Unmanned and Autonomous Systems: Opportunities, Challenges, and the latest from the IMO

Maritime Law Association of the United States
Fall 2022 Meeting
San Diego, California

CDR Joel Coito
Chief, Prevention Law Division
Office of Maritime and International Law
U.S. Coast Guard

IMO: WHERE WE'VE BEEN…

- **IMO MSC 98 (June 2017):** MSC launches "Regulatory Scoping Exercise" (RSE) to determine how the safe, secure and environmentally sound operation of Maritime Autonomous Surface Ships (MASS) may be introduced in IMO instruments;
  - Objective: assess the degree to which the existing regulatory framework might be affected in order to address MASS operations
  - Conducted by MSC, LEG, and FAL Committees
  - Prevent Mass Ops? Do not Prevent? May Need Amendment? No application?

- **IMO's Strategic Plan (2018-2023):** Key Strategic Direction to "Integrate new and advancing technologies in the regulatory framework."

- **IMO MSC 103 (May 2021)**: Regulatory Scoping Exercise Completed.

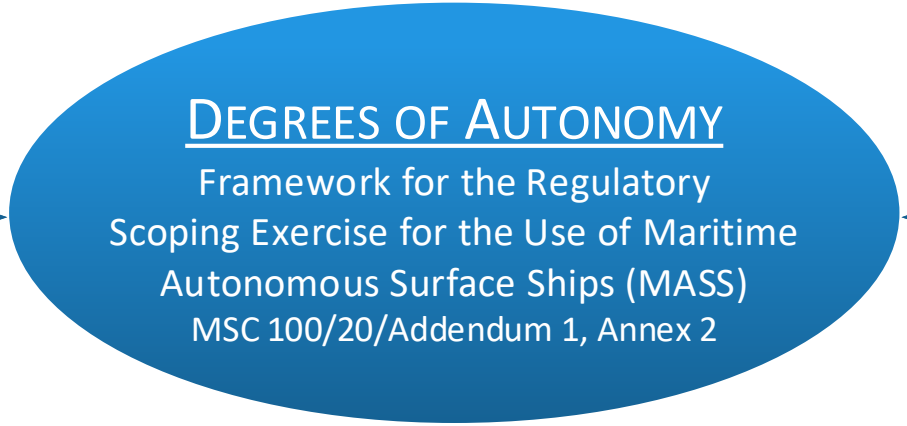
Degrees of Autonomy

Degree One: Ship with Automated Processes and Decision Support

- Seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated and at times be unsupervised but with seafarers on board ready to take control.

Degree Two - Remotely Controlled Ship with Seafarers On Board

- The ship is controlled and operated from another location. Seafarers are available on board to take control and to operate the shipboard systems and functions.



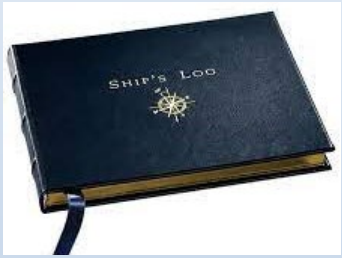
Degree Four – Fully Autonomous Ship

- The operating system of the ship is able to make decisions and determine actions by itself.

Degree Three – Remotely Controlled Ship Without Seafarers On Board

- The ship is controlled and operated from another location. There are no seafarers on board.

IMO Conventions: A "Seafarer-Based Regime"



- Conventions and IMO Regulations are premised/contemplated to have a human onboard
  - Making Notifications
  - Keeping Logs
  - Displaying lights/hoisting signals (day shapes)
  - Bridge-to-Bridge Communications
  - Maintaining proper bridge watch standing
  - Sufficient manning to ensure safety of life at sea
  - Effective crew performance in safety evolutions
  - Requirements to take a pilot onboard

IMO: WHERE WE ARE GOING…

- **MASS Code:** Committee agreed the best way forward to address MASS in the IMO regulatory framework a goal-based "MASS Code."
  - Non-mandatory Code for adoption in the second half of 2024
  - Mandatory MASS Code developed thereafter; entry into force 1 Jan 2028

- **Related Work:**
  - **MASS Intersessional Correspondence Group (ongoing);**
    - Develop common understanding of purpose/objectives of MASS Code
    - Commence development of "MASS Code"
    - Consider common potential gaps/themes

  - **Joint MSC-LEG-FAL Working Group on MASS**: address common high-priority issues identified by the RSE for the use of MASS;
    - 1st Session: September 7-9, 2022 (virtual)
    - 2nd Session: 2023 (in-person)

