United States Government Accountability Office

Testimony
Before the Subcommittee on Coast Guard and Maritime Transportation, Committee on Transportation and Infrastructure, House of Representatives

For Release on Delivery
Expected at 2 p.m. ET
Tuesday, December 16, 2025

COAST GUARD

Approaches to Autonomous Ship Regulation

Statement of Andrew Von Ah, Director, Physical Infrastructure

GAO-26-108762

Chairman Ezell, Ranking Member Carbajal, and Members of the Subcommittee:

Thank you for the opportunity to discuss our recent work on commercial autonomous and remote ship technologies. Autonomous ships have technologies that are capable of navigating, avoiding collisions, controlling the speed and direction of the ship, or communicating with other ships with little or no human involvement. Although their use is not widespread, autonomous ship technologies are developing quickly and have the potential to transform the maritime environment. In August 2024, we reported that autonomous ships have the potential to improve safety by reducing human errors, removing crews from hazardous situations, and helping to address mariner shortages.[1] While autonomous ships offer a range of potential benefits, uncrewed or fully autonomous technologies could also present challenges to a U.S. legal framework that generally requires (or is written with a presumption that) crews will be onboard and in control of every ship.

There are both domestic and international efforts to regulate these technologies. The Coast Guard is the federal agency responsible for regulating U.S. waterways—including the design, construction, and operation of commercial ships—to ensure that they are safe and secure. It acts as the lead agency within the U.S. delegation to the International Maritime Organization (IMO)—a specialized agency of the United Nations responsible for the safety, security, and environmental performance of international shipping. The IMO is currently establishing a framework for autonomous ships to operate in international waters. As autonomous ship technologies develop, some countries are pursuing various approaches to regulating them.

My testimony today is based on our August 2024 report entitled Coast Guard: Autonomous Ships and Efforts to Regulate Them.[2] This statement focuses on three areas: (1) U.S. Coast Guard efforts to regulate and monitor autonomous ships operating in U.S. waterways and the challenges it may face in the future, (2) International Maritime Organization efforts to integrate autonomous ships into its regulatory

[1]GAO, *Coast Guard: Autonomous Ships and Efforts to Regulate Them*, GAO-24-107059, (Washington, D.C.: August 8, 2024).

[2]GAO-24-107059.

framework, and (3) how selected countries are addressing challenges in regulating autonomous ships in their respective waterways.

To conduct our prior work, we reviewed the Coast Guard's legal authorities, strategic plans, policies, and other guidance. We interviewed Coast Guard headquarters and district officials to understand how the aforementioned authorities and documents are used to regulate autonomous ships. We also reviewed relevant IMO reports and interviewed U.S. Coast Guard officials who functioned as the Chair of the IMO Committee leading the efforts to develop a regulatory framework for autonomous ships and led the U.S. delegation to the IMO at that time.

In addition, for our prior work, we interviewed officials and subject matter experts familiar with specific autonomous ship projects and efforts to regulate autonomous ships in Canada, the United Kingdom (UK), and Norway and reviewed relevant documents from these countries. We selected Canada because of the shared waterways and the cooperative relationship with the U.S. We selected the UK and Norway because they were two leading countries regarding autonomous ships based on a literature review, stakeholder interviews, conference presentations, and review of submissions to the IMO. More detailed information on the scope and methodology of our work can be found in our report. For this testimony, we reviewed relevant information on IMO and selected countries' websites and updated information from the Coast Guard on its efforts.

We conducted the work on which this statement is based in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Coast Guard Regulates Autonomous Ships Within Existing Legal Framework and Has Identified a Few Challenges

Regulation of autonomous ships. The Coast Guard applies the same regulations to autonomous ships that it applies to conventional ships.[3] These regulations allow for the testing of novel technologies, including autonomous technologies, under certain conditions and provided the operator makes a request to local authorities, typically the Captain of the Port—the Coast Guard officer directly responsible for law enforcement activities within a designated area. The Coast Guard is currently conducting a statutorily directed pilot program for autonomous at-sea rocket recovery that provides Coast Guard the authority to waive certain crew requirements.

