USE AND REGULATION OF AUTONOMOUS AND EXPERIMENTAL MARITIME TECHNOLOGIES

(118–28)

HEARING

BEFORE THE

SUBCOMMITTEE ON
COAST GUARD AND MARITIME TRANSPORTATION

OF THE

COMMITTEE ON
TRANSPORTATION AND
INFRASTRUCTURE
HOUSE OF REPRESENTATIVES

ONE HUNDRED EIGHTEENTH CONGRESS

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SEPTEMBER 15, 2023

SUMMARY OF SUBJECT MATTER

TO: Members, Subcommittee on Coast Guard and Maritime Transportation
FROM: Staff, Subcommittee on Coast Guard and Maritime Transportation
RE: Subcommittee Hearing on "*Use and Regulation of Autonomous and Experimental Maritime Technologies*"

I. PURPOSE

The Subcommittee on Coast Guard and Maritime Transportation of the Committee on Transportation and Infrastructure will hold a hearing on Tuesday, September 19, 2023, at 2:00 p.m. ET in 2253 Rayburn House Office Building to receive testimony on "*Use and Regulation of Autonomous and Experimental Maritime Technologies*." Focusing on increasingly automated and experimental technologies in the maritime industry, the hearing will examine commercial and United States Coast Guard (Coast Guard or Service) uses of these technologies and the regulatory changes necessary to assure their safe use. Members will receive testimony from two panels of witnesses. The first panel will include representatives from the Coast Guard. The second panel will include representatives from the National Academy of Sciences, Triton Submarines, Sea Machines Robotics, Inc, and American Maritime Officers.

II. BACKGROUND

The maritime industry is currently experiencing significant innovations as the use of autonomous and experimental technologies increases in frequency. The global market size for autonomous ships alone was valued at $5.21 billion in 2022 and is projected to grow to $9.87 billion by 2030.[1] In response to this growing industry, Congress has enacted several legislative provisions to support the Coast Guard's efforts to leverage and regulate these developing technologies. The Frank LoBiondo Coast Guard Authorization Act of 2018 (P.L. 115–282) required an assessment of available unmanned, autonomous, or remotely controlled maritime domain awareness technologies for use by the Coast Guard.[2] The Don Young Coast Guard Authorization Act of 2022 (P.L. 117–263) established the unmanned system program and autonomous control and computer vision technology project as well as an at-sea recovery operations pilot program.[3] Most recently, the Coast Guard Authorization Act

[1] AUTONOMOUS SHIPS MARKET SIZE, SHARE: FORECAST REPORT [2030], (Aug. 2023), *available at* https://www.fortunebusinessinsights.com/industry-reports/autonomous-ship-market-101797.
[2] Frank LoBiondo Coast Guard Authorization Act of 2018, Pub. L. No. 115–282, 132 Stat. 4303.
[3] Don Young Coast Guard Authorization Act of 2022, Pub. L. No. 117–263, 136 Stat. 4024 & 4131.

of 2023, reported out of the Committee on Transportation and Infrastructure on April 26, 2023, includes a requirement for the Coast Guard to detail the establishment of an Unmanned Systems Capabilities Office and creates a National Advisory Committee on Autonomous Maritime Systems.[4]

III. USE WITHIN THE COAST GUARD

The 2020 National Academies of Sciences Report, *Leveraging Unmanned Systems for Coast Guard Missions*, recommended a major realignment of the Coast Guard's unmanned systems approach to better focus on a pacing mechanism that proactively identifies, investigates, and integrates potential systems.[5] The Coast Guard currently employs unmanned systems mostly for platform-centric missions, such as onboard National Security Cutters to increase surveillance capabilities.[6] However, the Service has identified various missions that the technology would greatly increase mission capabilities, including Arctic ice cover research, inspections of vessels and aids to navigation, oversight of fishing vessel operations, and criminal interdiction programs.[7] The Coast Guard's Blue Technology Center of Expertise (Center) is responsible for the identification of maritime technologies the Service can leverage to improve the execution of National security and humanitarian missions.[8] Additionally, the Center develops partnerships with industry, academia, and government agencies to best facilitate adoption of these technologies.[9] Coast Guard research and development pursuits currently focus on maritime unmanned systems technology, the conversion of Coast Guard boats to optionally crewed assets, evaluating and improving unmanned surface vehicle collision avoidance technology, and enabling reduced-cost sensor deployment capabilities.[10]

IV. REGULATION BY THE COAST GUARD AND INTERNATIONAL MARITIME ORGANIZATION

As the principal Federal maritime regulatory and law enforcement agency, the Coast Guard is working to craft regulations to monitor activities like the use of unmanned barges and spaceport drone ships for commercial space companies, autonomous navigation, and fully autonomous shipping vehicles.[11] Additionally, the Service must determine how best to counter small unmanned submarines moving illicit drugs.[12] While the use of autonomous and experimental systems are not yet common place, their expected future use raises a host of regulatory issues including manning, testing, safety, security, mariner credentialing, and pilotage.[13] The Coast Guard will likely need to develop comprehensive guidance or other regulatory standards for surface, subsurface, and aerial spaces similar to efforts underway at the Federal Aviation Administration.[14] The Coast Guard's broad range of statutory authorities will likely allow it to address most regulatory requirements, but it must continuously reassess and update future regulatory frameworks to account for evolving technologies.[15] However, the Coast Guard's authorities may be deficient in areas such as safety regulations, where international conventions are built around the assumption that humans will be physically on-board vessels at all times.[16] United States' Federal law currently makes similar assumptions.

Moreover, the Coast Guard and Congress may need to consider the International Maritime Organization (IMO) efforts to establish a regulatory framework for the op-

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[4] Coast Guard Authorization Act of 2023, H.R. 2741, 118th Cong. (2023).

[5] NAT'L ACADEMIES OF SCIENCES, ENGINEERING AND MEDICINE, LEVERAGING UNMANNED SYSTEMS FOR COAST GUARD MISSIONS, (2020), *available at* https://doi.org/10.17226/25987.

[6] UNITED STATES COAST GUARD UNMANNED SYSTEMS STRATEGIC PLAN, (March 2023), *available at* https://www.dco.uscg.mil/Portals/9/DCO%20Documents/2023%20Unmanned%20Systems%20Strategic%20Plan.pdf.

[7] *Id.*

[8] BLUE TECHNOLOGY CENTER OF EXPERTISE, (last accessed Sept. 12, 2023), *available at* https://www.dcms.uscg.mil/Our-Organization/Assistant-Commandant-for-Acquisitions-CG-9/Blue-Tech-COE/.

[9] *Id.*

[10] UNITED STATES COAST GUARD REPORT TO CONGRESS: RESEARCH AND DEVELOPMENT ON UNMANNED SURFACE VEHICLES, (2023), (on file with Comm.).

[11] NAT'L ACADEMIES OF SCIENCES, ENGINEERING AND MEDICINE, COAST GUARD'S NEXT DECADE: AN ASSESSMENT OF EMERGING CHALLENGES AND STATUTORY NEEDS 1, (2023), *available at* https://nap.nationalacademies.org/catalog/27059/the-coast-guards-next-decade-an-assessment-of-emerging-challenges-and-statutory-needs [hereinafter Assessment].

[12] *Id.*

[13] *Id.*

[14] *Id.*

[15] *Id.*

[16] *Id.*

eration of Maritime Autonomous Surface Ships (MASS).[17] The IMO created a joint working group on MASS to consider high-priority safety, legal, and facilitation issues following regulatory scoping exercises that looked at how existing regulatory instruments can apply to MASS and what regulatory gaps exist.[18] The joint working group has so far agreed on the need for a human master to be responsible for autonomous vessels, also determining that the master does not need to be present on board during operation, but must have the ability to intervene as needed and a single remote operations center must be responsible for an autonomous vessel at any point.[19] As the IMO joint working group continues to consider further matters pertaining to MASS operations, the Coast Guard can leverage lessons learned to align future United States regulatory regimes with best practices identified by the IMO.

V. AUTONOMOUS AND EXPERIMENTAL TECHNOLOGIES

The rapid introduction of autonomous systems within the maritime industry has the potential to increase efficiency and reduce operational risk. Autonomous systems can act as technology integration platforms linking vessel navigation, sensing, propulsion, and reporting capabilities with the potential to accomplish a variety of missions and operations.[20] The degree of autonomy in systems can vary. The IMO identifies four varying degrees of automation which include:

- Degree 1—Ships with automated processes and decision support where some operations are automated, but seafarers are onboard and can intervene as needed;
- Degree 2—Ships that can be remotely controlled from a separate location, but seafarers are onboard and can intervene as needed;
- Degree 3—Remotely controlled ships without seafarers onboard in which the ship is controlled from a separate location; and
- Degree 4—Fully autonomous ships with operating systems capable of making decisions and taking actions without any human intervention.[21]

Uncrewed Maritime Vehicles (UMV) constitute a range of maritime technologies currently being manufactured in the United States and elsewhere.[22] Common types of UMVs include:

- Remotely Operated Vehicles (ROV) that operate remotely underwater through the use of an umbilical or tether connected to a surface control system;
- Autonomous Underwater Vehicles (AUV) that operate independently underwater without any direct control from an operator;
- Unmanned Service Vehicles (USV) that operate on the water's surface either autonomously or remotely through air-based communication systems; and
- Hybrid UMVs that utilize a combination of technologies from these categories to provide varying mission capabilities.[23]

Each of these platforms have varying sizes, weights, and capabilities that can be utilized in the commercial sector or by the military.[24]

The testing and proliferation of uses for these technologies is growing as the industry continues to expand. SpaceX, a commercial space launch company, has utilized unmanned commercial barges for the recovery of booster rockets at sea, as the company promotes the barge's capability to navigate itself to and from port, without crew or tow.[25] The Mayflower Autonomous Ship, a project led by the non-profit maritime research organization ProMare with partners such as IBM, completed a trans-Atlantic crossing between England and the United States.[26] The Mayflower Autonomous Ship arrived in Plymouth, Massachusetts, in June 2022, and is the largest

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[17] IMO, *Developing a regulatory framework for autonomous shipping*, (Apr. 27, 2023), *available at* https://www.imo.org/en/MediaCentre/Pages/WhatsNew-1872.aspx.
[18] *Id.*
[19] *Id.*
[20] Assessment, *supra* note 11.
[21] Argyro Kepesedi, *Maritime Autonomous Surface Ships: A critical 'MASS' for Legislative Review*, UNCTAD, (Dec.13, 2022), *available at* https://unctad.org/news/transport-newsletter-article-no-97-fourth-quarter-2022.
[22] AUVSI, THE 2023 QUARTERLY INSIGHT—Q2, (2023), *available at* https://www.auvsi.org/sites/default/files/AUVSI-Quarterly-Insight-Q2.pdf.
[23] *Id.*
[24] *Id.*
[25] *SpaceX May Have the Largest Unmanned Merchant Vessel in Operation*, MARITIME EXEC., (July 13, 2021), *available at* https://maritime-executive.com/article/spacex-may-have-the-largest-unmanned-merchant-vessel-in-operation.
[26] *Mayflower Autonomous Ship Completes Historic Atlantic Crossing*, MARITIME EXEC., (July 1, 2022), *available at* https://maritime-executive.com/article/mayflower-autonomous-ship-completes-historic-atlantic-crossing.

uncrewed vessel to complete that journey.[27] Utilizing six Artificial Intelligence (AI) powered cameras along with over 30 sensors and 15 edge devices, the vessel's "AI Captain" adhered to maritime law and rerouted itself around hazards and marine animals, while optimizing decisions and mitigating risk based on data it collected.[28] Meanwhile, the *Yara Birkeland*, a fully electric and autonomous container vessel, has been sailing partially crewed in Southern Norway carrying up to 100 containers along a short fixed route.[29] Yara, the fertilizer company based in Norway that owns the vessel, plans to gradually reduce the crew onboard until operations can occur completely unmanned, with the bridge eventually being removed.[30]

These and other experimental crafts that operate both uncrewed or with passengers onboard continue to be developed and will require concrete regulatory frameworks to govern operations.

VI. THE TITAN SUBMERSIBLE

On June 18, 2023, five souls onboard perished when the OceanGate submersible vessel "Titan" imploded. As the first time someone died piloting or riding in a submersible in nearly a century, the extended search for the Titan garnered international headlines and launched a renewed interest in experimental craft. The Coast Guard coordinated the search and rescue efforts that spanned multiple days, cost millions of dollars, and utilized assets from the United States, France, and Canada.[31] Ultimately, the Coast Guard convened a Marine Board of Investigation to examine the loss of the Titan submersible.[32] The Transportation Safety Board of Canada is also investigating the case.

Titan fell outside a single country's jurisdiction or regulation. It was American made, operated in international waters by a Bahamian registered company, launched from a Canadian-flagged support vessel, and was not registered under the United States flag, or the flag of any other nation.[33] Titan also had several cost-saving departures from proven submersible designs. Specifically, Titan had a pill shaped hull to accommodate more passengers, which was constructed from a combination of carbon-fiber and titanium.[34] Unlike other deep-sea submersibles, Titan was not inspected by any reputable marine organizations, nor did it undergo a classification process.[35] While the Passenger Vessel Safety Act of 1993 (P.L. 103–206) increased safety standards for passenger vessels, including submersibles, OceanGate was able to circumvent these requirements by neither flying a United States flag nor setting off from a United States port.[36] In the days following the Titan implosion, underwater explorers and industry professionals claimed they had long-standing concerns about Titan's use of novel materials and designs, as well as Titan's failure to undergo an independent certification process that ensures safety standards.[37]

VII. WITNESSES

PANEL I

- Rear Admiral Wayne R. Arguin Jr., Assistant Commandant for Prevention Policy (CG–5P), United States Coast Guard
- Rear Admiral Todd Wiemers, Assistant Commandant for Capability (CG–7), United States Coast Guard

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[27] *Id.*
[28] *Id.*
[29] Adrienne Murray, *Crewless container ships appear on the horizon*, BBC, (Mar. 24, 2023), *available at* https://www.bbc.com/news/business-64875319.
[30] *Id.*
[31] *United States Coast Guard Will Lead Investigation of Titan implosion with help from Canada, France, UK*, CNBC, (June 25, 2023), *available at* https://www.cnbc.com/2023/06/25/us-coast-guard-will-lead-investigation-of-titan-implosion-with-help-from-canada-france-uk.html?&qsearchterm=U.S.%20coast%20guard%20will%20lead%20investigation%20of%20titan%20sub.
[32] *Id.*
[33] Tom Porter, *Stockton Rush deliberately structured OceanGate's Titanic Operations to be outside United States jurisdiction, says former employee: report*, INSIDER, (July 3, 2023), *available at* https://www.insider.com/oceangate-structured-titan-operations-to-fall-outside-us-law-report-2023-7 [hereinafter OceanGate].
[34] Helmuth Rosales, et al., *The Maverick Design Choices that May Have Doomed Titan*, N.Y. TIMES, (July 14, 2023), *available at* https://www.nytimes.com/interactive/2023/07/14/us/titan-submersible-implode-design.html.
[35] *Id.*
[36] *See* Pub. L. No. 103–206, 107 Stat. 2439.
[37] OceanGate, *supra* note 33.

PANEL II

- Mr. Sean Pribyl, Committee Member, Committee on Coast Guard Maritime Domain Awareness, National Academy of Sciences Report, "Leveraging Unmanned Systems for Coast Guard Missions"
- Mr. Michael Johnson, Chief Executive Officer, Sea Machines Robotics Inc.
- Mr. Patrick Lahey, Co-Founder and Chief Executive Officer, Triton Submarines
- Mr. T. Christian Spain, Vice President of Government Relations, American Maritime Officers

USE AND REGULATION OF AUTONOMOUS AND EXPERIMENTAL MARITIME TECHNOLOGIES

TUESDAY, SEPTEMBER 19, 2023

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON COAST GUARD AND MARITIME TRANSPORTATION,
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE,
Washington, DC.

The subcommittee met, pursuant to call, at 2:02 p.m. in room 2253 Rayburn House Office Building, Hon. Daniel Webster (Chairman of the subcommittee) presiding.

Mr. WEBSTER OF FLORIDA. The Subcommittee on Coast Guard and Maritime Transportation will come to order.

I ask unanimous consent that the chair be authorized to declare a recess—which might happen here any minute—during the hearing.

Without objection, show that adopted.

I also would ask unanimous consent for the subcommittee to permit those not on the subcommittee to ask questions and be a part of the hearing.

Without objection, show that ordered.

As a reminder, Members who wish to insert a document into the record, please also email it to DocumentsTI@mail.house.gov.

Before we begin, I want to take a moment just to send my deepest condolences to our colleague, Mrs. Peltola, and her entire family, on the loss of her husband, Buzz Peltola, Jr. And we are saddened by that, yet we reach out to them. We hope that they will have comfort in being together and having the time together.

So, I recognize the ranking member, Mr. Larsen, for remarks that he would like to provide for Mrs. Peltola.

Mr. LARSEN OF WASHINGTON. Thank you, sir.

I also want to extend condolences to Mary and her family on the loss of Buzzy. And I had a chance to meet him a few times over the last couple years. He was a great gentleman, a fun one to hang around with. And I know they are a large blended family, and there is a lot of sorrow in the Peltola family and the Bethel community, as well.

So, I want to extend my condolences, as well, to Mary. And we look forward to having her back, but she should be back on her own timeline, her family's timeline, as well.

So, thank you.

Mr. WEBSTER OF FLORIDA. Thank you.

I now recognize myself for the purposes of an opening statement for 5 minutes.

Due to time constraints we face today with the scheduling on the floor, I am going to forgo my opening remarks and statement and, for the sake of time, allow our first panelists—our witnesses—to give their testimony.

Thank you both for being here. We really appreciate it.

So, now, I recognize Mr. Carbajal for an opening statement, 5 minutes.

Mr. CARBAJAL. Thank you, Chairman Webster. I, too, am going to forgo my statement and submit it for the record, my opening remarks.

But I wanted to also extend my deepest condolences to the Peltola family and our colleague, Mary, on the passing of her husband, Buzzy. Certainly, this was tragic, and they are going—the family and our colleague are going through a lot. And I just want to extend my deepest, deepest condolences and sympathy, and I look forward to her coming back when she feels ready to come back.

But certainly, anytime we have something like this occur, it reminds us of the work we have and the challenges that we have and the fact that anything can happen to us or our families at any one time and the importance that we need to cherish them. So, again, my condolences to the Peltola family.

With that, I will yield back, Mr. Chair.

Mr. WEBSTER OF FLORIDA. So, I would like to welcome our witnesses and thank them for being here today. Today's hearing has noted two panels, and so, we will begin with the first panel.

Briefly, I would like to take a moment to explain the lighting system that we have. Green means go. Yellow means about over. Red means stop. That's it.

I ask unanimous consent that the witnesses' full statements be included in the record.

Without objection, show that ordered.

As your written testimony has been made part of the record, I ask you to limit your remarks to 5 minutes.

With that, Rear Admiral Arguin, you are recognized for 5 minutes for your testimony.

TESTIMONY OF REAR ADMIRAL WAYNE R. ARGUIN, ASSISTANT COMMANDANT FOR PREVENTION POLICY, U.S. COAST GUARD; AND REAR ADMIRAL TODD C. WIEMERS, ASSISTANT COMMANDANT FOR CAPABILITIES, U.S. COAST GUARD

TESTIMONY OF REAR ADMIRAL WAYNE R. ARGUIN, ASSISTANT COMMANDANT FOR PREVENTION POLICY, U.S. COAST GUARD

Admiral ARGUIN. Good afternoon, Chairman Webster, Ranking Member Carbajal, and distinguished members of the subcommittee. I am honored to appear before you today to update you on the autonomous and experimental maritime technology within the Marine Transportation System, or MTS.

I, too, would also like to express my deepest condolences to Representative Peltola and her family and friends. Our thoughts and prayers are with her and her family.

Our national security and economic prosperity are inextricably linked to a safe, efficient Marine Transportation System. Across the MTS, innovation is accelerating, creating new opportunities and benefits for the marine industry and the Nation.

Exciting new innovations, including remote-controlled and autonomous technologies, are being developed to improve the efficiency of various aspects of the Marine Transportation System that will transform the use of our waterways. Additionally, the needs of the maritime industry are driving future ship propulsion fuel solutions, including liquefied natural gas, methanol, fuel cells, lithium-ion batteries, hydrogen, ammonia, and nuclear energy sources.

While the potential benefits of these technologies could be significant, it is imperative to understand the potential risks and implement mitigation strategies to ensure the safety and security of our waterways. This responsibility is shared amongst all Marine Transportation System stakeholders.

As the lead agency for safeguarding the MTS, the Coast Guard is committed to taking a commonsense approach, founded on our prevention and response frameworks, to evaluate and facilitate the use of emerging technologies to preserve the safe and efficient MTS.

We must also ensure that mariners' training programs keep pace with this advancing technology. To achieve this, the Service must continue to invest in our ability to attract and retain the talent necessary to meet these challenges in an increasingly complex Marine Transportation System.

The workforce is the heartbeat of our Service and is the reason we succeed at our missions. I am committing to supporting our workforce and field commanders, and we must think differently about how we deliver those services to the marine industry.

We are investing in our national centers of expertise to augment and support our field commanders to meet this highly technical workload associated with this technology. We rely heavily on key partnerships throughout all levels of Government and industry in the United States and across the globe. Collaboration with the maritime industry is vital as we develop commonsense governance standards to rapidly employ these technologies safely and securely.

With congressional support, the Service is taking full advantage of newly authorized opportunities, such as the at-sea recovery operations pilot program for space rocket recovery, to work with early adopters and evaluate new autonomous technologies that will inform the development of new standards.

Internationally, the Coast Guard is leading U.S. efforts within the International Maritime Organization to develop standards for the safe, secure, and sustainable operation of maritime autonomous surface ships. The domestic and global focus on developing reimagined standards for these novel technologies will buy down risk inherent in an increasingly interconnected and cyber-dependent supply chain.

The Service stands ready to support the maritime industry to address these risks to the MTS to ensure the safety of life at sea, the security of our waterways, the protection of the marine environment, and the efficient movement of goods throughout the Nation's waterways around the world.

As the Coast Guard continues to evolve its oversight of these emerging technologies, we thank you for your essential and continued support on this important issue.

I appreciate the opportunity to testify before you and look forward to your questions.

[The joint prepared statement of Rear Admirals Arguin and Wiemers is on page 5.]

Mr. WEBSTER OF FLORIDA. Thank you.

Next we will have Rear Admiral Wiemers, and you are recognized for 5 minutes.

TESTIMONY OF REAR ADMIRAL TODD C. WIEMERS, ASSISTANT COMMANDANT FOR CAPABILITIES, U.S. COAST GUARD

Admiral WIEMERS. Chairman Webster, Ranking Member Carbajal, distinguished members of the subcommittee, thank you for your oversight and strong support of the Coast Guard. I am honored to be here today to update you on autonomous and experimental maritime technology.

I, too, would like to send thoughts and prayers out to the Peltola family. Buzzy Peltola, as a father of two Coast Guard members, will forever be part of the Coast Guard family.

