. Planning and budgeting personnel are determining how the additional duties will be performed and what resources are needed to perform those duties. Finally, analysts will continue to evaluate the trends in fishing vessel casualties to see if the new regulations are effective and whether other changes are needed.

About the author:
Mr. David Dickey is a management analyst in the Office of Investigations and Analysis at Coast Guard headquarters. He is a 1976 graduate of the U.S. Merchant Marine Academy, and has experience in marine safety including vessel inspection, investigation, and pollution response.

Endnote:

1. *A Review of Lost Fishing Vessels and Crew Fatalities, 1992–2010*, Washington, D.C.: U.S. Coast Guard, Office of Investigations and Analysis. The full report is available on the Coast Guard internet portal at http://homeport.uscg.mil, in the Investigations section. Most of the statistics in this article originate in this report.
2. Title 46, Code Of Federal Regulations, Part 28.
3. Title 46, Code of Federal Regulations, Paragraph 4.40-5(d), defines a major marine casualty as "a casualty involving a vessel, other than a public vessel, that results in: 1) The loss of six or more lives; 2) The loss of a mechanically propelled vessel of 100 or more gross tons; 3) Property damage initially estimated at $500,000 or more…"
4. *Census of Fatal Occupational Injuries 2010 (preliminary)*, Bureau of Labor Statistics, at www.bls.gov/iif/oshwc/cfoi/cfch0009.pdf, pg 19.
5. Public Law 100-424, September 1988.
6. The spate of clam and conch fishing vessel losses that occurred between December 28, 1998 and January 18, 1999 (the *Predator, Beth Dee Bob, Cape Fear,* and *Adriatic*), was the impetus for establishing the task force that presented the report: *Living to Fish, Dying to Fish*. Washington, D.C., U.S. Coast Guard. Fishing Vessel Casualty Task Force Report, March 1999.
7. Vessels that received a certificate of documentation from the U.S. Coast Guard. This figure does not include the smaller, state numbered vessels, generally less than 30 ft. in length.
8. Public Law 111-281, October 15, 2010, Section 604.

Communicate

Show Me the Data

Using information to drive safety improvements.

by Mr. Thomas A. Allegretti
President and CEO
The American Waterways Operators

In the film *Jerry Maguire,* Tom Cruise made famous the line, "Show me the money!" For those in the maritime industry and the Coast Guard, whose mission is the safety of crewmembers, vessels, the environment, and the public, a more appropriate phrase for this line of work is, "Show me the data!"

Why is that? The data that derives from Coast Guard pollution and marine casualty investigations has been a critical foundation for joint Coast Guard-industry initiatives to improve marine safety for nearly two decades.

In 1995, the American Waterways Operators (AWO), the national trade association for the tugboat, towboat, and barge industry, entered into a first-of-its-kind safety partnership with the U.S. Coast Guard. The mission: Improve vessel and personnel safety, enhance environmental protection, and strengthen the communication and working relationship between industry and the Coast Guard. To date, this partnership has launched nearly 40 quality action teams to address top-priority safety and environmental issues, ranging from crew fatalities to oil spills to bridge allisions.

Data as a Starting Point

From the beginning, data has been the essential starting point, helping the Coast Guard and AWO to focus efforts on the most critical safety challenges. Twice a year, under the auspices of the safety partnership, the Coast Guard and AWO review data on towing vessel crew fatalities, injuries, oil spills, and vessel casualties drawn from the Coast Guard's Marine Information for Safety and Law Enforcement database. The Coast Guard's willingness to "show us the data" has helped the partnership target our collective efforts on the safety challenges that most need our attention.

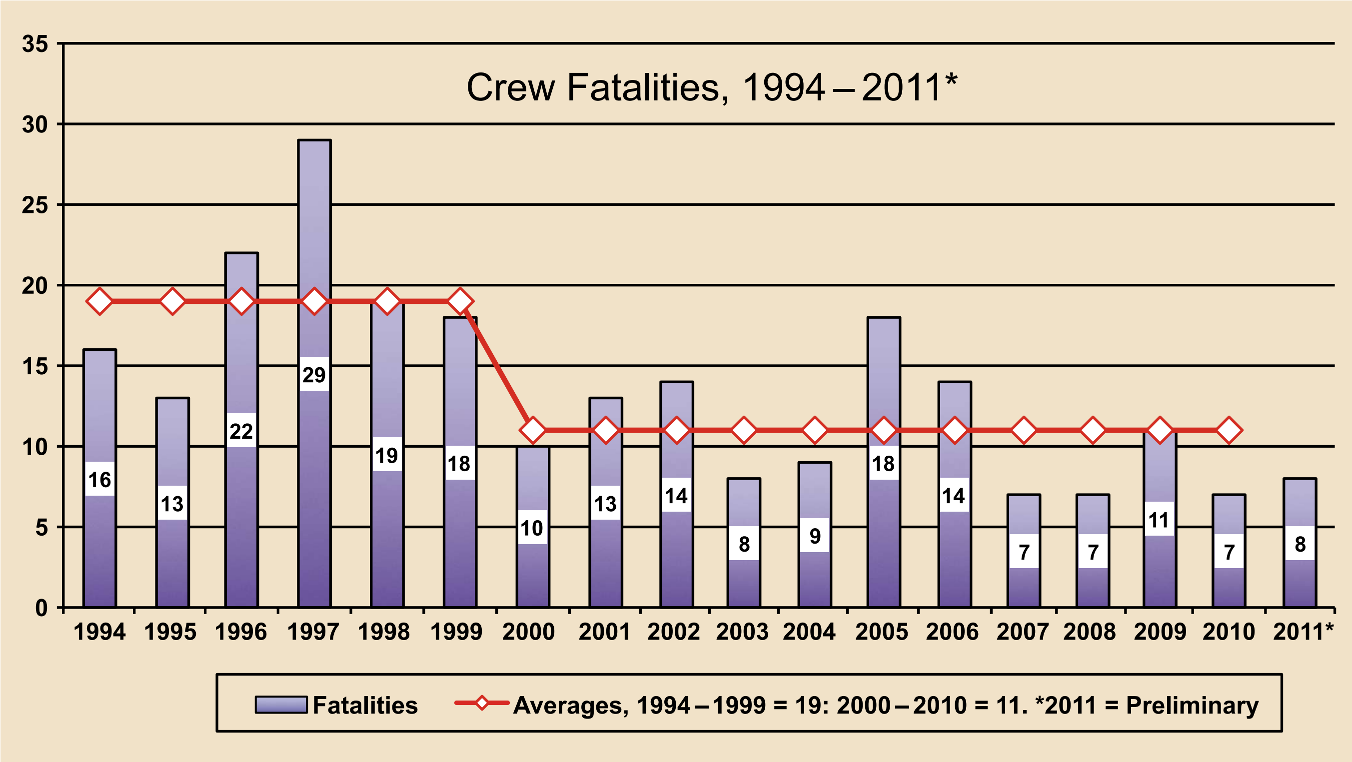
Reducing Crew Fatalities

For example, in 1996, the partnership's first quality action team focused on the critical need to reduce towing vessel crew fatalities, since the data indicated an unacceptable rate of crew fatalities in our industry. In 2011, the data again focused our attention on crew fatalities.

While Coast Guard data showed that the average annual number of crew fatalities had dropped by nearly half from 1994 to 1999, and from 2000 to 2010, it also showed that we reached a new plateau, suggesting the need for further analysis and intervention to drive fatalities down to our mutual goal of zero.

