Published by the United States Coast Guard Commercial Regulations and Standards Directorate June 2016

Marine Safety Engineering

A Note From The Director

Greetings! Welcome to the June 2016 edition of the Marine Safety Engineering (MSE) Newsletter. In this edition we are taking the opportunity to highlight and showcase the broader global impact that MSEs have on Coast Guard policy, regulations, inspections, the International Maritime Organization (IMO), and worldwide shipping.

Our daily tasks are important, but they take on true significance when looking at the broader picture of the impact of those efforts. In this edition you will hear about the significant changes that have come about as a result of the Deepwater Horizon casualty: a domestic and international regulatory effort that brings together work from many of our different offices and divisions into a product that has enormous impacts and safety improvements for one of the largest and most broad reaching global industries. Additionally, you will hear about how MSEs were instrumental in the salvage operations that eventually led to locating the Voyage Data Recorder for the EL FARO, one of the most significant maritime tragedies in recent U.S. history.

You will also read about Liquefied Natural Gas (LNG) and our work in the arena of safety for gas carriers and ships using LNG as fuel. Don't underestimate the incredible impact that this has on our country and the world. The U.S. is experiencing a powerful shift in the energy sector towards wider use of LNG for fuel, with increased emphasis on further safety improvements and research for LNG carriers that are necessary to make LNG exports a reality.

All of the efforts mentioned in this edition are the result of the hard work of not just one or two individuals, but teams and groups of people to ensure that all aspects of standards and regulation development are considered, from the conception of an idea to the implementation and maintenance of a regulatory scheme.

Finally, I offer my continuing appreciation for the hard work our MSEs devote to solving the challenges of regulatory and policy development as well as your consistent professional expertise in addressing the challenges of implementing and enforcing those regulations and policies. I look forward to welcoming new personnel this transfer season and I wish our departing personnel the best of luck in their new assignments and endeavors. I urge all of you to keep the global perspective in the back of your mind as you go about your work each day. Individual efforts may feel overlooked in the moment but are part of the critical large picture of facilitating safe, efficient, and environmentally friendly maritime transportation.

Regards,

Jeff Lantz,
Director of Commercial Regulations and Standards

The How and Who of Changing Safety Regulations in the Wake of the DEEPWATER HORIZON Casualty

By LT Chris Briggs, Master's Degree in Fire Protection Engineering

There is a common saying in the marine safety world, "Regulations are written in blood!" This saying is instilled in every marine safety professional and gives the notion that major casualties involving loss of life spur new regulations. What many marine safety professionals don't realize is how this process happens and who creates these new regulations. The who is easy: Marine Safety Engineers (MSEs)! How do we go from a pivotal marine casualty to new regulations? To better explain the how and the who, let's explore one of the most significant marine casualties in recent history.

On April 20, 2010, a series of explosions and fire onboard the Mobile Offshore Drilling Unit (MODU) DEEPWATER HORIZON (DWH) started a sequence of events that resulted in the loss of 11 people and the eventual sinking of the rig. This casualty also resulted in the largest oil spill disaster in U.S. history.

HOW: In the wake of the DWH casualty, a joint Coast Guard and Minerals Management Service (now Bureau of Safety and Environmental Enforcement) Marine Board of Investigation was convened. After seven public hearings and almost a year of collecting and processing evidence, the Marine Board published their findings and recommendations to the Commandant in a Report of Investigation. Of the 52 recommendations from the Marine Board, 24 involved working with the International Maritime Organization (IMO) to amend the MODU Code. After a thorough review of the recommendations, the Commandant published his Final Action Memo. This memo responded to the Board's recommendations and directed the Coast Guard to create new regulations from the lessons learned in the DWH casualty and propose those regulations to the IMO.

The Deepwater Horizon oil spill was the impetus for amending the MODU Code at IMO.