The Coast Guard Deputy Commandant for Operations, Vice Admiral Peter Gautier, released the Coast Guard's "Unmanned Systems Strategic Plan" in March. That plan outlines a vision for how the Service will respond to and embrace emergence of unmanned technology in the Maritime Domain.

The vision for the future is one where the Coast Guard effectively employs, defends against, and regulates unmanned systems in the maritime environment. We are moving toward a future where the Coast Guard employs unmanned systems in an interconnected data network integrated with artificial intelligence to deliver actionable information to Coast Guard operators.

Unmanned systems will be critical to the Coast Guard's ability to meet the challenges of an increasingly dynamic operating environment. Unmanned systems can help find mariners in distress; detect drug and migrant trafficking at sea; monitor illegal, unreported, and unregulated fishing in the Indo-Pacific; track icebergs in the North Atlantic; and gain awareness of activity in the Arctic.

Currently, the Coast Guard employs three types of unmanned aircraft systems. First, long-range systems are part of a joint program with the Customs and Border Protection. Second, medium-range are used on our National Security Cutters. And third, we have domestic-made, legally compliant, short-range systems that are used as force multipliers across the country.

The Coast Guard recently deployed unmanned surface capabilities. We deployed contractor-owned, contractor-operated, uncrewed surface assets in the Caribbean Sea and off the coast of southern California to study the assets' impact on illegal migration and drug trafficking. Additionally, the Coast Guard sees future opportunities to use underwater vehicles and commercial space assets to meet current and future demands. A constellation of unmanned systems may expand our Maritime Domain Awareness, support command and control of our forces, and enhance our mission execution.

Finally, the widespread use and low cost of unmanned systems mean these tools are available to those who might seek harm to the United States or interrupt the flow of commerce. As a result, the Coast Guard fields capabilities to counter threats from unmanned aircraft systems, also called counter-UAS.

The Department of Homeland Security's existing authority that enables the Coast Guard counter-UAS operations expires on September 30. It is critical that this authority be reauthorized to allow the Coast Guard to continue this mission in defense of the maritime transportation system.

I appreciate the opportunity to testify today. I look forward to your questions.

[The joint prepared statement of Rear Admirals Arguin and Wiemers follows:]

Joint Prepared Statement of Rear Admiral Wayne R. Arguin, Assistant Commandant for Prevention Policy, U.S. Coast Guard, and Rear Admiral Todd C. Wiemers, Assistant Commandant for Capabilities, U.S. Coast Guard

INTRODUCTION

Good morning, Chairman Webster, Ranking Member Carbajal, and distinguished members of the Subcommittee. Thank you for your continued oversight and strong support of the Coast Guard. We are honored to appear before you today to update you on Coast Guard activity related to autonomous and experimental maritime technology.

Across the maritime domain, the pace of innovation is accelerating. The opportunities presented by emerging technology could significantly benefit the Marine Transportation System (MTS). Technological advancements—such as autonomous systems—can evolve global transportation systems and provide novel solutions for ongoing and future challenges, including growing cybersecurity vulnerabilities, supply chain disruptions, navigational challenges, and interference with communication, information, and operational technology systems. With these advancements comes the potential for new and different vulnerabilities which should also be carefully considered. The Coast Guard will closely evaluate the emergence of autonomous and experimental technology, and encourage the growth of technology by updating standards, policies, and regulations.

Coast Guard Autonomous and Experimental Maritime Technology

The Coast Guard Deputy Commandant for Operations, VADM Peter Gautier, released the U.S. Coast Guard Unmanned Systems Strategic Plan in March of this year. That plan outlines a vision for how the Service will respond to and embrace the emergence of unmanned technology in the maritime domain. The Coast Guard's vision for the future is to not only establish a regulatory framework to ensure a safe and efficient MTS but to also actively defend against nefarious use of unmanned systems and to use unmanned systems to improve execution of the Service's 11 statutory missions.

Currently, the Coast Guard employs unmanned capabilities in the air domain in three ways. First, as part of a joint program office with U.S. Customs and Border Protection, the Coast Guard uses long-range unmanned aircraft systems (UAS) for land and maritime border security. Second, medium-range UAS on Coast Guard National Security Cutters provide tactical aerial surveillance and reconnaissance capability by leveraging a contractor-owned, contractor-operated (COCO) model. Finally, the Service utilizes short-range UAS as force multipliers in myriad operations, including post-storm assessments, law enforcement, pollution response, port and facility inspections, aids to navigation, and near-shore maritime domain awareness (MDA).

While the Coast Guard does not possess organic unmanned surface capabilities, the Service is learning how these capabilities can enhance mission execution. The Coast Guard recently utilized data from COCO unmanned surface vehicles (USVs) in the Caribbean and in Southern California. These assets provided data-as-a-service collected from a variety of sensors, including radar, cameras, and automatic

identification system receivers. Contracted deployments offer the opportunity to enhance MDA while avoiding prolonged acquisition processes and preserving the ability to quickly pivot to new technologies as they emerge. The Service is evaluating the USVs' performance for potential future use.

The rapid commercialization of these technologies—including COCO business models within industry—will likely provide greater access for affordable experimentation and deployments in the near future. The Coast Guard Research and Development Center and Blue Technology Center of Excellence continue to advise the Service regarding technological feasibility and best implementation strategies. This organizational insight enables the Service to continually integrate the platforms and sensors that will best serve the American public.

To maximize platform and sensor potential, the Coast Guard must effectively store, process, analyze, and visualize the data, converting it into information for better decision making to act more quickly and decisively. The Coast Guard created an Office of Data and Analytics to improve data governance and analysis and to reframe the organization's approach to data so that operators at all levels may leverage data to their strategic advantage. Furthermore, to avoid processing data in a vacuum, the Service is working with Department of Homeland Security (DHS) partners to share data and improve Department-wide operational outcomes.

The widespread availability and low cost of unmanned systems means nefarious actors may see opportunities to use UAS to disrupt Coast Guard operations, conduct illicit activities, or jeopardize the flow of commerce while avoiding detection or attribution. In response, the Coast Guard has rapidly acquired counter-UAS (C–UAS) capabilities. These capabilities are deployable ashore and afloat. The Service would welcome the chance to discuss these capabilities further in a classified setting.

Commercial Autonomous and Experimental Maritime Technology

The Coast Guard is monitoring and assessing novel uses of autonomous and experimental maritime technology across the MTS. For example, data collection platforms are being increasingly used within the MTS by companies leveraging autonomous technologies to conduct unmanned surveying operations. While many of these survey platforms are relatively small, some companies are exploring using larger platforms that may present greater potential risks to other waterway users.

The Coast Guard is focused on effectively managing the increasing use of these platforms on our waterways. In addition to survey platforms, the maritime industry is also considering remote-control operations on smaller commercial vessels (e.g., tugs) to improve maritime commerce efficiency.

As current statutory and regulatory regimes for commercial maritime operations are predicated on mariners being onboard vessels, the Coast Guard is working to develop suitable international and domestic governance frameworks to integrate autonomous and remote-control technologies safely and properly into the maritime domain. Internationally, the Coast Guard is leading U.S. efforts in ongoing discussions within the International Maritime Organization (IMO) to develop a code for safe, secure, and environmentally sound operation of maritime autonomous surface ships (MASS) within existing IMO instruments. Domestically, the Coast Guard-chartered Automated and Autonomous Vessel Policy Council is identifying gaps within U.S. laws, regulations, and policies and developing clear and consistent guidance regarding autonomous and remote-controlled technology for the maritime industry and marine inspectors.

With the maritime industry continuing to incorporate these technologies, the Coast Guard appreciates the authority provided in the Don Young Coast Guard Authorization Act for Fiscal Year 2022 to conduct a pilot program to better understand the potential use of remotely controlled or unmanned autonomous spaceflight recovery vessels. Within this pilot program, the Coast Guard is working extensively with commercial space interests to further the development of safe and secure operations for recovering rockets at sea using unmanned, autonomous vessels. As a result, the Coast Guard approved unmanned operations by recovery vessels while accompanying support vessels recover rocket fairings. Based on lessons learned from this proof of concept, the Coast Guard will be poised to facilitate greater use of autonomous systems to support maritime operations.

Alternative Fuels

The Coast Guard is also committed to working with the maritime industry to facilitate the increased use of alternative fuels and technologies for shipboard propulsion. While the use of liquefied natural gas (LNG) is currently a leading alternative to traditional petroleum-based fuels to meet current domestic and international air emission requirements, the maritime industry continues to explore other alter-

natives including methanol, fuel cells, lithium-ion battery, hydrogen, ammonia, and even nuclear energy sources.

The needs of the maritime industry will drive future ship propulsion fuel solutions, and the Coast Guard is positioned to consider the results of testing of the various alternative fuel options. For both regulators and industry, these alternative fuel options must be carefully considered and appropriate safeguards must be in place. Consideration must also be given to the infrastructure necessary for the development, delivery, and use of alternative fuels, which further increase the complexity of already busy maritime ports.

To this end, the Coast Guard is heavily engaged in ongoing efforts at the IMO to develop suitable requirements for these alternative fuel options. Leveraging the recent International Code of Safety for Ships Using Gases or Other Low Flashpoint Fuels (IGF Code), which was developed for the use of LNG, the IMO provided additional guidance on the use of methanol and fuel cells and is now developing guidelines for hydrogen, ammonia, and low flashpoint diesel. While these alternative fuels share many similarities, each has its own unique risks and challenges that must specifically be addressed to ensure safe use as a maritime fuel.

With limited exceptions, current domestic regulations do not address safe use of alternative fuels. However, they authorize the Coast Guard to consider equivalents to regulatory design standards to evaluate proposals for the use of new technologies and alternative fuels onboard ships. The Service utilizes that authority to facilitate industry efforts to innovate in safe and responsible ways.

In addition to engineering considerations, the Coast Guard is mindful of the need to ensure industry has the proper training and qualifications to operate these systems and that Coast Guard marine inspectors have the necessary competencies to inspect them. The challenges associated with learning to design, operate, maintain, and inspect multiple fuel systems at the same time cannot be understated, but the Coast Guard is committed to working with industry to ensure it is done safely.

Other Novel Technology

In addition to the technologies and fuels described above, the maritime industry continues to seek innovative and emergent technologies for use in the MTS. Submersibles are increasingly employed in commercial maritime operations for activities such as underwater exploration, offshore structure maintenance, and underwater salvage. Their versatility and advanced technology make them a valuable capability which also pose unique governance challenges. These challenges can be overcome through transparency and collaboration to develop necessary and timely standards to meet the needs of the public. The Coast Guard continuously evaluates our ability to assess new technologies and novel uses and is committed to working with industry leaders to develop new standards and leverage existing standards to ensure the safety of these vessels and the individuals that operate them.

Recent advancements in technology have given rise to the development of the next generation of Wing-In-Ground (WIG) crafts. A WIG craft looks and flies like an aircraft but operates at a low altitude above the water surface to take advantage of enhanced aerodynamic lift within the ground effect layer. While the use of WIG craft presents potential opportunities, WIG craft technology is novel and there are few Coast Guard and no Federal Aviation Administration regulations or other industry standards specifically pertaining to their design, construction, or operation, though FAA regulations governing aircraft would still apply to WIGs that operate within FAA's statutory jurisdiction.

WIG craft are, in essence, high-speed craft operating at low altitude over the water. There will be significant challenges integrating WIG operations with existing maritime traffic schemes. Further, due to the unique blend of maritime and aviation principles on which they rely for operation, the design, construction, pilotage, operation, maintenance, and inspection of WIG craft are beyond the Coast Guard's expertise. Successfully addressing the challenges associated with this technology will require the Coast Guard to rely on interagency partners who have the requisite experience, competency, and regulatory authority to evaluate the aviation aspects associated with WIG craft.

Cyber Connectivity

In close coordination with DHS and other DHS components, the Coast Guard is leading several initiatives to meet the growing demand of the modern maritime industry and MTS for updated cybersecurity policy and guidance. The modern maritime industry and MTS rely heavily on interconnected information and operational technologies to provide the most effective and efficient transportation system possible.

We must be cognizant of the fact that every new capability that leverages cyberspace, also presents additional risk of cyberattacks by malicious actors which could threaten the MTS.

The Coast Guard stands ready to support the maritime industry in the implementation and acceleration of new technologies and will continue to address increasing cyber challenges and risks to the MTS to ensure the safety of life at sea, the security of our waterways, and the protection of the marine environment.

Conclusion

The novel technologies being introduced into the maritime environment today are just the next step of maritime evolution. The Coast Guard stands ready to provide regulatory guidance and oversight to maintain safe and secure waterways, and the Service will continue to look for ways to leverage emerging technologies to enhance mission performance. We look forward to answering your questions.

Mr. WEBSTER OF FLORIDA. Thank you so much for your presence here. I really appreciate it. Thank you for your testimony. It's great.

So, we will begin by having questions.

I am going to skip mine, I guess, and call Mr. Carbajal. You are recognized for questions.

Mr. CARBAJAL. Thank you, Mr. Chair.

Again, I defer to the ranking member, if that is OK with you.

Mr. WEBSTER OF FLORIDA. I am going to remember that.

Mr. CARBAJAL. I am always trying to suck up to him.

Mr. WEBSTER OF FLORIDA. I don't blame you.

Mr. LARSEN OF WASHINGTON. Well, I am not deferring to anyone.

Thanks for coming. So, my first set of questions, I am not sure who is in charge of answering them. But I know a lot of the testimony is focused on autonomous vehicles and so on, but I want to step away a little bit—step back from that a little bit to talk a little about remote sensing, data collecting, and analytics, and then how you use that information so that it is actionable.

You mentioned, Admiral, creating actionable data so you can go do something with it.

So, with regards to—as a for instance, IUU fishing, are you working with other agencies, like the Navy or anyone else, on the use of satellites to track movements of potential targets of IUU fishing and then using, then, that information for interdiction? And if not, how are you using the various technologies to deal with IUU fishing?

Admiral WIEMERS. So, sir, yes, we are working very closely with the Navy and other partners in order to really expand our Maritime Domain Awareness capability through different systems, especially leveraging those that DoD has at their advantage.

We are on a journey to really increase our Maritime Domain Awareness. There are some program of records that the Navy has put that we are working with them to expand sea vision, which is a capability that allows for Maritime Domain Awareness, that we are sharing with different partners around the world to really understand what is out there and be able to address it.

Mr. LARSEN OF WASHINGTON. You have an Office of Data and Analytics. Is that designed just to—not just to—but is that designed to just collect the data, or do you have the capacity to analyze the data you are getting for actual use?

Admiral WIEMERS. So, sir, we are on a beginning stage. That office has been in existence now for a couple of years, and we are

going through all the data architecture that we need to put in place before we can really make it actionable for all enhanced.

We have got some use cases that we are using by pulling data out of our databases and being able to run some analysis on it, but for the most part, that office is working on setting up the data governance for our Service.

Mr. LARSEN OF WASHINGTON. So, as you are moving forward on that, are you also training up the folks who you will depend upon to analyze that data? And I would include not just the folks who will put physical eyes on, but any of the algorithms that you will need to develop to help you sift through the data.

Admiral WIEMERS. Yes. The training of our workforce moving out in the future is going to be really important, and we are partnering with others to help us on that journey. We are partnering—for one example, we have got an object detection joint group that we are working with DoD to be able to use their algorithms and partner in those algorithms to be able to use it, for example.

Mr. LARSEN OF WASHINGTON. Maybe for Admiral Arguin, you are responsible for answering this one. How is all that work then integrated? So, in the use of, say, either crewed vehicles or uncrewed vehicles.

Admiral ARGUIN. Congressman, we hope to take advantage of the work that the Office of Data and Analytics will be able to combine to evaluate risk-based regulatory projects. So, rather than moving forward with a prescriptive-based regulatory framework, being able to use data-informed risk analyses to help drive where we want to drive our resources and where we need to focus our efforts to reduce challenges with safety.

So, right now, we have got use cases to take a look at all the information that we capture with respect to the Marine Transportation System and be able to evaluate where we should be putting our resources to drive safety improvements.

Mr. LARSEN OF WASHINGTON. Yes. OK. Sorry. That is on the safety side. I appreciate that.

I think my questions maybe are more along the lines of the enforcement, interdiction use cases for not just collecting the data, but analyzing the data, and then turning that into something that we can use, and then the tools—like artificial intelligence algorithms—that, frankly, you need people to do.

And we shouldn't forget. It's—I always tell people that artificial intelligence—the artificial is the software part, the intelligence is the human part. It's not just some random algorithm that drops from the sky and then we get to use it. We actually need people to do this.

So, I will leave it at that. I do want to follow up, though, and I will follow up with some more specific questions, and maybe have you come in for a brief on a few of these issues. I appreciate that. Thanks.

Admiral WIEMERS. Thank you.

Mr. LARSEN OF WASHINGTON. I yield back.

Mr. WEBSTER OF FLORIDA. So, Mr. Carbajal and I have agreed to ask our questions when we come back after the voting break.

Maybe we can squeeze in Mr. Babin. You are recognized.

Mr. CARBAJAL. Mr. Chairman, I am not going to be able to come back. I am sorry. I might have——

Mr. WEBSTER OF FLORIDA [interrupting]. Oh, you're not.

Dr. BABIN. You have already called on me.

Mr. CARBAJAL. But you're not ranking member or chairman, so, you are out of luck.

[Laughter.]

Mr. WEBSTER OF FLORIDA. OK. All right.

Mr. Carbajal, you are recognized for your questions.

Mr. CARBAJAL. Thank you very much, Mr. Chairman.

I should reconsider deferring to the ranking member because he asked one of my questions. So, the good news is I am going to be short, Mr. Chairman.

Admiral Arguin, oceangoing vessels routinely carry dangerous explosive cargoes, while U.S. flight vessels carry cargo for the Department of Defense. Who should be responsible for regulating the cybersecurity of fully autonomous vessels? Is the Coast Guard currently capable of doing that?

Admiral ARGUIN. Ranking Member Carbajal, we do have that responsibility, both within the prevention policy responsibilities we have as cyber. Underneath our Marine Transportation Security Act authorities, we have the authority to manage and oversee cyber responsibilities. We are currently in the process of issuing a notice of proposed rulemaking that would raise the bar with respect to cyber responsibilities for both vessels and facilities.

Mr. CARBAJAL. Thank you, Admiral.

Admiral Arguin, regarding submersibles, Navigation and Vessel Inspection Circular, NVIC No. 5–93 states, "Because of the unique design and operating characteristics, as well as the inherent hazards of underwater operation, an uninspected submersible may be permitted in U.S. passenger operations only if it is designed and constructed to a recognized industry standard."

Does the Coast Guard stand by this statement? Is more needed?

Admiral ARGUIN. Congressman Carbajal, yes, sir, the requirement for a submersible, if you carry one passenger for hire, you need to meet the inspection requirements under subchapter T.

Mr. CARBAJAL. Thank you very much. And sorry, Admiral. The ranking member took my question.

So, with that, I will yield back, Mr. Chair.

Mr. WEBSTER OF FLORIDA. Mr. Babin, you are recognized for 5 minutes.

Dr. BABIN. Yes sir, thank you, Mr. Chairman.

And thank you, Admirals, for being here today.

I represent both Coast Guard Sector Houston-Galveston and Air Station Houston, each housed at Ellington Field in southeast Texas in my district.

My questions today are for our Coast Guard panel members, both of you. In the recent 2022 Coast Guard reauthorization, there was a provision, section 11225, titled, "Establishment of Unmanned System Program and Autonomous Control and Computer Vision Technology Project." It's a mouthful.

The goal of this project is to bring commercial autonomy and computer vision solutions directly to the operational components of the Coast Guard to use this technology in an operational environ-

ment for maritime interdiction, search and rescue, and ISR, just to name a few.

What is the Coast Guard's plan to execute this technology project in an operational setting through the Coast Guard Research and Development Center?

One of you.

Admiral WIEMERS. So, sir, the R&D Center is obviously doing a lot of research in the world of unmanned systems and improving Maritime Domain Awareness, and we are working hand-in-hand with them on a number of different activities.

We recently just finished the Saildrone deployment, as one example, where we were trying to use unmanned systems to really understand that capability and how we can best leverage that information to meet our mission.

That study that you specifically mentioned is still ongoing, and we are waiting for the results for it.

Dr. BABIN. OK. Thank you. All right. I will go to the next one.

The Department of Homeland Security's counter-UAS, or C–UAS, authority is expiring in September. Does that mean the Coast Guard will not be able to conduct counter-UAS operations if it is not reauthorized, or will the Coast Guard authorities allow you to continue C–UAS activities?

Admiral WIEMERS. Our authority is embedded with the act that brought that on. So, when it sunsets, our ability to conduct those operations will also sunset.

Dr. BABIN. OK. Good to know. Good to know.

I recently heard some great feedback from down in south Texas about the joint Coast Guard-CBP balloon monitoring project, the *Argos* surveillance balloon or tethered aerostat, as it is officially called.

In addition to supporting our border security in combating illegal immigration, drug trafficking, and smuggling, I am told that the aerostat is also playing a huge role in deterring illegal fishing in the region. This sort of partnership is vital, and I encourage you to keep working with agency and military partners to share this innovative technology.

For example, to my earlier point, Joint Base Ellington in my district also houses the Texas Air National Guard's 147th Attack Wing. They operate MQ–9 Reapers, a UAS platform with state-of-the-art sensor capabilities. I know the CBP has MQ–9s as well, and the Coast Guard has partnered with them in the past to share UAS assets.

What has the partnership looked like with the Air National Guard, and what can be done to enhance the shared technology utilization?

Admiral WIEMERS. Sir, we are working very closely with Customs and Border Protection. We are working jointly on requirements on what we need to have persistent Maritime Domain Awareness out to 200 miles. And CBP has got its sensors, we have our sensors, and we are committed to integrating them and sharing the data and working together in those areas.

As far as the MQ–9 Guardians that we fly with the joint program with CBP, we have flown over 3,100 maritime-hours since 2018, and we have been able to result in 26,000 kilograms of cocaine

being seized specifically because of those assets. It is a very good partnership for us.

Dr. BABIN. Absolutely. Thank you. Proud of you.

I yield back.

Mr. WEBSTER OF FLORIDA. Mr. Auchincloss, you are recognized for 5 minutes.

Mr. AUCHINCLOSS. Thank you, Chairman.

It seems that one of the core issues that the Coast Guard is facing from a regulatory perspective is this distinction between vessel and vehicle. And a lot rides on that distinction. The Coast Guard has previously promulgated a definition of vessel but has also said at the same time that that definition does not apply across all types that they may encounter.

You have put together the Automated and Autonomous Vessel Policy Council recently. What is the status of that, and is one of the mandates for that council to make that distinction between vessel and vehicle more clear?

Admiral ARGUIN. Congressman, yes, sir. The Autonomous Vessel Policy Council, AutoPoCo for short, is really focused on evaluating not only the regulatory framework that exists today to identify gaps where autonomous operations may impact the existing framework, but also looking at training requirements, evaluating that technology to determine how that technology can be brought to bear within the MTS in a safe and secure manner.