Data as a Catalyst for Solutions

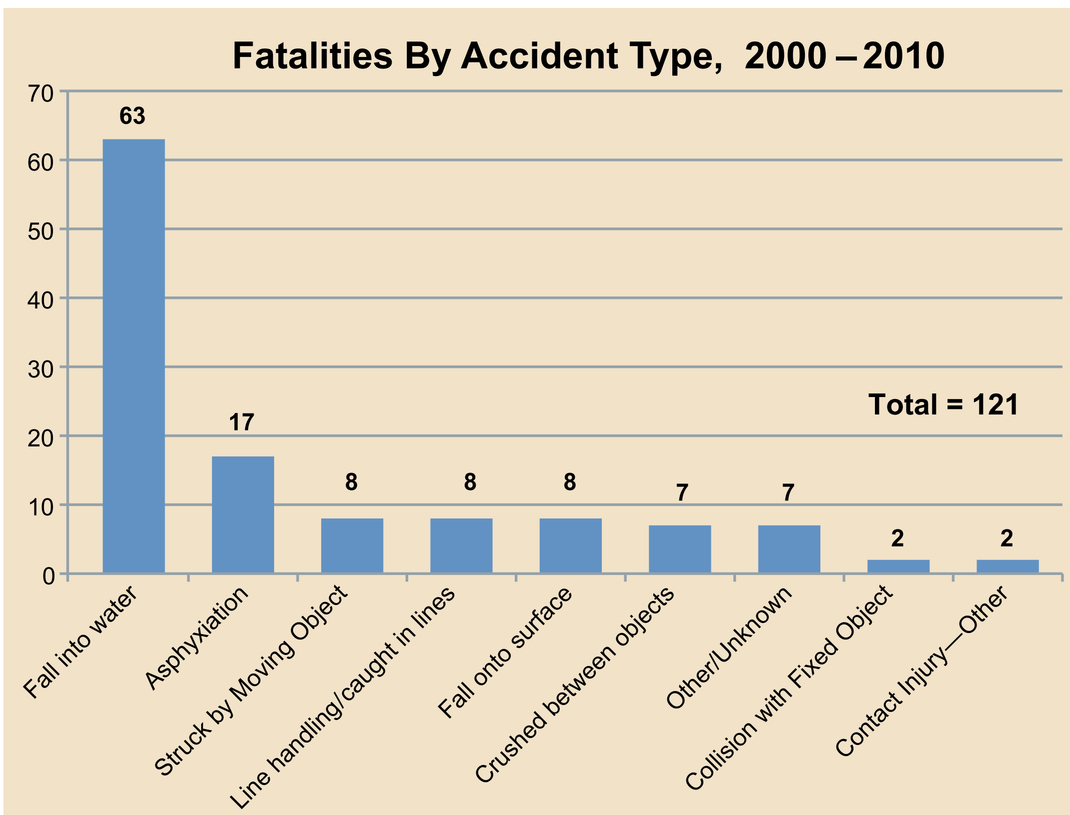
Data helped us to focus our efforts by highlighting the fact that the majority of towing vessel crew fatalities result from falls overboard, just as the first quality action team on towing vessel crew fatalities had determined in 1996. While the numbers were down, the essential problem of crewmembers falling overboard remained the same, motivating the partnership to convene a new quality action team specifically focused on reducing fall-overboard crew fatalities.



Clearly, safety data is important in helping us to identify safety problems that warrant Coast Guard and industry attention. As the experience of the Coast Guard-AWO safety partnership and the congressionally authorized Towing Safety Advisory Committee demonstrates, safety data also plays a critical role in developing safety solutions as well as ensuring their acceptance by those called upon to implement them.

The Bridge Allision Work Group

In 2002, the partnership chartered the bridge allision work group in response to a fatal bridge allision that claimed the lives of 14 motorists when a tow struck the I-40 highway bridge over the Arkansas River. The goal of this partnership was to investigate the prevalence of bridge allisions involving barges and towing vessels, and make recommendations to prevent such accidents and mitigate their consequences.



Data was essential to this effort. The Coast Guard compiled a database of nearly 2,700 bridge allision cases involving towing vessels or barges in U.S. waters during the period of 1992 to 2001. Additionally, data from the U.S. Army Corps of Engineers on towing vessel trips served as an essential denominator, showing that bridge allisions were occurring at the rate of approximately 0.06 percent, or six allisions for every 10,000 towing vessel trips.

The work group also relied on extensive analysis of investigation reports to reach the conclusion that human factors—specifically decision-making errors—are the predominant factors in bridge allisions. (The group emphasized that this finding does not mean that towing vessel operators are poor decision makers. On the contrary, the fact that the overwhelming majority of bridge transits take place without incident—and that most bridge allisions that do occur result in no damage to people, property, or the environment—testifies to the skill and professionalism of towing vessel operators who do a difficult job under challenging conditions, with very little margin for error.) The data also revealed that many factors contribute to human factor-based errors, suggesting the need for a multi-faceted approach to prevention rather than narrow focus on a single solution.

Analysis of this extensive data set helped the work group to identify those bridges that posed the most serious safety challenges, to draw conclusions about the causes of bridge allisions, and to target recommendations for preventive measures.

Recommendations

For example, the work group found that more than one-third of all bridge allisions between 1992 and 2001 occurred at bridges already identified as obstructions to navigation under the Truman-Hobbs Act, and under order to be altered or on the Truman-Hobbs backlog priority list.

The work group thus recommended that the Coast Guard and AWO work together to accelerate removal and alteration of obstructive bridges under the authority and procedures of the Truman-Hobbs Act.

Towing Safety Advisory Committee Working Groups

Data played a similarly important role in focusing the work of the Towing Safety Advisory Committee's towing vessel inspection working group, formed in 2004 to provide advice to the Coast Guard on developing regulations for towing vessel inspection as required by the 2004 Coast Guard and Maritime Transportation Act.[1]

The Coast Guard directed the Towing Safety Advisory Committee to take a risk-based approach to developing recommendations for a new towing vessel inspection regime. Accordingly, the working group established a risk-based decision making subgroup that analyzed towing vessel casualty data from 1994 to 2005, employing a classic definition of risk as frequency multiplied by severity, and a risk-based rulemaking that prioritizes addressing situations that are high frequency and high severity over those that are low frequency/low severity.

Results

The subgroup's highly analytical data-driven process provided a solid factual foundation for the working group's recommendations to the Coast Guard, making it easier for the diverse membership to reach consensus on recommendations ranging from the importance of safety management systems to equipment requirements for existing towing vessels.

Basing recommendations for corrective or preventive action on data increases the likelihood that those recommendations will be accepted and adopted by their intended audience, because the basis for those recommendations is transparent. The experience of the Coast Guard-AWO safety partnership bears this out.

For example, the data-driven recommendations of the quality action team on towing vessel crew fatalities and the bridge allision work group prompted the AWO membership to amend the AWO responsible carrier program (a safety management system that is a requirement for AWO membership) to include requirements for fall-overboard prevention and bridge transit procedures. For its part, the Coast Guard drew heavily on the recommendations of the Towing Safety Advisory Committee's towing vessel inspection working group in developing proposed regulations for towing vessel inspection, published as a notice of proposed rulemaking in August 2011.

Lessons for the Future

The experience of the Coast Guard and the tugboat, towboat, and barge industry for nearly two decades of collaborative effort to improve safety, security, and environmental stewardship demonstrates clearly the importance of data in targeting safety problems for collective action and developing effective and durable safety solutions. As we continue our joint efforts to make our industry safer for our crewmembers, the environment, and the public, we need:

- A continuing commitment on the part of the Coast Guard and industry to learn from casualty data and use it to drive our work. This means being willing to put aside our own ideas about "the way things should be" and letting the data tell us what the situation truly is. It means being willing to subject our proposed solutions to the acid test of data-driven analysis.
- High-quality data with which to work. The Coast Guard has made significant efforts to improve the utility and accuracy of its databases for years. These efforts must continue, since Coast Guard data will always provide a more comprehensive data set than voluntary industry data collection efforts, as important as the latter can be.
- A collaborative approach to data analysis. Our experience with the Coast Guard-AWO safety partnership and Towing Safety Advisory Committee has shown repeatedly that Coast Guard and industry experts bring distinct and essential perspectives to the analysis of casualty data. The Coast Guard has unique insight to the thought processes and the working procedures that guide its investigators; industry members often have experience with the situations discussed in casualty reports. The most accurate and comprehensive analysis results when these two bodies of expertise are joined together.
- A willingness to think beyond casualty data and explore the next frontier—sharing information about near misses and lessons learned. While this can be a daunting task, we would be well served to consider this challenge on three levels: intra-company, intra-industry (or intra-association), and industry-wide. At the company level, we need to help companies develop their own processes for reporting near misses and sharing lessons learned internally, creating cultures in which learning from such experiences is encouraged, not feared. At the industry or association level, we need to explore user-friendly mechanisms to share lessons learned among companies—even competitors. And, across the entire maritime industry, we need to work collaboratively with the Coast Guard to consider what would be involved in establishing a maritime industry equivalent of the near-miss reporting systems that exist or are being developed in other transportation modes. These are undoubtedly challenging tasks, but the potential for safety benefit is unparalleled.