Local Captains of the Port handle requests for operations and testing of autonomous ships by applying regulations and guidance on a case-by-case basis and, when appropriate, forwarding industry requests to the Coast Guard Commandant. Captains of the Port told us they keep Coast Guard headquarters informed of autonomous testing and operations and document these tests and operations in the Coast Guard's data systems. Headquarters officials noted that the Coast Guard's regulatory framework gives Captains of the Port discretion on decision-making. These officials told us that industry stakeholders have raised concerns about consistency across individual ports. Consequently, officials said that the Coast Guard is working to ensure Captains of the Port have the guidance they need and use the same risk assessment framework so that they can consistently assess project risks within the unique characteristics of each individual port and geographic location. Coast Guard officials told us that since 2024, local Captains of the Port have received 48 such requests involving autonomous ship technology and that these Captains of the Port had the relevant authorities to manage the autonomous ship operations and associated risks at the local level.

Current Coast Guard regulations also allow for automated systems to replace certain crew when they are shown to be reliable and safe. Additionally, the Coast Guard's regulations allow for equivalents to regulatory design standards when shown to be safe, including equivalents

[3]Executive Order No. 14269, Restoring America's Maritime Dominance, 90 Fed. Reg. 15635 (Apr. 9, 2025) directs the Secretary of Defense, the Secretary of Transportation, and the Secretary of Homeland Security to conduct a review of their regulations, and implementation thereof, across all components pertaining to the domestic commercial maritime fleet and maritime port access to determine where each agency may be able to deregulate to reduce unnecessary costs and clear barriers to emerging technology and related efficiencies.

for autonomous ship technologies within existing legal frameworks.[4] For example, Coast Guard officials advised that the agency could consider approving a system that would autonomously navigate a vessel, if it complied with statutory minimum crewing requirements.

Horizon Scanning. The Coast Guard conducts a number of activities to monitor autonomous ship technology as it develops domestically and internationally. These include forming an advisory committee and engaging with industry stakeholders. First, the Coast Guard has had an internal advisory committee called the Automated and Autonomous Vessel Policy Council (AutoPoCo) since 2021. It meets regularly to work on autonomous ship technologies planning and assessment activities, including developing guidance for Captains of the Port; identifying legal, regulatory, and policy gaps and providing recommendations; and engaging key industry stakeholders. Coast Guard officials told us that the AutoPoCo was focused on collecting data, monitoring, and providing guidance related to the at-sea rocket recovery pilot program. Second, the Coast Guard participates in stakeholder panels and events and has invited stakeholders to present their work to the AutoPoCo. It also collects industry perspectives through forums like the National Merchant Marine Personnel Advisory Committee, which provided the Coast Guard with recommendations on the role of seafarers on these vessels and the competence requirements for operators.

Challenges. The Coast Guard identified a few challenges that could constrain or complicate its regulatory role related to commercial applications of autonomous ships. Specifically, the Coast Guard has limited authority to reduce crew requirements due to various statutes that establish the minimum number of crew required per vessel. A primary statute establishing minimum crew requirements prescribes the minimum number of required officers on certain vessels generally depending on the gross tonnage of the vessel and requires that each vessel have a credentialed master. Other relevant statutory provisions include, for example, the requirement that the certificate of inspection issued to a vessel state the complement of officers and ratings necessary for safe operation. Coast Guard officials advised us that any statute based upon the assumption that humans are aboard the vessel may present challenges as human operators are removed from ships as autonomous

[4]According to the United Nations *International Convention for the Safety of Life at Sea (1974)*, an “equivalent” is an alternative fitting, material, appliance or apparatus, or type thereof, or provision that is at least as effective as that required by the present regulations. *International Convention for the Safety of Life at Sea*, Nov. 1, 1974, 32 U.S.T. 47.

ship use and technology progresses. Coast Guard officials said they currently do not have authority to waive these requirements for autonomous vessels outside of the limited scope of the at-sea rocket recovery pilot program.

Additionally, Coast Guard officials said that incorporating new technology into an existing regulatory regime requires sufficient data and examples of the technology for the Coast Guard to evaluate, and that they have not evaluated sufficient examples thus far. Officials said the lack of examples may be due to the nascent nature of the technology, companies being unwilling to share proprietary design standards, and the additional costs of complying with statutory minimum crew requirements that discourage companies from pursuing or testing autonomous vessel applications.

Lastly, Coast Guard officials told us they will need to determine how to adopt the forthcoming IMO autonomous ship regulatory framework within the U.S. legal framework, including any instances where the IMO framework may conflict with minimum crewing and other statutory requirements. Officials told us the Coast Guard did not intend to amend domestic regulations or issue policy guidance for autonomous ships in advance of the IMO regulatory framework because harmonizing U.S. regulations will be more effective once the IMO framework is established. Officials noted that the IMO framework is goal based and that member states will need to determine how to incorporate it and verify compliance with it. Therefore, U.S. implementation of the IMO framework will be subject to statutory requirements, including minimum crew requirements.