Mr. AUCHINCLOSS. So, is AutoPoCo going to produce recommendations for regulatory changes for the Commandant as well as legal changes for Congress for this new era?

Admiral ARGUIN. Yes, sir. They are working to evaluate not only with the international community as we evaluate where the international community wants to go, but making recommendations on not only policy changes, but law changes that may be necessary to support the expansion of that technology.

Mr. AUCHINCLOSS. And when can we expect those recommendations?

Admiral ARGUIN. I don't have a timeframe on those recommendations. They are continuing to evaluate not only the international standard, but also the domestic standard. And as those recommendations come forward, we will move forward with making recommendations for changes.

Mr. AUCHINCLOSS. And who is the flag officer who is responsible for timeline and for efficacy of AutoPoCo?

Admiral ARGUIN. I am.

Mr. AUCHINCLOSS. OK. Because that was one of the recommendations that came up in the National Academy of Sciences report on this issue, was that there needs to be accountability.

And so, you are the gentleman who Congress can turn to for these recommendations?

Admiral ARGUIN. Yes, sir.

Mr. AUCHINCLOSS. Great.

Is part of these recommendations going to be about which procurement authority the Coast Guard uses for these? I know there is a whole slew of ones that you could use. Are you going to be talking about how best to procure?

Admiral ARGUIN. No, sir. So, the AutoPoCo team is really focused on the external, so, non-Coast Guard-related activities with respect to autonomous operations. There is a different division that is working on the internal acquisition and how Coast Guard would use that technology within Coast Guard operations.

Mr. AUCHINCLOSS. And is there one program officer or flag officer who is in charge of that, is accountable to the Commandant and Congress on deciding whether it is going to be FARs or nonmajor acquisition programs, et cetera?

Admiral WIEMERS. Yes, sir. If I can jump in.

Our Assistant Commandant for Acquisition is in charge for all acquisition, including all contracting, which includes the other transactional authority that you are talking about.

Mr. AUCHINCLOSS. OK. But that is a whole portfolio. Is there one individual at the Coast Guard who is talking just about how to procure for this technology?

Admiral WIEMERS. So, the way we have it set up is I set the requirements for what we need, and I set those—that capability needs. I then turn it over to the contracting officer within the Assistant Commandant for Acquisition to actually acquire the goods.

Mr. AUCHINCLOSS. That sounds to me like a no. And my concern is that if the commercial sector—and I represent a State, Massachusetts, that has a tremendous ferment of innovation in marine science and technology. They want to know who is going to buy this stuff, and they want to be able to have sit-down conversations about that.

Are you the person?

Admiral WIEMERS. I am the person——

Mr. AUCHINCLOSS [interrupting]. All right. I am going to give them your cell phone.

Admiral WIEMERS. Yes, sir. I am the one who decides what to buy.

Mr. AUCHINCLOSS. OK. And then, on this point, you all have the Blue Tech Center of Excellence. It is in San Diego. My colleague, Mr. Garamendi, was instrumental in getting that instituted. How many people do you have working there?

Admiral WIEMERS. Sir, I will have to get back on the record with you for the exact numbers that we have there.

Mr. AUCHINCLOSS. Does two sound right?

Admiral WIEMERS. It is very possible, sir.

Mr. AUCHINCLOSS. And they are civilians?

Admiral WIEMERS. I am not sure what the makeup is.

Mr. AUCHINCLOSS. And what authority do they have?

Admiral WIEMERS. Sir, they are responsible to inform industry on Coast Guard requirements so that the industry can understand what the Coast Guard's—our need and what technologies will help us into the future.

Mr. AUCHINCLOSS. So, they are like sensors out there in the commercial ecosystem to bring back information to the Coast Guard, but they can't procure, they can't make investments?

Admiral WIEMERS. They would need to come back to us to make the procurements.

Mr. AUCHINCLOSS. We are not going to keep pace with innovation unless Blue Tech Center of Excellence has the dedicated funding

and the staffing that it needs, and I would like the Coast Guard to come back with a plan to do that.

I will yield back, Chairman.

Mr. WEBSTER OF FLORIDA. Thank you very much.

OK. So, the Chair declares that we are going to recess here for some votes, and then we will come back.

Be sure to come back, all the witnesses, both current and the future panel, and then all of the Members that can come back. And we will start again as soon as we are done.

[Recess.]

Mr. WEBSTER OF FLORIDA. The Subcommittee on Coast Guard and Maritime Transportation is called to order from the previous recess we just had.

And I recognize myself for 5 minutes to ask questions, and then we will move to the Members' questions.

Thank you all for coming back. It's great. Seems like we just left.

Admiral Arguin, earlier this year, the Coast Guard supported the search for the *Titan*, the submarine that ultimately caused five people to perish. The *Titan* was not registered, wasn't classified or inspected.

What processes does the Coast Guard need to implement to ensure vessels like the *Titan* do not evade regulation, particularly when such vessels are carrying passengers?

Admiral ARGUIN. Chairman Webster, we have initiated a Marine Board of Investigation, that is the highest level of investigative body within the Coast Guard, to evaluate the evidence in connection with that case. The Marine Board of Investigation will make recommendations to us with respect to either policy changes or regulatory changes that need to be made as a result of that investigation.

And so, in the meantime, we are evaluating our own existing policies to determine whether or not there are loopholes that can be closed in advance of the finalization of that investigation.

Mr. WEBSTER OF FLORIDA. Is there a timeframe for that?

Admiral ARGUIN. We want to make sure the investigations and the investigators have all the time they need to gather the evidence. We want to expedite the completion of that, but I want to make sure that the investigative team has all the time necessary to truly evaluate and pull up all the evidence that would be—now, if they do determine that there is something that needs to be acted on before the end, they will advise me, and then we can take action on those cases outside of the completion of the investigation.

Mr. WEBSTER OF FLORIDA. Admiral Wiemers, the Coast Guard intercepts about 10 percent of the cocaine flowing into the United States. It is constrained by limited assets covering a large area.

How is the Coast Guard using new technologies as a force multiplier to increase Maritime Domain Awareness?

Admiral WIEMERS. Chairman Webster, indeed, a lot of the conversation we have been having on trying to field unmanned systems is specifically to be able to target our resources more effectively in order to get at the threats that are coming into our country.

Mr. WEBSTER OF FLORIDA. What factors, if any, are hindering the Coast Guard's adoption of new technologies that can improve Maritime Domain Awareness?

Admiral WIEMERS. Chairman, so, just a couple of thoughts on that. One, we talked earlier about managing data. Putting out more unmanned systems collects a lot of data, and we need to be able to manage that data to really turn it into information that we can then use to target threats coming toward us.

And the other item I would say that would help us is having other transactional authority, similar to what DoD has, in order to be able to procure new technology in a more effective way.

Mr. WEBSTER OF FLORIDA. Admiral Arguin, a recent National Academy of Sciences report noted that one of the Coast Guard's challenges will be recruiting personnel qualified to oversee new maritime technologies.

How will the Coast Guard ensure it has the necessary expertise?

Admiral ARGUIN. Chairman Webster, to be sure, the challenges associated with increasing technology will put an additional strain on our ability to recruit and ultimately retain the talent necessary to meet that demand. We have got an all-hands-on-deck effort to find that talent, to be competitive to bring that talent into the Service, and then be able to employ them in the most effective way.

Mr. WEBSTER OF FLORIDA. Are there any areas where the Coast Guard currently falls short in regulation expertise for new technologies?

Admiral ARGUIN. Chairman, I think the regulatory framework is just not flexible and nimble enough to keep pace with emerging technology. We are working through a variety of different design basis agreements, which are essentially an equivalency determination against the current standard to ensure that that technology can be brought to bear and then be able to update the regulations, sort of, downstream.

And so, we have the ability to evaluate equivalencies, but the current regulatory framework just does not afford us the opportunity to keep pace based on the current standard.

Mr. WEBSTER OF FLORIDA. So, there are gaps?

Admiral ARGUIN. Sir, I wouldn't necessarily call them gaps, because if we identify that there is a challenge, we do have the ability to evaluate alternatives to that standard. Yes, sir.

Mr. WEBSTER OF FLORIDA. OK. I yield back my time.

And, Ms. Scholten, you are recognized for 5 minutes. Ms. Scholten.

Ms. SCHOLTEN. Thank you, Mr. Chair.

And thank you both for coming today, for your testimony, and for your concern and thoughtfulness over this critically important issue.

In my home State of Michigan, water is a way of life, from recreation to supporting the larger Great Lakes economy. The future of carbon-neutral fuels and autonomous vessels is of critical importance to the people in Michigan's Third Congressional District.

As you know, establishing these regulations is the province of the International Maritime Organization, but the Coast Guard, of course, can develop regulations and take their own step to build out processes, even in advance of a global standard.

My first question is for Rear Admiral Arguin. Given the speed at which the IMO produces regulations, what is the Coast Guard doing to ensure a more rapid but safe deployment of carbon-neutral fuels?

Admiral ARGUIN. Congresswoman, so, we have an Autonomous Vessel Policy Council that focuses on autonomy. We are also evaluating those new technologies as they are brought to bear. And so, in the event that we end up seeing that a particular alternative fuel becomes more mainstream, we will be able to develop more national regulations.

And so—but we also need to be mindful that we need to keep pace or at least be mindful of the International Maritime Organization's efforts, because shipping is global. And so, to ensure that we do have alignment with international requirements—we are all on the same journey trying to figure out how to make sure that these operations and these alternative fuels can be incorporated safely. And so, we are in partnership and working directly with IMO to help inform our own domestic standards as well.

Ms. SCHOLTEN. OK. Can you talk a little bit about specifically any of the processes or test sites or pilot projects or anything that might be happening right now?

Admiral ARGUIN. So, I am not aware of any particular test sites or pilot projects other than individual. For example, there are certain ships that are dual-fueled LNG models. They are being built. They are operating today.

And so, we work through those equivalency determinations to compare them against the existing standard, determine if new requirements need to be put in place based on those risks, and then that establishes a framework for that particular design. As those designs become more mainstream, then we will be able to essentially put together a national policy that will standardize and set a framework for future development.

Ms. SCHOLTEN. OK. How would you assess the competitiveness of the United States among other countries developing these technologies?

Admiral ARGUIN. I don't know that I would be in a position to compare and contrast other countries and sort of from a competitiveness perspective, but I think at least our domestic oversight of those new technologies and being a very deliberate standard to ensure that we have evaluated each of the risks and very confidently understand how those mitigation strategies are going to ensure an equivalent or better operation, I think, gives us a bit of an advantage.

Ms. SCHOLTEN. OK. This question of regulation is truly one of the key questions that we are facing right now moving forward and considering the nimbleness and, I believe, competitiveness of the United States military.

Currently, autonomous vehicles pose something of a loophole in Coast Guard regulations being classified as recreational vehicles, which are largely uninspected. Can you talk about the plan that we have, even more specifically regulating around this emerging class of vehicles? And either of you, please feel free to weigh in on this.

Admiral ARGUIN. Congresswoman, so, just the discussion of autonomous operations, automated systems have been incorporated

into shipping for years. The difference is now we are seeing more and more autonomous operations that are replacing what would typically be credentialed mariners or humans on board.

And so, I think the challenge is to ensure that the new systems, those computers that are driving operations, have the ability to meet or exceed what we would expect of a crew, and then be mindful that the crew that still remains on board needs to be trained and equipped to be able to continue to operate those vessels in an increasingly complex way.

Ms. SCHOLTEN. Rear Admiral Wiemers, do you have anything to add to that?

Admiral WIEMERS. No, ma'am. My colleague is the expert on regulations.

Ms. SCHOLTEN. Waiting for—I see my time is running out, but if you have anything additionally to submit for the record.

Waiting for technology to become more mainstream allows for certain gaps in the regulations. Does that give you any safety concerns?

Admiral ARGUIN. If we are aware of a technology that poses a threat, safety or otherwise, we have the ability, through our captain of the port authorities, to cease that operation. And so, if there are perceived gaps or real gaps, we would be able to take some action to prevent that from impacting the Marine Transportation System.

Ms. SCHOLTEN. Thank you.

Mr. WEBSTER OF FLORIDA. The gentlelady yields back.

Mr. Van Drew, you are recognized for 5 minutes.

Dr. VAN DREW. Thank you, Chairman.

And good afternoon, and thank you for being here today.

Southern New Jersey, as you probably know, is my home, and it is my district as well, and it is synonymous with the Coast Guard.

Training Center Cape May is one of the largest bases in the Coast Guard and the sole accession point for the entire enlisted workforce. It is a fundamental part of the culture and part of the economy in South Jersey. In turn, the push for more and more unmanned technology, while potentially beneficial, could greatly alter the functions of our training center.

Rear Admiral Arguin and Wiemers, will this technology be taught at the Coast Guard Training Center? Will there be a difference in the way we train the recruits as this moves forward, if it moves forward? Either one or both.

Admiral WIEMERS. So, Cape May is our primary accession source. A lot of the technical training that we give is follow-on training in, say, a sea school that we have, which is technical-based on what our people need to actually do the mission activities that we perform. So, the training that you are discussing would be performed at those locations.

Dr. VAN DREW. OK. So, the basic training would be the same—would be pretty much the same as we now have?

Admiral WIEMERS. We are constantly looking and leveraging technology to improve the delivery of our services, but the accession training would predominantly remain the same.

Dr. VAN DREW. Would there be any change just to teach people these skills, or, again, that would be done at the other location?

Admiral WIEMERS. So, the training specifically is not in either one of our portfolios. And there is a lot of looking going on right now within our Service on how we develop our folks. I am not aware of anything specifically at Cape May. But that is our main accession source, and it will remain that accession part.

Dr. VAN DREW. OK. Technology is good and advancement is good, but there are certainly concerns with safety at main sea, especially when these vessels—the autonomous vessels, such as fishing and private boats, are encountering them and the impacts of marine life.

Do you have any thoughts on that?

Admiral ARGUIN. Congressman, I think we need to be mindful that, while maybe in a laboratory, autonomous systems may be able to work properly operating within the entirety of the—and the complexity and diversity of the Marine Transportation System is a different sort of problem set. And so, we need to be deliberate about how we understand how those computer systems will operate and integrate and interact with all of the users of the waterway.

Dr. VAN DREW. I agree with you. And then, I am a very plain and basic guy. So, plain English, you don't want to rush into something that ends up being stupid and dangerous. So, I think you are right in your priorities there.

On top of these concerns, to me, is offshore wind, if it happens. And it has been delayed along our coast for another 2 years, and it may not happen at all. But if it did happen, will the wind turbines be a difficulty? For tourists, we know that already. For marine life and fishermen, we know that already. But the Coast Guard, I am interested in your viewpoint on the wind turbines. Is this developing as you hear more about it?

Particularly concerned with autonomous vehicles and how they are going to deal with them. I have a lot of fishermen in my district. A lot going on in the water, as you know. And they have concerns without autonomous vehicles. So, it particularly concerns me.

Two-part question. So, one, the concern with navigation. The second concern is—which has been expressed by some individuals in the military, including the Pentagon—concern with our national security. Concern these things are going to be thousands of them over millions of acres. They are 1,000 feet high, and there is concern about radar.

Any thoughts on that? From either one or both of you.

Admiral ARGUIN. Congressman, so, I will try to answer both of your questions maybe at the same time.

So, first and foremost, Coast Guard is responsible for safety and navigation and preserving the sea shipping lanes that support our $5.4 trillion economy. And so, as we work with BOEM and BSEE, specifically BOEM on the leasing areas, we want to make sure that the lease offerings have a minimal impact or minimize the impact to existing shipping lanes so that we can continue to move ships in a safe manner.

With respect to potential challenges with new structures in the ocean, we are evaluating that, again, with BOEM and BSEE, to understand not only the impact that it may have on our existing missions—search and rescue, oilspill response, and others—but understand what the impact of that system might be, even from a

cyber perspective. So, we are taking a comprehensive review of how that particular footprint changes the dynamics of the Marine Transportation System.

Dr. VAN DREW. And I am glad you are doing that. And I think it needs a good, solid, objective evaluation, regardless of political pressure on either side, just to make sure we stay safe.

I will take the other—my last question, I think, the other viewpoint. How do you think autonomous vehicles could increase safety? Or do you? And do we really need this technology?

Admiral ARGUIN. Congressman, I think that the opportunity to take advantage of technology, to minimize errors, to understand what that technology can bring in the way of better information, more efficient movement of commerce, is something we should certainly take advantage of. But we need to do that deliberately and make sure that those—as we are transitioning from what we currently have today into something that is a little bit more futuristic, that we understand the inherent and maybe even hidden risks that are——

Dr. VAN DREW [interrupting]. I think you are right. And I thank you for your good work. And I just want you to know I am always very proud of the Coast Guard and the presence it has not only along all our coast and in New Jersey, but particularly in South Jersey. Thank you.

I yield back.

Mr. WEBSTER OF FLORIDA. The gentleman yields back.

Mr. Ezell, you are recognized for 5 minutes.

Mr. EZELL. Thank you, Mr. Chairman.

Rear Admiral Arguin and Wiemers, thank you both for being here today. We really appreciate your staff and all the hard work that everybody puts into it.

I am proud of the work that has taken place in south Mississippi at the Roger F. Wicker Center for Ocean Enterprise, which includes numerous R&D partnership programs focused on uncrewed maritime systems in the broader blue economy.

My district is also home to many startup companies that are rapidly innovating in the unmanned maritime vehicle industry. To ensure their continued success, these companies must have a clear understanding of the legal requirements for lawful operation under relevant authorities.

Rear Admiral Arguin, what work is the Coast Guard doing to establish a regulatory framework for unmanned and autonomous systems to operate in the U.S. maritime transportation system?

Admiral ARGUIN. Congressman, so, I have established an Autonomous Vessel Policy Council that is taking a look not only at the gaps or the seams in areas where existing laws and regulations may be impacted by autonomous operations, and then making recommendations to those areas that may need to be improved so that that emerging technology can be incorporated.

They are also looking at how we train and equip our own inspectors and investigators to make sure that we are aware of that technology and that that technology can be brought to bear so that it can be done in a safe and effective way.

Mr. EZELL. Thank you.

I understand the International Maritime Organization has set up a working group to consider what a regulatory framework will look like for autonomous systems. Has the Coast Guard been involved in that?

Admiral ARGUIN. Yes, sir. The same lead that I have for my Autonomous Vessel Policy Council is also our representative to the MASS Working Group, the joint working group that is looking at the same thing but from an international perspective.

Mr. EZELL. Very good. All right.

Admiral Wiemers, could you tell us about the experience and expertise of the employees at the Coast Guard Research and Development Center?

Admiral WIEMERS. Yes, sir. Thanks for that question. We have got a fabulous group of folks that work in New London, Connecticut, at the Research and Development Center. They do a lot of different research for us. And as we get into technology and needing to stay up with the latest and greatest, doing the market research, and having that group be able to really work on the integration on how we use it is extremely important.

Mr. EZELL. Very good. Has the feedback from the industry taken into considerations the efforts of the entity? How has the feedback——

Admiral WIEMERS [interrupting]. So, the R&D Center, they do their reports. They do their experimentation. They work hand-in-hand and partner with industry to make sure we are understanding the latest that the market has to offer.

Mr. EZELL. Well, the Coast Guard has been a part of my life on the Mississippi Gulf Coast, and we fully support you, want to help you and be a part of all your success. So, thank you very much for being here today.

Mr. Chairman, I yield back.

Mr. WEBSTER OF FLORIDA. The gentleman yields.

So, I would like to thank the witnesses for coming today and for your testimony, but you can be excused if you want to be.

Dr. VAN DREW. Unless you want to stay.

Mr. WEBSTER OF FLORIDA. Yes.

Mr. WEBSTER OF FLORIDA. I would like to welcome our second panel of witnesses and ask them to take their seats.

[Pause as second witness panel takes their seats.]

Our second panel today consists of industry experts leading the development of autonomous and experimental maritime technologies and representatives of the mariners that will be operating these technologies. Their insights will be vital to developing an appropriate regulatory framework to ensure safe operation of these technologies in our maritime transportation system.

Thank you all for being here today. I really appreciate it.

I will take a moment to explain our lighting system, which I have already explained. G, green. Green is go. Yellow is slow up. Red is stop. That's it.

I ask unanimous consent that the witnesses' full statements on the second panel will also be included in the record.

Without objection, show that ordered.

And as your written testimony has been made part of the record, the subcommittee asks you to limit your oral remarks to 5 minutes.

With that, Mr. Pribyl, you are recognized for 5 minutes.

TESTIMONY OF SEAN T. PRIBYL, ESQ., MEMBER, COMMITTEE ON COAST GUARD MARITIME DOMAIN AWARENESS, NATIONAL ACADEMIES REPORT, "LEVERAGING UNMANNED SYSTEMS FOR COAST GUARD MISSIONS: A STRATEGIC IMPERATIVE"; MICHAEL GORDON JOHNSON, MARINE ENGINEER, AND FOUNDER AND CHIEF EXECUTIVE OFFICER, SEA MACHINES ROBOTICS, INC.; PATRICK LAHEY, COFOUNDER AND CHIEF EXECUTIVE OFFICER, TRITON SUBMARINES; AND T. CHRISTIAN SPAIN, VICE PRESIDENT OF GOVERNMENT RELATIONS, AMERICAN MARITIME OFFICERS

TESTIMONY OF SEAN T. PRIBYL, ESQ., MEMBER, COMMITTEE ON COAST GUARD MARITIME DOMAIN AWARENESS, NATIONAL ACADEMIES REPORT, "LEVERAGING UNMANNED SYSTEMS FOR COAST GUARD MISSIONS: A STRATEGIC IMPERATIVE"

Mr. PRIBYL. Thank you.

Chairman Webster, Ranking Member Scholten, and members of this subcommittee, I appreciate the opportunity to appear before you today to testify about the National Academies of Sciences consensus study report on "Leveraging Unmanned Systems for Coast Guard Missions: A Strategic Imperative," on which I served as a committee member.

This subcommittee also invited me to offer my comments on notable developments in the Coast Guard's use and regulation of maritime technologies since that report's publication in 2020. My testimony today is as a committee member of that report.

Briefly, Congress requested a study of the Coast Guard's existing and prospective use of unmanned systems to fulfill its many critical missions. Through the course of that study, the committee recognized the value that such technologies could offer the Coast Guard.

The committee made five recommendations related to unmanned systems. First was to issue a high-level strategy. Second was to designate a senior champion. Third was to stand up a program office. Fourth was to expand and normalize experimentation. And fifth was to get a fix on funding needs.

Through the study committee's understanding and as discussed in greater detail in my written testimony, several of those recommendations have been addressed by the Coast Guard.

The study committee also recognized the complex policy and legal questions raised with such technologies, in particular, as the Coast Guard is not only a potential user but also a regulator of unmanned systems.

Generally, statutes, regulations, and conventions did not contemplate vessels without humans on board when they were drafted.

Thus, traditional legal principles are being challenged. However, there is a great deal of ongoing effort to understand how these technologies fit in legal frameworks as they exist now, which was also part of the work conducted by the study committee.