About the author:
Mr. Thomas A. Allegretti is president and CEO of the American Waterways Operators, the national trade association for the tugboat and barge industry. He serves as co-chair of the National Quality Steering Committee of the Coast Guard-AWO safety partnership, and, together with VADM James C. Card (USCG, ret.), signed the 1995 memorandum of agreement that established the safety partnership.

Endnote:

1. The Towing Safety Advisory Committee is a congressionally authorized federal advisory committee that provides advice to the Secretary of Homeland Security on issues related to barge and towing industry safety.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Lessons Learned

from USCG Casualty Investigations

Alaska Ranger

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 taken from the report.

Lessons Learned *from* USCG Casualty Investigations

Catcher-Processor Vessel Sinks at Sea

by Ms. Sarah K. Webster
Managing Editor
USCG Proceedings

On Easter Sunday, March 23, 2008, The F/V *Alaska Ranger* was en route to Petrel Bank on a fishing trip, when the high-water bilge alarm sounded in the rudder room. Hours later, the vessel foundered in the swells then sank at sea: forty-two people aboard survived, four died, and one remains missing and presumed dead.

Prelude

12:10 p.m. On March 22, 2008, the 190-foot-long catcher-processor vessel was underway by noon, heading approximately 500 miles due west of Dutch Harbor located on Unalaska Island, Alaska, to fish for Atka mackerel. The captain and the day engineer were on watch. Forty-seven individuals were aboard the vessel including two deck officers, three engineers, five Japanese nationals (serving as foreign fisheries specialists), two National Marine Fisheries Service (NMFS) observers, and 35 deckhands.

F/V *Alaska Ranger.* All photos U.S. Coast Guard.

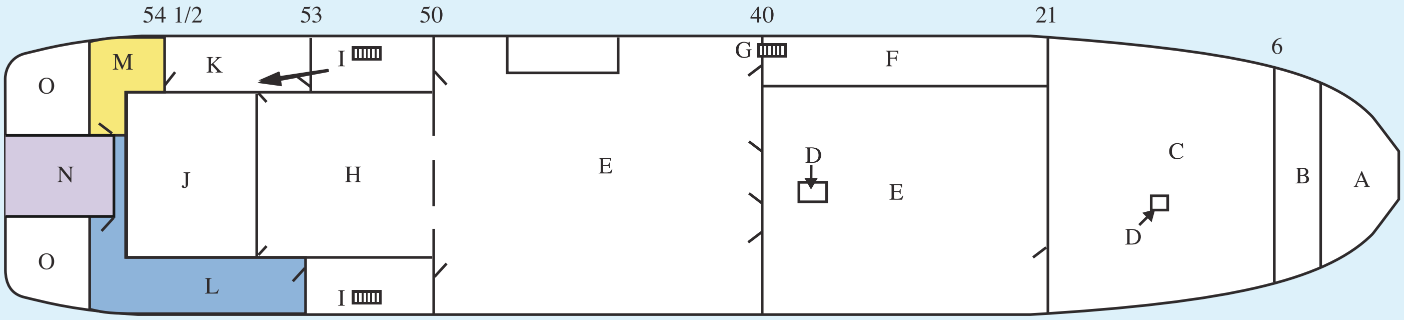
The processor crew busied themselves preparing for the catch by rigging nets, stowing stores, and setting up the factory space for operations. After finishing all preparations, the crew was free to relax for the rest of the transit—to be ready to work when fishing resumed. Some crewmembers watched movies, while others slept. At 7 p.m., the mate and the night engineer relieved the captain and day engineer.

The Incident

2:01 a.m. The following morning, the mate on the processor vessel called the mate on the F/V *Alaska Spirit* via the marine satellite telephone system. (The F/V *Alaska Spirit* is one of the seven vessels owned by the same company out of Seattle, Wash.) The conversation between the two men lasted for approximately 20 minutes; at this time, there were no reported difficulties.

2:26 a.m. Approximately 130 miles west of Dutch Harbor, the night engineer was in the

The main deck (factory deck) was above the hold deck. Entrances to the factory included two watertight doors in the aft bulkhead as well as a ladder, port side forward, leading up to the interior of the shelter deck. The ramp room (N) had port and starboard watertight doors that opened to harbor generator room (M) and starboard work shop (L), respectively. Between the ramp room and the number four freezer hold (J) was a small, narrow space open on the starboard side and enclosed on the port side with a bulkhead.



A – Forepeak Tank
B – Chain Locker
C – #3 Freezer Hold
D – Watertight Hatches
E – Factory Space
F – Forward Machinery Alley
G – Ladder to Shelter Deck
H – Fish Bin
I – Ladder Wells
J – #4 Freezer Hold
K – Aft Machinery Alley
L – Work Shop
M – Harbor Generator Room
N – Ramp Room
O – Storeroom

Note: Figure is not to scale.

engine room making a logbook entry when he heard the rudder room's high-water bilge alarm sound. The engineer proceeded aft to investigate the cause of the alarm. Upon arrival, he found the rudder room taking on water. He closed and dogged the watertight door and started the bilge pumps, in an attempt to control the flooding by taking suction from the rudder, hydraulics, and engine rooms. Minutes later, the engineer alerted the mate on watch about the flooding, and asked him to sound the general alarm. The engineer then called the chief engineer to inform him of the situation.

2:36 a.m. The mate on the fishing vessel called the F/V *Alaska Spirit* again by satellite telephone, and reported they were taking on water. The night engineer returned to the engine room with the Japanese chief engineer and they found water leaking around the edges of the rudder room door. Together, they hammered the dogs on the rudder room door to seal the door more tightly. Their efforts stopped most of the leaking around the watertight door, but not all of it. The bulkhead penetration above the door continued to leak.

Flooding in the Rudder Room

The mate told the bosun and the factory manager about the flooding and instructed them to head aft to assist. The bosun and the manager, both members of the vessel's emergency squad, went aft to the starboard side workshop to retrieve a portable dewatering pump. The men testified that they did not see water in the factory space, but did observe water in the harbor generator room, ramp room, and workshop. The men located the portable pump then went forward to search for a dry location to set it up.