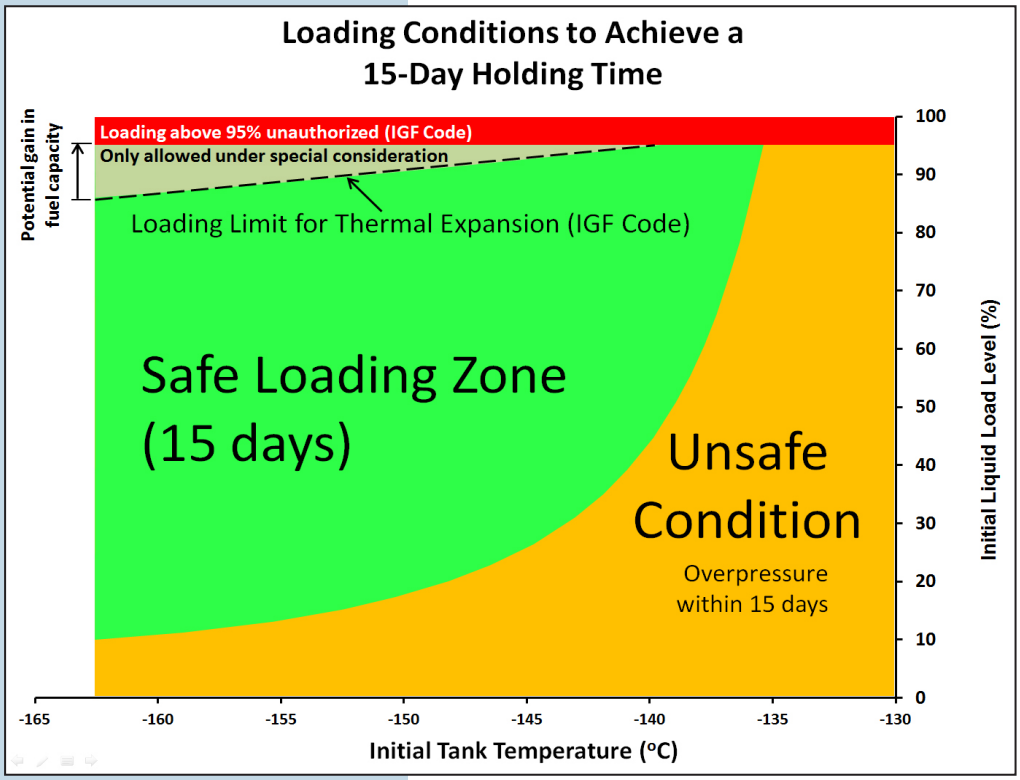
WHO: MSEs from the Office of Design and Engineering Standards (CG-ENG) received their direction from the Commandant's memo and worked to develop new international standards through the IMO. In 2012, MSEs from the Lifesaving and Fire Safety Division (CG-ENG-4) published a paper in conjunction with the IMO discussing the findings of the DWH report and suggested changes to the MODU Code. For 4+ years, MSEs worked closely with other Member States of the IMO on these changes. In March 2016, at the 3rd session of the Sub-Committee on Ship Systems and Equipment, consensus was reached and amendments to the MODU Code advanced to the final stages of approval. While the process is not 100% complete, MSEs will continue to champion these important changes through the IMO process in an effort to prevent another disaster of this magnitude and improve safety on the Outer Continental Shelf.

LNG Heats Up in an Alternative Loading Limit Proposal

By LT Bryson Jacobs, P.E., Master's Degree in Fire Protection Engineering and LT Ryan Mowbray, P.E., Master's Degree in Chemical Engineering

Liquefied natural gas (LNG) is cold. Really cold. When loaded at -259°F (-162°C), Mother Nature will do everything she can to warm it up. Modern insulating techniques are excellent, but no system is perfect. Vapor pressure inevitably increases with temperature; however, thermal expansion of the liquid can often be a greater concern. When a tank's "vapor space" (i.e. ullage space which contains cargo or fuel vapors) disappears completely due to expanding liquid, all bets are off; something has to give. Just as frangible bulbs in fire sprinklers over your head can burst when their tiny reservoirs get too hot, so too may a 250,000 gallon LNG fuel tank. Proper safeguards are obviously necessary.

As prescribed by current international standards, the maximum loading limit curve of an LNG tank ensures the preceding scenario cannot happen; the tank's internal vapor pressure will pop the relief valve well before the liquid can over-expand. This is acceptable for cargo tanks, however, this leaves a relatively large vapor space atop the fuel surface of a "full" fuel tank, taking up valuable space that could otherwise have been devoted to cargo or additional fuel in the overall vessel design. With bunkering schedules already tricky to manage given today's scarce refill locations, this space is sometimes seen as a waste by busy operators.