Thank you again, and I look forward to your questions.

[Mr. Pribyl's prepared statement follows:]

Prepared Statement of Sean T. Pribyl, Esq., Member, Committee on Coast Guard Maritime Domain Awareness, National Academies Report, "Leveraging Unmanned Systems for Coast Guard Missions: A Strategic Imperative"

Chairman Webster, Ranking Member Carbajal, and Members of the Subcommittee, I appreciate the opportunity to appear before you today to testify about the Transportation Research Board's (TRB) consensus study report on "Leveraging Unmanned Systems for Coast Guard Missions: A Strategic Imperative" (2020)[1] (the "Report" or "Study") and issues of regulation of autonomous and experimental maritime technologies germane to that Report.

I served on the study committee that developed the TRB report, although I was also invited by this Subcommittee to offer my comments on notable developments in the Coast Guard's use and regulation of autonomous and experimental maritime technologies since that Report's publication in 2020. By way of additional background, I am a business attorney and Partner at the law firm of Holland & Knight LLP in Washington, DC where I practice within our Transportation and Infrastructure Group and International Trade Practice and support our Autonomous Transportation Team. The focus of my practice is on maritime regulatory matters, international trade, coastwise trade (the Jones Act), autonomous transportation, civil litigation, and maritime environmental compliance. I have a background with more than 25 years of combined experience as an international maritime and trade attorney, international Protection and Indemnity (P&I) Club lawyer in Norway, U.S. Coast Guard officer and attorney (JAG), U.S. Department of Justice Special U.S. Attorney, and merchant mariner deck officer with the American Maritime Officers union following graduation from the U.S. Merchant Marine Academy (Kings Point). I am also a widely published author in treatises and publications on matters related to maritime law and autonomy, as well as a regular speaker at international legal and industry conferences and seminars. Outside my law practice I am, *inter alia*, a Member of the National Academies of Sciences Marine Board and serve as Chair of the Autonomous Ships and Smart Marine Technology Committee in the U.S. Maritime Law Association ("MLA"), where I am a Proctor in Admiralty. My testimony today is on behalf of the TRB and in my personal capacity and thus any views and opinions expressed are my own and do not necessarily represent the views or positions of Holland & Knight LLP.

STUDY SCOPE AND PROCESS

Congress requested the TRB report in Section 812 of the Frank LoBiondo Coast Guard Authorization Act of 2018 (the "Act") which called on the National Academies of Sciences, Engineering, and Medicine (the National Academies) to "prepare an assessment of available unmanned, autonomous, or remotely controlled maritime domain awareness technologies for use by the U.S. Coast Guard." The Act called for a study of the U.S. Coast Guard's existing and prospective use of unmanned systems (UxS)[2] to fulfill its many critical and often unique missions. The Act implied an interest in a range of technology-based concepts, from aerial, surface, and underwater vehicles that have no human occupants or controllers to vehicles that may have a crew but have some level of remote, automated, or autonomous control, as well as systems that are not vehicles such as intelligent decision aids. The legislative request further called for a review of the then-current and emerging capabilities of these systems; their affordability, reliability, and versatility; and any realignments in Coast Guard policies, procedures, and protocols that may be necessary to exploit them more fully and effectively.

To conduct the study, which was undertaken under the auspices of the TRB and its Marine Board, the National Academies appointed a committee of 10 experts in the fields of automation and control; systems research, acquisitions, and integration; Coast Guard operations and mission support; naval engineering and architecture, cybersecurity, field applications of unmanned systems; and relevant legal, regulatory, and policy issues. Overall, the study committee recognized that the Coast Guard has many important, complex, varied, and demanding missions, although its fleet and operational forces are being increasingly taxed. However, unmanned sys-

[1] National Academies of Sciences, Engineering, and Medicine. 2020. Leveraging Unmanned Systems for Coast Guard Missions. Washington, DC: The National Academies Press. https://doi.org/10.17226/25987.

[2] The Report used the term "unmanned" systems, although since 2020, nomenclature has moved to adopt the term "uncrewed" or "optionally crewed." Notably the Coast Guard still uses the description "Manning Requirements" in 46 CFR Part 15, and thus there is not uniform acceptance of gender neutral "crew" in lieu of "manning."

tems are being used today—and increasingly since the Report's publication in 2020—with high utility across the public and private sectors. Therefore, recognizing that the technologies that enable and underpin these systems are advancing rapidly, the study committee was struck by the magnitude and breadth of opportunity that lies ahead for the Coast Guard to pursue UxS in its multiple operational domains and across its many missions. To reach that potential, the study committee determined that a major realignment of the Coast Guard's UxS approach was warranted and concluded that to remain responsive and fully relevant to its many missions, it was imperative that the Coast Guard take a more strategic and accelerated approach to exploit the capabilities of existing and future unmanned systems. Moreover, legal and policy considerations remain critical to the Coast Guard's missions as a user of emerging technologies and notably, as a regulator of unmanned systems aboard commercial vessels.

Informed by the input from experts and collective knowledge of its members, the study committee made five critical recommendations to the Coast Guard, provided here in kind, along with relevant updates given the passage of time since the publication of the Report.

1. Issue a High-Level UxS Strategy

The study committee recommended that the Commandant issue a high-level UxS strategy that would articulate a compelling rationale for UxSs, set forth agency-critical goals that these systems should further, and outline the Coast Guard's approach for achieving them. The strategy would articulate a vision for the use of these systems across mission areas, setting strategic goals and objectives for achieving that vision, and establishing appropriate organizational structures and lines of authority to introduce and integrate UxSs across the force structure.

Since the Report's publication, in March 2023 the Coast Guard promulgated its Unmanned Systems Strategic Plan[3] which appears to have addressed this recommendation.

2. Designate a Senior UxS Champion

In light of the institutional responsiveness required to support the strategic commitment to UxSs and given the attendant scope and scale of the requisite responses that will be required, the study committee recommended that the Commandant designate a top Coast Guard official, at the Flag Officer or Senior Executive Service levels, to advocate for and advance the Service's UxS strategy. This top official would be responsible for identifying, promoting, pushing for, coordinating, and facilitating the changes that will be needed across the organization to further the Commandant's strategic goals and objectives for UxSs.

To date, and to my knowledge, the Coast Guard has not designated that level of senior official for that purpose, however, they have appointed CAPT Thom Remmers, P.E. as Unmanned Systems Lead, which should be viewed as a positive step that meets the intent of this recommendation. This is all the more relevant given the promulgation of the Unmanned Systems Strategic Plan by Deputy Commandant for Operations, VADM Peter W. Gautier while CAPT Remmers served in that role as Unmanned Systems Lead.

3. Stand Up a UxS Program Office

Given the many changes in Coast Guard priorities, practices, and procedures that will be required to more fully exploit UxSs—from systems acquisition to personnel hiring and training—the study committee recognized that no single directorate or subunit could be expected to initiate and implement them all. However, the committee concluded that a dedicated program office, in concert with a high-level UxS advocate, could play a vital leadership and coordinating role in sustaining and expanding the use of UxSs across Coast Guard operational forces. The study committee therefore recommended that the Commandant establish a UxS program office that will work in concert with the top official charged with advancing the Service's UxS strategy to plan out, coordinate, assess, and promote UxS activities across the Service and to leverage relevant activities and capabilities from outside the Service. The committee advised that an early initiative of the program office should be to develop a "roadmap" that translates the high-level UxS strategic goals and objectives into an actionable plan to accomplish them, which should specify tasks needing priority attention, time frames for completion, and performance metrics and milestones.

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[3] US Coast Guard Unmanned Systems Strategic Plan (2023), *available at* https://www.dco.uscg.mil/Portals/9/DCO%20Documents/2023%20Unmanned%20Systems%20Strategic%20Plan.pdf.

To my knowledge, the Coast Guard has not established a UxS program office. The Coast Guard has, however, formulated a multi-program office autonomous policy committee referred to as the "AutoPoCo" which meets at certain intervals to discuss the prevailing issues and attempt to offer a unified view. The AutoPoCo, however, is not an avenue to which the public has direct access, and thus commercial entities are still expected to approach a multitude of offices to understand the parameters of lawful operations, ranging from Sector, District, and Headquarters offices.

4. Expand and Normalize UxS Experimentation

Experimentation with UxS capabilities on a limited basis, in partnership with other military services and DHS agencies, is vital to expanding and transitioning UxSs across the Coast Guard and to meet its diverse and demanding missions in the face of resource constraints. Budgetary limits are a crucial factor in the Coast Guard's need to be a "fast follower" that leverages and adapts technologies developed by others. Therefore, the Coast Guard must be attuned to, and experiment with, technology developments elsewhere in the military and government and in the commercial sector.

To build on and reinforce its naturally innovative culture, the study committee recommended the Coast Guard expand and normalize efforts to ensure ample and systematic operations-related experimentation with low-cost UxSs. The committee concluded that encouraging experimentation with low-cost UxS technologies will not only help to identify beneficial uses, but also nurture a technology-curious and -proficient workforce across the ranks.

Since the Report's publication, the Coast Guard appears to have taken some steps in this regard. Indeed, U.S. Navy has continued to aggressively experiment with unmanned vessels and has aims for a future fleet that incorporates unmanned surface vessels (USV) (*Mariner*; *Ranger*; *Sea Hunter*; and *Seahawk*) and systems, and the Coast Guard has participated in joint exercises like the Rim of the Pacific Exercise (RIMPAC) with such USVs which are purportedly able to comply with the International Regulations for Preventing Collisions at Sea 1972 (COLREGS). The Coast Guard has also used Saildrone uncrewed vessels or vehicles in support of research and development, although it is less clear if these are vessels that are required to comply with the COLREGS, and if so, whether those capabilities are met. This is an important distinction discussed later as the COLREGS apply to all vessels, and thus are critical to the Coast Guard as both a user and regulator of unmanned vessels.

5. Get a Fix on UxS Funding Needs

The committee made its recommendations intent on expanding and accelerating the Coast Guard's investigation and implementation of UxSs for new concepts of operation. The committee recognized, however, that for the Coast Guard to act on these recommendations would require ample and sustained funding, and a commitment to continually increasing funding over time. To incorporate UxSs into the fleet and force structure, the Coast Guard will need to invest in R&D, acquisitions, field experimentation, strategic planning, systems integration, evaluation, cybersecurity, legal analyses, personnel recruitment and training, and many other field and mission support functions and requirements. While the committee was not able to estimate and advise on how much additional funding would be required for these investments, it recommended the development of a detailed assessment of investment needs.

Legal and Policy Considerations with Respect to UxS Use and Regulation

While the Report assessed all domains for UxS—air, surface, and subsurface/underwater—the advent of emerging unmanned vessel (UMV) technology has raised the most pressing legal and operational questions, in particular as the U.S. Coast Guard is both a user and regulator of UMVs. Indeed, while the Coast Guard possesses extensive statutory authorities to execute its regulatory mission and can be expected to rely and build on these authorities, continued technological capabilities are offering new UMV use opportunities that are outpacing existing legal frameworks.

In support, the Report provided analysis of prevailing legal authorities and policy issues to serve as guidance and a primer upon which the Coast Guard can rely to fully assess UMV capabilities and develop next steps for its legal framework, to include a survey of relevant precedent, guidance, and resources to support legal and policy assessments and decision making. The Report notes that the Coast Guard's legal and policy program offices will need to determine whether existing laws, regulations, and policies allow for the safe and effective use of UMVs across the full range of envisaged operations. If they do not, the Coast Guard will need to identify

the additional authorities and processes that can fill the gaps, and if appropriate, work to bring them about. In the near term, this effort may require the drafting of legal and policy memoranda. The Report cited the Coast Guard's August 11, 2020 "Request for Information on Integration of Automated and Autonomous Commercial Vessels and Vessel Technologies into the Maritime Transportation System,"[4] although I am unaware of any further developments that resulted from the RFI.

Essentially, UMV technology has outpaced the relevant regulations because existing legal regimes generally contemplated manned ship operations, or at least with a "human in the loop," when they were initially developed, such as the COLREGS, Inland Navigation Rules, and United Nations Convention for the Law of the Sea (UNCLOS). This legal conundrum is compounded by the dearth of current precedent related to UMV operations on which operators could otherwise rely for guidance. Consequently, stakeholders and scholars continue to assess the use of UMV operations under the existing regulations, laws, treaties, and conventions, and they have yet to reach universal consensus, although collegial dialogue is ongoing.

"VESSEL" DETERMINATION AND STATUS

Indeed, one of the most prevalent operational considerations is whether an envisaged platform or watercraft will be deemed a "vessel" because such determination involves questions of fact, law, and policy. Therefore, a threshold matter is determining a respective UMV platform's "legal status" because there are numerous types of platforms that vary in size and capabilities with different designations. Furthermore, whether a given UMV is deemed a "vessel" also depends on a review of the context of the purpose, classification, design, and operating characteristics of a respective UMV.

Of the relevant international conventions, the most formative ones appear to be the COLREGS that apply "to all vessels upon the high seas and in all waters connected therewith navigable by seagoing vessels," including warships. Notably, while the COLREGS do not specifically preclude operation of UMVs, a Coast Guard UMV would be expected to the general maritime law requiring the exercise of good seamanship in all respects. In other words, the COLREGS need to be translated into programming code when integrated into a UMV. Such programming could conceivably achieve compliance with certain COLREGS, perhaps through a method which factors in both the strict conformity with the obligatory decision making and historical dependency on human common sense in executing rules in all circumstances. In fact, the study committee was aware of several technological developers who take the position that compliance with the COLREGS is indeed achievable through programming that allows a UMV to understand and act on a codified set of navigational requirements.

In order to determine legal rights and obligations when operating a particular UMV, a threshold issue will be how to characterize the UMV given the language in key domestic statutes, regulations, and international laws, which primarily govern operations by "vessels" or "ships." Efforts toward compliance with governing legal authorities has invariably raised issues of fact, policy, and law, including the critical question of "is it a vessel?" Thus, to best assess risk and make well-informed decisions, the Coast Guard could develop legal and policy opinions contemplating the legal parameters for each prospective UMV, including how the Coast Guard will ensure legal compliance and whether provisions may be available for exemptions and equivalencies under mandatory instruments, taking into account the applicability and processes related to making, amending, and interpreting treaties. Such determinations remain a case-by-case threshold "legal status" determination of the respective platform to address the "is it a vessel?" conundrum that considers the size and type of platform, how the platform is utilized, and where the platform is utilized. Of critical importance to such an analysis is an assessment of whether a UMV can navigate in a demonstrably safe and prudent manner and whether technical noncompliance is deemed a reasonable legal risk.

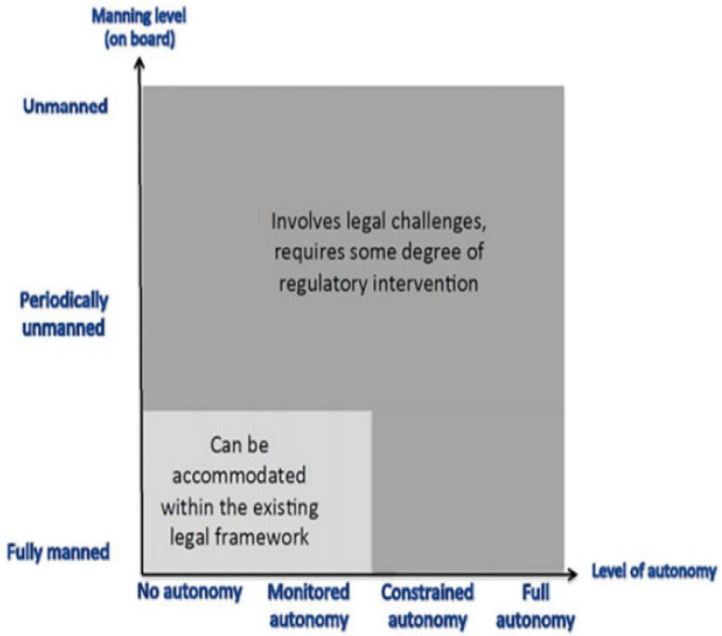
The issue of "what is a vessel" is not a novel matter for the Coast Guard. In fact, in its Legal Determination on Vessel Status of Paddleboard (Oct. 3, 2003), the Coast Guard Boating Safety Division (CG–5422) promulgated a determination on whether the Coast Guard considers a "paddleboard" to be a vessel. In that determination, the Coast Guard established a five-pronged test for determining whether any given watercraft is capable of being classified as a "vessel," provided here in relevant part:

1. Whether the watercraft is "practically capable" of carrying persons or property,

[4] Docket No. USCG–2019–0698 (85 Fed. Reg. 48548, Aug. 11, 2020): https://www.govinfo.gov/content/pkg/FR-2020-08-11/pdf/2020-17496.pdf.

2. Whether the useful operating range of the device is limited by the physical endurance of its operator,
3. Whether the device presents a substantial hazard to navigation or safety not already present,
4. Whether the normal objectives sought to be accomplished by the regulation of a device as a "vessel" are present, and
5. Whether the operator and/or cargo would no longer be safe in the water if the device became disabled.

As the Coast Guard acknowledged in that determination, the criteria outlined above will not be applicable to every watercraft for which there is a question of status, and there is no set formula for making vessel determinations—each determination must be made on an individual basis. Adding to the complexity of this legal status determination, industry and military services alike have been developing a range of terminology used in describing UMVs, often depending on the degree of autonomy the vehicle has, whether it is used in combat, and whether it is below, on, or above the surface of the water. To illustrate, the literature supporting this report has revealed there is no universally accepted name for an UMV, and the general position in the governmental, scientific, legal, and technical communities has yet-to-be aligned. To this end, a key legal consideration will be whether the Coast Guard procures and operates a platform characterized or classified as a vessel, vehicle, or system, taking into account the level of autonomy (or advanced automation) at which the UxS intends to operate since this will be relevant to how a respective platform fits into the prevailing legal framework. Observations on the "legal challenge involved" are illustrated in the Report, Annex E, Figure E–4:



Besides international law and conventions, the Coast Guard may rely on domestic statute, regulation, and policy in formulating determinations as to the legal status of a respective asset or platform. For example, under U.S. statute, the word "vessel" includes every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on water. (1 U.S.C. § 3). This definition does not distinguish between manned and unmanned watercraft. The Supreme Court has further established "reasonable observer test" in that a watercraft does not fall within the 1 U.S.C. § 3 definition of a "vessel" unless a "reasonable observer," looking to the structure or watercraft's physical characteristics and activi-

ties, would consider it designed to a practical degree for carrying people or things over water.[5]

However, the study committee recognized the disparities that may develop in a respective assessment of whether a watercraft is a "vessel"—and thus subject to Coast Guard jurisdiction and authority—or not, and by example cited to a pilot program for marine domain awareness that was being undertaken with Saildrone unmanned surface vehicles (USVs) in footnote 12[6] of the Report. The Report referred to a Saildrone vehicle that:

> " . . . weighs 750 kg and has a narrow 7 meters long hull, 5 meters tall wing, and a keel with a 2.5 meters draft. The system combines wind-powered propulsion technology that enables mission durations of up to 12 months (sailing on average 100 km per day) and solar-powered meteorological . . . It operates either under the constant supervision of a human pilot via satellite or can navigate autonomously from prescribed beginning and end points within a user-defined safety corridor."

By way of comparison, the study committee understood that the Coast Guard had generally accepted the classification of a Saildrone as a "vehicle" (and thus outside the COLREGS and other vessel requirements) while previously determining a paddleboard to be a "vessel" subject to the COLREGS and certain regulatory requirements. Also, the cited article in the Report indicated that the Saildrone can "navigate autonomously," although the study committee did not receive any clarification as to how such navigation capability assessments were conducted.

To my knowledge, the Coast Guard has not promulgated any formal public guidance on their process for making a "vessel" determination. However, relevant to the study committee's recommendation to expand and normalize UxS experimentation, it is notable that on February 16, 2022 the Coast Guard promulgated CG–CVC Policy Letter 22–01 (Guidelines for Human-Supervised Testing of Remote Controlled and Autonomous Systems on Vessels).[7] CG–CVC Policy Letter 22–01 provides useful guidelines for testing, under human supervision, of remote controlled and autonomous systems on vessels, although that Policy Letter does not allow for reduction of vessel manning prescribed by law or regulations, including manning that is less than the minimums in 46 U.S.C. § 8301 and 46 CFR part 15, and pursuant to the COLREGS, at all times must maintain a proper look-out by sight and hearing.

Notably, since the Report was issued, the Coast Guard, Navy, and Marine Corps in March 2022 published the Commander's Handbook on the Law of Naval Operations (COMDTPUB P5800.7A) (the "Handbook"),[8] approved by Rear Admiral Melissa Bert, USCG (Judge Advocate General and Chief Counsel), which determined that "unmanned systems constituting vessels will be governed by the COLREGS," and that unmanned systems may be under the commanded "by remote or other means." Thus, that Handbook seemed to affirm that an unmanned "vessel" will be subject to the COLREGS, hence the critical importance of the aforementioned "vessel or vehicle" distinction. The Handbook also determined that unmanned vessels and aircraft owned or operated by a State only on government, noncommercial service are entitled to sovereign immunity and may be used by States to exercise belligerent rights at sea.

INTERNATIONAL EFFORTS

Such legal questions on whether shipping regulations can keep pace with developing technology served as the basis for the International Maritime Organization (IMO) Maritime Autonomous Surface Ships (MASS) Regulatory Scoping Exercise (RSE) and legal surveys promulgated by the Comité Maritime International (CMI) to several national maritime law associations, through which the IMO and the CMI sought assessments on the applicability of MASS to certain conventions and domestic laws, and more generally. Since the Report's publication in 2020, the Maritime Safety Committee (MSC) of the IMO, at its 103rd session in May 2021, completed the RSE to analyze relevant ship safety treaties, in order to assess how MASS could

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[5] *Lozman v. City of Riviera Beach*, 568 U.S. 115 (2013).

[6] Saildrone. "Eyes and Ears at Sea: US Coast Guard to Test Saildrone Autonomous MDA Capabilities." https://www.saildrone.com/news/uscg-test-maritime-domain-awareness-solution. ("Congress has tasked the United States Coast Guard (USCG) with examining the feasibility, costs, and benefits of improving maritime domain awareness in the remote Pacific Ocean using a low-cost unmanned surface system.")

[7] https://www.dco.uscg.mil/Portals/9/DCO%20Documents/5p/CG-5PC/CG-CVC/Policy%20Letters/2022/CVC%20PL%2022-01%20Testing%20of%20remote%20and%20autonomous%20systems.pdf.

[8] https://usnwc.libguides.com/ld.php?content__id=66281931.

be regulated,[9] and agreed to develop a goal-based MASS instrument in the form of a voluntary "MASS Code," due to take effect in 2025, to address the various gaps and themes identified by the RSE. The CMI national maritime law association for the United States, the US MLA, has since established a standing committee on Autonomous Ships and Smart Marine Technology.