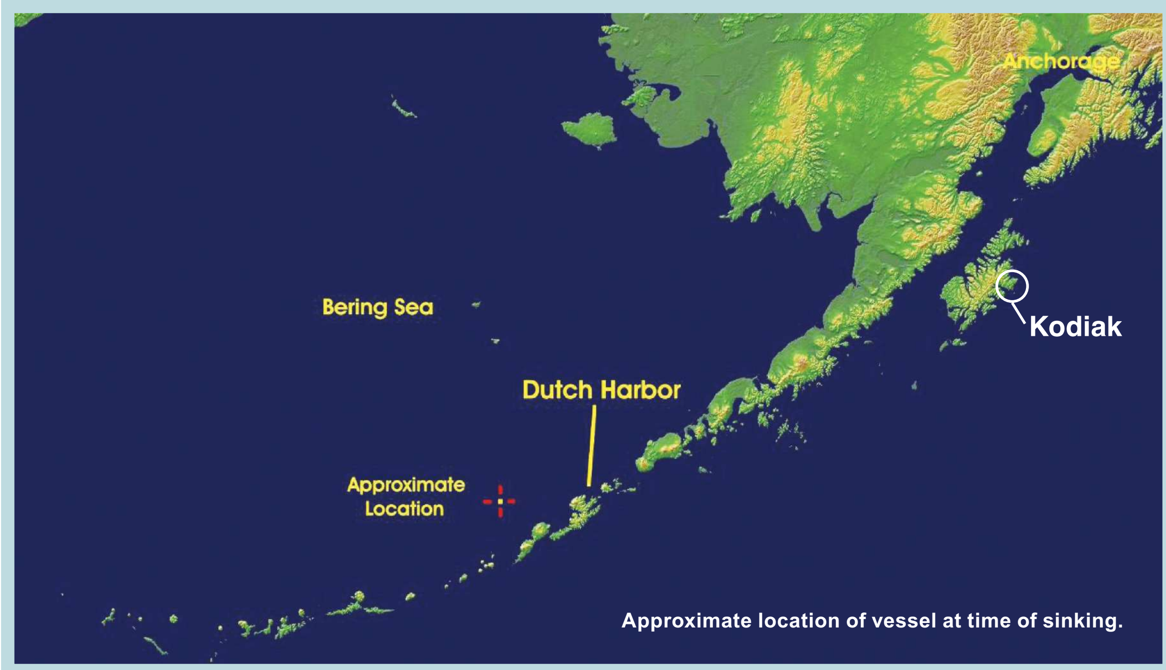
The factory leader, another member of the emergency squad, heard the mate report the flooding to the bosun and the factory manager, so he retrieved his boots and went aft to the vessel's workshop, in the ramp room, to grab a suction hose for the pump. He testified that he observed water striking against the port bulkhead in the harbor generator room.

Five members of the vessel's emergency squad attempted to set up the portable dewatering pump in the ladder well, forward of the starboard side workshop, approximately 10 minutes after the rudder room's alarm sounded.

The chief engineer, night engineer, and Japanese chief engineer all came out from the engine room a few minutes later. They directed the emergency squad to head to their muster stations to prepare to abandon ship. The crew abandoned the portable dewatering pump and no one attempted to start it to dewater any of the spaces.

Securing the Watertight Doors

The emergency squad and chief engineer went to the pilothouse, while the night engineer and Japanese



Approximate location of vessel at time of sinking.

chief engineer went to investigate the situation in the ramp room. When they reached the ramp room the engineers discovered it was filling up with the water that was flowing over the workshop's watertight door. The engineers testified that they could not locate the cause of the flooding. Nevertheless, the engineers closed the port-side ramp room watertight door, but they did not close the watertight door on the starboard side.[1] Soon after, they heard a "popping" sound and believed the noise was a result of electrical transformers becoming submerged in water. If that happened, there was a significant risk of electrocution.

The engineers proceeded forward on the starboard side to close and hammer tight the dogs on the watertight door that separated the workshop from the ladder well. On the way back to the pilothouse, the two engineers checked the factory overboard discharge chutes and ensured they were tight. By this time, the crew closed most of the watertight doors on the hold and main decks.

Crew and Observer Muster

A majority of the crewmembers and the fish observers were in their rooms, or in the galley, when the mate activated the general alarm. Several of the crew went room-to-room to wake up their shipmates to alert them of the emergency. The crewmembers not in the emergency squad proceeded as directed to the pilothouse for muster.

The survival suits on the vessel were stored together in individual bags, in deck boxes, outside the pilothouse with their sizes indicated by the color of the bag. The two National Marine Fisheries Service (NMFS) observers aboard the vessel did not don survival suits belonging to the vessel, since they had brought their own immersion suits. The crewmembers aboard the vessel did not have assigned immersion suits to match their size and build; sadly, this played a significant part in the death of the captain and some of the crew.

The chief cook and the factory leader attempted to account for the crew by retrieving the muster sheets stored in the pilothouse. However, they were unable to remove the sheets from their storage holders because the gloves on the cold-water suits limited their dexterity. Nevertheless, the chief cook used a pen to tear down the holders to obtain the sheets, while the factory leader attempted to use the muster sheets to account for the crew. However, the muster sheets were not accurate and did not reflect the current crew. Fortunately, the factory leader was familiar with the crew aboard and was able to account for all personnel.

Increased Flooding

In the pilothouse, the fish master sent the Japanese chief engineer, along with one of the Japanese technicians, back to the engine room several times to check on the extent of the flooding. The men went back to the engine room several times and observed an increase in flooding. On his last trip to the engine room, the chief engineer saw the water level in the bilges, located between the main engines, was around seven feet. At this time, the vessel had not assumed a noticeable list.

2:53 a.m. The crew reported to the U.S. Coast Guard that the vessel had lost its steering.

3:32 a.m. The crew reported to the U.S. Coast Guard that they were now operating on emergency lighting. (The Marine Board of Investigation later concluded the loss of lights and steering may have been the result of shorting of the vessel's electrical systems due to the rising water.)

The captain and the night engineer grabbed flashlights and went below deck to check the engine room to confirm the closure of the starboard watertight door on the shelter deck. They proceeded aft through the factory space, which had no water inside, and entered the starboard ladder well. The night engineer went up the ladder to the shelter deck, while the captain went down to the engine room. The engineer found the starboard watertight door at frame 52 open, and the trawl deck aft of the door at frame 52 largely submerged. He closed the door, and then proceeded down the ladder to meet with the captain, who had emerged from the engine room. Together, they headed back to the pilothouse, and as they reached the top of the ladder, the vessel suddenly rolled and assumed a substantial starboard list.

Problems Abandoning Ship

Those aboard watched the freeboard at the stern steadily decrease. Eventually, the stern was awash and waves swept fishing nets and gear off the trawl deck.

At this point, the battery-powered emergency lights had remained lit, and the main engines were still running. Nevertheless, the crew encountered an unforeseen situation just before the life rafts were launched; the controllable pitch propellers had gone to an astern pitch and the vessel began going in reverse.

The vessel's crew reported to USCG Communication Station Kodiak that they were in survival suits, attempting to abandon ship. They deployed the life rafts, but could not position them at the designated embarkation stations, since the vessel was moving backwards. On the port side, the crew launched life raft No. 2 over the side of the vessel, but it did not initially reach the water. The raft's canister was hanging over the port side, suspended by the sea painter. The sea painter parted when the crewmembers pulled on it, in an attempt to inflate the raft.

The crew on the starboard side had also faced a number of problems, while preparing to launch life rafts No. 1 and No. 3. Life raft No. 1 had inflated and shot past the bow, and the sea painter attached to the raft parted due to the strain caused by the vessel backing down. Life raft No. 3 also inflated and traveled past the bow, but this time the sea painter remained intact. The chief cook ripped the palms of the gloves on his survival suit, while unsuccessfully attempting to pull the life raft alongside, so those aboard could embark.

Several of the crew reported going aft to the intended embarkation area located near the gantry. However, the starboard life rafts were not alongside the vessel at their designated spots, so the embarkation areas were useless. Fortunately, the main engines had shut down and the ship was no longer going astern. As a result of the shutdown, the life rafts began drifting back toward the vessel.

4:24 a.m. The Coast Guard received a report that two people had fallen overboard and the vessel was listing 45 degrees to starboard. The upper decks were also near the water's edge.

Heroic Efforts

Most of the crew abandoned ship by climbing down the embarkation ladder or by jumping directly into the 32-degree Fahrenheit water. One crewmember managed to jump directly into a life raft, and others grabbed a hold of a sea painter that was attached to a life raft. Those who managed to board life rafts quickly shouted out over the water to alert others of their locations. In one instance, three people worked together to drag a nearly unconscious shipmate into a life raft.

The chief engineer had entered the water with the day engineer, but they quickly drifted away from each other. No one reported seeing the captain or the mate abandon ship. All together, 22 individuals managed to board two life rafts and 25 individuals went into the sea. Some of the crewmembers who did not manage to board life rafts joined together, while others floated alone.

Nevertheless, some crewmembers became unintentionally separated, as the seas and winds affected the water and the life rafts differently.

