

The regulatory approach for vessels capable of autonomous and remote controlled operation

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ABSTRACT

The Australian Maritime Safety Authority (AMSA) is a Commonwealth statutory authority responsible for maritime safety, protection of the marine environment from pollution, and search and rescue. As part of these responsibilities, AMSA regulates vessels operating within Australia's Exclusive Economic Zone (EEZ), including vessels capable of autonomous and remote controlled operation. AMSA's challenge is to put in place appropriate domestic regulatory arrangements for these vessels, which are flexible enough to support current as well as emerging technology in a rapidly evolving industry.

Our knowledge of this technology is in its formative stages, as is our regulatory approach. Until a defined whole of Government policy on autonomous and remotely operated vessels is confirmed, AMSA will pursue regulatory solutions in line with our policy settings and [statement of regulatory approach](#). These principles will guide AMSA in mapping out a fit-for-purpose regulatory treatment based on the risks presented, including considerations such as vessel size, area and concept of operational use, the ability to comply with collision regulations, environmental impacts and differing levels of autonomy.

Internationally, AMSA influences the regulation of the systems and technology that will support shipping of the future, through our work at the International Maritime Organization (IMO). Our interests include ensuring that these systems and infrastructure are safe and effective when operated in Australian waters. AMSA continues to play an influential role on the international regulation of Maritime Autonomous Surface Ships (MASS).

This paper explores the regulatory challenges posed by autonomous and remotely operated vessels, together with the work AMSA is undertaking in response, at a domestic and an international level.

1. INTRODUCTION

Major advances in technology in recent years have now made autonomous and remotely operated vessels a reality. In the past, law makers conceptualised vessels in traditional terms of a physical structure, physical machinery and experienced seafarers on board to operate it. The maritime laws currently in place at the domestic and international levels are well suited to such vessels – they balance the safety of vessels, their crews, and environmental protection, while allowing such vessels to operate with a level of intervention commensurate with the risks posed by the operation. However, these laws do not easily accommodate the sorts of technological advances being seen today, much less those that will be reality in coming years.

As Australia’s maritime safety regulator, AMSA’s challenge is to adapt longstanding regulatory and operational arrangements to provide for the safe operation of autonomous and remotely operated vessels, in a way that will be effective in the short, medium and long term. AMSA cannot achieve this in isolation, and is actively engaging with leaders and key stakeholders in the fields of autonomous and remotely operated vessel design, technology, operation and regulation. AMSA will leverage its experience and that of its stakeholders, to identify the best way forward, in order to provide effective regulation and continue to ensure the safety of people and vessels, and the protection of the marine environment in Australia.

AMSA’s role

AMSA is the Commonwealth statutory authority responsible for maritime safety, protection of the marine environment, and search and rescue. AMSA regulates commercial vessels operating within Australia’s Exclusive Economic Zone (EEZ), including vessels capable of autonomous and remote controlled operation. AMSA is committed to safety and the protection of the marine environment; it encourages and supports innovation and new technology, where possible.

AMSA is established by the *Australian Maritime Safety Authority Act 1990*, and is responsible for administering the following:

- *Marine safety (domestic commercial vessel) National Law Act 2012* (National Law)
- *Navigation Act 2012* (Navigation Act)
- *Shipping Registration Act 1981* (Shipping Registration Act)
- *Protection of the Sea (Prevention of pollution from ships) Act 1983* (PoTS Act)

Internally, AMSA has an Autonomous Vessel Team, which is made up of subject matter experts in regulatory and operational matters with expertise at both a domestic and an international level. The team is responsible for managing enquiries and applications received in relation to autonomous and remotely operated vessels. This ensures consistency in our treatment of these vessel operations, and provides AMSA with crucial data and intelligence sources to inform our future approach.

Domestic trends

What is operating today

New technology continues to be developed and used on vessels operating in Australian waters in commercial, research and government settings. To date, most autonomous applications

have related to data gathering and hydrographic survey. However, trends indicate that the systems and infrastructure that support autonomous and remote operation will play a large part in the broader maritime industry in the future. A range of sub-surface and surface autonomous and remotely operated vessels are already in operation. Some examples include:

- *Sub-surface*: Undersea gliders, autonomous underwater vehicles and under ice exploration systems; and
- *Surface*: OCIUS Bluebottle, IX Blue Unmanned Survey Vessel (DriX), Saildrones, C-Worker 5 and 8, and WAM-V.

