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Passenger Vessel Safety

Aiding cruise industry regulatory compliance

The Cruise Ship National Center of Expertise

PROCEEDINGS

Summer 2014 Vol. 71, Number 2

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Assistant Commandant's Perspective

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

For more than 100 years, the United States has demonstrated a proactive approach to international passenger ship safety. In May 2000, with Coast Guard leadership and international shipping community support, the International Maritime Organization (IMO) agreed to undertake a holistic examination of safety issues that pertain to passenger ships, with particular emphasis on large cruise ships. This significant effort identified a number of areas of concern related to cruise ships, and resulted in substantial amendments to the Safety of Life at Sea (SOLAS) Convention. The outcome of this initiative was an entirely new prevention and survivability-based regulatory philosophy for cruise ship design, construction, and operation.

Recognizing continuing growth in cruise ship size, capacity, and complexity, the Coast Guard created its Cruise Ship National Center of Expertise in 2008 to increase Coast Guard field personnel proficiency, capabilities, and consistency in the areas of cruise ship safety and environmental and security compliance. Despite international and industry efforts to ensure passenger safety, however, we've seen a number of high-profile cruise ship incidents—reminders to all of us that risks still exist. Fires aboard the *Carnival Splendor, Carnival Triumph,* and *Grandeur of the Seas* highlighted concerns about fire safety equipment design, maintenance, and operation. Similarly, the *Costa Concordia* grounding highlighted voyage planning, emergency power, and crew performance during an emergency.

Through initial lessons learned, we modified Coast Guard procedures to examine firefighting system installation and arrangement more closely, increased our expectations for fire drills, and now witness passenger musters before ships depart a U.S. port. So what else is being done and needs to be done?

In June 2013, the IMO Maritime Safety Committee adopted new rules governing cruise ship passenger safety briefings, which become mandatory in July 2015. These rules mandate that whenever passengers are on a SOLAS passenger ship for more than 24 hours, they will receive a detailed safety briefing, either prior to or immediately after the vessel sails. This change elevates the global standard for cruise passengers who don't embark ships in U.S. ports. Further, IMO has commenced reviewing design standards to make cruise ships safer and more damage-tolerant, through improved survivability standards. Industry has taken significant steps to identify and address system vulnerabilities, an initiative that it has embraced and that I applaud. Still, I believe more needs to be done to identify and address low-probability, high-consequence events on these large, complex, cities at sea. I look forward to working with industry to develop better leading indicators, stronger safety cultures, and greater data transparency.

The Coast Guard will continue to take a lead role in protecting the most precious cargo that ships carry: people. We will continue to place the highest priority on enforcing compliance with safety, security, and environmental regulations on vessels that embark passengers in the U.S. and embark U.S. passengers worldwide. We have a strong, effective port state control program, and we will continue to ensure that vessels are in substantial compliance with international and domestic standards. We hope that this edition of *Proceedings* will provide a better understanding of the many aspects involved with cruise ship regulation and oversight.

Champion's Point of View

by CDR Bradley W. Clare
Detachment Chief
U.S. Coast Guard
Cruise Ship National Center of Expertise

Every year, millions of people board cruise ships for exciting vacation experiences, and, during the past several decades, these vessels have grown to more than 220,000 gross tons and have installed complex machinery, systems, and novel passenger amenities. As the vessels and their onboard systems have grown more technically complex, cruise ship laws and regulations and those who enforce them must keep pace.

Recognizing this need, in 2007, the Coast Guard Commandant requested that retired U.S. Coast Guard Vice Admiral Card perform an independent analysis of the Coast Guard Marine Safety Program. Vice Admiral Card's report identified several areas for improvement. In response, Coast Guard leadership launched the Marine Safety Enhancement Plan, which focused on improving performance, optimizing service, and strengthening management. One part of this plan focused on creating "centers of expertise" to enhance Coast Guard personnel professional development and facilitate interaction with the marine industry.

In 2008, the Coast Guard established the Cruise Ship National Center of Expertise to focus on the cruise industry, support inspector competency, and promote port inspection consistency.

Unlike the marine inspectors in the field, my staff and I focus solely on foreign cruise ships and roll-on/roll-off passenger vessels, which allows us to develop a high degree of proficiency and to share best practices Coast Guard-wide. A number of articles in this edition focus on how the Coast Guard Foreign Passenger Vessel Program works, including training examiners, conducting examinations, and working with the industry to complete a large-scale mass rescue drill.

Numerous other agencies also play a role in enforcing cruise ship regulations, and we are fortunate to have articles from some of those agencies, including the U.S. Public Health Service and the Alaska State Department of Environmental Conservation, which explain their regulatory programs. Other articles highlight the contributions of the shore-side facility and classification societies.

It has been a real pleasure to champion this *Proceedings* edition, which highlights the regulatory environment in which cruise ships operate and the different entities and programs involved in that oversight. I would like to express my sincere thanks to Mr. Jason Yets and the *Proceedings* staff. Finally, I want to thank the authors who took the time to share their experiences in this edition. Without their efforts, this would not have been possible.

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One Stop Shop

The Cruise Ship National Center of Expertise.

by Mr. Jason Yets
Marine Inspector and Instructor
Cruise Ship National Center of Expertise

The Cruise Ship National Center of Expertise, or CSNCOE, is the nexus of the U.S. Coast Guard's Foreign Passenger Vessel Examination (FPVE) Program, which dates back to 1993 when Navigation and Vessel Inspection Circular 1-93 established examination procedures for cruise ships. By the late 1990s, Marine Safety Office (MSO) Miami staffers recognized the need for cruise ship-specific training and began administering the Passenger Vessel Control Verification (PVCV) Course.[1]

Inception

With the successful and popular PVCV course, MSO Miami became the "center of excellence" for the Coast Guard's cruise ship safety program, providing seasoned subject matter expertise to field units worldwide. As the cruise industry grew, so did the need to keep examiner proficiency on par with the pace of emerging technologies.

In 2008, the Coast Guard's Marine Safety Enhancement Plan memorialized the concept of "centers of expertise," to be focused on particular facets of the marine industry. The CSNCOE, first established in September 2008 as a sub-unit of Sector Miami, had a full complement of staff in place by summer 2009. In September 2009, it became a detached Coast Guard headquarters unit that reported to the Office of Traveling Inspectors.

Cruise Ship NCOE staff, from left: CDR Bradley Clare, detachment chief; LT Mike Metz, port state control officer; Mr. Scott Elphison, senior marine inspector; Mr. Brad Schoenwald, senior marine inspector; Mr. Jason Yets, marine inspector; and LCDR Eric Allen, national technical advisor. Not pictured: Mr. James Garzon.

Subject Matter Experts

The CSNCOE comprises seven staff members who have a collective total of more than 100 years of maritime experience. Cruise Ship National Center of Expertise personnel serve as subject matter experts at cruise line conferences and industry panels and have testified as expert witnesses for the Department of Justice.

The center's staff maintains expertise by attending conferences, expositions, and meetings; keeping in close contact with manufacturers, flag states, and class societies; and by attending training to enhance each respective member's areas of expertise. Information is brought back to the unit where it is relayed to all staff members, so they are able to stay abreast of industry technology and trends.

Continual Improvement

The CSNCOE has established three primary goals:

- increase examiner proficiency,
- improve consistency in foreign passenger vessel examinations,
- increase awareness of our services within the Coast Guard and cruise industry.

The field assessment program helps sustain continual improvement. Center personnel collaborate with units around the country, participate in examinations, and spend one-on-one time with leadership and those involved in the unit's Foreign Passenger Vessel Examination Program. This allows us to determine how each unit is conducting its examinations and verify examiner performance and proficiency.

Each examiner is also evaluated using the newly created inspector proficiency assessment tool, which ensures feedback is given in a consistent manner.

To achieve examination consistency, CSNCOE personnel developed a detailed work instruction that lays out all the necessary steps and associated actions necessary to conduct an examination. This work instruction has since been

modified into foreign passenger vessel examiner tactics, techniques, and procedures. This ensures everyone is on the same playing field and reading from the same playbook, so ship captains can expect the same examination experience in Alaska as in Miami.

What Can the CSNCOE Do For Me?

Each staff member is an assigned industry service manager for the various cruise lines and classification societies. In this role, the staffer serves as a "one-stop shop" for the latest relevant FPVE program information and policy. The regular communication allows the staffer to remain current with ongoing cruise industry trends and ensures the cruise industry has a resource to help with regulation and policy interpretation.

The Cruise Ship National Center of Expertise also boasts a unique ability to handle cruise ship-specific public affairs. The above-average number of media stories on cruise ship incidents recently has created a demand for this unique skill set. The news stations must gather their information from somewhere and, more importantly, verify its validity. The CSNCOE plays a large role in this fact-finding endeavor. The CSNCOE works with the media to handle any telephone, print, live, or recorded media inquiries.

During the unfortunate chain of events that occurred involving the *Costa Concordia*, the Cruise Ship National Center of Expertise was inundated with media inquiries. Every news station, reporter, producer, and camera operator who needed information regarding the Coast Guard FPVE program was directed to contact our office.

Moreover, Coast Guard captains of the port also contact our subject matter experts and instructors for examination and training assistance. Additionally, if you are a newly qualified marine inspector and are interested in obtaining your FPVE qualification, we offer basic foreign passenger vessel examiner training to ensure each unit's trainees are receiving consistent training nationwide. Additionally, the CSNCOE conducts the Advanced Passenger Vessel Examiner Course three times annually. We can tailor training and educational seminars for the seasoned marine inspector to maintain qualification and ensure the inspector remains proficient on the most up-to-date regulations, policies, and laws.

A cruise ship employee explains the procedure for deploying a life raft to Mr. Jason Yets (left), and LCDR Jason Boyer, the chief of prevention for Coast Guard Sector Juneau, during an inspection in Juneau, Alaska. U.S. Coast Guard photo by Petty Officers Grant DeVuyst.

National Centers of Expertise

- Cruise Ship NCOE, Ft. Lauderdale, Fla.
- Liquefied Gas Carrier NCOE, Port Arthur, Texas.
- Outer Continental Shelf NCOE, Houma, La.
- Towing Vessel NCOE, Paducah, Ky.
- Investigations NCOE, New Orleans, La.
- Suspension and Revocation NCOE, Martinsburg, W.Va.

Location, Location, Location

Selecting the Cruise Ship National Center of Expertise's location was a strategic decision. Originally in Miami, we have moved and are now conveniently located next to Port Everglades in Fort Lauderdale, just 26 miles north of the Port of Miami. This close proximity to Port Everglades and the Port of Miami allows us access to the majority of the cruise ships that sail under the FPVE Program, so we can get on ships at almost any time for training or to assist Sector Miami with examinations. It also allows us to maintain strong relationships with ship crews and keep informed about the cruise industry.

The Cruise Ship National Center of Expertise's mission is to provide the Coast Guard and the industry an exclusive global source of unsurpassed expertise and support. Our vision is to be recognized experts leading the Coast Guard Foreign Passenger Vessel Examination Program. These goals are not possible without the support and cooperation we receive daily from everyone with whom we correspond, and, from everyone at the CSNCOE: thank you.

About the author:
Mr. Jason M. Yets joined the Cruise Ship National Center of Expertise in February 2011, following his shipboard career as safety officer for a major cruise line. He serves as a subject matter expert in security, lifesaving, drills, mass rescue operations, and as the unit's public affairs officer.

Endnote:

1. PVCV course has since evolved into the Advanced Foreign Passenger Vessel Examiner course.

For More Information:

Visit our website at www.uscg.mil/hq/cg5/csncoe/ for CSNCOE newsletters and to find information about the AFPVE course, training programs, public affairs information, top cruise ship deficiencies, frequently asked questions.

The Coast Guard Traveling Inspection Staff

Continuing a 100-year legacy of safety expertise.

by CAPT Eric Christensen (Ret.)
Former Chief, Traveling Inspection Staff
NCOE Supervisor

The U.S. Coast Guard traveling inspection staff is a specialized team of marine inspectors and investigators who provide an independent perspective and, where necessary, make recommendations to safeguard commercial vessel safety. Travelers help form program direction by measuring the effectiveness of existing programs and policies through audits and field visits. These activities may arise from a marine casualty, a developing workforce trend, a maritime industry advocate or operator concern, or be related to a traveler's assigned specific area of interest. Travelers are on-call, mobile technical resources who assist Coast Guard sector, district, or area commanders with any vessel or vessel operation that is deemed unique, high risk, or of special interest.

Journeymen

Specifically, travelers are called in when technical expertise is beyond the capabilities of the local Coast Guard unit. For example, a recent activity involved repairs to a late 1800s wrought iron sailing barque with a riveted hull. While the vessel was in dry dock for significant repairs, traveling inspectors helped orchestrate the repairs and provided training to a number of Coast Guard marine inspectors on the vessel's unique construction and the modern techniques used to repair it.

Mr. Marc Cruder, traveling inspector, trains a group of Coast Guard marine inspectors on hull repairs to a sailing barque built in the late 1800s. U.S. Coast Guard photo by MSU Texas City.

As a natural outgrowth of this expertise, in recent years, the traveling inspection staff has overseen Coast Guard marine safety workforce training via audits and assessments that focus on all aspects of marine inspector performance support, including safety and resource management. Audits capture best practices, identify areas for improvement, and assess alignment with policy and guidance. Where policy and guidance gaps are found, traveler findings and recommendations inform and enhance policy and direction.

National Centers of Expertise

The traveling inspection staff also oversees four national centers of expertise (NCOEs),[1] formally established between 2008 and 2010 as a key part of a comprehensive marine safety enhancement plan, focused on:

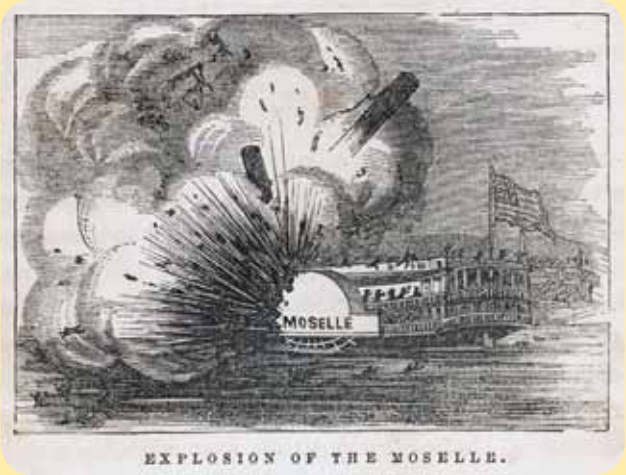
- improving the Coast Guard's marine safety capacity and performance,

History

"The many distressing accidents which have of late occurred in that portion of our navigation carried on by the use of steam power deserve the immediate and unremitting attention of the constituted authorities of the country."—Andrew Jackson, 1833 State of the Union

The Supervising Inspector General of the Steamboat Inspection Service created the first traveling inspector position in July 1914, launching a new era of marine safety, following decades of marine disasters.

Congress was called to action due to the high number of steamboat explosions with significant loss of life throughout the early 1800s. With the Steamboat Act of 1852, Congress placed enforcement powers under the Department of the Treasury, mandated licensing engineers and pilots on steam vessels carrying passengers, and tightened many safety requirements. Under this law, the country was divided into nine geographic districts with nine supervisory inspectors to oversee local inspectors. Each supervising inspector had the autonomy to enforce regulations in his district, which, unfortunately led to inconsistent application of the regulations.



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

On Feb. 28, 1871, Congress responded by authorizing a Supervising Inspector General for the Steamboat Inspection Service. The act also superseded or repealed nearly all previous legislation regarding steam vessel inspection and officer licensing and established the federal regulatory framework that remains in place today.

The Steamboat Inspection Service transferred to the Department of Commerce and Labor on Feb. 14, 1903, and then to the Department of Commerce on March 4, 1913. The actual office of a traveling inspector was made permanent in 1918.

"I cannot speak too highly of the efficiency which must come to the service by the proper use of this valuable corps of traveling inspectors, and you may be assured that they are being used in the most effective manner."
—Report of the Supervising Inspector General, 1919.

In 1932, the Steamboat Inspection Service merged with the Bureau of Navigation to become the Bureau of Marine Inspection and Navigation. On Feb. 28, 1942, President Franklin Roosevelt signed Executive Order 9083, which transferred the Bureau of Marine Inspection and Navigation temporarily to the control of the Coast Guard. This transfer was made permanent on July 16, 1946, and the marine safety mission has remained with the Coast Guard since.

Throughout the organizational changes, there remained a cadre of traveling inspectors.

- enhancing service delivery to mariners and industry customers,
- expanding outreach and advisory mechanisms for industry and communities.

The NCOEs provide a unique blend of operational support, technical expertise, and highly focused training for Coast Guard and maritime industry personnel. Each NCOE is in an area of high volume activity to address specific regulated maritime interests:

- Cruise Ship NCOE, Ft. Lauderdale, Fla.
- Liquefied Gas Carrier NCOE, Port Arthur, Texas.
- Outer Continental Shelf NCOE, Houma, La.
- Towing Vessel NCOE, Paducah, Ky.
- Investigations NCOE, New Orleans, La.
- Suspension and Revocation NCOE, Martinsburg, W.Va.

Recent NCOE Activities

The traveling inspection staff oversees four of the national centers of expertise. Recent accomplishments include:

Cruise Ship National Center of Expertise: Staffers conducted the Advanced Foreign Passenger Vessel Examiner Course. They were also instrumental to the response and investigation into fires on the *Carnival Splendor*, *Carnival Triumph*, and *Grandeur of the Seas*, and served as the Coast Guard nexus for media inquiries following the *Costa Concordia* disaster.

Liquefied Gas Carrier National Center of Expertise: Personnel provided boots-on-the-deck support to units during liquefied natural gas vessel and shore facilities examinations and assist in Coast Guard personnel on-the-job training.

Outer Continental Shelf National Center of Expertise: NCOE staff managed training and workshops for Coast Guard personnel who inspect/examine U.S. and foreign commercial vessels and platforms operating on the outer continental shelf. They also provide information on industry operations and technical systems such as dynamic positioning. Their expertise was critical to the Coast Guard's response and investigation into the *Deepwater Horizon* casualty.

Towing Vessel National Center of Expertise: The current focus is examining an estimated 5,000 U.S. towing vessels with an eye toward the future when those vessels will become an inspected commercial fleet. Staff members led training sessions for the Uninspected Towing Vessel Examiner Course. They are also involved in developing new inspection standards for towing vessels and support field units through on-the-job training and direct support during uninspected towing vessel exams.

In September 2013, the Coast Guard decommissioned the national center of expertise dedicated to vintage vessels (steam ships, historic vessels, etc.), due to budget reductions.

NCOE personnel conduct proactive outreach with the maritime industry to strengthen these vital partnerships, which allows all stakeholders to communicate concerns, resolve regulatory issues, and enhance proposed regulations and policy.

Here to Stay

While some of the methods and techniques have advanced with the times, the role of the traveling inspection staff has not changed in the 100 years since the first traveling inspector. The travelers and NCOEs remain dedicated to providing leadership, oversight, and expertise to promote and implement the Coast Guard's prevention goals to reduce personnel casualties and property losses, minimize security risks, and protect the marine environment.

About the author:
CAPT Christensen is a 1987 graduate of the California Maritime Academy. He spent his 26-year career dedicated to the marine safety mission, culminating in his assignment as chief of the traveling inspection staff and NCOE supervisor at Coast Guard headquarters. He retired from active duty in April 2014.

Endnote:

1. The traveling inspection staff oversees the Cruise Ship NCOE, the Liquefied Natural Gas NCOE, the Outer Continental Shelf NCOE, and the Towing Vessel NCOE.

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Healthy Cruise Ships

CDC's Vessel Sanitation Program.

by CDR Luis O. Rodriguez
U.S. Public Health Service
Centers for Disease Control and Prevention

You may be familiar with U.S. Coast Guard (USCG) inspections on cruise ships. But you may not know about health inspections conducted by officers from the Centers for Disease Control and Prevention (CDC) Vessel Sanitation Program (VSP).

VSP personnel prevent and control the introduction, transmission, and spread of acute gastroenteritis illnesses on cruise ships. Ships that carry 13 or more passengers and have a foreign itinerary with U.S. ports fall under the CDC Vessel Sanitation Program's jurisdiction.[1] These are the same cruise ships that the USCG routinely inspects for compliance with its cruise ship safety, environmental pollution, and security requirements. CDC Vessel Sanitation Program staffers accomplish this mission by conducting unannounced cruise ship operational inspections twice a year to assess compliance with VSP Operations Manual requirements including:

- acute gastroenteritis surveillance and reporting,
- potable water,
- recreational water,
- food safety,
- integrated pest management,
- housekeeping (infection control),
- child activity center,
- Legionella control.

Sigrid Albert/iStock/Thinkstock

In addition to operational inspections, VSP personnel provide ship construction consultation, acute gastroenteritis surveillance and outbreak response, and industry training seminars.

Program inspectors are experienced commissioned U.S. Public Health Service officers based in Atlanta, Ga., and Fort Lauderdale, Fla.

VSP personnel have developed cooperative relationships with the cruise ship industry and work collaboratively with cruise lines and associated partners, including the shipyards that build and renovate cruise ships, to develop the standards for the VSP Operations Manual and VSP Construction Guidelines. These documents describe all of the sanitation requirements cruise ships must follow.

Author CDR Rodriguez checks food temperatures in a walk-in refrigerator. Photos courtesy of CDC VSP.

Training

The VSP epidemiologist and environmental health officers lead training for cruise line management personnel regarding the requirements in the VSP Operations Manual. The seminars are held five times a year in Miami, Fla., and once a year on the West Coast, and provide a mixture of lectures, interactive exercises, and practical hands-on sessions.

Students guide each session with their questions about shipboard practices and the public health principles in the VSP Operations Manual. The seminar format also allows for informal information exchanges outside of class time. Combined operations sessions on the first day provide opportunities to discuss topics that overlap different areas of cruise ship operations. Hotel operations sessions and technical operations sessions are offered concurrently on the last day and a half.

VSP staffers have also partnered with the USCG Cruise Ship National Center of Expertise to give USCG sector members the opportunity to accompany VSP officers during inspections. This experience is a collaborative effort to share knowledge and build connections between the two programs.

Captain Jaret Ames, Vessel Sanitation Program chief, speaks at a training seminar.

Program staffers also work closely with federal and international agencies, including the USCG, the U.S. Food and Drug Administration, the World Health Organization, and port health agencies around the world.