A survivor of the F/V *Alaska Ranger* is taken aboard the CGC *Munro.* The *Alaska Ranger* began taking on water 120 miles west of Dutch Harbor, on March 23, 2008.

4:30 a.m. The entire trawl deck was submerged in water when the crew abandoned ship. The crew watched as the vessel stood upright on its stern—with its bow sticking out of the water, it finally sank.

Search and Rescue

2:42 a.m. The F/V *Alaska Spirit* phoned the F/V *Alaska Warrior* (another sister vessel en route to Petrel Bank at the time of the emergency) to inform their crew of the emergency. The F/V *Alaska Warrior's* captain set his vessel at best possible speed to lend assistance.

2:48 a.m. Kodiak received a mayday report from the distressed vessel over the 2182 kHz distress frequency then passed the information to District 17 Command Center, the North Pacific Search and Rescue Coordinator and Search and Rescue Mission Coordinator for the Bering Sea.

Command Center D17 directed USCG Air Station Kodiak to launch its HC-130 Hercules fixed wing aircraft, currently repositioned at Elmendorf Air Force Base in Anchorage due to the anticipation of inclement weather. The HC-130 was approximately 779 nautical miles (nm) from the scene. In addition, D17 also directed preparations to launch a HH-60 Jayhawk helicopter.

Soon after, D17 issued an Urgent Marine Information Broadcast to alert all mariners of the distressed vessel to request Good Samaritan assistance.

The Response

5:05 a.m. to **10:10 a.m.** The CGC *Munro,* two USCG helicopters, one HC-130 aircraft, and the F/V *Alaska Warrior* all arrived on scene to render assistance.

The HH-60 Jayhawk helicopter was the first to arrive and had to travel approximately 197 nm to reach the distressed vessel. The Jayhawk's crew of four, stationed at St. Paul Island for the busy crab season, was en route to the vessel by 3:50 a.m. Ten minutes later, the Hercules left Elmendorf Air Force Base.

Meanwhile, the CGC *Munro* was patrolling in the Bering Sea steaming at a slow bell, south of the Pribilof Islands, northwest of an approaching storm, and to the north of most fishing vessel activity. (The cutter's position allows it to transit south quickly if a fishing vessel needs emergency assistance.)

2:52 a.m. The *Munro* heard the mayday call from the distressed vessel over the same distress frequency as Kodiak. The *Munro* was running on diesel engines at the time, with gas turbines on five-minute standby. The crew immediately shifted to the gas turbines and began transiting at best speed to intercept the distressed vessel, located 127 nm to the south.

The First Sign of Help

5:05 a.m. While the Jayhawk was the first to arrive on scene, the helicopter's flight crew did not see any signs of the vessel; however, they did spot some strobe lights bouncing around in the water. As they neared the lights, they observed at least 20 strobe lights were attached to both individuals and life rafts.[2]

The Jayhawk crew communicated with the survivors in one of the life rafts via a handheld VHF radio. The helicopter crew deployed its rescue swimmer to aid in hoisting the survivors from the water. The aircraft crew rescued two individuals floating together followed by a group of six, another pair, and then a group of three. Upon completion of these hoists, the HH-60 recovered its rescue swimmer.

Loaded up, the HH-60 flew to the F/V *Alaska Warrior,* approximately five nautical miles away, in an attempt to offload the survivors. However, the crew of the Jayhawk determined the F/V *Alaska Warrior* did not have adequate open deck space to safely lower the survivors, so the helicopter departed the scene en route to the CGC *Munro* by 6:12 a.m.

Aboard the *Munro*

Meanwhile, back at the CGC *Munro,* crewmembers assigned to an onboard HH-65 Dolphin were planning their participation in the rescue mission. The aircraft commander knew the distressed vessel was taking on water; however, he initially determined launching the Dolphin when the CGC *Munro* was approximately 60 miles from the vessel would optimally balance the transit time to deliver a dewatering pump. Nevertheless, circumstances dictated an earlier launch once the crewmembers aboard the distressed vessel reported they were experiencing uncontrollable flooding.

Soon after, the commander received another report that more than 20 people were in the water. He decided the best course of action would be to leave the USCG rescue swimmer on the scene with a life raft—to create additional room in the aircraft cabin for an extra survivor. The rescue swimmer agreed to the plan and donned an additional layer of clothing beneath his survival suit to stay warm.

5:55 a.m. The HH-65 Dolphin launched when the *Munro* was almost 80 miles from the scene.

Back at the Scene

6:20 a.m. The Hercules arrived on scene. The crew on the HC-130 also reported seeing multiple strobe lights in the water. The Hercules served as the on-scene commander for the two helicopters. The Hercules crew also provided direction to the F/V *Alaska Warrior,* which helped locate and retrieve survivors.

6:33 a.m. The Dolphin arrived on scene and deployed its rescue swimmer. The helicopter hoisted a group of three survivors, recovered the swimmer, and then headed toward another group of four survivors floating in the sea. However, the crewmembers made a quick decision to avert and assist the day engineer and another crewmember, who were seen entangled in a fishing net and debris.

The HH-65 deployed its rescue swimmer and basket again to recover more survivors. The rescue swimmer started with an unresponsive deckhand, but encountered multiple problems trying to position him in the rescue basket. Although the helicopter crew attempted to rescue the man, all attempts failed. The *Alaska Warrior* later recovered his body.

Seaman Gregory Crane and Seaman Nathan Cramer assist a survivor from the *Alaska Ranger.*

The Dolphin managed to recover the day engineer and its rescue swimmer before the cabin was completely full. As the HH-65 returned to the group of four survivors they had spotted earlier, the rescue swimmer deployed and remained behind as the helicopter crew hoisted one of these survivors to safety.

7:33 a.m. The Dolphin crew dropped a life raft for the rescue swimmer, and then departed for the *Munro* with five survivors. The rescue swimmer helped the remaining three survivors into the life raft and stayed with them until the Jayhawk recovered them all approximately one hour later. The HH-60 arrived at the *Munro* and began lowering survivors by rescue basket (the helicopter was too large to safely land on deck). The crew of the CGC *Munro* hurried the survivors to the mess deck for medical triage and treatment.

7:16 a.m. The *Alaska Warrior* recovered a life raft with 10 people aboard, using a harness and the vessel's crane.

Low on Fuel

7:10 a.m. The CGC *Munro* and the Jayhawk began preparations for helicopter in-flight refueling. The HH-60 was approximately half way through its refueling process when the HH-65 Dolphin reported being critically low. The Coast Guard suspended the HIFR for the Jayhawk, and the CGC *Munro* shifted to gas turbines to make best possible speed to intercept the Dolphin to minimize the helicopter's transit distance.

Now refueled, the Jayhawk departed the *Munro* and arrived back to the rescue scene by 8 a.m. Meanwhile, the Dolphin landed on the *Munro* with three aircrew and five survivors.

8:00 a.m. The F/V *Alaska Warrior* recovered 12 additional survivors from a second raft. One survivor was recovered unconscious, but the crew aboard the fishing vessel revived him. He soon warmed up and was able to walk again. By 8:38 a.m., the Jayhawk had recovered three more survivors along with the Dolphin's rescue swimmer. The HH-60 Jayhawk also recovered the non-responsive mate, and then continued to search for other survivors. The Jayhawk's crew spotted three more life rafts and confirmed no one was in them. Next, they dropped a datum marker buoy to determine the set and drift of objects in the water—then departed for the CGC *Munro.*

9:07 a.m. The HH-65 Dolphin lifted off from the *Munro* to allow the Jayhawk enough room to transfer more of the survivors. The HH-60 lowered the non-responsive mate, along with three survivors, and the two helicopter rescue swimmers to the *Munro.* The cutter's crew attempted to revive the mate but without success.

9:55 a.m. The Dolphin returned to the cutter, picked up the Jayhawk's rescue swimmer, and then departed.

