

# The COAST GUARD Journal of Safety & Security at Sea PROCEEDINGS

SUMMER 2023

of the MARINE SAFETY & SECURITY COUNCIL

## Novel Uses



## New Challenges







Advances in fish farming technology and management practices significantly decreased the environmental footprint and increased economic performance of U.S. aquaculture in the last 40 years. Marine aquaculture in the United States represents an opportunity to provide healthy, domestic seafood; create jobs; and contribute to coastal economies. Coastal net pens, like these off the coast of Maine, have addressed environmental concerns about the effect on water quality, seafloor degradation, the sustainability of various fish feeds, and impacts to wild populations.

The demand for use of the nation's waterways is increasing with requests from the energy sector, space industry, aquaculture, sporting events, and recreation, among others. These demands are challenging the status quo and inspiring innovative responses as the Coast Guard works to safeguard users and marine ecosystems. NOAA photo



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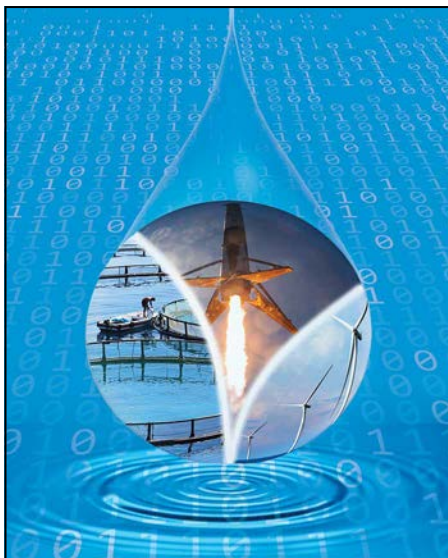
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*On the Cover: Advances in technology and greater demands for new, varied uses of our waterways are creating new challenges for those who work to ensure they remain healthy, safe, and viable for the future.*

Rocket photo: CRS-8 first stage landing courtesy of SpaceX.

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## Assistant Commandant's Perspective

by REAR ADMIRAL WAYNE R. ARGUIN JR.  
*Assistant Commandant for Prevention Policy*  
U.S. Coast Guard

Offering a wise view of our ever-evolving world, the Greek philosopher Heraclitus observed that, "The only constant in life is change." First spoken almost 3,000 years ago, the words still ring true today, and the phenomenal amount of change occurring within the U.S. Marine Transportation System (MTS) is a perfect example. The area of usable waterways has not

significantly changed, but the number of stakeholders traveling and working on them has steadily increased.

From the growth of aquaculture and offshore renewable energy installations to the advancement of autonomous vessels and water-based space launch/recovery operations, waterways uses are evolving. These uses showcase innovative methods in which people



## Champion's Point of View

by KEVIN KIEFER  
*Chief, Office of Waterways and Ocean Policy*  
U.S. Coast Guard

From small paddlecraft to ultra large container vessels, our nation's waterways have long played host to people employing them for such various uses as travel, food, energy, and military defense. As time and technology have advanced, so too have innovative waterway uses. The past few years, especially, have seen a huge rise in the novel

uses of our waterways, and it is some of these new uses that we bring to you with this *Proceedings* issue.

Autonomous vessels have been making news for a few years, but the rate at which their technology is advancing means updates happen continually. The June 2022 transatlantic crossing of the *Mayflower Autonomous Ship 400* is one



are harnessing water power for economically viable and environmentally conscious reasons; while space launches and recoveries highlight the multidimensional capabilities that only large areas of water can accommodate.

While the demand for recreational use, passenger vessel travel, and offshore development on our nation's waterways is growing exponentially, maritime stakeholders continue to advance traditional cargo movement methods. This issue of *Proceedings* highlights some novel waterways practices and how the MTS is accommodating them. Highlighting both technological advancements and traditional measures, the articles offer clever insights into the incredible expansion of waterway uses

and how the Coast Guard is encouraging collaboration to preserve safety and security of this vital national treasure.

Disruptive innovations, by definition, create markets where none previously existed. Whether technology to digitalize, model, and simulate a "Smart Port" to optimize security while lowering operational costs or installing autonomous systems to support navigation, the technology infusion into the MTS continues at an accelerated pace. This pace will challenge conventional norms as we focus efforts to preserve the efficiency, safety, and security of our nation's waterways. I am extremely proud to showcase how innovators are shaping the future of our waterways.

example featured in the following pages.

Offshore renewable energy installations is another topic that has increasingly gained attention, and with good reason. The last few years have seen a dramatic increase in wind farm construction, with the bold goal of powering 10 million homes with clean energy by 2030.

Aquaculture is a newer topic but one that is quickly gaining attention. In addition to increasing food production and boosting economic growth, the mechanics of this maritime farming naturally help clean the waterways and restore habitat and at-risk species.

Perhaps the most surprising topic within a Coast Guard journal is a new focus on space operations. Just as an *inland* Coast Guard unit might sound like a contradiction to many people (after all, doesn't the Coast Guard,

by definition, guard the *coast*?), the Coast Guard's new involvement with aeronautical space flights is causing the same confused amusement. However, a quick look back at astronaut Alan Shepard's iconic 1961 splashdown in the Atlantic Ocean shows that the United States has long recognized the value of waterborne space landings. As the return to space exploration has dramatically increased recently, many commercial space operators are choosing to launch and/or recover their spacecraft in our nation's waterways.

My hope for this *Proceedings* issue is that readers will gain a better understanding of, and appreciation for, these new waterway uses, and I thank the authors for their time in developing these articles and the work they do every day to keep our waters safe and secure.



# A Collaborative Approach

Mitigating risk in the evolving marine transportation system

by LCDR LINDSAY N. COOK

*Staff Officer*

*Office of Waterways and Ocean Policy*

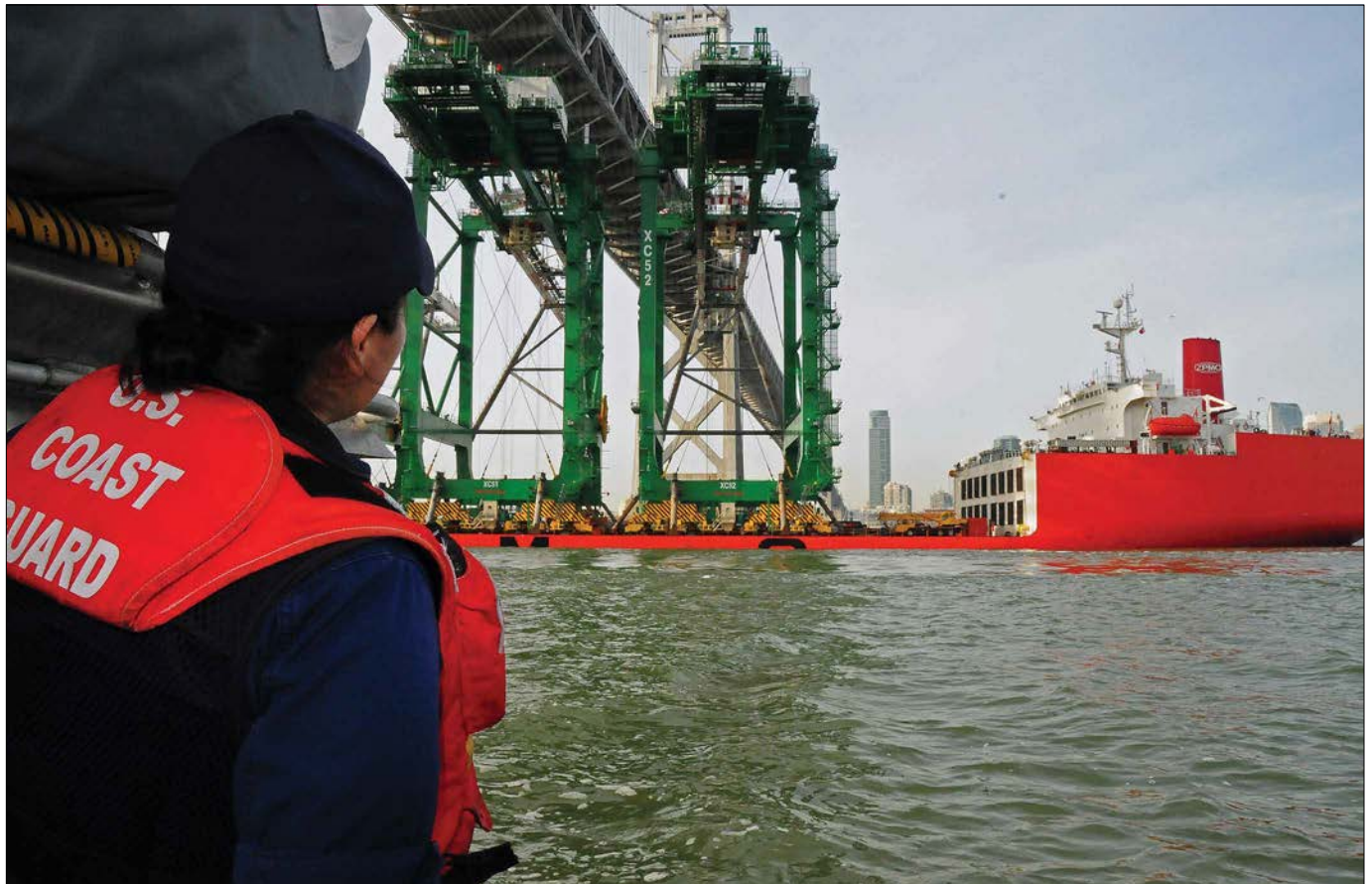
*Waterways Policies and Activities Division*

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The nation's navigable waterways are routinely characterized by maritime shipping, offshore mineral exploration, commercial fishing, scientific research and conservation, tourism, and recreation. While traditional uses remain dominant, the marine transportation system (MTS) is rapidly evolving as a platform for novel technological innovation. Space activities, offshore renewable energy installations, autonomous vessels, and aquaculture are diversifying the maritime

landscape.

It is important to note that market demand is not the sole impetus for novel technologies operating in the MTS. Rather, novel uses reflect the objectives and priorities of the United States government and its citizens, and are the result of executive mandates and/or legislation. To fully appreciate the complexity of the changes occurring in the MTS, this article will discuss what is driving novel technological innovation in the maritime



Seaman Diana Milian, of Coast Guard Station San Francisco, stands watch aboard a 25-foot response boat while maintaining a safety zone around a vessel carrying three 253-foot-tall cranes March 16, 2010. Two response boats from the station ensured mariners didn't present a hazard to navigation for the vessel that narrowly passed under the Golden Gate and Bay Bridges. Coast Guard photo by Petty Officer 3rd Class Erik Swanson





The San Francisco Bay Harbor Safety Committee, in coordination with the Coast Guard and local industry partners, evaluates the region's capability to respond to an emergency involving an ultra-large container vessel in San Francisco Bay on May 21, 2014. The purpose of the towing drill is to evaluate the capability of existing tugboats within San Francisco Bay to tow an ultra-large container ship. This was the first drill of its kind conducted in the United States. U.S. Coast Guard photo by Petty Officer Adam Stanton

domain. It will also explore the managed integration of novel technologies via regulatory updates, regional interagency cooperation, and risk analysis.

### Strategic Priorities

Enhancing American competitiveness and leadership is a prevailing strategic objective of the executive and legislative branches of the federal government. Since 2017, the president of the United States and Congress have outlined the importance of public and private sector investment in space activities, offshore renewable energy installations, artificial intelligence, and aquaculture. The national benefits of these industries are framed in executive orders and legislation as conduits for bolstering national security, reducing reliance on fossil fuels, pursuing environmental justice, creating jobs, and providing healthy food options.<sup>1</sup> While each industry is distinct, they all share a maritime nexus and are part of the MTS.

Coasts, lakes, rivers, canals, and ports are a component of the nation's transportation infrastructure.<sup>2</sup> The viability and health of navigable waterways are crucial to the nation's economy individually and collectively. According to the Association of Port Authorities, in 2018 maritime commerce generated \$5.4 trillion in economic activity, sustained 31 million domestic jobs, and created approximately \$378 billion in federal, state, and local

taxes.<sup>3</sup> Like any system, the whole is only as good as the sum of its parts.

Disruptions occurring in the MTS have cascading effects, including reducing the availability of goods and services. This is because approximately 71 percent of United States imports and exports, accounted for by tonnage, are transported by ship.<sup>4</sup> For example, during the COVID-19 pandemic, supply-chain disruptions and changes in consumption patterns caused unprecedented port congestion in multiple locations throughout the United States. Most notably, in late 2021, 80 container ships waited off the coast of Los Angeles-Long Beach, loaded with cargo valued at \$25 billion.<sup>5</sup> The significant delays experienced by ships waiting offshore or at anchorage to offload cargo contributed to domestic and global equipment, material, and consumable shortages.

Failure to monitor risk and prevent future disruptions in the MTS will be costly. For this reason, it is crucial that government entities, the maritime industry, and stakeholders work cooperatively to maintain the viability, accessibility, and health of navigable waterways, especially as novel technologies and new uses emerge.

### Regulatory Perspective

Thirty-five federal departments, agencies, and bureaus have authorities related to the MTS.<sup>6</sup> As time and

technology progress, these federal agencies initially assess novel uses through the lens of existing authorities and regulations. In some circumstances, existing authorities and regulations may insufficiently address novel uses because either the use or technology was infeasible when the authorities and regulations were promulgated. During this phase, regulatory agencies benefit from working alongside industries to further their understanding of novel uses and their impact to the MTS. With the shared goal of safe and secure operations in the maritime domain, regulatory agencies and industries can delineate requirements and expectations while alleviating unintended consequences.

Conceptualizing new regulatory frameworks for novel uses cannot be accomplished by a singular regulatory agency. The interconnected nature of the MTS and shared authorities necessitates information sharing and objective identification of tangential impacts resulting from updating or creating new regulations and policy. This is best accomplished through consistent interagency cooperation and communication.

The U.S. Committee of Marine Transportation Systems (CMTS), an executive-level federal interagency

coordinating committee established in 2005, is a robust forum for collaboration amongst federal agencies with a stake in maritime labor and operations. At this level, participating agencies collectively build corporate knowledge of the maritime domain by discussing novel uses and their communication with traditional users. In many ways, the CMTS mitigates risk in the marine transportation system by keeping a pulse on the interconnected elements of the system and facilitating interagency discussions on trends impacting the maritime domain. It is also a catalyst for championing solutions to known and/or forecasted challenges related to technological innovation and novel uses. Organizations such as this one enable unity of effort and maximize government oversight of the MTS. In many ways, the CMTS is a model for regional, interagency, and stakeholder collaboration.

### Local Coordination

While federal interagency coordination has an important role in maintaining the viability and health of the MTS, regional industry and stakeholder coordination is equally crucial. Local industry representatives and stakeholders have nuanced perspectives of local waterways.



Personnel and assets from Coast Guard Station Seattle, Port of Seattle Police Department, and Coast Guard Cutter *Blue Shark* enforce a 500-yard safety zone around *Polar Pioneer*, an Arctic drilling vessel, as it departs Terminal 5 in Seattle in June 2015. Coast Guard photo by Petty Officer 3rd Class Katelyn Shearer



Additionally, industry representatives and stakeholders possess knowledge of waterways exceeding that of local regulatory entities and have keen insight on how the introduction of novel uses will affect local maritime operations and marine species. Local input is key to mitigating risk and unplanned outcomes.

When novel uses of the MTS are under development, the value of regional collaboration cannot be understated. Local involvement in maritime spatial planning and operations typically occurs via harbor safety committees or equivalent industry groups. In fact, the Coast Guard encourages the formation of harbor safety committees to facilitate local governance of waterways in the form of recommendations concerning port safety, security, and environmental stewardship.<sup>7</sup> Participation in these committees or equivalent industry groups is voluntary. Membership usually includes “representatives of governmental agencies, maritime labor and industry organizations, environmental groups, and other public interest groups.”<sup>8</sup>

Harbor safety committees are renowned for cultivating safe, fair, and equitable use of waterways amongst diverse maritime operations and interests and developing consensus-driven best practices. When novel uses are proposed, the harbor safety committee or equivalent industry group is the preferred venue for discussing novel uses to ensure all stakeholders have an opportunity to share their viewpoints.

The Coast Guard participates in harbor safety committees in an advisory capacity and often solicits committee members’ feedback on proposed operations. Very rarely does the Coast Guard make decisions about waterways without first conducting outreach to members of industry and stakeholders. It should also be noted that some regions do not have harbor safety committees but have equivalent industry and stakeholder groups, which receive the same professional courtesies. Throughout the risk management process, the Coast



An MH-65 Dolphin helicopter from Coast Guard Air Station Atlantic City hovers above a wind turbine and a Coast Guard small boat during an October 14, 2020, search and rescue exercise 26 miles off the coast of Virginia. The exercise was to prepare for the potential need to rescue workers from the wind turbines. Coast Guard photo by Petty Officer 3rd Class Emily Velez

Guard remains engaged with harbor safety committees to maintain the navigability, safety, and security of port complexes.

## Risk Analysis

Risk analysis is an iterative and shared process, which the Coast Guard and the maritime industry manage using organizational methodologies and best practices. This section focuses primarily on Coast Guard navigation safety risk assessments.

Operations occurring in the MTS, novel or otherwise, are subject to Coast Guard navigation safety risk assessments. Evaluating risk in the maritime domain starts with clear lines of communication between the Coast Guard and industry. Once the Coast Guard engages the operator and reviews the proposed operation, a decision is made on what type of navigational safety risk assessment is needed. Depending on the scope and frequency of the operations, the assessment may be undertaken by the Coast Guard or the operator.


Navigation safety risk assessments for operations with a small footprint or one-time events are usually conducted by the Coast Guard. However, large or long-term projects with the potential to impact port dynamics and waterway usage are traditionally conducted by the operator. Risk assessments inform whether proposed operations influence public safety, the economy, and the environment. If the risk is found to be too high, risk-mitigation strategies must be implemented to lessen the risk prior to operating. Otherwise, the scope of the proposed operation must be modified.

As the presence of space activities, offshore renewable energy installations, autonomous vessels, aquaculture, and additional novel uses expand in the MTS, risk analysis will become more essential. Failure to thoroughly analyze risk could severely impact the backbone of our economy—the transport of imports and exports. Disruptions to the flow of cargo within the MTS hinder economic growth by limiting the sales of goods, which translates to business profits, employee wages, and tax revenue.

## Conclusion

The MTS is vast and becoming more dynamic as time and technology evolves. Its uses reflect the objectives and priorities of the United States' government and people. Maintaining the safety and security of the nation's waterways requires the implementation of multifaceted risk mitigation strategies. Such strategies include updating statutes, regulations, and policies that inadequately address novel operations; enhancing interagency collaboration at the federal and local levels; and thoroughly assessing risk in the maritime domain.

Similar to the interconnected nature of the MTS, the

aforementioned risk mitigation strategies are interdependent and will not successfully reduce risk if implemented in isolation. Integration of novel technologies in the MTS requires statutory and regulatory framework, interagency and stakeholder cooperation, and risk analysis. This is because jurisdictional authority provides agencies the legal responsibility for developing, updating, and enforcing laws and regulations. Furthermore, including novel uses within a department, agency, or bureau's jurisdictional authority legitimizes novel operations and assures the promulgation of minimum safety and environmental protection standards. Collaboration among federal agencies with a stake in the MTS engenders a macro viewpoint of domestic maritime labor and operations. Meanwhile, local collaboration and risk assessments evaluate the risk of operating in a specific environment. 

### About the author:

*LCDR Lindsay N. Cook has served in the U.S. Coast Guard for 13 years in many capacities; most notably in operational tours as a Prevention officer in the Pacific Northwest, Great Lakes, and Gulf of Mexico.*

### Endnotes:

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8. Ibid



# Charting a Course to Cybersecurity Regulations and Compliance

by MR. NICK PARHAM  
Marine Transportation System Cybersecurity Coordinator  
Atlantic Area Command  
U.S. Coast Guard

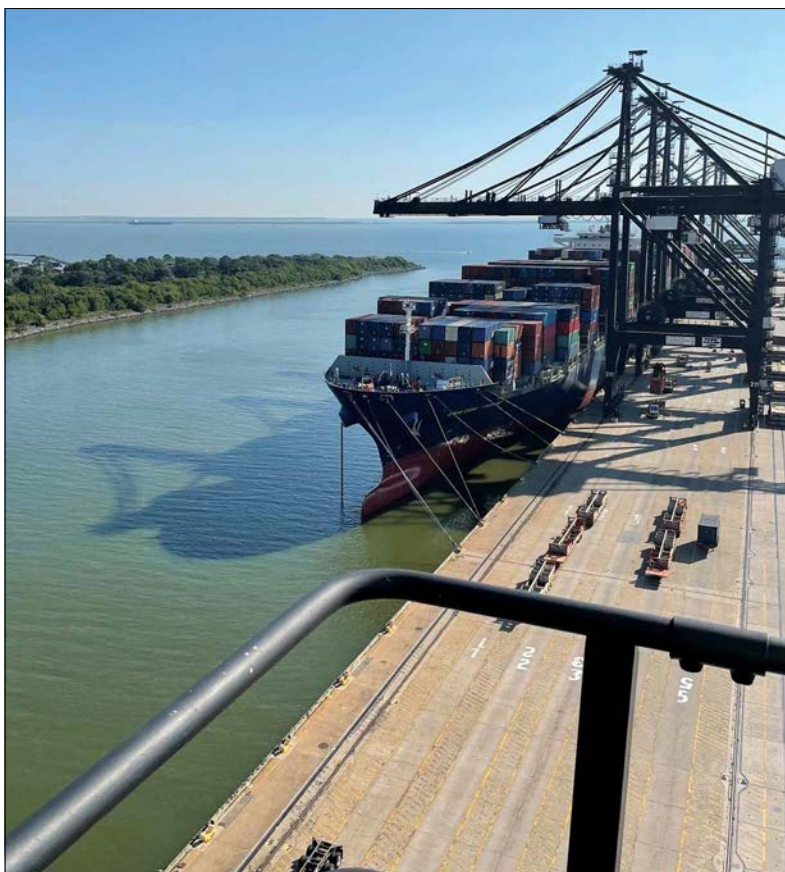
*I wish to have no connection with any ship that does not sail fast; for I intend to go in harm's way.* —John Paul Jones to M. Le Ray de Chaumont, November 16, 1778

When American Revolutionary War naval captain John Paul Jones wrote those words in a letter to his ally in France, the United States had decided to take the fight to the British coasts. After years of defending the newly formed United States against what was considered a superior British naval fleet, Jones knew that swift, powerful ships would give him the best chance of success. He took the ships his allies provided him and commanded several hastily assembled crews to successfully target and raid British convoys, disrupting their ability to attack the United States.

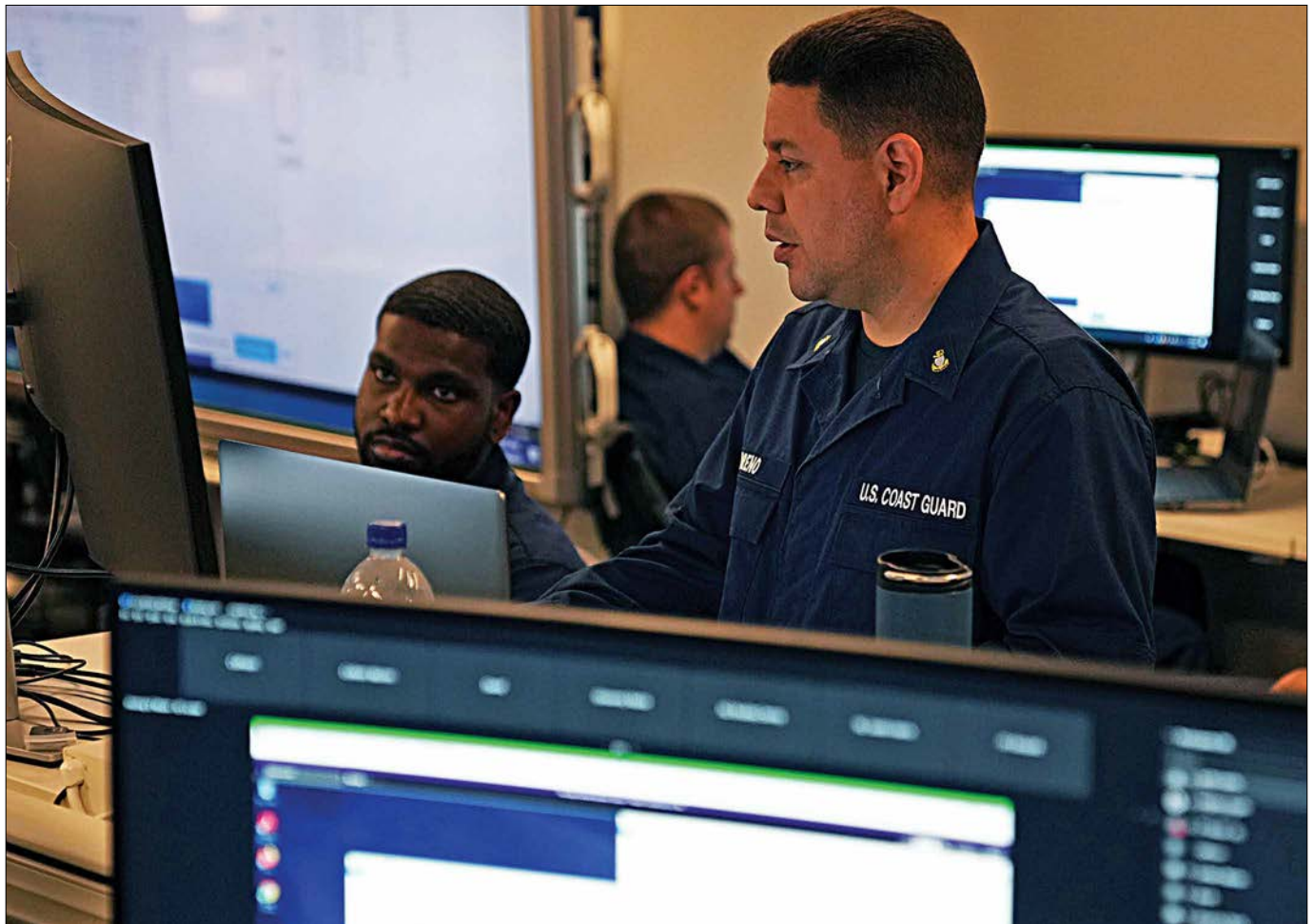
The need for swift, powerful assets to defend the United States and take the battle to our adversary remains. However, that battle is now being fought in the realm of cybersecurity. The bias towards action that fueled Jones lives on today in the Coast Guard's Cyber Strategic Outlook,<sup>1</sup> "[Working with allied agencies, countries, and stakeholders] ... we will act to protect the marine transportation system from threats delivered in and through cyberspace and we will hold accountable those who would do our nation harm ...."

Fighting this battle effectively to protect the marine transportation system (MTS) is part of the many statutory missions for the Coast Guard. To enhance this particular mission, the Coast Guard recently updated statutes and regulatory policies and established specialized cyber protection teams to provide deployable capabilities for assessment and mitigation of cybersecurity threats to the MTS. The past two years have seen great advancements for the assets related to this mission, but legislative

efforts to improve upon existing regulations and clarify authorities would serve to increase the speed and power for those assets. To accomplish these changes, it is imperative to understand what makes the defense of the MTS vital to the United States' national security and



The Coast Guard has enacted policies for port facilities and vessels to strengthen their cybersecurity and reduce vulnerabilities. This has primarily been accomplished by leveraging existing domestic authorities like those established by the Maritime Transportation Security Act. Coast Guard photo



More than 275 cyber professionals from across the Defense Department, U.S. federal agencies, and allied nations participated in Cyber Flag 22 from July 20 to August 12, 2022. They competed against robust, dynamic opposing forces of operators from the United Kingdom and United States. U.S. Cyber Command's annual exercise provides realistic "hands-on keyboard training" against malicious cyber actors to enhance readiness and interoperability among participating teams. U.S. Cyber Command photo

what legislative measures can enhance the cybersecurity capabilities and authorities of the Coast Guard.

### **What Makes the MTS a Focus for Cybersecurity Threats?**

The MTS is a vital component of the national supply chain, accounting for more than 25 percent of the United States' gross domestic product and providing the means for more than 90 percent of imports to flow into the country. Recent events have shown that a disruption to the flow of commerce, regardless of whether or not it was caused by a cybersecurity attack, can have cascading impacts across regional, national, and global supply chains. Look no further than the *M/V Ever Given* grounding, Colonial Pipeline ransomware attack, or COVID-19 pandemic as case studies to understand how vulnerable the global supply chain can be. Adversaries of the United States have noticed the detrimental impacts that supply chain disruptions can have and recognize that it is yet another vector to try and exploit. In the past,

defending against adversarial attacks from terrorists and rogue nations was focused on physical attacks, giving rise to the Maritime Transportation Security Act (MTSA) in 2004. However, it has become clear during the past decade that cybersecurity attacks must also be accounted for in security regulations and planning.

As the Internet of Things (IoT) continues expanding connectivity between humans and the equipment at shoreside facilities, as well as the ships that call upon them, "What would a 9-11-style cyberattack look like?" is often a discussion topic between security personnel. Could an adversary exploit vulnerabilities to not only shut down operational technology, putting a stop to all facility or ship operations, but also cause physical destruction, pollution, or even death? As those questions are answered across the MTS, the next question is what can be done to prevent those types of attacks, or mitigate the impacts should they succeed. The Coast Guard has enacted policies for port facilities and vessels to strengthen their cybersecurity and reduce



vulnerabilities, primarily by leveraging existing domestic authorities such as those established in the MTSA. Navigation and Vessel Inspection Circular (NVIC) 01-20, and Commercial Vessel Compliance (CVC) Work Instruction 027 were both released in 2020. MTS stakeholders who conduct operations subject to MTSA have since been making adjustments required by those policies to strengthen their defenses against cybersecurity attacks.

The MTS and its stakeholders have been a vital part of national security throughout the United States' history. This fact does not change with the threat of cybersecurity attacks, but it requires that a new level of understanding and trust be built between MTS stakeholders and government agencies that work to mitigate these threats. The need for public-private partnership in this effort has been recognized at the highest level through several executive orders and presidential policy directives during the past three administrations. There has been outstanding cooperation between the companies already operating under MTSA, but one of the challenges moving forward will

be establishing and maintaining that cooperation with operators who have not been subject to MTSA regulations and policies.

While cybersecurity concerns were present during the creation of the MTSA and subsequent regulations, the primary focus was on preventing physical terrorist attacks. Therefore, the applicability of MTSA was limited to facilities and ships where the consequence would be greatest in terms of destruction, pollution, and loss of life, via physical means. Many of those same terrorist organizations and rogue nations the United States was concerned about during the creation of MTSA have now included cybersecurity attacks in their arsenal to threaten other countries.

### What Legislative Measures Can Be Used?

The Coast Guard's 2021 *Cyber Strategic Outlook* expressed the following goal:

*Implement a risk based regulatory, compliance and assessment regime, incorporating international and industry recognized industry cybersecurity standards,*



U.S. Cyber Command's annual Cyber Flag exercise provides realistic "hands-on keyboard training" against malicious cyber actors to enhance readiness and interoperability among participating teams. During Cyber Flag 22, held from July 20 to August 12, 2022, more than 275 cyber professionals competed virtually from nine time zones in five countries. U.S. Cyber Command photo

*to manage cybersecurity threat risks to maritime critical infrastructure and promote the lawful exchange of goods and services in the global marketplace.*<sup>2</sup>

In order to meet this goal, the United States must continue to evolve cybersecurity laws and regulations. The speed of evolution in the cybersecurity world further complicates questions regarding legislative efforts as solutions can quickly become outdated even with the most efficient government action. Recognizing this, the administration signed a *National Security Memorandum on Improving Cybersecurity for Critical Infrastructure Control Systems* on July 28, 2021. The memorandum established a voluntary initiative intended to drive collaboration between the federal government and the critical infrastructure community to improve cybersecurity of control systems. The Department of Homeland Security was instructed to lead this effort.

In support, the Cybersecurity and Infrastructure Security Agency (CISA) published its updated Cross-Sector Cybersecurity Performance Goals and Objectives on March 21, 2023, resulting in Version 2.0. The performance goals were developed in conjunction with partners across the interagency and private sector through the Critical Infrastructure Partnership Advisory Council. The voluntary cross-sector common baseline cybersecurity performance goals address information technology and control systems cybersecurity activities. They consist of foundational activities for effective risk management and high-level cybersecurity recommended practices. The goals and objectives are not an exhaustive guide to all facets of an effective cybersecurity program. However, they provide "... clear guidance to owners and operators about cybersecurity practices and postures that the American people can trust and should expect for such essential services ..." to protect systems supporting National Critical Functions.<sup>3</sup>


Regarding regulations, the Coast Guard continues to work with its partners within the Department of Homeland Security and other agencies to identify how best to address cybersecurity requirements, with a focus on MTSA-regulated facilities and vessels. CISA's cross-sector performance goals will help serve as a framework for these efforts. For those who may be curious as to how the Coast Guard will maintain pace with the rapidly changing dynamics of cybersecurity, it has previously overcome this challenge. The greatest example of this comes through its vessel inspections program, where personnel have been inspecting commercial ships for decades. While some components of ship design and safety never change, there are many aspects that do and are subject to the pace of technological advancements, which are often much faster than regulatory procedures.

How has the Coast Guard addressed this in the past? By using the ability to request incorporation by reference

as authorized in the statutes.<sup>4</sup> This method of regulation has been used to accommodate the rapid change of technological advancement in vessel communication systems, engineering, and fire protection for many years.

To use this authority with respect to cybersecurity, the Coast Guard and MTS stakeholders would have to identify, and agree upon, recognized standards for measuring compliance to the statutes. The process would be very similar to the development of the CISA performance goals described above and following the intent of the National Security Memorandum. Given the broad range of operations that fall under MTSA, consideration will also have to be given to how these regulatory updates can be scaled up or down to match the cybersecurity maturity of the regulated entities. The continued collaborative involvement of maritime stakeholders in shaping these policies and regulations through active participation will be critical to meeting the needs of all MTS stakeholders.

## Conclusion

Those who know their naval history know that the ships received by John Paul Jones to fulfill his request were not exactly what he had in mind when he asked his allies for help, but he obviously succeeded in adapting to what he was given. In cyberspace, the Coast Guard and its MTS stakeholders are still determining what is needed to succeed against the many active adversaries and, in that process, they are recognizing that models for success may not fit previously held ideals. In Jones' case, the determination to use innovative ideas to defend his homeland against, and take the fight to, adversaries with overwhelming capabilities was crucial to success. It is with that same spirit that the Coast Guard, partner agencies, and MTS stakeholders have entered into the cyberspace battle and will continue to fight to protect one of our nation's most critical infrastructure sectors, the MTS. 

## About the author:

Mr. Nick Parham is the Marine Transportation System (MTS) Cybersecurity Coordinator for the Atlantic Area command. In this role, he is responsible for development and execution of Coast Guard cybersecurity regulations and policies impacting MTS stakeholders operating in an area of responsibility that encompasses all inland and coastal commercial maritime operations east of the Rocky Mountains including Puerto Rico. He would like to acknowledge the faculty and staff of the Cyber & Innovation Policy Institute, U.S. Naval War College and his cohorts at the 2022 CIPI Summer Workshop on Maritime Cybersecurity, in particular U.S. Navy LCDR Tyson Meadors for their contributions to this article.

## Endnotes:

<sup>1</sup> United States Coast Guard Cyber Strategic Outlook, August 2021

<sup>2</sup> United States Coast Guard Cyber Strategic Outlook, August 2021. Pg 28

<sup>3</sup> Cybersecurity and Infrastructure Security Agency—[www.cisa.gov/cpgs](https://www.cisa.gov/cpgs)

<sup>4</sup> [www.nist.gov/system/files/revised\\_circular\\_a-119\\_as\\_of\\_01-22-2016.pdf](https://www.nist.gov/system/files/revised_circular_a-119_as_of_01-22-2016.pdf)



# Safety at Sea: Vessel Traffic Service San Francisco

## Celebrating 50 years of Vessel Traffic Services

by MR. SCOTT HUMPHREY  
VTS Training Director  
Sector San Francisco  
U.S. Coast Guard

LCDR ALEXANDRA MILLER, P.E.  
Chief, Waterways Management Division  
Sector San Francisco  
U.S. Coast Guard

The glow of a computer screen illuminated the face of a Vessel Traffic Service (VTS) San Francisco operator on the windowless watch floor. On this Friday afternoon in April 2022, a 564-foot container ship moving goods from the Port of Oakland to Seattle checked into the VTS offshore sector 38 nm from San Francisco Bay. This route cut through the Greater Farallones and the Cordell Bank National Marine Sanctuary.

Something was wrong. The VTS operator noticed the vessel was no longer making forward progress. Querying the vessel, the operator learned that the container ship lost propulsion more than 12 nm from land and was drifting toward the rocky coast of Point Reyes National Seashore in 50-knot winds and 15-foot seas.

In more than 300 feet of water, the vessel continued to drift towards Point Reyes until it was shallow enough to deploy its anchor, which failed to hold. After unsuccessful attempts by the ship's crew to make engine repairs, the ship deployed its second anchor inside the Cordell Bank National Marine Sanctuary, within eight nautical miles of land. With 21 souls and approximately 364,000 gallons of potential pollution on board, in addition to 783 containers on deck, the vessel continued to drag anchor, drifting toward Point Reyes National Seashore.

The Captain of the Port issued an emergency broadcast for any available tug assistance. VTS operators diverted a tug toward the vessel, and three additional tugs got underway to make the 38 nm transit in arduous weather. Sector San Francisco established an incident command post and VTS operators monitored the vessel, keeping constant communication over the next 48 hours until weather conditions improved, allowing a towline to be passed to the vessel. The containership was eventually dead-ship towed 38 nm back to San Francisco Bay.