Operational Inspections

Inspectors conduct more than 280 operational inspections each year in more than 140 U.S. ports, including those in the continental United States, Alaska, Hawaii, Guam, Saipan, Puerto Rico, and the U.S. Virgin Islands. Each inspection takes a day, and the size of a ship inspection team depends on the size of the ship being inspected. Most ships require two inspectors, but a very large ship can require as many as four.

Inspectors carry backpacks loaded with all their inspection equipment—multiple types of thermometers, water test kits, flashlights, light meters, the current VSP Operations Manual, and laptops. Team members inspect each of the areas listed in the VSP Operations Manual with the ship's management. On the largest ships, this can include up to 60 restaurants and bars and more than a dozen recreational water facilities.

In food areas, inspectors check:

- food temperatures,
- logs to make sure food is being cooked and cooled properly,
- dishwashing machine temperatures,
- sanitizing solutions levels,
- light levels,
- areas for proper food storage,
- general cleanliness.

They also assess the overall construction from a sanitation standpoint and make sure there are no pests.

In technical areas, inspectors check:

- medical procedures related to acute gastroenteritis,
- chlorine and pH levels in the potable water and recreational water systems,
- safety compliance for recreational water facilities,
- the ship's outbreak prevention and response plan,
- sanitation procedures in housekeeping and the children's center,
- the cleanliness and construction of air handling ventilation units.

They also review logs for potable water, recreational water, ventilation, housekeeping, pest management, and acute gastroenteritis cases. Inspectors also question crew members to make sure they are knowledgeable about sanitation.

Inspectors provide a detailed, printed draft inspection report to the ship's management and then discuss their findings. Management also receives an inspection score and a final report, which includes recommendations to the cruise line.[2]

Ship Construction Consultation

At the request of the cruise industry, program personnel provide consultation during cruise ship construction and renovation. Environmental health officers conduct plan reviews to analyze the ship's design to eliminate environmental health risks and to incorporate modifications that create healthy environments. VSP involvement may include reviewing construction/renovation plans, performing construction inspections in the shipyard, and performing final construction inspections after the ship is operating.

VSP officers normally conduct plan reviews for new ship construction at least 18 months before a ship is scheduled for delivery to allow time for any necessary changes. At that time, program personnel submit a plan review report to the shipyard and owner representatives.

Officers then conduct construction inspections in the shipyard when 90 percent of the areas of the ship to be inspected are completed (approximately 4 to 5 weeks before ship delivery) to ensure compliance with the VSP Construction Guidelines. At the request of a ship owner or shipyard, personnel may also conduct a final inspection when construction is complete and the ship is fully operational.

CDR Aimee Treffiletti discusses potable water plumbing with a ship engineer.

VSP staffer LT Scott Daly checks swimming pool water chemistry.

Scoring

The inspection scoring system is based on inspection items with a total value of 100 points. Significant violations result in deductions; minor violations are noted on the inspection report and may not result in point deductions. Even though violations are often corrected on the spot, they are still included in the report. Critical violations—ones with a high public health risk—have to be corrected or mitigated while the team is aboard. A score of 86 or higher is a passing score. When a ship fails a routine inspection, inspectors conduct an unannounced re-inspection within two months.

Imminent health hazards can prevent a ship from sailing, such as:

- not enough disinfectant in the potable water distribution system;
- inadequate facilities for maintaining safe food temperatures;
- inadequate facilities for cleaning and sanitizing food equipment;
- continuous problems with liquid and solid waste disposal;
- infectious disease outbreak among passengers or crew, and where it is suspected that continuing normal operations may subject newly arriving passengers to disease.

The USCG assists when the CDC director issues a no-sail order to a ship that represents an imminent health hazard to passengers and crew members.

Surveillance and Outbreak Response

CDC's Vessel Sanitation Program also focuses on acute gastroenteritis syndromic (based on symptoms) surveillance and outbreak response. Cruise ships use VSP's electronic surveillance system to report the total number of cases (including zero cases) the medical staff has evaluated, before the ship arrives in a U.S. port from a foreign port.

Personnel also use the surveillance system to send automatic, real-time electronic notifications to stakeholders and partners when the illness count exceeds 2 percent of the total number of passengers or crew when the vessel is within 15 days of arrival at a U.S. port. Ship crew, cruise line representatives, and VSP staffers use this early alert to communicate and consult with one another, so they can reduce the further spread of illness. Ship personnel also send separate outbreak notifications when 3 percent or more of passengers or crew report acute gastroenteritis symptoms to the ship's medical staff and for other outbreaks of public health significance.

A team of environmental health officers and a program epidemiologist are dispatched to the ship to investigate the outbreak, recommend mitigation measures to minimize further spread during the voyage, prevent carry-over to future voyages, and develop program guidance to assist ships in avoiding similar occurrences. Outbreak updates are also made public online.[3]

Inspection Fees

CDC's Vessel Sanitation Program is unique in that it is entirely self-supporting. All program expenses—including personnel, travel, outbreak investigations, and direct training expenses—are covered by a fee cruise ship owners pay, based on the ship's size. This fee also covers operational inspections, re-inspections, and on-site and final construction inspections. There is no fee for plan reviews or outbreak investigations.[4]

Going Forward

The VSP staff assists the cruise ship industry in providing a healthy cruising environment through construction consultation, training, operations inspections, surveillance, and outbreak response.

About the author:

CDR Luis O. Rodriguez is an environmental health officer and the assistant VSP training coordinator. Previous assignments include serving as a consumer safety officer with the Food and Drug Administration in San Juan, P.R., and Rockville, Md.

Endnotes:

1. The Public Health Service Act, Part G, Quarantine and Inspection (Public Health Service Act: Quarantine and Inspection Regulations, 42 U.S.C.§264) provides the program's inspection and surveillance authority. U.S. foreign quarantine regulations (42 CFR Part 71) also require ships to immediately report onboard deaths and certain communicable illnesses to CDC, but not to VSP. Those reports are sent to CDC's Division of Global Migration and Quarantine.
2. Program staffers post all final reports for public view on VSP's searchable inspection database [wwwn.cdc.gov/InspectionQueryTool/InspectionSearch.aspx]. The Corrective Action Statement submitted by the cruise line for each of the inspection findings is also posted on the inspection results website.
3. See www.cdc.gov/nceh/vsp/surv/gilist.htm.
4. The fee schedule is published each year in the *Federal Register* and is also posted on the VSP website, www.cdc.gov/nceh/vsp/desc/about_inspections.htm.

For More Information:

Planning a Cruise?

If you're planning to cruise, check out VSP's website at www.cdc.gov/nceh/vsp/ for inspection scores and reports for cruise ships you're considering and to find tips on how to stay healthy while aboard.

Additionally, VSP holds an annual public meeting for all stakeholders, including the cruising public, to have a public forum discussing all aspects of the program. See program details at www.cdc.gov/nceh/vsp/.

Alternative Cruise Ship Design

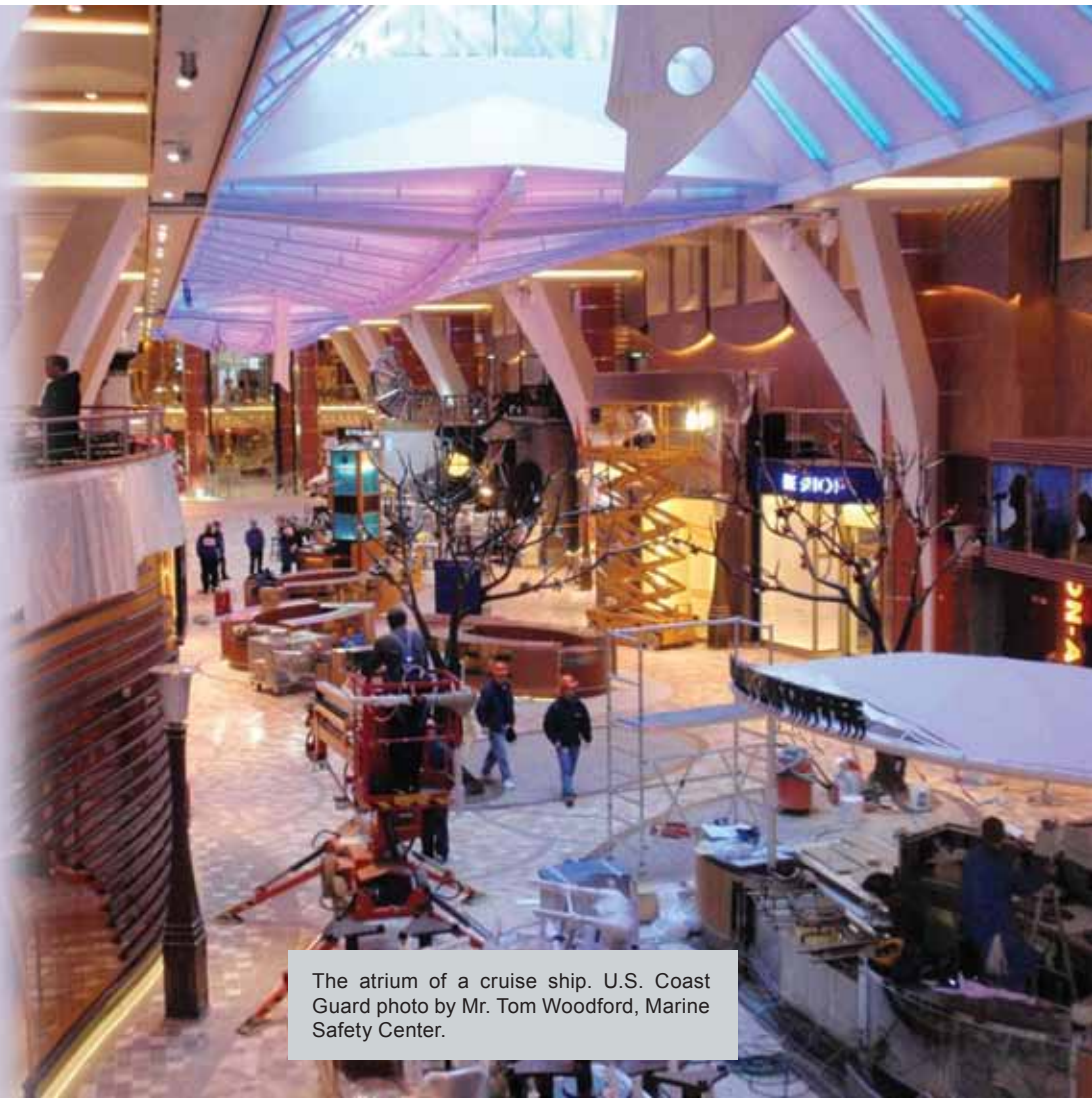
Working with the industry to ensure fun designs remain safe.

by LCDR Brent C. Yezefski
Major Vessel Branch Chief
U.S. Coast Guard Marine Safety Center

Mr. Tom Woodford
Fire Protection Engineer
U.S. Coast Guard Marine Safety Center

You walk through the entry door to the sound of a small band playing on a central platform; you smell pizza, cupcakes, and a host of other foods; and view a martini bar that ascends to the sky. You stand there, taking in the sensory experience and fascination of what most associate with Las Vegas casinos or high-end shopping malls.

You then pass the welcoming entrance of a celebrity chef's restaurant and exit a side door, taking in a deep breath of salt air, while observing a dramatic sunset at sea.



The atrium of a cruise ship. U.S. Coast Guard photo by Mr. Tom Woodford, Marine Safety Center.

This onboard waterslide passes through structural boundaries. U.S. Coast Guard photo by LCDR Brent Yezefski, Marine Safety Center.

What you have just witnessed is not a casino or mall, but the sights, smells, and experiences that are now common on cruise ships. These vessels ply the waters all over the world, embark millions of passengers, and the companies that operate them actively compete to make their guests' time aboard a truly unforgettable experience—one that will have them booking subsequent trips and recommending the vessel to their friends and family.

As the industry evolves, more unique cruise ship arrangements such as ice skating rinks, water slides that propel guests over the side of the ship and through the vessel's stacks, atriums the size of football fields, zip lines suspended 100 feet above exterior amusement parks, and even proposed environment-friendly improvements such as the use of liquefied natural gas as a source of fuel, will push the bounds of traditional design parameters.

While cruise ship operators are understandably attentive to adding new, exciting, and ever-more innovative entertainment activities, the U.S. Coast Guard must focus on one central question: Are these vessels designed to operate safely?

The Age of Regulation

The most notable maritime tragedy, the *Titanic* sinking and subsequent loss of more than 1,500 lives, became the impetus for the first international action to protect life at sea. The 1914 International Convention for the Safety of Life at Sea (SOLAS) focused on structural subdivision and stability as well as lifeboat sufficiency and capacity.

In 1934, the *Morro Castle* suffered a cargo hold fire that rapidly spread to the passenger spaces, resulting in the death of 124 persons. This incident led to passenger vessel structural fire protection regulations in 1940, which were subsequently incorporated into a 1948 SOLAS revision. A further tragic loss of 88 passengers and two crew members occurred aboard the *Yarmouth Castle* in November 1965, after a store room fire raged and spread throughout the vessel. These two catastrophic fire-related incidents provided further momentum to establish regulatory requirements to protect passengers and crew.

With the 1966 Fire Safety Amendments to the International Convention for the Safety of Life at Sea, the Coast Guard made cruise ship safety one of its highest priorities. In 1968, public law required the Coast Guard to verify that foreign passenger vessels complied with the 1966 fire safety amendments. As a response, the Coast Guard created the Control Verification Examination (CVE) Program and published Navigation and Vessel Inspection Circular 2-68 Fire Safety Standards for Foreign and Domestic Vessels, which set policy on how to perform fire safety examinations on foreign passenger vessels.

In 1983, new public law required the Coast Guard to verify that all foreign passenger vessels embarking passengers in U.S. ports comply with all SOLAS conventions. In August 2004, Congress passed an amendment that extended the CVE program to foreign cruise ships that make a U.S. port call with U.S. citizens as passengers, regardless of where the passengers embarked the vessel.

By conducting vessel plan review, examinations during construction, and follow-up examinations while the vessel is in operation, the Coast Guard verifies that the vessel's design maintains substantial compliance with international requirements and U.S. law.

The U.S. Coast Guard as Regulator

Many modern cruise ship designs meet U.S. Coast Guard interpretations of SOLAS, since these ships participate at some point in their service life in the U.S. cruise market. In support of the CVE program, the Coast Guard Marine Safety Center (MSC) provides the technical engineering oversight from the preliminary design proposal to the delivery of the cruise ship, as well as review of modifications to existing cruise ships, ensuring compliance with appropriate international standards and Coast Guard interpretations of those standards. This includes:

- holding concept meetings,
- conducting plan review,
- attending the structural fire protection examination and Initial Certificate of Compliance Examinations,
- training Coast Guard foreign passenger vessel examiners,
- developing Coast Guard guidance on international regulations.

During concept review meetings, MSC personnel meet with the vessel designers; shipyard, flag administration, and classification society representatives; and owners/operators to examine the vessel overview, and most importantly, any design proposals that are expected to be outside the scope of SOLAS. These are quickly identified with a course of action, determined to prevent them from creating delays in vessel construction and certification.

MSC's plan review focuses on cruise ship fire protection and life safety arrangements, ensuring the cruise ship's design keeps the effects of fire isolated by assessing the fire control, structural fire protection, and emergency escape arrangements. This review includes a space-by-space assessment of how different areas of the ship are to be used, how they are to be segregated and protected from impact damage and fire, and how to evacuate passengers in an emergency.

The roller shutter fire door on this cruise ship was the subject of a Regulation 17 analysis. U.S. Coast Guard photo by Mr. Tom Woodford, Marine Safety Center.

During construction, Coast Guard inspectors and Marine Safety Center personnel examine the vessel's fire safety construction and escape arrangements during the structural fire protection examination, which occurs before bulkhead and overhead finishings and trim are installed. Prior to the vessel entering service, this same team of inspectors conduct a comprehensive Initial Certificate of Compliance Examination, focusing on:

- fire protection and detection systems,
- ventilation shutdown,
- escape signage,
- transit to muster stations,
- lifesaving equipment,
- engineering systems,
- sources of emergency power,
- emergency fire and boat drills,
- resolving any outstanding plan review issues.

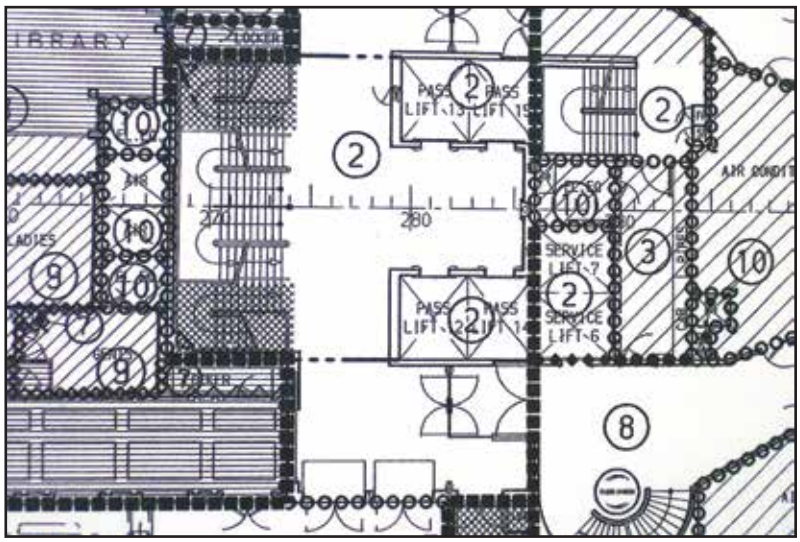
Additional examinations are conducted at regular intervals while the vessel is operating in the U.S., to ensure that the crew's training and vessel operations and maintenance continue to meet international requirements.

Performance-Based Design

As innovation pushes the bounds of regulation and standards development, performance-based design allows designers the flexibility to propose equivalent approaches to meet safety standards. Entered into force in 2002, SOLAS Chapter II-2, Regulation 17, Alternative Design and Arrangements, provides the necessary guidance for these performance-based designs, with additional details found in IMO's Maritime Safety Committee Circular 1002.

This process requires great effort on the part of the design team, which includes the owner, shipyard, flag administration, classification society, and most often a contracted fire protection engineering firm. While not a part of the design team, the Coast Guard is an "interested party" per Circular 1002, and must be involved in the analysis from the beginning to ensure that an acceptable alternative design solution is achieved, as these vessels are enrolled in the CVE program.

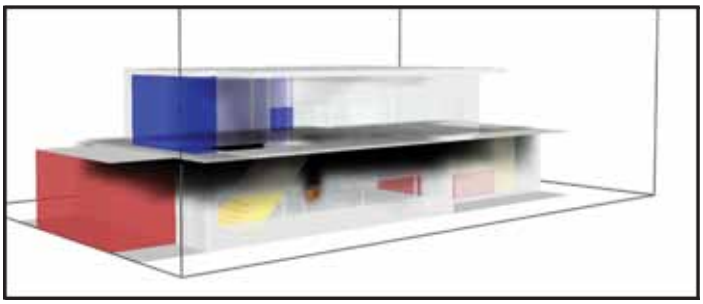
As such, upon realization that a concept design indicates the use of Regulation 17, early notification and concept review with the Marine Safety Center is paramount, as the goal of



Example of a structural fire protection plan. U.S. Coast Guard graphic courtesy of Marine Safety Center.

the concept review meeting is to review the scope of the design and establish the basis for the performance analysis and subsequent design acceptance. This further leads to Coast Guard and flag state approval of the performance criteria (limit on fire size, amount of smoke and other fire byproducts produced, maximum temperature allowed to be reached, etc.) prior to the conduct of any fire scenarios or simulations, to ensure that the performance criteria are independent of any idealized vessel arrangement.

Following the concept review meeting, the design team submits a preliminary analysis report to the flag administration and subsequently the Marine Safety Center to establish the approach, depth, and methods for all quantitative analyses. The key point at this step is to identify and agree to the performance criteria that the design must meet. Additionally, this stage involves a fire risk assessment, identifying and characterizing hazards, and developing fire scenarios. Specific fire scenarios must include the most challenging fire locations, as well as possible obstructions to the means of egress.



Example of a computer-generated fire simulation for quantitative analysis. U.S. Coast Guard graphic by Mr. Tom Woodford, Marine Safety Center.

The final step is conducting the quantitative analysis, which involves applying conservative assumptions in the fire scenarios and calculations that are routinely performed using a fire simulation model to determine the amount of time before the space becomes untenable due to lack of visibility, smoke toxicity, or extreme temperature. Similarly, another set of calculations may be performed using an egress model to determine how long it takes for occupants to evacuate the space.

The results of these analyses are then compared to the previously agreed-upon performance criteria to assess whether the proposed alternative design provides a level of safety that is equivalent to that of the prescriptive requirements.

Upon Coast Guard and flag state acceptance of the performance-based design, a copy of the approved documentation must be maintained onboard the vessel. It is critical that this documentation be comprehensive and should include at the minimum:

- the scope of the alternative analysis;
- details of the vessel's arrangements;
- SOLAS regulations that were affected by the design;
- a summary of the resultant quantitative analyses;
- any necessary testing, inspection, and maintenance regimens necessary or required as a basis for approval.

Circular 1002 and the Marine Safety Center's plan review guide, SOLAS-14, Review of Regulation 17 Alternative Design Documentation during the Initial Certificate of Compliance Examination, provide guidance in preparing this final design documentation. Additionally, prior to considering any modification after the vessel is placed in service, the final design report must ensure all assumptions, design details, and operating parameters remain applicable and appropriate, as future modifications to the vessel may require a new performance-based analysis.

The View From the Bow

There is no doubt modern day cruise ships have and will continue to depart from their early lineage as stark ocean liners, transporting people and cargo across the vast oceans from Europe to North America. With the launch of each new ship, passengers are pampered with amenities at sea that were once thought unachievable, and they will continue to be, as long as vessel designers continue to think outside the box with the application of performance-based design to ensure an utmost equivalent level of safety.

About the authors:

LCDR Brent Yezefski has served in the U.S. Coast Guard for 14 years. In addition to the Marine Safety Center, LCDR Yezefski served as Maritime Law Enforcement and Waterways Management chief at Sector Northern New England, South Portland, Maine, and has received the Coast Guard Commendation Medal.

