Committee on Transportation and Infrastructure
U.S. House of Representatives
Washington, DC 20515

Sam Graves
Chairman

Jack Ruddy, Staff Director

Rick Larsen
Ranking Member

Katherine W. Dedrick, Democratic Staff Director

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

[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.

operations pilot program.[3] Most recently, the *Coast Guard Authorization Act 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

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[3] *Don Young Coast Guard Authorization Act of 2022*, Pub. L. No. 117-263, 136 Stat. 4024 & 4131.
[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*

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 operation 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:

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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*.

[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.

- 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 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

[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.
[27] *Id*.

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

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[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.

industry professionals claimed they had longstanding 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

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

[37] OceanGate, *supra* note 33.