TESTING AND COMITY

In its Report, the study committee also recognized that the Coast Guard could utilize testing opportunities to clarify to what extent UMVs are subject to and comply with the COLREGS, how legal risk and allocation of responsibilities for gaining relevant use permissions is being obtained, what privileges and immunities are afforded the UMV and operator (e.g., "public vessel"), and which party is responsible for the handling of the data collected. To this end, the Report suggested that the U.S. Navy could be a useful indicator of these issues given their continued growth in the testing of UMVs, and since the Navy has also granted exemptions from regulatory and certification requirements for a discrete number of unmanned surface vehicles under 33 U.S.C. § 1605 "with respect to the number, position, range, or arc of visibility of lights, with respect to shapes, or with respect to the disposition and characteristics of sound-signaling appliances."

The Report had also recognized that "legal questions and challenges linked to autonomous shipping, as well as the solutions needed to resolve them, will differ depending on what choices are made in relation to manning, crew location, and autonomy level."[10] Generally, the Coast Guard has considered the statutes that govern the manning requirements for vessels to require a human onboard and that the Coast Guard cannot independently waive statutory manning requirements or the COLREGS absent Congressional authorization. This was addressed in more detail in the more recent National Academies' study on "New Coast Guard Authorities"[11], recently briefed to this Subcommittee and on which I served as a committee member, in which it was recognized that Congress authorized an "at-sea recovery operations pilot program" that expressly permits the Secretary (e.g., Coast Guard) "to allow remotely controlled or autonomous vessel operations to proceed . . . including navigation and manning laws and regulations" and "modify or waive applicable regulations . . . to allow remote and autonomous vessel at-sea operations."[12] Subject to certain considerations, this otherwise seems to answer the question in the affirmative of whether Congress can indeed waive the manning requirements and the navigation laws (i.e., COLREGS), and that waiver authority presents an important precedent for the Coast Guard as a user and regulator of UxS.

UNMANNED UNDERWATER VEHICLES AND AIRCRAFT SYSTEMS

Lastly, and as addressed in the Report, subsurface operations generally fall outside the purview of the COLREGS, and thus the study committee found few perceived legal impediments to such operations. However, the Coast Guard could still conduct an operational assessment for such types of subsurface and tethered remotely operated vehicle operations to review the varying levels of risk. And, as the U.S. Navy and National Oceanic and Atmospheric Administration (NOAA) are currently utilizing prototype unmanned underwater vessels/vehicles (UUVs), maintaining a collaborative approach and close communications with these entities could benefit the Coast Guard as a way to leverage lessons learned and best practices in development of the means to meet legal compliance. Similarly, in the case of unmanned aircraft systems (UAS), the use of UAS generally falls under Federal Aviation Administration (FAA) authorities and in parity with Department of Defense instructions. In all cases, however, the issue of budget and acquisition authority remains of vital consideration as the Coast Guard lags other services in the ability to rapidly acquire and deploy unmanned systems.

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[9] IMO MSC Circular.1/1638, Outcome of the Regulatory Scoping Exercise for the Use of Maritime Autonomous Surface Ships (MASS).

[10] Annex E, fn. 3, citing Henrik Ringbom. 2019. Regulating Autonomous Ships—Concepts, Challenges and Precedents, Ocean Development & International Law. DOI: 10.1080/00908320.2019.1582593.

[11] National Academies of Sciences, Engineering, and Medicine. 2023. The Coast Guard's Next Decade: An Assessment of Emerging Challenges and Statutory Needs. Washington, DC: The National Academies Press. https://doi.org/10.17226/27059.

[12] James M. Inhofe National Defense Authorization Act for Fiscal Year 2023, Pub. L. 117–263, div. K, title CXV, §11504, Dec. 23, 2022, 136 Stat. 4131; *see* At-Sea Recovery Operations Pilot Program § 11504(d)(1)–(2).

COAST GUARD ACQUISITION AUTHORITIES AND MODELS

The study committee assessed the challenges the Coast Guard faces when selecting the most timely and cost-effective acquisition authority and model. Although some acquisition authorities and models will be better suited to UxSs than others, the rapid pace of UxS advancements could require even more streamlined and nimble options to quickly respond to available opportunities and partnerships. The committee suggested that perhaps the most efficient way to acquire and accelerate the transition of UxS platforms and payloads to desired operations would be to identify and prioritize tested and proven technologies, and then adapt those systems for specific requirements. For example, mature technologies that are relatively inexpensive to operate, outfitted with operator-friendly control systems, and readily configured for multiple missions and payloads could be the primary focus of early transitions.

Several acquisition authorities are available to the Coast Guard, and selection of the most appropriate procurement mechanism for UxS is dependent on the scale and scope of the asset to be acquired:

- Federal Acquisition Regulation
- Level 3—Non-Major Acquisition Program
- Coast Guard Research, Development, Test, and Evaluation (RDT&E) Program
- Memoranda of Understanding
- DHS Cooperative Research and Development Agreements (CRADAs)
- Other Transaction Authority (OTA) (Research OTAs and Prototype OTAs)
- Silicon Valley Innovation Program
- DHS S&T Small Business Innovation Research Program
- Unsolicited Proposals
- Defense Innovation Unit (DIU)

As referenced in the Report, programmatic and technical specifications need to be addressed as part of the procurement decision making. Successful identification of acquisition programs requires a coordinated effort between the sponsor, resource, acquisition, and other stakeholders within the Coast Guard.

* * *

In conclusion, I want to thank you—Chairman Webster, Ranking Member Carbajal, and this Subcommittee—for the opportunity to testify.

Mr. WEBSTER OF FLORIDA. Thank you.

Mr. Johnson, you are recognized for 5 minutes.

TESTIMONY OF MICHAEL GORDON JOHNSON, MARINE ENGINEER, AND FOUNDER AND CHIEF EXECUTIVE OFFICER, SEA MACHINES ROBOTICS, INC.

Mr. JOHNSON. Thank you, Chairman Webster, Vice Ranking Member Scholten, and other Members, for inviting me to speak on this important topic of innovation in the maritime space and specifically, marine autonomous technology.

So, yesterday, my wife and I navigated to one of the only two memorials on the National Mall that is dedicated to a technology innovator. Just south of the Lincoln Memorial is a beautiful Milford granite, 20-foot edifice dedicated by President Coolidge and the Crown Prince of Sweden in full regalia in 1926. And it honors a Mr. John Ericsson. And he, like me, was a marine engineer. And in large bold Deco font, it says: "He invented the screw propeller." And above him are towering figures representing our national belief in adventure, labor, and vision.

Now, John Ericsson was, indeed, Swedish. And with his propeller design, he attempted to gain traction in Europe. And in the 1830s, he landed a pilot program with a marquee customer of that era, the British Royal Navy, who then passed on it because they comfortably believed in the continuing dominance of sailing vessels.

So, then in 1839, a bold and connected citizen of the United States invited John to our Nation and gained funding to build the U.S. Navy test vessel *Princeton*, which proved capabilities that began a major transformation of the world's fleets, along with the world order.

Within 20 years, 70 years after we penned our Constitution, the United States had the world's second largest merchant marine, just behind Britain, and today, 180 years later, it is all still moving by the screw propeller.

And so, this story is very important to me, because it's a clear example of our young country and a very lean Federal Government at that time investing with focus and disruptive innovation to build national value.

And today, just like then, the marine industry does everything on the water-covered surface of our planet, operating the largest machines made by humankind and connecting the world with trade. And licensed mariners, some of the best trained professionals of any industrial space, maintain these powerful machines and pilot them in the earth's most dynamic and forceful environment.

So, what is autonomous technology? It is the innate technical progression after 20th-century automation. Yet the power and capability of it is an exponential step. Where automation is a singular process, like a "if this, then that," autonomy is a comprehensive compute engine that prioritizes sensor data, weighs decisions to complete larger complex processes, like a full voyage.

So, that's valuable, because the industry and its mariners today are handicapped by the continued use of last century's technology and methods, resulting in accident rates that eclipse other comparable vehicle industries. As well, we have dismal on-time arrival rates and unoptimized operation of the world's cargo fleet that emits 3 percent of humanity's annual greenhouse gas.

So, autonomy will transform fleet operations and bring forward the reliability, productivity, and precision of advanced robotics, empowering mariners to do more, do it better and safer with less effort and less cost.

So, today, autonomy systems are being deployed by early adopters, both commercial and for national security. Task-driven workboats use it for open water surveying and data collection, as well as heavy dangerous work, like oilspill response and domain awareness. And it's beginning to be trialed in larger vessels that move cargo and people. So, maritime is a major contributor to our Nation's economy, accounting for 1.9 percent of our GDP and 2.3 million jobs, but the United States no longer holds a leading nor an influential position, and the global presence of the U.S.-flag fleet is continually shrinking.

In global cargo fleet ownership value, the U.S. now ranks number 14, well below China at number 1. So, autonomy is an emerging space, but it is advancing quickly and other determined nations that value its potential are investing heavily to take that commanding position.

The United States should not pass on this opportunity. We should focus our national lens on this technical field, or we are

handing the keys of the seas to others and further risk our position as a global super economy-driven superpower.

We must do the things today to shape where we want to be in the decades ahead. Thank you for this opportunity, and I am here at your service to answer any questions.

[Mr. Johnson's prepared statement follows:]

Prepared Statement of Michael Gordon Johnson, Marine Engineer, and Founder and Chief Executive Officer, Sea Machines Robotics, Inc.

OPENING

Chairman Webster, Ranking Member Carbajal, and Members of the Subcommittee, it's with sincere gratitude that I've been invited to submit testimony with my perspectives on the purposes and value of innovation in the maritime industry and specifically marine autonomous technology as it applies to surface operating vessels.

By way of additional background, I am a degreed marine engineer, and I held an engineering officer's license in the United States Merchant Marine before moving into ship repair and shipbuilding. I've managed vessel projects in many nations and was a Vice President of Project Management at Crowley Maritime and Vice President of Operations at Crowley's affiliate Titan Salvage. I have extensive experience in designing solutions for and leading teams in complex marine projects. After owning a marine project management company which mostly focused on offshore installations, I founded Sea Machines Robotics Inc. (Sea Machines) in 2017 to build autonomous technology for the marine sectors. Sea Machines sells products to domestic and international customers and has served multiple U.S. Government departments and agencies.

INTRODUCTION

The 21st century is the era of self-sensing and self-determining advanced automation, also known as autonomy. It's taking robotics and non-mechanical machines beyond the low-level and prescriptive tasks of the last century, enabling exponentially higher productivity and machine value to society. Autonomy is already active and growing in capability in general computer processing systems, data processing, medical diagnostics, aircraft and spacecraft control systems, agriculture, and warehouse logistics and now emerging in automobiles, trucking, and maritime.

INDUSTRY FACTS

The maritime industry does everything on the water-covered surface of the Earth, and that's almost three-quarters of it. It operates the largest machines built by humankind and facilitates most global trade. And licensed mariners, notably some of the best trained professionals of any industrial space, maintain these powerful machines and pilot them in the Earth's most dynamic and forceful environment. The industry is a leading contributor to our nation's economy and according to the U.S. Bureau of Economic Analysis and NOAA the marine economy accounted for 1.9% of our nation's GPD in 2021 or $432 billion. To put that in perspective, that's 2.5 times the reported output of America's farms in the same year. They further report that the marine sector provides 2.3 million jobs with an average annual salary of $81,000 which is 13% above the U.S. national average in the same year. Leading subsectors include marine tourism and recreation, national defense & public administration, offshore minerals, and marine transportation & warehousing.

Even though the marine industry contributes more to the U.S. economy than arts and entertainment, or utilities, or even modern data processing, it seemingly operates under the radar of most and receives comparatively little public attention.

PROBLEM FROM THE MACRO ECONOMIC PERSPECTIVE

The United States no longer holds the leading or influential position in the global maritime industry, the exceptions being the shrinking global presence of the US Navy and Coast Guard and some financing centered in New York City.

As the world's largest economy and the only world superpower, the United States has many reasons to maintain an influential stake in all industries that are key to global progress, economic value, and international politics.

The United States emerged mostly unscathed from the last global war. And as a capital-driven nation eager to rebuild the global markets and hence customers, while pushing back against a new potential foe, we spread our capabilities, our products, and our values across most of the world's nations, and built a castle of confidence in our strength that upholds the U.S. dollar as a current leading standard of world trade and leading reserve currency. This ensures the value of the dollar, giving our citizens at home a quality of life and security that we've come to expect. But leading positions are always subject to erosion, especially in a world that has seen continuous development for almost 80 years enabling a near leveling of lifestyles and quality of competitive capabilities and products across the world.

There are other nations, growing potential superpowers, that as competitors can surpass and displace the United States, which if this happens may critically impact the value of the dollar and risk shrinking our economy and our internal standard of living. In the last century we've seen such collapses of global position and national economy in the United Kingdom and the Soviet Union among others. Absent of major wars that can reorder global positions, the key to competitive economic fortune and global leadership comes from the combination of four elements.

1) Security, Order, and Trust
2) Culture that Encourages Merit and Elevation of Position
3) Open Market Economy
4) Technology Innovation

The United States does well against primary competitors in the combined value of the elements 1–3, but as we've transitioned into generations of leadership, both in business and government, that are guided less by long-term developmentalism and more through a lens of short-term finance, our nation has taken the eye off the strategic innovation ball. And because of that, competitors that, frankly, have learned from the United States, have a focused innovation strategy of such determined force that they seem to overcome their weakness in elements 1–3.

Natural Progression of Technology

It's easy for most Americans to overlook the fact that we live on a water-world. For over 3,500 years, the leading intercontinental nations, societies, and empires of each period were also dominant on the seas. Across 95% of that time, up until the mid-19th century, the highest technology was always in ships. But the 2nd Industrial Revolution (Industry 2.0) brought new fields such as electricity and assembly line manufacturing that cultivated immense economic value that by the time of Industry 3.0 maritime had become relegated to a lower return commodity driven sector.

And now today, autonomous technology is a key aspect of the 4th Industrial Revolution, which is continuing an ever-growing shift of both manual and cognitive effort from human to machine. Technologies in Industry 4.0 also include networked data-driven systems, Internet of Things (IoT), machine learning, and artificial intelligence (AI). However, it's difficult to see ways that these technologies can be applied generically across key industries. Meaning that one can innovate and build autonomy or AI for the automotive sector without much of it being applicable to aerospace or maritime.

Advancements from Autonomous Control

Advanced control systems have already been deployed in other vehicle sectors. From advanced flight control fly-by-wire systems in aircraft that began to enter the market in the 1980s to active driver assistance systems in cars and trucks that started to emerge in the early 2000s. And while there are many different capabilities to these technologies, the primary purpose is to increase safety by eliminating human operator errors and improve productivity and efficiency through precise data-driven control.

Marine autonomy is the innate technical progression after 20th century automation, yet the power and capability of it is an exponential step. Where automation is a singular process, often *if-this-then-that* control, autonomy is a comprehensive compute engine completing a larger complex process, like a full voyage, by prioritizing sensor data and weighing decisions to provide a desired outcome.

And that's valuable because the industry and its mariners today are handicapped by continued use of last century's technology and methodologies. Accident rates, both in commercial and recreational vessels eclipse most other moving vehicle industries, on time arrival rates that match airlines of the 1970s, and unoptimized operation of the world's cargo ships which are said to emit 3% of humanity's annual greenhouse gas.

SECTOR CHALLENGES

Accidents

According to Allianz and other sources such as the Japan P&I Club, on average approximately 2% of the global commercial fleet (vessels of 100 gross tons on greater) is involved in a non-machinery related major navigation incident or accident annually. In 2022, Allianz/Lloyds List reports 1,554 non-machinery related incidents and accidents in their tracked 58,000 vessels, of which 280 were vessel-to-vessel collisions and 209 were groundings. Japan P&I, latest data being 2016, tracks a fleet of 2,333 ocean going vessels reported 53 collisions and groundings, or a 2.2% rate.

2.2% is around the same rate as automobile accidents in the United States (2.4% of U.S. car fleet is calculated to have been involved in an accident in 2017) but a more appropriate comparison would be to airliners due to that sector being a professionally operated. Airlines in 2022 reported 39 accidents from a global fleet of 23,513 active aircraft or 0.17% rate; therefore, commercial maritime has an incident and accident rate 13 times commercial airlines.

Efficiency & Resource Use

Cargo ships are already around 2 times more fuel efficient per cargo ton compared to trains and 20 times versus average trailer-trucks but this is all due to size and quantity of cargo being moved by one vessel.

The approximately 58,000 commercial ships of the world burn around 350 million tons of fuel per year, *which is equivalent to 115 days of all oil consumption of the United States*. These vessels are said to emit 3% of society's global greenhouse gas emissions, which if the sector was a nation would rank No. 6 as an emitter.

It's believed that after power plants and aviation, cargo ships are the 3rd most concentrated source of greenhouse gas emissions, and therefore improvements that reduce fuel burn, can make a significant impact in reducing emissions in a short period of time when deployed across the fleets.

New technology brings great opportunity for improvement. Autonomous control systems, due to their more precise data-driven control and real time route optimization have the capability to reduce fuel usage, with presumed reductions up to 25% or more. Along with reducing emissions, this reduces operational costs and the U.S. Government is one of, if not the largest, buyer of petroleum products with the Department of Defense spending over $9 billion annually on fuel.

MARITIME APPLICATIONS

Autonomy transforms operations and brings forward the reliability, productivity, and precision of advanced robotics, empowering mariners to do more, do it better, with less effort and less cost. Autonomous control systems of various levels of faculty are being deployed by early adopters for both commercial and national security. And now, fueled by the prospect of opportunity and enhanced productivity, autonomy is beginning to be trialed in larger vessels that move cargo and people.

Workboats

Task driven workboats are using it for open water surveying, data collection, as well as heavy dangerous work like oil spill skimming and naval operations survey, security.

Response Boats

To improve response availability and response time autonomy systems are starting to be adopted by fireboats, lifesaving boats, and other response vessels; the technology being focused on routine or dangerous aspects of the work can enable the human crew to focus on specific complicated tasks.

Unmanned Naval and Security Vessels

Autonomy enables unmanned vessels which can provide new capabilities of persistent domain awareness or security; for example, providing a persistently patrolling sea-level sentry on watch for drug smugglers and complementing other common domain sensors or creating distributed networks of smaller naval vessels that extend the reach and support the power of the capital fleet.

Autonomous Pilot Assistance for all Vessels

The most significant benefit and uses of autonomous systems will be as advanced pilot assistance, bringing the value of onboard inherent control like that found in airliners and the ADAS systems emerging in road vehicles. It increases safety, performance, and overall efficiency of the operations. Within the next three years early adopters in sectors such as cargo ships, ferries, and yachts will begin deployments.

INFRASTRUCTURE

Infrastructure provides the foundation and common tools for our economy and society to grow and thrive. And over the years the federal government has taken numerous measures to promote our maritime sectors, from incentives to protectionism; however, both the scale and type of incentives are not aligned with the potential that can be unlocked. Along with maintenance and operational budgets for locks, navigation markers, dredging, and U.S. Coast Guard, the government has also spent about $100 million since 2010 in promotion of the U.S. Marine Highways System, or an average of $8.4 million per year, also around $20 million annually on grants to the shipbuilding sector. Most of these funds go to traditional physical assets, such as forklifts, cranes, welding machines. *This type of spending, while helpful at the micro-level, does very little to unlock the next era of maritime. The nation needs to be looking forward and invest in the digital infrastructure to stay ahead, inflate the value of the resulting products and services, and advance worker salaries*.

Marine Highway System

The Marine Highway System consists of 29 marine routes, along all coasts, major interior waterways, and around Puerto Rico, Hawaii, and other Pacific Islands. The intended reasoning behind establishing this system is well described by the Maritime Administration (MARAD), including reduction of traffic and local land air pollution within the nations roadways and land corridors, shifting hazardous cargo transit away from living areas, reducing road wear and maintenance costs, and improving transportation resiliency through alternatives. MARAD also presents the need to improve economic competitiveness by adding new freight and passenger capacities. These are all very important reasons to put focus and funding for the expanded promotion of the marine highways, but these trade lanes and passenger avenues also provide the venues to launch a new autonomy-enabled generation of technology.

COMPETITION

Looking at competition from the national perspective, we see development from each of the following nations, ranked by a combination of focus, maturity in development, funding, and momentum.

1) *China*: Deployment of many small autonomous collaborative boats, and now autonomous 300TEU containership, the ZHI FEI, commenced regular commercial short sea operations in 2022, as well a 200-ton trimaran unmanned naval patrol vessel.
2) *Israel*: Deploying and testing unmanned patrol vessels for over 15 years.
3) *United States*: Deploying naval test boats and larger vessels, often one-off for over 15 years. Venture-backed small businesses with commercially available products. Over 20 years of underwater autonomy development and commercial business.
4) *Singapore*: Deploying unmanned vessels for testing and military patrols for over 10 years; providing R&D funding to bring forward autonomous harbor tugs.
5) *UK*: Deploying and testing multi-unit unmanned mine counter measure (MCM) & patrol vessels for over 5 years.
6) *France*: Many R&D projects including MCM vessels, patrol boats, survey craft, and oil field support vessels.
7) *European Union*: Horizon 2020 technology funding track for autonomous vessel R&D, as well as funding for remote control cargo barging on inland waterways.
8) *Norway*: Government-funded development of autonomy associated with electrical cargo short sea shipping demonstrator.
9) *Japan*: Government funded R&D programs launched 4 years ago to developed autonomous cargo ships with multiple cohort collaborations.
10) *Sweden*: Deep commercial experience in underwater and direct remote control for naval vessels.
11) *Netherlands*: Multiple leading commercial marine operating companies that are deploying autonomy in survey and dredging projects.
12) *Turkey*: Multiple speculative commercially funded patrol vessel developments.

COMPREHENSIVE MARITIME NETWORK

This paper has been referring to marine autonomy mainly from a vessel or fleet perspective, but the opportunity is much bigger than the operational level. Autonomy is an enabling technology that can deliver the 1+2=10 systems of systems; when fully built out it will bring forth a global connected platform, much like the

internet, that ties new software applications and artificial intelligence to a major world-moving industry. For the same reasons that marine autonomy saw rapid initial adoption around the world, the domain being vast and open and suitable for even immature technology, makes an optimal environment for a fully connected active network to take shape. And whoever builds and dominates this network may take all value in a zero-sum competition.

IT'S TIME TO ACT

When looking at global fleet ownership, the United States now ranks No. 14, between Taiwan and Bermuda, well below China at No. 1 with a cargo fleet value that is nearly 5x that of the U.S. And China is pushing further ahead with government and government-backed investments both in the physical and digital infrastructure.

And while autonomy is a nascent space it's advancing quickly and other determined nations, such as China, that value its power and potential are investing heavily to take that commanding position. The United States shouldn't pass on this.

The federal government has a record of acting pro-actively to ensure new high value society-moving technologies are built and centered within our nation, from the internet to oil, from drugs to electric cars, it was members of Congress that used their voice and their legislation to bring focused attention, research budgets, steer federal agencies, or foster adoption through incentives.