10:00 a.m. The *Alaska Warrior* reported it had successfully recovered the captain, chief engineer, and another crewmember from the water—all found floating within 100 yards of each other. The three men were non-responsive, and their shipmates' efforts to revive them were unsuccessful. The crew of the *Alaska Warrior* reported having difficulty recovering the captain since his survival suit contained a significant amount of water.

One Remains Missing

10:10 a.m. (approximately) District 17 believed they had recovered all aboard the downed vessel, so they suspended all search efforts.

12:15 p.m. However, District 17 determined that the Japanese fish master still remained missing. He was last seen aboard the vessel, in the pilothouse, with his survival suit halfway up. Upon this discovery, search efforts immediately resumed using the *Munro,* another HC-130, and the Jayhawk. Nevertheless, the Coast Guard was unable to locate the fish master's body. Investigators believe the fish master may have not successfully abandoned ship.

Rescuers were able to recover all but the fish master within five-and-a-half hours of the vessel's foundering. The HH-60 Jayhawk and HH-65 Dolphin helicopters had successfully rescued 20 survivors, and pulled one deceased crewmember from the water. The *Alaska Warrior* had retrieved 22 survivors from two life rafts and three deceased crewmembers from the water. The four deceased crewmembers were the vessel's captain, mate, chief engineer, and a factory worker. The deceased captain was one of the last to abandon ship.

USCG Investigation

The Coast Guard's investigation revealed the vessel sank due to progressive flooding in the engine room and at the stern of the vessel. The flooding most likely commenced in the rudder room then spread to adjacent spaces—due to a lack of watertight integrity in the internal bulkheads and decks. Water filling the engine room produced a significant free-surface effect, which further degraded the vessel's ability to remain upright.

The exact initiating event that created the source of flooding is unknown; however, investigators believe the poor material condition of the vessel and the Kort nozzle struts may have contributed to the flooding. The Kort nozzle struts were improperly attached to the hull and could have experienced excessive stresses.

The investigation also revealed various discrepancies that challenged the integrity of the fishing vessel:

- doors and bulkheads were not watertight,
- dogs on some of the doors could not be secured properly,
- internal steel structure and hull plating of the vessel was significantly corroded in the vicinity of the port Kort nozzle struts,
- fractures in the Kort nozzle struts were regularly discovered and repaired.

If a fracture in one of the Kort nozzle struts propagated through the hull plating, it would have caused flooding in the rudder room.

Immersion suits used by the vessel's crew, undergoing inspection during the investigation process.

Lessons Learned

Coast Guard regulation 46 CFR 28.270(a) requires the master of each fishing vessel to conduct drills and provide instructions to each individual crewmember on a monthly basis.

Ten elements must be addressed in the monthly drills and instructions:

- abandoning the vessel,
- fighting a fire,
- recovering an individual from the water,
- minimizing the effects of unintentional flooding,
- launching survival craft,
- donning immersion suits,
- donning a fireman's outfit and a self-contained breathing apparatus,
- making a voice radio distress call and using visual distress signals,
- activating the general alarm,
- reporting inoperative alarm systems and fire detection systems.

Monthly training on the vessel was focused heavily on mustering and donning survival suits. Not all elements of the required instructions (seen above) were provided monthly; and, when provided, they were only offered to members of the emergency squad. The Marine Board of Investigation had identified at least one crewmember who had never donned an immersion suit, and did not know or understand the alarms used onboard the vessel. On March 23, when the general alarm sounded, the deckhand interpreted it as time to report to work in the factory, rather than go to his muster station. Another crewmember testified that he did not receive training on cold-water survival.

Coast Guard regulation 46 CFR 28.110 requires each wearable personal flotation device be stowed so that it is readily accessible to the individual for whom it is intended, and be properly sized for each individual aboard.

Not all of the crewmembers aboard the vessel had received survival suits that were the correct size. In fact, several of the smaller crewmembers received suits that were too large, allowing excessive water to enter the suit. Two crewmembers testified that their suits contained water or damage before they donned them. In addition, the captain had donned a "jumbo" immersion suit even though he was relatively small. There was water found in his suit when the USCG helicopter crew picked him up. The survival suits of the mate, along with three unconscious hypothermic survivors, also had water in their suits and were likely too large.

The U.S. Coast Guard Commercial Fishing Vessel Safety Examiner, who conducted the vessel's last exam, testified that all the survival suits onboard the vessel were in satisfactory condition, with the exception of several that were more than 10 years old. He required the vessel's owners to replace the older suits in January 2008. Regulations require the master in charge of a vessel to ensure all lifesaving equipment is in good working order, ready for immediate use, and readily accessible before the vessel leaves port and at all times when the vessel is operated. The Marine Board of Investigation inspected all of the suits after the casualty and found them in acceptable condition.

The vessel was equipped with three Viking 20-person inflatable life rafts manufactured in April 2007. The life rafts were new and in good condition, but they were not readily available; regulation 46 CFR 28.125 requires all inflatable life rafts, inflatable buoyant apparatus, and any auxiliary crafts be kept readily accessible for launching, or be stowed so as to float free in the event the vessel sinks. The rafts were mounted outside the pilothouse with two on the starboard side and one on the port side. It may have made more sense for the life rafts to be positioned under the embarkation station; however, this is not a mandatory requirement.

ADM Thad Allen, then Commandant, United States Coast Guard, presents the Award for Heroism to LT James Terrell, PO2 Barry Lawson, PO2 Robert DeBolt, PO2 Class O'Brien Hollow, PO2 Alfred Musgrave and PO3 Abram Heller, for saving 42 people aboard the F/V *Alaska Ranger.* USCG photo by Petty Officer Seth Johnson.

It is important to remember the handling and operating of vessels can change in emergencies. For example, it is unknown whether the captain or the mate was aware of the remote main-engine emergency shutdowns located in the pilothouse. It is also unknown if the captain or the mate knew the vessel could begin going astern (reverse) if the controllable pitch-propeller system lost its hydraulic pressure.

In addition, the crew continued to rely on electrical power provided by the shaft generators located in the flooded engine room. They did not use the two independent diesel generators in the engine room, or the harbor generator in the harbor generator room as alternate sources of power. All efforts to control the flooding and dewater the vessel were aborted, and the portable dewatering pump was never used. The chief engineer may have ordered the engine room abandoned because he believed the amount or rate of flooding far exceeded the capacity of the pump, but we will never know.

Commandant Action

The following is a list of some of the recommendations proposed to the U.S. Coast Guard, concerning this incident, followed by the commandant actions. Further information is available at https://homeport.uscg.mil/. Click on Investigations to get to Marine Casualty Reports.

Recommendation: The U.S. Coast Guard should broadly interpret and thoroughly apply all existing commercial fishing vessel regulations to best accomplish their purpose: safety. Waivers and exemptions should be minimized.

The Commandant concurs with this recommendation. The Coast Guard agrees to broadly interpret the existing regulations under 46 CFR Part 28 to ensure the safety of crew and observers on board commercial fishing vessels, until the government agency is granted the authority to mandate inspection and certification of the commercial fishing vessel fleet. Exemptions will be considered only on a case-by-case basis for issues that will not directly impact safety.

Recommendation: The Commandant should review and revise the comprehensive commercial fishing vessel inspection plan proposed in 1992, and, again, request the additional legislative authority and resources necessary to implement an inspection program. This inspection program should include mandatory, regular inspections.

The Commandant concurs with this recommendation and agrees to review the subject plan, as well as request a review be conducted by the Commercial Fishing Industry Vessel Safety Advisory Committee. Upon the completion of these reviews, the Coast Guard will make any necessary revisions to the plan with the intent of using it as a basis for a legislative change proposal seeking the authority to require mandatory, periodic safety inspections of commercial fishing vessels.

Recommendation: The Commandant should ensure the regulatory definition for "fish processing vessel" is revised to remove existing ambiguity and facilitate enforcement.