  - **IMO MASS Seminar**: September 5-6, 2022 (virtual)
    - Research, academia, business and government leaders;
    - Opportunities, challenges & approaches in creating a "MASS Code"

IMO: WHERE WE ARE GOING…

- **Major Themes, and Challenges Ahead:**
  - **Development of MASS terminology and definitions**;
    - "MASS master" and "MASS crew"
    - "remote operator"
    - "remote control station/center"
  - **Flag State Responsibilities;** (*see also* UNCLOS Article 94)
  - **Accounting for manual operations and alarms**;
  - **Actions by personnel** (firefighting, cargoes stowage/securing; maintenance);
  - **Watchkeeping**;
  - **Implications for search and rescue**;
  - and more…

- **Consideration of MASS Code Proposals:**
  - Preliminary: "starting point for a better-structured discussion," and a baseline to facilitate "structured consideration" of a potential MASS Code;
  - Includes "traditional" shipboard functions – maintenance, communication, fire safety;
  - Also includes new/novel provisions: cybersecurity and "safe fallback response"

IMO: WHERE WE ARE GOING…NEXT WEEK!

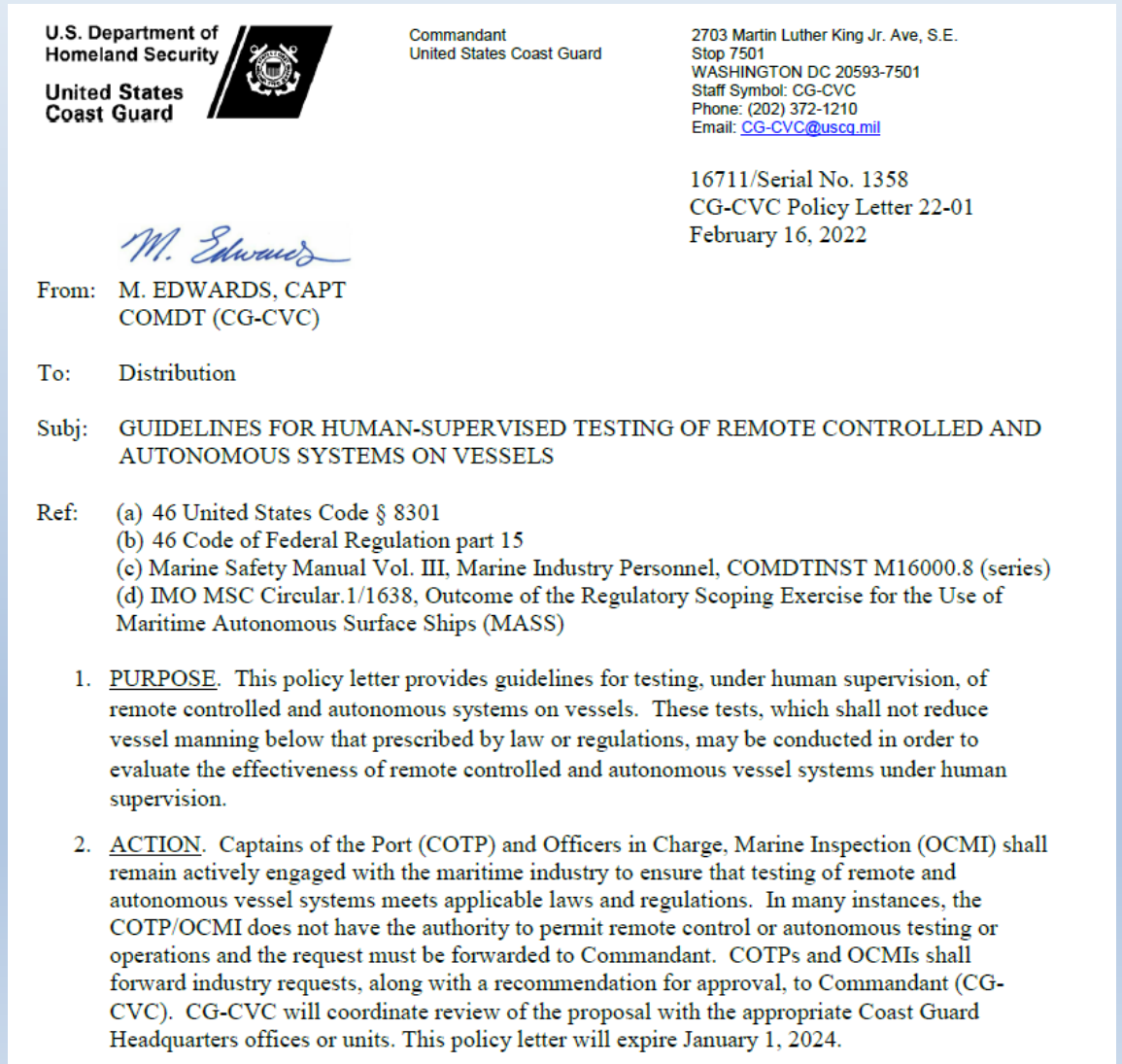
IMO MSC 106 : November 2-11, 2022

- First in-person meeting of the Maritime Safety Committee since COVID shutdown;
- Robust MASS Agenda:
  - Working Group on Development of a Goal-based Instrument for MASS:
    - Consider report of MSC-LEG-FAL Joint Working Group on MASS
    - Consider draft provisions on navigational tasks/functions for MASS Code
    - Incorporation of risk assessment into MASS Code
    - Draft outline/proposal of a goal-based MASS Code

U.S. Coast Guard: Policy Developments

- **Policy Letter 22-01: Guidelines for human-supervised testing of remote controlled and autonomous systems on vessels.**

- Potential for increased efficiency
- New safety risks and security challenges
- Ensure consistent OCMI/COTP responses to requests to test for remote/autonomous systems
- Assess risk of engineering, operational, and navigation failures and the potential consequence to people, property, and the environment
- Path for CG approval of remote & autonomous system ops under human supervision



U.S. Department of Homeland Security
United States Coast Guard

