



Research and Development on Unmanned Surface Vehicles

July 11, 2023

Fiscal Year 2023 Report to Congress



**Homeland
Security**

United States Coast Guard

Foreword

July 11, 2023

I am pleased to present the following report, “Research and Development on Unmanned Surface Vehicles,” prepared by the U.S. Coast Guard.

The Joint Explanatory Statement accompanying the Fiscal Year 2023 Department of Homeland Security Appropriations Act (P.L. 117-328) directs the Coast Guard to provide plans for research and development activities related to unmanned surface vehicles, including an evaluation of wind and solar powered vessels with surface and subsurface capabilities.



Pursuant to congressional requirements, this report is being provided to the following Members of Congress:

The Honorable David Joyce
Chairman, House Appropriations Subcommittee on Homeland Security

The Honorable Henry Cuellar
Ranking Member, House Appropriations Subcommittee on Homeland Security

The Honorable Chris Murphy
Chair, Senate Appropriations Subcommittee on Homeland Security

The Honorable Katie Britt
Ranking Member, Senate Appropriations Subcommittee on Homeland Security

I am pleased to answer any questions you may have, or your staff may contact my Senate Liaison Office at (202) 224-2913 or House Liaison Office at (202) 225-4775.

Sincerely,

A handwritten signature in blue ink that reads "L L Fagan".

Linda L. Fagan
Admiral, U.S. Coast Guard
Commandant



Research and Development on Unmanned Surface Vehicles

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I. Legislative Requirement

This document responds to the direction set forth in Joint Explanatory Statement accompanying the Fiscal Year 2023 Department of Homeland Security (DHS) Appropriations Act (P.L. 117-328).

The Joint Explanatory Statement accompanying P.L. 117-328 states:

Unmanned Surface Vehicles (USV).—The agreement directs the Coast Guard to provide a report on its research and development activities related to USVs, including an evaluation of wind and solar powered vessels with surface and subsurface capabilities, within 90 days of the date of enactment of this Act. The Coast Guard shall update the Committees on the findings of its research as they become available.

II. Report

The Coast Guard is researching new technologies, including autonomous systems, to improve maritime domain awareness (MDA). Increasing MDA contributes positively to numerous Coast Guard missions, including counter-drug, migrant interdiction, ports, waterways, and coastal security, environmental monitoring and response, living marine resource enforcement, and enforcement of laws and treaties. Comprehensive MDA supplemented by USVs in the maritime environment enhances the Coast Guard's capacity to communicate, integrate, and analyze information that facilitates effective and appropriate response actions.

USVs expand MDA by providing distributed intelligence, surveillance, and reconnaissance (ISR) platforms at a lower cost relative to crewed assets. Further, USVs enhance the performance of crewed assets by expanding ISR, which increases the probability of detection of illicit activity and promotes an effective response. Likewise, USVs can safely fill gaps where it may otherwise be too risky to send crewed assets or when they are unavailable.

In March 2023, the Coast Guard released an Unmanned Systems (UxS) Strategic Plan. The plan acknowledges the revolutionary impact that UxS could have on every Coast Guard mission and describes opportunities, capabilities, challenges, and desired future state for the Coast Guard's employment of UxS to include surface, subsurface, and aviation assets.

Unmanned Surface Vehicle Research and Development

Coast Guard Research and Development currently focuses on four primary areas surrounding USV employment.

The first is the Maritime Unmanned Systems Technology (MUST) project. DHS Science and Technology Directorate (S&T) in partnership with the Coast Guard is managing this multi-year project which began in 2019. The purpose of MUST is to evaluate the use of USVs to enable persistent and cost-effective ISR capability for law enforcement, security, and pollution response missions. Other participants include: Cherokee Nation Strategic Programs; Naval Research Lab; University of Southern Mississippi Maritime Research Center; Penn State Applied Research Lab; and the Homeland Security Systems Engineering and Development Institute.

The MUST project is developing a USV with surface ISR capabilities that also include some limited subsurface capability to avoid inclement weather or counter detection. The selected Ocean Aero Inc., Triton USV is wind and solar powered, which enables extended durations at sea, ideally for several months. DHS S&T has acquired six Triton USVs, completed system design work, and is completing sensor suite integration, conducting at-sea testing, and undertaking modeling efforts to inform system employment. The sensor suite includes an acoustic sensor, surface radar, electro-optical/infrared camera, encryption capable Automatic Identification System receiver, and pollution detector.