Mr. Tom Woodford is a fire protection engineer and has worked at the Marine Safety Center for 8 years. His prior work includes assistant professor in the School of Fire Protection and Safety [Engineering] Technology at Oklahoma State University, and working at a fire testing laboratory in Washington. Mr. Woodford honorably served as a U.S. Navy surface warfare officer for 12 years, concentrating in shipboard damage control and nuclear propulsion.

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The Cruise Vessel Security and Safety Act of 2010

Ensuring accountability in passenger safety.

by LT Michael Metz
Port State Control Officer
Cruise Ship National Center of Expertise

There are approximately 200 oceangoing cruise vessels worldwide. Moreover, the average vessel carries approximately 2,000 passengers with a crew of 950 people, and approximately 10 million passengers embark from U.S. ports on a cruise annually.[1]

Chris Rogers/iStock/Thinkstock

From 2002 to 2007, physical and sexual assaults on cruise ships were the leading crimes the Federal Bureau of Investigations investigated with regard to cruise ship incidents.[2] In response, Congress passed the Cruise Vessel Security and Safety Act (CVSSA) of 2010 to prevent and reduce the number of crimes committed on oceangoing cruise ships that embark or disembark passengers in the United States.

More than 90 percent of all large oceangoing cruise ships operate under the regulatory governing authority of foreign countries such as Panama, the Bahamas, Bermuda, and Holland.[3] Prior to the Cruise Vessel Security and Safety Act of 2010, foreign-flagged cruise ships operating in the United States were not required to report crimes to the federal government. Therefore, the federal government did not definitively know how many crimes took place or even how many people went missing while cruising.

Cruise ship companies were not required to make this data available to the public and it was extremely difficult for federal investigators to obtain this information. Federal crime scene investigators also had limited jurisdiction on these vessels, causing difficulties in collecting data and securing crime scenes involving U.S. citizens.

CVSSA Elements

The Cruise Vessel Security and Safety Act requires cruise companies to be transparent in recording and reporting crimes to the public, creates measures to prevent and respond to any assault committed on a vessel, and requires cruise ships to implement new policies and procedures as well as retrofit existing vessels for equipment required by the regulation.

The law applies to all vessels that are authorized to carry at least 250 passengers, have onboard sleeping facilities for each passenger, are on a voyage that embarks or disembarks passengers in the United States, and are not engaged on a coastwise voyage.[4]

Coast Guard Implementation

Immediately after the CVSSA went into effect, Coast Guard headquarters staff worked with the Cruise Ship National Center of Expertise, various field units, and other government agencies to determine how to implement the act

Cruise Vessel Security and Safety Act Requirements

- ✔ **Rail height around the edge of the vessel on open air decks that passengers can access increased from the international standard of 39 inches to 42 inches to prevent passengers from going overboard. This was quite a challenge for many cruise ships, because this adjustment needed to be made throughout the entire vessel.**
- ✔ **Each passenger stateroom and crew cabin must be equipped with a peephole or other means of visual identification, such as a video camera.**

Ship rails must be 42 inches high. These rails are CVSSA-compliant.

- ✔ **For ships with a keel lay date on or after July 27, 2010, each passenger stateroom and crew cabin must be equipped with security latches and time-sensitive key technology to prevent unauthorized access.**
- ✔ **Cruise lines must make location and contact information of U.S. embassies and consulates available to all passengers and crew for each country the vessel visits during a voyage. This information must be provided in each passenger stateroom and posted in areas readily accessible to the crew.**
- ✔ **All credentialed medical staff must possess a current physician or registered nurse license equivalent to the guidelines established in the American College of Emergency Physicians. Medical personnel must also have at least three years of post-graduate or post-registration clinical practice in general and emergency medicine.**
- ✔ **Vessels must maintain equipment to prevent, treat, and collect evidence for sexual assault cases. This includes providing anti-retroviral medication or other medication designed to prevent sexually transmitted diseases after an assault.**
- ✔ **Vessels must provide forensic sexual assault examination training to crew security personnel and medical staff.**
- ✔ **Vessels must provide sexual assault victims free and immediate information access and a means to contact law enforcement personnel, U.S. embassies, consulates, the National Assault Hotline, or equivalent hotline service on a private telephone or computer terminal.**
- ✔ **All cruise ship companies must post a link on their website displaying statistical data of criminal activity on the company's vessels, and each vessel is required keep a record of all crimes and incidents.**
- ✔ **Cruise companies must have the capability to detect and capture the images of passengers who have fallen overboard.**
- ✔ **Vessels must implement acoustical hailing and warning devices, as well as video surveillance.**
- ✔ **Select crew members must be trained in evidence preservation for criminal activities.**

Should a vessel be deficient in any of these areas, the Coast Guard will document the discrepancy and ensure the vessel corrects the condition. Fortunately, the cruise lines have been very proactive and very few deficiencies have been discovered. In fact, many of these requirements were already in place on most cruise ships well before the regulations went into effect.

without jeopardizing the safety of the passengers from dangers including fires and emergencies.

Some challenges included the requirement to install time-sensitive door locks that still allowed crew access to the cabin in case of an emergency such as fire response, and the effect on structural fire protection when adding peepholes in cabin doors. The Coast Guard also worked closely with the U.S. Maritime Administration and the FBI to develop training standards and curricula for personnel certification to

Per Cruise Vessel Security and Safety Act requirements, for ships with a keel lay date on or after July 27, 2010, all cabin doors must feature a peephole and be equipped with a time-sensitive key latch. All photos courtesy of the Cruise Ship National Center of Expertise.

cover crime prevention and detection methods as well as evidence preservation and reporting criminal activities in the maritime environment.

Coast Guard Foreign Passenger Vessel Examiner's Responsibilities

During the course of any cruise ship exam, Coast Guard foreign passenger vessel examiners (FPVEs) must verify vessel compliance with the CVSSA. This is a very extensive process; and, prior to boarding the vessel, examiners will check the vessel's advance notice of arrival to verify at least one crew member meets the training requirements. A letter from the company identifying the trained person must be kept onboard.

Examiners ensure vessels maintain adequate medication.

The FPVE will also examine the vessel's medical staff's credentials and their training. In addition, the examiner will confirm sexual assault medical exam equipment and materials are maintained onboard with an adequate supply of anti-retroviral medications.

Additionally, the examiner will spot-check passenger cabins to verify embassy and consulate contact and location information is available, ensure cabin doors have peepholes and are fitted with security latches and time-sensitive door locks, and verify cabin access procedures in the event of an emergency such as a fire. The examiner will also confirm there is a procedure in place to make video records available to law enforcement officials, for possible criminal investigations, and check that records documenting these crimes are available.

All vessels must have video surveillance.

Finally, FPVEs will verify there is a policy in place to ensure the confidentiality of patient medical exam information. They will check the ship's policy for sexual assault examination confidentiality and ensure patient records are not released without the prior knowledge and approval in writing from the patient. They will also verify sexual assault patients have free and immediate access to law enforcement and emergency hotline services via private telephone and computer terminals.

Results

Overall, the Cruise Vessel Security and Safety Act has increased and expanded the scope for the safety and security portions of the Coast Guard cruise ship exams. Likewise, the cruise companies have proactively ensured compliance with its requirements. Although minimal data is currently available regarding the results of CVSSA, industry regulators, operators, and stakeholders remain very optimistic that it has made cruise ships safer for passengers and crew.

About the author:
LT Michael Metz has served at USCG Sector Miami in the Inspections Division and at the Cruise Ship National Center of Expertise. He is a graduate of the U.S. Merchant Marine Academy, where he earned a degree in marine engineering and shipyard management. He holds an M.A. in management from American Military University and a U.S. merchant marine officer license as a third assistant engineer for steam, motor, and gas turbine vessels of any horsepower.

Endnotes:

1. *Cruise Ship Security and Safety Act 2010.* Washington, DC: U.S. Government Printing Office, January 2010. Available at www.gpo.gov/fdsys/pkg/BILLS-111hr3360enr/pdf/BILLS-111hr3360enr.pdf.
2. Ibid.
3. Available at www.cruising.org/regulatory/issues-facts.
4. *CG 543 Policy letter 11-09.* Issued June 28, 2011. Coastwise voyage is defined in 46 CFR 67.3 as "the transportation of passengers or merchandise between points embraced within the coastwise laws of the United States."

Foreign Passenger Vessel Examinations

The environmental survey.

by LTJG Dimitrios Wiener
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Inspections Division

LT Michael Metz
Port State Control Officer
Cruise Ship National Center of Expertise

Modern cruise ships are more than just floating hotels, these vessels are small cities incorporating every aspect of public works. As such, waste accumulates from food, recyclable materials, oil, chemicals, batteries, and water.

Each vessel must deal with this continual cycle of creating, collecting, and processing wastes. Food waste and recyclable materials must be stored in lockers and processed in garbage rooms; hazardous garbage like chemicals for photo processing, dry cleaning, and batteries must be stored in protected lockers; oily wastes from machinery spaces must be stored in tanks and filtered; and used water must be stored and appropriately filtered prior to overboard discharge.

Waste stream management for recycling. U.S. Coast Guard photos.

The Waste Stream

A material's life cycle on a ship is called a "waste stream," which refers to waste that is created, processed, and then eventually discharged from the vessel. Examiners refer to this as "cradle to grave," and categorize this waste into five different types:

- oil,
- non-hazardous,
- hazardous,
- gray water (the water associated with sink and shower drains),
- black water (sewage).

Each Coast Guard foreign passenger vessel examination includes a waste stream audit, where the examiner randomly audits the vessel's waste management operations to ensure they meet federal and international regulations.

All waste stream systems must follow fundamental processes that include a combination of administrative accountability, machinery and equipment verification, operational practices, and crew training. Examiners work with an engineering officer or an environmental officer—whoever is responsible for the examined system.

Each waste stream must have a logbook or record. For example:

- oil record books contain records of all vessel oil loading, transfers, and discharges;
- garbage record books list all wastes discharged from the vessel categorized by type and amount in cubic meters;
- black and gray water system records include any shoreside or underway discharges.

Examiners review these systems and their associated equipment manuals, documents, and receipts to verify proper operation. Following this review, the examiner will conduct a material exam of the system and question employees to verify the vessel's program is maintained in accordance with its procedures.

The Oil Waste Stream Examination

The oil waste stream is stringently controlled, due to its potential environmental impact. The examiner begins the oil waste stream examination by reviewing the oil record book, which notes all oil loading, transfer, and discharge. Examiners also observe the crew's ability to follow operating procedures and their competency with all equipment involving oils.

At the bunkering station (where the vessel receives oil), examiners check for all necessary posted items such as piping diagrams and emergency shutdown procedures and check oil containment and spill cleanup equipment. The examination continues in the machinery spaces where the examiner checks that equipment is free from excessive oil leaks, tests the oily water separator and its integrated oil content meter, and verifies the operator's competence.

Other Wastes

Hazardous wastes such as paint, dry cleaning chemicals, medical waste, and photo processing equipment, are all a part of daily cruise vessel operations. Therefore, examiners verify that waste is stored and segregated in accordance with the vessel's procedures and disposed of in accordance with the laws of the state or country in which the waste is discharged. The same procedures apply to non-hazardous items like papers, plastics, and food waste.

Finally, the Coast Guard inspector examines the black water and gray water waste streams. Black water is bio-hazardous water waste originating from toilets, photo processing labs, and medical spaces. Gray water includes discharges from galleys, sinks, wash basins, and showers.

During the black water system review, an examiner will verify the marine sanitation device is certified and operated in accordance with U.S. and international regulations,

Oil Monitoring

Belt and Suspenders

Once the oil content meter registers an oil content above the international maximum of 15 parts per million, the oily water separator system must automatically close the overboard valve and recirculate the oily water. Many cruise companies set their meters at a much lower level, usually 5 parts per million.

Cruise ship inspections include examining the oily water separator.

The White Box

Several major cruise companies also install additional oil monitoring equipment into their overboard discharge line, referred to as a "white box," which is an additional safeguard to prevent accidental oil discharge. The system normally employs tamper-proof equipment, secured in a cage that is only accessible to certain ship's officers.

The monitoring station contains a sensor and recording equipment that measures throughput and oil ppm levels. This information is stored for up to 18 months in the equipment and is accessible for examiner review.

Galley garbage sign.

Hazardous waste must be appropriately stored and labeled.

confirm that the amount of waste generated does not exceed the amount the system can process, ensure the system is within tolerance for effluent discharge rates, and verify the ship is discharging waste in accordance with international regulation.

Similar to black water, the examiner will verify gray water is stored and discharged in accordance with domestic and international laws. It is also important for the examiner to verify that waste from prohibited sources is not introduced into the gray water system.

The Human Element

Even if cruise ships have highly advanced machinery that works exactly as it should, the operating company should also encourage a culture that values environmental compliance and works to minimize human error.

Therefore, Coast Guard examiners focus on all aspects of the systems from machinery certification and proper operation to the human element and vessel waste management procedures. These examinations help to protect the world's waters and assist in reducing the environmental impact of vessel operations to keep our oceans clean for future generations.

About the authors:

LTJG Dimitrios Wiener is a graduate of the U.S. Merchant Marine Academy. He is a marine inspector at USCG Sector Miami. He holds a B.S. in marine engineering and a U.S. merchant marine officer license as a third assistant engineer for steam, motor, and gas turbine vessels of any horsepower.

LT Michael Metz has served at USCG Sector Miami in the Inspections Division and at the Cruise Ship National Center of Expertise. He is a graduate of the U.S. Merchant Marine Academy, where he earned a degree in marine engineering and shipyard management. He holds an M.A. in management from American Military University and a U.S. merchant marine officer license as a third assistant engineer for steam, motor, and gas turbine vessels of any horsepower.

Following the Rules

The role of the classification society in passenger ship safety.

by Mr. George Zeitler
Principal Surveyor
DNV GL

Following an increase in the number of incidents aboard cruise vessels from Fall 2011 to Spring 2013, including a number of large fires, blackouts, and the unfortunate loss of the *Costa Concordia*, the public has begun to question the safety record of the cruise industry.

For example, the public wants to know who is directly responsible for cruise ship safety. Well, the simple answer is that responsibility for safety starts and ends with ship owners and managers.

However, owners often seek assistance from classification (class) societies in identifying and evaluating safety risks. Although often referenced in the maritime world, class society roles and responsibilities relating to vessel safety are not widely known.

History

As noted by the International Association of Classification Societies, a class society is an independent, self-regulating, externally audited body that has no commercial interests related to ship design, building, ownership, operation, management, maintenance, repairs, insurance, or chartering. This lack of commercial interest is a significant safeguard to ensure the independence and integrity of class societies.

The first classification societies, founded in the latter half of the 18th century, served as a system for the independent technical assessment of ships that were presented for insurance coverage. As such, their initial role was to "classify" (rate) a ship annually. The societies used a series of ratings:

- A, E, I, O, U for the condition of the ship's hull;
- good, middling, or bad (later changed to 1, 2, 3) for the ship's equipment.

Based upon this rating, an insurer could better determine the risk involved with covering the vessel and then price the coverage accordingly. However, throughout the years, classification societies have established their own set of rules that would allow them to classify vessels more readily by measuring compliance with more standardized, predefined criteria. These rules continued to develop as the classification societies' experience and technological expertise grew, eventually evolving to specifically include requirements commonly recognized as safety critical and sound principles for how a ship should be designed, built, equipped, and maintained.

As these principles and rules developed, they were increasingly seen as absolute requirements, such that the rating aspect has mostly disappeared, and an owner must maintain the vessel in compliance with its class society's rules for the vessel to be considered to be "in" class.[1] This is significant, since in accordance with the International Convention for the Safety of Life at Sea (SOLAS), vessels are not authorized to operate without being in class.

What Does a Class Society Do?

The primary role a class society plays in relation to vessel safety is that of an independent third party that develops and enforces a set of standards for the design and maintenance of the vessel's hull and appendages, as well as the suitability of the machinery installed for propulsion, power generation, steering, and other auxiliary systems.

This role may begin before the ship is built. During the design phase (prior to design approval) vessel owners can choose to engage the classification society to provide advice on features they are considering. This helps identify new technology or systems that can or should be included in the design and helps the owner to develop methodologies to certify these systems and their maintenance. After the design of a new vessel is prepared, the class society will ensure it complies with the society's rules.

A surveyor witnesses main engine shutdown tests. All graphics courtesy of DNV GL.

Once the design is approved, the class society then audits the building process, as the new vessel cannot be approved as "in class" unless the shipyard complies with the approved design criteria. Once the building phase is completed and the vessel is determined to be in compliance with the rules, it is issued a class certificate.

The vessel then enters the operation phase, where proper maintenance is the most critical factor. Vessel owners are responsible for proper maintenance, and class surveyors perform periodic vessel surveys. For a passenger ship, DNV GL typically assigns two surveyors to attend the vessel and verify the condition of the hull and machinery through a sampling process (up to 100 percent of a system or component, depending on the results found by the surveyor). A set of annual surveys takes approximately seven days to complete.

In addition, there are other periodic surveys at various times throughout the vessel's 5-year class certificate validity. These include internal boiler inspections, internal examination and pressure testing of tanks integral with the hull, and bottom surveys where the vessel is inspected out of the water (there are provisions for in-water surveys in certain situations).

Recognized Organizations

Classification societies can also undertake the role of recognized organization or RO. As an RO, the class society acts on behalf of the vessel's chosen flag administration (flag) to verify compliance with the various international instruments to which the flag is signatory, such as the International Convention on the Safety of Life at Sea.

This role is a natural fit, due to the technical knowledge and experience that class societies possess among their surveyors, auditors, and plan-approval engineers, as well as the worldwide presence of class society survey stations.

With its global presence, the class society can quickly respond to survey any damage and discuss the various options that will allow the vessel to return to service sooner. It is important, however, to keep in mind that as an RO, the class society acts solely on behalf of the flag and not in its individual capacity. Thus, if the damage involves equipment related to the statutory certificates, the flag (rather than the class society) retains all authority to determine whether to allow the vessel to sail in a condition other than full compliance with the applicable international instruments. This means that in cases where an exemption from specific SOLAS requirements is needed to allow the ship to sail, the class society briefs the flag on the issue and provides technical justification for the requested exemption or other equivalency, and then the flag, in its sole discretion, will grant or deny the authorization to proceed.

Advisory Roles

Another role that class societies often play is that of advisor to the owner. Respecting its independent third-party role regarding overseeing compliance with the class rules, a classification society will not provide advice on the safety-critical elements covered by its rules. Thus, areas where a class society can provide advisory services are not safety-critical, although they are still important for the owner. Proper ship maintenance and operation, including such crucial activities as navigation and following up the

documented routines for maintenance of safety-critical parts of the ship including safety barriers, is the sole responsibility of the owner.

Technology, innovation, and national and international rules and regulations are constantly changing, and owners often need outside assistance to increase the level of ship superintendents' knowledge, competence, and compliance. Accordingly, owners often seek a class society's advice regarding such changes.

When requested, a class society can conduct meetings with owners, superintendents, and staff to:

- advise on new rules and regulations,
- discuss significant findings from recent surveys or audits for the owner to ensure compliance in the rest of its fleet,
- share information about casualties and risks faced by the industry as a whole,
- present relevant technical topics covering ship equipment.

Regardless of the advice, it is up to the owner to accept or reject instituting the recommendations.

Class societies undertake many roles in the passenger ship industry, and, in keeping with its purpose—to safeguard life, property, and the environment—DNV GL strives to fulfill these roles in the most effective and proficient manner possible. Nevertheless, it is important for the industry to keep in mind that the responsibility for ensuring safety on passenger vessels starts and ends with owners.

A surveyor witnesses fuel pump remote shutdown.

About the author:
Mr. George Zeitler has almost 20 years of experience in the cruise industry. He has spent the past five years as a senior surveyor for DNV GL in its global cruise center. His experiences include 13 years as a U.S. Coast Guard inspector working in various roles including chief of inspections and chief of the foreign passenger vessel training school in Miami. In addition, he spent four months on an industry training tour with Disney Cruise Line.

Endnote:

1. www.iacs.org.uk/document/public/explained/Class_WhatWhy&How.pdf.

Initial Certificate of Compliance Examinations

Getting it right before the vessel leaves the shipyard.

by LT James Schock
Marine Inspector
U.S. Coast Guard Activities Europe

Today, cruise ships are engineering marvels. They can accommodate thousands of guests and contain restaurants, full-sized gyms, multiple pools, and generators that can produce more than 80 megawatts in total power. Even after inspecting dozens of newly delivered ships, I am still impressed when I pull up to the quay and see the latest design coming to life.

Coast Guard Activities Europe is responsible for inspecting U.S. flagged vessels operating in Europe, the Middle East and Africa, as well as newly constructed cruise vessels built in Europe. For the past two years, I have led the U.S. Coast Guard Activities Europe Initial Certificate of Compliance Examination (ICOC) program. Just like the ships themselves, each challenge and decision is large and has far-reaching effects for the ship involved.

USCG inspector CDR Mike DeLury views life raft positioning during an inspection. All photos U.S. Coast Guard.

Design Review

The ICOC process begins years before delivery with a concept review meeting. U.S. Coast Guard Marine Safety Center (MSC) personnel and class society, shipyard, and ship owner's representatives come together to discuss the ship's general arrangement. I enjoy the concept review. It's almost like a boat show. We review the latest features and new ideas, ranging from liquefied natural gas propulsion to multi-level guest cabins to how much bigger the water slide is than the last. After hearing about new concepts, the meeting becomes more technical. We discuss alternative design arrangements and review the supporting quantitative and qualitative analysis.

Typically, about five months prior to delivery, shipyard or cruise company personnel submit structural fire protection, emergency escape, and fire control plans to MSC for review to ensure that the cruise ships will comply with IMO regulations and U.S. requirements for foreign passenger vessels. MSC personnel address questions or concerns and ensure designs incorporate necessary changes.

Onboard Inspection

The first time we board a vessel is to conduct the marine evacuation system test. We use the system, evaluate its ability to rapidly evacuate people, and engage the ship's officers to prompt them to consider the worst-case scenario.

The second visit to the ship is a joint Activities Europe/MSC review of the ship's structural fire protection. MSC staff engineers verify that installation and materials comply with domestic and international standards. Activities Europe marine inspectors examine escape paths, signage, corridors, and life-saving arrangements. At the conclusion, USCG personnel list any discrepancies the owners must address.

During the final vessel visit, Activities Europe personnel, Marine Safety Center staffers, and a marine inspector from the first U.S. port of call conduct three days of onboard tests and examinations. The marine inspectors split up into three teams: deck, Marine Safety Center, and engineering. Each team is comprised of Coast Guard, owner, shipyard, and class personnel.