While monitoring the container ship, and a large number of regularly scheduled marine events inside the Bay, the same VTS operator noticed on closed-circuit television a large plume of smoke at a port facility on a narrow channel. A fire had ignited at the terminal

encompassing a cargo storage tower, silo, conveyor belt, and a portion of the pier. At the time the fire broke out, a 576-foot tank vessel, a 623-foot bulk carrier, and a 637-foot roll-on/roll-off ship were moored at the pier. Located under the pier, but between the tank vessel and bulk carrier, the fire posed a grave threat to the lives of the facility workers, the crew members on the nearby ships, and those of the neighboring community. The VTS supervisor immediately contacted the San Francisco Bar Pilots to dispatch pilots to all three vessels and contacted each vessel to ensure crew safety and ask each master to expedite preparations to get underway. The pilots were able to get all three ships underway in less than 90 minutes from the initial notification; an evolution that would normally take several hours.

### The Beginning

In January 1970, the U.S. Coast Guard Research and Development Center and the San Francisco Marine Exchange teamed up on an experiment to determine the usefulness of shore-based radar in maritime traffic safety. From a small room atop San Francisco's Pier 45, Coast Guard personnel monitored vessel movements using state of the art radar displays and communicated vessel traffic information over UHF radio. The experiment, a first of its kind in the United States, was called the Harbor Advisory Radar (HAR) Project.

On January 18, 1971, the tankers *Arizona Standard* and *Oregon Standard* collided underneath the Golden Gate Bridge. The *Oregon Standard* spilled an estimated 20,000 barrels of oil into the San Francisco Bay. The November 1971 edition of *Proceedings* described the incident as "a catastrophe in terms of ecological harm, property damage, economic loss, and harm to the small boater and to the public's stake in the environment."<sup>1</sup>

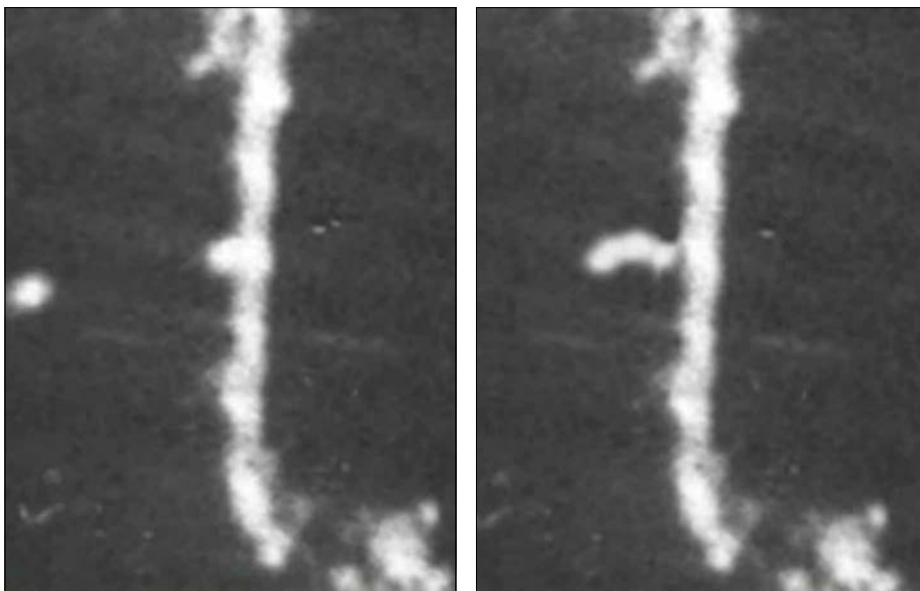
How did such a catastrophe happen under the eyes of the Coast Guard HAR watch team? And doesn't such a catastrophe happening during a research and development project prove the experiment a failure?

The August 11, 1971, Coast Guard accident report cites “two inherent weaknesses in the HAR system, both of which were contributing factors to the inability of the system to prevent the collision.”<sup>2</sup>

First, the HAR Project was voluntary for vessels. This meant it was optional for vessels to make reports to the HAR Project and optional for vessels to listen to the HAR Project radio channels. The accident report says the master of the *Oregon Standard* did not listen to the HAR operating radiotelephone channel because he “did not observe any traffic on his radar, so he did not think HAR’s assistance was necessary.”<sup>3</sup> The report goes on to say, “As a result of the master’s failure to participate, the primary purpose of the system was defeated.”<sup>4</sup> In fact, the HAR watchstanders tried to reach the *Oregon Standard* to warn them of the *Arizona Standard*.<sup>5</sup>

Second, the Coast Guard had no maritime traffic control authority in 1971. The HAR Project watchstanders

were only allowed to provide a “word picture of the position and general direction of movement of vessels” observed on radar,<sup>6</sup> but not any interpretative information. The Project operating manual stated, “Advice [from the HAR Project operator] in the sense of a recommendation for specific action to be taken by a pilot is strictly



January 1971 screenshots show the *Arizona Standard* and *Oregon Standard* radar images just before colliding under the Golden Gate Bridge, right, and after the collision. Coast Guard photo



U.S. Coast Guard watchstanders in the San Francisco Traffic Operations Center direct vessel movement in the harbor area using specially designed, high-resolution radar in 1976. The VTS reduces vessel delays and the ever-present danger of marine accidents and their related loss of life and property, as well as potential environmental damage. Coast Guard photo



prohibited.”<sup>7</sup>

As the accident report describes, referring to the HAR Project, these two systemic weaknesses were “due to lack of statutory authority for the Coast Guard to operate such traffic regulation systems.”<sup>8</sup> In the November 1971 edition of *Proceedings*, “Collision Under the Golden Gate,” the author says, “had the communication or authority been present, it is likely that the HAR Project would have prevented the collision.”<sup>9</sup>

In response to the collision, Congress enacted Public Law 92-63, the Vessel Bridge-to-Bridge Radiotelephone Act, on May 1, 1971.<sup>10</sup> Congress took further action on July 19, 1972, enacting Public Law 92-340, the Ports and Waterways Safety Act of 1972.<sup>11</sup>

Among many other things, the Ports and Waterways Safety Act of 1972 gave the Coast Guard authority to establish VTS, require vessels to participate in VTS, and the authority to control vessel traffic. The Bridge-to-Bridge Radiotelephone Act required certain vessels to carry a marine radio and established VHF FM marine radiotelephone channels that applicable vessels must monitor and use for navigation safety communications.

### OPA 90

Ironically, VTS San Francisco remained a voluntary service until the Oil Pollution Act of 1990 (OPA 90). Under OPA 90, the Coast Guard promulgated the National VTS Regulations in 1994. These regulations describe certain vessels that must participate in all VTSs. They also delegate full authority to the VTS to manage and control vessel traffic.

As for the pre-OPA 90 period, as a voluntary service, VTS San Francisco always enjoyed 100 percent participation. But budget shortfalls threatened the VTS program and, during summer 1988, VTS New York and VTS New Orleans were already preparing to shut down. As evidence of strong industry support for VTS San Francisco, in June 1988, the Marine Exchange of San Francisco appealed to Admiral Paul A. Yost, Commandant of the Coast Guard, to keep VTS San Francisco



Bob Hastings works on the Vessel Traffic Service watch floor in 1986. Photo courtesy of Bob Hastings

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In July 1972, Vessel Traffic Service San Francisco became the first VTS in the United States. A Vessel Traffic Service provides active monitoring and navigational advice for vessels in particularly confined and busy waterways.

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Watchstanders monitor vessel traffic at the Vessel Traffic Service Operations Center in 1995. Photo courtesy of Scott Humphrey



A vessel transits through the three bridges, including the Benicia-Martinez Railroad Drawbridge, also known as the Union Pacific Railroad Bridge. Photo by Michael Carlson

open despite budget issues. Attached to that letter was a check in the amount of \$140,000 to help the Coast Guard with VTS San Francisco operating expenses.

Today, VTS San Francisco operates with all three VTS mission areas—Information Services, Traffic Organization Services, and Navigation Assistance Services—outlined by the International Maritime Organization. Unlike the VTS San Francisco of 1972, where VTS operators were prohibited from giving advice, today, VTS San Francisco operators proactively respond to possible navigation errors and give mariners advice, warnings, or instructions.

### **Keeping the Marine Transportation System Running**

Petroleum remains one of the most critical cargoes in the San Francisco Bay Region, and VTS closely monitors every petroleum ship movement. Almost 100 percent of the petroleum consumed in northern California is refined at one of the San Francisco Bay region refineries.

However, an area large enough for a tanker ship to tie up and offload jet fuel is absent from any international airport in the San Francisco Bay region. That's because the enormous volume of jet fuel needed to refill the planes comes directly from the local refineries through

a network of pipes crisscrossing the region.

VTS not only focuses on preventing oil spills, but on maintaining a safe, efficient path for these petroleum tankers to get to and from the refineries. A single blockage in the San Francisco Bay could mean a devastating shortage of fuel for all the region's airports and gas stations. If tankers cannot get to the refineries, there is no refined petroleum to put into the network pipes. When the pipes run dry, so do the airports and the fuel depots that fill the tank trucks that supply the region's gas stations.

To keep ships moving safely and securely, the maritime community continues to champion safety through the San Francisco Bay Harbor Safety Committee. VTS often spearheads nonregulatory maritime safety and security solutions with the Harbor Safety Committee. Three examples of this are critical maneuvering areas (CMAs), the Ferry Traffic Routing Protocol, and the Benicia-Martinez Railroad Drawbridge Communications Protocol.

CMAs are a Harbor Safety Committee recommendation to limit ship movements during restricted visibility. They also provide a template for the VTS to enforce low visibility traffic management measures to require vessels to stay put. The Ferry Traffic Routing Protocol takes the



guesswork out of high-speed ferry transits. When ferries follow the routes there is safe space between opposing ferries, and recreational boaters know where to go to get out of their way. The Benicia-Martinez Railroad Communications Protocol is a unique agreement between commercial mariners, Union Pacific Railroad, Amtrak, and the Coast Guard. Its primary aim is to guarantee the drawbridge be fully open well in time for an approaching ship. It also helps minimize delays for passenger trains crossing the bridge.

### Enhancing Maritime Domain Awareness as a Multimission Platform

No other agency has the real-time maritime domain awareness of a VTS. In 2021, VTS oversaw approximately 153,000 Vessel Movement Reporting System (VMRS) users transit through the area. VTS knows the precise location, destination, planned route, underwater draft, and at least a dozen other details for every VMRS user vessel in its area. It also knows the status of every waterway, dock, and anchorage in its area, making it especially suited to support operations during regional emergencies.

The aforementioned events of April 2022 provide excellent examples of this capability. The VTS operator catching the vessel drifting was the start of a three-day emergency rescue evolution for which the Captain of the Port established an incident command post. VTS tracked and managed communications between the disabled vessel, rescue tugs, and other nearby vessels, while a VTS watch team, experts with knowledge of local geography and maritime operations, worked directly with the ship's captain and agent.

On the afternoon of the second day of the offshore crisis, the VTS operation center observed black smoke billowing from the Port of Benicia's petroleum coke terminal, which was on fire with three deep draft ships moored alongside the dock. The Captain of the Port established a second incident command post, and VTS became the source for all maritime information around the fire scene. When emergency evacuation off all three ships became top priority, the Port of Benicia crisis rapidly merged into what was now a pair of maritime crises competing for resources.

While pilots and tugs were dispatched to Benicia, VTS talked to the captains of the moored ships. As the fire blazed out of control, VTS realized the ships' captains and crews might have to cut the mooring lines and move their ships without a pilot. In the end, San Francisco Bar Pilots and tugboats, with the help of firefighters as line handlers, safely evacuated the three ships from the port.


### Normal Operations

While not every weekend is as out of the ordinary as the

one in April 2022, VTS San Francisco consistently safeguards the integrity of the MTS. This includes the San Francisco Bay region's sailing vessels and nearly 1,000 permitted marine events within the VTS area every year. Sector San Francisco is also one of the busiest sectors for search and rescue (SAR) cases, and professional mariners aboard VTS participants are often called on as SAR force multipliers.

Upon hearing a call for help over the radio, VTS San Francisco watchstanders quickly scan the area for VTS participants in the vicinity to render aid. When a fishing vessel began taking on water offshore, VTS contacted a vessel nearby to render assistance. This allowed the crew on the fishing vessel to focus on dewatering efforts in time for Coast Guard Station Golden Gate to arrive on scene to tow the vessel safely back to port.

### Conclusion

The civilian and active-duty workforce at VTS San Francisco is the steady force that maintains the safety and integrity of the MTS in the San Francisco Bay Area. While not every weekend is this busy in the VTS Operations Center, the diligence, expertise, and responsiveness of VTS personnel averted loss of lives, catastrophic environmental damage, and extensive property damage while maintaining the integrity of a \$70 billion marine transportation system. 

#### About the authors

*Frederick Scott Humphrey has 39 years with the U.S. Coast Guard. More than thirty of those years are in Vessel Traffic Service operations and training management in the San Francisco Bay region. He holds an VTS certification issued by the International Association of Marine Aids to Navigation and Lighthouse Authorities.*

*LCDR Alexandra Miller is the Chief, Waterways Management Division at Sector San Francisco. She earned a Master of Science in fire protection engineering from Worcester Polytechnic Institute and a Master of Arts in defense and strategic studies from the Naval War College. Previous assignments include CGC Thetis, Sector Jacksonville, and Coast Guard Headquarters Office of Design and Engineering Standards. She is a licensed professional engineer.*

#### Endnotes:

1. *Proceedings of the Marine Safety Council*, November 1971, Vol. 28 No. 11
2. Transportation Safety Board and United States Coast Guard Marine Casualty Report, "Collision Involving the SS *Arizona Standard* and SS *Oregon Standard* at the Entrance to San Francisco Bay on January 18, 1971" pg. 13
3. *Ibid*
4. *Ibid*
5. *Ibid*
6. *Ibid*
7. United States Coast Guard Harbor Advisory Radar Operating Manual
8. National Transportation Safety Board and United States Coast Guard Marine Casualty Report, "Collision Involving the SS *Arizona Standard* and SS *Oregon Standard* at the Entrance to San Francisco Bay on January 18, 1971" pg. 19.
9. *Proceedings of the Marine Safety Council*, November 1971, Vol. 28 No. 11
10. Pub. L. 92-63, §2, August 4, 1971, 85 Stat. 164
11. Pub. L. 92-340, July 10, 1972

# The U.S. Coast Guard and U.S. Space Force

Joint efforts protect our waterways

The foundational relationship between the nation's oldest maritime service and its youngest military service begins on our common waterways. The Coast Guard and Space Force are committed to balancing regulatory frameworks and standards to transform maritime operations to ensure that both the space and maritime domains are ready for the future.

## U.S. Coast Guard

Headquarters: Washington, D.C.

Parent Organization: Department of Homeland Security

Strength: 41,426 active duty personnel

Motto: *Semper Paratus*, Always Ready



For more than 230 years the Coast Guard has been the principal federal agency responsible for maritime safety, security, and environmental stewardship. It uses the broad legal authorities granted to it as a law enforcement agency to safeguard America's 95,000 miles of shoreline, 25,000 miles of navigable channels, 361 ports,<sup>1</sup> and its Exclusive Economic Zone. All of these are key components to maintaining American jobs and economic competitiveness.

With a combined active duty and civilian workforce of more than 51,000, the service operates a fleet of 243



A Coast Guard Station Port Canaveral, Florida, a crew patrols the waters off Launch Pad B in the early morning hours May 16, 2011, launch day for the space shuttle *Endeavour*. Since 1980, the Coast Guard has provided safety and security services to the Kennedy Space Center and Cape Canaveral Air Force Station. U.S. Coast Guard Photo by Petty Officer 1st Class Krystyna Hannum

cutters, 201 fixed and rotary-wing aircraft, and more than 1,600 boats to maintain the safety and security of America's ports. This is carried out while also serving as a first responder and providing humanitarian aid. These assets are vested in two geographical areas—Atlantic and Pacific—nine districts and 37 sectors located at strategic ports across the country.

It has supported space operations since 1955, and has been working with stakeholders since the early days of space flight.<sup>2</sup> Since the end of the federally operated Space Shuttle program in 2011, there has been a tremendous increase in the volume of commercial space operations as organizations like SpaceX, Blue Origin, Boeing, and Sierra Space are changing the business model through increasingly efficient operations.

—U.S. Coast Guard CDR Laura Springer  
*Waterways Policies and Activities Division Chief*

### Endnotes:

<sup>1</sup> USCG *Maritime Commerce Strategic Outlook*. Releasable.pdf (defense.gov). <https://media.defense.gov/2018/Oct/05/2002049100/-1/-1/1/USCG%20MARITIME%20COMMERCE%20STRATEGIC%20OUTLOOK-RELEASABLE.PDF>

<sup>2</sup> "Space Mission Support: Coast Guard Patrols Restricted Areas Around Launches, Re-Entries." *Seapower* (seapowermagazine.org). <https://seapowermagazine.org/space-mission-support-coast-guard-patrols-restricted-areas-around-launches-re-entries/>





### **U.S. Space Force**

**Headquarters:** The Pentagon

**Parent Organization:** The U.S. Air Force

**Strength:** 8,400 active duty personnel

**Motto:** *Semper Supra, Always Above*

**E**stablished December 20, 2019, U.S. Space Force (USSF) organizes, trains, and equips space forces in order to protect U.S. and allied interests in space and to provide space capabilities to the joint force. It is the first new branch of the armed services in 73 years, and was the result of widespread recognition that space is a national security imperative.

Space Force, organized under the Air Force, consists of about 16,000 military and civilian personnel referred to as Guardians. This name has a long history in space operations, tracing back to the original command motto of Air Force Space Command in 1983 which was "Guardians of the High Frontier." Military members who had originally served under Air Force Space Command (AFSPC) were assigned to USSF after the Command's redesignation as Space Force.

Operationally, Space Force is responsible for acquiring military space systems, maturing the military doctrine for space

power, and organizing space forces for Combatant Commands.

—U.S. Space Force MAJ Johnathan Szul  
*Director of Operations for the 1st Range Operations Squadron  
 Space Launch Delta 45*



A Falcon 9 rocket launches from LC-39A at Cape Canaveral Space Force Station, Florida, January 18, 2022. The Starlink 4-6 mission delivered 49 satellites into orbit. U.S. Space Force photo by Joshua Conti

# Coast Guard Support to Space Operations

A sector commander's roles and responsibilities—today and tomorrow

by CDR JILLIAN LAMB  
*Response Department Head*  
*Sector Jacksonville*  
*U.S. Coast Guard*

LCDR JOHN DiNINO  
*Supervisor*  
*Marine Safety Detachment Canaveral*  
*U.S. Coast Guard*

LCDR STEVE DROSS  
*Incident Management Chief*  
*Sector Jacksonville*  
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LT J.G. GRIFFIN TERPSTRA  
*Waterways Management Chief*  
*Sector Jacksonville*  
*U.S. Coast Guard*

Alexander Hamilton and our first Congress could not have predicted how a small fleet of 10 cutters would eventually evolve into today's Coast Guard. As our nation has changed, so too has the Coast Guard's mission. This was never more evident than in the difficult days following September 11, 2001. Coast Guard women and men were among the first to respond, providing immediate assistance in the maritime evacuation of citizens; mobilizing security forces to harden critical infrastructure; integrating intelligence personnel with interagency partners; and providing onsite clean up expertise.

This event fundamentally changed our organization, established comprehensive regulations for ships and facilities, and developed a robust, risk-based maritime security approach. Amplified by the events of 9/11, port, waterway, and coastal security (PWCS) policy and regulation matured over the months, years—and now decades—into what guides us today.

On June 1, 2022, the Commandant of the Coast Guard, Admiral Linda L. Fagan, noted in the *Commandant's Intent* that:

*Tomorrow looks different. So will we. We will be a Coast Guard that generates sustained readiness, resilience, and capability in new ways to enhance our Nation's maritime safety,*

*security, and prosperity.*

Today, units across the Coast Guard are establishing a new paradigm for how the Coast Guard will support space operations, and, much like with PWCS, how field commanders and service leadership will direct a long-term, enterprise-wide approach.

## Informed by the Past, Poised for the Future

Port security operations existed prior to September 11, 2001, however, globalization, advanced technology, and new threats required the Coast Guard to adapt. This same adaptability must now be applied to our space industry response. The Coast Guard has been supporting government and military space flight since the inception of the space program in the 1950s, and throughout NASA's Space Shuttle program, which ended in 2011.

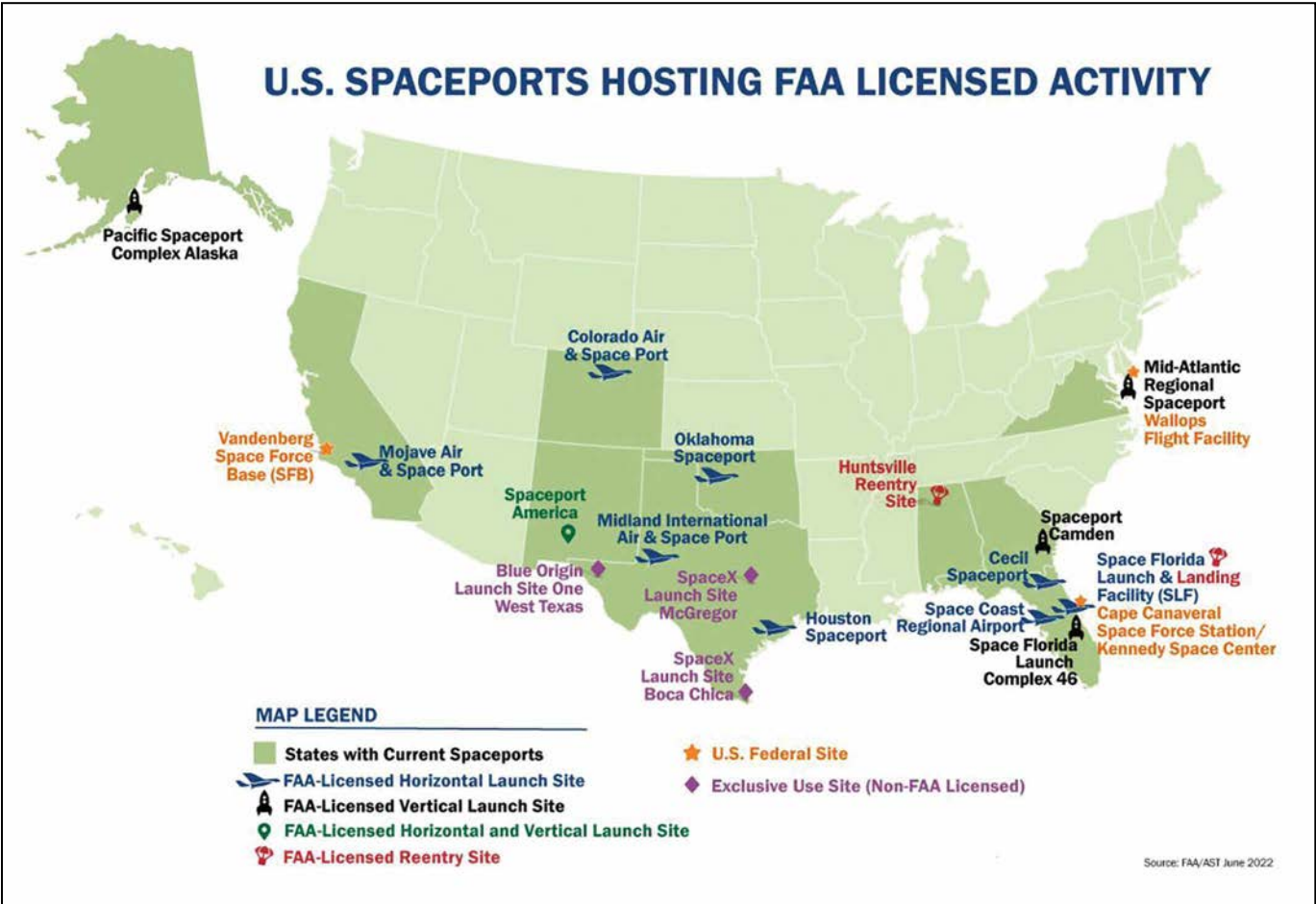
However, the reemergence of the space race has brought novel technology, a rapid pace of change, and the inclusion of maritime elements that require the Coast Guard to develop a transparent, equitable, and repeatable governance process.

America relies on a robust space program to fuel innovation, advance global interests, and preserve our military superiority. To meet these growing demands, old and new spaceports regulated

Regular access to space has been made possible through a rapidly growing space industry, supported by a number of federal launch ranges, state-owned spaceports, and privately-owned launch sites.

—Federal Aviation Administration



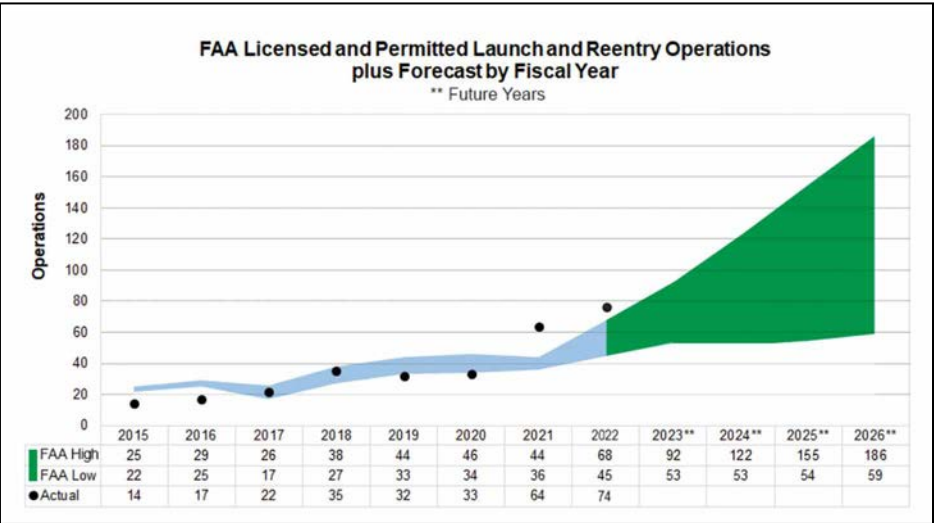


Map courtesy of the Federal Aviation Administration

predominately by the Federal Aviation Administration (FAA), are increasingly impacting the marine transportation system (MTS). Since 2015, FAA licensed and permitted launch and reentry operations have more than quadrupled—from 14 to 64 annually. Fiscal Year 2022 was a record year, with more than 50 permitted launches from Cape Canaveral alone. The FAA had projected a total of 37 to 55 launches. In Sector Jacksonville alone, there were more than 45 launches and four maritime reentries. Looking ahead, government agencies are sprinting to keep pace with the projected, exponential growth.

Space Operations are one of the few missions the Coast Guard performs that concurrently affects each of the five roles the sector commander maintains—Captain of the Port, Federal On-Scene Coordinator, Federal Maritime Security Coordinator, Officer in

Charge, Marine Inspections (OCMI), and Search and Rescue (SAR) Mission Coordinator. While each spaceport is unique, implications of space operations touch the maritime environment in nearly every district. Today, Coast Guard sector commanders are employing each



Graph courtesy of the Federal Aviation Administration



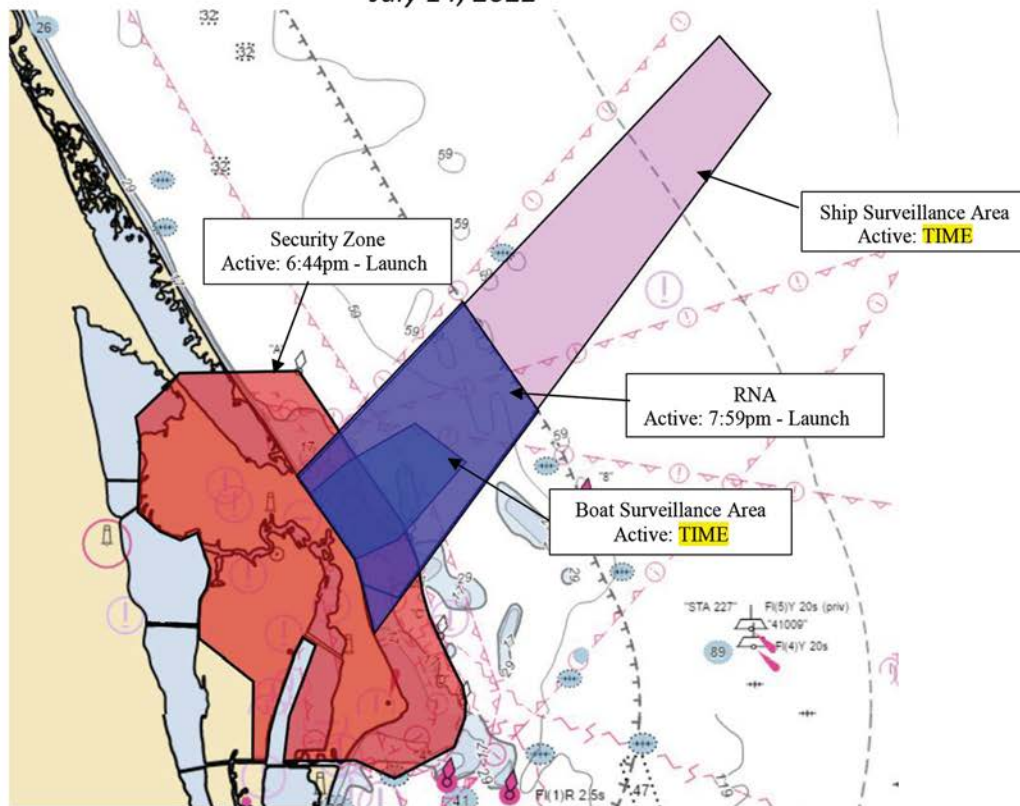
## UNITED STATES COAST GUARD SECTOR JACKSONVILLE SPACE LAUNCH DELTA 45



### Space Operations Rocket Launch Advisory

*Falcon 9 CRS-25*

*July 14, 2022*



### WARNING

#### RNA/Security Zone

No person or vessel may enter, pass through or remain in the regulated navigation area(RNA) or security zone unless authorized by the Captain of the Port under the authority of 33 CFR 160.111 and Title 46, United States Code (USC), Parts 70002 and 70036. Failure to comply is punishable by a fine of not more than \$250,000 or imprisonment for not more than six years, or both.

#### Surveillance Area

Extremely hazardous conditions will be present within the surveillance areas. Mariners are strongly advised to avoid these areas while active.

### For up to date Launch Information:

1. Scan the QR Code or copy link
2. Go to Upcoming Launches near the bottom of the page
3. Open Launch Hazard Area

<https://www.patrick.spaceforce.mil/>



USCG Command Center Jacksonville: (904) 714-7557

USSF Launch Information Recorded Line: 1-800-470-7232

**Mariners are advised to remain clear of all zones during the time of activation**

Detailed Launch Information can be obtained using Coast Guard channel 16 or FM81A and Notice to Mariners @

<https://www.navcen.uscg.gov/?pageName=InmDistrict&region=7>

Sector Jacksonville launch graphic



of these authorities to preserve our natural resources, protect the maritime public, and ensure economic prosperity.

### **Captain of the Port Responsibilities**

The fundamental role of the sector commander is to promote and enforce the safety and security of U.S. ports and waterways. Rocket testing, launches, and recovery operations taking place near the maritime community present a hazard to the MTS. As an organization, we support commerce and innovation, but we also have a responsibility to ensure the safety of the maritime community. Limited access areas (LAA), more commonly known as safety and security zones, and regulated navigation areas (RNA) are essential tools in this mission.

Due to the complexity of space operations and the unpredictable scheduling, waterways management staffs are continuously challenged to meet regulatory requirements while still providing industry and the public with adequate notice of hazardous operations. The establishment of these areas facilitates appropriate maritime domain awareness, adequate broadcasts and communication, and on-water patrol assets to enforce compliance. Providing this support not only prevents launch cancellations, but, in the event of a non-nominal, or emergency scenario, protects the public, enables first responders to perform uninterrupted operations, and

ensures the protection of astronauts or other proprietary national interest equipment.

Using the Ports and Waterways Safety Authorities under 46 USC Chapter 700, this year District Seven and Sector Jacksonville established an RNA to ensure the safety of vessels, mariners, and navigable waters during hazardous space operations. Working with space partners like the United States Space Force, NASA, FAA, and independent space companies, the Coast Guard uses all information available to evaluate potential maritime risk. Based on this risk, the Captain of the Port activates a portion of the RNA based on mission specific concerns. By activating a reduced area for a short time period, the effects of a launch on the MTS are drastically reduced. Additionally, the RNA provides Coast Guard assets a legally enforceable area tailored specifically to the size of the present hazard.

Notification of the activation of LAAs and RNAs is vital to public safety. In addition to traditional means of notification, such as Navigation Telex, marine safety information broadcasts, and local notices to mariners, Sector Jacksonville has developed space operations launch advisories and leverages social media to inform the public.

### **Confronting New Challenges**

Support of the space mission is not without its obstacles,



A U.S. Coast Guard Station Port Canaveral boat crew enforces a safety and security zone off the coast of Cape Canaveral, Florida, during a June 2016 rocket launch. Coast Guard photo by Petty Officer 2nd Class Anthony L. Soto

one of which is ensuring the safety of operations taking place outside of United States' territorial seas. To address this issue, the Coast Guard establishes safety zones beyond territorial seas but within the exclusive economic zone (EEZ) as part of a two-year pilot program authorized by Congress. The program recognizes the unique nature of these special activities and seeks to establish a baseline understanding of how the Coast Guard will execute this authority while preserving international maritime norms and behaviors. Once again we are leading the way, as this historic pilot program is establishing maritime law precedence globally.

Field commanders are leveraging creative thinking and adapting our traditional mindset to manage our waterways. Looking forward, however, many questions remain, including:

- How do you balance the economic interests and waterways access for all stakeholders? Does one user have greater weight or priority over another?
- Should the Coast Guard be the primary resource for monitoring and enforcing LAAs? What is the role of private operators? What local or other government agency authorities could be employed?
- What is the Coast Guard, and ultimately the United States government's, role in establishing LAAs in international waters? Should the pilot program be codified into law?
- In today's information age, does our current model to achieve public "notice" work? How do we leverage technology to ensure each method of notice is appropriate for the maritime user?
- What is the appropriate methodology and criteria to consistently and equitably assess risk? Our partners use the concept of aggregate risk—with a focus on the loss of human life—should other factors like environmental or economic risk weigh into launch approval?

### **Federal On-Scene Coordinator Responsibilities**

Under Federal On-Scene Coordinator authority, hazardous materials and spill response support involves operations on the launch pad, in-flight anomalies, or materials transport within our ports that introduce propellants or other hazardous materials into the environment. The emergence of space operations has forced incident

management personnel to learn about new propellants, understand hypergolic materials, and consider the safe recovery and salvage of space debris and support vessels. For example, in July 2020, NASA sponsored the Perseverance Rover launch from Cape Canaveral which uses radioactive plutonium, provided by the Department of Energy. The existing area contingency plans, network of experts, and regulatory framework do not squarely fit in the Federal On-Scene Coordinator response to space operations. Missions like the Perseverance require close interagency collaboration and communication.

Port Canaveral Coast Guard personnel staff the Launch Emergency Operations Centers (EOC), along with federal, state, and local partners, to provide real-time notification and coordination for non-nominal situations. In the event of an incident, embedded personnel can rapidly preserve the safety and integrity of the MTS. With industry treating each launch like a research and development opportunity, existing regulatory frameworks quickly become out of date. The commercial space industry continues to explore alternative fuels and propellants, as well as unique booster recovery and offload methods—challenging the professional expertise and capacity of local Coast Guard units. Several questions need further evaluation to effectively monitor or regulate industry processes, procedures, and equipment within the maritime domain, including:

- Should space providers be considered regulated facilities due to the nature and amount of hazardous materials and oil products stored onsite and transferred?
- What are area contingency plan requirements or provider contingency plan exercise needs?
- How do the regulatory requirements for a federal range differ from a commercial range?
- Should the National Response Center receive notifications of space activities within the EEZ?
- As we move towards long-range missions to Mars, how do we adequately leverage nuclear energy without increasing environmental or security threats? What is the Coast Guard's role?
- Are regulated timelines or contracts with oil spill removal organizations (OSRO) necessary to expedite response to maritime environmental threats?

### **Federal Maritime Security Coordinator Responsibilities**

For the Coast Guard, space operations predominately center around preserving the safety of our MTS. However, through the role of Federal Maritime Security Coordinator, the Coast Guard must also ensure the security of our ports, waterways, and coastal communities. Against a backdrop of global strategic competition and

## **Hypergolic Materials**

Hypergolic fluids are toxic liquids that react spontaneously and violently when they contact each other.

—NASA



conflict, the resurgence of the U.S. space program has earned national-level interest from senior government officials and patriotic citizens who recognize the symbolic nature of U.S. leadership within the industry.

Sector commanders use security zones to protect federal property, investments in technology, and our national security assets, like astronauts and launch vehicles. In Port Canaveral, the center of the space industry is near a concentration of assets including the world's second largest cruise ship port and a strategic naval port. It's also home to a growing energy industry that provides LNG bunkering capability to U.S. and foreign shipping, as well as jet fuel for Orlando International Airport. This dynamic port complex requires strong partnerships within the maritime community. Routine collaboration between all interested parties, to include law enforcement, security officers, intelligence agencies, and stakeholders, enables the Coast Guard to evaluate vulnerabilities, mitigate risk, and evaluate threats. As the number and variety of spaceport users continues to grow, coupled with the expected growth in launch frequency, it is critical that field commanders leverage their Federal Maritime Security Coordinator authorities and exercise their responsibilities within the MTS. Moving forward, some topics field commanders are examining include:

- Space support vessels (SSV) and maritime facilities at which they moor are not always subject to security requirements. Although these vessels and facilities are complying with similar security requirements they are not mandated. What are the future security requirements for SSVs?
- What is the best practice for integrating commercial and government space providers into Area Maritime Security Plans?
- Should Coast Guard waterways and port security risk assessment tools, such as Maritime Security Risk Analysis Model, Risk-Based Maritime Security and Response Operations, and

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Fairings are reusable shells that improve aerodynamics and protect the payload against the impacts of launching through the atmosphere.