Transient thermodynamic analysis tool to determine safe holding times of LNG tanks.

But what about a risk-based approach where LNG is filled above the calculated maximum loading limit, recognizing that as fuel is consumed, the amount of time the tank is exposed to the risk of over-expansion or over-pressurization is minimized? Such an approach is allowed under special consideration by a vessel's flag administration. When a company approached Headquarters (CG-ENG) and the Marine Safety Center (MSC) wishing to take advantage of this allowance to increase their fuel capacity, we immediately found ourselves in need of a transient thermodynamic analysis tool. Using Excel, Visual Basic, and saturated methane tables published by NIST, we developed a versatile application to determine the approximate safe holding time of a loaded tank with easily-measured tank properties as inputs: initial temperature and liquid volume.

The degree of risk the Coast Guard is willing to accept can be a challenging issue that often must take into account myriad factors. New tools, such as this one, use engineering analysis techniques to provide much needed insight in the evaluation of potential risk, and at the same time add to the ever-expanding toolbox that MSC staff engineers can use to tackle other complex liquefied gas issues. The MSC has even expressed interest in receiving cadet interns from the Academy to further develop and expand the application. Emerging technical challenges such as this highlight the remarkable readiness and ingenuity our Marine Safety Engineers are poised to apply to an ever evolving world.

Congratulations and Welcome to the MSE Community to the Following Graduates of the MSE Advanced Education Program:

Chemical Engineering - HAZMAT
LCDR Julie Blanchfield

Electrical Power Systems & Controls Engineering
LT Steven Lewis

Fire Protection Engineering
LT Kelley Brown

Mechanical Engineering
LT Laura Fitzpatrick

Marine Engineering
LT John Di Nino

LT Eric Doherty

LT Jonathan Duffett

LT Daniel Kilcullen

LT Chris Rabalais

LT James Schock

LT Maria Wiener

Marine Safety Engineering Program Manager:

LCDR Jennifer Doherty

Development of an International Design Standard for Gas-Fueled Ships – The IGF Code

By Mr. Timothy Meyers, P.E., Master's Degree in Chemical Engineering

In June 2015, the International Maritime Organization (IMO) successfully completed work on a major international standard that sets the bar for safety in design and installation of shipboard fuel systems using alternative fuels such as liquefied natural gas (LNG). This standard is the "International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels", also known as the IGF Code. Marine Safety Engineers from the Office of Design and Engineering (CG-ENG) played an active role in the code's development, and represented the U.S. in negotiations that made the code a reality.

The IGF Code, which will go into force in January of 2017, addresses not only LNG, but also other fuels that have a flashpoint below the 60 degree C limit otherwise allowed in the Safety of Life at Sea for oil fuels. Work on this new code began at IMO in May of 2004, when a proposal was introduced by Norway. At that time, two LNG-fueled Offshore Supply Vessels had just been built in Scandinavia, and Norway's experience attempting to develop national requirements in the absence of a global standard highlighted the compelling need for an international code to promote consistency and safety given the risks associated with these alternative fuels.

The U.S. delegation to IMO consisted of several MSEs who provided expertise in LNG and fuel transfer arrangements.

Technical experts from roughly 23 countries and 11 non-governmental organizations came together to work out the requirements that make up the IGF Code. Much of the effort took place in week-long working group sessions during IMO Committee and Sub-Committee meetings in London. This was supplemented by inter-sessional "correspondence group" meetings conducted by e-mail exchange. Staff from CG-ENG's Systems Engineering Division (CG-ENG-3) represented the U.S. at each of these venues, providing their technical expertise in drafting requirements to address areas such as design of fuel tanks, piping system components, hazardous areas, alarms and instrumentation, ventilation, gas detection, and fire protection.

The Coast Guard's involvement in development of international standards such as the IGF Code is important because it provides a mechanism to shape maritime safety on a global scale, while helping to ensure consistency with U.S. interests, objectives, and current regulations. Since the U.S. does not yet have regulations in place to address LNG-fueled vessels, policy was developed in 2012 by CG-ENG for the design and construction of U.S. gas-fueled vessels using interim guidelines published by IMO during development of the IGF Code. With the IGF Code now in place, CG-ENG staff engineers are in the process of updating that policy with criteria that will use the finalized IGF Code as the baseline standard. Future work under consideration involves incorporating the IGF Code into vessel design requirements within Title 46 of the Code of Federal Regulations.