Day one goes something like this:

- 8:30 a.m. to noon: tests and examinations. Inspectors add any deficiencies to the work list and clear them as they are corrected.
- Noon to 1 p.m.: lunch time, usually in the crew or officers' mess. We also use this time to catch up on administrative work and address any larger work list items.
- 1 to 5 p.m.: conduct more tests.
- 5:30 p.m.: discuss the day's tests and review any major discrepancies.
- 6 to 7 p.m.: dinner.
- 8 p.m.: the transitional power test, which takes about three hours, and includes a test of the emergency generator, transitional power supplies, fire door closure and indication, emergency escape signage and lighting, elevator programming, public address and general alarm, and other mechanical support systems.

Day two starts in much the same fashion:

- From 8:30 a.m. to noon: the USCG team runs tests, including the smoke extraction test. During this test, an atrium[1] is filled with smoke until visibility is at a minimum. The ventilation system must reduce the smoke levels to a point where an escape path is clearly visible from all locations in the space within 10 minutes.
- 1 to 5 p.m.: lunch and then more tests.
- 5:30 p.m.: the closing meeting, which usually lasts until 6 p.m.

A theater is filled with smoke in preparation for the smoke extraction test.

Author LT James Schock, marine inspector, inspects steering gear installation.

Day three starts a little later.

- We typically don't arrive onboard until 10 a.m., which gives the shipyard time to correct discrepancies and prepare for any remaining tests. The teams then conduct remaining tests and clear work list items.
- By 4 p.m.: the work list is typically cleared, with the exception of items that will need specialized parts or are larger in scope. During the closing meeting, we distribute an official work list and ensure that the first port personnel and the ship's captain and owner have good communication and that the expectations are clear for a smooth arrival in the U.S.

A large cruise ship under construction.

A Look Ahead

The cruise ship building cycle is currently in a lull, and the order book is quite shallow compared to years past. Thus, the ICOC schedule is reduced. At the same time, exams are becoming more complex. Safe return to port requirements[2] have vastly changed how ships are designed and increased the complexity of onboard technology. Add the growing desire to incorporate cleaner emissions, LNG as fuel, bigger ships, and increased passenger capacity, and the Coast Guard is faced with a daunting task to keep pace in a very fast-moving field.

Our relationships with the major shipyards and suppliers allow us access, and every inspection is filled with detailed discussions of how new equipment is designed, constructed, tested, and operated. Leading minds on the regulatory process from major class societies are present and open to discuss the current and future of regulation.

Most of all, the ICOC process pushes inspectors to dig into the regulations, research the facts, and make a truly educated decision. After all, if something goes wrong it could affect the thousands of souls aboard.

About the author:
LT James Schock is the ICOC coordinator at USCG Activities Europe. His prior duty stations include USCGC Boutwell *and inspections at MSU Port Arthur, Texas. He earned a B.S. in naval architecture and marine engineering from the U.S. Coast Guard Academy.*

Endnotes:

1. An atrium is a space that spans more than two decks.
2. Safe return to port standards define ship design thresholds including how long the vessel should remain safe for evacuation and circumstances where a ship should be able to return to port without requiring passengers to evacuate.

Ride-Along Training Program

A behind-the-scenes look at the PSSC survey.

by LT Kevin Whalen
Marine Investigator
U.S. Coast Guard Sector Miami

CWO3 Aaron Van Huysen
Senior Marine Inspector
U.S. Coast Guard Sector New York

The merchant marine industry training indoctrination ship rider program gives apprentice marine inspectors an orientation to the merchant marine industry by exposing them to a sustained period of merchant marine operations on a commercial vessel. Building on this premise, the Cruise Ship National Center of Expertise instituted an advanced training program designed to expand its staff's understanding of the scope of cruise ship flag state inspections relative to Coast Guard certificate of compliance examinations.

Under this program, foreign passenger vessel examiners ride aboard a cruise ship during its passenger ship safety certificate (PSSC) survey and shadow the classification society surveyors conducting that survey.

The Process

A passenger ship safety certificate survey begins with an opening meeting involving all the key parties. The PSSC survey schedule typically includes numerous intrusive engineering tests. If any discrepancies arise, the crew will make on-the-spot corrections. At the end of the day, unresolved discrepancies become work list items.

The surveys in which the authors participated took place during week-long cruises. One participant departed from the Port of Miami and the other from New York Harbor.

Each workday typically ran from 7:30 a.m. until 6 p.m. Occasionally, the day would finish at around 9 p.m., which allowed the surveyors to conduct scheduled deficiency checks and gave the crew the opportunity to make repairs.

As Coast Guard observers, we shadowed one of the two surveyors every day, observing tests including:

- the transitional power test;
- an external bottom survey with divers;
- water-tight door operation;
- smoke detector, fire door, sprinkler system, water mist system, and CO_2 alarm operation;
- lifeboat inspections;
- fire and abandon ship drill;
- quick closing fuel oil valve, remote valve, and section valve tests;
- international air pollution prevention survey;
- general engine room walk through;
- general safety walk through.

Mr. Brad Schoenwald and CWO Joseph Moskal, USCG foreign passenger vessel examiners, view a test of remote actuated valves. U.S. Coast Guard photos by ENS Jordan Ortiz.

In-Depth Testing

Transitional Power Test

During our surveys, we witnessed the transitional power test that verifies that the emergency source of power is able maintain electricity to critical systems during the time between loss of power and when the emergency generators come online.

To test for a worst-case power scenario, surveyors purposely prevent the emergency generator from coming online. The Safety of Life at Sea Convention (SOLAS) requires certain systems to function under transitional power. Additionally, SOLAS mandates that the batteries conform to a maximum voltage drop of less than 12 percent.

Surveyors walked through the ship to verify required systems such as water-tight doors operated, internal communications worked properly, navigation lights burned brightly, general alarms sounded, fire alarms activated, sprinkler section valves worked properly, and emergency lighting worked.

Views of transitional power battery banks.

Water-tight Door Test

We also witnessed closing water-tight doors remotely via bridge control. This SOLAS requirement allows the crew to safely close water-tight doors remotely to secure the ship if an emergency arises.

CWO Keith Macklin, USCG foreign passenger vessel examiner, observes watertight door testing.

Remote Operating Valve Test

Lastly, being able to witness testing remote operating valves provided a better understanding of all the systems and how they can be controlled. The system is so advanced that it lets the engineer know if the valve is closing, closed, open, or not fully closed due to an obstruction. It also features a safety redundancy that allows engineers to operate the valve locally during an emergency. (Pictured on previous page.)

Since many of the tests are intrusive for passengers, tests that would directly affect passengers were conducted while the ship was in port.

The vessel surveyors were extremely knowledgeable and took the time to explain each system in great depth to us, sharing priceless insight into their processes. As such, this opportunity greatly expanded our proficiency and provided invaluable information.

About the authors:
LT Kevin Whalen is a 2009 graduate of the U.S. Coast Guard Academy. He works as a marine investigator at USCG Sector Miami and previously served as a marine inspector at USCG Sector New York, where he received his foreign passenger vessel examiner qualification. LT Whalen holds a B.S. in marine and environmental science and an M.A. in management and leadership.

Chief Warrant Officer Van Huysen is a senior marine inspector at USCG Sector New York and is a qualified foreign passenger vessel examiner. He previously served on two aids to navigations teams at a Coast Guard small boat station and as engineering petty officer aboard the Coast Guard cutter Crocodile.

Authors' note:
Special thanks to DNV-GL surveyors, Mr. Christos Aspiotis and Mr. Bharat Madan, and Lloyd's Register surveyors, Mr. C.K. Chan and Mr. E. Buoso.

Training for the Future

The science of building a proficient workforce.

by LT Sarah Geoffrion
Instructor
U.S. Coast Guard Training Center Yorktown
Marine Inspections and Investigations School

Mr. Richard W. Symonds
Master Training Specialist
U.S. Coast Guard Office of Chief Traveling Inspector

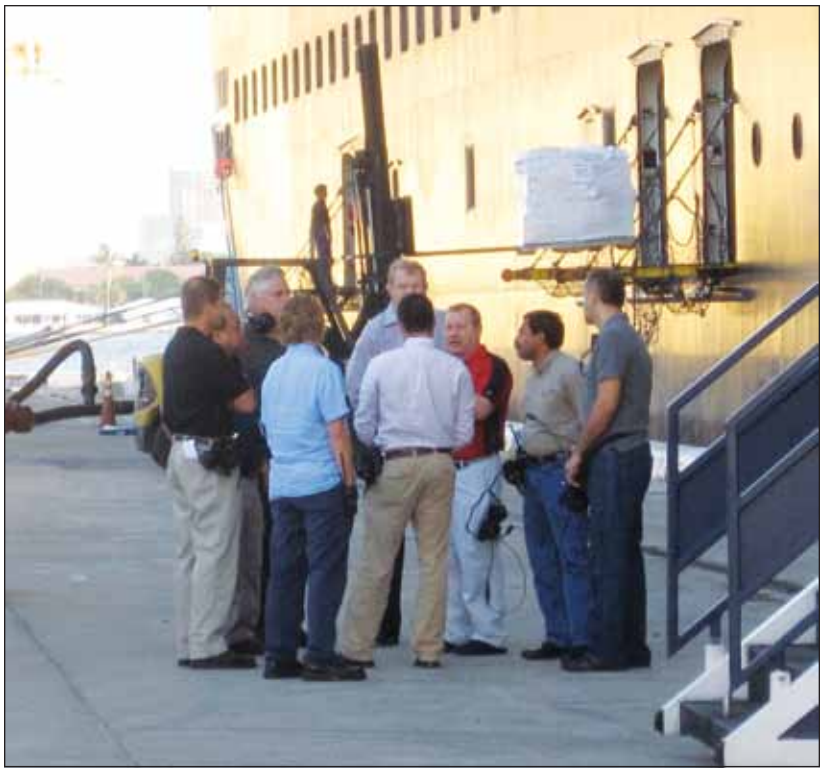
The Coast Guard Training Center Yorktown Marine Inspections and Investigations school develops performance-based training for marine inspections, waterways management, and casualty investigations, to uphold regulations and protect life, property, and the environment. Marine inspection training officers, verifying officers, and other subject matter experts guide trainees through the resident training course, which includes a performance-based task list, oral board, and vessel check ride.

Developing the Training

It is our job to ensure trainees understand marine safety requirements in domestic laws, international regulations, navigation vessel inspection circulars, policy letters, Commandant instruction manuals, and industry standards. To accomplish this, subject matter experts first identify tasks that support U.S. and/or international regulations, policies, or standards. Afterward, accomplished performers (the best of the best in their fields) rate a particular task's complexity, frequency, and importance, as it relates to mission success.

Next, human performance technology practitioners use job task analysis to determine the critical tasks necessary to accomplish a goal, which, in our trainee's case, is to earn a qualification. They also perform statistical analysis to determine the recommended performance intervention for each individual task, such as training to memory or developing a field job aid.

Finally, development teams utilize the validated task list to create performance and qualification standards, course curricula, and other performance support tools. Because all training processes originate from the same validated task list, we are able to maintain a consistent single performance standard.



Mr. Scott Elphison, senior marine inspector, speaks to trainees during an Advanced Foreign Passenger Examiners Course ship visit. U.S. Coast Guard photos.

Mr. Brad Schoenwald, senior marine inspector, leads an Advanced Foreign Passenger Examiners Course.

Ensuring Consistency

Verifying officers and marine inspection training officers ensure that the qualification process consistency is maintained in the field. This effort is especially important, as our job aids have not always contained references to support the tasks contained within. As a result, regional "best practices" and policies found a way into the training process, and these unit-developed job aids had an adverse impact on consistent training standard application.

We now verify and cite the regulations and national policies from which performance and qualification standard, training aid, job aid, and resident "C" school curricula are based, to verify that all training adheres to the recognized qualification standard. That way an apprentice marine inspector who completes the foreign passenger vessel examiner performance and qualification standard at the unit in Alaska will use the same performance support tools that are built into the training curriculum for a "C" school resident in Florida.

Results

By applying these practices across the full workforce development spectrum, the myriad teams that develop curricula are better equipped to ensure that our marine safety professionals are appropriately trained. Journeyman marine inspectors then put this training into action, equipped to perform their jobs efficiently and effectively.

About the authors:

LT Sarah Geoffrion has served in the U.S. Coast Guard for more than 10 years as a marine inspector, senior investigating officer, and marine safety detachment supervisor. She has received two commendation medals, two achievement medals, and the permanent marine safety insignia.

Mr. Richard W. Symonds is a retired U.S. Coast Guard officer with more than 20 years of experience working within the Coast Guard training system. He works extensively with the Cruise Ship National Center of Expertise to develop foreign passenger vessel performance solutions. Mr. Symonds is a master training specialist and holds advance level certificates in human performance technology and as an instructional systems designer.

The Advanced Foreign Passenger Vessel Examiner Course

Improving field expertise and organizational performance.

by Mr. Brad Schoenwald
Senior Marine Inspector and Lead Instructor
U.S. Coast Guard Cruise Ship National Center of Expertise

Foreign cruise ships are like large floating cities, with many different types of spaces, so examining them requires coordination, analytical proficiency, technical knowledge, and communication skills. Consequently, the U.S. Coast Guard established the Advanced Foreign Passenger Vessel Examiner (AFPVE) Course to improve overall field expertise.

The course's origin dates back to 1999, when Marine Safety Office Miami examiners began teaching the in-house Passenger Vessel Control Verification Course to improve cruise ship examination knowledge and competency. The course format remained largely unchanged until the Cruise Ship National Center of Expertise (CSNCOE) took ownership, overhauled the curriculum, and changed the course's name in 2008.

Course Revision

Of course, this is easier said than done. CSNCOE personnel first conducted an overall course review. As is often the case, there was good news and bad news. The good news: Knowledge of cruise ship systems was actually quite good throughout the Coast Guard. The bad news: Personnel identified two troubling trends:

- over-reliance on checklists,
- examination inconsistency from port to port.

Formerly, cruise ship examination teams conducted a systems-based ship examination using a checklist. However, an examiner could walk through multiple spaces to get to the next item on the list and walk past potential problems. The CSNCOE overhaul mandated a holistic examination approach in which examiners divided their responsibilities by ship's decks. Conducting a holistic examination removes the examiners' blinders and captures a broader random sampling of the ship.

To counter the trend of examination inconsistency throughout the Coast Guard, Cruise Ship National Center of Expertise staff intertwined elements of human performance with the new holistic cruise ship examination process to improve and standardize organizational performance.

The Course

The AFPVE course is formal resident training, also known as a "C" school, that is administered three times a year for up to 15 Coast Guard members and 10 cruise industry stakeholders per class. Industry attendees include shoreside cruise line representatives, ship officers, classification society surveyors, equipment manufacturers, and service representatives. In recent years, flag state representatives from the Bahamas, Bermuda, Netherlands Antilles, Japan, and the Dubai Maritime Authority have attended the class. Including industry and foreign flag state representatives in the course provides unique interaction that leads to greater transparency and understanding about what industry expects from the Coast Guard and what the Coast Guard expects from industry.

Although class participants have differences in opinion and outlook, their feedback is important to us since it helps us

"A" is For Advanced

Students often ask why the course is called the "Advanced" Foreign Passenger Vessel Examiner Course.

This dates back to our original course review process. We learned that very good Coast Guard examiners with great knowledge and subject matter expertise sometimes stumbled when it came to examination performance and communicating our expectations of the outcome from the examination.

We altered the course from knowledge-based criteria to a team performance-based model. Our goal was to advance examiners' proficiency, with the result of optimal performance for the examination team.

Basically, the AFPVE can be considered the "graduate school" for foreign passenger vessel examiners.

Advanced Foreign Passenger Vessel Examiner Course instruction includes video presentations, class discussions, and group projects. U.S. Coast Guard photos.

Mr. Scott J. Elphison, of CSNCOE, provides hands-on training during a ship visit. U.S. Coast Guard photo by Petty Officer Nick Ameen.

improve the course. Coast Guard participants gain valuable insight into how their decisions affect the safety, security, and commercial viability of the cruise industry. The class is divided into six teams of up to five people (made up of a mixture of Coast Guard and industry attendees) to ensure that each team has multiple points of view. Throughout the course, these teams encounter mock scenarios typical of Coast Guard cruise ship examinations, and they are asked to jointly evaluate and decide on a course of action. These scenarios build upon each other; and at the end of the course, students must provide a compiled list of deficiencies and enforcement recommendations for the fictional cruise ship.

The Follow-Up

About a month after each class, Cruise Ship National Center of Expertise personnel send surveys to attendees to ensure continual course improvement and gauge how they have been able to apply what they learned in the course. We also follow up with class members' supervisors to gain information on the member's improvement after the course.

We then score each part of the course, use the scorecard to steer our continual improvement process, and post the scorecards on our external website, so all attendees can see how we use their feedback.

About the author:
Mr. Brad Schoenwald retired from the U.S. Coast Guard as a CWO3 in 2007. He is a senior marine inspector, lead instructor, and the CSNCOE subject matter expert for structural fire protection, fire suppression, ship design and construction, bridge resource management, and shipboard operations.

For More Information:

If you are interested in attending the AFPVE course, contact the CSNCOE via our website:

www.uscg.mil/hq/cg5/csncoe/afpveapply.asp.

Black Swan 2013

A behind-the-scenes look at the Coast Guard's largest mass rescue operation exercise series.

by Mr. Paul Culver
Passenger Vessel Safety Specialist
U.S. Coast Guard District Seven

Mr. Jesse Rangle
Exercise Support Team Leader
U.S. Coast Guard Force Readiness Command

All swans were assumed to be white—until the late 1600s, when a European explorer found black swans in Australia. Similarly, the term "black swan"[1] has come to mean a rare, unpredictable, or unforeseen event, typically one with extreme consequences.

For example, 9/11 was a black swan event. In risk management terms, we call this low probability/high consequence and, true to its motto, the U.S. Coast Guard must be always ready to respond to this type of event.

To that end, we established a series of mass rescue operation (MRO) exercises named Black Swan, to improve preparedness within the passenger transport industry (cruise lines, airlines, railroads) and emergency management agencies. The *Monarch of the Seas* cruise ship hosted the first Black Swan exercise from April 1-5, 2013, during a post-refitting cruise to the Bahamas.

These exercises will help improve MRO plans, while simultaneously applying previously identified response gaps, lessons learned, and best practices, as the foundational framework.

Setting the Scene

The Black Swan project began in 2011 on a fast track. The exercise's first design and planning conference involved the U.S. Coast Guard, Royal Caribbean Cruise Lines, Norwegian Cruise Line, Carnival Cruise Lines, Disney Cruise Line, the Florida Advanced Surgical Transportation team, U.S. Embassy Nassau, Grand Bahama Island Rand Memorial Hospital, the Grand Bahamas Island Disaster Preparedness and Safety committee, and the Bahama emergency management agency.

Planners determined that the exercises would utilize the Homeland Security Exercise and Evaluation Program[2] process and include as a minimum:

- emergency notification,
- resource coordination,
- landing site management,
- passenger and crew accountability and reception center operations,
- medical surge support,
- incident management operations.

The Exercise Design Process

The Black Swan process started in Fort Lauderdale, Fla., with about 50 design team members. However, as the planning and design cycle continued, so did the design team's growth. The final design team totaled an unprecedented 168 members.

Planners needed to incorporate the realities of a mass rescue operation, so the team reviewed previous exercises and several risk-based studies to establish a plan with the necessary logistical

Cruise Line Support

Royal Caribbean Cruise Lines planners decided that the *Monarch of the Seas* personnel would:

- **embark the exercise staff and volunteer passengers;**
- **provide the hotel services throughout the exercise for volunteers and exercise staff;**
- **activate the international maritime distress processes;**
- **conduct, validate, and exercise its abandon-ship process, including lowering lifeboats;**
- **help coordinate the rescue and accountability process.**

Norwegian Cruise Line provided landing site plans for the exercise. Additionally:

- ***Norwegian Sky's* forward team managed the Bahamas Yacht Club landing site.**
- ***Norwegian Sky* personnel also provided transportation services during the exercise in Freeport and provided Freeport Harbor landing site coordination.**
- **The care team received the *Monarch of the Seas* exercise participants and transferred them to Carnival's care team at the family reception center.**

Timing was crucial, as the *Norwegian Sky* had to disembark its own passengers in Freeport for their excursions, send the forward team to the landing site, and return by 5 p.m., so the vessel could depart Freeport and continue with its normal cruise itinerary.

Carnival Cruise Lines care team members established a family reception center at the Grand Lucayan Hotel; and Disney Cruise Line provided a safety officer for the exercise and care team members for the family reception center.

The Norwegian Cruise Line forward team met up with the exercise volunteers who acted as passengers and crew at the landing site at the Grand Bahama Yacht Club, Port Lucaya, Freeport. Photos and graphics by Mr. Chris Todd, assistant public information officer, Black Swan Mass Rescue Operation Exercise.

Cruise line crew assisted with portions of the exercise including the abandon-ship process and survival craft embarkation.

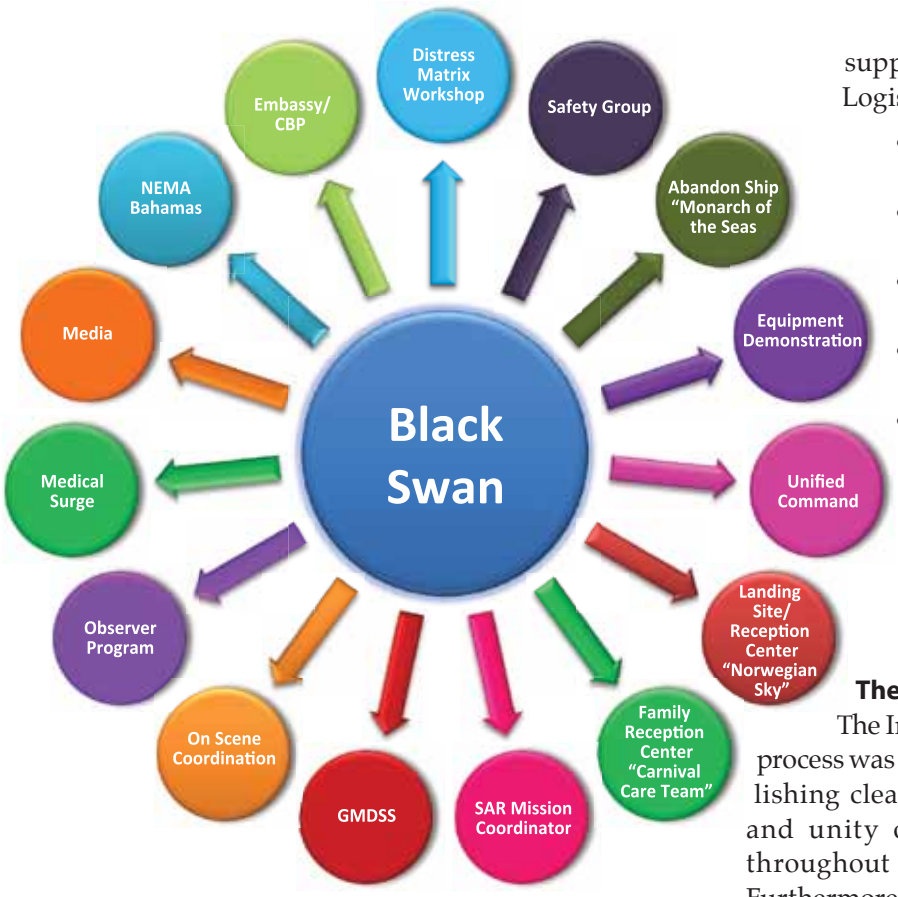
support. The team determined the Black Swan series would focus on the Incident Command System, passenger and crew accountability, and communications. Team tasks included:

- coordinating the rescue, landing site, and reception center management;
- activating a proactive media plan.