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A SpaceX Falcon 9 rocket carrying the company's Crew Dragon spacecraft is launched on NASA's SpaceX Crew-4 mission to the International Space Station on April 27, 2022, at NASA's Kennedy Space Center in Florida. NASA photo by Aubrey Gemignani

Navigation Safety Risk Assessment be updated across the Coast Guard to incorporate space operations?

- Should spaceports be reviewed for designation as maritime critical infrastructure?
- Private or adversarial unmanned aerial systems are vulnerabilities within the port complex. What are the potential threats, and who is the lead agency to spaceports with maritime equities?

#### **Officer in Charge, Marine Inspection Responsibilities**

Under OCMI authority, the Coast Guard's marine inspectors and investigators provide oversight of a maritime space fleet. That fleet includes remotely operated



The *Orion* spacecraft, for the Artemis I mission, waits for launch on the pad at Kennedy Space Center's Launch Complex 39B in Cape Canaveral, Florida, on August 22, 2022. Artemis I will provide a foundation for human deep space exploration. NASA photo by Ben Smegelsky

dynamic positioning rocket recovery vessels, or drone ships; vessels designed to recover rocket fairings; vessels used to support human flight recovery, vessels with command-and-control functionality, and vessels to support fixed sea launch and recovery operations. These U.S. flag vessels, installed with the latest technology to support hazardous equipment and operations, are inspected and certificated by the Coast Guard.

However, many of the space support vessels are specially modified for their particular space operations, and thus, do not fit into existing regulation and policy. Additionally, due to the nature of the commercial space industry's need to continuously innovate and evolve, their vessels do the same, which requires a constant cycle of engineering plan review, modification oversight, and final verification. Coast Guard marine inspectors are thus required to work closely with offices at the district and headquarters levels and with industry to appropriately advise the OCMi on regulatory waivers, equivalencies, design basis approvals and, occasionally, detentions when the risks to safety and security are too high.

A typical industrial vessel averages three in-person inspections by Coast Guard Marine inspectors each year. However, due to the novel technology and rapid change for space support vessels, more than 30 in-person inspections a year is not out of the ordinary for space industry vessels. This significantly increases resource burden on units that are already charged with overseeing and inspecting vessels not meeting a typical regulatory compliance regime.

New companies seeking high volumes of launches at low costs are working towards at-sea recovery of their most expensive assets. In a few years, the number of vessels actively engaged in supporting space activities will nearly double and the Coast Guard will need to identify streamlined paths towards regulatory compliance, versus individual approvals, in order to meet industry demand. In addition, the commercial space industry will likely continue to modify vessels with remote and autonomous capabilities of increasing sophistication to support their operations. These capabilities are not merely designed to increase efficiencies or reduce manning.



There is a specific need due to operations which are inherently hazardous to human life. These vessels, both current and future, present unique challenges for the Coast Guard programs and field commanders responsible for overseeing their design, engineering, construction, and operation. What was once thought impossible, recovering intact rocket boosters and fairings at sea, is now an everyday occurrence and it raises some important questions, to include:

- What are the Jones Act implications for space equipment launched from land into the maritime domain and what is the future for companies operating assets supporting at-sea commercial launch and/or recovery?
- As remote and autonomous technologies continue to propagate into SSVs due to the inherent hazards to human life, how will the technology be accepted and allowed in operations?
- With the expected exponential growth in SSVs, which do not cleanly fit into standard regulatory subchapters, what is the best path to implement reasonable compliance standards to meet the needs of today and tomorrow?
- With the advanced power, remote, and

autonomous technologies being used, how is the Coast Guard training and retaining marine inspectors to serve in this rapidly expanding field?

### **Search and Rescue Mission Coordinator Responsibilities**

No SAR case is the same, and the Coast Guard leads the way in planning, coordinating, and executing SAR. Across the Coast Guard, units are providing support for crewed space launch/recovery operations and for potential space vehicle anomalies.

Beginning with the shuttle missions, the Department of Defense (DoD) has historically taken the lead on global SAR for government sponsored astronauts. However, current launch and recovery operations are more complicated and reflect public-private partnerships or even private astronauts. Contractually, a private space company may be required to recover NASA-sponsored astronauts safely from the water in a planned reentry, without the real-time command-and-control or ready resource support of the DoD. For example, NASA commercial crew missions with SpaceX between 2020 and 2022 had DoD support ready for global SAR response



U.S. Coast Guard Cutter *Maria Bray* gets positioned to support a SpaceX rocket launch, May 30, 2020, in Cape Canaveral, Florida. Coast Guard units and crews enforced safety and security zones in order to protect the public, vessels, harbors, ports and waterfront facilities. Coast Guard photo by Petty Officer 3rd Class Vincent Moreno

at launch. The same DoD resources were not actively standing by for the planned maritime reentry to one of seven pre-determined locations across Districts 7 and 8. Further, the Inspiration-4 and Axiom-1 missions were all-civilian crewed missions to low earth orbit and the International Space Station, respectively. These dynamic, inaugural missions, required field commanders to identify policy gaps, determine appropriate SAR resource response posture, and create new pathways for communications with current and past partners. As new space companies emerge with unique operating plans, including various capsules—even air balloons soaring to low earth orbit and landing on the water—early communication with the providers is necessary to ensure SAR mission coordinators and rescue coordination centers are prepared to respond. Despite great strides ahead, some critical questions remain, including:


- What is the Coast Guard's role in private astronaut recovery?
- Is there a role for commercial space SAR companies? If so, should it be regulated or be subject to government oversight? Is it the next generation of maritime SAR assistance policy?
- Given the potential hypergolic threats to capsule recovery and space related SAR, should there be structured training, exercises, or safety programs?
- Space recovery could happen in any district or sector; is a National Quick Response Card necessary? Should space vehicles be included in SAR operations?
- As the model for international SAR, is there a role for the Coast Guard in global recovery policy development?

## Looking to the Future

The Coast Guard workforce is highly adaptive and possesses a penchant for leveraging on-scene initiative to get the job done. Just like field commanders did following the terrorist attacks of September 11, today's workforce is functioning across districts and sectors to create



Marine Safety Detachment Port Canaveral staff attend a Space Support Vessel (SSV) in Port Canaveral. Detachment inspections personnel average 30 annual visits to SSVs versus 3 visits to traditional Coast Guard inspected vessels. Coast Guard photo

a repeatable, equitable, and transparent approach to the emerging space mission. The development of any new program requires organizational mission prioritization, including acceptable risk, projected investment in resources and budget, and commitment of intellectual capital on policy development. Today, sector commanders are leveraging broad authorities to apply common sense regulatory oversight amidst novel technology, rapid change, and the growth of the maritime space industry. Anticipating change is essential to adequately applying current resources and making tough decisions in the future. The breakneck development of the space industry makes sustaining the current operational tempo and regulatory approach a top challenge for sector, district, area and headquarters. As we look forward, the next decade of Coast Guard support to space operations is certain to look different from today's. 

### About the author:

*This article is a collaboration between CDR Jillian Lamb, LCDR John DiNino, LCDR Steve Dross, and LT j.g. Griffin Terpstra. Sector Jacksonville and Marine Safety Detachment Port Canaveral work across all departments and divisions to successfully execute the space mission, Operation Solar Guardian. Together, Sector personnel are establishing relationships throughout the Coast Guard to build the requisite space expertise and to support District, Area, and Headquarters personnel with this evolving mission.*

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United States Space Priorities Framework. December 2021.



# Celestial Navigation

## The Coast Guard and DHS in a new era of space activities

by IRANGA KAHANGAMA

*Assistant Secretary for Cyber, Infrastructure,  
Risk, and Resilience*

*Department of Homeland Security*

NICK REESE

*Deputy Director for Emerging Technology Policy  
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Department of Homeland Security and the Coast Guard are not often mentioned in conversations about space, but this large ecosystem demands champions for cybersecurity, resilience, and contingency planning. Today, data from space assets and innovations resulting from space activities permeate our homeland and play vital roles in our security. Those innovations come with the responsibility to defend and protect these assets as they grow in number and complexity.

While today's space environment features a growing commercial space industry and an increase in deployed warfighting capabilities, the Coast Guard's space mission is not a new one. It's rich history in supporting space activities will help it sail into the future and remain on the leading edge of protecting our homeland and maritime commerce.

The Coast Guard has a history of supporting American space activities dating back to the earliest days of U.S. space exploration. In March 1965, the U.S. Coast Guard Cutter *Vigilant* left its homeport in New Bedford, Massachusetts, to join 19 other ships assembled for the March 23, 1965, launch of Gemini 3. In the first Gemini mission with two astronauts, Gus Grissom and John Young would launch from Cape Canaveral, Florida, to spend two weeks in orbit. The astronauts performed docking and rendezvous maneuvers between the command module and the lunar lander that proved central to the American space program and its eventual mission to the moon.

Today, the evolution of space activities in the United States includes a strong commercial space sector and a significant increase of on-orbit assets. The Coast Guard's modern mission includes the use of robust and resilient space-based data, and new capabilities are coming online constantly. This continued innovation is driving

economic opportunities and has implications for homeland security. As new systems come online, the potential for our adversaries to target those assets and compromise our mission readiness is undeniable.

In December 2020, more than 55 years since *Vigilant* set sail for the Gemini 3 recovery mission, the White House released a new National Space Policy making it clear that space is a contested warfighting domain. It is no secret that some nation states seek primacy in space, and test antisatellite capabilities to exert influence. Following Vice President Kamala Harris' remarks on April 18, 2022, the United States introduced a proposal to the United Nations General Assembly on September 12, 2022, to create a binding resolution banning the conduct of destructive, direct ascent antisatellite missile testing. These dangerous tests create on-orbit debris from a ground-based missile system which poses the most significant threat to our satellite assets and our low-earth orbit human space activity. The United States has already committed to not undertaking these dangerous tests and we hope to make this the norm internationally. Our



Coast Guard Cutter *Vigilant* (WMEC-617) was commissioned in October 1964, and homeported in New Bedford, Massachusetts. In 1990, the cutter moved to its new homeport at Port Canaveral, Florida. Coast Guard photo



The SpaceX Falcon 9 rocket, with the Dragon spacecraft onboard, launches from Launch Complex 39A at NASA's Kennedy Space Center in Cape Canaveral, Florida, on June 3, 2017. Dragon carried almost 6,000 pounds of science research, crew supplies, and hardware to the International Space Station in support of the Expedition 52 and 53 crew members. This was the 100th launch, and the sixth SpaceX launch, from this pad. NASA photo by Bill Ingalls

adversaries, however, have made no such commitment.

Likewise, our adversaries make no commitment to confine their cyber activities to passive espionage against government targets. Instead, they are establishing a persistent presence across our critical infrastructure and finding novel ways to attack orbital and ground assets with the potential for physical effects. Per the National Space Policy, attack on our space assets will be met with a response and such a conflict could easily bleed over into the homeland and Coast Guard's mission.

In December 2020, the Department of Homeland Security (DHS) undertook an effort to produce the first DHS Space Policy update since 2011. The policy clarifies DHS' role in American space activities and communicates our priorities to DHS operational components, like the Coast Guard, so they can align their mission to meet these priorities.

In 2020, the White House released Space Policy Directive-5 providing cybersecurity principles for space assets that helped guide DHS' approach to cybersecurity for space. With new and novel cyberattack methods and techniques, and geopolitical events necessitating a new vision for DHS' role in American space activities, cybersecurity for space assets is a priority at the highest levels of government.

### **Talking and Listening to Industry**

Currently, DHS has some of the most robust space industry relationships in the government and continues to promote cyber and supply chain security for the space industry. As such, it will take a leading role in promoting cybersecurity for space-based and ground assets.

In response to the recognition that space assets cross into many critical infrastructure sectors, in 2021 the Cybersecurity and Infrastructure Security Agency (CISA) formed a Space Cross-Sector Working Group. This working group serves as a venue for DHS to engage

with commercial space companies of all sizes to discuss challenges, share information, and offer cybersecurity resources. DHS also has excellent relationships with all 16 critical infrastructure sectors, as well as state, local, tribal, and territorial government partners, many of whom rely on space-based data for their operations. Those relationships facilitate engagement and information sharing on cybersecurity and resilience, since the threat or vulnerability presented by use of space-based data may not be immediately apparent to the user.

### **Attacks in Space, Impacts in the Homeland**

As demonstrated with the hacking of the U.S. company Viasat, space systems are under threat from adversarial nations. By providing inaccurate data to operational

## **Critical Infrastructure Sectors**

The critical infrastructure sectors include:

- Chemical
- Commercial Facilities
- Communications
- Critical Manufacturing
- Dams
- Defense Industrial Base
- Emergency Services
- Energy
- Financial Services
- Food and Agriculture
- Government Facilities
- Healthcare and Public Health
- Information Technology
- Nuclear Reactors, Materials, and Waste
- Transportation Systems
- Water and Wastewater



units or completely denying access, a cybersecurity breach of an on-orbit or ground asset could result in significant mission impact. While physical effects or data theft are common outcomes of a cyberattack, a more nuanced threat comes from a threat actor's ability to send corrupt data to a device or to slow down the speed of communications. This threat is particularly acute in space cyberattacks, necessitating cybersecurity as a central requirement for the procurement and use of space systems.

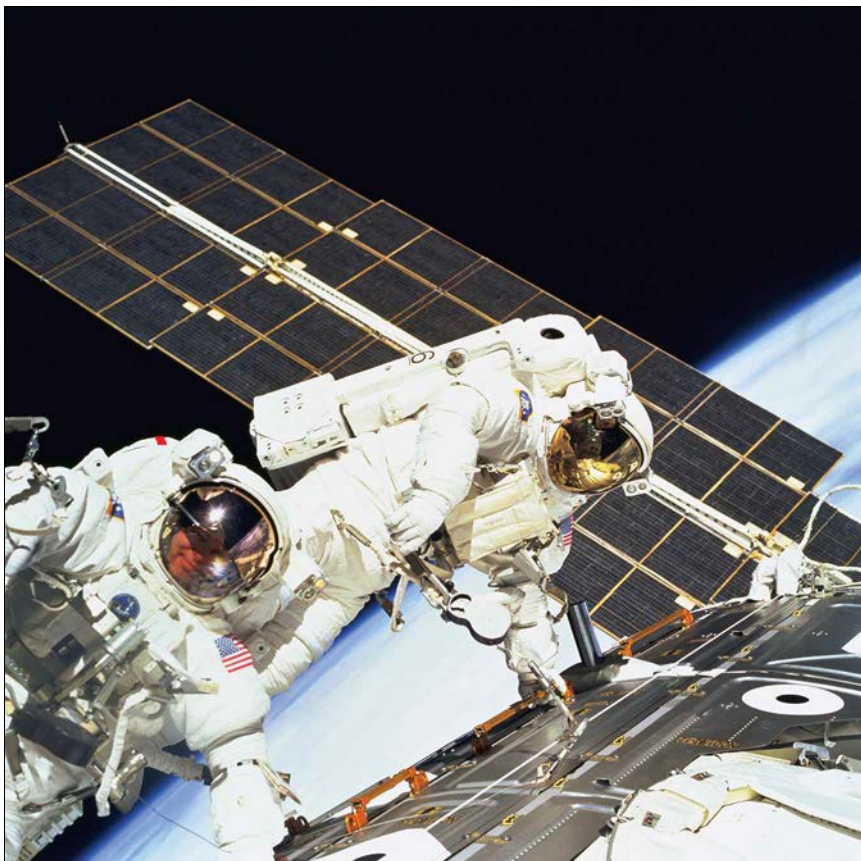
Cybersecurity of space systems is not confined to defensive measures and cybersecurity practices, but includes the security of supply chains, important research and development material, and procurement requirements that prioritize security by design. Consistent with the core of our space policy, DHS is leading the promotion of cybersecurity measures across the spectrum.

Our adversaries will continue to seek ways to disrupt our space assets, which is why the DHS Space Policy also prioritizes resilience. Resilience means different things to different missions, but a denied or degraded space environment will impact most of our mission areas and the homeland depends on our ability to continue through outages without an impact to our success. Imagining how our operational units would function without GPS or other space data is important to mission planning and capabilities development. Training our operators to recognize disruptions and be resilient is central to our national security.

## Conclusion


Future conflict in space will not be confined to outer space and will almost certainly have implications for, and effects on, the homeland. Adversaries' attacks on our critical infrastructure or outposts are not out of the question and having contingencies in place is critical to our support of space activities. As a military force, the Coast Guard has an advantage since its mission covers multiple domains. However, space is a new and important domain, and must be integrated into the service's planning efforts. Some nations are less concerned with international norms than their national goals, something they have demonstrated through their willingness to endanger space assets through destructive missile tests.

Escalations happen in every conflict. The homeland



Astronauts Jerry L. Ross (left) and James H. Newman, both mission specialists, work together on the last of three space walks of the STS-88 mission in December 1998. One of the solar panels of the Russian-built Zarya module is visible in the background. Photo courtesy of NASA

and our maritime commerce are attractive targets. Space is a new vector for attack and DHS' role in mission planning gives it an advantage to plan for responses or escalations.

What was once the exclusive domain of a few U.S. government agencies and a handful of defense contractors is now a broad and exciting ecosystem driving innovation and opportunity, but also national risk. So, though DHS and the Coast Guard are not often mentioned in conversations about space, protecting our on-orbit assets and the intellectual property that fuels further innovation is central to the homeland security mission. This is an all-hands effort. 

### About the authors:

*Iranga Kahangama is the assistant secretary for Cyber, Infrastructure, Risk, and Resilience at Department of Homeland Security. Prior to joining DHS, he served on the National Security Council as director for Cyber Incident Response. He earned a master of public policy from the Harvard Kennedy School of Government.*

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# A Changing California Gold Coast

by TYRONE CONNER  
*Deputy Chief, Waterways Management  
District Eleven  
U.S. Coast Guard*

*Join the Coast Guard  
to play on the high seas, save lives,  
and bust drug-runners!*

In the 1990's, this was a slogan that recruiters used to appeal to new Coast Guard recruits. As the mission of today's Coast Guard grows and evolves, so must our vision and message. While law enforcement and search and rescue missions remain the Coast Guard's core roles, we must expand our missions to address the growing demands of industry. Innovations, including space operations in the maritime domain, are changing Coast Guard operations. Further, advancing spatial data analysis and modernizing communications tactics are improving data and information sharing.

## A Rapidly Evolving Maritime Domain

The marine transportation system (MTS) has witnessed tremendous growth and innovation in recent years. The interest in using the nation's waterways to test technological innovations is outpacing current federal and state policy related to shared waterway use and marine planning. This rapid pace challenges marine planners' efforts to establish waterway safety for all users.

The Coast Guard continues to see tremendous growth in multiple commercial industries that are already competing for viable waterway space. These industries include:

- aquafarms
- floating and fixed offshore wind platforms
- shipping
- sanctuary expansions
- marine life protection programs
- wave energy development
- power storage facilities
- Department of Defense operations
- fishing
- commercial space
- recreational boating
- other historic marine uses

## Operations off the California Gold Coast

Historically the California coast has been home to traditional waterway uses like fishing, cargo transportation, Department of Defense operations, and recreational activities. Technical advances have increased the demand for the use of these same waters, migrating the prowess of Silicon Valley's technical expertise in engineering, programming, and entrepreneurship starts from the hills of northern California to the blue waters of the Pacific Ocean to shape the United States' burgeoning commercial space operations. The California coast stands in a new era of waterways growth and innovation. Some of the major space companies we know today had their first success in California's Silicon Valley industry. Even NASA's Ames Research facility is located in Silicon Valley.

## Coast Guard Support for Space Operations

The Coast Guard has supported government-sponsored space programs since the first rocket launch from Cape Canaveral, Florida, in 1950 and continued in 1978 with Vandenberg Air Force Base, California, space operations. Now, we have a new group of commercial space



Recreational boaters are seen in close proximity to the SpaceX GO Navigator recovery vessel, August 2, 2020. The SpaceX Dragon capsule performed a successful splashdown, returning two astronauts safely to Earth. Coast Guard photo



entrepreneurs requiring novel protocols.

Coast Guard District Eleven in Alameda, California, has seen significant growth in commercial space operations off the coast of California since 2016. SpaceX has become a key player in the commercial space industry, while dozens of other companies are exponentially pushing the technological boundaries of commercial space operations. Companies including SpaceX, Virgin Orbit, FireFly, and StratoLaunch have applied for licensing from the Federal Aviation Administration (FAA) and have planned or conducted operations from Vandenberg Space Force Base and Mojave Air and Space Port.

Some of these commercial operators have proposed launch operations from shore launch pads, while other companies have submitted plans to launch rockets at 30,000 feet from a large fixed-wing aircraft. Coast Guard District Seventeen is working with a commercial company, SpinLaunch, that is prototyping to launch 200 kilogram class satellites from a kinetic launching system in Alaska.

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**Kinetic launching uses stored kinetic energy from a rotary wheel drive powered by electricity to launch an object to the desired path and location.**  
—SpinLaunch

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Commercial companies are pressing process improvements to increase the pace of operations and streamline the reusability of space components. New trends with offshore launch facilities, 100 percent recoverable and reusable rocket segments, and increased operations will be parts of the new normal for future space programs. The Coast Guard is tracking space program updates and working with federal regulators to ensure the MTS is part of the calculation of future needs.

Why does the Coast Guard care about commercial rocket launches? It is the authorized regulatory authority serving the maritime community in all federal navigable waters out to the Exclusive Economic Zone and works with regulations outlined in the Code of Federal Regulation, Titles 33 and 46. Most of these regulations have been developed due to catastrophic failures and loss of life incidents, but all regulations are developed to protect public health and safety from potential conflicts.

### **Coast Guard Waterways Management and Space Operations**

Local Coast Guard waterways management divisions take great pride and responsibility in supporting



The Sentinel-6 Michael Freilich satellite launches from Vandenberg Air Force Base, California, on November 21, 2020. The Sentinel-6 is the first of two identical satellites to head into Earth orbit to continue sea level observations for at least the next decade. The second satellite is scheduled to launch in 2025. U.S. Space Force photo by Michael Stonecypher

emerging commercial space operations and the FAA space program. Coast Guard members have familiarized current and potential commercial space operators with the intricacies of the MTS environment. Coast Guard areas and district waterways management offices also evaluate data on each launch and reentry to assess the risks associated with space launch trajectories, first-stage rocket reentries, and capsule splash-down zones. Data collected relates directly to variables of time, speed, path, location, current vessel traffic patterns, and charted vessel routing measures.

Automatic Identification Systems (AIS) vessel tracking data is one of many critical resources used in waterways management and ocean planning. AIS data allows the Coast Guard to visualize where vessels have operated and predicts where they will likely continue to operate in the future. This data associated with all vessels can be displayed as a ratio of transits calculated into densities based on efforts per area, or enumerated to show the number of transits and unique vessels transiting specific regions.

Coast Guard District Eleven uses various data sources and techniques to visualize potential conflicts with commercial and government-sponsored launches. Geographic Information System's applications are used to display hazard zones associated with the launch, maritime vessel densities, and other areas of interest.

Overlapping regions between the different data layers are noted, and mitigating measures are taken if necessary. This level of research is critical in evaluating the risk associated with federal government and commercial space changes due to modifications of flight paths, reentry zones, and last-minute schedule changes.

The Coast Guard continues to grow these technical skillsets in their civilians and junior officers to support the growing need for spatial planning in the marine environment.

In the last few years, the maritime safety program has expanded legal authority to support the risk mitigation strategy associated with first-stage rocket reentry plans, as well as space debris impact trajectory with limited access area authority, by delegating district commanders the authority to establish a temporary final rule for safety zones.

District commanders now have additional procedures for establishing restrictions for federal and commercial space programs. These procedures provide details for the limited timeframe needed outside of 12 nautical miles and restrict interference on critical phases of space recovery operations. This extended authority is delegated from Section 8343, Safety of Special Activities, Division G – Elijah E. Cummings Coast Guard Authorization Act of 2020, William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021. Congress established a trial period for extending this authority for specific offshore programs, and affords the Coast Guard the tools to implement new policies by establishing additional safety measures in high-risk maritime space evolutions.

The Coast Guard continues to evaluate the offshore

programs' scope and need, only using these tools when extenuating circumstances are necessary to keep vessels at a safe distance from splash down and first-stage reentry recovery efforts on the high seas. The programs are relatively new from a policy perspective and have not been used for a space mission. But, the programs provide options for current and future space operations. Coast Guard districts continue coordinating with federal partners and commercial agencies to assess risks and potential protocols to support safe navigation.

The greatest fears consuming Coast Guard waterways managers are scenarios involving major failures of safety procedures, causing a catastrophic impact with a vessel carrying passengers, or a vessel loaded with products that could pollute and harm the sensitive environmental ecosystems.

The space program is one industry that has major risks associated with scheduled operations. However, it has a proven track record of well-rehearsed programs and procedures that mitigate risk and provide safety protocols to cancel or divert launch and reentry anomalies. Multiple safety systems and procedures are built into the program to control rocket functions and abort the mission by detonation or diverting the rocket. But, with any failed launch or reentry, there remains risk of fallout from chemicals, fuels, mechanical components, and structural pieces.

The space industry calculates the risk associated with vessel traffic to plan a trajectory that minimizes the risk associated with the flight path. Two examples of failed launches, and the risks associated, occurred May 26, 2020, and September 2, 2021. The first occurred when Virgin Orbit conducted its first rocket test by launching a



The Sentinel-6 Michael Freilich satellite launches November 21, 2020, from Vandenberg Air Force Base, California. U.S. Space Force photo by Tech. Sgt. Brittany E. N. Murphy





Lonestar, a technology demonstrator designed to provide space-based situational awareness directly into the hands of the tactical warfighter, lifts off July 1, 2022, from Mojave Air and Space Port as a payload aboard Virgin Orbit's LauncherOne two-stage orbital air-launch vehicle. LauncherOne was attached to a pylon on the aircraft's left wing before being launched over the Pacific Ocean from the Boeing 747-400 carrier aircraft, named Cosmic Girl. The launch was made available by the Department of Defense Space Test Program. U.S. Army Space and Missile Defense Command photo

two-stage rocket from the underwing of a Boeing 747-400 aircraft. The rocket failed within seconds of release and after first-stage ignition, though there was no impact to any vessels below the incident.

The second involved Firefly Aerospace's attempted launch from Vandenberg Space Force base. Just after lift-off the rocket experienced an anomaly and the launch was aborted to detonate in midflight. There was no risk to residential neighborhoods or the maritime community during the attempt. With every rocket launch, there are inherent risks to vessels transiting internationally and traffic near the warning area. This risk is aggravated by the distance they can travel in a short period of time and the size of the warning area.


### Meeting the Needs of the Marine Environment

Communication is key to improving the maritime community's awareness and developing processes to provide maximum distribution of information to all waterway users. The Coast Guard continues to evolve to meet these needs with software, tools, vessels, equipment, and communication networks.

The Coast Guard has multiple resources to provide

notification to mariners via the Local Notice to Mariners, Broadcast Notice to Mariners, Navigation Telex, SafetyNET, social media, and local harbor masters. These services and notifications allow for maximum distribution via required equipment on board a vessel.

### Conclusion

As new systems emerge, accessibility and pricing of equipment improve, and social media platforms continue to be prominent sources of information. The Coast Guard must meet the new trends and add these platforms to increase awareness and achieve improved situational awareness of all waterway users. The Coast Guard must continue to evaluate each space launch, reentry, and recovery process and provide continuous improvement protocols to meet the expectations and needs of our maritime community. 

#### About the author:

*Tyrone Conner, MBA, retired from the Coast Guard after 23 years of active duty as an aviation maintenance technician, command duty officer, marine inspector, and waterways manager. He started as the deputy chief of Waterways Management in 2016, and has developed and implemented the first commercial space maritime communication standards.*

# Space Cowboys

## The commercial space industry's return to South Texas

by LCDR ANTHONY GAROFALO  
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**L**ocated just a few miles south of NASA's Johnson Space Center in Houston, the commercial space industry got its start in a seemingly improbable place along the South Texas coast. In 1982, Matagorda Island became the first licensed private commercial spaceport when Space Services Inc. (SSI) spectacularly launched the *Conestoga 1* rocket.<sup>1</sup>

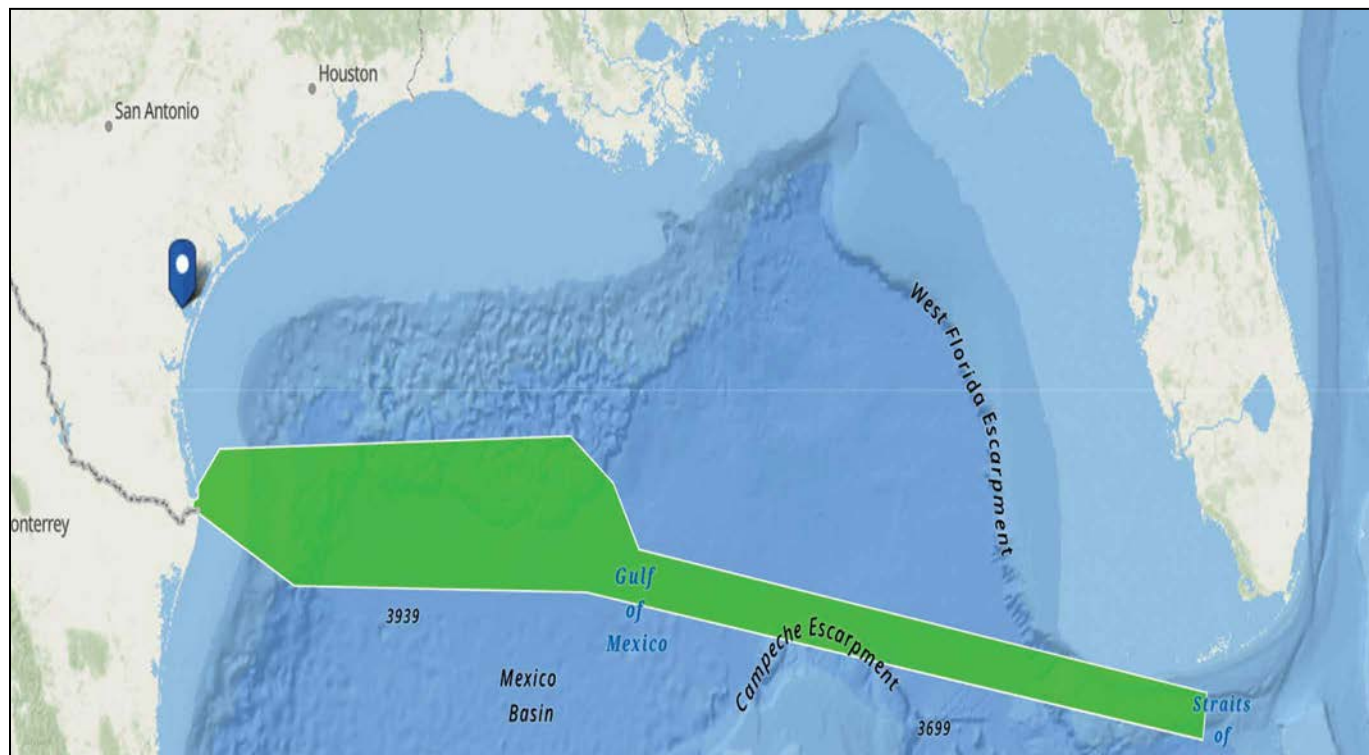
Catering to the private sector, SSI was positioning itself to provide a low-budget solution to deliver commercial satellites to space.<sup>2</sup> While this endeavor never came to full fruition, it paved the way for future growth in the industry. At the time, President Ronald Reagan acknowledged the achievement in a letter to SSI which stated, "In blazing a new trail through the skies, you have shown the potential of private enterprise to perform even the most sophisticated technical feats."<sup>3</sup>

Starting in the 1980s and continuing today, the

government has supported the development of the commercial space industry. The push to commercialize a once government-controlled process added a novel element to the waterways with commercial space operators and traditional maritime users sharing them in ways never before envisioned.

### The Spaceport That Never Was

During the development of NASA's space shuttle program, Matagorda Island was a finalist in the launch site selection. The Space Shuttle Launch and Recovery Site Review Board considered mission capability, abort planning, logistics planning, weather and climate, air and water quality, and the potential impacts of noise/sonic boom in determining a suitable site for the next NASA program.<sup>4</sup> Due to its favorable geographic location for launch trajectories and relatively low population density,



Example of potential commercial range in the Gulf of Mexico. Coast Guard map by LCDR Anthony Garofalo





Coast Guard Cutter *Cypress* assists in a 2018 NASA test of the *Orion* capsule. Photo courtesy of NASA

Matagorda Island in the Gulf of Mexico was ideally situated to provide a single launch site. However, the initial investment costs were a barrier to using Matagorda Island as a spaceport. Ultimately, Kennedy Space Center and Vandenberg Air Force Base were selected as the future space shuttle program launch sites. Consequently, a governmental range was never established in the Texas region.<sup>5</sup>

For many of the same reasons mentioned above, the South Texas coast remained a viable starting point for space exploration. SSL, recognizing the area's potential, selected the same location for the *Conestoga 1* launch. After the successful launch, rocket engines on Matagorda Island went silent. Although the regulatory landscape has changed since the 1980s, the South Texas coast continues to attract companies to the region.

### **Where Is the Space Industry on the South Texas Coast Today?**

The South Texas coast is experiencing a resurgence of commercial space activity a few miles south of Matagorda Island, in Boca Chica, Texas. SpaceX continues to rapidly develop its research and development facility as it continues to test and launch its Starship/Super Heavy rockets. With Mars in its crosshairs, the company is positioned to launch the largest rocket in our nation's history.<sup>6</sup> Similar to the Matagorda Island launch site, the Boca Chica site

sits adjacent to the Gulf of Mexico and provides comparable appeal for rocket launches.

Situated just a few miles south of the Brownsville Ship Channel, rockets and marine vessels once again share our waterways on the Texas coast. While not a novel endeavor, it does introduce new waterway complexities yet to be experienced in most other parts of the country. Additionally, the regulatory scheme has matured through the creation of the office of Commercial Space Transportation (CST) under the Federal Aviation Administration (FAA) and establishment of specific commercial space transportation regulations, most notably range management.

### **U.S. Government Ranges and Commercial Ranges**

In the late 1940s and 1950s two primary government ranges were established on the east and west coasts. These ranges supported Air Force testing and the future NASA space programs. Over the years, the ranges have grown in size and support much of the current space industry.<sup>7</sup> The commercial space industry has benefited greatly from use of government ranges through use of similar government resources and authorities within these established regions.

The government's commitment to the commercialization of launch vehicles was highlighted in a 1983 White House directive, which included support through use

of national ranges, facilities, equipment, tooling, and services on a reimbursable basis.<sup>8</sup> Use of these ranges requires the commercial space industry to follow all rules and regulations governing the ranges. Today, the U.S. Coast Guard continues to support space launches in the eastern and western ranges under agreements with U.S. Space Force.

Commercial ranges however, are regulated by the CST and entirely monitored and managed by commercial entities. Commercial space operators perform the function of range monitoring through deployment of commercial technology. While not prescriptive in regulations, operators depend on inputs from shipboard automatic identification systems, radar, visual observations, and other maritime technologies. The ultimate goal of monitoring is to detect vessel intrusions on the launch range.

Range management is a multifaceted approach aimed at reducing incursions into the area. Commercial space operators are governed by set risk tolerances established by the FAA, which, in the end, influences the ability to launch. On the waterways, vessel type and density, number of persons on board, and location are main drivers in calculating risk scores for a particular launch. Real time risk calculations determine go/no-go decisions for launches.

To a large degree, commercial space operators must rely on industry and public partnerships to achieve shared use of our waterways. This includes coordinating with local port harbor masters; marine industry stakeholders; vessel operators; state, county, and local officials; and the recreational boating public before planned launches. The Coast Guard aids in facilitating these discussions through established harbor safety committees or with other stakeholders who have knowledge of the waterway. Early, effective outreach can reduce intrusion into the range and decreases overall risk.

Commercial space operators employ a host of other methods to manage the range. On the landside, they can partner with the county for local road and beach closures to safeguard the public. Additionally, local law enforcement and contracted third-party resources can be used to inform the public of the hazard area during launches.

### The Way Ahead

As part of the FAA licensing process, commercial space operators enter into agreements with the Coast Guard to publish Notice to Mariners alerts. These alert the marine community of the hazardous area boundaries and scheduled launch windows. Captains of the Port disseminate the information through marine safety information bulletins, VHF radio broadcasts to mariners, or other appropriate means. The notices provide the maritime community information necessary to avoid the range

when it is activated for a launch or testing.

Unlike the eastern and western government ranges, Coast Guard on-water asset support is limited in South Texas, as resources and staffing are allocated for statutory missions. Duration, location, and shortage of other government resources and authorities create a challenge for government support of commercial ranges. This model differs from the one developed under the NASA umbrella during the space program's birth in the 1950s in that the government no longer supports just governmental launches. Now it must delineate between supporting governmental, private, and commercial launches.

A new approach to commercial ranges, one that allows vessels and rockets to comele over the high seas, is necessary to provide public safety. The model may differ slightly from that of the traditional national ranges, but it does provide an equivalent level of safety, an assurance supported through FAA regulations. Commercial space operators conduct a thorough operational risk analysis and tie in real time data to assess the range. Education and maritime understanding of the hazards are key factors in facilitating a cooperative environment between marine and space. As the commercial space industry demonstrates success and decreases operational risk,



Coast Guard supports egress training for the *Apollo 9* crew. Photo courtesy of NASA






The Boca Chica, Texas, launch site developed rapidly, with SpaceX using the facility it dubbed "Starbase" to develop its Mars-bound Starship rocket. Photo courtesy of RGV Aerial Photography

range areas will ultimately shrink allowing for less interference to the maritime transportation system and space operations.

## Conclusion

The commercial space industry is moving down divergent paths; one supported by established government assets and another governed by partnerships with traditional waterway users. Both are viable solutions, but require different tactics and techniques. Development of commercial ranges will require increased planning and partnerships between the marine community and commercial space operators.