Chemical Engineering Advanced Education Program

By LT Andrew Murphy
Master's Degree in Chemical Engineering

The Chemical Engineering Advanced Education program is one of 5 marine safety post graduate programs that produce Marine Safety Engineers (OAP-16) for the Coast Guard. Each year, one or two high performing officers are selected for the program. The program exists to provide the Coast Guard with the technical proficiency necessary to understand the complexities of the products and cargoes that are shipped throughout the ports and waterways of the United States.

Chemical engineers apply the principles of chemistry, biology, physics, and mathematics to solve problems that involve the use of chemicals, fuels, drugs, food, and many other products. They design processes and equipment for large-scale manufacturing, plan and test production methods and byproducts treatment, and direct facility operations. Chemical Engineering is heavily based on thermodynamics and mass transfer with a further emphasis on separation processes and process control.

(continued on page 6)

Coast Guard Chemical Engineers help regulate complex cargos such as LNG.

Where Are They Now: CDR Suzanne Hemann

By LT Brian Bonomi, Master's Degrees in Naval Architecture and Marine Engineering, and Industrial Operations Engineering

CDR Hemann, Chief of Hull Division at the Marine Safety Center

MSE: *Congratulations on your assignment as the Chief of the Hull Division at the Marine Safety Center (MSC). Can you give us an overview of your career so far, and how it led to this position in "Techie" leadership?*

SH: I served my first tour in CGC BOUTWELL as a student engineer. During that time I read the book Lost at Sea by Patrick Dillon, which detailed the Coast Guard's efforts to improve commercial fishing vessel safety. The book ignited my interest in the program by showing me how inspectors, investigators, and policy makers work together to make significant improvements to vessel safety. The impact of our work drew me into the program as an engineer after seeing how I could apply my undergraduate degree as a naval architect. My subsequent tours were at MSO New Orleans, Activities Far East, and in the Advanced Education program. I studied fire protection engineering at the University of Maryland, College Park, and then I served in the Office of Design and Engineering Standards (CG-ENG) as a fire protection engineer. After that, as the Chief of Prevention at MSU Texas City, I was able to bring all aspects of my career together to directly support the maritime industry and marine safety in that region. Now at the MSC, I have returned to the MSE sub-specialty.

MSE: *What would you like our readers to know about the impact that MSEs have on our domestic and the international maritime communities?*

SH: I can't overstate the positive impacts that MSEs have on our community at large. MSE's have developed and validated each of the technical standards that we apply to our fleet today. Further, it is through casualty investigation and analysis that we, MSEs, contribute to the revision of vessel regulations to further improve safety. Additionally, MSEs provide the Coast Guard the skills and knowledge to conduct in-depth review and analysis of new and emerging marine systems. For example, MSEs at the MSC and within CG-ENG are working with our industry partners to address safety issues associated with emerging maritime technologies, such as use of lithium-ion batteries in shipboard power systems and compressed gasses as marine fuel. MSEs are critical to the Coast Guard's success in these areas, as engineering capability is central to the development of sound technical policy, domestic vessel regulations and international standards.

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Chemical Engineering Advanced Education Program (cont.)

Chemical engineering is a critical field of marine safety, as chemical compatibility, chemical classification, and identifying chemical hazards are essential to ensuring safe transport. Coast Guard chemical engineers work predominantly with the development of domestic and international regulations and standards for the maritime transport of hazardous materials.