In calendar year (CY) 2022, the team tested individual sensors, finalized integration of the sensor suite, completed a technical readiness review, improved vessel reliability, and concluded acceptance testing of individual vessels. The team began a series of progressively more

challenging sea trials, which will culminate in CY 2023 with a full system test event in the Gulf of Mexico to evaluate the system's ability to detect, classify, and track targets of interest related to Coast Guard law enforcement missions. In CY 2023, the team plans to finalize an analysis of alternatives and business case analysis, refine cyber security and data management requirements, and continue modeling and simulation development. This project is scheduled to terminate at the end of CY 2023.

The second area of focus is converting existing Coast Guard boats to "optionally crewed" assets: Conversion technology represents a rapidly maturing market and offers distinct advantages over adoption of an entirely new class of USV. The Coast Guard Research and Development Center (RDC) operates three optionally crewed vessels and has gained exposure to command-and-control systems of varying levels of sophistication. Through a Cooperative Research and Development Agreement with Sea Machines Robotics Inc., the RDC partnered in the development of a modular conversion package with multiple operating modes: Crewed, Remote Helm, Autonomous Navigation + Collision Avoidance. This strategy allows for the exploration of the operational utility of uncrewed vessels and crewed/uncrewed deployment using existing Coast Guard platforms.

The third area consists of evaluating and improving USV collision-avoidance technology through partnerships with industry and academia. Offering rapid platform integration and continuous field evaluation, the RDC partnered as a test agent for several sensor and system tuning exercises to improve collision-avoidance technologies. The RDC's 29-foot Response Boat-Small USV platform conducted two separate system refinement trials, resulting in an improved radar-based navigation capability that demonstrated contact avoidance at transit speeds up to 30 knots. The RDC also facilitated the installation of the Sea Machines "AI-ris" computer vision system onboard Coast Guard Cutter Campbell for a 70-day period. This expanded the vessel detection algorithm through substantially increased target volume and environmental imagery, thus improving product functionality.

Finally, the RDC is working to enable reduced-cost sensor deployment capabilities. The RDC explored USV integration into reduced-cost MDA sensor networks to evaluate USV-based radar effectiveness, Electro-Optical/Infrared systems, and Automatic Identification System data streams within a multi-sensor network, and control and display capabilities. The RDC constructed a shore-side sensor networking test for integrating received data from the USV's existing control station. This testing will enable future deployments of USV-based sensors with an established data collection framework in place.

Unmanned Systems Strategy and Operational Employment

In response to the National Academy of Sciences' *Leveraging Unmanned Systems for Coast Guard Missions* report from 2020, the Coast Guard chartered a cross-functional working group to develop an enterprise strategy to advance unmanned and autonomous systems. This strategy will outline how the Coast Guard will employ unmanned systems, defend against other unmanned systems, and establish a regulatory framework for unmanned and autonomous systems in the marine transportation system.

The Coast Guard has awarded two contracts for operational use and concept development of how this capability should be integrated into the existing force structure. First, four Saildrone Voyager USVs are currently deployed to enhance Coast Guard MDA on the U.S. Southern maritime boarder approaches. Second, in partnership with Customs and Border Protection and the Defense Innovation Unit, an additional five Saildrone Voyagers will be deployed on the U.S.-Mexico maritime border near San Diego to provide surveillance capability for both components. Saildrone USVs are wind and solar-powered vessels that are contractor-owned, contractor-operated assets; meaning Coast Guard personnel direct positioning for surveillance, but vehicle control remains with Saildrone. While these USVs will improve surveillance capability, the deployments also integrate key enabling technologies including communication networks, data platforms, analytics, and visualization systems for the collected USV data. This expands a data architecture for future unmanned and autonomous systems integration and employment.

III. Conclusion

These efforts represent the research and development into USV employment by Coast Guard and selected partners. These projects will inform wider scale use of USV technology and capabilities, and improve Coast Guard mission execution, crew safety, and national security.

Appendix: Abbreviations

Abbreviation	Definition
CY	Calendar Year
DHS	Department of Homeland Security
ISR	Intelligence, Surveillance, and Reconnaissance
MDA	Maritime Domain Awareness
MUST	Maritime Unmanned Systems Technology
RDC	Research and Development Center
S&T	Science and Technology Directorate
USV	Unmanned Surface Vehicle
UxS	Unmanned Systems