Commandant
United States Coast Guard

2703 Martin Luther King Jr. Ave, S.E.
Stop 7501
WASHINGTON DC 20593-7501
Staff Symbol: CG-CVC
Phone: (202) 372-1210
Email: CG-CVC@uscg.mil

16711/Serial No. 1358
CG-CVC Policy Letter 22-01
February 16, 2022

From: M. EDWARDS, CAPT
COMDT (CG-CVC)

To: Distribution

Subj: GUIDELINES FOR HUMAN-SUPERVISED TESTING OF REMOTE CONTROLLED AND AUTONOMOUS SYSTEMS ON VESSELS

Ref: (a) 46 United States Code § 8301
(b) 46 Code of Federal Regulation part 15
(c) Marine Safety Manual Vol. III, Marine Industry Personnel, COMDTINST M16000.8 (series)
(d) IMO MSC Circular.1/1638, Outcome of the Regulatory Scoping Exercise for the Use of Maritime Autonomous Surface Ships (MASS)

1. PURPOSE. This policy letter provides guidelines for testing, under human supervision, of remote controlled and autonomous systems on vessels. These tests, which shall not reduce vessel manning below that prescribed by law or regulations, may be conducted in order to evaluate the effectiveness of remote controlled and autonomous vessel systems under human supervision.

2. ACTION. Captains of the Port (COTP) and Officers in Charge, Marine Inspection (OCMI) shall remain actively engaged with the maritime industry to ensure that testing of remote and autonomous vessel systems meets applicable laws and regulations. In many instances, the COTP/OCMI does not have the authority to permit remote control or autonomous testing or operations and the request must be forwarded to Commandant. COTPs and OCMIs shall forward industry requests, along with a recommendation for approval, to Commandant (CG-CVC). CG-CVC will coordinate review of the proposal with the appropriate Coast Guard Headquarters offices or units. This policy letter will expire January 1, 2024.

TECHNOLOGICAL INNOVATION

THE 1ST INDUSTRIAL REVOLUTION USED WATER AND STEAM POWER TO MECHANIZE PRODUCTION. THE 2ND USED ELECTRIC POWER TO CREATE MASS PRODUCTION. THE 3RD USED ELECTRONICS AND INFORMATION TECHNOLOGY TO AUTOMATE PRODUCTION. THE 4TH HAS BEEN OCCURRING SINCE THE MIDDLE OF THE LAST CENTURY AND IS CHARACTERIZED BY A FUSION OF TECHNOLOGIES THAT IS BLURRING THE LINES BETWEEN THE PHYSICAL, DIGITAL, AND BIOLOGICAL SPHERES.