Shared usage of our waterways is a balance between industries and the general public. The oceans are shared resources that make possible a host of recreational activities, the movement of goods, research, marine resources cultivation, and space exploration. No one activity in the waterway takes precedence, thus the relationships fostered between all stakeholders are key for continued safe and secure waterways. 

### About the author:

*LCDR Anthony Garofalo serves as the chief of Waterways Management at Coast Guard Sector Corpus Christi. He previously served as a division chief in the Office of Design and Engineering Standards where he*

*oversaw development of national regulations and represented U.S. interests at the International Maritime Organization and other standards organizations.*

*CDR Douglas Salik serves as the Prevention Department head at Coast Guard Sector Corpus Christi. He has 20 years of Coast Guard experience across the nation and globe. Previously, he served as the chief of Waterways Management and as a Marine Safety Detachment supervisor where he managed shared waterway conflicts among stakeholders.*

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# From Recreational Boaters to Astronauts

The Coast Guard has the responsibility—and authority—to keep waterways safe

by LCDR TANNER STIEHL  
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On January 1, 2021, the United States Senate passed the *William M. (Mac) Thornberry National Defense Authorization Act of 2021*.<sup>1</sup> Hundreds of pages in length and covering a wide range of topics, it included a particular provision regarding the creation of a two-year pilot program for safety zones in the Exclusive Economic Zone (EEZ).<sup>2</sup> While that provision may have seemed short and simple, it spurred a necessary conversation about the Coast Guard's authorities in the EEZ.

In the months and years since the passage of that bill, the Coast Guard has taken significant steps to define what those authorities are from a domestic and international perspective. Before digging too deeply into the actions the Coast Guard has taken, it is important to discuss the text of the bill itself and why these authorities were needed in the first place.

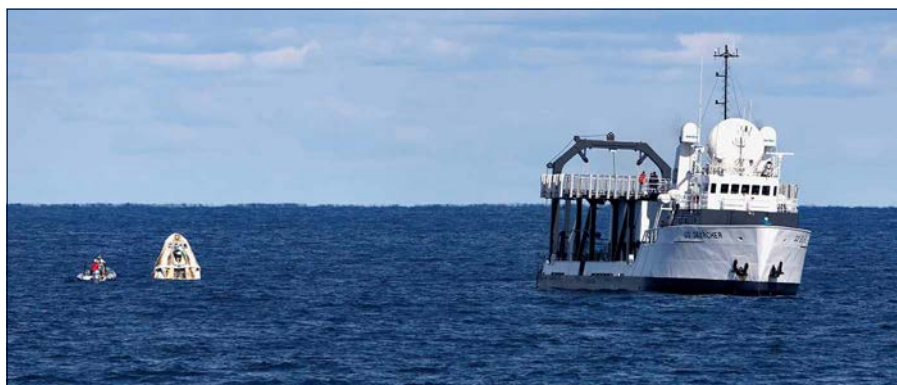
In the bill, Congress directed the Coast Guard to "establish safety zones to address special activities" in the EEZ.<sup>3</sup> These special activities include, "space activities, including launch and reentry ... ." This directive has far-reaching ramifications that involve significant U.S. and international law. However, from an operational perspective, this language is necessary to ensure the safety of launch and reentry operations for NASA and other SpaceX missions, at least in the present and immediate future.<sup>4</sup>

While space launch and reentry operations have been a recurring concern for decades—the Coast Guard has recovered U.S. space objects since 1955—there had not been a specific need for safety zones in the EEZ in recent memory. This all changed with the recovery of the

Crew Dragon Demo-2 mission, which splashed down in the Gulf of Mexico on August 2, 2020.<sup>5</sup> In that widely publicized event, many boaters crowded around the capsule during the recovery operation.<sup>6</sup>

Although there were no resulting casualties, it exposed some potential weaknesses in the government's legal and regulatory framework. Currently, NASA has a contract with SpaceX to send its astronauts to the International Space Station until 2030.<sup>7</sup> The specific reentry sites that NASA and SpaceX have provided to the Coast Guard for these types of missions are all within the EEZ.<sup>8</sup> Therefore, these weaknesses must be addressed for splash-down operations to continue.

Historically, the Coast Guard has used safety and security zones to deter spectators, onlookers, or potential nefarious adversaries from getting too close to vessels, facilities, and other targets. This not only includes navigable waterways, but also space launch and recovery operations. Safety zones are described as, "water area, shore area, or water and shore area to which, for safety or



SpaceX's recovery ship, *Go Searcher*, prepares to retrieve the company's Crew Dragon from the Atlantic Ocean, about 200 miles off the Florida coast, March 8, 2019. SpaceX's inaugural flight with NASA's Commercial Crew Program, known as Demo-1, is the first flight test of a space system designed for humans and built and operated by a commercial company through a public-private partnership. NASA photo by Cory Huston



environmental purposes, access is limited to authorized persons, vehicles, or vessels.”<sup>9</sup> They may be stationary or encompass a moving vessel.<sup>10</sup> Largely the same, security zones are prescribed for different purposes. For example, a safety zone might be used to keep spectators from getting too close to a fireworks display, while a security zone might be used to prevent nefarious actors from getting too close to a high interest vessel or person.<sup>11</sup>

While these zones are great tools, domestic and international law has limited their establishment to the waters of the territorial seas,<sup>12</sup> meaning they can only be established within 12 miles of shore.<sup>13,14</sup> That presented a problem with recovery operations like that of the Demo-2 because the recovery site was outside that boundary line.

Luckily, Congress was quick to act. Within months of the Demo-2 recovery, the *William M. (Mac) Thornberry National Defense Authorization Act of 2021* was passed, and the Coast Guard was granted authority to begin the aforementioned pilot program, and test out its newly granted authorities. However, the statutory language, domestic precedent, and established international law left significant room for interpretation. If the Coast Guard moved forward with these zones, what other equities could be implicated?

Ultimately, the relevant Coast Guard entities met in September 2021 for the inaugural Coast Guard Judge Advocate General Space Conclave, a meeting covering a wide array of legal and space-related issues, where this was a featured topic of conversation. Within a few weeks of that meeting, consensus was reached that the Coast Guard had the authority to enforce these safety zones on U.S. vessels in the EEZ, but not on foreign vessels. The Coast Guard could, however, still warn foreign vessels to stay away from the planned recovery sites during recovery operations. With this knowledge in mind, staff at the Seventh and Eighth Coast Guard Districts and the Office of Regulations and Administrative Law (CG-LRA) were on a tight deadline to publish a safety zone regulation. The Crew-3 mission launched on November 11, 2021, and was expected to re-enter in April 2022.<sup>15</sup>

While the Coast Guard publishes hundreds of safety and security zone regulations in the *Federal Register* every year, this one was different. Not only would the zones be very large, but they would be in the EEZ, and the Coast Guard may not know which landing site would be used until a few days before the recovery operation. All of those considerations, in addition to the previously discussed issues, meant this would be a highly novel rulemaking.

Over the course of the next few months, Seventh District and CG-LRA considered several drafts. Both parties knew it was critical to balance the Coast Guard’s operational constraints with the safety concerns of NASA and SpaceX. However, they also needed to

consider the Administrative Procedures Act (APA), the Paperwork Reduction Act, and other relevant laws that are implicated in the Coast Guard rulemaking process. In its initial iteration, the Coast Guard determined the best course of action was to publish a Temporary Final Rule (TFR) without notice and comment, so there would be a safety zone in place for the Crew-3 and Axiom-1 mission recoveries.<sup>16</sup> Based on the authorities held by the district commanders, two rules were published; one for the Seventh District and one for the Eighth District. These rules created seven safety zones that encompassed NASA and SpaceX pre-approved recovery sites. They were published in late April and early May 2022, and were in effect until May 15, 2022.<sup>17,18</sup>

## Naming Space Missions

NASA and SpaceX name their missions after the program and the number of the mission. For instance, the moon landing was the 11th mission of the Apollo program, so it was called Apollo-11. This naming convention is still used today. All of the missions discussed here employed the SpaceX Dragon capsule, but they are part of different programs. For the purposes of the missions discussed here, the Demo program was to demonstrate SpaceX was capable of safely taking crew to the International Space Station, the Crew missions are part of the Commercial Crew Program, the CRS missions are part of the Commercial Resupply Services Program, and the Ax missions are contracted by the commercial space operator Axiom. —NASA

After the recovery of the Axiom-1 capsule, the Coast Guard had some time to contemplate its next move. The CRS-25 mission was expected to splash down sometime in late summer.<sup>19</sup> Additionally, Crew-4 launched in the same period as the previous TFR, but recovery was not expected until fall 2022.<sup>20</sup> The Coast Guard needed to leverage the lessons learned from the previous rulemaking and ensure there were still safety zones in place for these recovery missions. A second Space Conclave was convened in May 2022 to help iron out the details.

The Coast Guard published a notice of proposed rulemaking (NPRM), which allowed it to meet its obligations under the APA and receive feedback from the public on the original rule. The Coast Guard also proposed for the rule to last for a much longer period, so it significantly narrowed the scope of the safety zones. Under the initial rule, all five landing sites were considered safety zones for the entire period the regulation was in effect.<sup>21</sup>



After three days orbiting Earth aboard SpaceX's Dragon spacecraft, Inspiration4's all-civilian crew splashed down in the Atlantic Ocean off the coast of Kennedy Space Center, Florida. As they returned to Earth, their Crew Dragon capsule's descent was slowed by four parachutes before splashing down in the Atlantic Ocean off the coast of Florida. Photo courtesy of SpaceX

The NPRM proposed that, in the second rule, the zones would only be activated in the days prior to the recovery mission, and they would cease to exist when the Dragon Capsule was safely recovered.<sup>22</sup>

During that comment period, the Coast Guard received a single public comment, endorsing the rule as proposed in the NPRM. With that in mind, a new temporary final rule was published on August 4, 2022, without changes to the NPRM.<sup>23</sup>

The Seventh District started the rulemaking process for the third time in fall 2022. There were several comments on the second NPRM that were adjudicated, and the new temporary final rule was published in late December 2022.<sup>24</sup> The new rule came into effect on January 1, 2023, and will remain in effect until the pilot program ends in February 2024. In addition to the offshore safety zones for recovery of the Dragon Capsules, the



SpaceX's Crew Dragon is carried by the company's recovery ship, *Go Searcher*, in the Atlantic Ocean, about 200 miles off the Florida coast, on March 8, 2019, after returning from the International Space Station on the Demo-1 mission. The uncrewed spacecraft docked to the orbiting laboratory on March 3, following a March 2 liftoff aboard a SpaceX Falcon 9 rocket from NASA's Kennedy Space Center in Florida. Crew Dragon made 18 orbits of Earth before successfully attaching to the space station. The spacecraft splashed down in the Atlantic on March 8. NASA photo by Cory Huston





SpaceX's Crew Dragon Endeavour, which transported Crew-2 to the International Space Station for a six-month orbit is seen in early November 2021, after the crew's splash landing in the Atlantic off the coast of Florida. Photo courtesy of SpaceX

Coast Guard used this authority in the late summer and fall 2022 to create a safety zone for the launch of the Artemis-1 moon rocket. This zone extended from 12 to 30 miles from shore, and was adjacent to the existing regulated navigation area that the Coast Guard uses for all rocket launches in Cape Canaveral.

At this point the pilot program is expected to conclude in the winter 2024. At that time, Coast Guard Headquarters will evaluate the utility and effectiveness of these provisions in a congressional report, and a determination will be made if this new law achieved its goals. If the determination is positive, Congress may decide to permanently codify this authority, or make modifications to its scope and continue the evaluation process. In the meantime, the Coast Guard continues to streamline and clarify these processes with the goal of ensuring the safety of the waterway for all users, whether they be boaters or astronauts. //

#### **About the author**

LCDR Tanner Stiehl spent seven years as a prevention officer at Sector New Orleans, Sector New York, and Marine Safety Detachment American Samoa. He then attended the University of Miami, earning his JD and LLM in Maritime Law. He currently serves as a judge advocate in the Seventh District legal office.

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# Digitalization

## Achieving a maritime security advantage

by LUKE RITTER  
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The term “smart port,” a label with many definitions that can be used to describe a variety of different maritime initiatives, is appearing regularly in trade journals and other industry news. One of the most compelling examples of putting “smart” into the maritime domain has to do with going digital, and digitalization has the potential to provide any port enterprise with a maritime security advantage.

For the purposes of this discussion, we will use a definition that supports security management and anchors any approach to becoming more secure and resilient. Published in a 2021 *Port Technology*<sup>1</sup> article, a smart port was defined as one “that uses automation and innovative technologies including artificial intelligence (AI), big data, Internet of Things (IoT) ... to improve its performance.” Those last four words are important, and are what sophisticated, mature enterprises tend to pursue—continual, incremental improvement.

Opportunities to improve performance, in maritime security, exist through the application of digitalization, modeling, and simulation. Digitization, “the process of converting information into a digital, or computer-readable, format.”<sup>2</sup> is a fundamental pre-requisite—a building block—for establishing a technology baseline that supports and fosters innovation.

Digitalizing security functions follows as the next logical step up from digitization, and is defined by research and advisory firm Gartner as “the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business.”<sup>3</sup> To simplify, owners of maritime critical infrastructure that digitalize their enterprise create an opportunity to use advanced technology in a way that optimizes security requirements, while lowering specific operational costs.

The return on investment associated with becoming a smart port is compelling. Security threats in the maritime domain are persistent, and pervasive, and geopolitical issues are creating new security challenges for ports around the world. There is no better time than the present to digitalize to achieve a maritime security advantage. But as an industry, the maritime sector has

some catching up to do, as stated in a report published by Deloitte titled *Smart Port—Point of View*.<sup>4</sup>

*Seaports are playing catch-up with the large transport & logistics players when it comes to developing insight driven solutions and IoT applications.... Even though some ports today are starting to come to terms with the importance and need for digitalization and IoT, there is still a long road ahead to get to relatively mature smart port concepts.*

This comment is echoed in the *Port Technology* article, “Although the maritime industry is often criticized for being too conservative and resistant to change, there are digital technologies, systems and solutions emerging in the maritime that will alter this perception.”

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The Internet of Things (IoT) is a term used to describe devices, other than computers and smart phones, that connect to the internet.

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### Digitalization: The Importance and the First Steps

In the United States, port security can digitalize to achieve a higher level of security competency, preparedness, and resilience. By driving maritime critical infrastructure into the digital age, maritime security leaders have an opportunity to facilitate change that can achieve multiple advantages, including:

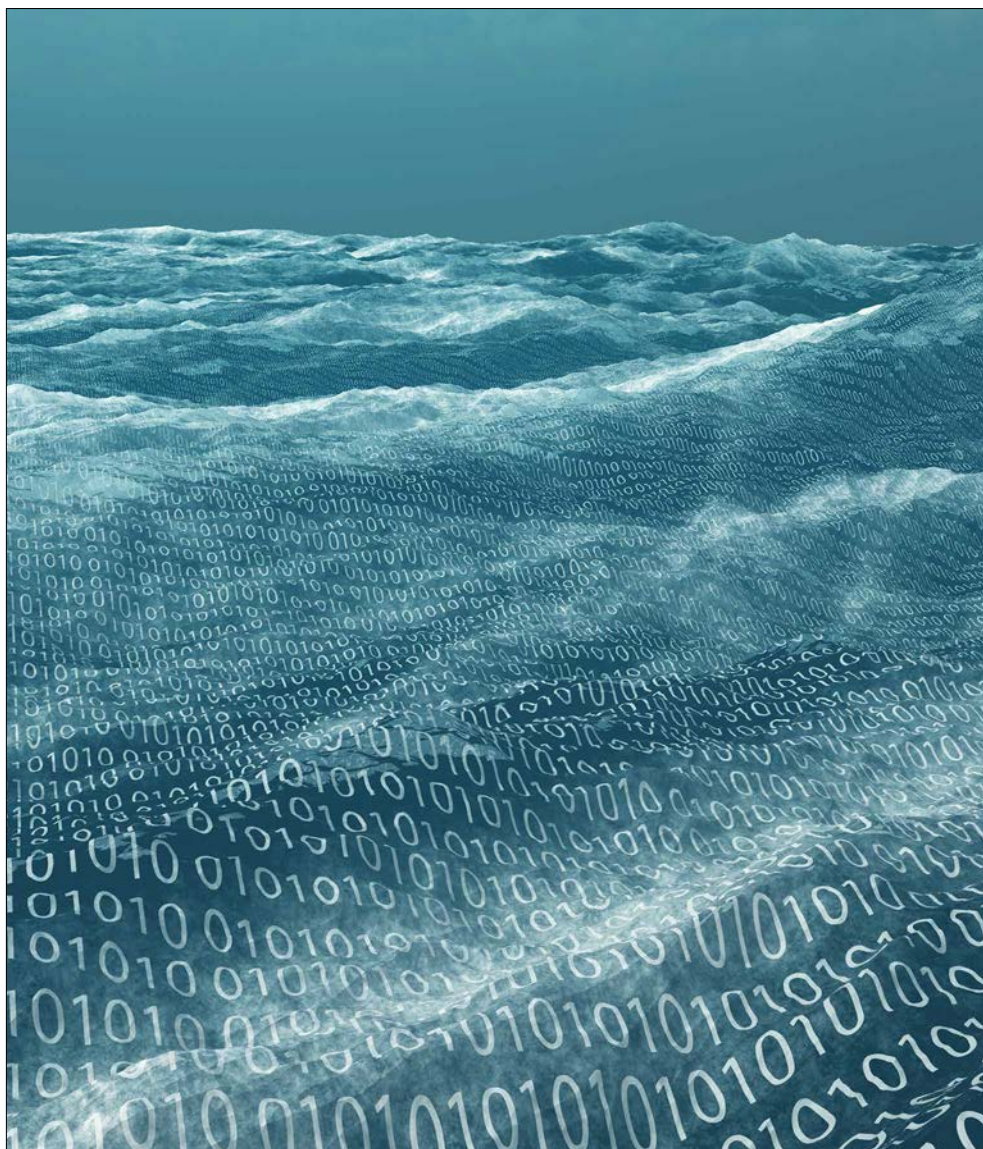
- increased productivity
- lower operational costs
- enhanced decision making
- improved information security
- process automation
- increased agility and mobility

Creating a digital twin is one of the first and most fundamental investments a port can make in pursuing a digital security advantage. By creating a digital twin, port security professionals establish a virtual representation



of the port. This three-dimensional model shows the terrain features and major physical elements, including structures, capital equipment, and other objects, like critical infrastructure that are being protected. The twin then serves as a digital foundation for security improvement by allowing for accurate modeling of different security scenarios.

Digital twin models for security can be incredibly accurate, and ultimately include details about a site's guard force; security concept of operations (CONOPS); and installed security technology—cameras, radar, perimeter structures, and barriers. Once a site's security posture is accurately modeled, maritime security professionals can use software to identify, monitor, analyze, and optimize both operational and security requirements. Digital decision support tools can be used to support various requirements such as vulnerability assessments, training, and exercises that directly impact maritime security preparedness, readiness, responsiveness, and resiliency.



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### Security Cost Savings

The process of addressing complex security questions can be facilitated using digital decision support tools. In the hands of a qualified subject matter expert, security software can be a force multiplier and rapidly process comprehensive answers to complex security questions. Advanced algorithms and digital security libraries can be applied to compliance-related tasks like the Maritime Transportation Security Act of 2002 Facility Security Assessments. Digital tools can make future assessments and related security analyses more efficient by eliminating the need to re-baseline with each iteration. Digital twins are typically refreshed annually meaning vulnerability assessments do not need to start with a site survey. Additionally, maritime security teams can use their digital twin to continually perform rapid cost/benefit

### Digital Tools and Security

Digital tools provide security teams with a way to easily and cost-effectively address important questions that can have a significant impact on overall security effectiveness. Questions like:

- Are there any gaps in coverage that could impact security readiness?
- How will the current security strategy work against different threats?
- What improvements can be made to optimize security posture?
- What are the costs versus the benefits of various security solutions?

analyses to thoroughly analyze new threats or proposed security design changes. This results in reduced costs for future security analyses and assessments.

A digital twin can also be used to facilitate virtual security exercises, thereby removing the guesswork and wildcards associated with traditional exercises while providing a realistic training opportunity in a virtual environment. Users can be prompted to make decisions based on computer-generated analysis, and then view and evaluate the outcome of those decisions in real time. Additionally, recordings and files can be archived and reused, as desired. Expenses associated with a traditional physical exercise—travel, lodging, labor, and logistics—are reduced or eliminated.

Security software that uses simulations to evaluate security vulnerabilities is available to the industry, and its algorithms and digital libraries of security characteristics can reliably determine various potential vulnerabilities in any maritime facility with a digital twin. These tools provide security professionals with a complete understanding of their existing security posture, the predicted success of threat mitigation strategies, and options to optimize the security solution for both effectiveness and costs.

### **Security Efficiency/Effectiveness**

Analysis parameters can be easily changed within digital models to address a wide range of security system configurations, threats profiles, and risk elements. Once the vulnerabilities and pathways have been identified and analyzed, users can adjust, test, and evaluate various notional security solutions—sensors, systems, and procedures—by testing their effectiveness using software. An unlimited number of iterations can be considered using this process, at a very low cost. Output from these digital tools provides port security experts with a detailed analysis of security effectiveness and thorough cost/benefit analysis.

Using a quantitative approach to maritime security management also offers operators a cost-effective means to continually assess risks and optimize security effectiveness. Rather than assessing facility security requirements once every 3 to 5 years, digital solutions can analyze continually, and on a case-by-case basis, as security upgrades are made and threat profiles change, and at no additional cost.

Savings through cost-reduction examples like those shown above represent “hard savings,” and are often the easiest to identify. Using digital tools can also result in savings and improved effectiveness in less obvious ways. Digital security simulations can be used to evaluate a security CONOPS and can lead to operational changes that highlight areas where costs can be reduced, such as headcount. Additionally, planned security upgrades, like



sensor additions and perimeter detection systems, can be digitally evaluated before a commitment is made to procure. And finally, digital tools can be used to cost-effectively evaluate plans for future capital improvements, changes in threat or regulatory requirements, and new or modified design basis threats.

### **Return on Investment**

Vulnerability assessments provide the foundation for the effective implementation of maritime security measures at ports and port facilities. Every one of America's more than 300 ports have different security infrastructure and risk profiles. Vulnerability assessments can be both expensive and subjective, based on how they are performed. Using a digital twin, and applying software tools, can reduce cost, eliminate variability in analysis and output, and optimize results.

Digital security tools enable experts to visualize, quantify, assess, and optimize the security posture at a designated site. Digitalizing maritime security processes delivers accurate, measurable, and repeatable results to optimize the physical security analysis process. Potential benefits derived from using digital security tools include:

- quantifiable, systematic, automated process to evaluate facility security posture
- data-driven input regarding security risks,





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- expenditures, and benefits
- evaluations of security designs permutations to verify desired performance outcomes
- ability to evaluate alternative security detection and deterrence strategies/technologies
- virtual testing and validation of vulnerabilities and changes to security plans and procedures
- processing of thousands of threat scenarios and responses to determine security effectiveness
- identification of security cost savings through quantified risk assessments and cost benefit analysis

### All Hands on Deck

Effective maritime security requires attention to a unique set of capabilities and often demands expertise in an array of specific disciplines from law enforcement to infrastructure protection to security technology. Sensitivity to the nuanced nature of the individual missions, capabilities, and cultures of many federal, state, and local law enforcement agencies can be critical. The ability to build bridges among maritime security stakeholders, and to remain current in relevant best practices—public, private, domestic, and international—is a critical component of an effective maritime security solution.

Finally, reliable analysis of emerging issues and industry trends, and the ability to adapt and respond rapidly to complex challenges to business continuity, are the characteristics differentiating maritime organizations with successful security solutions from the rest of the marketplace. Security leaders need as many tools at their fingertips as possible to manage this complex environment, and digital security solutions are exceptional tools. Digital twins, and associated digital tools, are critical components in a comprehensive security strategy.

Whether one is charged with managing the security of a small facility, with a limited security profile, or a large enterprise that must address complex hazards, digital tools help protect critical infrastructure from threats that suspend operations, interrupt business, and compromise the well-being of personnel. Smart ports put software to work to evaluate “what if” scenarios and assess security options in a virtual environment to prioritize future investments and operational procedures.

### Knowledge is Power

*Ex Scientia Tridens.* From Knowledge, Seapower.

The U.S. Naval Academy motto, reminds us that knowledge and information can, and should be, at the root of our security initiatives. The National Maritime Law Enforcement Academy’s motto, *Per Scientiam Vires*,

or Strength Through Knowledge, conveys the same message. These are certainly true in the case of maritime security, as well.

Mitigating natural and man-made threats in the maritime domain using digital solutions is becoming increasingly more important. These tools put the power of data-driven optimization, and knowledge, in the hands of maritime security leaders.

Asking “Why?” can be an essential first step in the pursuit of security excellence. By focusing on an end result that is designed to create both operational and security benefits, end users can do more than simply check boxes toward compliance. The power of machine learning and artificial intelligence offers the maritime security industry an opportunity to gauge the effectiveness of its overall security or response plans, as well as the individual systems, staff, and procedures. A knowledge-based approach to security management is critically important to ensure that security information does not become just another cumbersome stockpile of data.

The maritime industry continues rapidly evolving, and connectivity is a key component of success in security operations, threat intelligence, and incident response. Driving operational efficiencies and lowering costs, while maintaining or improving security effectiveness, is a realistic goal—particularly when digital tools are employed.

The most important part of any organization is its people. And as the world around us has demonstrated, today’s workforce is dynamic. As retention, recruitment, retirement, and diversity challenges continue, it is more critical than ever to adapt to preferred learning styles. Adult-learning research tells us that providing on-demand, readily accessible training through a learning management system is critical to achieving an organization’s goals. Digital training tools can ensure that maritime security professionals will have what they need, when and where they need it. Digital tools also allow for opportunities to optimize training by creating a more accessible, affordable, and adaptable training environment that maximizes the people part of the equation.

## Conclusion

So, what is the ‘secret sauce’ with regard to achieving a maritime security advantage? It includes, but is not limited to:


- investing in a digital twin to serve as the baseline for digital growth
- applying digital decision support tools, and quantitative analysis, to enhance security readiness
- employing software solutions to essential security tasks, including vulnerability assessments and exercises

## Fundamental Aspects of Maritime Security Connectivity

There are some fundamental aspects of connectivity that apply to maritime security:

- connectivity enhances readiness and resiliency
- access to information enhances opportunities to succeed
- remaining current with events, threats, and dynamic changes in the maritime environment is an essential element of a comprehensive security strategy

It is hard to argue with the reasoning that a more secure and resilient port is a more valuable one. Mitigating risks and optimizing security posture creates value. Digitalization represents a clear path toward reduced cost, optimized security, and the ability to continually verify and validate that proposed security investments have been optimized to achieve the desired results. Using data analytics to support risk-informed, cost-effective, and quantifiable improvements in security will become the hallmarks of a smart port. Data-based decision making has always driven continual, incremental improvement, and security initiatives are no exception.

America’s ports can get “smarter,” in how they conduct security operations, train their people, do vulnerability assessments, and conduct exercises through digitalization and the application of machine learning. It is time to consider pursuing digital initiatives that impact the fence line, as well as the bottom line. 

### About the authors:

*Luke Ritter is senior vice president for maritime solutions at ARES Security Corporation. He is a graduate of the U.S. Naval Academy, a former surface warfare officer, and the co-author of Securing Global Transportation Networks (McGrawHill).*

*Mark DuPont (USCG ret) is the executive director of the National Maritime Law Enforcement Academy (NMLEA), and formerly Florida FWC’s chief intelligence and domestic security officer. NMLEA hosts the Maritime Security Digitalization & Accreditation Program.*

### Endnotes:

- <sup>1</sup> [www.porttechnology.org/news/what-is-a-smart-port/](http://www.porttechnology.org/news/what-is-a-smart-port/)
- <sup>2</sup> Collins Dictionary. (n.d.). Definition of ‘digitize’. Retrieved December 15, 2021, from [www.collinsdictionary.com/dictionary/english/digitize](http://www.collinsdictionary.com/dictionary/english/digitize)
- <sup>3</sup> [www.gartner.com/en/information-technology/glossary/digitalization#:~:text=Digitalization%20is%20the%20use%20of,Scale%20and%20Lead%20Digital%20Initiatives](http://www.gartner.com/en/information-technology/glossary/digitalization#:~:text=Digitalization%20is%20the%20use%20of,Scale%20and%20Lead%20Digital%20Initiatives)
- <sup>4</sup> <https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/energy-resources/deloitte-nl-er-port-services-smart-ports.pdf>



# It's Here!

## What did we learn from the *Mayflower 400's* Atlantic crossing?

by LCDR MASON WILCOX  
Chief, Inspections and Investigations  
First District  
U.S. Coast Guard

**O**n June 30, 2022, the *Mayflower 400* (MAS400)<sup>1</sup> arrived in Plymouth, Massachusetts, after departing Plymouth, England, in the early morning hours of April 27, 2022. With the exception of two detours and assistance into port, she crossed fully autonomously.

This is the first time there has been an arrival of an autonomous vessel to the United States. We must leverage the lessons learned to develop policy and guide regulatory change to embrace this new technology.

During her 64-day transit across the Atlantic, the team at Promoting Marine Research and Exploration (ProMare) closely watched all of the decisions MAS400 made from its command center. Though it trusted the technology, MAS400 had yet to complete such a long transit and the team wanted to ensure it had minimized all the risks associated with such a long voyage.

The ProMare team knew the Atlantic transit would be a very risky operation, but also an opportunity to advance the industry. The last thing ProMare wanted was a bad outcome from the MAS400 transit—collision, pollution, sinking, etc. Autonomous vessels do not comply with Rule 5 of the International Regulations for Preventing Collisions at Sea (COLREGs), which requires lookouts, among other rules. This highlights a significant gap between human-controlled vessels and the MAS400. Therefore, the consequences of a collision could catastrophically impact the reputation of this new technology, delaying its implementation.

COLREGs were developed prior to computer technology, thus the legalities of

shipping have been based on crewed ships.<sup>2</sup> So, when taking action to avoid impending collisions, vessel



Standing atop the *Mayflower 400* after its arrival to Plymouth, Massachusetts, in June 2022, Coast Guard LCDR Mason Wilcox presents owner, Brett Phaneuf, with a copy of *Proceedings'* Spring 2022 issue highlighting the autonomous vessel. Photo courtesy of Laura Wilcox

operators have been able to deviate from the rules of the road. However, computers operate in a robotic manner and are designed to strictly adhere to their programming.<sup>3</sup> This significant difference in the capability to follow the COLREGs was evident in the *MAS400* transit.

Generally, when the *MAS400* was in a crossing situation with one other vessel, she was able to make the proper decision to avoid collision. The issue became more complex when there were several vessels in a crossing situation. Most notably, she lacked the ability to effectively communicate with another vessel. When there are inherent conflicts in the application of the rules for multiple ships, the complexity of the situation became problematic for *MAS400*'s computer as the COLREGs are a set of ship-to-ship rules.

One of *MAS400*'s standing orders was to maintain a 10-mile Closest Point of Approach (CPA). On her first encounter out of the United Kingdom, *MAS400* quickly had an encounter with two tankers ahead and one tanker at her starboard quarter. The larger ships were cruising at 15 knots while *MAS400* was cruising at 6 knots. The three ships were to pass the *MAS400*, respectively, across her port bow, starboard bow, and overtake her on her starboard side.

The *MAS400* recommendation was to turn to starboard to avoid the two head-on oil tankers. However, this altering of course to avoid collision would have compromised the tanker on her starboard quarter. The *MAS400*'s presence caused the ships to act differently, and this could have led to negative consequences. Because of the complexity of the situation, ProMare's watchstander took over, maintaining speed and course, ensuring a safe encounter.

Similarly, after leaving the Azores following an electrical repair, *MAS400* encountered another crossing situation that was made more complex due to sea state and maneuverability issues. *MAS400* was on a course of 270 degrees with a container ship 20 miles to the southwest. *MAS400* was content to maintain course and speed as the stand-on vessel with an expected 10-mile CPA. However, due to sea state and maneuverability concerns, the ProMare watchstander was concerned the other ship may not have considered *MAS400* and overrode the decision, slowed down, and turned to port. At the same moment, the other ship, having seen *MAS400*, had changed course 10 degrees to starboard to open the CPA. The watchstander changed back to 270 degrees, and the vessels never came within 10 miles of each other.

### **Lessons from Complex Encounters**

Route planning algorithms must be sophisticated enough to anticipate the assumptions of other vessels. Autonomous ships must be able to navigate complex

multi-ship situations reliably and in a predictable manner. Decision-making is a rapidly changing process and autonomous ships must be able to anticipate the influence of other vessels' actions. When one vessel assumes the right of way, requiring another vessel to maneuver to avoid collision, it causes a domino effect on all other vessels in that vicinity.

Imagine two autonomous vessels on track for a head-on collision. In consultation with a ProMare engineer, it was concluded that the vessels would have a challenge responding to such a constricted space where each ship is relying on hydrodynamic interaction with the other vessel to safely navigate. There is a tendency to move far away from the other vessel to avoid collision, but this may result in the *MAS400* running aground or alliding with a sea wall. This is where human skill overtakes a computer's ability to "judge" what is going on.

### **What is Needed to Succeed**

Globally, regulations are still catching up to innovation, and we need to consider a change to the COLREGs to incorporate autonomous vessels. The Coast Guard needs to continue taking a proactive approach with evaluating risks and developing policies and regulations that will provide a safe, secure governance framework for autonomous vessels.

Specifically, there should be a standard of digital communication requiring autonomous vessels to communicate with each other in route-planning to avoid collision. For now, we must make assumptions about the other ship's intent based on our belief that the other ship also intends to follow the COLREGs.

There is a need for voice-over-satellite and the ability to communicate intent, though it may not be the optimal solution due to latency. Natural language processing for discreet VHF communications at sea—intership—is very challenging and nowhere near ready for deployment, so we must accept the latency of VHF to satellite communications while striving to predict and resolve potential issues. Additionally, there is a need for a standard protocol for communicating intent.

How can we measure this risk in such a complex situation? The *MAS400* minimized this risk by using four redundant computers to run the necessary operating programs in order to safely function. If a piece of software or hardware failed during the transit, another computer could run the operating program instantly and take control.

Unfortunately, one cannot plan for every situation, but ProMare found ways to reduce risk with *MAS400* by incorporating watertight compartments, adding "dead-man" switches for external safety shutdowns, and ensuring a neutral/midship reset during a power outage.

Right now, we must continue to verify that the





The *Mayflower 400* (foreground) is anchored next to the *Mayflower II*, a replica of the 17th century original, in Plymouth, Massachusetts. Photo courtesy of LCDR Mason Wilcox

autonomous community is reducing and addressing risks to the marine transportation system. This is new, intrusive technology that will, in a best-case scenario, be viewed with cautious skepticism or, at worst, hostile rejection. We must work together to develop the trust necessary to advance its use by understanding it is a balancing act between risk, safety, and innovation. Industry's reputation is on the line and they are the last ones that want to see this fail. The key to the success of this industry is information sharing to allow everyone to learn from mistakes and develop a safer operation.

## Conclusion

MAS400's future is exciting and the opportunities to learn from her operations are endless. There are plans to conduct offshore oceanographic studies while simultaneously learning from her computers' decision-making process to act accordingly with the COLREGs. The Coast Guard will continue to see increased use of this type of technology and we will need to continue to assess

risks and develop suitable mitigating strategies for safe operation and then incorporate lessons learned into the development of future policies and regulations. //

### About the author:

LCDR Mason Wilcox has served in the U.S. Coast Guard for 18 years. Since direct commission into the Maritime Academy Graduate (MAR-GRAD) program in 2005 from Massachusetts Maritime Academy, he has spent his career as a marine inspector and investigator.

### Endnotes:

- <sup>1</sup> The *Mayflower 400*, a 50-foot-long diesel electric trimaran, is capable of speeds of up to 10 knots and is navigated by onboard artificial intelligence with information from six cameras and 50 sensors. In addition to its lithium ion batteries, it has a diesel powered generator to provide electricity when solar energy is not available to the 20 KW electric propulsion motor. <https://mas400.com/>
- <sup>2</sup> The International Regulations for Preventing Collisions at Sea were adopted as a convention of the International Maritime Organization on 20 October 1972 and entered into force on 15 July 1977
- <sup>3</sup> Isaac Asimov's Three Laws of Robotics —1. A robot may not injure a human being or, through inaction, allow a human being to come to harm. 2. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law. 3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws Asimov, Isaac (1950). *I, Robot*

# The U.S. Aquaculture Industry

Evaluating navigational risk posed by fish farming in the marine environment

by PETTY OFFICER 1ST CLASS ERIN WESTOBY  
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**H**ave you ever feasted on seafood and wondered where it came from? It is highly likely your dinner was sourced from marine aquaculture, more commonly known as a fish farm. The term aquaculture is defined as the farming of aquatic species like fish, shellfish, and plants in a controlled or selected environment. In the United States, marine aquaculture primarily produces oysters, clams, mussels, shrimp, and salmon, in addition to other marine fish products.