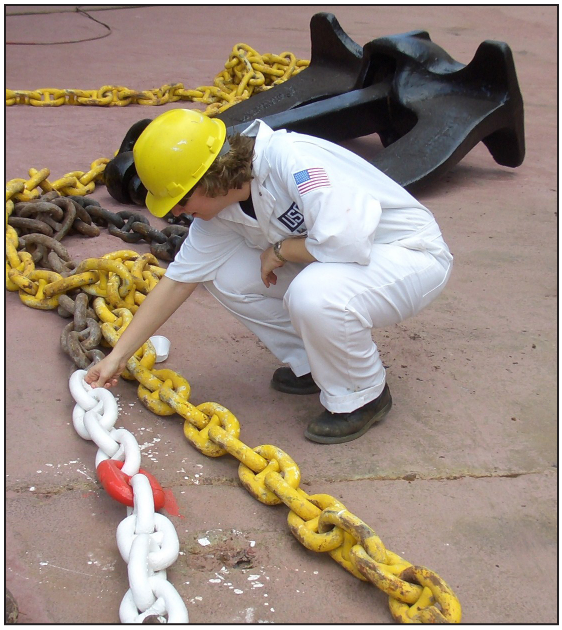
Coast Guard chemical engineers from the Hazardous Materials Division (CG-ENG-5) regularly attend IMO subcommittee meetings as members of the U.S. delegation. In particular, they provide subject matter expertise at the Pollution Prevention and Response (PPR) subcommittee and the Carriage of Cargoes and Containers (CCC) subcommittee meetings for the U.S. delegation. Chemical engineers at the Marine Safety Center (MSC) conduct plan review, engage industry, and support field units to ensure that tank vessels carrying hazardous cargoes meet required domestic and international regulations and operate safely. Payback tours for the chemical engineering program are 4 years either at the Office of Design and Engineering Standards, Hazardous Materials Division (CG-ENG-5) or the MSC. Once payback tours are complete, chemical engineers typically receive assignments where their unique set of skills will be most beneficial.

If you are interested in applying for the program or would like more information, please contact the chemical engineering program manager, LT Andrew Murphy, at 202-372-1398 or Andrew.J.Murphy@uscg.mil.

Where Are They Now: CDR Suzanne Hemann (cont.)

MSE: *Very early in your Marine Safety career you were assigned as a casualty investigator. Are there cases you remember that you would have investigated differently if you had the experience and knowledge you later gained as a MSE?*
SH: Excellent question. Yes, I do remember investigating an explosion in a cargo hold of a vessel carrying grain. We, the investigations shop, thought it was related to a buildup of the fumigant used or was an explosion caused by the grain dust. I remember cold-calling some of the nation's top grain-dust explosion experts. I don't remember finding a satisfying result, more of an assumption based on our limited knowledge. Looking back, I realize that the Coast Guard has in-house fire protection engineering expertise which could have helped us understand what happened. In fact, I now know that the MSC could have assisted by modeling the cargo hold and looking at ventilation paths to try to determine if there was a buildup of grain dust in the hold. Additionally, I didn't know that CG-ENG has connections to maritime experts throughout the world who study and develop requirements for keeping cargo holds safe from this type of explosion. If I had known this, I would have certainly reached out internally. It likely wouldn't have changed our investigation's conclusions, recommendations, or federal regulations for fumigation or grain carrying requirements, but one never knows where an investigation may lead.

MSE: *You mentioned your time as a Chief of Prevention. How do you think your background as an MSE helped you succeed in that position?*
SH: While I wasn't directly applying my skills as a Fire Protection Engineer on a daily basis, I believe that my technical background and the skills I developed within CG-ENG allowed me to be more successful than I would have been otherwise. Looking back at my technical education, it provided me the opportunity to expand my creative and critical thinking as well as my problem solving skills. This has prepared me for technical and nontechnical work. As a Prevention Chief, I applied those skills to projects unrelated to fire protection engineering, such as developing action plans to improve port security and analyzing data collected on employee training. I was also able to exercise my engineering skills and background in making operational decisions. In several instances, I was able to use my knowledge of naval architecture to assist with reviews of salvage plans. In another instance, my understanding of fire and smoke dynamics allowed me to assist my staff investigating a fire on a harbor tug.



CDR Hemann inspecting anchor chain while at Activities Far East.

MSE: *Do you have any recommendations for junior officers just entering the MSE community?*
SH: Take every opportunity you can to expand your understanding of the maritime industry by interacting with our partners. Changing technologies, economics, and public sentiment drive constant evolution in the marine industry. What I learned from our maritime partners guides my thoughts and contributions to discussions about pending regulations and policies. This is what I find fascinating and engaging about our work as MSEs, and it guarantees that we'll always be valued for our contributions to the industry.