Each of these vessels has different physical and operational characteristics, which in turn changes the way AMSA has approached their regulation.

Future domestic industry insight

The technology currently being developed will soon be implemented in sectors of Australia's maritime industry. This does not mean that autonomous and remotely operated vessels will replace all conventional vessels, but that Australia's maritime industry will increasingly feature more connected, intelligent and automated systems. The systems and infrastructure that supports high levels of automation and remote operation of vessels in Australia has the potential to significantly improve efficiency and safety for operators and seafarers alike.

While these changes bring with it opportunity, AMSA is cognisant of the need to ensure that the migration to such systems and infrastructure does not negatively impact on safety and the protection of the environment in Australia. AMSA will develop an appropriate regulatory approach which is consistent with our statement of regulatory approach, and is fit for purpose.

International trends

International trends indicate that the advent of highly automated and technologically advanced vessels is a reality today. A wide range of technology, systems and infrastructure are being developed to support these vessels. It is becoming increasingly evident that the commercial shipping industry is not working towards completely unmanned vessels, but instead to increasingly 'smarter' ships, which are designed and equipped to be able to operate across a range of autonomous operation.

Some significant international projects include:

- *One Sea Autonomous Maritime Ecosystem* – The primary aim of Finland's One Sea project is to lead the way towards an operating autonomous maritime ecosystem. The project brings together leading maritime experts, technology companies, businesses and government in a collaborative approach to creating a maritime environment suitable for autonomous ships by 2025.
- *Yara Birkeland* – The vessel "Yara Birkeland" is intended to be the world's first fully electric and autonomous container ship with zero emissions. The 80m x 15m ship will operate in Norwegian waters, and be monitored from a shore control station, with a human in the loop, whilst the ships systems and supporting infrastructure are

responsible for a large number of the ship functions. The ship will be delivered in 2020, and will gradually transition to fully autonomous mode by 2022.

- *The AutoFerry project in Trondheim, Norway* – The primary aim of this project, led by the Norwegian University of Science and Technology, is to develop ground breaking new concepts and methods which will enable the development of all-electric autonomous passenger ferries for transport of people in urban water channels.

Many of the international trends relate to the use of systems and infrastructure to support decentralised control, monitoring and support arrangements for vessels; and provide enhancements to safety and efficiency in the maritime industry.

2. AMSA'S INTERNATIONAL INFLUENCE

IMO progress with addressing autonomous vessels

The International Maritime Organization (IMO) is a specialized agency of the United Nations, and is the global standard-setting authority for the safety, security and environmental performance of international shipping.

In 2017, the IMO's Maritime Safety Committee (MSC) agreed that there was a need to address the regulation of autonomous shipping. The committee also agreed to the use of a universal term, Maritime Autonomous Surface Ships or MASS, to describe a ship which, to a varying degree, can operate independently of human interaction. MASS are generally considered to be large ships which undertake international voyages, rather than smaller domestic vessels. In 2017, the IMO initiated a Regulatory Scoping Exercise (RSE), to examine IMO regulatory instruments with an aim of determining:

- a. what regulations apply to MASS, do not apply to MASS, prevent MASS operation, or require amendment to allow for MASS operation, and
- b. the most appropriate way of addressing the issues identified during the course of the exercise, for example where a specific convention prevents MASS operation.

The RSE is being conducted by a number of volunteering member states, and is due for completion at the 102nd session of the MSC in 2020. Only after the IMO is satisfied with the results of the RSE will it consider the next steps to properly addressing MASS, and/ or making regulatory change if considered necessary.

AMSA's role at the IMO

AMSA considers it to be in Australia's best interests to remain engaged in the IMO's work on MASS. Key characteristics of our maritime environment, including Australia's remoteness, sensitive marine environment, challenging sea conditions, and a significant dependence on shipping, means that Australia brings a different perspective to this work than some other IMO member states. For example, while we have a focus on environmental protection, and retaining our "blue economy" and our raw mineral export industry, other member states have a focus on ship building, the production of ship technology, and the maintenance of a large ship register. Our interests can be summed up as wanting to ensure that the on board systems

and the infrastructure that will support shipping are safe, effective, and fit for purpose when operated in our region of the world.

Whilst Australia is not directly engaging in the design, build or operation of MASS today, it is important that future regulation is appropriate for such vessels operating in Australia in the future.

It is for these reasons that Australia takes an active role in the work on MASS, championing its progress, and focusing on ensuring that changes to international regulation is modern, practical, safe and will be effective for Australia.