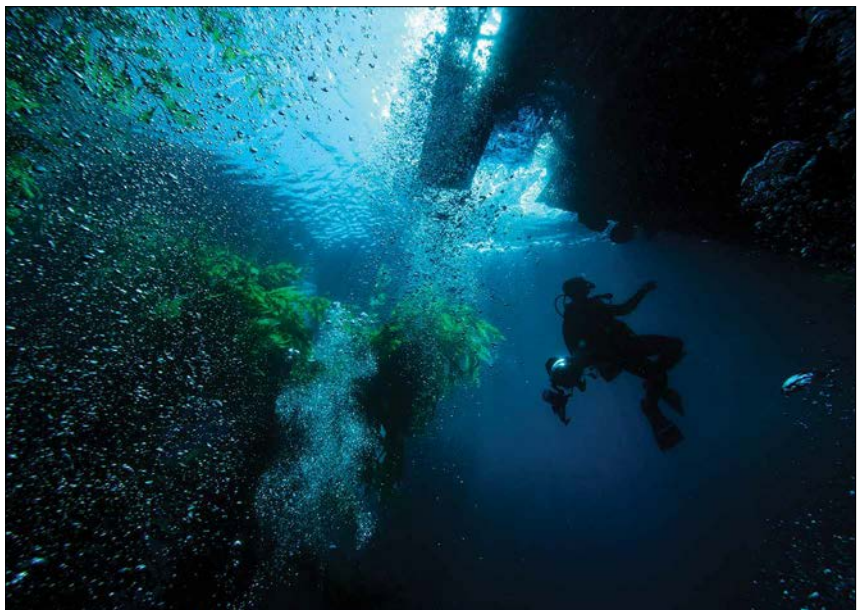
The aquaculture industry is a crucial resource needed to meet the increasing global demand for seafood. The United States imports between 70 and 85 percent of the seafood consumed domestically, half of which is sourced from aquaculture.<sup>1</sup> Not only is aquaculture a necessary form of food production in the world, it also supports commercial and recreational fisheries and aids in the restoration of various species and marine habitats. The United States works hard to support the growth of this novel technology while ensuring operations meet wide-ranging compliance standards.

## Aquaculture Gear

Aquaculture uses two main methods to farm a variety of organisms—natural environment or onshore tanks. Species farmed in a natural environment, like the navigable waters of the United States, require a range of regulatory oversight from multiple federal and state agencies, and can use an assortment of gear. What kind of gear and how it is deployed

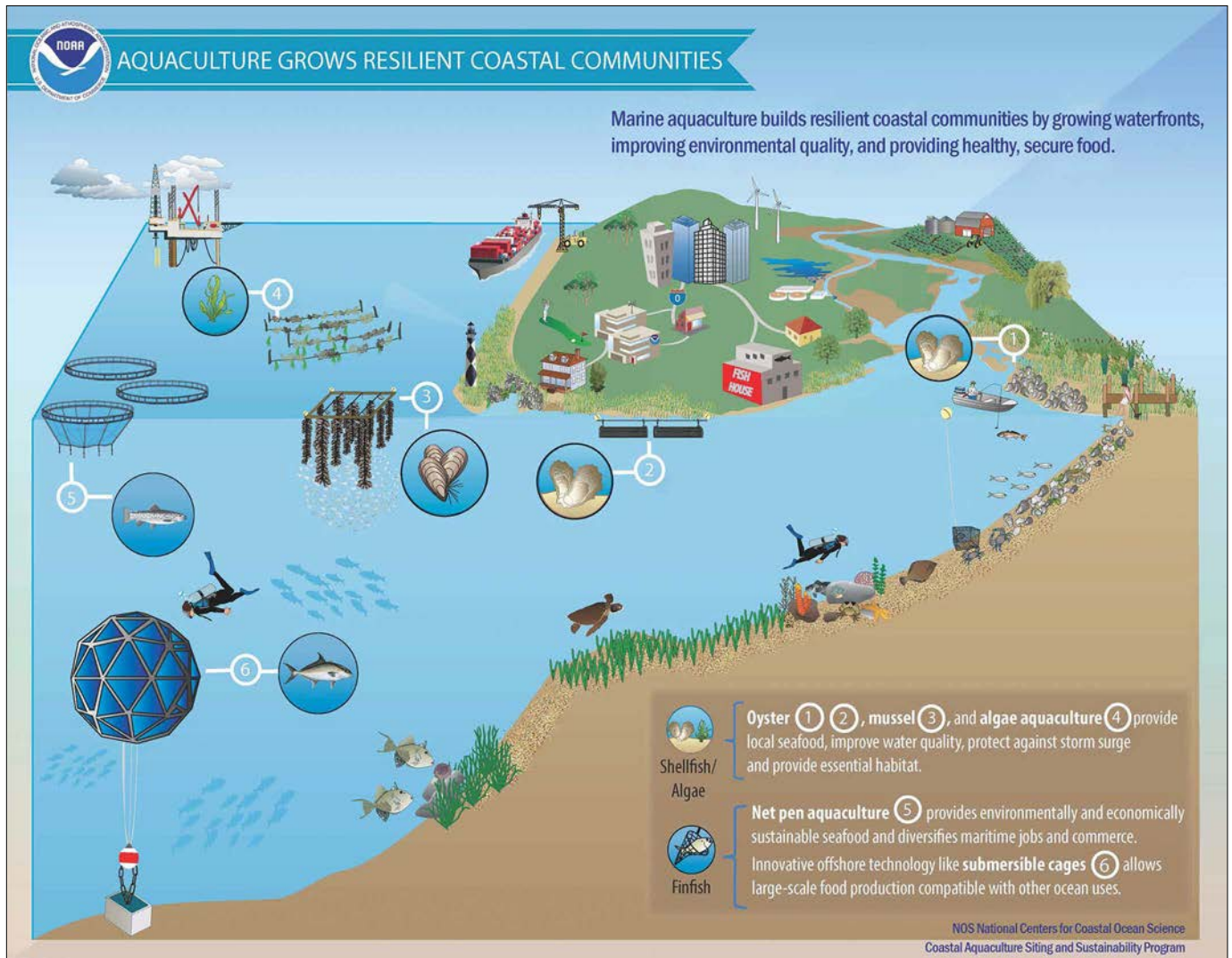


A vessel transfers feed into Atlantic Salmon fish net pens using a high-tech, automatic feeding system off Black Island, Maine. Photo courtesy of Maine Aquaculture Association



A member of the Underwater Photo Team assigned to Fleet Combat Camera Pacific, ascends to the surface after conducting photography training near kelp beds on the seafloor off the coast of San Diego. Navy photo by Petty Officer 2nd Class Nicholas S. Tenorio





Graphic courtesy of National Oceanic and Atmospheric Administration

depends on the species being farmed and can include:

- mussel longlines
- mussel rafts
- floating shellfish bags
- floating/sinking oyster cages
- bottom culture for oysters, mussels, and clams
- open net pens for finfish
- suspended kelp lines

With an extensive variability of gear types situated throughout the maritime community, the concern aquaculture poses for mariners and safe navigation is understandable. To address these concerns, in 2020 the U.S. Coast Guard established new procedures for its workforce to assess and mitigate risks posed by novel uses of the marine environment and the Marine Transportation System. The development and location of aquaculture in the marine environment has become a keen point of interest for the Coast Guard in the last two years. New procedures are constantly evolving in order to keep up

with the increasing demands of aquaculture applications, and these innovations require safety and risk assessments.

### Developing New Processes

Following the release of the policy letter, *Evaluation of Risk Posed by Novel Uses of the Marine Environment*, Coast Guard units throughout the nation were tasked with developing programs aimed at tracking and assessing risks associated with aquaculture sites.<sup>2</sup> The program must facilitate operations specific to a unit's area of responsibility (AOR), to account for differing aquaculture operations depending upon the region, waters, and species cultivated there.

Data obtained from the U.S. Department of Agriculture, state agencies, and industry groups found the Atlantic region accounts for 40 percent of the nation's aquaculture, followed by the Pacific region with 38 percent, and the Gulf of Mexico at 22 percent.<sup>3</sup> Coast Guard

units in these regions will have the most exposure to, and experience with, aquaculture, therefore establishing best practices to meet the objectives of the Coast Guard's navigation safety risk assessment guidelines.

It is important for the Coast Guard to identify who the marine aquaculture licensing and permitting agencies are in their AOR and establish direct lines of communication and working relationships with these state and federal counterparts. Agency involvement and the regulatory process will differ among states. For example, in Maine, the Maine Department of Marine Resources (MEDMR) receives and processes aquaculture applications and determines whether an applicant will receive a license or lease. Applicants must also apply for a federal permit through the U.S. Army Corps of Engineers (USACE) to operate gear within the United States' navigable waters.

Conversely, New Hampshire directs all aquaculture applications through the New Hampshire Fish and Game Department, and licensing durations differ greatly from those issued in Maine. Most marine aquaculture in the United States takes place in coastal state waters. If an applicant wishes to establish an offshore aquaculture operation in federal waters, the National Oceanic and Atmospheric Administration (NOAA), the U.S. Environmental Protection Agency, and USACE will all be involved in the permitting process.<sup>4</sup>

Once a Coast Guard office identifies the aquaculture application process in its AOR, they can activate their unit-specific program and use software like ArcGIS Pro to formulate vessel traffic data to conduct a navigational risk assessment. Additional resources may be used to populate data and aid in the assessments. Coast Guard Sector Northern New England in Portland, Maine, has found the Northeast Ocean Data Portal, used to illustrate traffic patterns in its AOR, to be a great resource in conducting risk assessments. Along with evaluating the traffic density in an area, the Coast Guard also notes the proximity of the proposed project to federal aids to navigation and any potential impact it may have on the service's ability to maintain them. Once a risk level is determined for each assessment, the Coast Guard will document the review.

### Coast Guard Limitations

If a proposed site is determined to be a high risk to safe navigation, the Coast Guard will work with the permitting agency to mitigate or remove the risk. The Coast Guard has no official authority

to approve or disapprove an application. Its role is to provide the permitting agency with an assessment of potential impacts to safe navigation if a proposed project is approved. Through a Coast Guard business letter, the Captain of the Port (COTP) can document recommendations to the permitting agency that certain conditions be implemented or risk mitigation factors considered before a permit is issued.

In addition to having no approval authority, the Coast Guard may be time-constrained to review aquaculture applications. Often, one unit will be responsible for reviewing permits for multiple state governments.

## Navigation Safety Risk Assessment

A navigation safety risk assessment is a tool the Captain of the Port (COTP) uses when preparing input for the permitting agency regarding port or waterway safety issues associated with a structure or work project located on or near the navigable waters of the United States. The assessment helps the COTP identify potential navigation risks and determine if a more extensive analysis is necessary, or what recommendations to provide to the permitting agency.

—Waterways Management (WWM): Navigation Safety Risk Assessments Tactics, Techniques, and Procedures (TTP). CGTTP 3-71.7, August 2015



A crew from Bangs Island Mussel Farm harvests kelp in Casco Bay near Portland, Maine. Bangs Island has been growing mussels and kelp for more than 10 years. Photo courtesy of Maine Aquaculture Association




Some states, like Maine, have a variety of different applications that can be categorized as either a standard lease, experimental lease, or limited-purpose aquaculture (LPA) license. A standard lease can include a farming site of up to 100 acres for a term of up to 20 years; whereas experimental leases allow for applicants to apply for a maximum of 4 acres for a duration of up to 3 years. Both types of leases require an extensive review from MEDMR, which provides the Coast Guard more time and flexibility to complete risk assessments. On the other hand, LPA licenses are one-year licenses that cover an area of no more than 400 square feet and do not require an extensive MEDMR review. MEDMR streamlines the LPA permitting process with the intent of allowing shellfish growers the ability to sample different site locations prior to applying for a longer standard or experimental lease.

This short turn-around, combined with other mission-critical responsibilities, has limited the Coast Guard's ability to conduct risk assessments for all LPAs in the state of Maine. In 2021 alone, a total of 179 new LPAs were issued in addition to the 804 existing licenses.<sup>5</sup> In order to circumvent this gap in oversight, Sector Northern New England requested that MEDMR inquire about Coast Guard risk assessments on LPAs only concerning navigation safety.

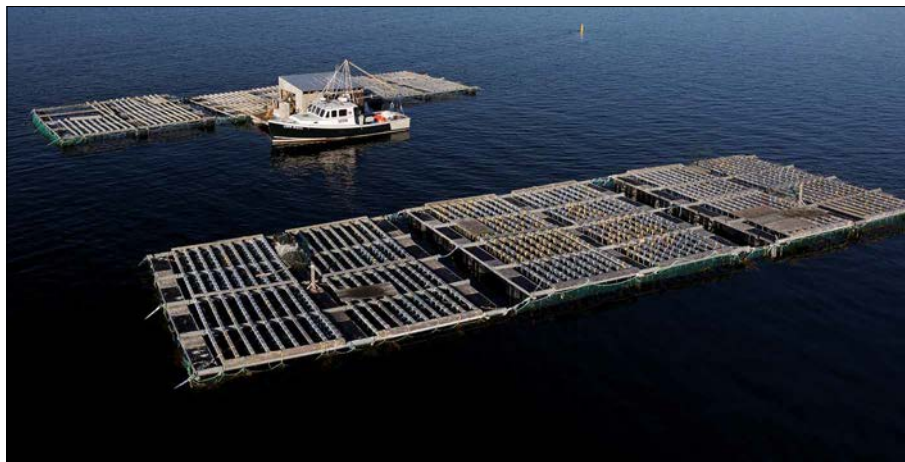
## Conclusion

Aquaculture is a growing industry, and the Coast Guard's involvement in support of these projects has just begun. The majority of aquaculture sites in the United States are located in state waters, where species and gear are more protected from the harsh weather conditions often found offshore. As the industry expands, competition for space may push more operations offshore and into federal waters where projects impact additional waterway users.

Only time will tell what the future holds for marine aquaculture, but the Coast Guard's steadfast dedication to the safety of navigation for our maritime community will remain certain. The Coast Guard is committed to ensuring that the marine transportation system remains open for innovation. 

### About the author:

*Petty Officer 1st Class Erin Westoby has served in the Coast Guard for 11 years, completing operational assignments in search and rescue, inspections, and pollution response. She currently serves in Coast Guard Sector Northern New England's waterways management division as the aquaculture program coordinator.*



Islesboro, Maine, is home to this farm of mussels rafts that are owned and operated by Marshall Cove Mussels. Photo courtesy of Maine Aquaculture Association



The U.S. Army Corps of Engineers Norfolk District Oyster Reef Team hosts Norfolk Christian Schools' fifth-grade students to assist with the oyster restoration on the Elizabeth River near Fort Norfolk, Virginia, in November 2018. The monthly field trip to the reef offers a lesson in science, technology, engineering, and math while helping bolster the struggling oyster population in the area. Army photo by Andria Allmond

### Endnotes:

1. [www.fishwatch.gov/aquaculture](https://www.fishwatch.gov/aquaculture)
2. WWM 01-20 Policy Letter *Evaluation of Risk Posed by Novel Uses of the Marine Environment*
3. NOAA "2020 Fisheries of the United States" <https://media.fisheries.noaa.gov/2022-05/Fisheries-of-the-United-States-2020-Report-FINAL.pdf>
4. NOAA *Guide to Permitting Marine Aquaculture in the United States* (2022)
5. Maine Aquaculture Harvest, Lease, and License (LPA) Data. [www.maine.gov/dmr/aquaculture/data/index.html](https://www.maine.gov/dmr/aquaculture/data/index.html)

# Navigating the Course Ahead with Offshore Wind Development

## U.S. Coast Guard prepares and responds

by Mr. JOHN STONE  
*Program Analyst*  
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Offshore wind has been active in U.S. waters for over 15 years, beginning with the now-defunct Cape Wind project off of Cape Cod, Massachusetts. The First and Fifth Coast Guard Districts are at the forefront of offshore wind development in the United States where, especially in the Northeast, there are several key drivers to offshore wind development. The primary driver is the demand for electricity, which is highest along coastal states. Other drivers include some of the highest offshore wind speeds in proximity to states with the highest demands for increased energy supply, and the Biden Administration's goal of 30 GW nationwide by 2030.

As of August 2022, there were 27 active leases in various stages of development in federal waters on the Atlantic and several auctions expected on the West coast, Gulf of Mexico, and Gulf of Maine in the next few years. Vineyard Wind and South Fork Wind, in the First District area of responsibility, were the first projects permitted to begin construction, which started in 2022. All of these projects will result in the construction of hundreds of turbines and installation of miles of submarine cables.

Under the National Environmental Policy Act (NEPA), the Coast Guard serves as a cooperating agency to the Bureau of Ocean Energy Management (BOEM), the lead federal agency responsible for issuing offshore wind farm permits beyond 3 NM in federal waters. While the Coast Guard does not have the authority to approve, disapprove, permit, or authorize an offshore wind permit application, ensuring safe navigation and efficiency of the marine transportation systems are top priorities.

The director of the marine transportation systems issued a Navigation and Vessel Inspection Circular

(NVIC 01-19) on August 1, 2019, to explain the Coast Guard's roles and responsibilities with respect to Offshore Renewable Energy Installation (OREI) development. The NVIC is intended to assist the Coast Guard in providing BOEM with input on how an installation may impact safe navigation for all waterway users and the Coast Guard's ability to execute its missions. Additionally, it provides members of industry, port safety and security stakeholders, and the public with information on the Coast Guard's roles and responsibilities in the OREI application process.

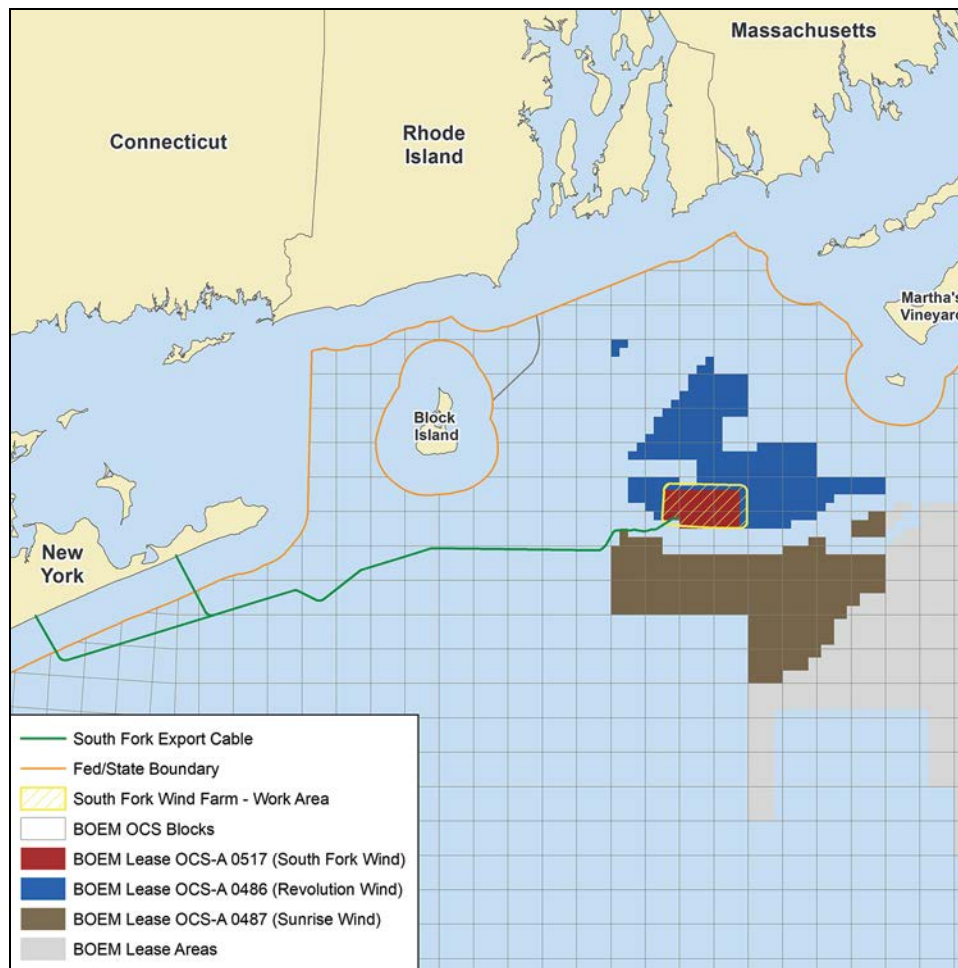
As projects are permitted, sector and district staffs become involved with vessel inspections, incident investigations, and other waterways management activities during construction and operation of the wind farm. The Coast Guard will review any proposed changes to its area of operations from offshore wind development and evaluate how these changes will affect standard

### Established Offshore Wind Projects on the East Coast

- In 2016, the Block Island Wind Farm came online in state waters off the coast of Rhode Island with five 6 MW turbines.
- In 2020, the Coastal Virginia Offshore Wind demonstration project came online in federal waters with two 12 MW turbines. For example, the Bengis case involving a network



## Commercial Wind Leasing Off Rhode Island and Massachusetts



Bureau of Ocean Energy Management



Wind turbine farms such as the one above bring renewable energy to many. Blue Planet Studio/Getty Images


operating procedures and missions. Based on the findings of this review, operational commanders will make necessary updates to guidance as required to mitigate any potential impact to the Coast Guard's 11 statutory missions. Eventually, units of all types and geographies will be involved in response activities, like search and rescue (SAR) and oil spill.

### Port Infrastructure

With the increase in offshore construction comes an increase in shoreside facilities to support these activities. These facilities support crew boats transporting workers to and from construction sites, survey boats, wind farm component construction, and assembly yards. Many of these facilities are located at existing commercial waterfronts, some of which have been repurposed as part of wind farm construction support. In many instances, there are coastal and river locations that have not had significant commercial traffic in some time, and this increased traffic density may cause conflict with local marine traffic.

With shoreside support facilities coming online over the coming years, determining whether they come under the Maritime Transportation Security Act is important to ensuring the safety and security of the port. One of the requirements is the development of a facility security plan required under the Maritime Transportation Security Act. Each sector's prevention department will work with these facilities to ensure they are following all applicable regulations.

For the Coast Guard, new shoreside facilities pose several challenges, from increased vessel traffic to a project running across several Coast Guard sectors and districts. Coordination with marine construction organizations working on these wind farm sites, as well as cooperation with the maritime community in each sector through outreach and information sharing, is paramount to ensuring these communities can adapt to changing port operations. Working with entities such as area maritime security committees and various maritime groups, will set the groundwork for better cooperation between all involved in this complicated work.



Block Island Wind Farm, just a few miles off the coast of Rhode Island, was the first commercial offshore wind farm in the United States. Construction started in late 2015 and has paved the way for numerous additional projects nationwide. diane39 | iStock/Getty Images Plus

## Marking and Lighting

While many mariners will navigate around wind farms, others may choose to transit through them. This presents some unique challenges with marking and lighting. Not only must these structures be well-marked to provide mariners ample time to avoid them, each turbine needs to provide orientation within the farm. In essence, the Coast Guard needs to balance the need to mark farms as one single obstruction with turning the individual turbines into individual aids to navigation.

Although the United States' offshore wind development is just beginning, the Coast Guard has assisted with marking and lighting guidelines for several years through its participation in the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA). IALA published a guideline for *The Marking of Offshore Man-Made Structures (G1162)* on December 17, 2021.


Recognizing the growing development of offshore windfarms worldwide, IALA seeks to provide consistency between all nations to ensure mariners are able to determine the outer perimeter of a windfarm. The guideline provides the mariner the ability to distinguish not only which structures are on the perimeter, but also which structures mark a corner by differentiating between what IALA calls Significant and Intermediate Peripheral Structures (SPS/IPS). This allows mariners a means to safely navigate around the windfarm.

While the guideline provides additional lighting and marking recommendations for the interior structures, the Coast Guard is standardizing these recommendations to provide mariners a safe way to determine their vessel's location within the farm and ultimately navigate through, if desired. As described in NVIC 01-19, the consistent spacing and a standard grid pattern with two lines of orientation provides an organized way to label each individual turbine. Large areas with multiple adjacent farms, like the Massachusetts/Rhode Island Wind Energy Area, will be marked as one single farm, allowing mariners a clear position identification throughout the area.

In addition to traditional marking and lighting, automatic identification system (AIS) aids to navigation (ATON) will be leveraged. These will not only assist mariners with their location, but also provide additional information in the unlikely event the marking and lighting on specific turbines are inconsistent. The intent is to provide each individual wind turbine with the *capability* to broadcast, while only continuously broadcasting on the SPS turbines. This strategy will reduce potential

radar and electronic chart clutter versus if AIS ATON were to be broadcast continuously. IPS and interior turbines would only broadcast to alert the mariner of any ATON discrepancies. These ATON could also be used to alert mariners of any emergencies in the area, such as SAR cases. By leveraging AIS technology, the Coast Guard could supplement its Broadcast Notice to Mariners procedures by sending a message to a wind farm's command center for broadcast throughout the AIS transmitters located across the farm. This judicious use of AIS may ultimately provide the Coast Guard and developer a force multiplier to broadcast marine information and ensure navigation safety throughout a wind farm.

## Conclusion

In order to meet the demand of the additional users that offshore wind development brings, the Coast Guard's role in marine planning is important, and our work with BOEM and offshore wind developers is critical to the success of this program. The offshore energy industry continues to evolve, and floating wind turbines and other types of offshore renewable energy development will bring new concerns. As the development of offshore renewable energy installations advances, the Coast Guard will continue to coordinate a collaborative effort focused on safe navigation and harmonious waterway use by multiple maritime stakeholders. By looking forward to balance the potential impacts of proposed offshore energy projects with navigation safety, traditional uses of the waterway, and port infrastructure, the Coast Guard can better position itself to continue serving the maritime communities. 

### About the authors:

Mr. John Stone is a program analyst with the Office of Waterways and Ocean Policy at Coast Guard Headquarters. He specializes in marine planning, navigation safety regulations, and aids to navigation. Prior to this, he served on active duty in the Coast Guard for more than 23 years as a career afloat officer.

Ms. Michele Desautels has worked on maritime energy projects in the First Coast Guard District's Prevention Division for 10 years. Prior to that, she worked at the Bureau of Ocean Energy Management and the U.S. Department of Energy Office of Renewable Energy in the Wind Program.

Mr. Daniel Dugery has worked for the First Coast Guard District over the last 4 years as a port security specialist. He has more than 40 years combined active duty and civilian service with experience in marine construction, marine safety, and environmental response.

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Dr. John Smith, *Search and Rescue: A Study of North American SAR Response*, Random House, 2003, p. 5



# The Unique Waterways of The Arctic and Western Alaska

by LCDR RVEN GARCIA  
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**A**rctic waterways are some of the most unique waterways in the United States. While many take the efficiency of modern transportation systems for granted, rarely thinking about how supply chains affect their lives, Alaska's citizens are well aware of how crucial the ports and waterways are to their survival. The harsh Arctic weather can impact delivery schedules, making the efficient use and management of resources mandatory.

## Maritime Cargo

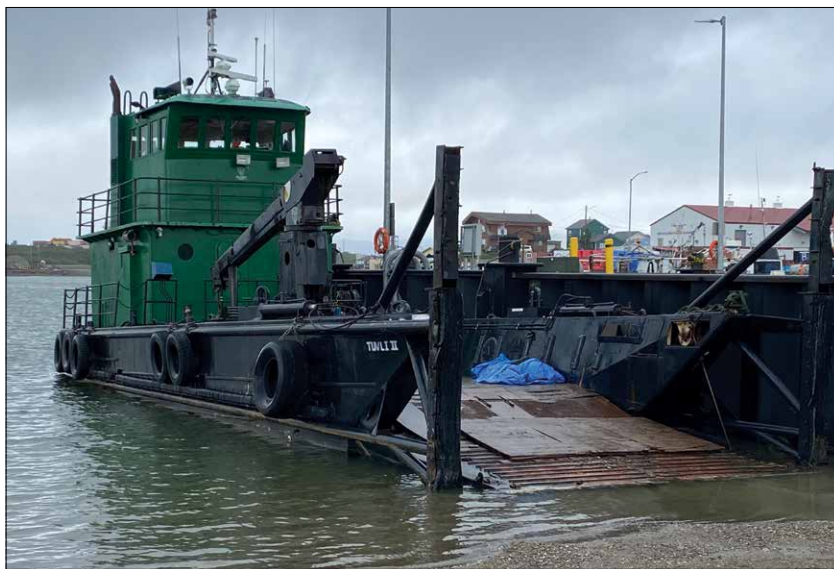
Intermodal transportation is essential to moving Alaska's imported and exported goods, which keep the state and local economies thriving. Alaska's top exports include seafood, mineral ores, crude oil, and wood, and the top imports are refined oil/fuels; electrical and industrial machinery; and iron, steel, and manufactured products. The Port of Alaska, located in Anchorage, is the state's primary cargo handling facility. Half of the cargo received at the port is redistributed throughout the state to sustain its residents, native corporations, and native tribes in remote regions. To put into perspective how dispersed the population is, only 78 percent of the population lives in regions connected by traditional road or rail systems.

In 2022, the U.S. Department of Transportation's Maritime Administration awarded the city of Seward and the Alaska Railroad Corporation nearly \$20 million for improvements to the Port of Seward's freight dock, rail corridor, and cruise ship terminal. The expansion of the port's infrastructure will absorb the Port of Alaska's overflow of vessel traffic and create an

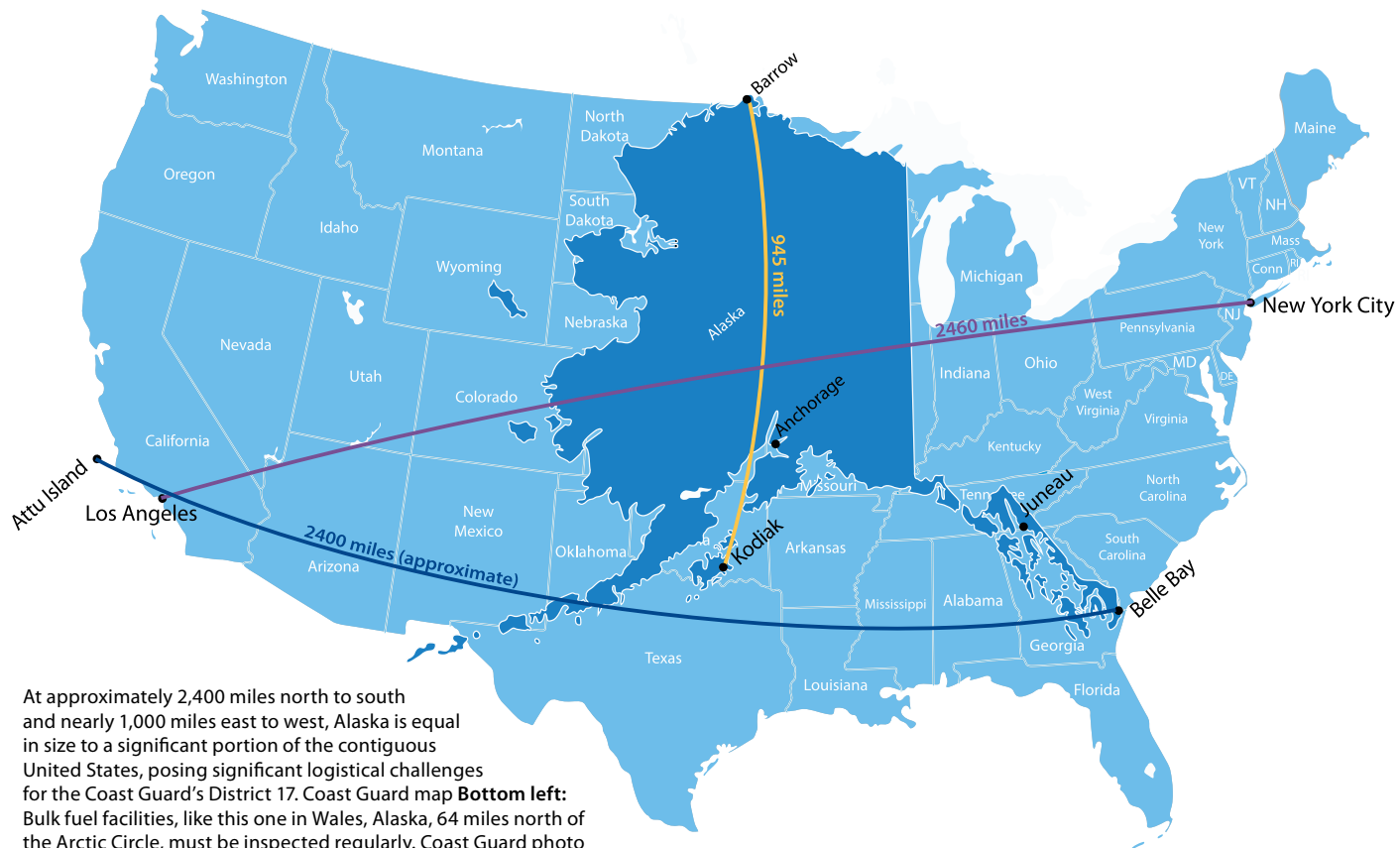
alternate port in western Alaska to ensure continuity of cargos when disaster strikes. With a highway system that doesn't reach every community and other modes of transport that are often impacted by unpredictable weather for success, the state's transportation system highlights the importance of a resilient, dynamic supply chain.

## Geographical Challenges

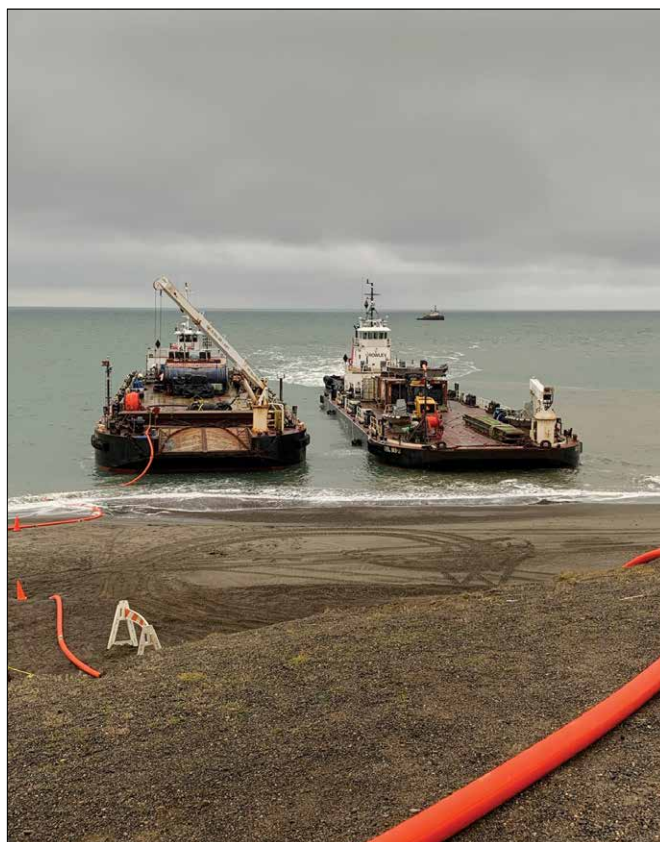
Unforgiving geographical features across the state limit the use of highway and rail systems, making commercial aircraft and vessels the only modes of transportation for cargo. Seasonal weather disparities across the state pose major challenges to the delivery of cargo due to operational limitations for both aircraft and vessels. Extremely low temperatures require aircraft and vessels to be fitted



A landing craft prepares to load cargo in Nome, Alaska, 142 miles south of the Arctic Circle. Coast Guard photo by LT William Mason



At approximately 2,400 miles north to south and nearly 1,000 miles east to west, Alaska is equal in size to a significant portion of the contiguous United States, posing significant logistical challenges for the Coast Guard's District 17. Coast Guard map **Bottom left:** Bulk fuel facilities, like this one in Wales, Alaska, 64 miles north of the Arctic Circle, must be inspected regularly. Coast Guard photo by LT William Mason **Bottom right:** Two hundred and twenty miles north of the Arctic Circle, Crowley Fuels Alaska vessels discharge fuel to Utqiagvik, Alaska, using a specialized mile-long transfer hose. Photo courtesy of Scott Wilson, Crowley Fuels Alaska





with additional equipment to prevent operational systems from freezing. When an aircraft is unavailable, delivering cargo by vessel is the only option, and that comes with its own set of challenges when operating in Alaska.

During the summer, if weather cooperates, there is an approximate three-month operating season on the North Slope and in the interior of the state. During this time-frame, Alaskan communities depend on commercial vessel operators to maintain schedules for delivery of essentials that will help them survive the long, harsh winters.

In mid-September, once ice begins to form and winter weather begins to encroach, there is inherent risk to transiting through the Arctic Ocean, as well as through the state's rivers and bays. Any error—even a loaded barge becoming beset in ice—can result in threats to safety, property, and the environment, meaning essentials can go undelivered. Without essentials like petroleum products used for power generation and heating, as well as fuel for boats, airplanes, ATVs, and snowmobiles, communities are unable to refuel alternate means of transportation used for subsistence hunting and fishing. If these deliveries are missed, it can be devastating, as the community may not receive another shipment for an entire year unless they rely on air support. While relying on expensive commercial air service for essential goods like food and fuel makes life in the Arctic possible, even aircraft are limited by weather.

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**Residents also rely on these deliveries for construction materials and prefabricated buildings for use as schools, housing, and other dwellings.**

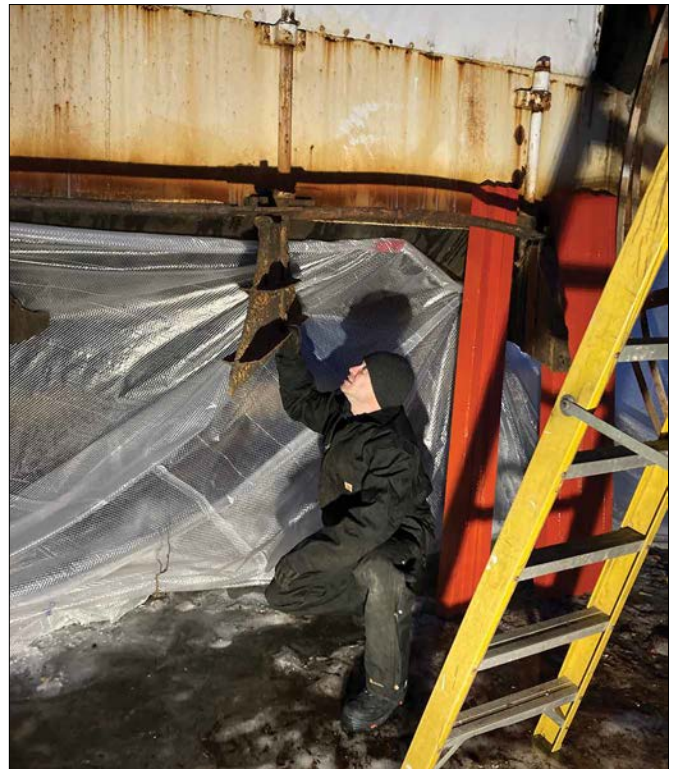
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### **Maritime Transportation**

Weather is not the only challenge in Alaska. Once vessels reach their intended waterway, they are sure to encounter uncharted and unmarked channels, daily changes in water depth, and constantly shifting bottom contours. In particular, the water depth changes throughout the year due to melting snow, ice, glacial sediment, and summer rainfall.