Planners also established a safety group, made up of representatives from all agencies and stakeholders, to develop and promulgate exercise safety procedures, preventive measures, protective equipment, and an overall site safety plan to ensure participant safety and equipment safety standards. Stakeholders decided it would be unnecessary to use a disaster "scenario," which could detract from the processes being exercised.

Key Players

Overall, four major cruise lines participated in the exercise: Royal Caribbean Cruise Lines, Norwegian Cruise Line, Carnival Cruise Lines, and Disney Cruise Line, with the Cruise Lines International Association as the U.S. Coast Guard/cruise line liaison. Each cruise line provided functional elements that related to mass rescue operations and provided a senior-level executive to act as an exercise unified



This graph displays the 15 elements of the Black Swan mass rescue operation full-scale exercise.

command member. Additionally, representatives from more than 25 countries participated in the exercise observer program. The observer element coordinator worked with the observer group to ensure they could watch each element, without interfering.

Of course a mass rescue operation exercise could not take place without "passengers" to rescue, so planners recruited 125 volunteers to act as passengers and crew members. This task was easier said than done, but we managed to locate the appropriate volunteers and get them checked in, briefed, and embarked on the vessel, before the sailing time.

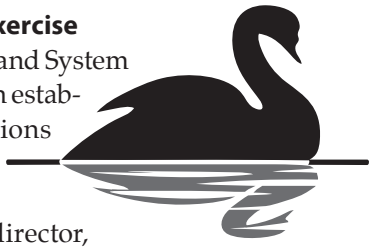
Logistics

The Balearia Ferry and Celebration Cruise Line were instrumental in providing outstanding logistical support to bring the 2013 exercise to fruition. Additionally, the West Palm Beach-based Pathfinder Task Force provided the processes, equipment, and personnel to provide instantaneous situational awareness for the exercise control and management during the three days of the exercise.

The actor coordinators, logistic section, and the Seventh District Contingency Preparedness and Planning staff managed, procured, contracted, and ensured that the exercise's support elements were present and ready to go. Logistical issues included:

- conducting site visits to establish exercise venues and identify safety issues,
- deploying a forward team to conduct final training and site setup,
- identifying volunteer actors and establishing exercise eligibility criteria,
- securing appropriate customs and immigration permissions,
- providing transportation and personal protection equipment for all exercise participants,
- securing lodging for the volunteers,
- establishing a situational awareness process and an exercise control communications network.

The Black Swan Exercise



The Incident Command System process was instrumental in establishing clear communications and unity of command throughout the exercise. Furthermore, the exercise director, deputy directors, and staff members supervised exercise "elements," which were grouped together to maintain span of control.

The exercise incorporated 15 major elements:

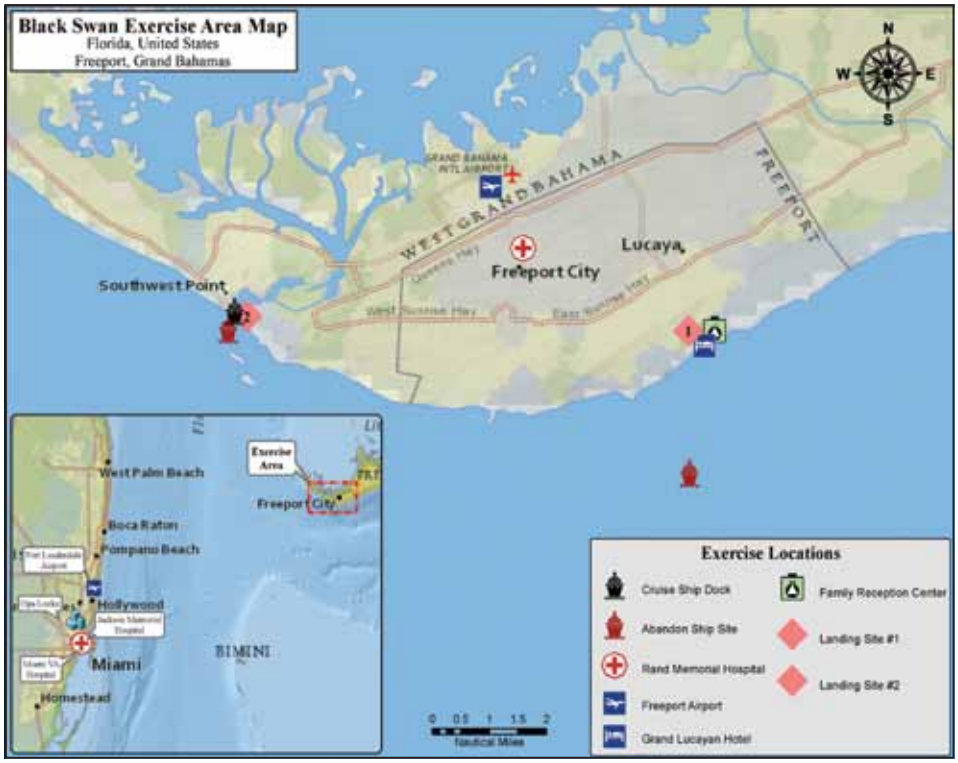
1. Evaluate the SAR system and validate interoperability with SAR partners.
2. Validate the VHF-FM and MF/HF digital selective calling process.
3. Validate survivor/responder accountability; family reception center logistics plan; and communications flow among family reception center, unified command, and the Carnival Cruise line rescue coordination center in Miami.
4. Establish and validate unified command organization progress and establish a virtual process to ensure a common operating picture.
5. Validate landing site management, accountability, and plan coordination.
6. Validate command and control team deployment, establish full ICU mobility, and coordinate medical surge response with Rand Memorial Hospital.
7. Validate abandon-ship ability and accountability process for passengers and crew.
8. Ensure the safety and welfare of all exercise participants.

Lifeboats are escorted into the Lucaya Port Harbor.

9. Guide observer program exercise experience.
10. Establish a joint information center and develop a crisis communications plan.
11. Utilize the Global Maritime Distress and Safety System Masters of Ships Decision Matrix guide.
12. Validate accountability processes and procedures, while supporting cruise line resources, and validate the crisis task force database system.
13. Validate mass rescue operation processes, protocols, and response capabilities.
14. Validate logistics and management processes for actors/participants.
15. Activate Grand Bahamas emergency operations services and validate security, accountability, and emergency shelter.

continued on page 43

Black Swan command and control team, from left: Mr. Paul Culver, exercise director, Seventh District; Mr. Stan Deno of the Cruise Line International Association; and Mr. Jesse Rangle, deputy exercise director, ESB-Alameda, Calif.



This graphic shows the region where the first Black Swan mass rescue operation exercise took place.

Chronology

March 29 to March 31, 2013

- The exercise forward team departs Fort Lauderdale, Fla., via the Balearia fast ferry with the control network communications equipment, and conducts controller and evaluator training.
- Pathfinder task force members embark the *Bahamas Celebration* in West Palm Beach, Fla.
- Exercise team members coordinate secure parking for staging sites and finalize the bus transportation contract.

April 1, 2013

- Buses pick up volunteers in Clearwater, Fort Pierce, West Palm Beach, and Port Everglades.
- Van shuttles between Orlando and Port Canaveral.
- *Monarch of the Seas* disembarks last passengers and prepares for exercise.
- Volunteer check-in at Port Canaveral cruise ship terminal.
- Control radio network activates in Freeport; repeaters on hotels and *Monarch of the Seas*.
- Vessel familiarization, safety training, and cabin assignment.
- *Monarch of the Seas* departs Port Canaveral to begin exercise.

April 2, 2013

- *Norwegian Sky* arrives at Freeport Harbor.
- *Norwegian Sky's* exercise forward team conducts Freeport participants' safety training, then deploys to the landing site at the Grand Bahamas Yacht Club.
- *Monarch of the Seas* arrives three miles offshore of entrance channel, and personnel conduct safety brief before the abandon-ship process.
- Safety group vessel, cutters, Royal Bahamas Police Force, Bahamas Air Sea Rescue Association, and field observers in place offshore to begin the scheduled elements of the day.
- Observer group in place offshore aboard the M/V *Victoria* to observe the offshore portion of the exercise.
- Security in place and escorts ready for landing site and volunteer transportation to second rescue element.
- Landing site ready to receive passengers and crew.
- Bahamas customs and immigration set up.
- Incident command post active.
- Rand Memorial Hospital personnel conduct triage training for medical staff, as per exercise medical plan.
- *Norwegian Sky* departs for Nassau, Bahamas.
- *Monarch of the Seas* moors at shipyard.
- Volunteers and exercise staff check in at hotel.
- Exercise staff conducts hot wash of the day's elements.

April 3, 2013

- Sixty-five volunteer actors deploy to Freeport International Airport for processing through U.S. Consulate and U.S. Customs and Border Patrol, and then back to the landing site to serve as arriving passengers and crew at the family reception center.
- Sixty volunteers serve as wounded passengers for triage and medical surge processing.
- Florida advanced surgical transport (FAST) team embarks U.S. Coast Guard C-130 in Opa Locka, Fla., to Freeport to set up critical care unit.
- Rand Memorial Hospital trauma center activates.
- Opa Locka airport patient receiving center activates.
- Family reception center activates.
- Medical patient triage at Rand Memorial Hospital.
- Critical patients transfer to FAST team for stabilization, and then board U.S. Coast Guard C-130 to Opa Locka for advanced medical care.
- Eighty volunteers process through family reception center and board the *Bahamas Celebration* for evacuation home.
- U.S. Coast Guard C-130 returns to Freeport for additional patients and transports FAST team back to Opa Locka.
- Secure Opa Locka airport receiving center.
- Dry dock *Monarch of the Seas*.

April 4, 2013

- Move *Monarch of the Seas* volunteers to Bahamas temporary shelter.
- Transport 80 volunteers from West Palm Beach to secure parking areas at original staging locations.
- Provide transportation for remaining volunteers.
- Secure control communications network.
- Open temporary shelter and provide food and water.
- Evaluators' meeting and hot wash.

Unscripted Challenge

The *Monarch of the Seas* was not scheduled to be dry-docked until the afternoon of April 4. The dry dock became available just before midnight on April 3, so the ship was dry-docked several hours early.

Numerous volunteers experienced the challenging dry-docking process. Deprived of lights, air conditioning, and other modern conveniences, they finally disembarked the ship, carrying their gear down numerous 45-degree ladders.

After Action Report

The after action report became the repository for numerous and comprehensive lessons learned, observations, and recommendations. Totaling 220 pages, the document identified 48 lessons learned and 62 recommendations for improvement. Some key elements identified in the improvement plan:

- **Cruise line standing safety committees and rescue services should work more closely together to develop mass rescue operation exercises.**
- **Rescue services and shore-side stakeholders should look into establishing a database of possible landing sites that could be used for mass rescue operations.**
- **Mass rescue operation accountability processes should be linked to existing processes used aboard the cruise ships or other modes of mass transit.**
- **Develop a mass rescue operation liaison officer training program for all stakeholders to improve the coordination and capabilities between cruise lines and rescue services.**
- **Medical surge capabilities and resources should be identified and processes established or amended to activate these resources.**
- **Media management training and exercises should be developed and utilized as a means to better coordinate a mass rescue operation. (Utilize the U.S. Joint Information center management process as the foundation for the training and exercises.)**
- **Establish an international mass rescue operation working group to share and develop lessons learned and best practices.**

The Challenges

The design team faced a number of challenges including a government sequestration just days away from the exercise start date. Sequestration-engendered process challenges included:

- replacing design meetings with teleconferences;
- coordinating tariff and entry fees with the U.S. Customs and Border Patrol; Port Authorities in Port Canaveral, Fort Lauderdale, and West Palm Beach, Fla.; and the Bahamas;
- eliminating the exercise control staff and assigning the roles and responsibilities to the exercise director and deputies;
- replacing the cancelled U.S. Air Force transport plane with a U.S. Coast Guard C-130, two days before the start of the exercise.

Additionally, 99 percent of our volunteer actors were Coast Guard Auxiliary personnel who required Coast Guard headquarters-level approval for travel. Therefore, the Seventh Coast Guard District office conducted numerous headquarters teleconferences to achieve the necessary travel approvals for more than 200 Coast Guard members to meet the new travel requirements.

Moreover, the Black Swan 2013 exercise overlapped with Easter week in the Bahamas—an official government holiday. As a result, the exercise forward team deployed two days before the exercise start date to arrange for the ground transportation for April 2-5.

Planners also had to embark equipment and support personnel on the *Bahamas Celebration* on March 30, in West Palm Beach, Fla., and embark the command staff and communications unit on the *Bahamas Express* on March 31, in Port Everglades, Fla. While the logistic team and command staff worked on the transportation challenges before the holiday, the communication unit set up the exercise control radio network and installed repeaters on hotel roofs in Freeport Harbor and on the *Monarch of the Seas* bridge deck, to provide offshore radio communications. All of this work and installations had to be accomplished before March 31 (Easter Sunday).


The Freeport News

FRIDAY

GUIDE

80°F

Black Swan 'a success'

ICIALS SAY THEY'RE BETTER EQUIPPED FOR REAL LIFE CIRCUMSTANCE

The Black Swan mass rescue operation made the front page of the *Freeport News*, April 5, 2013.

Lowering the survival craft for the Black Swan offshore mass rescue operation exercise.

Finally, driving around in the Bahamas can be a bit of a challenge for U.S. personnel, as traffic flows on the left side of the road, just like in the United Kingdom.

The Results

All told, the exercise involved more than 1,200 personnel and stakeholders, representatives from several countries, and spanned 29 geographically dispersed venues from Florida to the Grand Bahamas Islands. The exercise attained 100 percent personnel accountability with no injuries, no mishaps, or near misses, and now holds the rank of the largest, most complex full-scale exercise in U.S. Coast Guard history.

From concept to fruition, the Black Swan Offshore Mass Rescue Operation exercise established a benchmark in exercise design, validated preparedness plans, and created exercise standards that will enhance safety processes and protect lives for years to come.

About the author:

Mr. Culver has served as the Seventh Coast Guard's passenger vessel safety specialist since 2002. He is the primary liaison between the international cruise industries and regions emergency aviation management, and was the Black Swan exercise director in Freeport, Grand Bahama Island, Bahamas. He is a master exercise practitioner.

Mr. Jesse Rangle has served as a Senior Planner and Team Leader for the Force Readiness Command, Exercise Support Branch Alameda, California since 2008. He provides planning, coordination, and execution support for the U.S. Coast Guard all hazard contingencies throughout the United States. He is a master exercise practitioner.

Special thanks to:

Royal Caribbean Cruise Line; Norwegian Cruise Line; Carnival Cruise Lines; Cruise Line International Association; Celebration Cruise Line; Balearia Ferry Ltd.; Pinar Del Rio; Pathfinder Task Force and Angel Wings; Grand Bahamas Island disaster management; Freeport Emergency Operation Center; Freeport Salvation Army and Red Cross; Bahamas National Emergency Management Agency; Royal Bahamian Defense Force and Royal Bahamian Police Force; Bahamas Air Sea Rescue Association; Grand Bahamas Yacht Club; Freeport Ship Services; Overseas Marine Group Ltd.; Rand Memorial Hospital Freeport and their Emergency Medical Services; Florida advanced surgical transport team; Florida state medical response team-7; Freeport Harbor Company; U.S. Department of State Consulate team Bahamas; U.S. Jackson Trauma Centers Miami and Veterans Hospital Miami; Fort Lauderdale-Hollywood International Airport; Port Authorities of Port Canaveral, West Palm Beach, and Port Everglades; U.S. Coast Guard Seventh District and cutters *Joshua Appleby, Diamondback, Tarpon,* and *Cormorant;* Sectors Jacksonville and Miami; and Air Stations Clearwater and Miami; Seventh Coast Guard District Auxiliary members; Miami Rescue Coordination Center; Seventh Coast Guard District Incident Management Branch; the offices of Contingency Preparedness and Exercises; and to the volunteers for your understanding and support.

Endnotes:

1. See www.svswans.com/black.html.
2. *The Challenges and Risk of Managing an Emergency at Sea.* Washington, DC: U.S. Coast Guard, Black Swan After Action Report, Jan 2014, unpublished.

The Alaska Department of Environmental Conservation

Addressing Alaska's cruise ship wastewater discharge requirements.

by Mr. Rob Edwardson
Former Manager, Cruise Ship Program
Alaska Department of Environmental Conservation

Alaska is a maturing market for the cruise industry. Consequently, dozens of large commercial passenger vessels, including cruise ships carrying 250 or more passengers, transit to Alaska each year. And, although wastewater from these ships is arguably the cleanest in the world, the issue of cruise ship wastewater discharge in Alaskan waters has been long and contentious.

The History

In 1999, the Alaska Department of Environmental Conservation (DEC) established the Alaska Cruise Ship Initiative (ACSI) to address public concerns of historical cruise ship violations for discharging oily water and chemicals into Southeast Alaska waters and reports of discharges of untreated sewage and garbage in the Inside Passage. The ACSI also addresses concern toward the dramatic growth of the cruise industry and its possible impact on fisheries and the marine environment.

Effluent sampling conducted through the ACSI in 2000 revealed cruise ship marine sanitation devices (MSDs) were not performing well. In fact, just 43 percent of the samples complied with the federal MSD standard for fecal coliform, and only 32 percent of the samples complied with the federal standard for total suspended solids.

In response, the U.S. Congress passed Title XIV, Certain Alaskan Cruise Ship Operations, which prohibited discharge of untreated sewage in Alaskan waters and mandated that treated sewage and gray water must meet minimum requirements. It also allowed the EPA to create minimum effluent quality regulations that would be consistent with state of Alaska water quality standards, while allowing Alaska's state government to implement additional requirements.

Standards for Alaskan Waters

In July 2001, Alaska statute 46.03.460 established effluent limits for fecal coliform and total suspended solids and required sampling of discharged sewage and gray water from large cruise ships. Prior to 2001, cruise ships operating in Alaska discharged sewage through conventional Type II MSDs (marine sanitation devices). However, the EPA and the Alaska Department of Environmental Conservation determined that effluent quality from these devices did not meet required effluent standards. This resulted in Public Law 106-554, which required cruise ships operating in Alaskan waters to meet more stringent effluent standards.

Responding to this requirement, cruise ships installed advanced wastewater treatment systems by 2003. Although these systems meet certain federal requirements for primary and secondary wastewater treatment standards, they have proved ineffective in removing four pollutants that have been of particular concern in Alaska: ammonia, dissolved copper, nickel, and zinc.

In 2006, Alaskans passed a ballot measure that included several provisions relating to cruise ships, including requiring that pollutants in cruise ship wastewater discharge meet Alaska water quality criteria at the point of discharge. It also called for changes in cruise ship taxation, regulation, and disclosure. The initiative assessed a $46 per person/per voyage tax on large cruise ships and assessed a $4 per passenger berth fee to fund ocean rangers—licensed marine engineers placed aboard cruise ships to observe health, safety, and

Cruise ships transport approximately one million tourists through Alaskan waters yearly. U.S. Coast Guard photo by Petty Officer Levi Read.

wastewater treatment and discharge operations. The initiative also required operators to gather and report more information and obtain a new type of wastewater discharge permit. Moreover, it authorized citizen lawsuits for alleged violations.

In 2008, the Alaska Department of Environmental Conservation issued a new large commercial passenger vessel wastewater discharge permit with a term of 2008 to 2010. The permit required additional reporting and sampling and contained interim (2008 and 2009) limits for ammonia, copper, nickel, and zinc, to allow permittees time to improve effluent quality. The interim limits required cruise ship operators to submit a source reduction evaluation to DEC that documented progress to achieve the final limits. The permit established final effluent limits for ammonia, copper, nickel, and zinc that applied Alaska water quality criteria at the point of discharge beginning in 2010.

In April 2010, the DEC issued the 2010 large commercial passenger vessel wastewater discharge permit, which incorporated the previous statutory changes, added limits for stationary discharge, established limits based on treatment system used, and established a chlorine effluent limit for all ships. While it eliminated the source reduction evaluation requirements, the 2010 permit included updates to reporting, monitoring, permit transfers, and discharge restrictions.

The Effort Continues

On February 28, 2013, a new law allowed an extension of the 2010 permit and allowed the DEC to issue a new permit that includes mixing zones. Today, the DEC is developing a general permit compliant with the new statutes.

About the author:
Mr. Rob Edwardson retired from the Coast Guard in 2007, as a CWO3 with 20 years of service. He has worked as the manager of the Alaska Capitol, chief of Contingency Planning for Sector Juneau, and has been the DEC Cruise Ship Program manager for three years.

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Alaska Wastewater Standards

Closing the doughnut hole loophole.

LCDR Jason Boyer
Chief of Prevention
U.S. Coast Guard Sector Juneau

U.S. Coast Guard Sector Juneau's Prevention department tracks all cruise ships that come in and out of Alaska waterways. The department found that in 2012, 32 cruise ships transited the waters of Alaska and made port calls from Ketchikan to Whittier, delivering more than 925,000 passengers to these ports. Moreover, in 2013, 42 cruise ships operated within the Inside Passage (a sea route along the western coast of North America), carrying an estimated one million passengers.