International Maritime Organization is Developing a Regulatory Framework for Autonomous Ships That Includes Input from the United States

As previously stated, the IMO is a specialized agency of the United Nations that sets global standards for the safety and security of international shipping for member states, in accordance with the Convention on the IMO. It has been taking steps to integrate autonomous ships into its regulatory framework of international conventions since

2018.[5] These steps include conducting regulatory scoping exercises of IMO conventions related to maritime safety and security, establishing guidelines for testing autonomous ships, and developing a regulatory framework for member states to use in regulating autonomous ships.

From 2018 to 2022, three committees at the IMO, each comprised of member states, conducted regulatory scoping exercises to assess how the existing regulatory framework might be affected by autonomous ships. These committees reviewed IMO regulations and conventions under their respective purviews that address safety at sea, mariner competence (including training), preventing collisions at sea, and the facilitation of international maritime traffic, among other subjects. As a result of these exercises, the committees identified priority issues such as clarifying the roles and responsibilities of the person in command of the ship (in maritime terminology, "master") and crew, clarifying the roles and responsibilities of people who remotely operate ships, and designating remote operators as seafarers. The IMO's Maritime Safety Committee concluded that many of the potential regulatory gaps could be addressed through a new regulatory framework for autonomous ships that could be made mandatory by means of amending an existing IMO convention.

In 2019, during the regulatory scoping exercises, the Maritime Safety Committee approved interim guidelines for autonomous ships conducting sea trials. These guidelines are still in effect. These guidelines assist relevant authorities and stakeholders with ensuring that at-sea tests are conducted safely, securely, and with regard to protecting the environment. The guidelines also provide direction in managing safety risks, compliance with mandatory instruments, compliance with crewing and certification requirements, ensuring human involvement, and cyber risk management.

The Maritime Safety Committee is also currently developing a framework that addresses the regulatory gaps identified in the scoping exercises mentioned above. This framework intends to ensure that autonomous commercial cargo ships sailing internationally operate safely and in coexistence with conventional ships. The IMO expects to adopt the framework on a non-mandatory basis in 2026 and adopt a mandatory

[5]The IMO adopts standards and recommended practices in accordance with the Convention on the International Maritime Organization to facilitate cooperation among participating states (including the U.S.) in the field of international shipping and to encourage the adoption of the highest practicable standards in matters related to maritime safety and efficiency of navigation.

framework in 2030 that will be effective in 2032. The then-Chair of the IMO Maritime Safety Committee, who led the overall effort to develop this framework at that time, told us that the mandatory date is not certain because of the time needed to work through complex issues. Further, the then-Chair and the head of the U.S. delegation working on the regulatory framework at that time told us that it is important that the committee gets the non-mandatory framework right the first time, since making major changes after the framework is approved could be difficult.

As the lead agency for the U.S. delegation to the IMO, the Coast Guard has led and assisted in international efforts to regulate autonomous ships. This includes aspects of the IMO regulatory scoping exercise, specifically in the review of IMO conventions related to crew competence and certification, and prevention of collisions at sea, among other conventions. According to Coast Guard officials, the U.S. is also leading IMO efforts to develop proposed text for the electrical, engine machinery, and lifesaving appliances sections for the autonomous ship regulatory framework that is currently under development.

Finally, Coast Guard officials told us that the Coast Guard leads the U.S. delegation working on the international autonomous ship regulatory framework. This delegation is comprised of a working group that includes the Navy, the U.S. Maritime Administration, the State Department, the American Pilots' Association, and a training facility affiliated with the American Maritime Officers. According to the head of the U.S. delegation at that time, it discusses issues and develops joint decisions on what it thinks should be included in the regulatory framework.

Selected Countries Have Taken Various Approaches to Autonomous Ships

Other countries, such as Canada, Norway, and the United Kingdom, have taken various approaches to addressing the challenges of regulating autonomous ships. According to regulators from these countries, these approaches include providing guidance to stakeholders on how to comply with existing laws and regulations, modifying regulations, and creating new regulations and policies. In some cases, approaches by regulators in these countries, specifically related to allowing uncrewed vessels, have differed from the Coast Guard's approach due to statutory requirements. Some of the challenges they identified in regulating autonomous ships are a lack of clarity on the definition and role of a ship's master and on the requirements for remote operators and remote operating centers.

