Unmanned Maritime Systems and COLREGS: An Industry Perspective

Rand D. LeBouvier, Ph.D.
CAPT USN (ret)
Chair- AUVSI COLREGS Subcommittee

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Association for Unmanned Vehicle Systems International (AUVSI) COLREGS Subcommittee

- AUVSI Mission Statement: Represent the unmanned maritime systems industry by providing advocacy for the industry and input to the United States Coast Guard (USCG) and IMO related to proposed regulatory efforts including the COLREGS and other international maritime rules and practices.
- Work Completed to Date:
  - AUVSI has been present at the Navigation Safety Advisory Council (NAVSAC- USCG's advisory group) since 2013 and has established a strong working relationship with them, the US Navy, NOAA and the EU's SARUMS group.
  - Established Liaison with the UK's Maritime Autonomous Systems Regulatory Working Group (MASRWG).
  - Co-Authored an article with the USCG in the USCG *Proceedings*
  - Multi-media information dissemination through AUVSI
  - Reviewed USCG Draft Best Practices
- Work Plan through Quarter 4, 2016:
  - Liaison with partner organizations
  - Review Lloyd's documents

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AUVSI COLREGS Subcommittee Membership

- ASV
- Blank Rome LLP
- CMRE NATO
- DRDC Canada
- General Dynamics Mission Systems
- ISE
- Juliet Marine
- Just Innovation
- Hydroid, Inc. a Kongsberg Company
- Leidos
- Lockheed Martin
- MIT
- Naval Postgraduate School
- NOAA
- Rolls Royce
- SAAB Kockums
- SeaRobotics

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Unmanned Maritime Systems Considerations

Man portable, Lightweight, and Heavyweight UUVs

- Preponderance of UUVs in use today are less than 8M in length and 1M in diameter. Large Diameter and above will require separate consideration.
- Not remotely piloted
- Not in constant communication with operator
- Size, power and hydrodynamics limit what can be done to increase visibility or to add automated identification systems
- Undersea (acoustic) communications will remain a significant limitation
- Vehicles are rarely on the surface except for GPS update and for launch and recovery
- Operate at 2-3 knots submerged, thruster normally stopped when on the surface (i.e. underway, not making way)
- Due to size, construction, speed, and low profile, more likely to BE damaged than to cause damage to surface traffic

USVs

- Can be remotely piloted
- Can be in constant communication with operator
- Surface systems more able to accommodate means to increase visibility or to add automated identification systems, within size constraints
- Communications are not necessarily a significant limitation, although bandwidth will still remain a concern in terms of processing data
- Vehicles operate exclusively on the surface
- Can operate at higher than normal traffic speeds

Innovation and Initiative: the DARPA ASW Continuous Trail Unmanned Vessel (ACTUV) Program

- **Key challenges for ACTUV:**
- **Create a comprehensive world model**
  - All weather, sea conditions and surface contacts
  - Wide variety of targets
  - Robust to false contacts and spoofing
  - Implies diversity of sensing approaches—radar, AIS, EO/IR, acoustic
- **Vessel COLREGS classification**
  - Sailing, fishing, restricted in ability to maneuver
  - Implies object recognition including interpretation of lights and day shapes
- **T&E strategy that builds confidence; high-nines reliability**
  - Implies extensive data collection and early at-sea integration and testing, augmented by robust modeling and simulation.

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Thoughts…

- Applicability:
  - ROVs, since they are tethered pieces of shipboard equipment, would not be specifically governed by the COLREGS, nor would unpowered or buoyancy driven gliders and floats, although Best Practices might be relevant and applied.
  - Should cover situations between manned and unmanned vessels, as well as between unmanned vessels
- Determination of vessel status becomes important if intent is to change COLREGS.
- Code of Conduct and Code of Practice Procedures are a very good start. Will need to address technical feasibility and practicality.
- Proposed rules changes require careful definitions and avoidance of de facto hierarchy imposition.

Definitions

- Unmanned Maritime System: The term “Unmanned Maritime System (UMS)” means any unmanned system that has been determined to be a vessel that does not physically contain a human that may operate on the surface of the water (at any time) and may include autonomous, semi-autonomous or remotely operated systems (including systems intermittently operated in these modes). It does not include ROVs, since they are tethered pieces of shipboard equipment, or unpowered or buoyancy driven gliders and floats.
- UMS Community: All owners, operators and manufacturers of UMS

Levels of Autonomy

- Difficult to achieve consensus
- Currently in fashion:
  - Human Operated
  - Human Delegated
  - Human Supervised
  - Fully Autonomous
- May not be appropriate to try to capture in COLREGS
- Could be a determinant in liability, certification

Rule 18 Hierarchy

- Comment: Please be careful not to inadvertently impose the lowest level of the hierarchy simply because the vehicle is unmanned.
- Recommended verbiage:

“An Unmanned Maritime System (UMS) that has been determined to be a vessel and while operating on the surface may fall within one of the categories in paras (a) through (d) above depending upon its employment and capabilities.”

Rule 23 Lighting

- Current USCG draft:

"In addition to the lights required by the Rules of this Part based on size, a UMS while operating on the surface shall display a special flashing light. This light shall:

- operate at all times, irrespective of visibility or daylight,

- be white, and

- Signal/Morse code signal – To Be Determined

Other Issues

- What will constitute a Proper Lookout on an Unmanned System?
- Technical Implementation of Collision Avoidance
- Technical Implementation of COLREGS behaviors

Certification / Indemnification

American Bureau of Shipping (ABS) and others…

- Classification
- Definition
- Pressure Vessels
- External Structures
- Emergency Recovery
- Ballast Systems
- Stability
- Emergency Surfacing
- Propulsion and Steering
- Control Systems
- Navigation
- Emergency Location
- Communication
- Mechanical and Electrical Systems
- Testing

Lloyd's Register

- Design Code for Unmanned Marine Systems
- Cyber-enabled ships; ShipRight Procedure – Autonomous Ships, First edition, July 2016

Recommendation

- Changes to existing COLREGS if any need not be extensive. Rules should account for size, speed, and ability to control.
- Industry would show good faith in publishing/endorsing Best Practices/ Code of Conduct