These numbers are exciting to all those cities and businesses that rely on cruise ship tourism. These floating cities provide financial benefits throughout southeast Alaska, as tourists coming ashore will spend money on local goods and services.

Somewhat offsetting these benefits, large cruise ships bring the potential of significant environmental, mechanical, and personnel challenges including equipment failures, collisions, groundings, and personal injuries or deaths. Additionally, vessel waste discharge such as garbage; gray water; black water; or hazardous substances also presents concerns.

The Doughnut Hole Loophole

As the majority of these cruise ships carry more than 3,000 people, one can imagine the challenges that accompany every aspect of their visit. These tourists come to Alaska to experience the thousands of islands, countless miles of shoreline, and pristine inland waters that stretch through most of the southern portion of the state.

Additionally, Alaska's Inside Passage is laden with areas well inside the line that separates inland waters from outside waters. These larger expanses of water are known as "doughnut holes," and are large enough that they stretch more than three nautical miles from shore on all sides. Unfortunately, this distance from shore provided a legal area for all vessels to enter and discharge sewage and gray water without restriction.

An advanced wastewater system handles gray and black water waste. All photos by Mr. Bert Sazon, marine inspector.

Admiralty Environmental LLC Sampler Kim Valverde verifying proper tests for consistency.

High turbidity could be an "alarm sign" that the treatment process is not functioning well, so a turbid meter can be a valuable process indicator.

The back pulse system provides suction, moving the water through the membrane.

Closing the Loophole

In 2000, U.S. Sen. Frank Murkowski introduced legislation, known today as the "Murkowski Law," that eliminated this legal loophole and made it illegal for large cruise ships to discharge without meeting stringent regulations.

On December 21, 2000, the U.S. Congress voted these wastewater regulations into law and established the governing rules for discharges of sewage and gray water within Alaskan waters. This law mandated that vessel operators meet sampling and testing schedules and established reporting and record keeping requirements for all applicable cruise ships.[1] In addition to these federal regulations, there are also state regulations that apply to vessels carrying less than 500 passengers.

It is important to understand that these wastewater regulations do not eliminate the legal discharge of "treated" sewage or gray water within the inside waters of Alaska; rather they establish a specific set of requirements to allow vessels to legally discharge.[2]

The Options

One option available to the cruise industry is for ships to transit beyond the baseline at least three nautical miles into the Gulf of Alaska to conduct any discharge operations. This alternative is not conducive to most cruise ship operations, as this would force them off-course and disrupt their schedules.

There is another option to the above rule that requires the cruise ship operator to make notification to the captain of the port, southeast Alaska, not less than 90 days before initial entry into Alaskan waters. The company must provide proof that the vessel's treated wastewater meets the effluent standards found in 40 CFR 133.102.[3]

The last wastewater discharge option available to large cruise ships allows them to continuously discharge while operating on the inside waters of Alaska. This program grants permission to those ships that meet the stringent 40 CFR 133.102 requirements and allows them to conduct discharge operations throughout the operating season without having to request approval or complete sampling prior to each discharge. The captain of the port provides a letter to the companies that meet these requirements—highlighting compliance with the reporting, sampling, record keeping, and discharge effluent requirements as outlined in the regulations.

Additionally, the vessel must maintain a Coast Guard-approved quality assurance/quality control plan that outlines vessel-specific sampling techniques, required onboard equipment, wastewater sample preservation methods, laboratory chain of custody, and such. The vessel-specific sampling plan must note:

- passenger/crew capacity;
- vessel's daily water use;
- holding tank capacities and discharge port schematics;
- a table documenting type of sample, test parameters, and information specific to each sampling event.

Finally, each vessel that operates under this program must submit to unannounced random wastewater sampling two times per month.[4]

Admiralty Environmental LLC Sampler Kim Valverde checks the effluent sample taken from black and gray water.

Kim Valverde tests for residual chlorine and pH.

An Even Playing Field

All cruise vessels operating within Alaskan waters are subject to compliance inspections and potential enforcement for noncompliance with applicable regulations. These inspections are noted in 33 CFR 159.313. Specific examined items include the sewage and gray water discharge record book and environmental compliance records. Noncompliant vessels are subject to civil penalties ranging from a maximum of $10,000 per violation to $10,000 per day for each day the violation occurred.

The Results

Coast Guard sectors throughout Alaska work very closely with the Alaska cruise ship industry to ensure they fully understand the applicable regulations and are aware of any changes to policies. Each operating season begins with preseason visits to each ship to welcome them to Alaska and to discuss all applicable regulations and expectations.

This program has proved very successful. It has forged partnerships, ensured open communications, and enhanced regulatory understanding—thus maximizing compliance across the board. The Coast Guard, its regulatory partners, and the cruise ship industry are very conscious of Alaska's attraction. Therefore, we work together to reduce any harm from cruise ship operations.

About the author:

LCDR Jason Boyer is the chief of Prevention for Sector Juneau, Alaska. He has served in the U.S. Coast Guard for 22 years. He has completed nearly 12 years in the "M" field and gained the bulk of his inspection/investigation qualifications in the Gulf of Mexico oil industry, serving seven years in Louisiana. He recently completed his B.S. in organizational leadership and maintains a current merchant mariner's license.

Endnotes:

1. These regulations are outlined in 33 Code of Federal Regulations (CFR) part 159, subpart E and apply to each cruise ship authorized to carry 500 or more passengers operating in the waters of the Alexander Archipelago and the navigable waters of the United States within the state of Alaska and within the Kachemak Bay National Estuarine Research Reserve.
2. These requirements are outlined in 33 CFR 159.309, which states that no person shall discharge treated sewage or gray water from a cruise ship in the applicable waters of Alaska unless the vessel is underway and proceeding at a speed of not less than six knots and the cruise vessel is not less than one nautical mile from the nearest shore except in areas approved by the U.S. Coast Guard or in an emergency. Additionally, the discharge must comply with all applicable cruise vessel effluent standards specified in 40 CFR 133.102.
3. Specifically, the vessel's treated sewage must be sampled in accordance with the sampling guidelines outlined in 40 CFR 136 and the samples must have been collected a minimum of five times during a 30-day period prior to any consideration for permission to discharge. Each of these samples must be sent to a laboratory accepted by the Coast Guard for testing conventional and priority pollutants. Conventional pollutants include total suspended solids, fecal coliform, oil/grease and pH. Priority pollutants include the various toxics found in sewage. The results of each sample shall remain within the published acceptable limits if permission to discharge is to be considered.
4. It should be noted that not all companies request this option; the Coast Guard issued 14 continuous discharge letters for the 2013 operating season.

Ocean Rangers

Monitoring marine discharge requirements.

by Mr. Rob Edwardson
Manager, Cruise Ship Program
Alaska Department of Environmental Conservation

In August 2006, Alaskans passed a law that contained provisions for commercial passenger vessel environmental practices, including the Ocean Ranger program.[1] Ocean rangers are independent observers deployed on cruise ships to monitor state and federal requirements for marine discharge and pollution. To qualify, an ocean ranger must hold a U.S. Coast Guard marine engineer license, a marine safety and environmental protection degree, or have completed an equivalent course of study from an accredited maritime educational institution.

The Alaska Department of Environmental Conservation (DEC) Cruise Ship Program implemented an ocean ranger pilot program in 2007 and has managed the full-scale program since 2008. Each cruise ship operating in Alaskan waters pays a $4 per-berth, per-voyage fee that funds ocean ranger program activities.

Mr. Morris Mickelson, ocean ranger, checks life raft inspection records.

Deployment

The deployment schedule contains three types of deployments. Ocean rangers board cruise ships in Seattle, Wash., or Vancouver, Canada, for the entire round-trip voyage; board in Alaska and depart in Alaska on a partial voyage; or conduct in-port inspections.

Deciding factors on whether to have an ocean ranger conduct an in-port inspection versus a full voyage deployment include the ship's permitted wastewater discharge status in Alaska, the ship's compliance history and itinerary, ocean ranger availability, and daily cabin costs. Ocean rangers change ships after approximately four weeks, which allows them enough time to become familiar with each ship, yet not become complacent.

Monitoring Compliance

As a part of their duties in monitoring vessel compliance with state and federal environmental laws and regulations, ocean rangers submit daily reports for each day a cruise ship is in Alaskan waters, whether underway or in port, and complete general reports that inform DEC about vessel conditions that might evolve into noncompliance or recommend program improvements. Ocean rangers also inform a cruise ship's crew of potentially noncompliant conditions.

For potentially noncompliant conditions that fall outside of the cruise ship program's jurisdiction, personnel notify appropriate state and federal agencies, including the U.S. Coast Guard, U.S. Centers for Disease Control and Prevention, U.S. Environmental Protection Agency, and the appropriate state of Alaska and local health agencies.

In the case of an actual noncompliant condition, cruise ship program staffers research the laws, regulations, permits, and required plan terms and conditions; decide the appropriate compliance

2012 Ocean Ranger Statistics

Out of 451 voyages in 2012, ocean rangers monitored 289 (64 percent) and provided port inspections for an additional 106 voyages (24 percent). All told, ocean rangers reported:

- **55 oil pollution-related findings. Of these, in six cases, petroleum products from a cruise ship entered Alaskan waters, caused by faulty propulsion equipment, leaking seals, or ruptured hydraulic lines. Other findings were potentially noncompliant conditions or were not attributable to cruise ships.**
- **seven findings for non-pollution oil-related matters, including oil record, equipment, and oily water separator operation.**
- **14 cases where oil (including fuel) leaked internally on the ship, but not into Alaskan waters. Additionally, some cruise ships had oil in bilges, oil lost from tanks or machinery, leaking fuel pipes to combustion equipment, and internal fuel spills.**
- **24 non-traceable pollution incidents or "mystery" sheens. Ocean rangers observed these oil pollution incidents, but could not find the source.**
- **four oil pollution cases related to port operations (from forklifts and cranes on docks), but not attributable to a cruise ship.**
- **35 potential safety findings including loss of power, crew members not using adequate safety gear while working aloft, internal fuel leaks or drips, electric power cords through open metal doors, and covers missing on rotating equipment.**
- **10 potential health findings, most related to potable water connections between the cruise ship and public water supplies (hose and connector sanitation items). The findings also included potential norovirus occurrences.**
- **22 wastewater findings. Several wastewater discharge logs did not meet state of Alaska regulatory requirements. Ocean rangers also reported several sampling plan inaccuracies, including an undocumented wastewater stream into an advanced wastewater treatment system and inaccurate storage tank identification.**
- **11 potential "other" waste findings, including objects dropped into the water, such as plastic safety gear; drops of paint into the water; and an anchor lost overboard (later recovered).**
- **13 air pollution or opacity findings. Ocean rangers also assisted with researching cruise ship self-reported opacity events. Ocean rangers are not certified Environmental Protection Agency opacity readers and could not perform official opacity readings. However, marine engineers understand "excessive smoke" conditions and receive training on opacity regulatory requirements.**
- **one accidental discharge of pool and spa water in Alaskan waters. Concerns about the release of pool water and spa water into Alaskan waters included a potential release of pathogens into surrounding waters.**

There was an increase in potential noncompliance items compared to 2011 (47 more items), which was likely the result of a small increase in the total number of reports, a much more detailed guidebook, and more comprehensive ocean ranger training in 2012.

There was also an increase of safety-related items. Ocean rangers noted many of these items while waiting to board a cruise ship, gain access to the engine room, or meet with crew as part of the other daily checks.

assistance, administrative, or compliance action; and work with the owner or operator to stop or correct the condition.

Ongoing Efforts

Ongoing refinements in ocean ranger training, guidance documents, communications, and reporting improve clarity and processing time, allowing ocean rangers to devote more time to monitoring and less to supporting activities. As a result, ocean rangers can provide timely and high-quality information regarding oil pollution, opacity (air emissions), wastewater treatment, solid waste processing, and required documentation.

Ocean rangers also assist cruise ship crews in understanding state of Alaska requirements. Detailed ocean ranger monitoring and reporting verified that, in general, cruise ships follow sound environmental, health, and safety practices.

Challenges

Cruise ship cooperation is strong. However, intermittent communication issues persist among ocean rangers and vessel crews. While the issues represent a small fraction of interactions, if left unaddressed, the frequency of the issues could increase or result in avoidable noncompliant

Mr. John Webb, ocean ranger, checks an overboard valve.

conditions. The cruise ship program will continue to foster a team approach with vessel crews and owners/operators.

Access issues indicate that some cruise lines may remain reluctant to cooperate with ocean rangers. Although these incidents represent a small fraction of interactions, the cascading effect may continue to impact ocean ranger monitoring. The cruise ship program will address these issues with continued efforts to improve communications with owners and operators and by reminding operators that ocean ranger monitoring is a legal requirement, not a voluntary activity.

Mr. Morris Mickelson checks a food waste chute.

Ocean rangers have reported numerous harbor sheens that, while not attributable to cruise ships, still represent concern for Alaskan water quality. DEC will continue to focus ocean ranger efforts toward determining the source of these sheens to assist the appropriate agencies and responsible parties in resolving the conditions.

Ocean rangers have also reported wastewater findings related to required documentation. The findings tended toward improper required documentation completion, rather than the absence of the documentation. While improperly kept documentation does not represent an immediate danger to water quality, it can indicate possible systemic problems with a cruise ship's wastewater management practices and reporting.

Additionally, daily reporting indicated that a number of cruise ships had submitted deficient or inaccurate vessel-specific sampling plans (VSSP). Although the cruise ship program did not find that the deficiencies or inaccuracies caused effluent quality concerns, they may have been contributing factors for wastewater spills in previous years and may contribute to mishaps in the future. The cruise ship program will increase future VSSP verification projects to help avoid cruise ship mishaps and to maintain the statistical integrity of sampling data.

About the author:
Mr. Rob Edwardson retired from the Coast Guard in 2007, as a CWO3 with 20 years of service. He has worked as the manager of the Alaska Capitol, chief of contingency planning for Sector Juneau, and has been the DEC Cruise Ship Program manager for three years.

Endnote:

1. Visit the Alaska Department of Environmental Conservation at http://dec.alaska.gov/water/cruise_ships/Law_and_Regs/index.htm.

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Port Everglades Gets It Done Safely

The multi-layered approach to safety and security.

by Mr. Glenn A. Wiltshire, Captain USCG (ret.)
Deputy Director
Port Everglades

Ms. Ellen Kennedy
Corporate and Community Relations Manager
Port Everglades

Port Everglades, Fla., is one of the three busiest cruise ports in the world, with nearly 4 million passengers anticipated to sail in and out during 2014. It is also the top container port in Florida and the only receiving seaport for all petroleum products coming into South Florida.[1]

So how does this 2,190-acre international seaport facilitate commerce, while ensuring the safety and security of the traveling public? The short answer: through a multi-layered approach that requires communication and partnership with the cruise lines, law enforcement agencies, security professionals, and port users.

Pre-9/11 Open Access

Prior to 9/11, area residents commonly used the port's main through streets as shortcuts to the interstate, the beach, or to the shopping district. One of the city's most popular restaurants was located on a cruise dock. The Broward County/Greater Fort Lauderdale Convention Center is also within the port's jurisdictional area and has hosted 5 million guests since opening its doors in 1991. Trade show vendors were used to loading and unloading their trucks right at the entrance, and many of the events were open to the public without prior screening or restrictions.[2]

Additionally, 13 petroleum terminals reside within the port's jurisdictional area, located along public open access roads. Tanker truck drivers depended upon the port's easy access to pick up loads and hop right on the interstate.

Post 9/11

After 9/11, however, new security standards restricted access to the port's interior facilities, thus affecting cruise terminals, the convention center, and other businesses within the port's jurisdictional area. Today, eight-foot-high fencing, topped with three strands of barbed wire, stands around the perimeter of the port and in restricted areas.[3]

Gates control access at each of the port's four main entrances, and to gain entrance, workers must undergo background checks annually to obtain port business-purpose badges. Visitors must present government-issued photo identification,

Cruise passengers must show a valid ID and their cruise tickets at port access control points. Photos courtesy of www.broward.org.

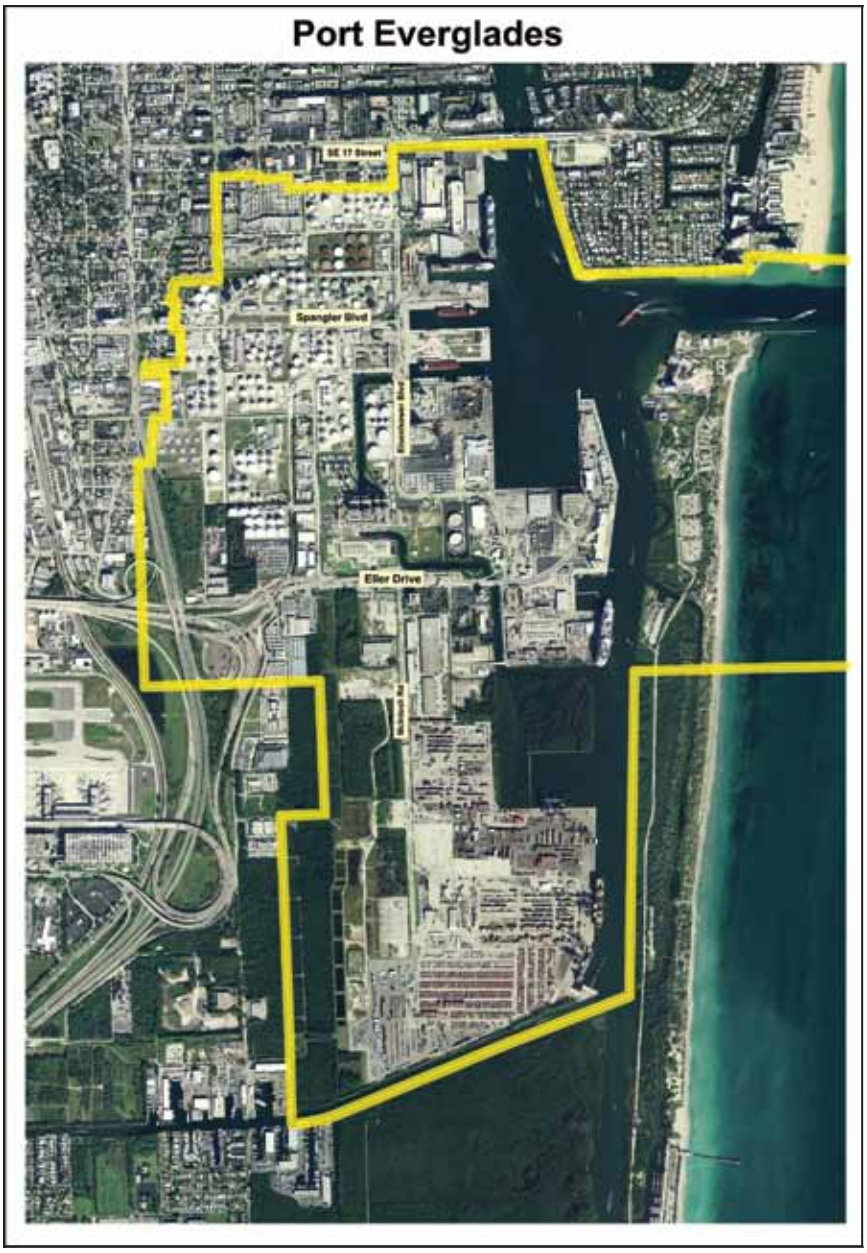
Security Is Everyone's Business

Non-law enforcement personnel at Port Everglades are trained to be on the lookout for suspicious behavior and take an active part in crime prevention.

For example, Broward Sheriff's Office initiated a training program specifically for taxi drivers on how to spot and report suspicious activity in Port Everglades. The International Longshoremen's Association also trains its members to look for suspicious activity around the cruise terminals.

Additionally, the port publishes tips for all port workers, including linehandlers, harbormasters, cruise service managers, and greeters on what is considered suspicious or unusual. Such as:

- **unknown persons attempting to access facilities;**
- **individuals without an identification badge;**
- **unknown persons loitering in an area for extended periods of time;**
- **unknown persons photographing facilities in and around the port;**
- **telephone calls to ascertain security, personnel, or standard operating procedures;**
- **persons in vehicles or small vessels photographing, taking notes, or drawing sketches;**
- **low-flying general aviation aircraft operating in proximity to facilities;**
- **emails requesting information about facilities, personnel, or standard operating procedures;**
- **unusual package drop-offs or attempts to do so;**
- **small boats loitering near ships or docks.**



Port Everglades jurisdictional area is outlined in yellow.

have a business purpose inside the port, and are limited to just five visits within a 90-day period.

The port also utilizes two automated security gates for petroleum tanker trucks, and a new security operations center consolidates port security system control.

Challenges

The current challenge is ensuring the safety and security of our passengers, cruise line customers, port users, and staff, while facilitating their movement in and out of an active cargo port.

To achieve this, Port Everglades uses a multi-layer approach that begins upon entering the port's two-mile jurisdictional area. Upon arrival, all visitors must present valid government-issued photo identification and comply with periodic vehicle screening at the security checkpoint.

Non-cruise visitors must have a business purpose to enter the port, and security staff members scan their identification before issuing a required visitor's badge. Cruise guests provide their cruise tickets, along with government-issued photo identification, to show proof of ticket ownership. (See sidebar for more information on cruise ship security.)

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Cruise Ship Safety and Security

Prior to the ship's arrival, which typically occurs before 6 a.m., Broward Sheriff's Office personnel sweep the terminal, looking for explosives and illegal narcotics. The sheriff's office also provides waterside and air patrols.

Once at the cruise terminal, all cruise passengers, crew, and personal belongings are screened.[1] The cruise line provides private security guards within the terminal as well as shipboard security personnel, and each terminal has at least two sworn law enforcement officers on duty within the terminal during any passenger activity. The cruise lines also establish security screening points aboard the ships for passengers and crew.

Regulations

The cruise lines are heavily regulated under U.S. and international law, maritime conventions, and flag and port state laws, and the regulations cover every aspect of the cruise experience—from ship design and construction to operations—all aimed at protecting passengers and crew. Cruise lines must also adhere to strict International Maritime Organization requirements, which mandate global cruise ship safety and operational standards.[2]

For example, the International Convention for the Safety of Life at Sea requires all persons on cruise vessels be accounted for prior to departure. Prior to departure, the master must also record details regarding those who have declared a need for special care or assistance in an emergency, and cruise staff must record names and gender of all persons (distinguishing between adults, children, and infants) for search and rescue purposes. Additionally, all of this information must be kept ashore, readily available to search and rescue services.[3]

Industry and Government Agency Efforts

The port files a seaport security plan with the U.S. Coast Guard (USCG), and its cruise terminals are inspected regularly. Moreover, each cruise line also submits cruise terminal security plans. Depending on the number of vessels at the port, a cruise line may be assigned to any of the cruise terminals at the port, so each line must have approved security plans covering all terminals.