- KLAUS SCHWAB

TECHNOLOGICAL INNOVATION: AUTONOMY AT SEA

SpaceX Autonomous Spaceport Drone Ship

Rolls-Royce/Finferries: First Fully Autonomous Ferry *Falco*

USING AUTOMATION IN NAVAL OPERATIONS

U.S. Navy Unmanned Surface Vessel *Sea Hunter*

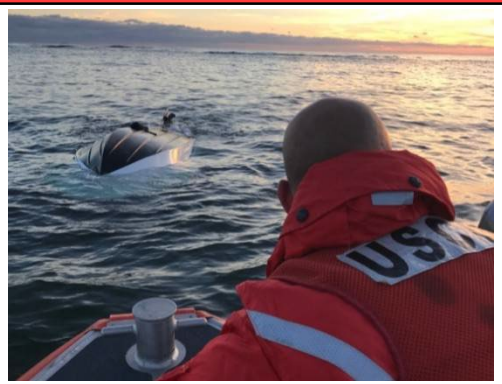
USCG *29RDC (USCG Research & Development Center)*

OPERATIONAL IMPACT OF AUTONOMY

MILITARY

LAW ENFORCEMENT

COUNTER DRUG



SEARCH AND RESCUE

FISHERIES ENFORCEMENT

INTELLIGENCE

Counter-Drug: Pros/Cons of Autonomy

Seized drug contraband from maritime interdiction operations

Unmanned Aerial Vehicle (UAV) Launched from USCG National Security Cutter

Counter-Drug: Pros/Cons of Autonomy

?????

Duty to Render Assistance

- Customary roots date back to antiquity
- Modern Codification
  - UNCLOS
    - Flag states "shall require **the master**" to "proceed with all possible speed" to render assistance, so long as doing so does not endanger the ship, crew, or passengers. UNCLOS 98(1)
  - Safety of Life At-Sea (SOLAS)
    - "The **master of a ship** at sea" in a position "to be able to provide assistance… is bound to proceed with all speed to their assistance" Chapter V, Reg 33

Duty of Naval Commanders

- Commander's Handbook on the Law of Naval Operations:

- **3.2.1.2 Duty of Naval Commanders**
- U.S. Navy Regulations, 1990, Article 0925, requires that, insofar as he can do so without serious danger to his ship or crew, **the commanding officer or senior officer present**, as appropriate, shall proceed with all possible speed to the rescue of persons in distress if informed of their need for assistance; render assistance to any person found at sea in danger of being lost; and, after a collision, render assistance to the other ship, its crew and passengers, and, where possible, inform the other ship of his identity. U.S. Coast Guard Regulations. Section 4-2-5, Assistance (COMDTINST M5000.3B), imposes a similar duty for the Coast Guard.

DUTY TO ASSIST? DEGREES OF AUTONOMY

DEGREE ONE: SHIP WITH AUTOMATED PROCESSES AND DECISION SUPPORT

- Seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated and at times be unsupervised but with seafarers on board ready to take control.

DEGREE TWO - REMOTELY CONTROLLED SHIP WITH SEAFARERS ON BOARD

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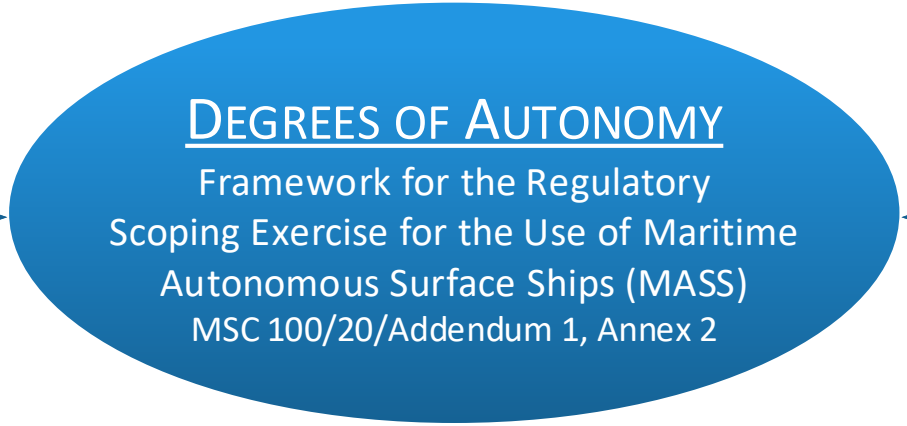

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Vessel/Ship Determination

- **Ship/Vessel' Defined Broadly under Domestic Law**

  "*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

  → *See* ***Lozman v. City of Riviera Beach*** (SCOTUS, 2013): structure/watercraft does not fall within 1 U.S.C. § 3's definition of a "vessel" unless a "reasonable observer," looking to the structure or watercraft's physical characteristics and activities, would consider it ***designed to a practical degree for carrying people or things over water***.