Consider the example of the internet. In the 1980s, select members were actively bringing focus on the opportunities that can be had from the envisioned supercomputing network. Then in 1991 Congress delivered The High-Performance Computing and Information Act to President Bush which allocated $600 million to accelerate the development of the super-information highway. Almost immediately new companies were forming around the nation and by 2020, less than 30 years since the bill was signed, the internet directly contributed over 10% ($2.45 trillion) to our nation's annual GDP. A return on that 1991 investment like no other.

But there are also examples of new technical fields where our nation showed indifference or even stifled, from advanced high-tech and digital equipment manufacturing to aerial drones, allowing competitors to take the space.

And right now, the signal flags are snapping in the wind because marine autonomy is that next opportunity to capture immense future value for our nation and our citizens, bringing forth a digitally connected, network to machine autonomy that powers the next generations of marine fleets.

Action today is critical because competitors are clearly showing their desire, and without focusing our national lens we risk handing over the keys of the seas. The subject of marine autonomy is well known in many government departments and agencies that operate on water and some have developed strategic plans, supported by specific budget line items, that mostly include experimental roadmaps, knowledge and experience building, and industry partnering. These are all positive steps, but the reality is that leading competitors are fielding more autonomous vessels into determined active daily operations to force-forward a rate of development that cannot be achieved with a paced approach. We ask our Congress and other agencies to take the time to understand this opportunity in marine autonomous technology and proactively do things today to shape where we want to be in decades ahead.

CONCLUSION

The United States marine industry is at a crossroads of opportunity on the ever-important sea lanes and open oceans.

We, as Americans, are very aware of the value that industry brings to our society through products, jobs, wages, tax base, security, and happiness. Yet the value of each form of industrial technology normally decreases with time on the market as it becomes conventional, and therefore it's paramount to maintain a continuous re-inflation of our economic value through innovation of new technologies. And I believe it's the responsibility of leaders in the United States, from government to business, from labor to social, to purposely promote and foster this.

We have a workforce and knowledge base in maritime, software, robotics and a marine infrastructure that is ripe for improvement. With the right motivations through Government focus, voice, and funding and a permissive regulatory attitude, we can release a spirit into the veins of our commercial marine industry that breaks the molds of complacency and builds new technologies that bring U.S. maritime back to the tip of the spear on all fronts. Opportunity is knocking, let us answer before it is too late.

Thank you. I wish to thank you Chairman Webster, Ranking Member Carbajal, and Members of the Subcommittee for this chance to testify before you on the subject and I will make myself available for any further needed information.

Mr. WEBSTER OF FLORIDA. The gentleman yields back.

Now, Mr. Lahey, you are recognized for 5 minutes.

TESTIMONY OF PATRICK LAHEY, COFOUNDER AND CHIEF EXECUTIVE OFFICER, TRITON SUBMARINES

Mr. LAHEY. Thank you very much.

I am on a starkly different topic here, ladies and gentlemen. Good afternoon, ladies and gentlemen, Mr. Chairman, distinguished members of the committee. I greatly appreciate the opportunity to address all of you today.

My name is Patrick Lahey. I am the cofounder and CEO of Triton Submarines. I started Triton Submarines 17 years ago with the sole objective of creating the most advanced human-occupied vehicles, HOVs, in the world today that will allow our clients, along with their friends, family members, and guests, to safely explore the wonder and beauty of the deep sea.

Every sub built by Triton is still in class and in service, certified to the original depth and in the care and in the control of a client we enjoy a mutually beneficial relationship.

Every Triton is certified and accredited by an independent third-party classification society, which should be a requirement for all human-occupied vehicles. Triton created the deepest diving sub in the world today, the Triton 36000/2, which is the only classed and certified HOV with an unlimited diving depth.

Triton delivered this revolutionary new sub in 2018. In addition to completing dives to the deepest point in each of the world's five oceans during the historic and unprecedented Five Deeps Expedition, this extraordinary machine has made 16 dives to full ocean depth, the Challenger Deep in the Mariana Trench, and more than 100 dives to the hadal zone, an area of the ocean that lies between 20,000 and 36,000 feet.

I had the privilege of making five dives in the Mariana Trench, including the certification dive in 2019 with a DNV surveyor, which also turned into the deepest ever salvage at 35,865 feet. Classed and certified human-occupied vehicles still have a perfect track record of safety spanning more than 50 years.

During this time, tens of millions of people have enjoyed the wonderfully sublime experience of diving in the comfort and safety of an HOV without a single fatality. The OceanGate sub was an aberration, a mistake, and this experimental craft, which was not subjected to any type of peer review, should never have carried human beings.

The message is, the OceanGate tragedy was entirely avoidable. It should have never happened. There is no place in the human-occupied exploration of the deep sea for experimental subs.

Certification, accreditation, and independent classification society compliance is essential to avoiding a repeat of the OceanGate tragedy. HOVs must be independently peer-reviewed and validated to ensure they are safe for human occupancy. Any craft carrying human cargo should be required to meet or exceed the high bar of certification. No exceptions.

In addition to the tragic loss of life caused by the OceanGate disaster is the fear it has indirectly created or reinforced about subs, and the collateral damage it has done to legitimate builders of

classed HOVs in our small industry, like Triton and so many others.

We willingly and enthusiastically embrace the need and importance of the accreditation process, which is necessarily arduous, thorough, time-consuming and expensive, but results in a machine that is fit for purpose and safe for people to use within the limits stipulated by the certification agencies and the manufacturer.

Continued human-occupied exploration of the deep sea is essential to furthering our knowledge and understanding of these largely unexplored areas of our own planet.

HOVs, or human-occupied vehicles, are magical machines that I have had the privilege to work with for more than 40 years. I have devoted my professional life to the development and the safe operation of these vehicles.

Classed and certified HOVs safely transport you to the most fascinating place on our planet and help us to better understand and appreciate and begin to care about the importance of the ocean's health and well-being and the undeniable connection it has to our own continued survival.

We will only protect what we love, and properly designed and engineered subs allow you to connect viscerally and emotionally to a place most people never get the privilege and opportunity to visit.

But I can assure you that if you ever have a dive in a human-occupied vehicle, it will change your perception of the ocean forever. The experience will leave an indelible impression on you, just as it did to me more than 40 years ago. Just make sure the craft you are diving in is certified. The deep ocean is no place for compromise.

Thank you.

[Mr. Lahey's prepared testimony follows:]

Prepared Statement of Patrick Lahey, Cofounder and Chief Executive Officer, Triton Submarines

Mr. Chairman and members of the Committee, it is an honor to appear before you today and address concerns regarding the safety of human occupied vehicles (HOVs) or submersibles (subs) and to highlight the stark difference between the thoughtfully designed and carefully engineered machines created by Triton and other legitimate builders of certified HOVs in our small industry and the experimental craft built by OceanGate (OG), which should have never carried people.

My name is Patrick Lahey, and I am co-founder and CEO of Triton Submarines (Triton), a company with manufacturing facilities in Sebastian, Florida and Barcelona, Spain. During a career spanning 42 years in the underwater business, I have participated in the design, manufacturing, testing and operation of more than 60 HOVs. At Triton, I have overseen the development of our entire range of subs, including the Triton 36000/2 (36K/2), which is the first and only full ocean depth (FOD) rated HOV certified by an internationally recognized, and independent third-party classification society (DNV formerly DNV/GL). This remarkable craft provides safe daily access to the most extreme and least understood area of our ocean (the hadal zone, which lies between 6,000 and 11,000 meters or 20,000–36,000 feet), for the first time in history.

The Triton 36K2 was created during the same time frame as OG built Cyclops II (later renamed Titan). However, at Triton, we embrace certification as an essential deliverable for all our subs and we insisted on it as a requirement for the Triton 36K/2 too, despite the fact it made the project more difficult, time consuming and expensive. Certification is a key reason this unique craft was able to set records and accomplish more in the deepest and most remote areas of our oceans than any vehicle before it. Our goal at Triton was to create a new paradigm in ocean exploration and deliver an HOV that made it possible for people to safely make repeated dives

to any place in the ocean and accomplish meaningful work, even at the most extreme depths.

I have had the privilege and good fortune to complete five dives in the Mariana Trench, including a certification dive in 2019 with DNV surveyor, Jonathan Struwe, during which we successfully completed the world's deepest ever salvage at 10,932 meters or 35,865 feet. The Triton 36K/2 has made 18 dives to FOD and more than 100 dives to depths below 6,000 meters since we delivered the sub in late 2018. For context, the deepest point in the Mariana Trench is almost three times the depth of RMS *Titanic*, which lies in 3,800 meters or 12,500 feet.

The Triton 36K/2 is a great validation of the accreditation process and underscores the critical importance of subjecting a HOV to a peer review. Rather than stifle innovation, the DNV principal engineer, Jonathan Struwe together with the considerable resources, capabilities and insights of the Underwater Technology Team at DNV were essential to our success.

Certification is the crucible in which responsible innovation in extreme environments is possible. Certification is not an impediment to innovation (as OG publicly stated) and the success of the Triton 36K/2 and development of this revolutionary HOV, is a direct result of our relationship with a classification society and clearly demonstrated the benefits of the accreditation process.

Unfortunately, HOVs have been the subject of a lot of negative press since the OG tragedy, which is unwarranted, particularly if people understood the facts. This tragic incident has brought into sharp focus the vast difference between an experimental craft such as the one built by OG, and the carefully designed, thoughtfully engineered, and thoroughly vetted machines created by legitimate builders in the HOV industry, which are subjected to an arduous, time consuming, necessarily thorough, and expensive accreditation process, implemented and overseen by internationally recognized and independent third-party classification societies, to ensure a HOV is safe and suitable for carrying human cargo.

The OG tragedy captivated public attention because of the notoriety of the dive site and of course the loss of human life, which play into people's worst fears about the sea and this type of craft. Most people mistakenly believe HOVs are wildly dangerous and unnecessary. At Triton, we have been pushing back against these myths and stereotypes for nearly two decades because they bear no resemblance to reality. The OG tragedy was an anomaly, an aberration and would never have happened if this ill-fated craft had been subjected to the certification process.

In fact, accredited or certified HOVs enjoy a 50+ year track record of perfect safety, making them the safest mode of transport in the world. People have no hesitation in jumping in a car and going for a drive or flying in an aircraft where the potential for an accident is thousands of times greater. In fact, in the last 50 years, tens of millions of people have safely enjoyed the thrilling experience of diving in a certified HOV, without a single fatality.

Many found the failure mode of the OG craft particularly shocking because it was without precedent but to those of us in the HOV business, the OG hull collapse was not a surprise. It was a predictable result of the pressure hull being made of a capricious material, which was not suitable for the intended application. The filament wound carbon fiber cylinder in the OG craft was degrading from the exposure to pressure associated with each dive or cyclic use.

OG created an 'acoustic monitoring system' for Cyclops II, which they described as innovative and a system all HOVs should use, but the requirement for such a system was an acknowledgement their filament wound carbon fiber cylinder was weakening on each successive dive and its capacity to resist the crushing pressure at 3,800 meters or 12,500 feet was diminishing over time and would continue to degrade until it failed, catastrophically and without warning. A properly designed and engineered HOV doesn't require an acoustic monitoring system because the health of the hull is fundamental and beyond question.

A capricious material that degrades in performance and efficacy from normal use, is unacceptable as a pressure boundary for an HOV. If the OG sub had been subjected to any kind of peer review, this fact alone would have disqualified it from certification. OG dismissed certification because they claimed their craft was so cutting edge and innovative the classification societies wouldn't understand it, but the reality is the OG craft could not be classed and there were many other design features, which would not have complied with the classification society requirements.

Triton and every legitimate manufacturer in our small industry would not endorse the use of an 'experimental' HOV. Instead, these companies exclusively manufacture HOVs, which are fully certified and accredited by independent third-party classification societies.

Certification begins with a review of our initial design assumptions and ideas, which includes Finite Element Analysis (FEA), calculations, etc. The process con-

tinues through to the selection, independent analysis, and approval of all materials, which must be procured from qualified vendors, and the conformance of these materials to the dimensional tolerances stipulated in our reviewed and approved drawings. Approved and tested materials are then fashioned into assemblies, which are subjected to additional testing and validation requirements as stipulated by the class society.

Certification requires the involvement of a surveyor during the commissioning process of a HOV, which includes witnessing factory, harbor, and sea acceptance trials and continues through to delivery and the qualification of all personnel who are responsible for operating and maintaining it. Certification is required for the lifetime of the sub and is an on-going process where continued compliance is validated by regularly scheduled surveys, inspections of paperwork and testing as required and witnessed by an attending surveyor representing the classification society.

Every Triton sub is designed, manufactured, tested, and operated in compliance with the rules of an internationally recognized classification society (DNV, ABS, etc.). These rules have evolved over many decades and been influenced by the experiences gleaned from a wide variety of operating environments (industrial, recreational, scientific etc.).

The accreditation of a HOV is like that undertaken by the FAA for an aircraft. There are hundreds of pages of safety compliance criteria. Triton subs meet the requirements of numerous other authorities, including Flag State Registries, Pressure Vehicles for Human Occupancy (PVHO) rules, and International Maritime Organization (IMO) Guidelines for the Design, Construction and Operation of Passenger Submersible Craft.

There must be a simple requirement applied to all HOVs. Either they are certified and can carry people safely, or they are not. Either a HOV complies with the rigorous design, engineering, validation, testing protocols, annual and special periodical survey, and inspection requirements of a third-party and independent classification society (such as DNV and ABS), or it does not. If it does not, it should not carry people, period. If we stick to this simple rule, tragedies like the OG disaster can and will be prevented.

I have spent most of my adult life going to sea and diving in certified and accredited HOVs. The ocean is a magnificent but unforgiving environment. Being at sea and diving in subs requires an understanding and an awareness of the extreme forces at work and demands the humility and respect of anyone who intends to work and play in this space while ensuring the occupants of a HOV remain safe.

To date, Triton has designed, manufactured, and sold dozens of subs. Every Triton remains in class, certified to the original depth and in the hands of a client with whom we enjoy a mutually beneficial and on-going relationship. The after sales service and technical support relationship is essential to ensuring a HOV performs as expected and is being operated and maintained in accordance with both the classification society requirements and those of the manufacturer.

We are fortunate indeed to have inherited the wisdom and collective experience of generations of engineers, designers, and operations personnel who preceded us. The cornerstone of any product intended to carry people into the deep sea is that it must be simple to operate, easy to maintain, reliable and most of all safe.

At Triton, the culture of safety is foundational. In contrast to the OG approach of ostracizing those who called attention to safety concerns, we adhere to the "see something, say something" model, where anyone can and should raise a safety concern at any time and for any reason. Everyone knows we look out for each other and take the responsibility of building equipment capable of safely transporting people thousands of feet into the deep sea personally. Everyone benefits when everyone contributes towards a shared culture of safety.

If a person wants to dive beneath the surface in a HOV, they have a reasonable expectation the craft they are in meets some type of recognized standard of safety. The predatory and unscrupulous practice of selling unsuspecting people a seat in an experimental HOV and calling them "mission specialists" or "crew" to skirt the rules or avoid regulations is unacceptable and must be stopped. If certification with a recognized classification society is made a requirement for any HOV being used for these types of commercial operations, future tragedies can be avoided.

At Triton, we're proud to create magical machines that allow people to explore the most beautiful but least understood area of our planet. Our clients undertake ambitious and inspiring science, film making and exploration missions in the deep sea. Their notable achievements are a great source of pride and further validation of the importance of continued exploration of the deep sea with HOVs.

I conclude with the simple wisdom that sunlight is the best disinfectant. Transparency in all facets of safety is critical to building confidence and maintaining the

enviable and unprecedented track record of safety classed HOVs still enjoy today. The role of the certification agencies is paramount to the development of safe HOVs. These agencies grade our work. They demand a design be proven, not just postulated, and rigorously tested before any people ever dive in it. I have every reason to believe that adherence to this simple rule will permit exploration of our ocean for decades to come, safely. At Triton we recognize the deep sea is no place for compromise.

Thank you.

Mr. WEBSTER OF FLORIDA. The gentleman yields.

Mr. Spain, you are recognized for 5 minutes.

TESTIMONY OF T. CHRISTIAN SPAIN, VICE PRESIDENT OF GOVERNMENT RELATIONS, AMERICAN MARITIME OFFICERS

Mr. SPAIN. Mr. Chairman, Ranking Member, and members of the committee, I would like to thank you for the opportunity to testify for American Maritime Officers; Marine Engineers' Beneficial Association; Masters, Mates & Pilots; and the Seafarers International Union here today.

I hope everyone will take the time to read my written testimony, which is quite technical. I would like to share with you my 30 years of experience as a U.S. seafarer in the international maritime industry.

I am Captain Christian Spain, and I am proud to represent the 3,400 officers at American Maritime Officers as their vice president of government relations. I have been working for AMO in Washington for about a decade. And prior to that, I sailed aboard AMO-contracted vessels as a master and deck officer for nearly 20 years.

Maritime autonomous surface ships, or MASS, are called by different names, such as autonomous vessels, drone vessels, or unmanned surface ships. I will just refer to them as MASS. For the safety of all seafarers, MASS must adhere to the existing maritime regulations, such as the International Regulations for Preventing Collisions at Sea, often referred to in the maritime industry as ColRegs or the rules of the road.

Instituting separate parallel regulations for MASS should be given little consideration. For instance, vessels have a duty to render assistance by providing manpower, equipment and/or shelter to survivors in the event of a maritime emergency. This duty goes back a millennium and cannot be shirked because it is inconvenient for innovative technology.

MASS must be able to use both spoken and written language, as safe communication is vital for the safety of the seafarers, passengers, and the marine environment, but also for the efficiency of daily tasks and the ship's integrity. MASS, like traditional vessels, should be equipped with VHF radios to exchange information with nearby vessels, ports, and maritime authorities. This includes communication for collision avoidance, navigation updates, and emergency situations as required by current domestic and international maritime laws and regulation.

The upfront cost of retrofitting existing vessels or purchasing new autonomous ships are substantial. Shipowners have reservations about making such significant investments, especially if the benefits are not immediately realized.

While proponents of MASS argue that the autonomous vessels can reduce OpEx over time, shipowners worry about the ongoing

expense related to maintenance, software updates, and cybersecurity measures.

Ships generally are only making money for an owner when they are underway. Without seafarers aboard, preventive maintenance would have to be exceptionally well-tailored and timed to occur in geographically advantageous areas to see cost savings over the life of a vessel, based on labor arbitrage. When considering an unplanned maintenance and repair, it would seem very unlikely to save money when there are no seafarers aboard your vessel to repair it.

Use of MASS will not eliminate or prevent the risk of maritime accidents, including collisions, allisions, and groundings, which can lead to oilspills and significant environmental damage. The absence of onboard seafarers may hinder the rapid response to oilspills, exacerbating the environmental impact.

MARPOL and OPA 90 are complementary and critical instruments for regulating the discharge of pollutants from vessels, including oilspills. Crewmembers must be trained to take immediate steps to minimize spillage, such as deploying oilspill containment equipment, and regularly drilling in the use of such equipment so that crewmembers are well-versed in emergency procedures.

Seafarers play a pivotal role in mitigating the environmental impact of oilspills from vessels. Crewmembers on board are integral to the effective implementation of MARPOL and OPA 90 regulations in response to oilspills.

Digitization in the maritime sector allows the further automation of some functions and better control of processes as a whole. It can enable an increased use of remote-control technology. Many of these technologies could be used to the benefit of seafarers and improve the safety conditions while providing more efficient operations. Other than in niche markets, this technology should be used as a tool and not a complete replacement for seafarers.

In closing, I want to emphasize that there is a substantial difference between commercial international shipping and the mission of the U.S. Coast Guard and other Government agencies.

Thank you, Mr. Chairman, and the committee for your attention on this pivotal matter.

[Mr. Spain's prepared statement follows:]

Prepared Statement of T. Christian Spain, Vice President of Government Relations, American Maritime Officers

Mr. Chairman, Ranking member, and members of the committee, I would like to thank you for the opportunity to take this seat representing American Maritime Officers, Marine Engineers Beneficial Association, Masters, Mates & Pilots and Seafarers International Union for today's hearing. Maritime Labor would like to express our gratitude for the chance to appear before this distinguished congressional committee to provide testimony on the critical issue of ensuring safety in the Marine environment with the introduction of Autonomous vessels.

My name is Christian Spain I am proud to represent the 3400 officers at American Maritime Officers as their Vice President of Government Relations. I have been working for AMO in Washington for about a decade. Prior to that I sailed aboard AMO contracted vessels as a Master and Deck Officer for nearly 20 years. As a collateral duty I currently serve as the Vice-Chair of the International Transport Workers Federation—Maritime Safety Committee. As a member of this committee, I have the honor of representing the world's 1.9 million seafarers at the International Maritime Organization where we have been discussing policy and regula-

tion surrounding Maritime Autonomous Surface Ships or MASS for nearly 8 years. I have found that MASS are called by different names such as autonomous vessels, Drone vessels or unmanned surface ships. For the purposes of this hearing, I will just refer to these vessels as Maritime Autonomous Surface Ships or MASS. Discussion of the MASS can quickly devolve into a discussion of Classes or variations of autonomy such as the IMO's 4 Classes of Autonomy ranging from MASS with Manual Control to Fully Autonomous vessels. For this limited discussion unless otherwise noted I will assume that we are talking primarily about fully autonomous vessels.

With 33 years in the industry, addressing the safety concerns associated with this transformative technology, I stand here not only as a representative of the seafaring community but as a concerned citizen eager to contribute to the development of policies that prioritize the well-being of the world's 1.9 million seafarers. My testimony today will focus on the imperative of safety of the seafarers, the challenges and risks associated with MASS vessels, and the steps that both policymakers and industry stakeholders must take to mitigate these risks effectively. In doing so, I aim to shed light on a few of the complex issues surrounding MASS safety and offer insights that can guide the development of legislation and regulations that safeguard the interests of our citizens while fostering innovation.

In my brief time here, I would like to cover three broad areas of what I feel are the most important issues that the committee should take into consideration. First and foremost, safety for seafarers, passengers, the public and the marine environment. Those regulations most recognizable in the maritime industry such as the International Convention for the Safety of Life at Sea (SOLAS), International Regulations for Preventing Collisions at Sea (ColRegs) and International Convention for the Prevention of Pollution from Ships (MARPOL) all deal with almost exclusively the safety of humans and the marine environment. Secondarily, commercial shipowners are not clamoring for MASS technology. The Capital Expenditure and Operational Expenditure savings for a MASS vessel seem uncertain at best. Many of the largest ship owners are partnered with companies working on MASS development which on the face of it appears they are advocates for MASS technology. However, when talking to the largest shipowners you would be hard-pressed to find more than a few who see their ships operating in the coming decades without seafarers aboard. Shipowners are involving themselves in MASS to keep apprised of what is going on; but just because you can do something does not mean you should. There is a niche market for MASS but on the commercial side it is small in grand scheme of things. Lastly, concern regarding the inability of MASS to mitigate marine environmental damage after a collision, allision, grounding or oil spill should be considered.