As towing vessels make their way up the rivers, they deploy a small skiff ahead of them to manually sound and chart a navigational route. This data becomes proprietary to each company, therefore special automatic identification systems waivers are granted to prevent competitors from copying these uncharted routes.

In order to operate in shallow, Alaskan waterways,



LT William Mason oversees repairs to a vessel's damaged rudder on the frozen Chena River in Fairbanks, Alaska, where—about 120 miles South of the Arctic Circle—the air temperature was approximately minus 40 degrees Fahrenheit. Coast Guard photo by LT William Mason

towing vessels and barges navigating the inland rivers of Alaska are specifically designed with towing vessels restricted by length and only able to push a maximum of two barges. Moreover, in an effort to maximize deliveries, barges “of less than 1,500 gross tons carrying refined petroleum product in bulk as cargo in or adjacent to waters of the Bering Sea, Chukchi Sea, and Arctic Ocean...” (46 USC 3703), are exempt from the federal double hull regulations. These single-hulled vessels create environmental and operational safety concerns for villages and responders.

Most fuel deliveries are dependent on the tide, therefore, it is normal for operators to intentionally ground their barges while transferring fuel and remain aground until the next tide cycle. Maintaining the integrity of the vessel's hull is of the upmost importance, and towing vessels and barges needing repair or dry-docking service in the Arctic or western Alaska only have two options. The first uses the tidal difference to ground the vessel on high tide and complete the work on low tide. The second, and increasingly popular, option uses specially designed airbags to roll the vessel out of the water and onto land using tractors and ground anchors. Once on dry ground, the airbags are deflated, and the vessel is lowered onto blocks.

Damage requiring parts and labor, which are usually

not readily available, to correct these issues is often identified during the dry docking of vessels. This often requires that the materials, skilled labor, Coast Guard inspectors, and class surveyors to be flown in via chartered air service. To adequately complete repairs to specially designed vessels, skilled welders and marine inspectors/surveyors must be extremely knowledgeable about steel repair on single-hull barges that are also carrying freight on deck. Any error or misstep could result in additional environmental risks and financial costs. The Coast Guard works closely with industry to effectively mitigate hazards and ensure regulatory compliance, while simultaneously facilitating commerce and modern life within the Arctic and Western Alaska.

### Bulk Fuel Facilities

The vast majority of western Alaska's 386 bulk fuel facilities are isolated, without any physical connection to other communities. This means that fuel and supply deliveries are only possible by sea or air. These bulk fuel facilities are critical to sustaining modern living conditions throughout Alaska and the Arctic regions. They primarily fuel machinery that contributes to survival, like diesel furnaces in locations where temperatures frequently dip below minus 50 degrees Fahrenheit in the winter months. Annual planning is crucial to avoid emergent needs when sea ice prevents fuel delivery, requiring costly alternatives. In emergency situations, where transporting fuel via barge is not possible, airplane tankers are used, pushing fuel costs to nearly \$20 per gallon.

These remote communities often have populations of less than 1,000 people, yet many have three regulated bulk fuel facilities. In contrast, regulated bulk facilities in the continental United States may have 1,000 people employed within a single facility and occupy more land than one of Alaska's remote communities.

The drastic differences do not stop there. Most U.S. fuel facilities are owned by major petroleum companies, but in Alaska they are owned by public schools, general grocery and hardware stores, and tribal entities. Alaskan facilities are often managed by school principals, "gas station" clerks, city mayors, and part-time employees, who often manage two facilities at once. Federal regulations do not differentiate between these small remote communities and major petroleum companies; both are expected to comply with the same set of regulations, requiring training and incorporating costs not easily met by small communities.

### Challenges and Solutions


Transferring life-sustaining critical fuel supplies and the regulatory oversight from several government agencies is a delicate balance. The communities' fuel facilities typically only transfer fuel once or twice annually, with

all facilities in a community receiving shipments at the same time and from the same barge.

The logistics and exorbitant costs do not just apply to the delivery of the fuel to the community facilities. The Coast Guard is tasked with providing regulatory oversight of these facilities, encountering difficult logistics and high costs to inspect these remote facilities. Current transportation to examine vessels and facilities requires the use of commercial airlines, Alaska National Guard, U.S. Air Force Civil Air Patrol, and Alaska State Troopers' aircraft with members deployed throughout Alaska for weeks at a time. Typically, this transportation only gets the team to a gravel runway. The final travel to each facility must be completed on ATVs, snowmobiles, or foot.

### Conclusion

Effective waterways management is critical to the survival of Alaskan communities. Without balanced maritime governance, many communities would fall short of required resources, suffer tremendous economic impacts, or experience a catastrophe affecting their traditional methods of subsistence hunting and fishing for generations. As climate change opens the Arctic to more commerce, the Coast Guard's footprint needs to grow with additional focus on the marine safety mission. This includes waterways management with an emphasis on vessel and facility inspections.

Coast Guard District 17 and Sector Anchorage are managing innovative logistical solutions to ensure personnel can reach even the smallest communities of the Final Frontier to guarantee environmental safety and preserve life in the harsh Arctic environment. 

#### About the authors:

*CDR John Downing currently serves as the chief of Prevention at Sector Anchorage, Alaska, where he oversees all marine inspections, marine casualty investigations, and waterways management in western Alaska and the U.S. Arctic. He attended the U.S. Merchant Marine Academy, has a master's degree in organizational leadership and a master's in marine affairs.*

*LCDR Roen Garcia serves as the chief of the Inspections Division at Coast Guard Sector Anchorage, Alaska. His previous tours include PACAREA Prevention, Sector Anchorage as the senior investigating officer, supervisor of Marine Safety Detachment American Samoa, Marine Safety Unit Portland, Oregon, and Coast Guard Cutter Morgenthau. He is a graduate of California Maritime Academy.*

*LT Kaitlyn Moore is the chief of Investigations Division at Sector Anchorage, Alaska. Her previous tours include serving as an investigator at Sector Los Angeles-Long Beach and as an inspector at Marine Safety Unit Houma, Louisiana. She is a graduate of the Merchant Marine Academy and, prior to joining the Coast Guard, she worked as an engineer on harbor tugs.*

*LT William Mason is the chief of Waterways Management Division at Sector Anchorage, Alaska. His previous tours include Sector Anchorage as the assistant chief of Inspections, Sector Mobile, Alabama, as an inspector, Station Tybee, and Coast Guard Cutter Saginaw. Prior to joining the Coast Guard, he was a tankerman for a towing vessel company.*



# Harbor Safety Committees

Community solutions to complex challenges

by GREG HITCHEN  
Director  
Vessel Traffic Service New York  
U.S. Coast Guard

In April 2000, Assistant Commandant for Marine Safety, Security, and Environmental Protection Rear Admiral Robert C. North, provided guidelines to formally establish harbor safety committees throughout the United States. Already established in key ports, the Coast Guard acknowledged these committees were very effective venues for meeting challenges and providing opportunities to enhance the safety of the Marine Transportation System through local coordination.<sup>1</sup>

Prior to the identification of these committees as ideal venues for developing community solutions to complex challenges in crowded waterways, the Port of New York and New Jersey already had a well-established Harbor Safety, Navigation, and Operations Committee. For decades, the unique, complex nature of the port dictated a high level of stakeholder coordination, driving the New York/New Jersey committee to continually influence improvements to both the safety and efficiency of the East Coast's largest seaport.

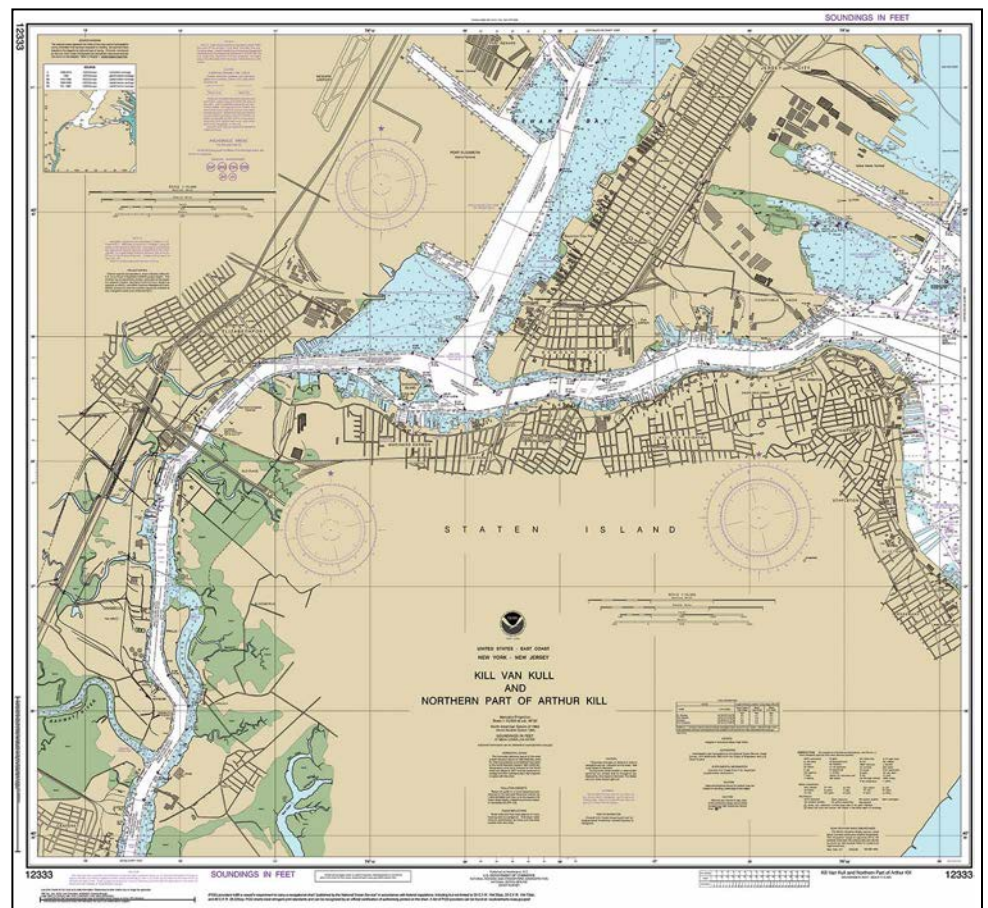
## The Port of New York and New Jersey

New York Harbor surrounds one of the United States' densest population centers. Some of the world's most iconic destinations—the Statue of Liberty and United Nations among them—are located on the city's busiest waterways. Global trade supplying one-third of the country's population transits within 4 miles of

the southern tip of Manhattan. Almost all of this traffic navigates the Kill Van Kull waterway nestled between Bayonne, New Jersey, and New York's Staten Island. Roughly 800 feet wide, this channel, sometimes referred to as the Suez of the West, has several bends and ends in a sharp turn into one of the world's busiest container ports. Close management and coordination is crucial to ensuring it stays open for business.

New York regularly receives the largest container ships to call on the East Coast. These ships, measuring

## Kill Van Kull and Northern Part of Arthur Kill



Map courtesy of National Oceanic and Atmospheric Administration

upward of 1,200 feet in length, have complex navigational needs to ensure safe navigation of the harbor. Adding further complexity to the navigation, container ships must share the Kill Van Kull with tankers providing the full spectrum of petroleum products to the entire Northeast United States. Arriving via tanker and departing via tug and barge, the port transfers the largest amount of refined petroleum of any seaport in the United States.

Each month, roughly 4,500 tugs and barges transit throughout the port, with many transiting between Manhattan and Brooklyn, through the heart of New York City, via the East River, infamous for its strong currents. Most carry petroleum products, while others carry building materials to areas not easily reachable by road or the bulk of the city's trash and other waste streams to final disposal sites.

As with many other ports, the Port of New York and New Jersey is constantly changing. The size of commercial ships calling on the port has dramatically increased as the harbor has been deepened and key bridges have been raised. These ships transported 8.9 million TEUs of container cargo in 2021 alone.<sup>2</sup> Most New Yorkers live on an island, and commuting by boat has exploded in popularity over recent years, topping more than 1 million transits per year throughout the harbor. Furthermore, more area residents have been drawn to recreational use of "blue space" as the harbor gets cleaner and green space gets more crowded. Portions of the harbor that have been exclusively commercial for hundreds of years are now occupied by sailboats, jet skis, kayaks, and paddle boards. The region has also become a popular cruise destination with some of the world's largest cruise ships operating out of the port.

As might be imagined, the number of stakeholders with interest in management of the port is impressive. Two states and one, rather large, municipality have overlapping jurisdictions throughout the harbor. Although the Port Authority of New York and New Jersey provides oversight of the region's container terminals, there is no specific management body for the numerous petroleum facilities in the region. Four separate pilot organizations conn ships entering the port dependent on route and type of vessel. A wide variety of municipal organizations and

private companies manage commuter ferry operations throughout the region.

The consequences of failing to manage the safety and efficiency of the Marine Transportation System in the port are huge. Within 48 hours after the Captain of the Port restricted commercial maritime traffic after the events of 9/11 and Super Storm Sandy, supply chain shortfalls rippled throughout the Northeast United States. Even routine port-wide activities, such as the annual convening of the United Nations and Fleet Week have to be carefully planned to minimize impact on daily commerce. These consequences highlight the need to promote waterway efficiency as well as safety, since critical supply chains are dependent on the timely arrival of cargo to the port.

All of this complexity drives a critical need for close and continuous coordination between stakeholders on the water and shoreside. The Harbor Safety, Navigation, and Operations Committee, fondly known as Harbor Ops, successfully meets this need.

### The Harbor Ops Committee

The port's Harbor Ops Committee is not a Coast Guard-run committee. The Coast Guard, as well as other government agencies, serve solely in an advisory capacity to the voting members of the committee. This structure, in which committee governance is reserved for nongovernmental stakeholders, provides greater flexibility for the community to freely discuss issues, provide advice to decision-makers, and nimbly develop navigational safety guidelines.

Due to the size and complexity of the port, the full committee has open membership, allowing any interested individual to attend and participate in bimonthly meetings. As a result, the full committee meetings are



Three dredges work simultaneously to deepen the Kill Van Kull, part of the New York and New Jersey Harbor. Coast Guard photo



primarily reserved for the presentation of agenda items first vetted through the executive steering committee to best allocate time and gather stakeholder feedback in a general venue. Consequently, most business is conducted via side conversations outside of the formal meeting.

The Executive Steering Committee meeting is robust in size, with more than 25 individuals representing either user communities or government entities. In addition to the more traditional commercial users of the harbor, the committee has representatives from the sail/power recreational community, kayak/paddleboard users, and marine event organizers. The committee meets monthly and

very effectively serves as a forum for open dialog. It also routinely provides direct advice on emerging issues and refers larger challenges for presentation to the full committee for greater feedback.

Given the enormous scope of challenges and opportunities in the port, Harbor Ops has also formed a number of standing and ad-hoc subcommittees to provide greater focus on pressing issues. Some groups, like the Passenger Vessel Subcommittee and Deep Draft Vessel Working Group, are centered on industry segments. Others are centered on specific challenges, including the Harbor Education Subcommittee, formed to increase navigational safety for recreational users new to the harbor; and the Energy Subcommittee which provides advice on emerging alternative energy projects that impact waterways users. These subcommittees meet as needed and provide feedback to the Executive Steering and full committees on their efforts.

Harbor Ops has many benefits to the Coast Guard and, more importantly, the Port as a whole. The committee has been crucial as “one stop shopping” for numerous entities seeking to conduct a wide number of varied activities through the harbor. With the recent explosion of activity surrounding offshore wind energy sites in New York Bight, Harbor Ops has been crucial as a venue for energy developers to get advice from all maritime users regarding activities that impact the port. Likewise, Harbor Ops served as a key advisor to the Coast Guard with the completion of *The Northern New York Bight Port Access Route Study*.

Harbor Ops successfully developed and updated a



Part of the annual New York Jet Ski Invasion, an event that began in 2017, hundreds of jet skis take to New York's waterways. Beginning on the East River at Long Island City, they travel around the tip of Manhattan and up the Hudson River toward the George Washington Bridge. Coast Guard photo

comprehensive set of navigational guidelines ensuring safe transit and on-time arrivals of ultra large container ships and other vessels that require greater oversight. Although not regulatory in nature, these guidelines provide a framework for the Coast Guard, particularly the Vessel Traffic Service, to monitor riskier transits and implement operational controls on a vessel-specific basis. Furthermore, since these guidelines are not regulatory in nature, they are easily adjusted to account for the constantly-evolving nature of traffic in the Port.

### Successes

Harbor Ops has ensured the success of the port throughout the years, particularly as it expanded to meet the evolution of increased global trade being carried on ever larger ships. The committee provided crucial

## ***Northern New York Bight Port Access Route Study***

The *Northern New York Bight Port Access Route Study* was a Coast Guard-led effort. It was conducted to evaluate the adequacy of existing vessel routing measures in the approaches to the Port of New York and New Jersey, improve navigational safety in response to factors like planned offshore energy development, and improvements to port capabilities.

advice during the decade-long deepening of the Harbor so it could accommodate the next generation of container ships. Harbor Ops developed crucial guidelines for the Vessel Traffic Service to manage the closure of half of the already narrow Kill Van Kull as dredging and blasting was completed as part of the deepening. Additionally, the committee provided guidelines for the safe transit of the first new ultra large container vessels to arrive in the port, and continues to regularly revise them in response to feedback from the pilots on the ships. This has maintained safety while also improving the efficiency of vessel transits.

The committee also nimbly responded to the impressive growth of recreational activity in the harbor by establishing recreational community representation on the Executive Steering Committee and using its views to develop innovative outreach to recreational waterways users. This outreach included Operation Clear Channel, a comprehensive program to educate recreational users of the risks of operating in and around shipping channels. Harbor Ops also hosted an annual Captains and Paddlers Day, during which commuter ferry captains and kayakers could exchange ideas on safety, and actually operate from each other's craft.

Finally, Harbor Ops was a tailor-made Maritime Transportation System Recovery Team for major emergencies, notably 9/11 and Super Storm Sandy. The existing coordination between all stakeholders was crucial to the region's rapid recovery, and the Harbor Ops Team ensured the quick reopening of the port and resumption of critical commerce after both events. During 9/11, Harbor Ops provided essential advice to the Coast Guard as it rapidly established security protocols to get traffic moving through the port. The working relationships developed through the committee ensured the unqualified success of the 9/11 boat lift of thousands of people from downtown Manhattan, the largest maritime evacuation in Coast Guard history.

## What is on the Horizon

But the work is never done.


The committee continues to advise the Coast Guard and other decision-makers on a host of changes throughout the port. Offshore wind and other alternative energy



A containership passes under the Bayonne Bridge which spans the Kill Van Kull connecting Bayonne, New Jersey, with New York City's Staten Island. Photo by Ultima\_Gaina | iStock/Getty Images

continues to develop at a rapid pace. Although many of these projects are sited well outside the port, construction and maintenance activity will change the dynamics of port operations for years to come. In particular, much of this construction activity will take place in the Upper Hudson River and has, in large part, contributed to the creation of a distinct Hudson River Harbor Ops Committee.

It does not end with offshore wind. Container traffic increased by 18 percent over the past year and is projected to continue to grow.<sup>3</sup> As roads become more congested, the harbor is increasingly viewed as the best option for last-mile delivery of various goods. Finally, as sea levels rise, coastal resiliency projects will potentially result in major changes to the waterfront in all areas of the port.

This story can be repeated in a wide variety of forms in every port in the country. Harbor safety committees have been, and will continue to be, essential to providing community solutions to meet these challenges. 

### About the author:

*Greg Hitchen has served the Coast Guard in uniform and as a civilian for 35 years. Prior to retiring from active duty and becoming New York's Vessel Traffic Service director, he served as deputy commander of Sector New York. He is also a career cutterman, serving 10 years on five ships.*

### Endnotes:

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2. Port Authority of New York and New Jersey. [www.panynj.gov/port/en/our-port/facts-and-figures.html](http://www.panynj.gov/port/en/our-port/facts-and-figures.html). Facts and Figures.
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# Eventful Days on the San Francisco Bay

## Management of the largest Coast Guard marine event permitting program

by LT WILLIAM HARRIS  
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*Sector San Francisco*  
*U.S. Coast Guard*

As the sun rises over Oakland Hills, California, a westerly wind propels a sailboat along the San Francisco city front near Crissy Field, a public recreation area. Ahead of the sailboat is a large collection of vessels—recreational motorboats and sailboats, police and Coast Guard vessels, ferries with sightseeing passengers and, at the center of it, a group of high-speed sailing vessels that appear to be racing.

As one of the most active and iconic waterways in the country, a sight like this is not all that uncommon in the waters of San Francisco. Marine events, in the tens of thousands, occur annually on the waterways across the country and require the efforts and coordination of Coast Guard Waterways Management representatives. Coast Guard Waterways Management, part of the Coast Guard Maritime Prevention Program, works to prevent personnel casualties and property losses, minimize security risks, and protect the marine environment.

A marine event is an “organized on-water event of limited duration conducted according to a prearranged schedule, and which presents an extra or unusual hazard to the safety of life that cannot

be protected against by the existing Navigation Rules.”<sup>1</sup> This extra or unusual hazard may be a large collection of vessels associated with regattas or marine parades or could be a large group of swimmers racing in a highly trafficked area. Some marine events are more complex than others and may take up a larger footprint in the waterway, requiring close coordination with event sponsors and other external stakeholders. Examples of these types of events within the Sector San Francisco area of responsibility include Sail Grand Prix high-speed race, Blessing of the Fleet/Opening Day on the San Francisco Bay, and the Escape from Alcatraz swim. Another recurring on-water event requiring high level coordination is



A crowded field of competitors compete during the 2022 Sail Grand Prix race in San Francisco. Photo courtesy of Michael Carlson | Michael R. Photography

the San Francisco Fleet Week parade of ships. Each event type presents unique challenges to be addressed.

There are several ways the Coast Guard is notified of a potential marine event. A few of those come from alerts by local partner agencies or departments, social media, or event sponsors who reach out to the Coast Guard directly. Sponsors complete an Application for Marine Event form that allows a Coast Guard Waterways Management office the opportunity to gather a substantial amount of information and make a permit determination. The determination of whether an event requires a Marine Event Permit comes from local district policy that establishes guidance for evaluating an application.<sup>2</sup> The Sector San Francisco Waterways Management office developed a form to gather information that addresses common concerns specific to the San Francisco Bay Area.

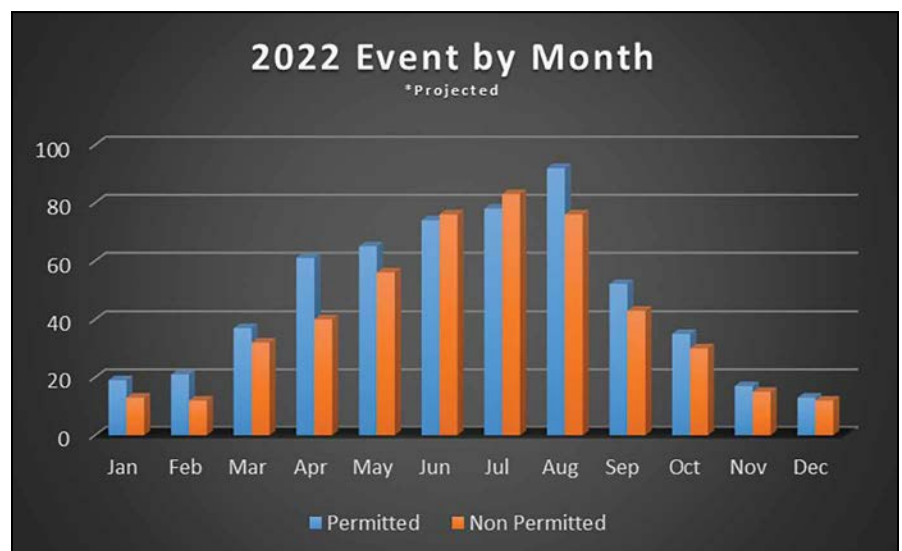
After all pertinent information is collected, the Coast Guard analyzes event participation requirements, safety and communication plans, routes of travel, and possible traffic conflicts or overlap with other marine events. Once any concerns identified in the review process have been addressed or mitigated, the Captain of the Port (COTP) may issue a Marine Event Permit. It should be noted that not all applications meet the threshold to be permitted. In those instances, an event can proceed as organized, provided participants follow established navigation rules. For permitted events, safety measures are inserted when appropriate during the review process. For larger events, public notification is made to allow for overall awareness.

Within an issued permit, the event is outlined and conditions and expectations are documented. These conditions could include the obligation to report an incident with a marine mammal, coordination with local police, or designated check-ins with Vessel Traffic Service (VTS) San Francisco. Annually, Sector San Francisco reviews more than 1,000 Marine Event Permit applications,

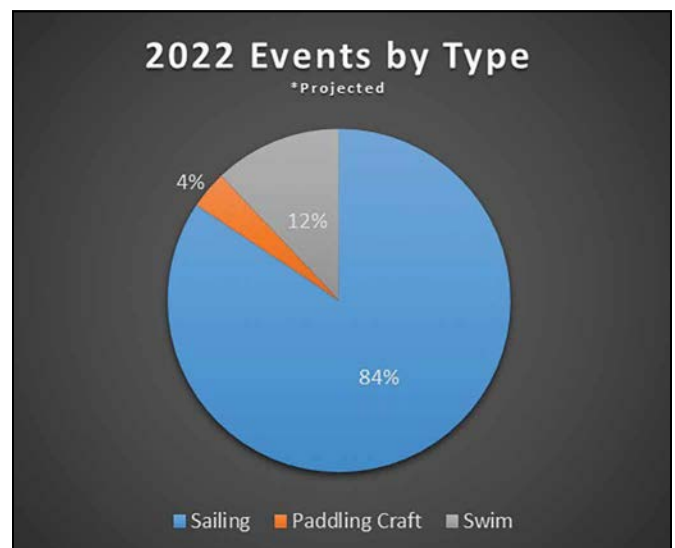
making this office's programs one of the busiest in the Coast Guard.

All permits are approved by the Captain of the Port San Francisco, or delegated to the prevention department head at Sector San Francisco. Permitted marine events inherently have an "extra or unusual" hazard associated and the complexity of an event may increase the level of risk which may in turn elevate the final review authority.

For example, the final review of an offshore event is completed by the COTP. This level of review has been standard following a high profile marine casualty that occurred more than a decade ago. In April 2012, the sailing vessel *Low Speed Chase* participated in a permitted event around the Farallon Islands and capsized, primarily due to heavy weather. Five of the eight crew members perished and the San Francisco COTP ordered a



Coast Guard graphic



Coast Guard graphic

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Responsible for coordinating over 153,000 vessel transits annually within the Bay Area, the VTS maintains predictability and good order through vessel movement coordination.

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Coast Guard Cutter *Hawksbill* provides a watchful eye while teams New Zealand and Australia vie for the lead during the 2022 Sail Grand Prix race in San Francisco. Photo courtesy of Michael Carlson| Michael R. Photography

temporary halt to offshore races, prompting the review of the marine event permitting process.<sup>3</sup> Current policy stems from this incident, where all off-shore marine events are reviewed and signed by the COTP.

Overall, the goal of the permit application review process is to provide for the safety of event participants and non-participants alike. Additionally, the permit review process seeks to protect the associated marine environment. Outside of the marine event permit process review, there are several administrative measures available to limit non-event participant access. For example, notification to the public through marine broadcasts can de-conflict vessel traffic and the regulation writing process can provide means to limit access.

### Preparing for Significant Marine Events

On top of the hundreds of races and swims sponsored by local organizations, there are several significantly more complex annual events. Events of this nature may have hundreds of participants, thousands of on-water spectators, and a national profile that brings unique challenges and attention to the area. These events provide examples of some of the considerations that go into the application review, and the additional administrative measures taken, to ensure the safety of these larger scale events.

### Fleet Week

San Francisco Fleet Week consists of two separate on-water events—the Parade of Ships, and the Blue Angels airshow. During these events, access is restricted to the specified locations listed in the Code of Federal Regulations (CFR). This particular event, and similar large-scale events listed in the CFR, limit access through the use of control measures established through regulation writing. A published Notice of Enforcement for the established regulation serves as notification to the public. A typical control measure associated with a recurring marine event is a Special Local Regulation (SLR), which generally establishes traffic lanes, restricts access to areas, or provides requirements for participating vessels.

SLRs are one means of mitigating hazards that may result from a congregation of vessels around a regatta or vessel parade. The regulation for Fleet Week creates a designated path for vessels participating in the Parade of Ships to follow without interference, mitigating the risks of collisions and other accidents on the parade route. The second part of the regulation designates the “air show box,” where the Blue Angels flight demonstration team performs a low-altitude pass over the San Francisco Bay. By requiring that no vessels enter the box without permission, and having on-water enforcement with vessels

on the outer edge, this regulation mitigates hazards from a potential aerial accident and has resources on-scene to quickly respond if the need arises.<sup>4</sup>

SLRs can be permanently established in the CFR, or temporarily written to serve a one-time event. It is not uncommon for an event to occur for multiple years as a one-time event before the event sponsor finally decides to go through the process to permanently establish the event in the CFR. This delayed approach to permanent listing can actually allow for a more polished event, since any unsettled event details would be worked out by going through the process multiple times.

### *Sail Grand Prix*

The Sail Grand Prix organization sponsors high-speed sailing catamaran races around the world with San Francisco Bay serving as the final location in the year-long circuit. A review of the event permit application identified the high speeds at which the vessels operate to be an extra or unusual hazard. Additionally, the sponsors proposed a race course located along the city waterfront, which encompassed the eastbound San Francisco Bay traffic lane with normally high vessel traffic, including passenger ferry operations.

To address these items, a Notice of Proposed Rulemaking was drafted, which allowed the public to make comments on any concerns associated with the event. Comments from the public generally focus on navigability or environmental concerns. Sail Grand Prix

also had opportunity to present to local stakeholders at the Harbor Safety Committee of the San Francisco Bay Region for additional comments. After considering all comments, the SLR was established to create both the race course box and designated spectator areas. All environmental safety plans must be adhered to throughout an event. This was made evident in 2022 when a whale in the course prompted use of the marine mammal protection plan.

Incorporating lessons learned from previous iterations of this event, spectator zones were established to prevent congestion and congregation of vessels along the waterfront. With these efforts, the event concluded safely and the sponsors plan to return to the San Francisco Bay in the future, which may prompt the establishment of a permanent regulation to support continual safe event operations.

### *The Escape from Alcatraz Swim*

The Escape from Alcatraz Swim, consisting of 1,850 athletes braving the cold temperatures and strong currents in the vicinity of “The Rock,” is another iconic Bay Area event. A swim of this size requires careful consideration during the review of both the Marine Event Permit application and additional information collected through sponsor meetings.

For swims of any size, particular attention is given to the ratio of swimmers to safety vessels. During the review process for this event, or similar events, such as a



Sail Grand Prix teams race past “The Rock,” Alcatraz Island, during the 2022 Sail Grand Prix race in San Francisco. Photo courtesy of Michael Carlson | Michael R. Photography



triathlon, athlete safety is the highest concern. To address this, the Waterways Management Office office reviews the event safety plan and focuses on accounting for all swimmers and distressed swimmer recovery plans. Marine event sponsors are expected to contact the Command Center immediately if there are any reports of injury beyond first aid or less than 100 percent accountability for participating members. This expectation is a stipulation of an issued Marine Event Permit and contributes to safe recovery and quick response to unaccounted for or injured participants. The Coast Guard also partners closely with local law enforcement marine units for event safety coordination. They assist with communication of local emergency medical requirements and provide us with local area expertise for different events.

## Partnerships and Coordination

Sector San Francisco cannot act alone and uses well-established internal and external partnerships to accomplish its goals and keep the events on the Bay running smoothly. For events requiring on-scene Coast Guard oversight, such as enforcement of special local regulations, boat crews or a Coast Guard cutter may serve as the on-scene assets. These assets provide ready search and rescue platforms in case of an emergency while also preventing non-event participants from impeding the events.

Vessel Traffic Service San Francisco is another actively involved internal partner. VTS is an around-the-clock watch of professional civilian and active duty military personnel who manage the transits of deep draft vessels, a multitude of ferry routes, and maintain awareness of marine events. They keep the Bay safe through vessel traffic monitoring and dissemination of information to waterway users. Using radar displays, multiple camera installations, and radio communication with vessels, the VTS acts as a preventative watch for more than 6,590 square miles of the San Francisco Bay and the Delta region.

Rounding out the list of partnerships is the “Neptune Coalition,” which consists of local, state, and regional law enforcement agencies with maritime assets. During Fleet Week and Sail Grand Prix, Sector San Francisco coordinates with the Neptune Coalition to ensure enforcement of the SLRs and safety coverage of the events. Additionally, for other non-major marine events, these organizations may be asked to provide on-scene support.

## Conclusion

Holding a marine event may start with the submission of



Team USA surges ahead as a safety boat looks on during the 2022 Sail Grand Prix race in San Francisco. Photo courtesy of Michael Carlson | Michael R. Photography

an application, but it encompasses so much more. Without the efforts and coordination of the Coast Guard, VTS, local partners, event sponsors, and average waterway users, these types of exceptional events could not occur in a way that keeps the Bay safe for all who enjoy it. ▀

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# Economies of Scale Through Partnerships

Effectively managing port expansion and complex evolutions

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The demand for waterway and port capacity continues to increase across the entire Marine Transportation System (MTS). Larger ships, shifting trade patterns, and novel uses of our nation's waterways are exciting, but present new risks that must be mitigated. From offshore wind development and autonomous vessels to ultra-large container ships, port expansion, expanded use, and increased waterway congestion, this growth, along with advancements in technology, presents unique challenges that need to be managed to safeguard our vital MTS.

To effectively reduce new risk profiles and address evolving complexities, coordination and cooperation among MTS stakeholders is more essential now than ever. A well-connected and robust port coordinating body, commonly known as a harbor safety committee (HSC), provides the mechanism to tackle risk and facilitate complex port evolutions to prevent major disruptions. HSCs are defined by U.S. Coast Guard Navigation and Vessel Inspection Circular (NVIC) 01-00.<sup>1</sup>

Furthermore, when port disruptions do occur, a resilient HSC provides an existing network for critical incident communication, crisis management, and stakeholder engagement to buy down risk within the complex. In 2021 and 2022, the Port of Baltimore and its approach channels faced several complex events where partnerships within the local HSC paid dividends in safety, quality communications, and effective port management to control risk and manage multifaceted port evolutions.

## The Port of Baltimore

### *Established, Historic, and Growing*

June 2006 marked the Port of Baltimore's 300th anniversary. At this milestone, the Maryland governor renamed the state's public terminals the Helen Delich Bentley Port of Baltimore.<sup>2</sup> The name honors the six-term U.S. representative who represented suburban Baltimore from

1985 to 1995 after working as a maritime reporter for the *Baltimore Sun*.<sup>3</sup> During her time in office, Representative Bentley was a strong advocate for protectionist trade policies in support of U.S. manufacturing and the U.S. Merchant Marine fleet.<sup>4</sup>

Coincidentally, the Port of Baltimore Harbor Safety and Coordination Committee also formed in the late 1980s when federally maintained navigation channels and aids to navigation systems were being improved to accommodate larger cargo vessels. Today, this vibrant HSC continues to play an essential role in ensuring safety and coordination in a continually growing port. In the midst of a global pandemic, the Port of Baltimore positioned itself to become the largest e-commerce port and one of the busiest shipping ports in the nation.<sup>5</sup> In 2021, auto trade through the port increased by 13 percent, paper products by 73 percent, roll on/roll off farm and construction machinery rose 30 percent, and general cargo was up 9 percent.<sup>6</sup>

## Complex and High Flying

Throughout 2020 and 2021, the HSC spurred coordination among stakeholders to facilitate sustained and safe maritime commerce during the complex Baltimore Gas and Electric (BGE) Key Crossing Reliability Initiative. This two-year project, adjacent to the Francis Scott Key Bridge, began with driving approximately 120 steel piles, erecting eight monopole towers, and constructing water-level collision protection structures. The conclusion included two miles of high voltage power lines installed across the entire width of the Patapsco River, a vital shipping channel.<sup>7</sup>

BGE engaged with the Port of Baltimore HSC on a regular basis, providing port stakeholders with briefings on the project's status and collaborating to minimize any waterway impacts. This was critical to the port community's understanding of the project's importance



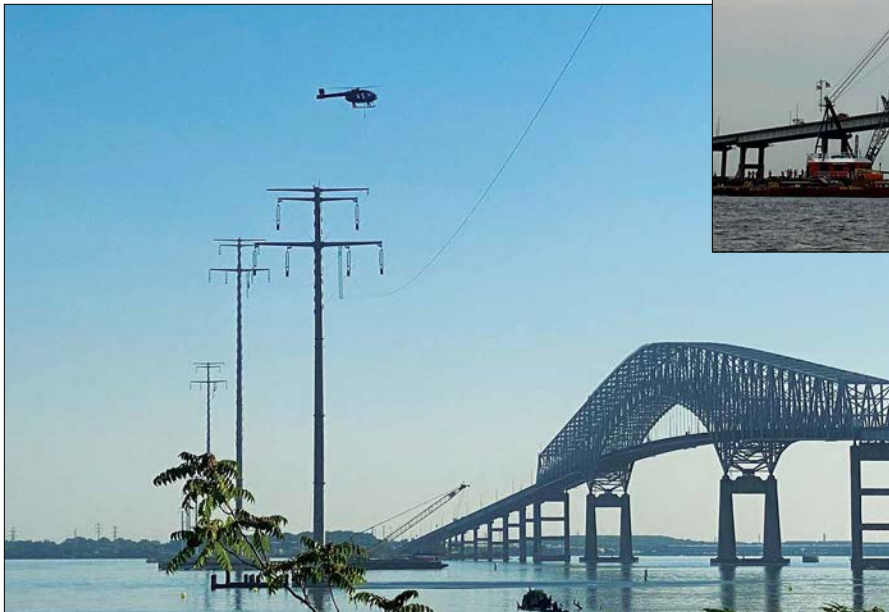
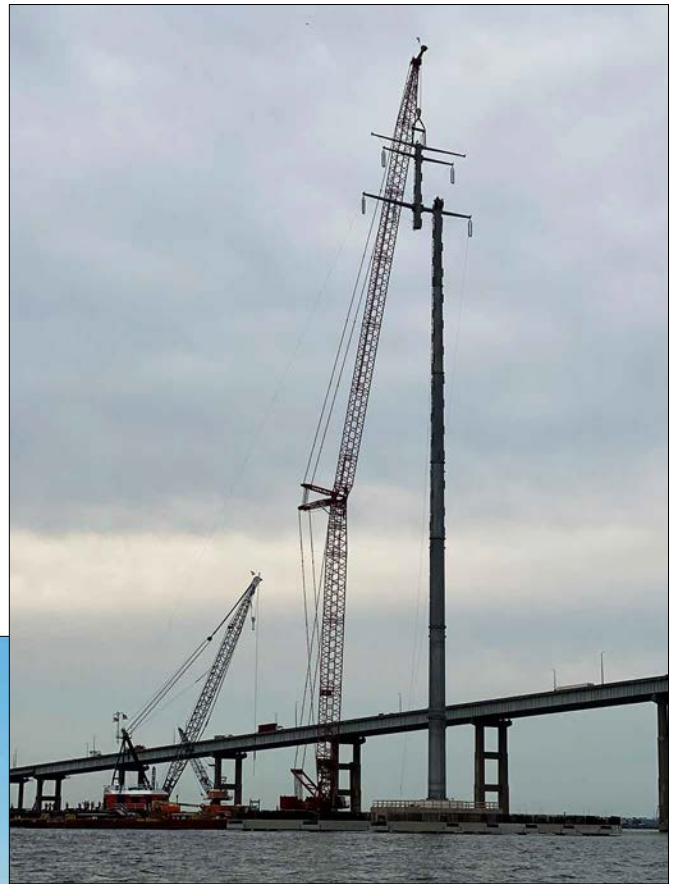
to maintaining a reliable electric grid by replacing the existing, aging high voltage transmission lines running under the Patapsco River and Fort McHenry Channel. Furthermore, it established a network of contacts between key stakeholders. In fall 2021, the U.S. Coast Guard, Association of Maryland Pilots, local vessel operators, Maryland Port Administration, and other regulators engaged to manage the sequential activities required to safely install conductors across the waterway.