U.S. Customs and Border Protection (CBP) personnel secure the cruise terminal's debark facility, so each passenger can be processed before re-entering the United States. Port Everglades has also worked very diligently to ensure compliance with CBP's cruise terminal design and operating standards in each of its cruise terminals.

U.S. Department of Agriculture personnel conduct inspections in the cruise terminals to prevent potentially hazardous food, plants, and animals from being brought into the United States through the port.[4] Staff from the U.S. Center for Disease Control and Prevention's Vessel Sanitation Program are also based at Port Everglades to perform recurring cruise ship sanitation inspections as well as respond to gastrointestinal illness outbreaks.

In addition, the USCG Cruise Ship National Center of Expertise (CSNCOE), located at Port Everglades, is the repository of Coast Guard expertise and best practices. As the industry liaison, the CSNCOE provides training and mission support to the Coast Guard and industry.

Endnotes:

1. See www.cruising.org/regulatory/cruise-industry-policies/cruise-industrys-commitment-safety-security.
2. See www.uscg.mil/hq/cg5/csncoe/codeandcfr.asp.
3. See www.cruising.org/regulatory/clia-policy-recording-nationality-passengers.
4. See www.aphis.usda.gov/.

Porters are trained to look for any suspicious behavior or activity.

Cruise guests and their belongings are screened inside the cruise terminals.

What Role Does the Coast Guard Play?

by LTJG Kirsten Haas
U.S. Coast Guard Sector Miami

The U.S. Coast Guard helps to ensure Maritime Transportation Security Act regulations are implemented, but no one agency can carry out all the responsibilities of security alone. Coordination and partnerships among the Coast Guard, industry, local law enforcement agencies, and port representatives are vital in ensuring successful port security.

Facility Security Plan

For example, every five years, cruise ship companies must submit a facility security plan to the Coast Guard for review, which is a result of an extensive facility security assessment. The facility security officer (the person designated to oversee all security operations for the company) surveys the terminal's threats and vulnerabilities and provides the vital information needed to write the security plan and mitigate those threats.

When the Coast Guard receives the facility security plan, personnel perform a detailed plan review that includes a site inspection. After the facility security plan is approved, the facility will also be subject to one announced and one unannounced Coast Guard inspection each year.

The Declaration of Security

Interface between the cruise ship and the terminal is another area of concern. The cruise ship facility security officer must coordinate security needs and procedures with the vessel master or vessel security officer. Upon vessel arrival, both parties must sign the declaration of security. Neither the facility nor the vessel may embark or disembark passengers until this is signed and implemented. Additionally, the declaration of security must be available for Coast Guard inspection at any time.

TWIC

Controlling access to secure areas is a vital step in port security. For example, all pier space at Port Everglades is restricted and secure; therefore, anyone accessing these areas must have a Transportation Worker Identification Credential (TWIC), which is a biometric security credential.

A TWIC is required for any individual who requires unescorted access to secure areas of the port, or regulated facilities and vessels, and all U.S. mariners must hold Coast Guard-issued credentials. TWICs are valid for five years.

The Port Security Grant Program

To strengthen the nation's critical infrastructure against risks associated with potential terrorist attacks, Congress authorized the Port Security Grant Program to help ports improve their security. Each year, ports across the U.S. can apply for federal money to enhance their maritime domain awareness, support maritime security training and exercises, improve port recovery and resiliency capabilities, or improve port-wide maritime security risk management. The Coast Guard and Federal Emergency Management Agency review all plans and assign funds to groups based on relative risk rankings.

U.S. Coast Guard Station Fort Lauderdale, located across the Intracoastal Waterway from Port Everglades, monitors pleasure craft in and around the port.

To ensure that all take a coordinated approach, Port Everglades' security and communications staff and representatives of the port's business community meet monthly with security partners, including representatives from Transportation Security Administration, U.S. Coast Guard, U.S. Customs and Border Protection, Federal Bureau of Investigation, and Broward Sheriff's Office to discuss security initiatives and opportunities to further enhance safety and security. Port staff members also hold weekly operations meetings to review upcoming ship arrivals and ensure coordinated security efforts.

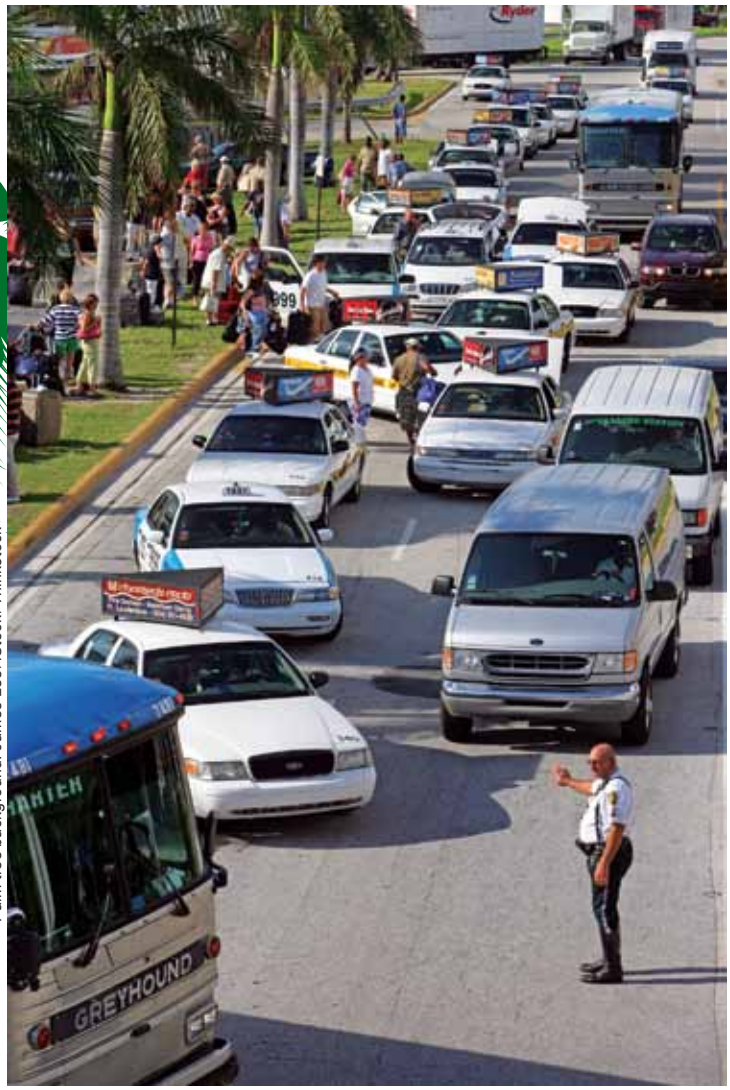
The Results

We believe our multi-layered approach is key to Port Everglades' success. The port complies with all national and international security mandates and exercises ongoing

U.S. Customs and Border Protection officers screen cruise guests upon debark.

Private security companies handle security checks inside the cruise terminals, before the guests board the ship.

Palm tree background: James Lee/iStock/Thinkstock



The Broward Sheriff's Office oversees security at Port Everglades and keeps traffic moving on busy cruise days.

communications with its law enforcement partners and the cruise lines to ensure safety and security at one of the world's busiest cruise home ports.

It is imperative that we protect our economic assets and ensure our vendors and customers can move about the port without concern for their personal safety and security.

About the authors:

Mr. Glenn A. Wiltshire is a 30-year U.S. Coast Guard veteran who served as the deputy port director for Port Everglades since 2006. His last Coast Guard assignment was as Sector New York commander and USCG captain of the port for New York/New Jersey. He graduated from the USCG Academy and received a master's degree in public administration from the John F. Kennedy School of Government, Harvard University.

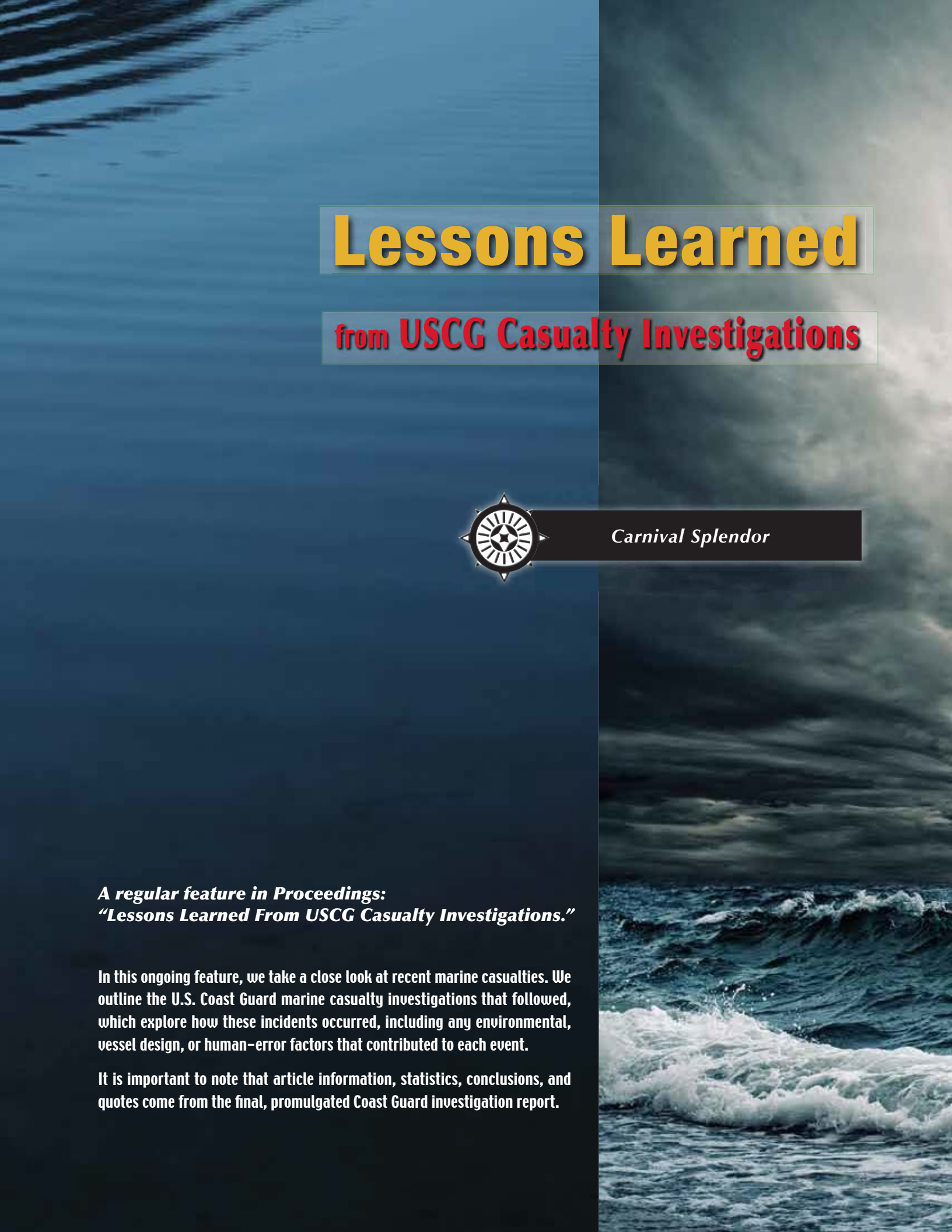
Ms. Ellen Kennedy has worked to promote business development, strengthen community relationships, and build an international reputation for Port Everglades for nearly 13 years. She previously served as vice president for the local public relations firm Bitner.com, and as director of public relations for the Lee County Visitor and Convention Bureau.

Endnotes:

1. See www.porteverglades.net.
2. See http://ftlauderdalecc.com/overview.html.
3. Code of Federal Regulations, Title 33.

Lessons Learned

from USCG Casualty Investigations



Carnival Splendor

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 outline the U.S. Coast Guard marine casualty investigations that followed, which explore how these incidents occurred, including any environmental, vessel design, or human-error factors that contributed to each event.

It is important to note that article information, statistics, conclusions, and quotes come from the final, promulgated Coast Guard investigation report.

Pleasure Trip Gone Wrong

"There is a fire, is a fire…"

by Ms. Sarah K. Webster
Managing Editor

On Nov. 8, 2010, a cruise ship suffered a major mechanical failure in the number five diesel generator, while sailing off the coast of Mexico. Engine components, lube oil, and fuel ejected through the engine casing—resulting in a fire in the aft engine room. Although there were no fatalities and the crew extinguished the fire, the vessel lost all power for propulsion and hotel services. A commercial salvage company towed the vessel to port with the passengers still aboard.

This incident became a great concern to the vessel's flag state and the U.S. Coast Guard, because the post-casualty analysis revealed a number of system failures, which allowed the fire to spread. Moreover, the fire protection system's failure became of particular interest during the investigation, because it should have extinguished the fire. A closer inspection of the electronic records revealed that a bridge watch stander had reset the emergency alarm panel on the bridge within seconds of the first alarm. The watch stander's action delayed activation of the installed fire protection system above the generators for approximately 15 minutes—allowing the fire to spread vertically and damage power cables. The marine investigation also revealed problems with the vessel's installed CO_2 system, emergency generator, and problems with firefighting team training and proficiency.

Port of Los Angeles/Long Beach, Calif.

Sunday, Nov. 7: The *Carnival Splendor,* a steel passenger cruise ship with 17 decks, had just returned to the U.S. from a recent trip to the Mexican Rivera.[1] The vessel was tied to its berth at the Port of Los Angeles/Long Beach and passengers disembarked, as the 1,167-member crew prepared for another seven-day trip to Puerto Vallarta, Mexico.

While it was moored, U.S. Coast Guard inspectors boarded the ship and performed a port state control cruise ship examination. Inspectors focused on various safety equipment and procedures. They observed firefighting and emergency drills, rescue boat and lifeboat evolutions, and conducted a thorough check of the vessel's statutory certificates and documentation. The Coast Guard found no outstanding deficiencies with the vessel's material condition and compliance with International Safety Management Code requirements.

Around 5 p.m., the crew conducted a routine passenger muster drill and safety meeting with the 3,299 passengers. Shortly after, the ship unmoored and transited out of the harbor and into the Pacific Ocean.

Fire in Aft Engine Room

Monday, Nov. 8: At 5:51 a.m., approximately 150 nautical miles south of San Diego, the second and third engineers and an engine cadet were on watch in the engine control room (ECR). The second engineer stayed in the engine control room, while the third engineer and engine cadet performed a roaming watch in the engine room. Diesel generators 2, 3, 5, and 6 were online and equally loaded—providing power to the propulsion motors and the ship's service power. The engine room's ventilation dampers and the aft engine room's watertight doors were open in accordance with company policy.

Shortly before 6 a.m., diesel generator 5 (DG 5) experienced a torsional vibration alarm, which indicated an unusual vibration in the DG 5 engine. One minute later, DG 5 experienced a fail start alarm, signaling something had gone wrong. The second engineer on watch sent the third engineer and the engine cadet to investigate the alarm activations. As they made their way to the lower engine room, located on deck C, they heard an explosion and then saw black smoke. As the third engineer and cadet retreated to the engine control room, they observed smoke and flames above DG 5 via a closed circuit television system. Soon after, the smoke near DG 5 quickly obscured the cameras. The engineers had no choice but to evacuate the engine control room, because of the increased intensity of the heat and smoke.

At 6 a.m., the second engineer shut down DG 5 and 6 and then notified the chief engineer of the situation. The engineers on duty initiated the vessel's engine room fire emergency procedures, which included shutting down the machinery space's ventilation system, closing engine room dampers, fire screen and watertight doors, and quick-closing fuel valves. At this time, the watch standers in the engine room did not manually activate the ship's installed fire protection system.[2]

Next, the automatic fire detection system activated in the aft engine room and numerous visual and audible alarms activated on the bridge's emergency management system panel. The engineers phoned the bridge to notify them of the fire and smoke in the engine room.

One minute later, the deck officer made an announcement to the personnel on the bridge:

"There is a fire, is a fire."

The deck officer initiated the crew response and ordered the Alpha fire team to the aft diesel generator. At 6:01 a.m., two fire/smoke detectors above DG 5 and 6 activated. Within seconds, a bridge watch officer performed a general reset of the fire detection system, and the fire and smoke detectors then returned to a normal status.

By 6:03 a.m., the fire damaged the detectors above DG 5 and 6, placing them in a "fault" status. As a result, the fire protection system did not automatically activate. At 6:04 a.m., the captain arrived on the bridge and took command of firefighting efforts.

Activating the Fire Protection System

At 6:04 a.m., the fire protection system activated in the fuel oil purifier room.[3] Then, two minutes later, the quick response team arrived in the staging area, followed shortly afterward by three fire teams. Three minutes later, the quick response team entered the engine room to assess the situation. From 6:09 to 10:54 a.m., the fire teams rotated in succession to assess the situation and extinguish the fire.

At 6:10 a.m., DG 3 and 6 tripped offline and the vessel lost all sources of primary electrical power. Shortly thereafter, the emergency diesel generator (EDG) automatically started with loss of the main power supply; it ran for one minute before it shut down. It took ship's crew 25 minutes to diagnose and fix the problem: a damaged solenoid valve in the fuel line. Engineers opened the inline bypass valve to restore the EDG's power. A minute later, the fire protection system's pumps experienced a fault condition, and the fire protection system switched over to the back-up nitrogen cylinders to maintain pressure.

Emergency Power Loss

At 6:14 a.m., the cruise director informed the passengers of the situation via the public address system. Then at 6:15 a.m., the local fire protection system automatically activated near DG 5 and 6. This caused the machinery section valves for the aft engine room to open, and the nozzles above DG 5 and 6 supplied water mist. At 6:25 a.m., the cruise director ordered all crew members to their emergency stations and all passengers to the open decks. At 6:31 a.m., the general emergency alarm activated; and, about five minutes later, the EDG's power restored and the fire protection system's pumps came back online.

At 8:06 a.m., Charlie fire team entered the engine room with the chief engineer and the second engineer. About 15 minutes later, the fire team located the fire above DG 5. The team observed electrical cables burning, but did not see oil or additional combustible materials. Shortly after, the captain ordered the fire teams to use portable dry powder and CO_2 extinguishers on the fire.

At 8:51 a.m., the quick response team and chief engineer extinguished the fire above DG 5 with portable dry powder

and CO_2 extinguishers. Then around 9:05 a.m., the captain ordered his staff to ventilate the aft engine room to remove smoke from the space.

At 9:47 a.m., the captain reported the fire above DG 5 re-flashed from the ventilation and the aft engine room again filled with smoke. The quick response team extinguished the re-flashed fire with portable extinguishers. At 10:15 a.m., the Charlie fire team reported the fire above DG 5 had again re-flashed, and so they used portable extinguishers to put it out. About a half-hour later the captain ordered the staff to close all shell doors and the engine hatch cover. At 10:54 a.m., the chief engineer reported another DG 5 fire. The captain decided to activate the CO_2 system in the aft engine room. Prior to releasing the CO_2, the captain requested the chief engineer to verify that the engine room dampers closed and everyone had evacuated the space.

At 11:03 a.m., the crew closed the forward door and the aft door to the aft engine room. A minute later, the hard switch dampers and ventilation closure stops for the aft engine room activated. However, activation was unsuccessful due to several elements being in fault condition. At that time the captain ordered the fire teams to evacuate from the engine room and proceed to the staging area.

CO_2 System Activation Fails

At 11:13 a.m., the captain ordered the chief engineer to release CO_2 into the aft engine room. The chief engineer attempted to release the CO_2 by using the remote station on deck zero located outside the engine control room, but the system failed to activate.

At 11:26 a.m., the emergency diesel generator experienced another shut down due to a coolant problem. It took the ship's crew 45 minutes to diagnose and fix it. Engineers refilled the unit with coolant, and the emergency diesel generator restored power. The emergency diesel generator failure had minimal impact on the response and firefighting efforts, due to battery back-up systems, and the ability of ship's crew to fix the EDG problems quickly. Additionally, once the EDG stopped running, the ship's battery system kept critical safety systems online (such as the emergency lighting system).

About 20 minutes later, the captain ordered CO_2 system activation from the back-up local controls in the CO_2 room. The captain and chief engineer activated the valve for the aft engine room through the master panel. The pilot manifold filled up and provided an indication alarm, but the start and discharge sequence failed. Upon entry into the CO_2 room, the crew observed the valve on the pilot cylinder leaking and the valve for the aft engine room remained closed. The crew also observed numerous gas leaks from the flexible connectors between the CO_2 cylinders and the manifold.

Crew members from the Coast Guard Cutter *Morgenthau*, a 378-foot high endurance cutter home ported in Alameda, Calif., ensure the safety of the passengers and crew aboard the stranded cruise ship. U.S. Coast Guard photo.

The crew switched the system to the other pilot valve and attempted to activate the system manually by opening the manifold valves at the heads. Upon opening the manifold valves, the crew observed gas leaking from multiple fittings in the CO_2 system. Upon further inspection, they observed the zone valve for the aft engine room closed, and the valve arm on the big ball valve had fallen off.[4] The officers attempted to use a wrench on the valve stem, but were unable to turn the valve. No CO_2 released, except incidentally into the CO_2 room, due to leaks at fittings, hoses, and connections. Post-casualty inspection revealed the pressure differential across the valve was too great, which prevented the valve from opening.

At 1:15 p.m., the chief engineer entered the engine room and observed smoke, but no fire. He reported the temperature in the engine room as 165°F. Shortly before 2 p.m., the captain reported no fire and the engine room's temperature steadily decreasing. At 2:31 p.m., the crew installed a fan to supply cold air to the engine room, which dropped the temperature to 74°F. At 3:11 p.m., the crew extinguished a small fire in the cabling above DG 4. Fire patrols took turns throughout the night monitoring the aft engine room. There were no reported injuries from the engine failure or the fire.

Vessel Towed to Port

Following the fire, the crew could not get the ship's diesel generators to restart. Consequently, the vessel could not produce power to supply to the propulsion motors or hotel service. Therefore, on Nov. 11, the cruise line had the vessel towed to the port of San Diego, Calif.