The Commandant concurs with the intent of this recommendation and believes the definition of "fish processing vessel" in 46 U.S.C. 2101(11b) needs to be amended. The Coast Guard agrees that clarification and improvement is needed in identifying the actions taken by individual fishing vessels to commercially prepare fish or fish products, in order to determine whether they meet the definition of a fish-processing vessel. This can be done without amending the statutory definition. The Coast Guard is also using information from commercial fishing vessels, as reported in the National Marine Fisheries Service (NMFS) Product and Delivery Codes published in Table 1 to 50 CFR 679, to determine the types of preparation activities being conducted on vessels and assess whether or not they meet the definition of a fish processing vessel.

Recommendation: USCG CFVS Examiners should educate the masters, officers and crew on the importance of correctly fitting survival suits and emphasize that individuals have ready access to a survival suit that fits reasonably.

The Commandant concurs with this recommendation. USCG commercial fishing vessel safety examiners, while conducting dockside safety examinations, which include checks of survival suits, will ensure that masters, officers, and crew members of fishing vessels are aware of the importance of correctly fitting survival suits and the need for individuals to have ready access to those suits. In addition, a lessons learned will be published highlighting this issue for those who have not submitted to a dockside safety examination.

Recommendation: Owners and operators of vessels with controllable pitch propellers should understand how their installed system will respond to a loss of power and other likely modes of failure, develop and implement sufficient emergency procedures, and ensure officers and crews are trained to take appropriate measures.

The Commandant concurs with this recommendation. A lessons learned on this issue will be published to raise awareness of fishing vessel owners and operators so they can address this issue.

Recommendation: The Commandant should develop and publish standards for the proper placement of bilge high-level alarm actuators to provide the earliest warnings of abnormal bilge accumulation for all vessels, and establish inspection and verification procedures for inspected vessels to ensure they are properly installed. Current inspection procedures ensure bilge high-level alarms are operable, but, without a standard for placement of the actuator, there is no inspection requirement or practice to verify the height of the alarm actuator above the bilge.

The Commandant partially concurs with this recommendation. The placement of bilge high level alarm actuators should be such that they provide adequately early warning of abnormal bilge accumulation, and will provide guidance to our examiners to check that the installations are such that they meet that requirement. However, it is not believed the development of prescriptive standards for the placement of bilge high level alarm actuators is feasible given the wide variance of vessel bilge arrangements. Instead, the Commandant will advise their examiners to refer to existing performance based rules on bilge alarm placement, such as classification society rules, for those instances where the appropriateness of the installation is in question.

Recommendation: FCA (FCA Holdings Inc.) should consult with a competent naval architect or structural engineer and ensure existing Kort nozzles on other FCA vessels are properly installed and maintained.

The Commandant concurs with this recommendation and will provide FCA with a copy of this report and this recommendation for their consideration and action.

Bibliography:

Investigation into the Circumstances Surrounding the Sinking of the Uninspected Fish Processing Vessel. United States Coast Guard, Official Number 550138, March 23, 2008.

The Alternate Compliance and Safety Agreement. Available at www.uscg.mil/d13/cfvs/acsa.asp.

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About the author:

Ms. Sarah K. Webster is the managing editor of U.S. Coast Guard Proceedings of the Marine Safety & Security Council *magazine. She was previously a news reporter and feature writer for Gannett Inc., and a beat reporter for Micromedia Publications, in New Jersey. She has a B.A. in communication from Monmouth University, and an A.S. in humanities of art from Ocean County College.*

Endnotes:

1. The Alternate Compliance and Safety Agreement (ACSA) program requires doors in watertight bulkheads to be kept closed at sea, except when crewmembers need to pass through the doors. This requirement was not implemented aboard the vessel. The operation manager for the Seattle-based company had stated to the Marine Board Investigators, "To me, telling a licensed deck officer that he needs to maintain his watertight doors in an operable condition is like reminding a child to eat. You shouldn't have to go there." Yet, many watertight doors on the FCA vessels were not maintained.

2. Strobe lights played an essential part in this rescue, since they were the only thing able to guide rescuers to the survivors. All immersion suits are required under the ACSA program to be fitted with a Coast Guard or SOLAS approved strobe light.

Chemical of the Quarter

Understanding Sodium Hydroxide

by ENS Rebecca Rebar
Watch Officer
USCGC Sequoia

What is it?

Sodium hydroxide (also known as lye) is a white, odorless compound, commonly manufactured in solution, or as pellets or beads. It is a strong base, so its uses include neutralizing acids produced during chemical production and natural gas refinement. Sodium hydroxide is present in some cleaning agents such as drain and oven cleaners, because of its ability to break down fats.

Shippers sometimes use it in ballast tanks to increase the pH level to kill any foreign species in the tanks, as the ships visit different ports. This decreases the chances of bringing invasive species to other areas of the world.

How is it shipped?

Sodium hydroxide is most often shipped in solution with water, and must be labeled as a Department of Transportation Hazard Class 8 corrosive material. The chemical should also be stored in sealed containers provided by the manufacturer.

Why should I care?

Shipping concerns

Sodium hydroxide is corrosive. Therefore, when stored for later use, one should not expose it to acids; flammable liquids; organic halogen compounds; nitro compounds; or metals such as aluminum, magnesium, and zinc, as these metals can act as either an acid or a base in solutions.

If sodium hydroxide releases from ballast tanks to an aquatic environment it can raise the pH level of the body of water. As a result, high levels of sodium hydroxide can cause severe damage to the established organisms in that environment. Therefore, sodium hydroxide levels must be monitored and analyzed in and around major ports and waterways.

Health concerns

Sodium hydroxide is an irritant that causes severe burns to the eyes and skin on contact. In highly concentrated solutions, sodium hydroxide can cause deep tissue burns and permanent scarring. If inhaled in the vapor form, which rarely occurs, sodium hydroxide becomes an irritant to the respiratory tract.

Onset of pain from exposure to sodium hydroxide may take anywhere from minutes to hours from the time of exposure. Repeated exposure may cause dermatitis and, in some cases renal cancer. Wearing safety equipment including rubber or vinyl gloves, aprons, boots, chemical goggles, or a face shield can help those working around it avoid any health issues. Personnel should wear a respirator if sodium hydroxide vapor is produced.

Fire or explosion concerns

Sodium hydroxide is not combustible, so there is little risk of fire or explosion. However, it should not be stored near combustible materials. Accidental interaction with water or other substances, such as the heat from a reaction of sodium hydroxide with water, acid, flammable liquids, or certain metals, can cause materials near the container to combust.

What is the Coast Guard doing about it?

The Coast Guard manages sodium hydroxide spills and the pH levels in coastal waterways to ensure that this use of the chemical does not disrupt the environment. The United States Environmental Protection Agency regulates hazardous waste through its Resource Conservation and Recovery Act. If the pH of waste is greater than 12.5, it must be classified and disposed of as an RCRA hazardous waste.

Sodium hydroxide, as a packaged hazardous material, must be transported in accordance with 49 CFR 173. Its identification number, UN1824, lists it as a Class 8 hazard during transport due to its corrosive nature. Sodium hydroxide is not a reportable quantity if shipped in bulk of 2,500 lbs. or less.

About the author:
ENS Rebecca Rebar recently graduated from the Coast Guard Academy with a B.S. in marine and environmental science, with an emphasis in the chemistry and biology fields. She is currently a deck watch officer on the USCGC Sequoia.