This tricky operation required numerous waterway closure and safety zones in order for the work to be performed safely. Overall, more than 100 hours of waterway closures were needed over a three-month period to complete this high-risk work.<sup>8,9</sup>

In addition to managing deep draft arrivals and departures around the waterway closures, a mechanism was established to immediately and directly inform key waterway users of any changes to the schedule due to weather or mechanical issues. Following a break of a synthetic line during a scheduled waterway closure, the Port of Baltimore HSC, BGE, and a contractor developed port guidance for draft-restricted vessels to use when planning departures and arrivals around the closures.

The port guidance mitigated the potential of a deep draft vessel grounding or fouling its main propulsion in the event of a line break. This coordination was critical because once vessels begin transiting along Baltimore Harbor and its approaches, there is nowhere for them to stop or turn around in the event of an obstruction or dropped wire, which could take hours to recover.

Although the waterway closures were established to prevent an immediate danger to commercial and recreational traffic, the port guidance helped further optimize voyage planning for commercial vessels during



**Top:** A helicopter prepares to land on a temporary landing area in the vicinity of the Baltimore Gas and Electric (BGE) Key Crossing Reliability Initiative project. Spanning the Patapsco River, the Francis Scott Key Bridge and the Fort McHenry Channel are seen in the background. Photo courtesy of Burns McDonnell **Middle:** A crane sets the top of a monopole on Tower 4 along the Baltimore Gas and Electric Key Crossing Reliability Initiative project. Photo courtesy of Burns McDonnell **Left:** A helicopter pulls rope across Patapsco River and Fort McHenry Channel for the Baltimore Gas and Electric Key Crossing Reliability Initiative project. Photo courtesy of Burns McDonnell

the scheduled port waterway closures. It also prevented a major incident from any unforeseen delay in line pulling operations. This complex evolution, with more than 70 channel closures, was successfully completed with minimal disruption to port operations only because of the close coordination between the HSC and all stakeholders.

### **Under Bridges and Through Narrow Channels**

In September 2021, and during the BGE Key Crossing Project, Port of Baltimore stakeholders also coordinated for the arrival of a heavy lift ship laden with four post-Panamax container cranes to the Seagirt Terminal. These cranes were an important element to Ports America Chesapeake's \$166 million Port Expansion Project, which would allow the port to accommodate two ultra-large container ships simultaneously.<sup>10</sup>

In order for the cranes to transit underneath three critical highway bridges, their booms were lowered at the Annapolis Anchorage, providing less than 6 feet of vertical clearance. Lowering the cranes at anchor introduced additional complexity. The lowered cranes essentially increased the breadth of the vessel, making

its supersized cargo approximately 490 feet wide for a transit in 800-foot-wide channels. Due to this increased breadth, it would not be safe for two-way traffic to occur along the channel during this phase of transit if a meeting situation occurred with other deep draft vessels. To mitigate this risk, a moving safety zone was established through the rulemaking process to include a comment period for public input. Engagement through the HSC several months before the cranes' anticipated arrival was critically important toward keeping waterway users apprised of the timing and allowing for proper voyage planning to ensure safety and mitigate any harmful impact to commerce. This information flow and quality communications proved extremely important among HSC stakeholders and contributed to the successful, and highly visible, evolution.

In addition, outreach was required beyond the maritime community, including coordination with the Maryland Transportation Authority, to halt vehicular traffic across the three bridges during off-peak hours; a necessity to prevent accidents by distracted drivers. Furthermore, the cranes were delivered when the BGE Key Crossing Project power line transmission was



Crewmembers from Coast Guard Station Annapolis, Maryland, provide and escort for the delivery of four new neo-Panamax cranes to the Port of Baltimore in September 2021. Coast Guard crews provided security zones throughout the transit into the port's Seagirt Marine Terminal. Coast Guard photo by Petty Officer 1st Class Tara Molle-Carr





Transporting these neo-Panamax container cranes to Maryland's Port of Baltimore meant transiting under the William Preston Lane, Jr. Memorial Chesapeake Bay Bridge, an endeavor requiring significant cooperation among multiple partner agencies. Photo courtesy of Maryland Port Administration/Bill McAllen

beginning. The great coordination among the HSC, Maryland Transportation Authority, BGE project team, and public ensured that there would be no negative impact or unsafe situation to either evolution.

### Hard Aground and Channel Management

On the evening of March 13, 2022, the *Ever Forward*, laden with 4,965 containers and 600,000 gallons of mixed fuels, ran hard aground outside the Craighill Channel, a critical artery to the Port of Baltimore.<sup>11</sup> The relationships forged among Committee members and the greater port community proved essential to rapidly resuming commercial traffic and maintaining maritime commerce over the 36-day event, which set the standard for environmental and MTS disaster responses. Galvanizing teamwork across our federal and state partner agencies, as well as leveraging port and industry stakeholders, the vessel was safely refloated without pollution or injury, while largely mitigating adverse impacts to the MTS.

Although the grounded vessel did not directly impact the channel, its proximity required intense stakeholder engagement and coordination. The salvage operation necessitated a unified approach to coordinate the required safety zones and management of commercial traffic. It involved the dredging of 206,280 cubic yards

of material, safe removal of 505 shipping containers at sea, as well as complex push-pull operations to free the vessel without compromise to the environment or MTS. These critical operational phases impacted the channel and, at times, required waterway closures. Furthermore, the risks involved with salvage operations—pollution and vessel stability concerns—could have negatively impacted the 50-foot-deep access to a major U.S. port during a time when there were already supply chain issues.

Once again, longstanding port partnerships yielded great communication and mitigated risk, while ensuring there were no “blind spots” in the response. Salvage operations were highly dependent on weather, daylight, equipment, and tidal cycles. Sharing these intricacies with port partners and stakeholders via the HSC network facilitated communications and understanding.


Only permitting one-way traffic in the vicinity of the *Ever Forward* for the duration of the response was a key decision. During critical phases of the salvage operation, full channel closures were imposed. All key stakeholders were notified via routine briefs, detailed marine safety information bulletins, and broadcast notices to mariners. The unified command was intentional in providing enough advance notice to facilitate planning and

minimize impacts to traffic and commercial port operations.

## Conclusion

Certainly, the Port of Baltimore is not unique in the diversity of the challenges it faces. Modernizing infrastructure, port expansion, larger ships, and increasing congestion on our waterways; all port complexes face new challenges and evolving risks that will continue to require exceptional coordination among MTS stakeholders.

In 1999, the U.S. Department of Transportation's (DOT) report to Congress on the MTS envisioned a desired end state in 2020. Improved coordination among stakeholders was cited as a key element in achieving this vision.<sup>12</sup> This report is a key reference in the Coast Guard's NVIC 01-00, which provided guidance to HSCs for addressing MTS issues at a local level. It provided a great playbook for port partners within HSCs to implement those recommendations from the 1999 DOT report to optimize the MTS.

In March 2022, the U.S. Committee on the Marine Transportation System, provided an updated report to Congress that reassessed the MTS.<sup>13</sup> This report discusses emerging trends and concerns within the MTS, to include offshore wind energy development, growing ship sizes, and cybersecurity. With NVIC 01-00 being predicated on the 1999 report, it would be quite timely to gather best practices across all HSCs in order to update existing guidance. The findings of this updated report could be implemented to help guide MTS stakeholders in addressing these complex challenges across our nation's MTS. Let us envision the desired state of the MTS in 2040, today. 

### About the authors:

LCDR Samuel Danus has served in the U.S. Coast Guard for 15 years. As the Waterways Management Division chief at Sector Maryland-National Capital Region, he is responsible for overseeing aids to navigation and marine event permitting mission areas, while also preventing waterway impacts. In addition, he oversees the inspection of U.S. Coast Guard regulated waterfront facilities and containers.

CDR Baxter Smoak has served for 18 years with assignments on the east, west and Gulf coasts, as well as the Great Lakes. He is a seasoned marine safety professional with afloat and ashore experience, as well as a robust background and qualifications in vessel and facility inspections, waterways management, marine investigations, and enforcement. As



Containers are lightered off the grounded *Ever Forward*. Coast Guard photo

*the current head of the Prevention Department at Sector Maryland-National Capital Region, CDR Smoak is responsible for all marine safety missions across the navigable waters of Maryland and the District of Columbia.*

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# Building Cyber Resiliency into Maritime Supply Chains

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**D**isruptive events may arise from many sources, including natural, such as hurricanes; intentional, such as accidents, cyberattacks, or transportation failures; pandemics; and geopolitical instability. A salient lesson learned from the disruptions arising from the COVID-19 pandemic was the fragility of our maritime supply chains.

This lesson provided an opportunity to examine the impacts on the maritime supply chain. In response to this “opportunity,” the Department of Homeland Security (DHS) funded a project to review and develop principles and best practices for cyber resiliency in maritime supply chains. The project was conducted through the DHS Center of Excellence based at Texas A&M University, the “Cross Border Threat Screening and Supply Chain Defense.”

The research from this project resulted in a guidebook on principles and best practices for resiliency—the ability to maintain expected outcomes despite disruptive events—in maritime supply chains.

## Background

As one of 16 DHS-defined critical infrastructure sectors, the transportation system sector is unique. Most other sectors, like energy, chemical, critical manufacturing, and the defense industrial base are highly dependent on the resiliency of transportation systems for delivering necessary products, supplies, parts, and feedstock. These sectors, defined for protecting cyber assets, have given rise to the concept of resiliency, which is the concept that all assets and systems—physical and virtual—in both the operational technology (OT) and information

technology (IT) environments remain operational during and after a disrupting event.

A key component of the transportation system is the maritime supply chain. This supply chain captures the flow and movement of goods and cargo using vessels, ports, and terminals and excludes the end points where the goods and cargo are transferred to or from intermodal transportation, like truck and rail. COVID-19 disrupted the maritime supply chain with myriad consequences to both the international and United States’ economy. As stated in the DHS Resilience Framework document, the pandemic had a “debilitating impact on security, national economic security, and national [and] public health or safety.”

While resiliency is currently associated with cyberattacks—maintaining power while the grid is attacked—similar response and recovery concepts are



As the world becomes more connected, the supply chain becomes more vulnerable to cyberattacks, which can threaten our national security. When one aspect of the supply chain is compromised by a disrupting event, it cascades throughout the supply chain causing further disruptions. ake1150sb with NASA images | iStock/Getty Images Plus



used in maintaining or restoring operations in America's ports after hurricanes. This project investigated whether resiliency concepts developed for cyberattacks and hurricanes can be used to generalize resiliency in the supply chain regardless of the initial cause(s). If so, these generalized principles and best practices could result in improving maritime supply chain design and execution and provide a common basis for response and recovery that would protect America's maritime environment.

Our conjecture is that recovery and response operations from a disruptive event, regardless of its cause—cyberattack, hurricane, global pandemic—have much in common. For example, hurricanes and the COVID-19 pandemic disrupted the food supply chain. While the ways it was disrupted were different, the consequences were the same. Directly, food in homes that hurricanes have damaged or flooded is to be thrown away because of contamination that causes it to be considered unsafe to eat. Indirectly, hurricanes affect the food producers. The latest hurricane, Ian, destroyed a key crop of Florida citrus causing consumer prices to rise as the supply decreased when orchards were flooded or damaged by wind.<sup>1</sup>

Similarly, COVID-19 caused a disruption in the processing or transportation of food due to closures or worker shortages that resulted in a disruption getting<sup>2</sup>

food from the producers to consumers given the limited shelf life.<sup>3,4,5</sup> Similarly, cyberattacks could result in disrupting operations at food processors, the transportation network, or the food deliverers. All three produce the same consequences because disrupted operations result in bottlenecks, shortages, and competition for resources.

## Resiliency

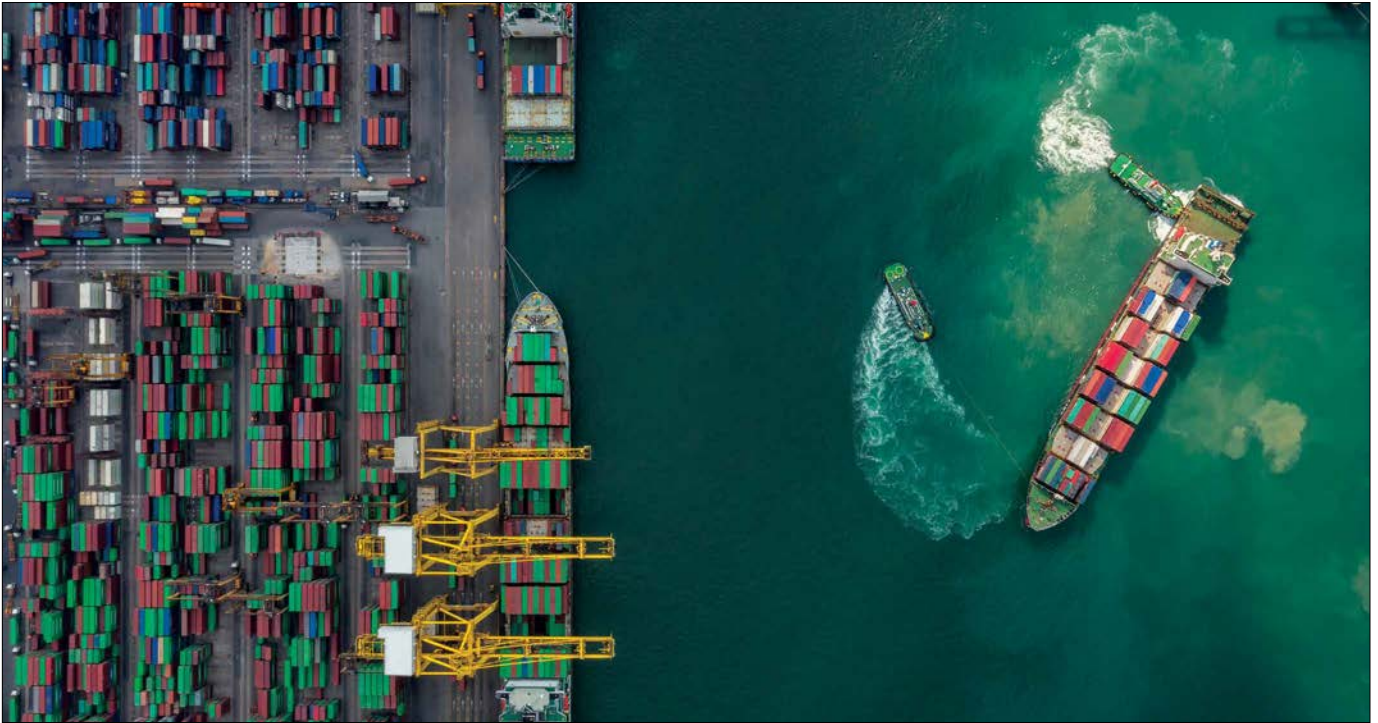
To better understand resiliency as a mechanism to effectively manage the supply chain, a new review of the concept is required. Resiliency allows supply chain stakeholders to better manage unforeseen and unpredictable events that influence productivity, performance, and routine and non-routine business operations.<sup>6</sup> If the model and resiliency are properly executed, we would expect actions to be less reactive and more proactive, as well as more predictive. Hence, concepts of building resiliency into entities are necessary to promote supply chain success, economic prosperity, and national security.

Optimally, systems are resilient from their initial design, however, they must be continually adapted to achieve resiliency. Further, given the dynamic nature of innovative technologies implemented with legacy systems and the maritime transportation environment, the goal of resiliency is a moving target. As such, there must



The maritime supply chain is a key component of the transportation system. It captures the flow and movement of goods and cargo using vessels, ports, and terminals, but it excludes the end points where the goods and cargo are transferred to or from intermodal transportation, like truck like truck and rail. pigphoto | iStock/Getty Images Plus





Disruptions to the supply chain differ in their causes and provenance, but they result in common consequences, including increased prices, unacceptable delays, bottlenecks, and compromised operations that create cascading results for both maritime and intermodal transportation systems. MAGNIFIER | iStock/Getty Images Plus

be a continuous focus on the principles and best practices associated with building resiliency into the supply chain.

### Viewpoint

*Guidebook: Principles and Best Practices for Supply Chain Resiliency* approaches the topic from the viewpoint of the Coast Guard as vessel traffic managers. There are several recognized supply chain disruptors, though this project recognizes only those within the purview of the Coast Guard. For example, the Coast Guard does not have authority over detecting counterfeit goods or control over the actual sourcing, production, or product tampering that may occur during manufacturing.

The Coast Guard's role begins when goods and cargo transit from international waters into those ocean or inland waterways controlled by the United States and ends when the goods and cargo exit waterways and enter intermodal transportation. Hence, our project focuses on the data provided by the information flow governing supply chains to better manage the physical movement of vessels that are within the purview of the Coast Guard. Although the Coast Guard is a key stakeholder in this project, the results are also useful to the commercial shipping industry, which directly controls the goods and cargo in the supply chain. As such, we are requesting a review of the research results from industry sources after the Coast Guard and DHS complete theirs.

### Project Innovations

The innovations in this project include the development of a supply chain maturity model and associated metrics. Previous, similar models were from the viewpoint of those who have custody and control of the goods and cargo in the supply chain—commercial shipping. Further, their profitability depends on the efficient movement of these goods and cargo, so their decisions may be optimized for the respective entity and not over a larger group of entities. Because supply chains are so complex, the dependencies between factors affecting them are also more complicated.

When one aspect of the supply chain is compromised by a disrupting event, it cascades throughout the supply chain causing further disruptions. For example, when the *Ever Given* obstructed the Suez Canal in 2021, there were 150 ships queued behind it. Many had contractual issues for delivery of goods. Others may have had cargo that would expire if not delivered on time. Each of these disruptions can cascade into additional disruptions for their respective entities, and also affect the security and economy of impacted countries because disruptions make it difficult for countries to maintain a stable workforce or maintain ready military forces.<sup>7,8,9</sup> Ships could forego the Suez Canal and travel around the African continent, a longer voyage with added risks, like increased costs and piracy.

Typically, supply chain factors are modeled using a

type of complex mathematical analysis involving data networks, relationships between the different components of a supply chain, and figuring out the probabilities of certain events, to determine the unintended consequences; for example, interrelated factors such as availability of critical supplies or equipment, labor shortages, and closures of ports. The dependencies would have an economic impact on the supply chain, and the responsibility, responsiveness, and overall interaction of the Coast Guard can be of major importance for mitigating the consequences of the supply chain downfall caused by disrupting events.


The innovation in this project is developing the maturity model to be more holistic, including complex supply chain dependencies and expanding viewpoints to include vessel traffic managers without physical control of the goods and cargo within the supply chain. The second innovation is metrics, which are near-real-time measurable factors used to better manage vessel traffic. The understanding of these metrics—their capture, storage, and further data analysis—can identify industry best practices to increase the maturity level in the organization's model.

## Conclusion

Supply chain disrupters may be natural, fabricated, or caused by other factors, like pandemics or geopolitical instability. The most recent supply chain disruptions caused severe consequences to United States' economic<sup>10,11</sup> and national security.<sup>12</sup> Many of these threats to national security came from increased numbers of cyberattacks that took advantage of the disruptions in the workforce caused by the pandemic.<sup>13,14</sup> It highlighted the fragility of supply chains and dependence of the United States on foreign materials and supplies; for example the inability to obtain critical supplies such as N95 masks and computer chips. These disrupting events differ in their causes and provenance, but they result in common consequences, including increased prices, unacceptable delays, bottlenecks, and compromised operations that create cascading results for both maritime and intermodal transportation systems.

This project examined these disrupting events, their impacts, and the risks they pose to the marine

transportation system, to design a set of resiliency principles and best practices for maritime supply chains from the Coast Guard's viewpoint of vessel management. Beyond the initial use of these best practices and guidelines for DHS and the Coast Guard, there has been considerable interest from members of Texas A&M University-Galveston's network of industry board advisors as these findings should be useful to those involved in commercial shipping.

It is without question that commercial shipping has a different mission than the Coast Guard. However, each entity will benefit if the principles and best practices are integrated and transparent, giving each entity insight into the other. 

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*The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Department of Homeland Security.*

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## For more information

**Guidebook: Principles and Best Practices for Supply Chain Resiliency can be viewed at <https://cbts.tamu.edu/files/2022/08/Guidebook-Principles-and-Best-Practices-for-Supply-Chain-Resiliency.pdf>**



# It is Not the Same Sea

## Reconciling multiple waterway uses in the PAC-PARS

by LCDR SARA CONRAD

Port and Facilities Activities Section Chief

Pacific Area

U.S. Coast Guard

**E**rnest Hemingway spent significant time from the summer of 1942 to 1943 in his 38-foot fishing boat, *Pilar*, patrolling the northern coast of Cuba for German U-boats. It was an operation conducted with the U.S. military under the guise of catching fish.<sup>1</sup> His romantic love of fishing and the sea were often espoused in his works. To Hemingway, the Gulf Stream, specifically, was a place of adventure.

*In the first place the Gulf Stream and the other great ocean currents are the last wild country there is left. Once you are out of sight of land and of the other boats you are more alone than you can ever be hunting and the sea is the same as it has been since before men ever went on it in boats.*<sup>2</sup>

While the sea remains largely unused, large swaths of it are being taken up by more than adventure seekers and fishers. The commercial transit industry is building larger vessels with changing handling characteristics, automation, and crewing requirements. Marine sanctuaries are expanding to safeguard more living marine resources and their ecosystems, which have always inhabited the waters and need continued stewardship and protection. Tribes are acting to protect sacred sites. Military practice ranges are operating to ensure national security readiness. Alternative energy sources are expanding renewable, clean energy technologies. Most recently, space operations are carving out temporary hazard areas for launch or reentry of space vehicles.

Seeing the need to reconcile the sometimes overlapping physical requirements of all these interests and stakeholders prompted Coast Guard Pacific Area Districts 11 and 13 to conduct a Pacific Coast Port Access Route Study (PAC-PARS). The study involved an in-depth vessel traffic analysis combined with public outreach, comments, and contributions to evaluate the need for new or modified vessel routes. These routes would ensure the safety of navigation by providing

unimpeded paths for vessels proceeding to or from ports along the western United States, while also accommodating other waterway uses.

### What is the PARS Process?

The Ports and Waterways Safety Authorities in 46 USC Chapter 700 requires the Coast Guard to conduct a Port Access Route Study before establishing or modifying any fairway or traffic separation scheme.<sup>3</sup> Two overarching components informed the study—public contributions and the vessel traffic analysis. Using data from both inputs, the Coast Guard PAC-PARS team developed recommendations to establish shipping fairways for vessels transiting along the coasts of California, Oregon, and Washington. Once the recommendations were formed, the Coast Guard released the draft study to the *Federal Register* for public comment.<sup>4</sup> This non-mandatory step allowed additional transparency to inform stakeholders on how the data were collected and analyzed and how the public comments were adjudicated. It also requested final input and recommendations. Once those additional comments are considered, the Notice of Study Results will be released to the Federal Register and sent to Headquarters to validate the recommendations and initiate the next steps, including the federal rulemaking process.<sup>5</sup>

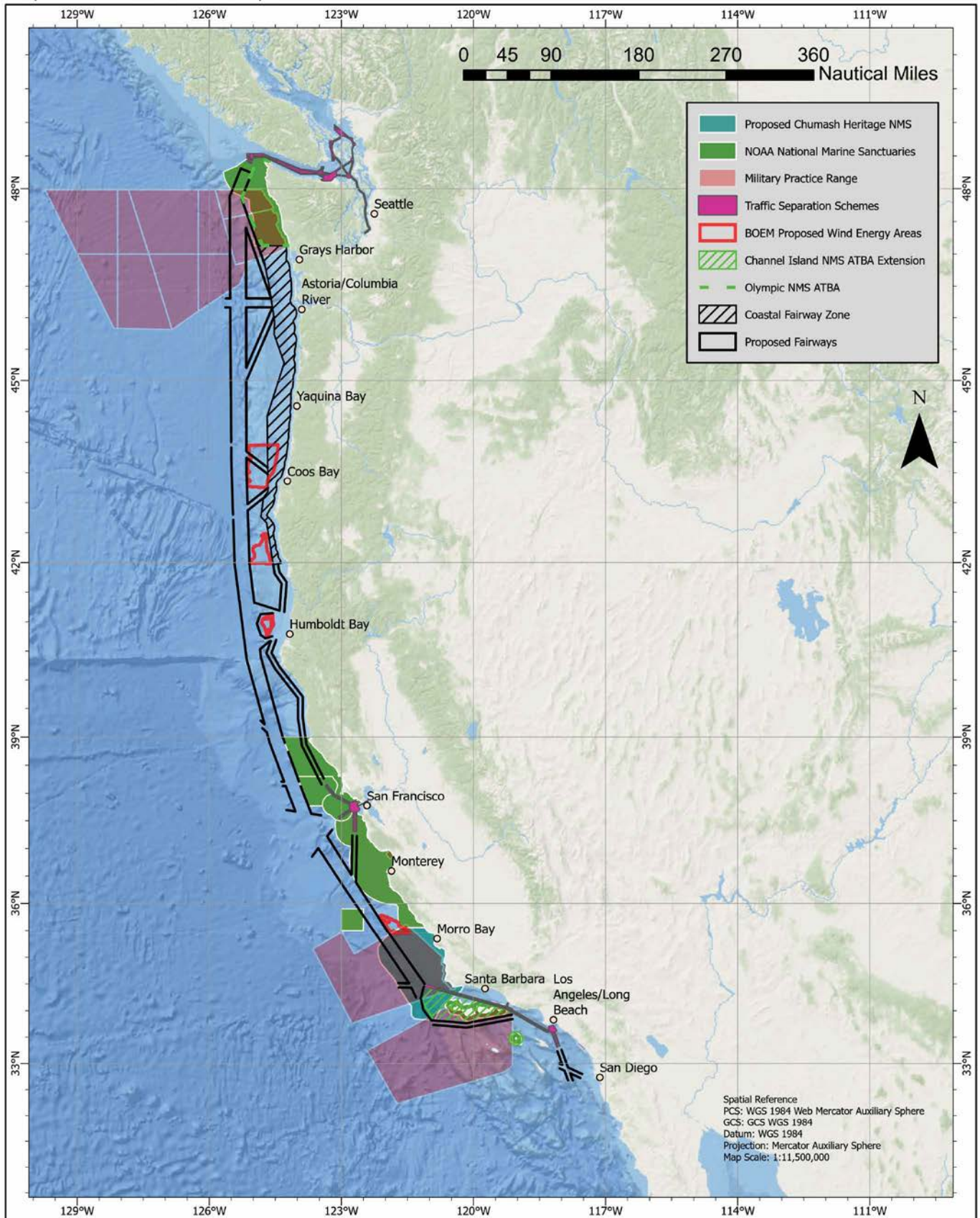
### Public Engagement and Collaboration

The PAC-PARS started in July 2021 by seeking a 180-day public comment period on a Notice of Study posted in the *Federal Register*.<sup>6</sup> This initial announcement notified the public of the study, giving them the opportunity to contribute, and also ensured the entire process remained

transparent to all stakeholders, allowing any interested parties to provide input. During the comment period, Districts 11 and 13, in collaboration with sectors and other local units, conducted extensive outreach efforts. For the study to be a successful

The study involved an in-depth vessel traffic analysis combined with public outreach, comments, and contributions to evaluate the need for new or modified vessel routes.

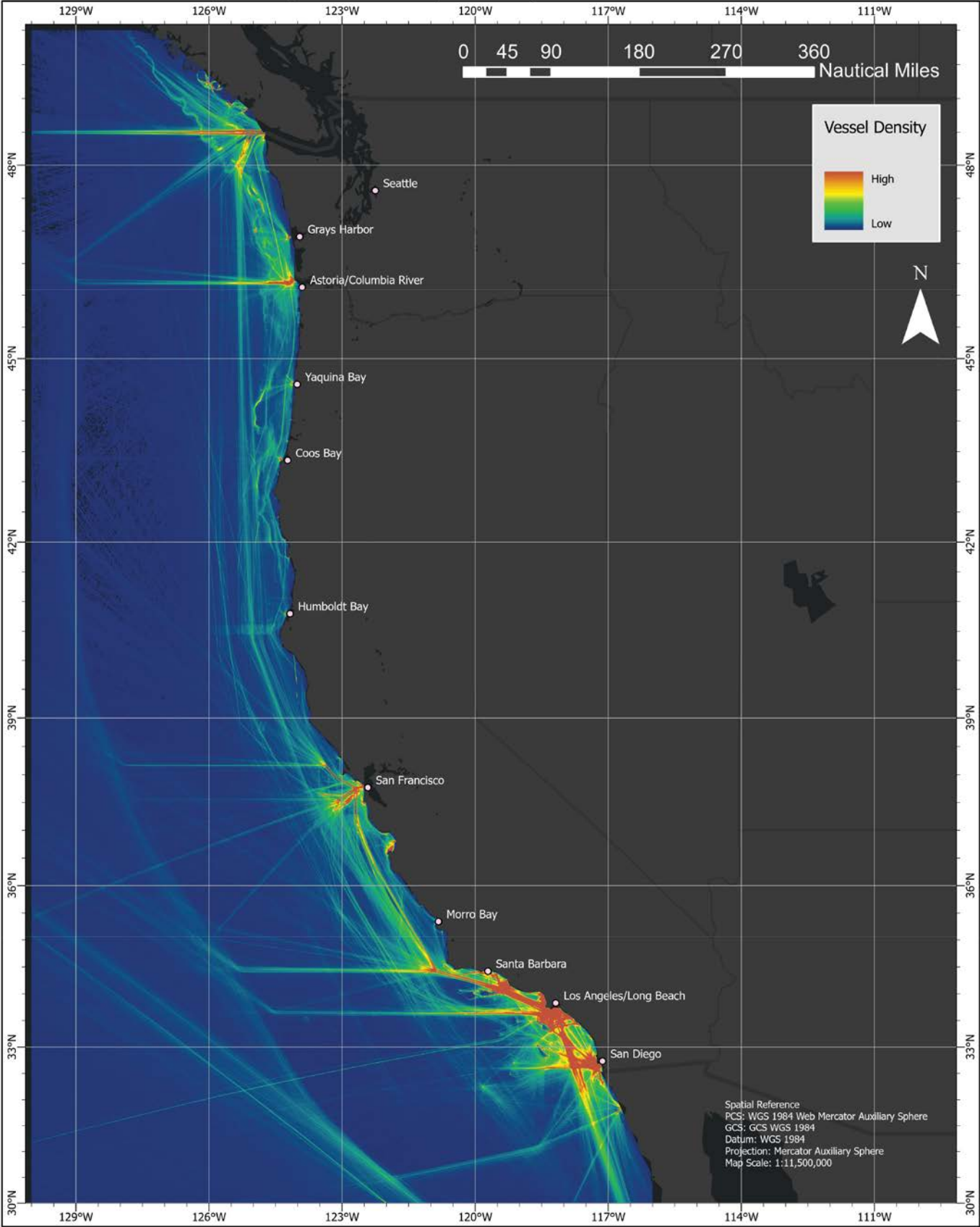
## Proposed Pacific Coast Fairways



This map represents the proposed fairways published as part of the draft study but may not reflect the final study recommendations. Basemap: Esri, GEBCO, DeLorme, NaturalVue. Overlays: USCG, NOAA, BOEM.

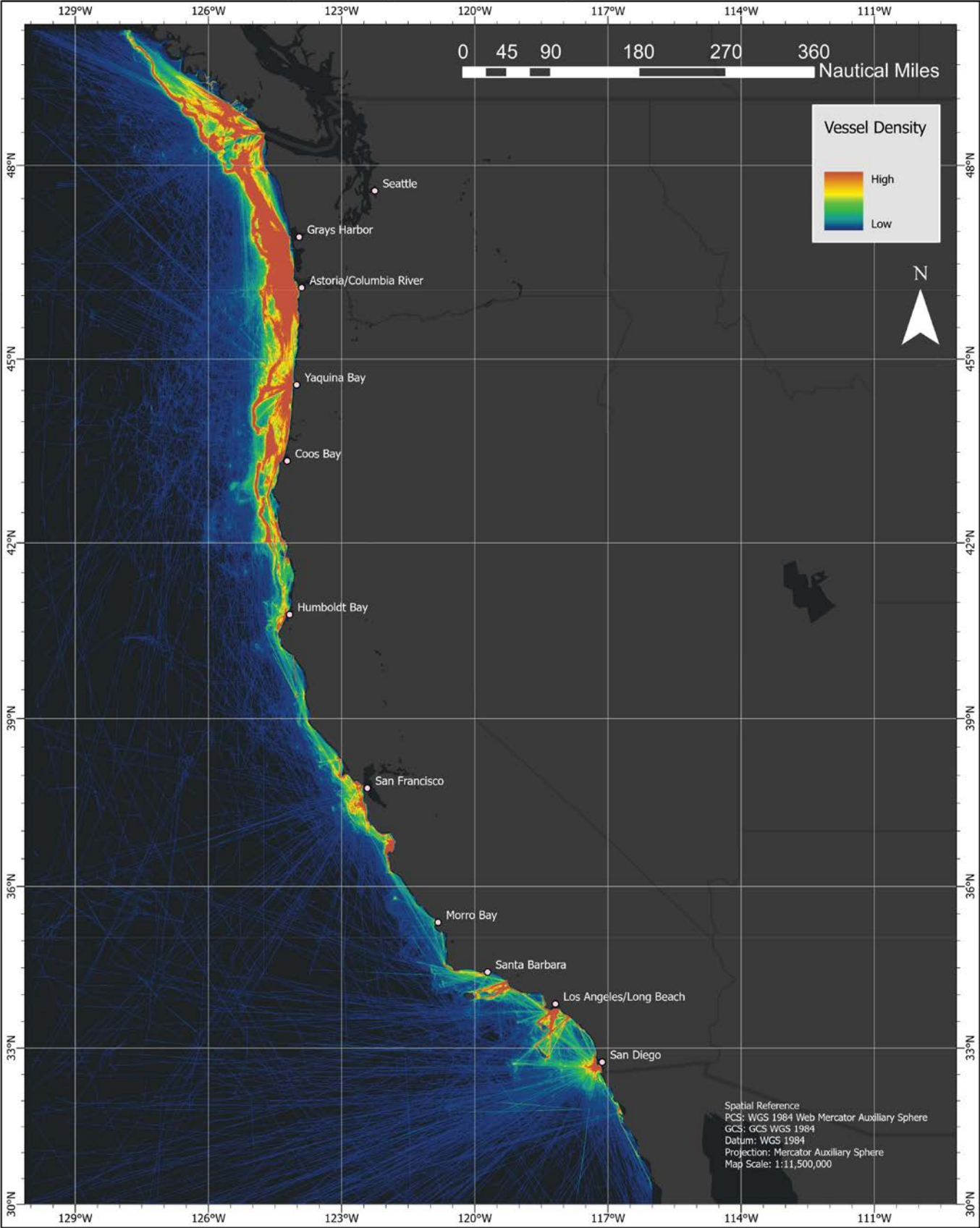


Annual AIS Vessel Density: Average of All Vessels (2017-2021)



Basemap: Esri, HERE, Garmin, FAO, NOAA, USGS, EPA. Overlays: USCG.

Annual AIS Vessel Density: Average of Fishing Vessels (2017-2021)



This map does not reflect the final study recommendations. Basemap: Esri, HERE, Garmin, FAO, NOAA, USGS, EPA. Overlays: USCG.



and accurate reflection of all the waterway needs, they wanted to ensure significant collaboration from a broad range of waterway users.