MSEs Help Find EL FARO's VDR

By LT Evan Reger, P.E. and LCDR Judson Wheeler, Master's Degrees in Naval Architecture and Marine Engineering, and Mechanical Engineering

On October 1, 2015, the U.S. flagged freight ship EL FARO sank off the Bahamas in Hurricane Joaquin. In the months immediately following the vessel's disappearance, the wreckage was located and inspected by the U.S. Navy. MSC's Salvage and Engineering Response Team (SERT) member LT Joseph Burgess joined active duty and contractor personnel from Navy's SUPSALV for the first search expedition which, despite extensive investigation of the wreck and associated debris field, failed to locate the VDR.

LCDR Wheeler (left) and LT Reger (second from right) selecting side-scan sonar targets for close-up inspection by OV.

In April 2016, the NTSB resumed the search for the VDR using oceanographic engineering systems designed and operated by the National Deep Submergence Facility at the Woods Hole Oceanographic Institution (WHOI). As current or former members of SERT, we were fortunate to be invited to collaborate with NTSB, Tote Services, and staff from WHOI as part of a small investigative team embarked aboard the research vessel ATLANTIS. We were assigned roles in the mission planning process, interpretation of sonar data, and watchstanding at an equipment control console.

The two vehicles used for this second search included the Autonomous Underwater Vehicle (AUV) "Sentry" and a camera platform referred to as the "Observation Vehicle" (OV). With a tight timeline of only ten days on site, the vehicles were immediately put to work.

The AUV was used to cover large areas with side-scan and multibeam sonar, following a pre-programmed parallel search grid known as "mowing the lawn" to create large, detailed maps of the seafloor surrounding the wreck. From the acoustic images collected by the AUV, we helped select likely targets for the OV to investigate. The OV was far more limited in its mobility than WHOI's ROV, which was assigned to a project on the west coast of the U.S. and therefore unavailable for this expedition. The OV, a cube-shaped steel frame with lights and cameras, was dangled from ATLANTIS nearly three miles to the seafloor by a fiber optic cable, and maneuvered primarily by ship movements. Due to the short time on site and the slow process of maneuvering the vehicle around the extensive debris field at two tenths of a knot, it was crucial that targets were carefully selected.

In the early morning hours of April 26, the OV watch team came upon the EL FARO's radar mast in the main debris field, approximately a quarter mile north of the hull. The VDR was found still attached to a beam at the base of the mast, a miraculous find considering the trauma experienced by the upper portion of the EL FARO's superstructure during the sinking. Due to the lack of capability by the vehicles used on the expedition, the VDR could not be recovered. The Navy, however, plans to return to the site with additional equipment to retrieve the VDR in the coming months.

The remaining five days on site were spent documenting the hull and superstructure, with the goal of creating high definition photo mosaics and photogrammetric images of the wreck. Once the VDR is recovered and all post-processing of data is complete, Coast Guard and NTSB investigators hope to gain a better understanding of the EL FARO's final moments.

World Maritime University Introduces Future IMO Leaders to the Coast Guard

By CDR Joshua Pennington
Master's Degree in Fire Protection Engineering

The World Maritime University (WMU) in Malmö, Sweden, is a postgraduate maritime university founded by the International Maritime Organization (IMO). Established by an IMO Assembly Resolution in 1983, the aim of WMU is to further the objectives of IMO and IMO member states through education, research, and capacity building. The University operates on the basis of a charter adopted by the IMO Assembly, and is accountable to the IMO Secretary-General, Council and Assembly, and to an international Board of Governors composed of representatives of some 50 different governmental, industry, labor and educational bodies.

The Coast Guard maintains a Memorandum of Understanding (MOU) with WMU and supports an on-campus liaison officer billet. In addition, the Coast Guard Academy (CGA) is signatory to a faculty exchange MOU to promote academic collaboration between the institutions. Since inception of the faculty exchange MOU in 2011, MSEs serving in CGA's Prevention billets have travelled to WMU to provide basic stability, structures and MARPOL training. Though contributing to the international community is gratifying, the true reward is mentoring a multinational classroom of students who, in the not-to-distance future, will be representing their member states in the IMO Assembly.

International Standards Development

By Mr. Thane Gilman, P.E.

Most people are aware that the Coast Guard and many other federal agencies incorporate industry standards by reference in the Code of Federal Regulations (CFR). Many would be surprised to know that the Coast Guard alone adopts over 600 standards in Titles 33 and 46 CFR. These standards are developed and maintained by numerous standards development organizations, including American Society of Testing and Materials (ASTM) International, the American Society of Mechanical Engineers (ASME), the National Fire Protection Association (NFPA), the American Boat and Yacht Council (ABYC), and many other technical groups.

