

Autonomous Ships/Vehicles: Classification Society Perspective



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Agenda

- Trends/Challenges
- Regulatory Development
- Autonomy Levels
 - New Technology Qualification
 - 5 Qualification Stages
- Smart to Autonomous Framework
 - Condition Based Class
 - Software notations
 - SMART notations
 - Goal Based Autonomous Vessel Certification
- Supporting the Journey



Trends in Autonomy for Marine application

Improved

- sensors and imaging technology,
- connectivity within the vessel and from the vessel to shore
- data management and analytics
- machine learning and artificial intelligence tools
- Increasing application of technology to augment and replace personnel
 - Subsurface autonomous vehicles
 - Remote areas surface surveys and security monitoring
 - Government sponsored test surface vessels
 - Navigation and bridge level crew augmentation
- Dedicated routes/short shipping routes with remote operation centers





Challenges

- Technology
- Human factors
- Regulatory Framework

Autonomous functions which will perform tasks mandated by current regulations (for e.g. an autonomous navigation system performing the duties of a Lookout as required by COLREGS) would have to be shown to be equivalent to being carried out by humans, and an exemption would have to be granted by the flag state.







IMO Regulatory Scoping Exercises

IMO Scoping Exercise

MARITIME SAFETY COMMITTEE

Maritime Autonomous Surface Ships (MASS) – Proposal for a regulatory scoping exercise

Degrees of Autonomy

- Ship with automated processes and decision support
- Remotely controlled ship with seafarers on board
- Remotely controlled ship without seafarers on board
- Fully autonomous ship

Source: MSC 100



ABS System Autonomy Levels



ABS System Level of Autonomy		Integration and Application to Decision Loop			
		Monitoring	Analysis	Decision	Action
1	Smart	М	М	Н	Н
2	Semi-Autonomous	Μ	М	H/M	H/M
3	Autonomous	Μ	М	М	М
Notes: 1. H-Human, M-Machine					

Smart systems augment human capabilities by assisting during the Monitoring and Analysis phases. A smart system may make recommendation, but the decision and final choice rests with the human operator.

Semi-Autonomous systems take a decision-making role and performs action selection. A human is in the loop for approval and possible override of system-selected actions.



Concepts within each Autonomy Level

- Vessel Details
 - Туре
 - Size, capacity
 - Design envelope
- Concept of Operations
 - Intended Area of Operations
 - Autonomous System Application to Voyage Phases (seagoing, port operations, piloting, anchor/mooring, distress/emergency)
 - Operational Envelope (limitations and restrictions)
- Modes of Control by Humans
 - Where
 - How
 - Concept of Support Logistics
 - Maintenance
 - Emergency Response



ABS New Technology Qualification

- Five stage process compatible with API RP 17N/Q, ISO 16290 and US DoD
- Tailored for new/unproven vendor applications
 - System, Sub-system, Equipment, Component or materials
- Autonomous Review is aligned to a Goal Based Framework.





ABS Smart to Autonomous Framework



*Safe execution of mission has to consider the impact on/consequences to people, environment and the vessel



Shift to ABS Condition-Based Class





ABS Software Quality and Integrity





ABS CyberSafety® Type Approval Process









Getting to a Smart Vessel or Asset



14 | ABS Smart Guide



Smart in Context





Autonomous Operations







ABS Supporting the Journey to Autonomy

- Data scientists and software engineering capability investment
- Industry collaboration via MASS projects
- Industry collaboration via Condition Based Class projects
- Refining foundational requirements: cyber, software, data collection and usage
- Defining autonomy requirements and pathways to safety equivalency
- Utilizing New Technology Qualification: risk assessment and engineering-based verification
- IMO Regulatory Scoping Exercise with MPA (Maritime & Port Authority of Singapore)
 - Assist with scoping exercise for SOLAS Chp. V and COLREGS.
- ISO 23860 MASS Terminology
- Widely accepted thought leadership



Considerations for Advancing Autonomy

- Joint development projects with government and industry
- Testing and evaluation of subsystem functionality and software reliability
- Algorithm testing and validation protocols and interoperability testing
- Standards development committees and peer review opportunities
- Regional surface vessel test sites and data collection centers
- Open source software and relaxed restrictions on technology transfer
- Line of sight remotely operated and optionally manned surface vessels
- Public outreach regarding safety and regulatory acceptance
- Demonstrated cost savings and risk reduction







Thank You

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