As the data analysis began, concurrent with outreach efforts, District 11 realized it wanted more granularity on public concerns regarding certain areas where conflicting waterways uses were likely. Specifically, the District sought public input regarding the two California Wind Energy areas, the Navy's Pacific Missile Range, and the approaches to San Francisco Bay. It released a Notice of Inquiry in the *Federal Register* with an additional 28 questions regarding those areas to expand the Coast Guard's dialog with the maritime community.<sup>7</sup> All comments received for both notices were considered in the drafted PARS recommendations and adjudicated as part of the study.

### Data Analysis

The data analysis was an enormous task conducted by the Coast Guard Navigation Center (NAVCEN) and District 11. NAVCEN's vessel traffic analysis was based on Automatic Identification Systems (AIS) transponder data for 10 port entrances along the West Coast. The District completed a similar analysis for offshore vessel traffic which included data for both Districts 11 and 13. The offshore analysis considered a number of data points including, but not limited to:

- vessels (calendar years 2017–2021)
- vessel density (calendar years 2017–2021)
- type of vessel
- seasonal routing changes
- industry agreements
- recommended routes
- changes in traffic patterns since 2012
- marine sanctuaries
- whale location data
- environmental data
- fishing industry data
- marine incidents
- casualties

The years 2012, 2015, and 2017 through 2021 were selected to determine both the average vessel activity over the last five years as well as long-term traffic pattern trends over the last decade. This was done to showcase changes given various AIS carriage requirements and environmental regulation shifts. The data was used to create track-lines, which resulted in hundreds of thousands of individual transits from baseline to outside the exclusive economic zone. This data could then be broken down into components for individual study, like those noted above, or further processed for many other statistical analyses.

Using geographic information system software, the District 11 Waterways staff overlaid the vessel traffic data with other significant ocean uses and obstructions that

included:


- Bureau of Ocean Energy Management wind energy areas
- National Oceanic and Atmospheric Administration (NOAA) national marine sanctuaries
- marine life statistics
- NOAA fishing vessel data
- space industry marine activities
- military practice ranges

The resulting maps offered details for a comprehensive understanding of vessel traffic patterns and projected conflicts with existing and emerging uses of Pacific Coast waters. These statistical analyses were critical to developing marine spatial planning with the least disruptive solution that met all avoidance needs.

### The 90 Percent Solution Fits 100 Percent

In many projects, 90 percent would not necessarily be a respectable metric to measure success. For the PAC-PARS project, where wide-ranging needs and concerns of waterway uses and stakeholders were considered, the team aimed to accommodate all reasonable waterways uses to the extent practical while providing for safety of navigation along the Pacific Coast. Finding this solution inevitably resulted in some sharing and concessions, but Districts 11 and 13 found ways to ensure each conflicting space usage worked to protect the safe navigation of vessels without encroaching on other uses.

### Conclusion

The waterways are national priorities due to their energy resources, sacred sites, critical supply chain role, particularly pertaining to food security, importance to national defense, and opportunity for exploration and adventure. The ultimate goal of the PARS process was to maintain those priorities while allowing emergent technologies to flourish and to provide an unobstructed space for vessels' safe navigation. Balancing overlapping waterways' uses is critical to the strategic needs of the United States and its citizens. As the uses for the sea continue to change, those strategic needs will as well. 

#### About the author:

LCDR Sara Conrad has served in the U.S. Coast Guard for 14 years, serving in many capacities, most recently as the Pacific Area project manager for the PAC-PARS. She has received three Coast Guard Commendation Medals, two Achievement Medals, and three Meritorious Unit Commendations.

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# Complex Risk Factors and Cascading Consequences in the Maritime Supply Chain

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**D**iverse and complex, the global maritime supply chain is by far the largest single component of global trade. Most operational planning and academic research has focused on single disruptions such as oil spills, hurricanes, or security threats to this system, especially at the port level. While maritime trade has proven resilient, challenges over the past few years have revealed that, when multiple disruptions coincide, maritime supply chains can be unexpectedly strained leading to cascading consequences.

A greater understanding of how these various disruptions interact can improve risk analysis, resilience, and stakeholder engagement. Quantifying the economic impact can improve modeling and demonstrate the value of reliable maritime supply chains. This research can also help prepare for a future where climate change, digital transformation, emerging technology, workforce demographics, and new trading patterns all present dynamic maritime supply chain risks.

## The MTS and Maritime Supply Chains

The Marine Transportation System (MTS) is composed of port and vessel operators, agencies, seafarers, stevedores, and service providers that see marine transportation as central to their purpose and responsibility. A somewhat U.S.-centric term, in plain language, the MTS is made up

of the organizations that show up for local harbor safety and area maritime security committee meetings.

In this article, MTS and the term “maritime supply chain” are not interchangeable. The latter includes the MTS and extends to other players, including overseas shipping, upland warehousing, long haul rail and truck lines, and endpoints such as retailers and manufacturers. These additional players are equally important to enabling the maritime supply chain to serve the broader economy.

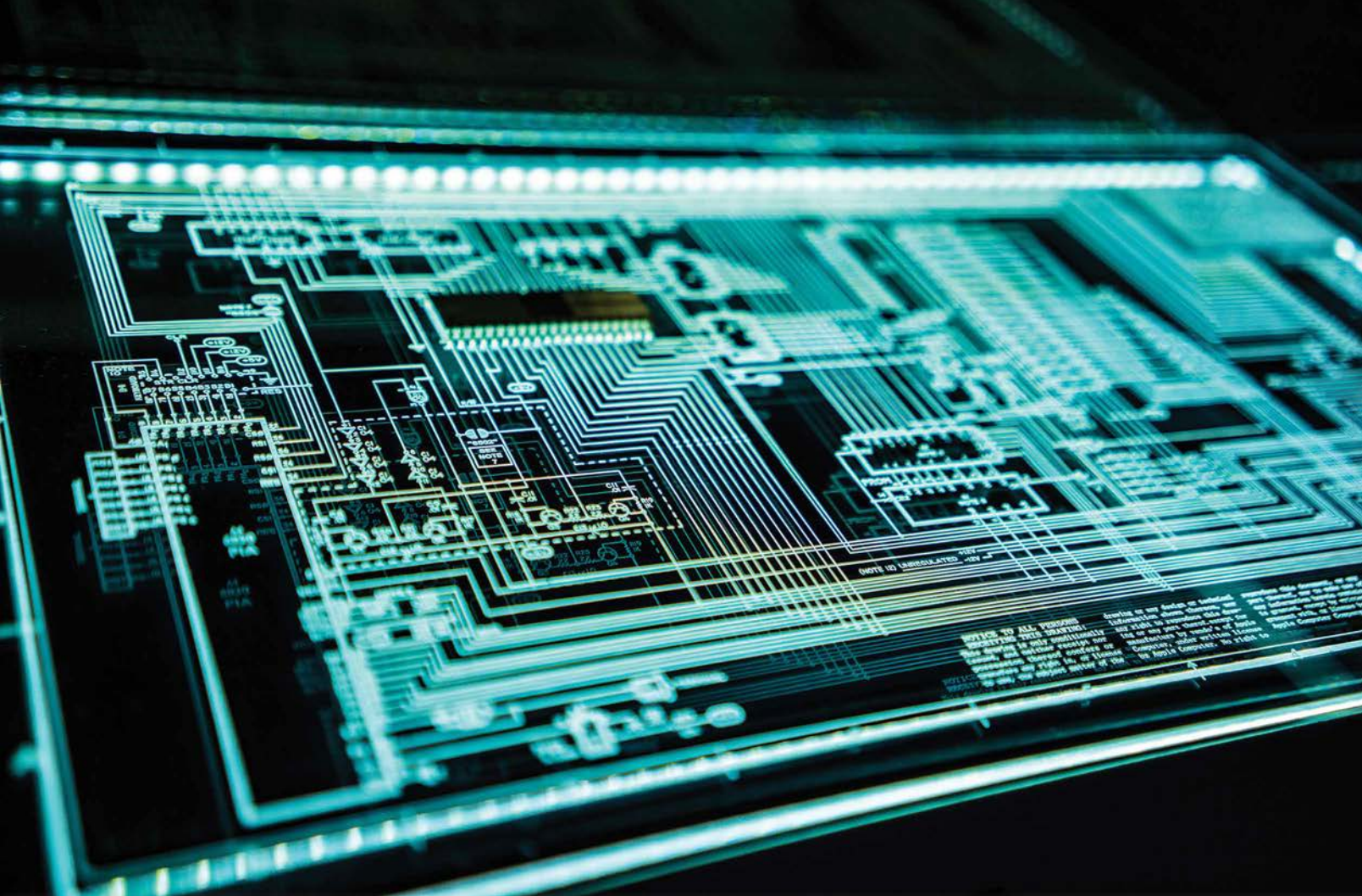
The most serious consequences of marine supply chain issues may fall on entities not represented in traditional MTS discussions. Accordingly, our research is focused on understanding “cascading consequences” to all of these components of maritime trade.

## Background and Purpose

Since 2020, a diverse collection of disruptions has unexpectedly impacted maritime supply chains, as well as non-traditional stakeholders. The COVID-19 pandemic was, and remains, a significant driver in these disruptions. Still, other events, including the blockage of the Suez Canal, cyberattacks, changing trade patterns, and the Russian invasion of Ukraine, have impacted maritime supply chains. When multiple disruptions coincide, or a new disruption occurs when another one is already underway, the risks and impacts can be significantly harder to understand and quantify.

Consumers, manufacturers, MTS-related organizations, and government officials have all been impacted by these events, often in unanticipated ways. These cascading consequences continue to flow through our





As automation increases, so does the potential for cyber related disruptions. Adi Goldstein | Unsplash

economy and society. We seek to understand how these various disruptions interact; how one type can magnify the impact of another; and where hidden or disproportionate consequences may occur. Improved modeling of these complexities can help us prepare for future events.

In a project that is a joint effort, we are exploring complex, multivector disruptions to the MTS. The research includes an extension of Center for Risk and Economic Analysis of Threats and Emergencies' Economic Consequence Analysis Tool, or E-CAT, which has successfully addressed the economic consequences of supply chain issues.

### Complex Disruptions: What Makes Them So Complicated?

All disruptions require some combination of capabilities, authorities, and skills to respond effectively. Resource limitations can aggravate responses if similar resources are needed to address multiple components of complex disruptions. For example, a vessel grounding and oil spill might both require work boats and crews to stabilize the vessel and deploy pollution

equipment. But, this type of scenario also has its advantages in that the similarity of the events may make it relatively easy to prioritize needs and sequence the use of specific resources.

Another way a complex disruption can play out is if different resources must be brought to bear against different aspects of the situation. It might seem counterintuitive that this could make things worse since there is reduced competition for individual resources. However, coordinating the response and resuming normal marine supply chain activity could be challenging if different

## Types of Disruptions

Hurricanes	Oil spill	Cyber attacks to ports/vessels	Tariffs/trade war
Earthquakes/tsunami	Vessel grounding/fire in port/channel	GPS/AIS disruptions	Labor/management dispute
Storm surge/sea level rise	Damage to bridges and port infrastructure	Sustained security threat/incident	Specialized marine fuel shortages
Infectious disease	Sustained power outages	Radiological risks (e.g., Fukushima scenario)	Truck, chassis, or container shortages

There are countless examples of maritime disruptions, and even more ways to organize them. At the risk of oversimplification, this table provides a short list of the many types of disruptions that maritime supply chains may experience and should be read vertically.



agencies and private sector organizations, each with their own priorities and cultures, must still coordinate actions.

For instance, imagine a vessel collision in a channel combined with a GPS/Automatic Identification System disruption. The collision requires tug boats, traditional marine casualty investigators, and salvage experts. The GPS disruption requires technical experts skilled in electronics, satellite, and radio transmissions. Coordination between the groups and communication to supply chain stakeholders about how and when the situation will be resolved will be challenging. If there is any suggestion that the GPS disruption was a deliberate event, and that it contributed to the vessel collision, then a third, law enforcement-focused, set of players will be involved.

Consider the above scenario from the perspective of a shipper, freight forwarder, pilot, or other maritime supply chain player. A blocked channel alone is unfortunate, but precision GPS might enable the use of alternate routes. Alternatively, GPS disruptions are a concern, but as long as ships can use established channels, marine traffic should continue at an acceptable, if not ideal, rate. However, when combined, commerce is seriously hampered. The GPS disruption might also affect terminal

## Maritime Supply Chain Study Partners

Study partners include three Department of Homeland Security (DHS) university centers of excellence:

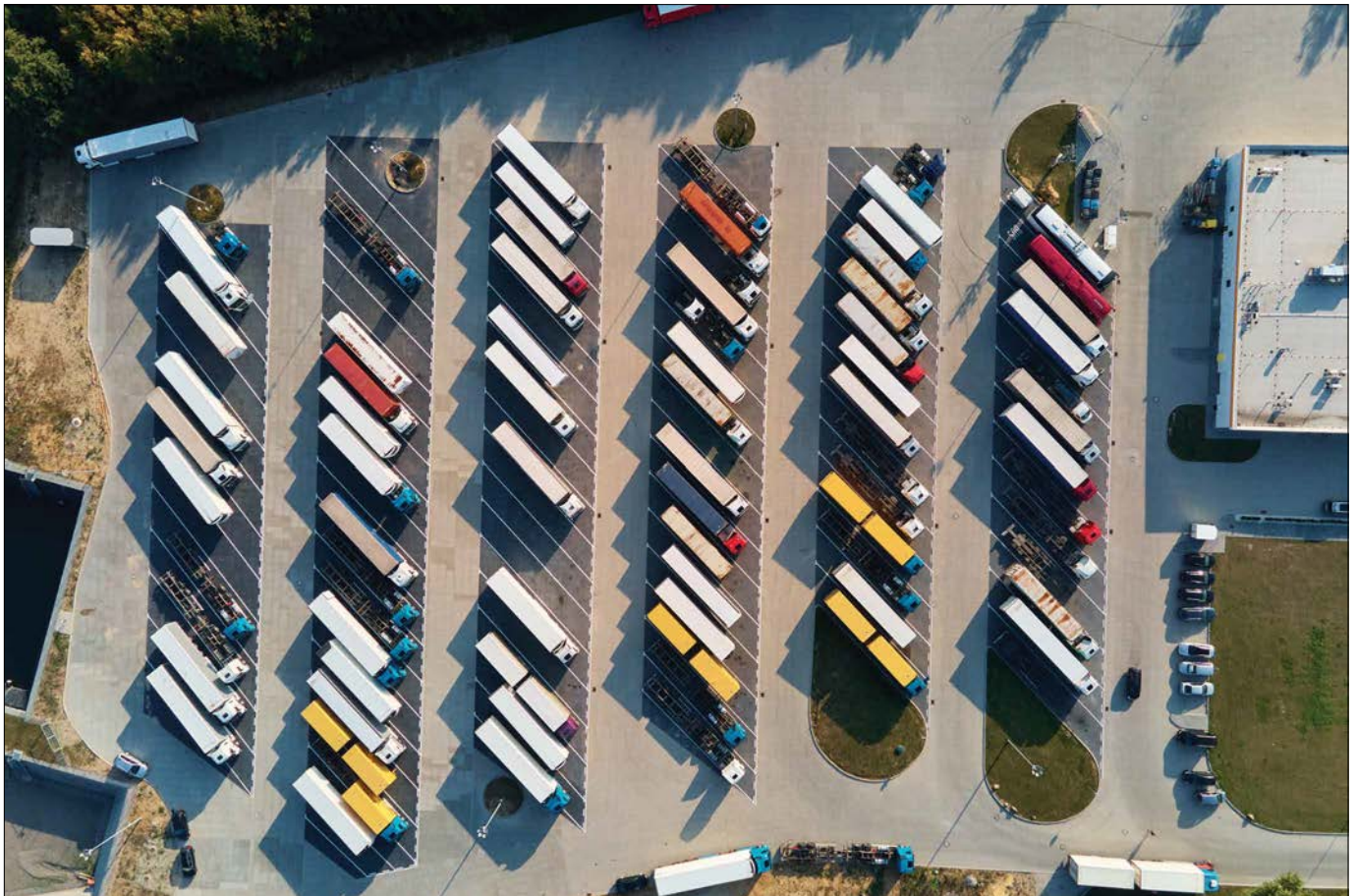
- the Command, Control, and Interoperability Center for Advanced Data Analysis (CCICADA)<sup>1</sup> at Rutgers University,
- the Center for Risk and Economic Analysis of Threats and Emergencies (CREATE)<sup>2</sup> at the University of Southern California,
- and the Center for Accelerating Operational Efficiency<sup>3</sup> at Arizona State University.

### Endnotes:

<sup>1</sup> <https://ccicada.org/>

<sup>2</sup> <https://create.usc.edu/>

<sup>3</sup> <https://caoe.asu.edu/>



Ports are congested areas. Small disruptions can quickly have ripple effects. Lazy\_Bear | Getty Images



operations, further increasing the complexity of the event and its impact on maritime supply chains.

Furthermore, disruptions that are new, novel, or reliant upon skills, capabilities, and resources from outside the MTS community can also comprise complex supply chain issues. This is especially true if outside experts do not prioritize the maritime supply chain.

The novel coronavirus is an example where seafarers and port workers had no special skills or training to respond to the virus and public health experts had no understanding of maritime work environments. Therefore, the priorities were not aligned.

A similar situation could arise from widespread power outages impacting ports and other maritime supply chain players. The power generation and transmission organizations will be responding from different locations than the Coast Guard and potentially with different priorities. Meanwhile, freight forwarders and other logistics providers will struggle to track and reroute cargo while on emergency power. A power outage, combined with some other disruption, could certainly lead to significant cascading consequences.

How Do Maritime Supply Chains Work?

Despite these scenarios, maritime supply chains *do* work. Countless individual workers and businesses innovate, improvise, and overcome obstacles, working independently and on a business-to-business level. Government agencies find ways to use their authority and capabilities to allow a company to efficiently resume business. The hard work of all of these individuals has meant that, while the consequences of recent disruptions have been significant, they have been economic and transitory, not societal and persistent.

To help understand the impact of disruptions, the table on this page provides a highly simplified diagram of critical supply chain elements. If any of these elements is negatively impacted, the system is resilient enough to recover with minimal costs and impacts—if the disruption is small. When the severity, duration, geographic scale, or other factors are sufficiently large, cascading impacts occur.

In our model, people are the foundation of all maritime supply chain activity. Despite automation, computers, and other technology, we rely on skilled workers at every step. This is what has made COVID-19 so disruptive. COVID-19 did no physical or cyber damage, but its impact on people slowed every link in the supply chain.

The various non-human components are subject to damage and destruction, and MTS members, like other businesses,

need to minimize costs, including replacement costs, which does not necessarily promote resilience. For example, gantry cranes at container terminals are vital for cargo operations, but no facility can afford to have an extra \$35 million gantry crane sitting idle on standby just in case a working crane becomes damaged.

At the retail and manufacturing levels, the widely adopted “just in time” inventory system meant that businesses had little ability to absorb supply chain disruptions. While there is a great deal of discussion in the business community about revising this approach, the economic incentives for a lean inventory will likely prevail.

While economic incentives do not necessarily promote resilience, in some cases they may even aggravate disruptions. Such is the case when ocean carriers find it more profitable to leave empty containers in port, rather than wait for them to be filled and loaded back on ships. In other cases, the economic consequences of a disruption may be primarily borne by manufacturers and retailers, rather than by the maritime and port entities.

Finally, government agencies, classification societies, insurance companies, and similar organizations provide independent, expert risk oversight and governance functions. Their capacity is limited, and disruptions may push risk tolerances to uncomfortable levels.

The MTS is continuously evolving, however, and it is important to plan for its future. Will investment in systems allowing vessels to use new types of fuels lead to new infrastructure requirements and vulnerabilities? Will increasing automation lead to problems in the case of power outages? Will autonomous and semi-autonomous vessels on the water and trucks in the ports lead to new kinds of complex disruptions? We need to develop ways to address these kinds of questions.

Development of Complex Disruption Scenarios

The first phase of our research was to interview a variety of transportation experts on their experiences with disruptions. While all of the researchers have had some experience in this field, listening to these experts explain

Critical Supply Chain Elements

Port authorities, government agencies, governance structures, insurance		
Distant Navigation	Port Area	Upland
Vessels Long range communications Locks and dams Canals and straits Vessel navigation, routing and voyage planning systems Bunkering & ship support	Port facilities and infrastructure Tugs and other support vessels Aids to navigation Port and cargo technology Cargo containers, chassis, and other cargo systems Drayage	Customers Suppliers Long haul rail and truck Warehousing Power and utilities Manufacturing Specialized services
People		
Seafarers, port workers, technicians, truck and rail operators, agency personnel, others		

how the systems work, how they sometimes fail, and “what keeps them up at night,” was fascinating. Our initial round of interviews included port authorities, vessel operators, dry cargo and energy terminal representatives, Coast Guard personnel, academics, and even a representative from the air forwarders industry, for an outside perspective on supply chains.

These experts helped us identify plausible and potentially useful scenarios to examine in more detail—a key element of our research. It soon became apparent that disruptions do not happen in a vacuum or against a backdrop of “ideal” supply chain activity. Accordingly, we are including pre-existing conditions and other considerations in our test cases.

In our first scenario, a fire on a container ship leads to a blockage of the Kill van Kull Federal Channel. The account below is an abbreviated version of the scenario we are developing with the cooperation of Coast Guard Sector New York and the Port of New York and New Jersey, which is planning an exercise along these lines.

**Background Condition:** A surge in port activity coincides with a shortage of trucks and some road and bridge repairs. The result is long lines at container terminals and greater than normal congestion.

These conditions add cost but don’t otherwise affect port activity.

**Initial Disruption:** A fire breaks out in the cargo hold of a container vessel as it approaches a terminal in the Kill van Kull in New York Harbor. There are no deaths, but the intense heat and smoke, and concerns about a possible capsizing, make moving the vessel risky. The channel is blocked for a week. Overhaul, salvage, and cargo transfer take an additional week, with much of the cargo and other vessels diverted to other nearby terminals.

**Secondary Disruption:** A cyberattack corrupts the data and stops operations at two terminals for three days. Other terminals slow their cargo operations by 50 percent for two days, while both internal IT personnel and law enforcement agencies check data integrity. The combination of a suspicious fire and a cyber attack suggests that a coordinated, sophisticated attack on the port is in progress. The Coast Guard sets Maritime Security Level 2. This further slows the movement of cargo and vessels through the port area.

**Additional considerations:** The source of the fire might have been illegal or improperly stored



Delayed or diverted cargo can have serious impact on businesses far from port areas. liorpt | Getty Images





Small, novel threats—like a lithium ion battery fire—can have big impacts. Photo courtesy of Tavo Romann

hazardous materials or sabotage. Uncertainty about what is in any given, and now fire-damaged, container, compounded by data integrity questions, will complicate the response. Large amounts of heavy black smoke in the middle of a densely populated area raises public health concerns in two states, including for ferry passengers. Various cargo owners may decide to sue each other or the vessel owner, further slowing cargo and vessel disposition. Longshore workers may refuse to work until air monitoring deems it safe.

#### **Questions We Would Like to Answer**

While this scenario poses a host of emergency response challenges, our research is focused on understanding and quantifying the supply chain impacts. How many vessels and how much cargo would this event affect? Would vessels and cargo divert to other ports? After the channel is clear, how long would it take for normal trade to recover, and would that happen in steps or all at once? Who outside the port area would be affected, and by how much? What actions would promote a fast economic recovery?

With the help of Sector Los Angeles/Long Beach,

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The Kill Van Kull Federal Channel, a tidal strait between Staten Island, New York City, and Bayonne, New Jersey, is one of the most heavily travelled waterways in the Port of New York and New Jersey. The vast majority of containerized cargo bound for the port passes through the Kill Van Kull.

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the LA Port Authority, and security leads at the Port of Long Beach, we are developing a West Coast scenario involving a wildfire-caused power loss combined with more conventional port disruptions. As in New York, an already planned exercise provides the perfect opportunity to examine the cascading impacts of these scenarios. We are grateful to Coast Guard and port authority personnel for finding ways to dovetail their preparedness

The majority of all containerized cargo destined for the Port of New York and New Jersey traverses the Kill Van Kull Federal Channel. Photo courtesy of Jim.henderson





work with our research, as we are confident it will benefit all parties.

The goal of the research is to develop a model, useable by various stakeholders, to better understand multiple risks to maritime supply chains, including the likely economic consequences of such events.

## Ukraine

A few short months after our initial research was approved, Russia invaded Ukraine. We quickly expanded the scope of our work to track the maritime disruptions of the invasion, and DHS has approved continued research on that topic.

While the direct impacts to the U.S. MTS have been small, there have been substantial impacts to other maritime stakeholders, from stranded seafarers to the superyachts of oligarchs. Energy, food, and commodity trading have been impacted, and smuggling and sanctions-evading activity have accelerated.


While much of the focus has been on food and energy trade, we are completing a study that describes the conflict's impact on grains and certain metals, including nickel, palladium, titanium, aluminum, copper, and uranium. Russia is an important source of these materials, and trade restrictions have led to skyrocketing commodity prices. This has various cascading impacts, including on European automotive production lines, and on the production of semiconductors and catalytic converters in the United States.

We will provide a much more detailed accounting of this significant disruption in the future. For now, we note that the war has weakened governance, shifted trade patterns and partners, strained ports, upended markets, and threatened the lives and livelihoods of people well beyond the combat areas.

## Initial Observations

While our work is in no way complete, we have learned a tremendous amount from the various professional

experts we have interviewed, as well as from ongoing reviews of industry publications, government data, and other sources. A few of those observations include:

- Cybersecurity remains a concern, and even the perception that data integrity may be in doubt could impact supply chain activity.
- Improperly labeled or packaged hazardous materials, including flammable items such as lithium ion batteries, is a growing concern.
- With much of the maritime community's focus on COVID-19 and technology issues in recent years, the ability of port communities to implement and sustain meaningful security requirements (e.g., maritime security) is uncertain.
- Maritime supply chain challenges caused many businesses to shift from a "just in time" to a "just in case" approach to their inventory and supply chain management practices. As supply chains stabilize, it is unclear if organizations will continue this practice or return to their former, cost-minimizing approach. 

### About the authors:

*Andrew Tucci is a retired U.S. Coast Guard captain with over 30 years of experience working with the marine industry in security, safety, and environmental risk management.*

*Dennis Egan is a research professor at Rutgers University and assistant director of the Command, Control and Interoperability Center for Advanced Data Analysis (CCICADA). His research includes cyber security and complex disruptions to the marine transportation system. Mr. Egan represents CCICADA on the Port of New York and New Jersey Area Maritime Security Committee.*

*Christie Nelson, Ph.D., is an assistant research professor for the Command, Control and Interoperability Center for Advanced Data Analysis Center and the Professional Science Masters Program. She has done various maritime projects for the U.S. Coast Guard, security related projects, and more, and is the director of the Rutgers MBS Externship Exchange Program.*

*Fred Roberts, Ph.D., is distinguished professor of mathematics at Rutgers University and director of the Command, Control and Interoperability Center for Advanced Data Analysis, a U.S. Department of Homeland Security university center of excellence. He has done extensive research on cyber and physical disruptions to the marine transportation system, much of it in collaboration with the U.S. Coast Guard.*

*Latha Vijayagopal is a graduate student of the Rutgers MBS program and parttime research assistant at the Command, Control and Interoperability Center for Advanced Data Analysis. She previously worked 17 years for a Fortune 500 company that builds enterprise management software, in their research and development and technology offices.*

*Ryan Whytlaw, holds a Master of Public Policy and is an emergency planner with 20 years of experience in the fields of emergency management, security and transportation. He originally joined Rutgers in 2009 and currently supports the Command, Control and Interoperability Center for Advanced Data Analysis as a consultant. His experience as a researcher includes supporting emergency management and evacuation planning, entertainment venue and stadium security, and transportation systems disaster resiliency.*

### How You Can Help

**If you have opinions, observations, or recommendations related to "complex disruptions" and how the industry can improve its resilience, please contact Dr. Fred Roberts, director of the Command, Control, and Interoperability Center for Advanced Data Analysis, at [froberts@dimacs.rutgers.edu](mailto:froberts@dimacs.rutgers.edu). We'd love to talk with you!**



# Chemical of the Quarter

## Understanding Methyl Alcohol

by LT LUKE ORR  
*Tank Vessel and Offshore Division  
U.S. Coast Guard Marine Safety Center*

### What is it?

Methyl alcohol ( $\text{CH}_3\text{OH}$ ), more commonly known as methanol ( $\text{MeOH}$ ), is an organic compound and the simplest of all alcohols. Unlike ethanol, the alcohol found in adult beverages, two ounces of methyl alcohol is considered a lethal dose. It is toxic if ingested, inhaled, or when it comes into contact with skin or eyes. In addition, methanol is highly flammable in both the liquid and vapor state.

The United States produces more than 5.7 million metric tons of methyl alcohol, a process that involves reforming natural gas with steam then distilling the mixture, annually. Methanol is used as a precursor in chemical production for products such as paints, medicine, and adhesives. It is used as an antifreeze in fuels and a solvent in laboratories.


### Why should I care?

With the increased desire to use alternative fuels that reduce or eliminate greenhouse gases, the International Maritime Organization (IMO) approved methyl alcohol as an alternative maritime fuel in 2020. Ship builders have started designing vessels that not only transport methyl alcohol, but also use it as a fuel, which can significantly reduce the amount of greenhouse gas emissions compared to conventional fuels.

Even with known toxic traits, it was not until the 2021 publication of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk, published by the IMO, that methyl alcohol was categorized as a safety hazard. Prior to the updated code, it was categorized only as a pollution hazard. This new update also recognizes methyl alcohol vapor as toxic and not just flammable as it was previously categorized. One of the newest requirements is that vessels must have

separate piping and ventilation systems for carriage of methyl alcohol. Typically, the restrictions placed on toxic cargo also include preventing it from being stored next to fuel tanks, though methyl alcohol is exempt from this rule.

### What is the Coast Guard doing about it?

There is no current regulation regarding methyl alcohol as a safe alternative fuel for U.S. vessels, meaning the Office of Design and Engineering Standards approves the use of methyl alcohol for this purpose on a case-by-case basis. The office is also responsible for developing and maintaining cargo regulations. The Marine Safety Center, however, ensures that vessel plans comply with regulations ensuring toxic and hazardous cargos are transported in a safe manner and provides a Cargo Authority Attachment (CAA) to marine inspectors in the field. Marine inspectors verify the vessel is within compliance and, if they are, the inspectors will issue the Certificate of Inspection and the CAA endorsing the cargo list. Through this team effort, the Coast Guard enforces the regulations for both fuel usage and the shipment of hazardous and toxic cargos, enabling safe carriage of methyl alcohol on our nation's marine transportation system. 

### About the author:

*LT Luke Orr works in the Tank Vessel and Offshore Division at the U.S. Coast Guard Marine Safety Center. He graduated from the Coast Guard Academy in 2018 with a B.S. in mechanical engineering, and the University of Washington in 2022 with an M.S. in chemical engineering. He was previously stationed onboard CGC Vigilant as a student engineer.*

### References:

PubChem, U.S. National Library of Medicine. <https://pubchem.ncbi.nlm.nih.gov/compound/methanol>

International Maritime Organization. MSC.1/Circ.1621 Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel (2020)

International Maritime Organization. "Methanol as Marine Fuel: Environmental Benefits, Technology Readiness, and Economic Feasibility" (2016)





# Nautical Engineering Queries

Prepared by NMC Engineering Examination Team



1. How is a wattmeter electrically connected in a circuit?

- A. In Series
  - B. In Parallel
  - C. In Series – parallel
  - D. Inductively
- 

2. The seal piping obtains liquid from the discharge side of the pump and directs the liquid to the \_\_\_\_\_.

- A. packing gland
  - B. wearing ring
  - C. vacuum seal
  - D. lantern ring
- 

3. When a vessel is inclined due to an external force, such as the action of seas, in which no cargo shifts, the tendency of the vessel to return to its original position is caused by the shift in \_\_\_\_\_.

- A. center of buoyancy
  - B. center of gravity
  - C. center of flotation
  - D. metacentric radius
- 

4. Accumulation tests are conducted in order to determine the \_\_\_\_\_.

- A. steam generating capacity of an individual boiler
- B. steam relieving capacity of safety valves
- C. maximum combined oil consumption of all oil burners installed on a single boiler
- D. maximum combined steam generating capacity for all propulsion boilers of a single plant

1. A. In Series  
B. In Parallel  
C. In Series – parallel

Incorrect  
Incorrect

**Correct Answer.** The wattmeter, is an instrument with both a current and a voltage or potential element. The current element is connected in series and the potential element in parallel with the circuit in which the power is being measured.

- D. Inductively

Incorrect

*Reference: Electric Circuits and Machines, 5th Ed., Lister, page 38, and fig 2-15*

2. A. packing gland  
B. wearing ring  
C. vacuum seal  
D. lantern ring

Incorrect  
Incorrect  
Incorrect

**Correct Answer.** Clear water under pressure should be piped to the seal cages (lantern ring). In the event that no water is readily available, it may be possible to run a line from the discharge of the pump(s).

*Reference: Centrifugal Pump Clinic, 2nd Ed., Karassik, page 475*

3. A. center of buoyancy

**Correct Answer.** When a vessel is inclined, the center of buoyancy will move since it is the center of volume of the immersed portion of the vessel, and a wedge of buoyancy has been transferred. It is this movement of B which results in a tendency of the vessel to return to its original position.

- B. center of gravity  
C. center of flotation  
D. metacentric radius

Incorrect  
Incorrect  
Incorrect

*Reference: Stability and Trim for the Ship's Officer, 3rd Ed., George, page 7*

4. A. steam generating capacity of an individual boiler  
B. steam relieving capacity of safety valves  
C. maximum combined oil consumption of all oil burners installed on a single boiler  
D. maximum combined steam generating capacity for all propulsion boilers of a single plant

Incorrect

**Correct Answer.** An accumulation test is conducted in the presence of a USCG Inspector to determine that the boiler's safety valves have a sufficient capacity to relieve the steam from the boiler.

Incorrect

Incorrect

*Reference: Fundamentals of Steam Generators as applied to Marine Propulsion Power Plants, MEBA Dist. 2, Page 58, 303, 304*



# Nautical Deck Queries

Prepared by NMC Engineering  
Examination Team

# Q

uestions

1. **BOTH INTERNATIONAL & INLAND:** In complying with the Rules, of what must the mariner take due regard?
  - A. Radar information about nearby vessels
  - B. The occupation of the other vessel, if known
  - C. Limited backing power of his vessel
  - D. All of the above

---
2. **A passenger vessel in river service which operates in fresh water at least 6 out of every 12 months since the last dry dock examination must be dry-docked at intervals not to exceed which time frame?**
  - A. 12 months
  - B. 24 months
  - C. 48 months
  - D. 60 months

---
3. **Which statement concerning satellite EPIRBs is TRUE?**
  - A. The coded signal identifies the nature of the distress situation.
  - B. Once activated, these EPIRBs continuously send up a signal for use in identifying the vessel and for determining the position of the beacon.
  - C. The coded signal only identifies the vessel's name and port of registry.
  - D. If the GMDSS Radio Operator does not program the EPIRB, it will transmit default information such as the follow-on communications frequency and mode.

---
4. **You are on a course 201°T. To check the speed of your vessel, you should observe a celestial body on which bearing?**
  - A. 090°
  - B. 180°
  - C. 111°
  - D. 201°

1. A. Radar information about nearby vessels Incorrect
- B. The occupation of the other vessel, if known Incorrect
- C. Limited backing power of his vessel Incorrect
- D. All of the above

**Correct answer.** "In construing and complying with these Rules, due regard shall be had to all dangers of navigation and collision and to any special circumstances, including the limitations of the vessels involved, which may make a departure from these Rules necessary to avoid immediate danger."

Reference: Int'l./Inland Navigation Rule 2(b)

2. A. 12 months Incorrect
- B. 24 months Incorrect
- C. 48 months Incorrect
- D. 60 months

**Correct answer.** "Vessels that operate in fresh water at least six months in every 12-month period since the last drydock examination must undergo drydock and internal structural examinations at intervals not to exceed five years."

Reference: 46CFR71.50-3(b)(3)

3. A. The coded signal identifies the nature of the distress situation Incorrect
- B. Once activated, these EPIRBs continuously send up a signal for use in identifying the vessel and for determining the position of the beacon
- C. The coded signal only identifies the vessel's name and port of registry Incorrect
- D. If the GMDSS Radio Operator does not program the EPIRB, it will transmit default information such as the follow-on communications frequency and mode Incorrect

**Correct answer.** "An important feature of 406MHz emergency beacons is the addition of a digitally encoded message, which provides such information as the country of origin and the identification of the vessel in distress, and position data from onboard navigation equipment."

Reference: Marine Radionavigation and Communications, Monroe and Bushy, pages 148–149

4. A. 090° Incorrect
- B. 180° Incorrect
- C. 111° Incorrect
- D. 201°

**Correct answer.** "Observations made directly on the beam are helpful in determining whether the ship is on the track line, while observations obtained dead ahead or astern show how far she has advanced."

Reference: Dutton's Nautical Navigation, Cutler, 15th ed., page 349



## In the News: Orcas Greet *Polar Star* in Antarctic



Orcas spy hop in the broken ice behind the Coast Guard Cutter *Polar Star* as it conducts ice breaking operations in the Southern Ocean, on January 1, 2023, as part of Operation Deep Freeze 2023. Operation Deep Freeze is one of many U.S. military operations in the Indo Pacific region that promotes security and stability across the region. Inset: Fireman Kenadi Kane, a member of the auxiliary engineering division on Coast Guard Cutter *Polar Star*, watches orcas swim near the cutter. Coast Guard photos by Petty Officer 3rd Class Aiden Cooney



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Coast Guardsmen enforce a safety zone around wild horses as they cross the Assateague Channel separating Virginia's Assateague and Chincoteague islands during the 83rd Annual Pony Swim in 2008. Events like the pony swim, New York's Fleet Week, America's Cup sailing race on San Francisco Bay, and space launch and recovery operations are just a few of the novel uses of the nation's waterways that require Coast Guard presence. Coast Guard photo by Petty Officer 3rd Class Mark Jones