Canada: According to Transport Canada officials, the Canadian government regulates autonomous ships as it does any other vessels. However, in cases of highly autonomous ship operations, Transport

Canada can provide small autonomous ships with exemptions from legal requirements such as the requirement for an onboard lookout. Canadian officials told us that this process has been effective and that there have not been any challenges in approving autonomous ships through the exemption process. In 2022, Transport Canada created a policy that establishes an alternative process specific to uncrewed small autonomous ships for complying with existing laws and regulations by establishing minimum design, construction, and operational standards.[6] For example, the guidance specifies that (1) small autonomous ships must carry a device that can broadcast a distinct signal that identifies it as an autonomous ship; (2) operations must be communicated to the local Canadian Coast Guard prior to operation so that the time, place, and distinct signal for autonomous ship operations can be communicated to others; and (3) autonomous ships must have a qualified person at a remote-control center at all times to either operate the ship or stand by to take control in case of an emergency.

Norway: According to Norwegian Maritime Authority guidance issued in 2020, the Norwegian government relies on existing laws as the basis for regulating the construction and operation of autonomous ships. The guidance states that the Norwegian government uses IMO guidelines to approve alternative and equivalent autonomous ship technologies to ensure autonomous ships have at least the same level of safety as conventional ships. The guidance includes design and safety requirements, including cybersecurity. Further, when the ship is remotely operated or crewing is eliminated, it describes the process for ensuring that all required functions are performed.

An official at the Norwegian Maritime Authority told us that the agency encountered challenges related to (1) ensuring the safe function of ships with minimal or no crew onboard and (2) determining whether a remotely located master can replace one onboard the ship under current law. To address these challenges, the Norwegian Maritime Authority is working with ship owners to test the safety of the technology and adjust requirements accordingly. In 2024, one ship owner told us that the Norwegian Maritime Authority allowed them to reduce their crew from the prior requirement of five to three persons because of successful tests and no safety incidents.

[6]This policy applies to autonomous ships 12 meters in length or less, or 15 gross tons or less in weight. See: Transport Canada, *Tier I – Policy – Oversight of Small Maritime Autonomous Surface Ships*. Ottawa, Canada. (February 1, 2022)

United Kingdom: According to the Maritime and Coastguard Agency, the UK regulates the operations and testing of autonomous ships through exemptions and equivalences to existing regulations. The larger the autonomous ship and the higher the level of autonomy proposed, the more complex the burden becomes because more regulations must be accommodated through equivalence or exemption. With such a process, a tailored approach is required for each ship and voyage. An official from the Maritime and Coastguard Agency told us that it is facing the same challenges as that of many other countries in updating its maritime laws that were put in place assuming a ship would have a crew onboard.

In September 2023, the UK government completed a regulatory review aimed at addressing areas where existing regulations may be outdated, a barrier to innovation, or not designed with new technologies and business models in mind. The review highlighted a number of issues and areas for clarification in existing law, including gaps in requirements at remote operations centers. The regulatory review proposed amending legislation to regulate all autonomous ships regardless of size; however, it also acknowledged that there is a risk in developing a domestic legal framework that could diverge from the IMO regulatory framework when it is developed.

In December 2023, the UK Maritime and Coastguard Agency modified its regulations for small commercial ships only.[7] These regulations were modified to allow for remote operation of vessels under 24 meters and provide certain exemptions for remotely operated unmanned vessels, such as the requirement to keep a logbook aboard.

In August 2024, the UK Maritime and Coastguard Agency issued a general exemption that allows autonomous ships of less than 2.5 meters in length to operate without certification from the agency.[8]

Chairman Ezell, Ranking Member Carbajal, and Members of the Subcommittee, this concludes my prepared statement. I would be pleased to answer any questions you have at this point.

[7]*The Merchant Shipping (Small Workboats and Pilot Boats) Regulations 2023* (UK).

[8]To qualify for the exemption, the vessel must be unmanned with a remote operator that can safely operate the vessel. Navigation charts that plan and display the vessel's route must be kept at the control position, and the vessel must have a communication system that can transmit and receive safety communications.

GAO Contact and Staff Acknowledgments

If you or your staff have any questions about this testimony, please contact Andrew Von Ah, Director, Physical Infrastructure, at vonaha@gao.gov. Contacts for the Office of Congressional Relations and Public Affairs may be found on the last page of this statement.

GAO staff who made key contributions to this testimony are John Stambaugh (Assistant Director), Steve Rabinowitz (Analyst in Charge), Rebecca Morrow, Kelly Rubin, and Amy Rosewarne. Other staff who made key contributions to the reports cited in the testimony are identified in the source products.