For the safety of all seafarers MASS must adhere to the existing maritime regulations such as the International Regulations for Preventing Collisions at Sea often referred to in the maritime industry as the ColRegs or "Rules of the Road". Instituting separate parallel regulations for MASS should be given little consideration. For instance, vessels have a duty to render assistance by providing manpower, equipment, and/or shelter to survivors in the event of a maritime emergency. This duty goes back a millennium and cannot be shirked because it is inconvenient for MASS deployment. Additionally, effective communication between MASS and other vessels in the vicinity, maritime authorities and ports is important to the smooth operation in the maritime environment.

The emergence of Maritime Autonomous Surface Ships (MASS) has raised significant questions regarding the adaptation of nearly all existing maritime regulations, particularly the International Regulations for Preventing Collisions at Sea (ColRegs). There is a complex debate surrounding whether the ColRegs should be altered to accommodate MASS or if MASS should be required to adhere to existing regulations. The central argument presented herein is that altering the ColRegs to accommodate MASS is not only unnecessary but also fraught with risks, and that it is imperative for MASS to adapt to the established ColRegs framework. Safety is paramount in the maritime domain, and this testimony underscores the importance of maintaining a uniform set of rules to ensure the safe integration of MASS into our oceans. It explores the challenges and opportunities presented by MASS, the key arguments against modifying ColRegs, and the ways in which MASS can seamlessly align with existing regulations.

Maritime Autonomous Surface Ships (MASS), also known as autonomous ships or unmanned surface vessels, represent a transformative development in the maritime industry. These vessels are equipped with advanced technologies such as artificial intelligence, automation, and machine learning systems, allowing them to operate without direct human intervention. The potential benefits of MASS are numerous, including increased operational efficiency, reduced operating costs, and enhanced

environmental sustainability. However, the integration of MASS into the global maritime ecosystem raises critical questions about safety and regulatory compliance.

At the heart of this debate is the International Regulations for Preventing Collisions at Sea (ColRegs), a set of rules established by the International Maritime Organization (IMO) to prevent collisions between vessels and ensure the safety of navigation at sea. ColRegs, also known as the "Rules of the Road," serve as the foundation of safe maritime navigation. They provide a standardized set of regulations that govern the conduct of vessels, including right-of-way, navigation lights, sound signals, and more.

As the maritime industry stands on the cusp of a technological revolution with the advent of MASS, the question arises: Should the ColRegs be modified to accommodate these autonomous vessels, or should MASS be required to adapt to the existing regulatory framework? I would assert that altering the ColRegs to accommodate MASS is not only unnecessary but also counterproductive to the goal of ensuring safety at sea. Instead, MASS should be expected to conform to the established ColRegs. Integration while maintaining safety is the paramount objective.

MASS are equipped with advanced sensor systems, such as radar, lidar, and cameras, coupled with sophisticated artificial intelligence algorithms. These systems can detect and respond to potential collision threats with a speed and precision that may surpass human capabilities. While these advantages are compelling, they must be carefully weighed against the potential risks and challenges associated with the integration of MASS into existing maritime operations. Safety remains the paramount concern, and the question of how to ensure the safe coexistence of autonomous vessels with manned vessels and traditional maritime practices cannot be overstated.

The maritime industry has a long history of regulating navigation and ensuring the safety of vessels at sea. The development of international maritime regulations, including the ColRegs, has been driven by a fundamental need for standardized rules and practices. The International Regulations for Preventing Collisions at Sea (ColRegs) were first established in 1889 at the International Maritime Conference held in Washington, D.C. The goal was to reduce the risk of collisions between vessels and establish a consistent set of rules for mariners worldwide.

One key principle underlying the ColRegs is the concept of "common practice." This principle dictates that mariners should be able to rely on consistent behaviors and responses from other vessels based on the ColRegs' rules. In other words, vessels navigating international waters should adhere to a shared set of standards and expectations, regardless of their flag state or technological sophistication.

Mariners can anticipate the actions of other vessels based on the ColRegs, enhancing overall safety, and reducing the risk of collisions. This predictability is vital for safe navigation, especially in congested waterways and under adverse weather conditions. A common regulatory framework allows vessels from different countries and operators with diverse backgrounds to navigate safely together. This interoperability is essential for international trade, commerce, and cooperation on the high seas.

The ColRegs assign responsibilities to vessels in various situations, making it clear who is at fault in the event of a collision or navigational error. This accountability is essential for legal and insurance purposes.

Given the historical importance of uniform regulations and the fundamental principles of predictability, interoperability, historical continuity, and accountability, any proposed changes to the ColRegs must be carefully considered in the context of their potential impact on safety and the global maritime ecosystem.

The question of whether the ColRegs should be modified to accommodate Maritime Autonomous Surface Ships (MASS) has generated significant debate within the maritime community. While proponents of modification argue that it is necessary to accommodate the unique characteristics and capabilities of MASS, several compelling arguments suggest that altering the ColRegs is neither prudent nor in the best interest of safety. Safety is the paramount concern in maritime operations. The ColRegs are designed to ensure the safety of vessels and mariners at sea by providing a common set of rules that govern navigation and the prevention of collisions. Any modification to these regulations must be rigorously evaluated to determine whether it enhances or diminishes safety.

One of the primary safety concerns associated with modifying the ColRegs for MASS is the potential for confusion and uncertainty. If MASS were subject to a different set of rules than manned vessels, mariners navigating near these autonomous vessels might struggle to predict their actions and respond effectively. This unpredictability could lead to an increased risk of collisions and accidents and a threat to our marine environment. Moreover, MASS, like all vessels, are susceptible to technical malfunctions, system failures, and cyberattacks. In the event of such incidents, it is crucial that MASS adhere to the same rules as manned vessels to ensure a consistent and coordinated response. Deviating from the established ColRegs

framework for MASS could create legal and operational challenges in emergency situations.

In a maritime emergency, a coordinated effort involving various parties is essential to ensure a swift and effective response that maximizes safety and minimizes harm. The specific parties involved can vary depending on the nature and severity of the emergency, but here are some key stakeholders who typically play a crucial role in lending a hand during maritime emergencies are the crew of the distressed vessel, Maritime Authorities and Nearby vessels, especially those in the vicinity of the distressed vessel, may be called upon to aid a vessel in distress. This is a fundamental principle of maritime law known as the "duty to render assistance." Vessels in the vicinity are required to offer support by providing manpower, equipment, or shelter to survivors.

Maritime Autonomous Surface Ships (MASS) represent a cutting-edge development in the maritime industry, with the potential to transform various aspects of shipping, including safety and emergency response. However, when it comes to referring assistance in a maritime emergency, MASS systems must be equipped to handle such situations in a manner that ensures the safety of human life, property, and the marine environment. The duty to render assistance at sea is a longstanding maritime tradition that has evolved over centuries. It is deeply rooted in the principles of maritime ethics and human solidarity. While it does not have a specific age or date of origin, this duty has been recognized and practiced for as long as humans have been engaged in maritime activities. It can be traced back to ancient seafaring civilizations, such as the Greeks and Romans. These ancient mariners often came to the aid of shipwrecked sailors out of a sense of duty and honor.

MASS must be able to use both spoken and written language as safe communication is vital for the safety of crew, passengers, industrial personnel or special personnel, ship, and external environment, but also for the efficiency of daily tasks and the ship's integrity. Very High-Frequency (VHF) radio communication is a standard method for ship-to-ship and ship-to-shore communication. MASS like traditional vessels should be equipped with VHF radios to exchange information with nearby vessels, ports, and maritime authorities. This includes communication for collision avoidance, navigation updates, and emergency situations as required by current maritime laws and regulation.

Safe and correct communication is particularly important for ships that cross national borders, especially in connection with radio communication between ships and other actors (land bases, various suppliers, shipping companies, authorities etc.). MASS communication should include acknowledgment of correct receipt and understanding. This applies both to normal operations as well as in maritime emergencies.

It is important that law makers and regulators insist for the safety of seafarers and the public that Maritime Autonomous Surface Ships be held to the same regulatory standards as manned vessels for they are working in and around manned vessels who should be able to rely on consistent behaviors and responses from other vessels regardless of their level of Autonomy. This includes MASS adherence to the ColRegs, MASS ability to comply with a "duty to render assistance" and MASS ability to communicate with manned vessels and other entities for day-to-day operations as well as maritime emergencies.

Maritime labor has been in close communication with many of the largest shipowners since MASS started to be discussed in earnest around 2016. While many of the largest Shipowners work with companies developing MASS technologies the owners continue to worry about the reliability and redundancy requirements of the technology. Unlike traditional ships, which have experienced crews capable of handling unforeseen technical failures, MASS relies heavily on complex systems. A malfunction or cyberattack could lead to catastrophic consequences, including collisions, grounding, or environmental disasters. All the largest shipowners we continue to discuss MASS with do not see a future of commercial shipping that does not include some crewmembers based on these concerns and probably more importantly the costs of not having crew aboard when needed.

The upfront costs of retrofitting existing vessels or purchasing new autonomous ships are substantial. Shipowners have reservations about making such significant investments, especially if the benefits are not immediately realized. While proponents argue that autonomous vessels can reduce operational costs over time, shipowners worry about the ongoing expenses related to maintenance, software updates, and cybersecurity measures. Ships generally are only making money for an owner when they are underway. Without seafarers aboard preventive maintenance would have to be exceptionally well-tailored and timed to occur in geographically advantageous areas to see cost savings over the life of a vessel based on labor arbitrage. When considering unplanned maintenance and repair it would seem very unlikely

to save money when there are no seafarers aboard to repair your vessel. Shipowners question whether the promised cost savings will materialize in practice.

With increased reliance on digital systems and connectivity, shipowners are also concerned about the vulnerability of MASS to cyberattacks. The potential for hackers to gain control of autonomous vessels or disrupt their operations poses a significant safety risk to seafarers and the marine environment.

Determining liability in the event of accidents or incidents involving MASS is a complex and evolving issue. Under current maritime custom operators (Masters), owners and equipment manufacturers typically take the brunt of liability in this order, both civil and criminal. Without an operator the logical replacement would be the "creator" of AI or machine learning for the MASS in question. This leads to the next question of who has jurisdiction over the "creator"? Currently the Master and/or seafarers are held criminally liable and imprisoned. In a situation where a MASS is found criminally liable will the "creator" or the shipowner be imprisoned? How does one obtain jurisdiction over these people or for that matter a remote operator if there is no extradition treaty with their country of residence? Shipowners worry about the potential legal disputes and the associated financial burdens that may arise from unclear liability scenarios. The uncertainty surrounding the safety and liability aspects of MASS can lead to increased insurance premiums which are viewed as an additional financial burden.

The adoption of Maritime Autonomous Surface Ships (MASS) has garnered significant attention in the maritime industry due to its potential benefits, including improved efficiency. However, it is crucial to acknowledge the potential dangers that MASS poses to the environment. The environmental risks associated with MASS technology, including issues related to energy sources, pollution, navigational challenges, and the broader ecological impact. It underscores the importance of addressing these concerns to ensure that the transition to MASS aligns with the goal of minimizing oil pollution.

The use of MASS does not eliminate the risk of maritime accidents, including collisions, allisions and groundings, which can lead to oil spills and significant environmental damage. The absence of onboard seafarers may hinder the rapid response to oil spills, exacerbating the environmental impact. The International Convention for the Prevention of Pollution from Ships (MARPOL) and the Oil Pollution Act of 1990 (OPA 90) are complimentary and crucial instruments for regulating the discharge of pollutants from vessels, including oil spills. The crew requirements in response to oil spills, emphasize the importance of crew preparedness, vigilant reporting, and effective response measures. Crew members are required to be familiar with spill response equipment, such as oil booms which are essential for effective response. Crew members must be trained to take immediate steps to minimize spillage, such as deploying oil spill containment equipment. Regular oil spill response drills should be conducted to ensure that crew members are well-versed in emergency procedures. Seafarers play a pivotal role in mitigating the environmental impact of oil spills from vessels. Crew members on board are integral to the effective implementation of MARPOL and OPA 90 regulations and the response to oil spills.

In this testimony I have highlighted three overarching areas that warrant the committee's careful consideration. Firstly, paramount importance must be placed on ensuring safety and well-established regulations in the maritime industry, such as the International Convention for the Safety of Life at Sea (SOLAS), International Regulations for Preventing Collisions at Sea (ColRegs), and International Convention for the Prevention of Pollution from Ships (MARPOL), predominantly address the safety of human lives and the protection of our precious marine ecosystems.

Secondly, I have delved into the fact that commercial shipowners are not fervently advocating for the widespread adoption of Maritime Autonomous Surface Ship (MASS) technology. This advocacy is coming from the developers of MASS. The anticipated cost savings in terms of Capital Expenditure and Operational Expenditure for MASS vessels remain uncertain, with many of the industry's major shipowners maintaining reservations about transitioning away from crewed vessels. It is a reminder that just because we have the capability to pursue a particular path does not necessarily mean it is the most prudent course of action. The commercial applicability of MASS, while promising in niche markets, may not have a significant impact in the broader context of the maritime industry for many decades.

Lastly, it is crucial to consider the concerns surrounding the capacity of MASS to effectively mitigate environmental damage in the aftermath of maritime incidents such as collisions, allisions, groundings, or oil spills. Ensuring that our technological advancements align with environmental protection measures is imperative.

In light of these considerations, the committee should prioritize safety, remain cognizant of the evolving landscape of commercial shipowners concerns and underscore the importance of environmental responsibility when deliberating on the fu-

ture of MASS technology in the maritime industry. The development of better software, smaller sensors and better communications is leading to the increasing digitalization throughout the global economy. Digitalization in the maritime sector allows the further automation of some functions and better control of processes as a whole. It can enable the increased use of remote-control technology. Many of these technologies could be used to benefit seafarers and improve safety conditions while providing more efficient operations. Other than in niche markets, this technology should be used as a tool and not a complete replacement of seafarers.

Again, thank you Mr. Chairman and the committee for your attention to the pivotal matter.

Mr. WEBSTER OF FLORIDA. The gentleman yields back.

I now will turn our attention to the questions for the panel. I recognize myself for 5 minutes.

Mr. Pribyl, in your opinion, where can the Coast Guard immediately leverage existing commercial unmanned technologies to support its missions?

Mr. PRIBYL. We looked at this in the report, and we laid forth what we felt were the areas, the mission areas where the use of unmanned systems could provide the most immediate value. I think that it is a combination of some that were mentioned on the first panel, things like search and rescue and pollution response.

The issue, in terms of the commercial access to that that we found in the report, was the acquisition process, that it wasn't moving quickly enough, that they didn't have the mechanisms in place to avail themselves of that technology. And in the United States, most of this technology is being developed on the commercial side.

So, we had made some recommendations related to that. And I think if you look in combination with the recommendations as to the areas of missions that are of value and then see if they can make improvements as to the acquisition side, I think that is where they would have the most value.

Mr. WEBSTER OF FLORIDA. Mr. Johnson, what are the biggest regulatory hurdles that you have encountered in development of systems built by your company?

Mr. JOHNSON. Yes. Thank you for the question, Chairman. We have not seen many regulatory hurdles. We are mariners. I came from the marine industry. The reason for what we are building is because of challenges that I saw in my work up in Alaska and in the salvage industry as well, where we dealt with many marine accidents.

And so, we operate within the Maritime Domain and from the beginning have built our technology to work within the current regulatory structure.

So, we are a technology company, and then we support our customers, operators, to ensure that they gain the approval of U.S. Coast Guard, Danish Maritime Authority, and other places. Plus, we work closely with the class societies as well, who have worked to certify our technology and also type approve it to be able to be installed across fleets.

Mr. WEBSTER OF FLORIDA. Mr. Lahey, if OceanGate had submitted the *Titan* to appropriate regulatory oversight, including a class inspection, what do you think would have been the likely result?

Mr. LAHEY. Well, thank you for the question. I think the end result of them subjecting that vehicle to the accreditation process is

it would have failed miserably. It was a craft that would have never been able to meet the high bar of certification.

Mr. WEBSTER OF FLORIDA. Mr. Spain, how would you, in your role as a mariner, change aboard vessels with increased automated capabilities?

Mr. SPAIN. I could see the need for upscaling, depending on what the systems are the systems being installed. There are so many different systems out there in development right now, I wouldn't comment other than to say that.

Mr. WEBSTER OF FLORIDA. Well, what needs to be done to ensure that mariners are adequately trained in these new technologies?

Mr. SPAIN. Well, each system is different and requires unique training, I believe, at least in its current iteration. I would say that I believe going forward, we will see different sectors develop different training needs.

Mr. WEBSTER OF FLORIDA. Thank you very much. All right. I know you may think this is a small group, but it is a powerful group. It is an awesome group of people, and we are ready to change the world. So, anyway, you just stay with us.

So, anyway, I would recognize Ms.—well, you are kind of the ranking member now.

Ms. SCHOLTEN. I would be happy to, but I defer to you as well. OK.

Thank you all so much for your critically important testimony today. I have got a number of different questions, so, bear with me.

Mr. Johnson, in your testimony, you talk about how the U.S. lags in the development of new tech behind other countries, like China.

What can we be doing now in the U.S. to position us as a leader in maritime technology and innovation?

Mr. JOHNSON. Yes, thank you for the question. We listened this morning to the testimony of the admirals and the questions around that. And a lot of it was around regulation and from that standpoint.

And so, I look at our Nation kind of from two hands. You have the Hamiltonian, which was on developmentalism, about being the coach and using the Government to coach industry and bring it forward. Then you have the Jeffersonian, which was about being the umpire and controlling.

And so, I think we have been doing really well on the umpiring side of it and the refereeing of it. And I think, as Government, we need to be doing much more on the coaching and promotion of innovation to continue to build our GDP.

Marine autonomous technology is a significant opportunity. The way that I look at it is similar to what we did and what the Government did—Congress did—with the internet going back to 1991, with the High-Performance Computing Act. That act, which then also put $600 million out there, sparked that whole development. And that whole industry now puts $2.5 trillion into our GDP.

And so, that was a really good investment. And so, from our side, or looking at autonomous technology, I see the scale of the space. Our industry moves, I think it's $17 trillion of world trade. And it's a great place to be on the leading edge of technology for the future ahead.

Ms. SCHOLTEN. Thank you. That is incredibly helpful.

Staying on this but switching gears a little bit, this question is for Mr. Spain.

I would like you to expound a little bit on the point in your testimony regarding liability. And currently, liability rests with the master.

On a fully autonomous vessel, who would be responsible for a maritime casualty?

Mr. SPAIN. Thank you, Congresswoman. That is the question and why I put it in the testimony. I do do a lot of work at the IMO. I have been working there for 10 years, and I have been involved with the MASS discussions for the last 8.

This has not been worked out. The criminal liability part is a real stickler there, because if you don't have jurisdiction over the person, then where are you? Some people have suggested that if a vessel is operating in your space, such as the U.S., if you want to have jurisdiction over them, then you have got to ensure that the remote operation center is within your jurisdiction in the U.S.

There is a tradition in our industry, at least with regard to flagging vessels out, or flagging vessels and flags of convenience in order to skirt jurisdictions for other reasons. And I foresee this as being one of the biggest issues, determining how this lays out, who is responsible and who somebody can put hands on, really. Thank you.

Ms. SCHOLTEN. It is, indeed, an important question not only in maritime vessels but in autonomous vehicles as well. We are grappling with it across industries.

What guides do you look to to make these decisions, or what do you think that we can look to to come to some sort of conclusion here?

Mr. SPAIN. I am no expert on this. Initially, I would have thought before being involved with this that I would go with the owner, but the issue is that if you have a manufacturer of a unit and say it has got 15 different safety options and 5 of them are required and somebody buys one with 6, and then you find after an accident that, hey, if you would have had another 6 of these options that this likely wouldn't have happened, well, is it the owner's responsibility? Probably.

But if that is not the issue, and the issue is about the actual unit and which portion of it fails to operate, then it's probably on the manufacturer.

Ms. SCHOLTEN. Thank you.

I will yield back at this point.

Mr. WEBSTER OF FLORIDA. The gentlelady yields back.

Mr. Ezell, you are recognized.

Mr. EZELL. That was quick.

Mr. WEBSTER OF FLORIDA. Well, you have been made part of a team. It is a very powerful team, and now it has gotten even more powerful. So, welcome aboard.

Mr. EZELL. Thank you. Thank you, Mr. Chairman.

Mr. Pribyl, I can't even spell it, I am interested to learn more about your role on the study committee that helped author the TRB report and the advancement in technologies and the programs since then.

Can you expand on what the Coast Guard can do to develop autonomous maritime system programs as rapidly as the Navy and the Marine Corps?

Mr. PRIBYL. Yes. Thank you for the question. And the report itself is 3 years old now, so, part of what I was invited to do today was to give our understanding of where we had seen the progression with that.

Certainly, the U.S. Navy is leading in this space, especially in the U.S., very forward-leaning in the use of the technology. My understanding is that the Coast Guard has been involved in joint exercises with the Navy, trying to understand how the Navy is using that technology and see how it could be implemented into the Coast Guard missions. We didn't get a full briefing from the Coast Guard on exactly how that is playing out, but that is our understanding.

The other issue, again, is different acquisition streams. So, the Navy and special forces and other DoD services and branches, they have different acquisition opportunities that the Coast Guard is not able to avail themselves of.

So, in terms of what the Coast Guard can be doing, we had listed a number of different acquisition streams and processes. So, I would say just to continue to evaluate those opportunities.

And again, in the U.S., it is still going to continue to come from the commercial sector, the academic sector as well. Southern Mississippi is obviously doing quite a bit down there with NOAA and others.

So, continuing to leverage those opportunities from the commercial and academic sectors.

Mr. EZELL. Thank you very much.

Mr. Johnson, I would like to talk more about the current market. How do you compare the Coast Guard and the Navy as a customer in this market? Do you believe the Coast Guard has made the necessary investments in their force structure to support unmanned maritime systems?

Mr. JOHNSON. So, yes, thank you for the question, sir.

The Coast Guard has made some investments, and we have been able to serve them with technology as well. What we would like to see is innovation moving quickly. And today, a lot of the Coast Guard work and innovation stays in the lab.

When it comes to comprehensive technology like this, you've got to get it out of the lab and get it out into its operating domain. So, just like we do internally, we have a test fleet with captains on staff. And so, daily, we are running that technology, like you see with autonomous car companies as well.

And so, we encourage the Coast Guard to request, obtain the budget to get the systems out into operations and go out with a real plan on what they are trying to achieve with it as well, not just trialing technology.

Mr. EZELL. Thank you. Some companies in my district tell me about their limited resources to focus on business development activities.

In your opinion, what could the Coast Guard do to be more effective and a probable customer for companies such as yours and the ones that have operations in my district?

Mr. JOHNSON. Yes. So, thank you for the question. The Coast Guard has 11 missions. They do a lot with a relatively small budget. Plus, they have, probably, one of the most diverse responsibilities of missions across the Government.

We feel that, as I said, that if we could help them in being able to help craft the applications—and we build autonomous technology that enables the increased productivity and efficiency as well as precision of operation of vessels. We also build computer vision systems as well. And so, we needed that to enable our technology to see more and understand a domain, but we know that like within the Coast Guard's roles and responsibilities, they also need to be able to see more and have more domain awareness.