The Coast Guard works with various standards development organizations in drafting regulations.

Initially, most U.S. regulations reflected the incorporation of American national standards such as those developed by organizations listed above. In recent years, there has been a tremendous growth in the development of international standards, particularly through the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

The American National Standards Institute (ANSI) represents U.S. interests for participation in the ISO standards development process. Stakeholders that participate normally affiliate with an ANSI-accredited Technical Advisory Group (TAG), which processes ISO ballots and coordinates the U.S. position for a particular issue. For instance, the ASTM committee on Ships and Marine Technology serves as the ANSI TAG for standards developed in the ISO Technical Committee 8, which is comprised of member countries developing maritime safety standards for ships and offshore activities.

It's important to remember that ANSI and ISO develop standards using a consensus process, where any concerned party can participate, and any comments received during balloting are resolved by the working group technical experts. Similar to the way legislative processes work, there may be instances where a negative vote cannot be resolved via due process, so the document may move forward only with a large majority of participating countries' approval.

Most agencies of the executive branch are actually required to employ industry standards in lieu of government-unique requirements whenever possible. This mandate is largely driven by policies outlined in OMB Circular 119 and the National Technology Transfer Act of 1995.

Participation in the standards-development process provides many benefits to the Coast Guard, not the least of which is maintaining awareness of the rapid developments in private-sector technology for ship mechanical, electrical and environmental protection systems. Although the CFR still reflects a majority of national standards incorporated, there are many important ISO and IEC documents also adopted in the regulations. In addition, on the international level at the International Maritime Organization (IMO), ISO and IEC serve as force multipliers to governments developing international policies and regulations for marine safety and environmental protection. Finally, there are a number of studies documenting the direct economic benefits of standardization in international trade.

MSC Global Impact - Initial Certificate of Compliance Process

By LT Dale Cressman, P.E., Master's Degrees in Naval Architecture and Marine Engineering, and Industrial Operations Engineering

With a global economic impact of nearly $120 billion in 2014, cruising is big business -- and it's growing every year. Over 22 million passengers cruised in 2014, with projections that 24 million passengers will choose a cruise for their vacation experience in 2016. To meet the growing demand and entice customers, the industry is building larger and more innovative vessels than ever before. 92 vessels are scheduled to be delivered by 2022, a pace which is keeping industry and our Coast Guard engineers very busy.

With competition for customers strong, each cruise line is building bigger ships and constantly seeking to push the envelope with the latest technology and attractions. Increasingly, projects are using alternative designs to meet SOLAS rules. The alternative design process allows the use of non-traditional methods to achieve compliance with SOLAS requirements, such as those involving structural fire protection. Examples include the use of moveable fire walls and vortex wind-tunnel smoke curtains to create grander central shopping atriums. To ensure these new technologies provide a level of safety at least equivalent to that intended by existing standards, marine safety engineers (MSEs) conduct extensive review of the engineering systems involved, and their related risk analyses.

Large movable fire wall in the deployed position during a smoke extraction test of the atrium.

MSEs attend concept review meetings with cruise ship designers where these innovative technologies are presented. Safety concerns are identified and addressed during concept review before detailed vessel plans are finalized and submitted to the Marine Safety Center for engineering review and approval. However, MSEs' involvement is not limited to concept and plan review. For each vessel, they travel on-site to conduct structural fire protection and initial certificate of compliance exams. As part of the examination team, they provide technical assistance to the Officer in Charge, Marine Inspection by testing and validating that the highly complex systems are installed properly and perform as intended. MSEs, local inspectors, classification societies, and shipyards throughout the world all work together to ensure the vessels are SOLAS compliant and safe for passengers.

The goal for all involved parties is to provide the safest cruising experience possible by ensuring compliance with all applicable regulations. It's clear that with today's new technologies and massive ships, MSEs play a crucial role by facilitating the incorporation of novel features in modern cruise ships while ensuring that public expectations for safety continue to be met.

If you have any comments about this e-newsletter, or would like to contribute an article to an upcoming edition, please contact LCDR Jennifer Doherty:

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