- **No Specific Definition for 'Ship' under International Law.**
  - However, majority of scholarship finds that autonomous craft are "vessels" subject to the COLREGS and other international instruments.

- **COLREGS Rule 1(a)**: COLREGS "apply to all **vessels** upon the high seas and in all waters connected therewith navigable by seagoing vessels."

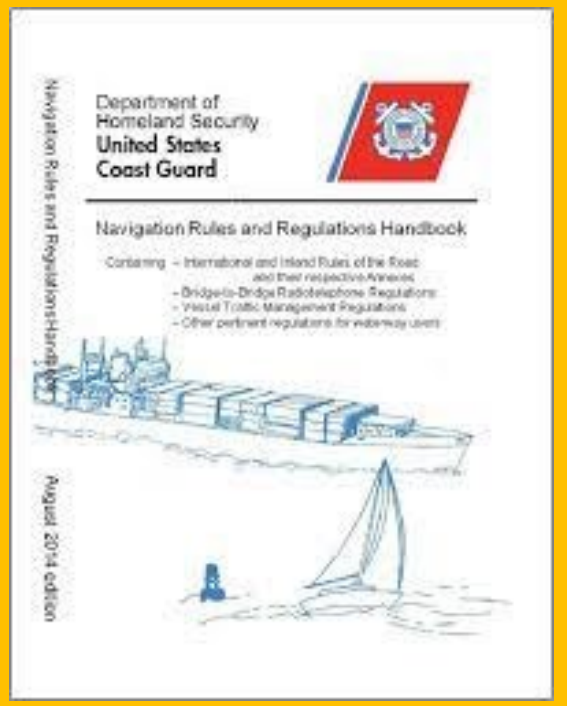
- **Ships enjoy Rights (defined in UNCLOS)**
  - Freedom of the Seas/Innocent Passage/Straits Transit/Archipelagic Sea Lanes

- **But, have Responsibilities**
  - Flag State Registration/Jurisdiction
    - Must abide by flag state requirements for seamanship, lookouts, engineering, manning, and pollution control
  - COLREGs (seamanship, collision avoidance, lighting, signals)
  - Customary Duties
    - Render Assistance

COLREGS

Case Study

- Rule 2: Responsibility
- Rule 5: Lookout



Rule 5: Maintaining a Proper Lookout

- Every Vessel Shall at All Times **Maintain a Proper Lookout by Sight and Hearing** as well as by all available means appropriate to the prevailing circumstances and conditions so as to make a Full Appraisal of the Situation and Risk of Collision.
  - **COLREGS,** Rule 5
- Detailed requirements for what the "conning officer" should be able to see (2 ship lengths or 500 meters), bridge design (range of vision in degrees), window size and thickness (to permit sound and see), and height cargo can be stacked above the bridge of a ship.
  - **SOLAS Reg 22**

Could automated sensors, cameras and audio devices meet the requirements of a "proper lookout" and comply with SOLAS regs?

- SOLAS permits deviations and functional equivalents, e.g. "sound reception systems" are permitted to fulfill the requirement for bridges that are too insulated from outside sounds. (IMO V/19)
- **COLREGS, unlike SOLAS, offer no provisions for substitutions or functional equivalents**.
  - Onboard personnel maintain ability to exercise control
    - Prof Allen – Can a 'Master' be a program or a well tested system?

Rule 2: Responsibility

- Nothing in these rules shall exonerate any vessel, or owner, master, or crew thereof, from the consequences of any neglect to comply with these Rules or of the neglect of any precaution **which maybe required by the ordinary practice of seamen**, or by the special circumstances of the case…. This requires **due regard** to all dangers and to any special circumstances, **which may make a departure from these Rules necessary** to avoid immediate danger.
  - COLREGS, Rule 2

- So the rules require "due regard," "ordinary practice of seamanship," and "departure from the rules."

- Technological Challenge:
  - Challenge 1: Programming to ***follow rules***.
  - Challenge 2: Programming to know when ***to break rules***.

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