1. **In a refrigeration system, once the compound gauge manifold lines are attached to the service connections, you should ascertain that the valves on the gauge manifold are closed, and then ____________.**

   A. open the discharge service valve service port by closing the service valve
   B. continue to back-seat the discharge service valve by turning it clockwise
   C. open the discharge valve service port by closing the service valve approximately ¼ to ½ a turn
   D. open only the valve connected to the discharge service fitting on the outlet of the king valve

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2. **A degree of control over the speed of a slip ring induction motor can be obtained by what means?**

   A. adjusting governor linkage
   B. changing the number of phases to the motor
   C. inserting resistance into the stator circuit
   D. inserting resistance into the rotor circuit

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3. **Most practical diesel engines today operate on a cycle that is a combination of the Diesel and Otto cycles. In this process, compression ignition ____________.**

   A. begins on a constant volume basis
   B. begins on a constant pressure basis
   C. ends on a constant volume basis
   D. begins and ends on a constant volume basis

1. *Note: The purpose of attaching a gauge manifold set to a refrigeration unit is either to check the low- and high-side system pressures or to assist in performing a particular service procedure. If the purpose is to check the refrigeration unit's system pressure, the gauge manifold set valves are to be closed, and the refrigeration unit's low- and high-side service valves must be in the mid position. This is accomplished by cracking the service valves off their back-seats by turning in clockwise approximately ¼ to ½ a turn of the stem.*

A. open the discharge service valve service port by closing the service valve	Incorrect Answer. When the discharge service valve is back-seated, the service port is closed. While it is necessary to take the discharge service valve off its back-seat by turning the valve in the closed direction to the gauge-position, the unit would never be run with the discharge service valve completely closed.
B. continue to back-seat the discharge service valve by turning it clockwise	Incorrect Answer. In order to monitor the high side pressure, the discharge service valve cannot be left back-seated. Turning it clockwise would take the discharge service valve off the back-seat.
C. open the discharge valve service port by closing the service valve approximately ¼ to ½ a turn	Correct Answer. Closing the service valve ¼ to ½ a turn from the back-seated position, places the discharge service valve in the mid position, also called the gauge-position. This is the required position for checking or monitoring system pressure.
D. open only the valve connected to the discharge service fitting on the outlet of the king valve	Incorrect Answer. Since both gauge manifold valves are closed and it is desired to check or monitor both the low- and high-side system pressures, it will be necessary to ensure that the low side service valve is in the gauge position.

2. *Note: Another name for a slip ring induction motor is a wound rotor induction motor. Discrete multispeed operation of a wound rotor motor can hypothetically be achieved by changing the number of poles, which at constant frequency changes the speed of rotation of the rotating magnetic field associated with the stator. Discrete multispeed operation can also be achieved by inserting discrete amounts of resistance into the wound rotor circuit, which changes the torque-speed characteristics of the motor.*

A. adjusting governor linkage	Incorrect Answer. Governors, as used for speed control purposes, are used on prime movers (engines), not electric motors.
B. changing the number of phases to the motor	Incorrect Answer. Changing the number of phases is not used to change motor speed.
C. inserting resistance into the stator circuit	Incorrect Answer. Inserting resistance into the stator circuit is not a means of speed control for a wound rotor induction motor.
D. inserting resistance into the rotor circuit	Correct Answer. See explanation in Note above.

3. *Note: In the theoretical Diesel cycle, ignition is achieved by the heat of compression of air. The fuel used has relatively low volatility and burns very slowly. During the entire ignition/combustion event, the cylinder pressure is held essentially constant, as fuel continues to be injected and burned.*

In the theoretical Otto cycle, ignition is achieved by means of a spark. The fuel utilized has a relatively high volatility and burns instantly, resulting in a rapid build up in cylinder pressure. During the extremely brief ignition/combustion event, the cylinder volume is essentially constant.

In an actual diesel engine, the cycle behavior takes on characteristics of both the Diesel and Otto cycles. Since the diesel fuel has a moderately low volatility, a fair amount of diesel fuel accumulates in the cylinder before ignition actually begins. This results in a rapid pressure rise at constant volume. As the piston descends downward on the power stroke, fuel continues to be injected and continues to burn moderately slowly. This results in combustion ending on a constant pressure basis.

A. begins on a constant volume basis	Correct Answer. In the practical diesel engine, combustion begins on a constant volume basis as explained above.
B. begins on a constant pressure basis	Incorrect Answer. In the practical diesel engine, combustion begins on a constant volume basis, not on a constant pressure basis as explained above.
C. ends on a constant volume basis	Incorrect Answer. In the practical diesel engine, combustion ends on a constant pressure basis, not on a constant volume basis as explained above.
D. begins and ends on a constant volume basis	Incorrect Answer. In the practical diesel engine, combustion begins on a constant volume basis, but ends on a constant pressure basis as explained above.

1. **Both International and Inland: Which vessel may use the danger signal?**

   A. Either vessel in a meeting situation
   B. The give-way vessel in a crossing situation
   C. A vessel at anchor
   D. All of the above

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2. **The great circle distance from Lat 25° 50' N, Long 77° 00' W to Lat 35° 56' N Long 06° 15' W is 3616 miles, and the initial course is 061.7° T. Determine the latitude of the vertex.**

   A. 37° 32.2' N
   B. 37° 34.9' N
   C. 37° 41.6' N
   D. 37° 45.2' N

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3. **Which is an advantage of using watertight longitudinal divisions in double-bottom tanks?**

   A. Cuts down free surface effect
   B. Increases the rolling period
   C. Decreases weight because extra stiffeners are unneeded
   D. Lowers the center of buoyancy without decreasing GM

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4. **Your vessel's draft is 16'-00" fwd. and 18'-00" aft. The MTI is 500 ft-tons. How many tons of water must be shifted from the afterpeak to the forepeak, a distance of 250 feet, to bring the vessel to an even draft forward and aft?**

   A. 52 tons
   B. 50 tons
   C. 48 tons
   D. 24 tons

1. A. Either vessel in a meeting situation — Correct Answer
B. The give-way vessel in a crossing situation — Correct Answer
C. A vessel at anchor — Correct Answer
D. All of the above — Correct Answer

Reference: International and Inland Rule 34 (d) states: "When vessels in sight of one another are approaching each other and from any cause either vessel fails to understand the intentions or actions of the other, or is in doubt whether sufficient action is being taken by the other, to avoid collision, the vessel in doubt shall immediately indicate such doubt by giving at least five short and rapid blasts on the whistle."

The rule does not specify power-driven vessels, vessels underway, or the type of maneuvering situation, only that they are in sight of one another.

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2. A. 37° 32.2′ N — Incorrect Answer
B. 37° 34.9′ N — Correct Answer
Reference: *The American Practical Navigator*
The problem can be solved utilizing the following formula:
Cos L_V = (Cos Lat1) × (Sin Initial Course)
Cos L_V = (Cos 25.8333°) × (Sin 61.7°)
Cos L_V = (.792487211)
L_V = 37.5814°
L_V = 37° 34.9' N
C. 37° 41.6′ N — Incorrect Answer
D. 37° 45.2′ N — Incorrect Answer

---

3. A. Cuts down free surface effect — Correct Answer
B. Increases the rolling period — Incorrect Answer
C. Decreases weight because extra stiffeners are unneeded — Incorrect Answer
D. Lowers the center of buoyancy without decreasing GM — Incorrect Answer

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4. A. 52 tons — Incorrect Answer
B. 50 tons — Incorrect Answer
C. 48 tons — Correct Answer
Reference: *Merchant Marine Officers Handbook*
The problem can be solved utilizing the following formula:
Trimming Moments = (weight) × (distance)
Change in Trim = (Trimming Moments)/MTI
Change in Trim = ((weight) × (distance))/MTI
24" = ((weight) × (250'))/500 ft-tons
12000 = (weight) × (250') Weight = 48 tons
D. 24 tons — Incorrect Answer

SEEKING VOLUNTEERS

Exercise Black Swan

Exercise "Black Swan" is part of a series of mass rescue operations exercises designed to educate and prepare participants for a potential mass rescue operation at sea.

U.S. Coast Guard District 7 seeks volunteers and role players

- Active Duty, Reservist, CG Auxiliarist, Military Dependents, Military Retirees, Civilians
- Must be 21 or older
- No children allowed
- Valid U.S. passport
- In good health
- Transportation cost to and from departure port not covered

Disclaimer

This is a full-scale mass rescue exercise. Every volunteer will be required to actively participate in the exercise as an actor or victim.

For additional information or to volunteer, contact Joel Morgado, Passenger Vessel Safety Specialist at (787) 729-2376 or Joel.D.Morgado@uscg.mil or the CG District 7 Public Affairs Office by December 31, 2012.

Exercise Black Swan
CG District 7
Miami, Fla.

April 1–5, 2013

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