A Coast Guard landing safety officer directs a Navy helicopter during a supply delivery to the cruise ship. U.S. Coast Guard photo.

Coast Guard and Navy personnel unload pallets of food and supplies aboard the cruise ship. U.S. Coast Guard photo.

Coast Guard boat crews monitor the cruise ship as it enters San Diego Bay. Coast Guard photo by Petty Officer Cory J. Mendenhall.

Lessons Learned

While the fire was eventually self-extinguished, the failure of the installed CO_2 system and the poor execution of the firefighting plan contributed to the ineffectiveness of the crew's firefighting effort.

Firefighting Strategy, Actions, and Training

Evaluation of the firefighting effort against the procedures in the Safety Management Systems and Firefighting Standard Operating Procedure revealed the following areas of concern:

- choice of fire extinguishing equipment (portable dry chemical fire extinguishers instead of fire hoses),
- decision made to ventilate the aft engine room before the fire was fully extinguished,
- lack of familiarity with the engine room spaces and equipment,
- isolation of the affected space and maintenance of smoke boundaries.

Moreover, company records indicated that the vessel complied with Safety of Life At Sea requirements for monthly fire drills; however, the level of documentation for fire drills differed with each drill, and many drills had very little documentation beyond the logbook entry.

With that said, marine investigators did find evidence in the logbook that revealed the fire teams conducted several fire drills that lasted less than 30 minutes, and that these drills happened on the aft mooring deck or in the marshalling area—not in the actual spaces. It also appeared to

investigators that the captain and bridge crew did not actively participate in the fire drills—beyond the announcement and logging of drills. In addition, from May to November 2010, there were no fire drills conducted in the engine room.

Fire Suppression System

Once the teams located the fire, they attempted to extinguish the fire with CO_2 and dry powder portable extinguishers. While the extinguishers did put out the fire, the agents did not adequately cool the cable conductors, so the cable insulation and jacket materials continued to burn, and the fire re-flashed when the captain decided to ventilate the aft engine room.

Although the fire in the cable runs did eventually extinguish, this most likely happened due to a lack of oxygen resulting from closing the watertight doors, during the attempt to use the fixed CO_2 system.

Coast Guard marine inspectors and one of the ship's engineers scan the engine room. U.S. Coast Guard photo by Petty Officer Erik Swanson.

Coast Guard Petty Officer Alexis Roschitsch-Przeszlowski, a marine inspector at Sector San Francisco Port State Control, walks the decks of the cruise ship to verify emergency lighting is properly working. U.S. Coast Guard photo by Petty Officer Erik Swanson.

Post casualty analysis of the event revealed that the installed fire protection system had activated 15 minutes after the initial fire started. The bridge watch stander delayed the installed fire protection system by resetting the fire alarm panel on the bridge. This was a critical error, which allowed the fire to spread to the overhead cables and eventually caused the loss of power. Activating the installed fire protection system immediately would have extinguished or possibly prevented the spread of the initial fire between DG 5 and 6.

Loss of Power and Propulsion

Because of the extensive damage to cables and wire from the fire, marine investigators could not determine the exact cause of the power loss. However, investigators believe

continued on page 65

Cruise Ship Fire Safety Alerts

NOTE: These safety alerts address critical concerns uncovered during a marine casualty investigation and should be of vital interest to ship builders, classification societies, owner/operators, and others involved with vessel operations.

Part 1: Wrong Directions: A Recipe for Failure

Quick response team firefighters aboard a cruise ship responded to a fire in a machinery space by using portable extinguishing equipment. However, approximately five hours after the fire started, the master of the vessel decided to release CO_2 from the vessel's fixed firefighting system, but the system failed to operate as designed. Subsequently, the crew could not manually activate the fixed firefighting system to supply CO_2 into the machinery space.

Marine investigators discovered the following issues could have negatively affected the crew's emergency response and may have contributed to the CO_2 system failure:

- Shipyard commissioning test procedures appeared to differ from procedures documented in the vessel's firefighting instruction manual (FIM).
- The FIM referred extensively to a control panel that differed vastly from the one onboard the vessel.
- The firefighting instruction manual incorrectly stated the location of the CO_2 release station.
- The FIM incorrectly used the word "Pull" when it should read "Turn," in reference to valve operation.
- The firefighting instruction manual contained confusing language: "Once the fire has been extinguished make sure that the temperature has decreased before investigate the area same time is needed to wait hours."
- The FIM referenced elements of an emergency shutdown graphic on numerous occasions. However, the location of this graphic is unknown.
- The FIM contained photographs of the internals of the CO_2 release stations that appeared to differ from actual CO_2 release stations onboard the vessel.
- The CO_2 release stations installed on the vessel had instructional placards that referred to elements of a completely different control panel than the one used onboard the vessel.
- Shipyard piping schematics and drawings did not match the actual installation.

Because of these and other issues, the United States Coast Guard strongly recommends those involved with these systems:

- Ensure that all supporting documentation, piping schematics, plans, manuals, component labeling, and instructions are consistent with each other and relevant to the systems, equipment, and components installed onboard the vessel.

Part 2: Failures Render CO_2 System Inoperative.

Investigators found the following issues pertaining to the CO_2 system:

- Numerous piping and hose connections leaked extensively. When the system activated, the monitoring system showed numerous leakages into the CO_2 room.
- The zone valve for the aft machinery space, which admits CO_2 from the bottle bank manifold to the space, failed. Specifically, the ball valve's opening actuating arm fell off the valve when the gas-powered piston actuator attempted to move it. (A very small machine screw and washer held the ball valve actuating arm in place.) When the fire team attempted to open the valve manually—using the provided hardware—they could not. The valve would only move after the gas pressure relieved the inlet side of the valve.
- Actuating arms to five of the six other zone valves were loose and attached by small machine screws.
- Pipe sealant found on pipe threads throughout the system seemed, in some instances, to have entered the system.
- Certain elements of the distribution manifold contained low points, which allowed water to accumulate within the piping. Consequently, such a circumstance could cause corrosion and possibly negatively affect the operation of other components.
- The CO_2 system's pilot and co-pilot bottles did not appear to operate correctly; thus, the crew attempted to activate them manually by using the valve handles located on top of the cylinders.
- An authorized service provider recently serviced and inspected the system.

Because of these and other issues, the United States Coast Guard strongly recommends those involved with these systems:

- Carefully and critically review and routinely inspect, maintain, verify, and test fixed firefighting installations to ensure that they will operate correctly during an emergency.

the significant fire damage to the wires and cables in the aft engine room contributed to the loss of power. Additionally, the extent of the fire damage prevented the vessel engineers from starting the forward engine room diesel generators and/or closing the appropriate breakers to supply power at the switchboard.

Prior to releasing the final report of investigation, the Coast Guard issued two safety alerts based on initial findings, which covered CO_2 system operation, testing, and maintenance. (See sidebar.)

Finally, this investigation resulted in safety recommendations that addressed the conditions on the cruise ship that contributed to this casualty, as well as the problems with the CO_2 system installation.

About the author:
Ms. Sarah K. Webster is the managing editor of the 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. She is finishing her M.A. in communication with Kent State University, has a B.A. in communication from Monmouth University, and an A.A. in humanities from Ocean County College.

Acknowledgement
Proceedings would like to thank CDR Michael Simbulan of the Office of Investigations and Analysis at USCG headquarters for contributing to this story.

Endnotes:

1. See www.carnival.com/cruise-ships/carnival-splendor.aspx for more information.
2. See www.marioff.com/water-mist/fire-suppression-with-fire protection systemr-how-does-it-work for more information.
3. This was the first area where the fire protection system activated. The Fire protection system activated in other machinery spaces, as recorded in the EMS log. However, activation of the Fire protection system near the DG 5 and DG 6 did not occur until 6:15 a.m.
4. When the piston extends, the valve arm turns 90 degrees and CO2 enters the aft engine room. In this instance, the line was pressurized with CO2, and the piston could not extend to open the Zone A valve. The crew tried to open the valve with the red bar, but could not turn it. Therefore, in this configuration, the only way to operate this valve would be to open the Zone A valve first, and then open the CO2 flood valves—the crew did not do this.

For More Information:

The U.S. Coast Guard's Office of Investigations and Analysis developed the safety alerts. For more information, email:
HQS-PF-fldr-G-PCA@uscg.mil.

Understanding Nitromethane

by Ms. Stephanie Jocis
United States Coast Guard Academy Cadet

Chemical of the Quarter

What is it?

Nitromethane (also known as nitrocarbol, NM, or NMT) is a colorless, oily liquid that is slightly soluble in water. It produces a fruity to disagreeable odor.

Nitromethane is a commercially produced nitroalkane that is used as a fuel additive in racing cars, boats, and model engines. It is also used as a component in a binary explosive formulation with ammonium nitrate, as was the case in the tragic Oklahoma City bombing in 1995.

Why Should I Care?

Shipping Concerns:

The U.S. Department of Transportation classifies nitromethane as a hazard class 3 flammable liquid. Nitromethane is shock sensitive and thermally unstable. To reduce likelihood of detonation, avoid conditions such as:

- very severe shock,
- severe and rapid compression under adiabatic conditions,[1]
- heating under confinement.

Health Concerns:

Nitromethane is a flammable liquid, and its vapors may cause central nervous system depression and liver damage. It can also cause eye, skin, and respiratory tract irritation, and may be harmful if swallowed or inhaled.

Fire or explosion concerns:

Nitromethane is very explosive with a flash point of 95°F. A single 5-gallon can has a fatality range of 42 feet and can cause significant injury or damage to a range of 316 feet, while a full 55-gallon drum of nitromethane has a blast radius of 92 feet and can cause significant injury or damage up to 700 feet.

Nitromethane forms an explosive sodium salt that bursts into flame on contact with water. Nitromethane is made more sensitive to detonation by contamination with other compounds such as reducing agents, strong bases, amines, or heavy metals.

What is the Coast Guard doing about it?

Nitromethane is considered a hazardous material and special requirements have been set for marking, labeling, and transporting this material. The legal airborne permissible exposure limit is 100 parts per million (ppm), averaged over an 8-hour workday. Clean Air Act performance standards subject nitromethane manufactures to certain provisions for the control of volatile organic compound emissions. The National Institute for Occupational Safety and Health notes that 750 ppm is immediately dangerous to life and health.

The U.S. Coast Guard enforces these limits. In addition, the Coast Guard operates the National Response Center, which is the sole federal point of contact for reporting chemical spills. In the event of a spill or emergency with nitromethane, call (800) 424-8802.

About the author:
Ms. Stephanie Jocis is a cadet at the U.S. Coast Guard Academy, studying marine and environmental science. She is interested in a career in sector response operations.

Endnotes:

1. Occurring without gain or loss of heat.

References:

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Nautical Engineering Queries

Questions

Prepared by NMC Engineering Examination Team

1. The usual method of unloading a low pressure air compressor at start-up is accomplished by _____.

A. holding the discharge valve open
B. the use of a pre-charged accumulator
C. holding the suction valve open
D. temporarily discharging to the air receiver

---

2. What must be done to manually equalize the power factor of two alternators operating in parallel?

A. Voltage settings of both units are adjusted in opposite directions.
B. Governor speed settings of both units are adjusted in opposite directions.
C. Voltage settings of both units are adjusted in the same direction.
D. Governor speed settings of both units are adjusted in the same direction.

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3. The most severe cavitation erosion occurring on the waterside of diesel engine wet cylinder liners normally occurs _____.

A. throughout the lower one-half of the liner
B. throughout the upper one-half of the liner
C. at TDC opposite the thrust side of the liner
D. near the middle of the thrust side of the liner

---

4. While donning the positive-pressure self-contained breathing apparatus, you discover that the air cylinder pressure gage and the regulator pressure gage differ from each other by 500 psi. Which of the listed actions should you consider as appropriate?

A. Replace the defective gages with a new pair from the spare parts inventory.
B. Replace the air cylinder.
C. Assume that the lower gage reading is correct.
D. Take the average of the two gages as the correct pressure.

Engineering Answers

1. *Note: Unloading an air compressor at start-up reduces both the starting current and the amount of time that it takes to come up to operating speed. Unloading may be accomplished by a pneumatic, hydraulic, magnetic, or centrifugal type pilot device fitted to the suction valves of the compressor.*

A. holding the discharge valve open	Incorrect answer. Unloader mechanisms are generally fitted to the suction valves, not the discharge valves.
B. the use of a pre-charged accumulator	Incorrect answer. Pre-charged accumulators are not used for unloading.
C. holding the suction valve open	**Correct answer.** This action prevents compression from being achieved, thus unloading the compressor.
D. temporarily discharging to the air receiver	Incorrect answer. This action would not unload the compressor, as this is the resulting status of the compressor after the unloading period is over.

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2. *Note: Equalization of the power factor of two alternators is accomplished by equalization of the reactive power, which in turn is accomplished by equalization of the magnetic field strengths, which in turn is accomplished by adjusting the voltage settings of both units in opposite directions until the power factors are equalized.*

A. Voltage settings of both units are adjusted in opposite directions.	**Correct answer.** This is the correct procedure as described in the note above.
B. Governor speed settings of both units are adjusted in opposite directions.	Incorrect answer. This is the procedure for equalizing the kilowatt load of two alternators in parallel, not the power factor.
C. Voltage settings of both units are adjusted in the same direction.	Incorrect answer. This is the procedure for raising or lowering the bus voltage, not equalizing the power factor of two alternators in parallel.
D. Governor speed settings of both units are adjusted in the same direction.	Incorrect answer. This is the procedure for raising or lowering the bus frequency, not equalizing the power factor of two alternators in parallel.

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3. *Note: Wet cylinder liners are subject to waterside cavitation erosion due to harmonic cylinder vibrations that cause vapor bubbles in the coolant to form and collapse. The resulting pitting is most pronounced near the middle of the thrust side of the liner.*

A. throughout the lower one-half of the liner	Incorrect answer.
B. throughout the upper one-half of the liner	Incorrect answer.
C. at TDC opposite the thrust side of the liner	Incorrect answer.
D. near the middle of the thrust side of the liner	**Correct answer.** This the expected pitting pattern as described in the note above.

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4. *Note: The appropriate action to take should facilitate quick and safe entry into the hazardous atmosphere in response to an emergency. The gages should indicate a full cylinder and the gages should read within 200 psi of each other.*

A. Replace the defective gages with a new pair from the spare parts inventory.	Incorrect answer. This action does not facilitate quick entry.
B. Replace the air cylinder.	Incorrect answer. This action does not facilitate quick entry.
C. Assume that the lower gage reading is correct.	**Correct answer.** By taking this action, the chance is minimal that the assumed pressure is lower than it actually is, and the wearer may safely exit the space before running out of air.
D. Take the average of the two gages as the correct pressure.	Incorrect answer. By taking the average of the two pressures, there is a good chance that the assumed pressure is lower than it actually is, and the wearer may actually run out of air prior to exiting the space.

Nautical Deck Queries

Questions

Prepared by NMC Deck Examination Team

1. INLAND ONLY: While underway and in sight of another vessel a mile ahead, you put your engines on astern propulsion. Which statement concerning whistle signals is TRUE?

A. You must sound three short blasts on the whistle.
B. You must sound one blast if backing to starboard.
C. You must sound whistle signals only if the vessels are meeting.
D. You need not sound any whistle signals.

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2. The stamped full weight of a 100-lb. CO_2 bottle is 314 lbs. What is the minimum weight of the bottle before it has to be recharged?

A. 282 lbs.
B. 294 lbs.
C. 300 lbs.
D. 304 lbs.

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3. You are riding to a single anchor. The vessel is yawing excessively. Which action should be taken to reduce the yawing?

A. Veer chain to the riding anchor.
B. Heave to a shorter scope of chain on the riding anchor.
C. Drop the second anchor at the extreme end of the yaw and veer the riding anchor.
D. Drop the second anchor at the extreme end of the yaw, and then adjust the cables until the scope is equal.

---

4. The equation of time is 12m 00s and the mean Sun is ahead of the apparent Sun. If you are on the central meridian of your time zone, at what zone time will the apparent Sun cross the meridian?

A. 1148
B. 1200
C. 1212
D. It cannot be determined from the information given.

1. A. You must sound three short blasts on the whistle.
Incorrect answer. Reference: Inland Rule 34: The signal to indicate "I am operating astern propulsion" is only required when vessels are meeting or crossing within a half mile of each other.

B. You must sound one blast if backing to starboard.
Incorrect answer. Reference: Inland Rule 32: Defines the terms "short blast" and "prolonged blast," this choice does not specify either term.

C. You must sound whistle signals only if the vessels are meeting.
Incorrect answer. Reference: Inland Rule 34: Rule 34 applies to power driven vessels when in sight of one another and meeting or crossing within half a mile of each other.

D. You need not sound any whistle signals.
Correct answer. Reference: Inland Rule 34 only applies if both vessels are power driven, in sight of one another, and meeting or crossing within half a mile of each other.

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2. A. 282 lbs. Incorrect answer.

B. 294 lbs. Incorrect answer.

C. 300 lbs. Incorrect answer.

D. 304 lbs. **Correct answer.** Reference: 46 CFR Table 91.25-20(A)(1): Under Type Unit Carbon Dioxide: "Recharge if weight loss exceeds 10 percent of weight in charge."

The weight of charge is 100 lbs.
10% of charge would be 10 lbs.

Calculations are as follows:
Recharge weight = Total weight of container and contents minus 10% of the charge weight.
Recharge weight = 314 lbs. – 10 lbs.
Recharge weight = 304 lbs.

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3. A. Veer chain to the riding anchor.
Incorrect answer.

B. Heave to a shorter scope of chain on the riding anchor.
Incorrect answer. Shortening the scope decreases the holding power of the anchor and does not decrease the yawing of the vessel.

C. Drop the second anchor at the extreme end of the yaw and veer the riding anchor.
Incorrect answer. This action will not employ enough scope to allow the second anchor to set correctly, thus increasing the possibility of fouling on the original set anchor.

D. Drop the second anchor at the extreme end of the yaw, and then adjust the cables until the scope is equal.
Correct answer. Reference: The Theory and Practice of Seamanship, Graham Danton, 11th Edition. Veering the chain until the length of scope is approximately the same as the riding anchor will ensure ample holding power, assist in maintaining an equal strain on both anchors, and reduce yawing.

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4. A. 1148
Incorrect answer. In order for the apparent sun to cross the meridian prior to 1200, the apparent sun would have to be ahead of the mean sun.

B. 1200
Incorrect answer. This choice is not taking into account of the equation of time and thus defines "mean sun."

C. 1212
Correct answer. Reference: American Practical Navigator, 2002 Edition. If the mean sun is ahead of the apparent sun then the equation of time from the nautical almanac is added to Mean Solar Time.

LAN = Mean Sun (+/-) the Equation of time
LAN = 1200 + 12 minutes (the mean sun is ahead of the apparent sun)
LAN = 1212

D. It cannot be determined from the information given.
Incorrect answer.

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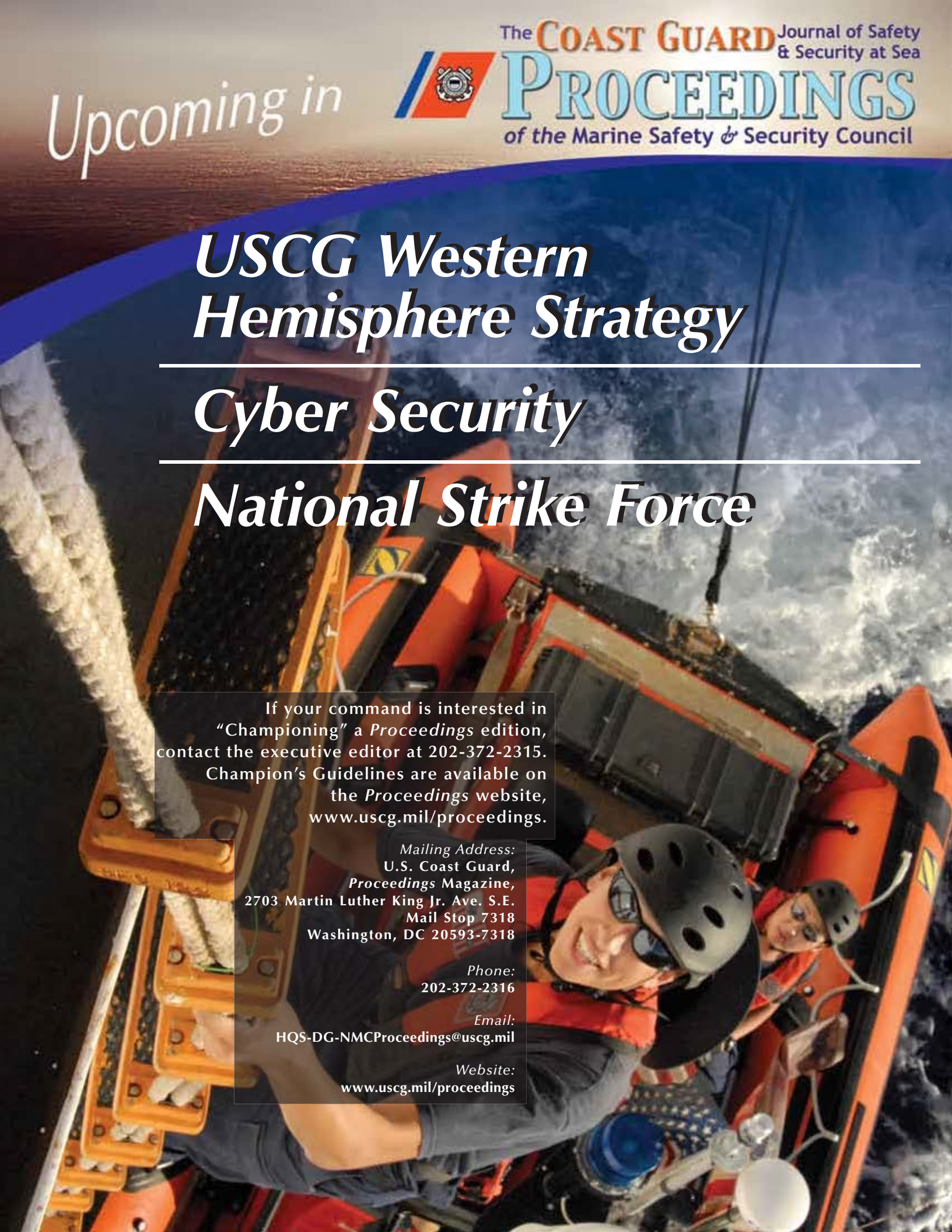

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