So, our team is regularly working to interface with the Coast Guard, and I guess the more time we can get with them, the better.

Mr. EZELL. Mr. Chairman, I am about out of time, so, I yield back.

Mr. WEBSTER OF FLORIDA. The gentleman yields back.

Mr. Auchincloss, you are recognized.

Mr. AUCHINCLOSS. Thank you, Chairman.

Mr. Johnson, your testimony, written testimony was striking. The word that was coming to mind as I read it was "leapfrogging," in the sense that it seemed like in the 19th and 20th centuries, the United States built up an advantage. Navy and merchant marine have since lost it, at least in the merchant marine, increasingly maybe even in the Navy. And that autonomy can be one way to regain that edge.

And then you have talked about coaching as a way to get there. And so, I want to build on previous questions from both sides of the aisle. It sounds like you want the Coast Guard to be better at procurement practices and how they interface with the private sector. Is that correct?

Mr. JOHNSON. Yes. And then I am just also speaking to leadership as a whole within the Nation and in a business environment to really set goals around innovation, around the value that it can bring that future value.

Mr. AUCHINCLOSS. I hear that, but it is helpful for us here in Congress to have more specific things. I mean, I have been hearing testimony for 3 years from entrepreneurs, and I have never had somebody say that they are fine with all the regulations that exist. I mean, there is really nothing that you would want to change around MARAD or——

Mr. JOHNSON [interrupting]. It's a good question. We work to navigate it, but, of course, speed is our friend. And, in fact, we are working with one U.S.-flag company now that has our technology on a harbor tug, and we have been going through the approval process with the Coast Guard. And that's 1½ years into it now.

And so, if there is a way to speed those approvals up, but at the same time, we also want to ensure that this technology is safely deployed. We understand when there is an accident maybe in some part of a sector that might be close to us, maybe not even us, it could also impact us.

Mr. AUCHINCLOSS. Do you have an opinion about the method of procurement that the Coast Guard uses, the Federal acquisition

regulation, their RDT&E program? Is there any one that has been best to work with and that should be built upon?

Mr. JOHNSON. Somebody on my team will for sure. I am not close enough to be able to answer that question.

Mr. AUCHINCLOSS. You mentioned in your written testimony also digital infrastructure and the importance of investing in that alongside the Marine Highway Program that we have had over the last decade.

Can you expound upon that? What does digital infrastructure for MASS look like?

Mr. JOHNSON. So, actually, it kind of starts at the Coast Guard level when you look at the GAO's review of the Coast Guard and how they are implementing or executing their work.

Almost all the things where they point out gaps is around data and being able to do their inspections better with data and be able to track the industry better with data.

But from a digital infrastructure, I mean, this is the 21st century. The 20th century, as I mentioned, was automation but a lot of separate systems working together. The digital infrastructure centralizes and brings a leap in productivity and value.

You see it, say, like, in an Amazon warehouse. An example I would just give you real quick is Amazon back in 2014, 2015, the quickest they could get their click-to-ship with their manual processes was 60 to 75 minutes. Then they brought in the Kiva robots into their warehouses, connected it digitally from their logistics system to the robot fleets, and were able to get it down to 15 minutes to click-and-ship. And, of course, now you see what they do for our economy.

Mr. AUCHINCLOSS. Switching gears, Mr. Pribyl, do you think that the ColRegs should be modified to accommodate MASS?

Mr. PRIBYL. It is an interesting question, and it is something that has been ongoing in legal and academic circles for several years now.

And I think what is interesting and what has happened since the report's publication in 2020, where we had explained some of these issues with the ColRegs in one of the appendix. We had laid out what we thought could be issues, because the Coast Guard as a user of the——

Mr. AUCHINCLOSS [interrupting]. We have 45 seconds, so, just give me the quick answer.

Mr. PRIBYL. It is being evaluated at the IMO.

Mr. AUCHINCLOSS. Could they have—I mean, because right now there is a duty to render care, as Mr. Spain laid out in his written testimony. Could they fulfill that duty?

Mr. PRIBYL. Yes. There are interpretations that say that there could be a way by which that could be successfully rendered, even remotely, but that's all legal and the interpretations of it are varied.

The issue, though, with the ColRegs that I want to point out was that, as a user, the Coast Guard has said that the ColRegs can be complied with without anyone on board or with remote operations by promulgation of the Naval Commanders Handbook. And in that publication, that is clearly made as a position of DoD's and Navy's——

Mr. AUCHINCLOSS [interrupting]. There could be a human in the loop, even remotely, to step in.

Mr. PRIBYL. That's the Naval Commanders—that has been published since 2020, and that's the interpretation there. So, the bottom line is these are all subject to interpretation right now.

Mr. AUCHINCLOSS. I yield back.

Mr. WEBSTER OF FLORIDA. The gentleman yields back.

That pretty much concludes where we are going. Thank you for the people that came, testified; it was very informative, and we really appreciate it.

I ask unanimous consent that the record of today's hearing remain open until such time as our witnesses have provided answers to any questions that may be submitted to them in writing.

Without objection, show that ordered.

I also ask unanimous consent that the record remain open for 15 days for any additional comments and information submitted by the Members or witnesses to be included in the record of today's hearing.

And with that, this powerful subcommittee is adjourned.

[Whereupon, at 4:57 p.m., the subcommittee was adjourned.]

SUBMISSIONS FOR THE RECORD

Prepared Statement of Hon. Daniel Webster of Florida, Chairman, Subcommittee on Coast Guard and Maritime Transportation

We meet today to discuss the use of autonomous and experimental maritime technologies by the Coast Guard and industry, and to consider the work that must be done to establish an appropriate regulatory framework for their safe operation.

I'd like to welcome our distinguished witnesses joining us today. We will be hearing testimony from two panels. On our first panel, we have Rear Admiral Wayne Arguin Jr., Assistant Commandant for Prevention Policy; and Rear Admiral Todd Wiemers, Assistant Commandant for Capability.

On our second panel, we will hear from Mr. Sean Pribyl, Committee Member for the National Academy of Sciences report on Leveraging Unmanned Systems for Coast Guard Missions; Mr. Michael Johnson, Chief Executive Officer and Founder of Sea Machines Robotics; Mr. Patrick Lahey, Chief Executive Officer and Co-Founder of Triton Submarines; and Mr. Christian Spain, Vice President of Government Relations for American Maritime Officers.

Autonomous and experimental maritime technologies consist of a wide range of evolving systems that promise to revolutionize many processes while drastically changing the operations of our current marine transportation system. Industry has led the way in developing unmanned and autonomous technologies, which can greatly expand the capabilities of U.S. mariners to perform a variety of missions and tasks both safer and more efficiently.

The Coast Guard is just beginning to leverage some of these technologies, such as the limited use of unmanned systems to expand domain awareness. However, Service-wide integration is still a ways off. Congress, meanwhile, has enacted several legislative measures to ensure the Coast Guard has comprehensive plans to successfully leverage these technologies.

Given the ongoing drug and migrant crises that continue to strain already limited Coast Guard resources, it is crucial that the Service implements these technologies as soon as possible to improve surveillance and intelligence-gathering capabilities and allow manned resources to be more readily available for response and interdiction efforts. Adversaries and criminal networks are already using these technologies to their advantage, such as using unmanned submersibles to move illicit drugs, and we must counter with similar technologies to establish persistent maritime domain awareness.

As the Coast Guard works to integrate these technologies throughout its missions, the commercial sector continues to increase its use of autonomous systems. Industry-led technological innovations have led to the development and testing of autonomous container vessels, the successful trans-Atlantic voyage of the Mayflower Autonomous Ship, and the use of autonomous barges by the commercial space industry for at-sea recovery of rocket boosters.

All of these examples underscore that it is imperative the Coast Guard develop a stable regulatory framework for the safe operation of these technologies. This is no longer in-the-future technology. The technology is here.

As federal statutes currently assume that operators will be physically onboard vessels, we must also ensure our laws meet the changing nature of vessels in our waters. In addition to these autonomous technologies, other experimental technologies, such as Wing-In-Ground Craft and manned submersibles, are also increasing in use, requiring the Coast Guard's regulation and oversight.

In light of the totally preventable tragedy of the Titan submersible earlier this year, prompt attention to governing evolving maritime technologies is essential to avoid a similar disaster in the future.

I'd like to thank all our witnesses for joining us here today and look forward to a great discussion.

Prepared Statement of Hon. Rick Larsen of Washington, Ranking Member, Committee on Transportation and Infrastructure

Thank you, Chair Webster and Ranking Member Carbajal for holding this important hearing. Today we will hear from leaders in the Coast Guard and the maritime industry about exciting innovations in autonomous and experimental vessels.

Autonomous Vessels

Automation will play an increasingly important role in both the commercial maritime industry and Coast Guard operations. Coast Guard UAVs, engine automation, use of uncrewed vessels, and the better collection and use of data will expand the reach of the Service without requiring more Coasties.

To best leverage new technologies, the Coast Guard needs significant financial and human resources. Any cuts to the Coast Guard's funding will send us in the wrong direction.

Autonomous vessels present some clear opportunities for the Coast Guard to expand its capacity, such as in completing dangerous missions in inhospitable climates like the Arctic, increasing surveillance capacity and enhancing oversight of fishing operations. However, I have concerns over the lack of a regulatory framework for new technologies and autonomous vessels. For example, the Titan submersible tragedy demonstrates a need for stronger rules and safety requirements for experimental vessels and emerging technologies.

The international maritime industry, where ships are often owned by investors, built in one country, registered in a different country, and operated by mariners from all over the world, is defined by a complicated framework of regulations and oversight.

Plus, current law assumes that vessels are crewed by people. Developing an effective regulatory framework for autonomous vessels will be a major undertaking—requiring coordination between Congress, the Coast Guard, and the International Maritime Organization.

Labor

We must also consider automation's potential impact on maritime jobs. Maintaining the availability of well-paying jobs and minimizing the displacement of jobs from automation is a priority of mine.

Innovation cannot come at the cost of American jobs. To this end, it is important to include labor organizations early in conversations around a regulatory framework.

Clean Vessels

On the topic of innovation, the development of new vessel technology brings the opportunity to incorporate low- and zero-carbon emission technologies into vessel design.

Many vessels in use today use heavy fuel oil, which emits carbon dioxide, sulfur dioxide and nitrogen oxide when combusted. Carbon dioxide is a well-known greenhouse gas, and sulfur dioxide and nitrogen oxide are both air pollutants linked to respiratory disease.

New vessels must be built to reduce and eventually eliminate emissions and makes our waterways and communities cleaner.

I'm proud that, in my home state of Washington, we are in the process of building a fleet of hybrid-electric ferries. Washington State Ferries is the largest ferry system in the U.S. and is the biggest contributor of greenhouse gas emissions among Washington state agencies. This transition to hybrid-electric ferries will greatly reduce pollution.

I see a similar opportunity for developing new, clean autonomous vessels and building them in U.S. shipyards.

Closing

At their best, new technologies increase safety and efficiency, reduce emissions and create a better experience for workers. At their worst, new technologies introduce security vulnerabilities, decrease safety, increase the risk of accidents, and displace workers.

I look forward to hearing from our witnesses today on how we can ensure a smooth and safe transition to new technologies.

Prepared Statement of Hon. Salud O. Carbajal of California, Ranking Member, Subcommittee on Coast Guard and Maritime Transportation

I wanted to also extend my deepest condolences to the Peltola family and our colleague, Mary, on the passing of her husband Buzzy. The family has my deepest sympathy and I look forward to her coming back when she feels ready.

On June 18th of this year, 5 lives were lost when the Titan submersible imploded descending to the depths of the ocean to visit the Titanic wreckage. I share my condolences to the families of the victims.

Today, we will look at new and experimental maritime technology and, particularly in the shadow of this tragedy, I hope to hear from the Coast Guard and industry on how they plan to ensure safety.

It is important to foster innovation while also protecting lives. The passengers onboard the Titan were not designated as passengers by Oceangate—the owners of the submersible. Rather, they were referred to as a crew, which allowed the company to subvert legal consequences.

In addition, the submersible was not classed, was flagged to the Bahamas, and used materials and designs that had been rejected as unsafe by the rest of the industry.

I am an advocate for passenger and crew safety and we should all demand the utmost regard for safety to apply to any new technology, submersible, or autonomous vessels.

The maritime industry is innovating rapidly. For both the Coast Guard and the maritime industry, automation has the potential to reduce operational risk, increase safety for mariners and the environment, increase efficiency and transparency, reduce emissions and increase capacity. This is an exciting time and I look forward to hearing about new technological advancements.

However, I have concerns about the removal or reduction of crew unless safety is taken into full consideration and the proper regulations are developed. Current applicable regulations are written with the assumption that crew are onboard the vessels. These regulations are not meant to apply to these new crewless vessels.

We've seen instances in the past where a lack of a watchstander has cost lives. In many circumstances, you simply cannot replace a human presence. When automation is implemented, we must protect U.S. jobs and train the workforce to oversee those systems.

It is imperative that the International Maritime Organization and the U.S. Coast Guard update regulations on autonomous vessels before they become widespread. The recreational vessel classification of the MAYFLOWER—an autonomous vessel that recently sailed across the ocean unmanned—is unacceptable and reduced safety oversight to practically zero.

While I hold concerns, I recognize that technology is progressing and innovation should be embraced when done properly. The U.S. must position itself to be a leader in new maritime technology.

My state of California is a leader in blue technology development such as autonomous or remote systems that allow the Coast Guard to expand their mission capabilities and improve maritime domain awareness.

The Maritime Environmental and Technical Assistance program (META) is a small but important program for innovation within the Maritime Administration. This program assists the research, development, and demonstration of new technology in the maritime industry.

META is incredibly underfunded at $10 million this year and without expansion, it will never reach the potential it could have in establishing the U.S. as a leader in maritime innovation. We must continue to fund this program and expand its reach.

Climate change is the single largest threat of our time. I would be remiss not to advocate for the acceleration of alternative fuels and emissions reducing technology in maritime in a conversation about innovation. This year we've already seen extreme heatwaves, intense hurricanes, deadly floods, and historic wildfires. My own district saw devastating flooding and mudslides; events that will forever impact my constituents.

Each one of these threats puts increased burdens on the U.S. Coast Guard and has the potential to disrupt the U.S. economy and the maritime supply chain.

Innovation in maritime and Coast Guard assets is vital but we must proceed with caution. Safety is always paramount, and we must keep jobs and emissions in mind as we progress.

Thank you and I yield back.

APPENDIX

QUESTIONS TO REAR ADMIRAL WAYNE R. ARGUIN, ASSISTANT COMMANDANT FOR PREVENTION POLICY, U.S. COAST GUARD, FROM HON. SALUD O. CARBAJAL

1. Autonomous Ships

Question 1.a. What risks do autonomous vessels pose to the U.S. Marine Transportation System (MTS)?

ANSWER. The Coast Guard's priority is to effectively manage the risks associated with the increasing use of these platforms on our waterways. Depending on the level of autonomy, known risks include, but are not limited to, navigational safety concerns, cybersecurity vulnerabilities, and equipment and technology failures. The Coast Guard is committed to continuously evaluating the unique risks associated with autonomous and experimental maritime technology and is working, both internationally and domestically, to develop a suitable governance framework that safely and effectively integrates autonomous and remote-control technologies into the maritime domain.

Question 1.b. What is the USCG doing to prepare for those risks?

ANSWER. The Coast Guard leverages its authorities to address novel designs and operations to facilitate innovation in the maritime domain. The Coast Guard partners with industry and other Federal agencies to institute best practices and safety management systems to ensure vessel designs and operations are executed safely while not being hampered by unnecessary regulations. Additionally, the Coast Guard is actively engaged with the International Maritime Organization (IMO) and interagency partners to develop an appropriate regulatory framework for autonomous cargo vessels, subject to the Safety of Life at Sea convention that will provide for safe, secure, and environmentally sound incorporation of these new technologies. The Coast Guard is committed to developing suitable international and domestic governance frameworks to integrate autonomous and remote-control technologies safely and properly into the maritime domain, and a workforce that is ready and capable to oversee these technologies.

Question 1.c. Regarding autonomous ships, what safety features need to be legislated/regulated?

ANSWER. The Coast Guard leverages its current authorities to support and oversee the safe implementation of these technologies and their operations in the U.S. Marine Transportation System (MTS). However, several current domestic statutory and regulatory regimes for commercial maritime operations are predicated on mariners being onboard vessels; therefore, there are design and operational aspects of autonomous vessels that are not contemplated by the existing statutory and regulatory regime. The Coast Guard, through its Automated and Autonomous Vessel Policy Council, consistently evaluates emerging system automation, remote operational capabilities, and vessel autonomy through various lines of effort, to include: review of laws, regulations, and policies; examination of manning and credentialing issues; assessment of risk associated with integrating automation and autonomous operations; and, improvement of project development and compliance tools. As the Coast Guard identifies definitive legislation needed to best ensure the safe and efficient incorporation of these new technologies, the Service will propose updates to current legislation through the legislative change proposal process.

Question 1.d. Will autonomous vessels be more vulnerable to cyber threats?

ANSWER. These new technologies rely heavily on interconnected information technology, operational technology, and cyber-connected systems. As these technologies are incorporated into vessels and maritime systems, maintaining sufficient safeguards to protect against cyber-attacks from malicious actors will be critical.

Question 1.e. Will autonomous vessels be required to have a "person in charge"?
ANSWER. At present, U.S. laws require all vessels to have a "person in charge" or master.

Question 1.f. With crewed and autonomous vessels operating together, how will collisions be avoided?
ANSWER. All vessels, regardless of the number of crewmembers onboard, are currently required to comply with the Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs). If vessel owners or operators are seeking to reduce the number of crew onboard, due the use of autonomous technology, they must demonstrate that these technologies are able to comply with the requirements of the COLREGs.

Question 1.g. Is the U.S. Coast Guard and other international bodies prepared to investigate an incident involving these vessels?
ANSWER. The Coast Guard is prepared to investigate incidents involving vessels with increased levels of automation. As with any change in technology, the Coast Guard training programs for Marine Investigators are updated to ensure investigating officers are knowledgeable on the current technology used in the maritime domain.

Question 1.h. What resources does the U.S. Coast Guard need to prepare for such investigations?
ANSWER. The Coast Guard continuously evaluates the training resource needs to ensure the proficiency of our workforce. If new resources are needed to prepare for and conduct investigations into marine casualties involving automated vessels, the Coast Guard will evaluate these resource needs as part of the annual budget process.

Question 1.i. What will be the role of Federal and State Maritime Pilots aboard an uncrewed vessel?
ANSWER. The future role of Federal and State Maritime Pilots onboard autonomous vessels without a crew is currently being evaluated. A representative from the American Pilot Association is included within U.S. Delegations discussing this issue within the Maritime Autonomous Surface Ships (MASS) initiative at the IMO.

Question 1.j. If autonomous vessels use AI, are there elevated risks associated with that?
ANSWER. Similar to the incorporation of other new technologies, there are new risks that must be evaluated and accounted for to ensure the benefits are safely and efficiently incorporated into the MTS.

Question 1.k. Could autonomous vessels still be used as vessels of opportunity in search and rescue operations, how would they impact SAR?
ANSWER. The ongoing MASS discussions at the IMO include consideration of how search and rescue obligations apply to autonomous cargo vessels. The Coast Guard will consider how to best incorporate any outcomes from the IMO into our regulatory and operational frameworks.

Question 1.l. Would hazardous materials be transported on autonomous ships?
ANSWER. Presently, hazardous material cannot be transported on autonomous commercial vessels. In the future, the United States may consider allowing hazardous materials to be transported onboard autonomous commercial ships, if and only if the vessels meet equivalent level of safety of existing law or regulation.

2. Titan Investigation

Question 2.a. What challenges does the TITAN sinking pose to Coast Guard investigators?
ANSWER. The primary challenge thus far in the investigation was deconflicting and coordinating with the various nations that have jurisdiction to conduct a safety investigation into the incident. The United Kingdom, France, and Pakistan are considered substantially interested states (SISs) under the IMO marine casualty investigation protocols. The United Kingdom and France exercised their SIS status and are participating in the U.S. Coast Guard's Marine Board of Investigation (MBI). In addition, Canada has primary IMO jurisdiction as the flag administration of the vessel that towed the submersible TITAN to the accident site and provided operational oversight and support for the submersible operations. The Transportation Safety Board of Canada (TSB) is conducting an independent safety investigation on behalf Canada and the MBI is cooperating with TSB during the joint fact-finding and evidence collection phase of our concurrent safety investigations.

Question 2.b. Did the U.S. Coast Guard get cooperation from other agencies? Countries?

ANSWER. The cooperation, to the extent allowed by the domestic laws of the other involved countries, has been excellent between all international investigative entities. In September 2023, investigators from the U.S. National Transportation Safety Board (NTSB) and TSB joined marine safety engineers from the MBI during a second salvage mission that successfully recovered the remaining submersible TITAN debris and other evidence from the accident site. The MBI leveraged an existing contract with Navy Supervisor of Salvage and Diving (SUPSALV) to conduct the second mission. Engineers from the U.K. Royal Navy also supported the salvage operations. The MBI is hosting a TITAN debris evidence review session next month with all the safety agencies to determine next steps for forensic testing of the debris.

The post-salvage support from multiple U.S. agencies and the Navy has been superior. The Navy is providing secure storage of the debris and the Federal Bureau of Investigation Evidence Response Team assisted with all processing of presumed human remains from the accident. Those remains are now being forensically tested at the Armed Forces Medical Examiner's Office in Dover, DE.

Question 2.c. Regarding the TITAN, how much did the evidence recovery cost and how can we better prepare for such needs in the future?

ANSWER. The MBI coordinated two salvage missions through Navy SUPSALV and the total cost was $3.4 million. The NTSB covered salvage costs for past major marine casualties (e.g., the steamship EL FARO salvage operations to recover the vessel's voyage data recorder) because they were serving as the lead Federal agency. Between U.S. Coast Guard and NTSB resources, future salvage missions related to marine casualties are expected to be supported.

Question 2.d. Is the operator of the TITAN cooperating in this investigation?

ANSWER. Yes. To date, the operator of the TITAN is fully cooperating with all MBI and NTSB requests and subpoenas.

Question 2.e. Do you anticipate similar submarine excursion operators and what, if any, laws or regulations are needed to address risk in this sector?

ANSWER. There are seven submersible vessels that are United States flagged. Two of these vessels are uninspected Oceanographic Research Vessels (ORVs), as defined by 46 United States Code (USC) 2101(24) and are no longer in operation. Five vessels are small passenger vessels, as defined by 46 U.S.C. 2101(47), and are inspected under 46 Code of Federal Regulations Subchapter T. The Coast Guard has confirmed that there are no other active submersible ORVs operating in U.S. navigable waters or internationally under the U.S. flag. Further, the Coast Guard is unaware of non-U.S. registered submersible vessels operating in or intending to operate in U.S. navigable waters. The potential need for any changes to laws, regulations, or international convention remains under investigation by the Marine Board.

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