3. REGULATORY REQUIREMENTS THAT APPLY DOMESTICALLY

AMSA regulates domestic commercial vessels (DCVs), regulated Australian vessels (RAVs) and foreign vessels. The majority of autonomous and remotely operated vessels operating in Australia are DCVs.

Domestic commercial vessels

DCVs are Australian vessels for use in connection with a commercial, governmental or research activity that operate within Australia's Exclusive Economic Zone (EEZ). Australia's DCV fleet is made up of approximately 35,000 vessels, in a broad range of categories such as fishing vessels, ferries, charter vessels, kayaks, jet skis, and barges. All DCVs over 24m are required to be registered under the Shipping Registration Act, and will receive an official number if registered.

Under the National Law, DCVs are required to have a unique vessel identifier, certificate of survey, a certificate of operation, and must be crewed by persons holding the required certificate of competency. There are also general safety duty requirements that must be complied with. The owner and master must also develop and implement a safety management system (SMS), that ensures the safe operation of the vessel so far as reasonably practicable. DCVs are inspected by AMSA Port Marine Surveyors or accredited Marine Safety Inspectors.

AMSA is responsible for administering the National Law regulatory framework, which was not developed to cater for autonomous and remotely operated vessels. Despite this, the broad definitions of 'vessel' and 'domestic commercial vessel' mean that autonomous and remotely operated vessels are subject to the same requirements as other domestic commercial vessels. Given that autonomous and remotely operated vessels do not usually have crew on-board (or at all, in the case of fully autonomous vessels), and have complex operating systems not provided for in established technical standards, this causes significant challenges from a regulatory perspective.

AMSA has introduced a range of risk-based *general exemptions* which provide a degree of flexibility for designated kinds of operations and vessels. Operators may also apply for a *specific exemption*, which allows AMSA to assess individual operations and vessels on a case by case basis and potentially use administrative conditions to create a tailored regulatory approach. AMSA may only grant exemptions when satisfied that doing so will not jeopardise the safety of a vessel or a person on board a vessel, and the exemption does not contradict an

international Convention. While using the exemption mechanism may be appropriate through the formative stages of AMSA's approach to regulating autonomous and remotely operated vessels, it does not necessarily provide the foundations of a longer term framework.

Regulated Australian Vessels (RAV)

RAVs are commercial vessels that are required to be registered under the Shipping Registration Act and are either proceeding on an overseas voyage or surveyed and certified under the Navigation Act. There are several hundred RAVs and the composition of the fleet varies from small 6.5m vessels to fishing vessels to large 272m LNG carriers.

Vessels registered under the Shipping Registration Act receive an official number. RAVs require safety certificates, which are issued based on their compliance with international Conventions, (such as SOLAS, ILLC, and COLREGS), as determined by the regulations (Marine Orders), based on the class of the vessel. RAVs may either be surveyed by a recognised organisation (Classification Societies) on behalf of AMSA or by AMSA itself. RAVs are subject to flag State control inspections by AMSA Port Marine Surveyors. An autonomous RAV would need to comply with relevant regulations and international conventions depending on its size and class.

Provisions for flexibility through exemption or alternative means of compliance are provided within international Conventions, but these are limited by a variety of strict parameters and conditions.

One of the common scenarios AMSA sees is where a small autonomous or remotely operated vessels is operated off a mothership. AMSA treats these vessels as "*ships equipment*". The smaller vessel is considered to be part of the ship for the purposes of survey, and is included and operated in compliance with the ship's safety management system. This has been common practice in industries such as passenger vessel and offshore oil and gas for many years.

The more complex scenario is where the autonomous or remotely operated vessel is a standalone, independently operating vessel. To a degree, for RAVs, AMSA is reliant on the IMO making changes to the international framework so that they can then be implemented in the domestic framework. In the meantime, AMSA would be looking for appropriate safety assurance and risk management processes to be in place, and for support from a recognised organisation, before it could consider using a flexibility arrangement to allow the vessel to operate, for example through an exemption, equivalent means of compliance, or alternative design arrangements.

Foreign vessels

Foreign vessels entering Australian ports are subject to AMSA's port State control regime and may receive an inspection based on the eligibility criteria. Vessels are expected to be certified and in compliance with the relevant conventions ratified by the vessel's flag State. Vessels sailing under a flag not party to a Convention receive "no more favourable treatment" and are expected to meet the same standard as any other vessel. Vessels may be detained under the

Navigation Act if considered unseaworthy or substandard (in line with SOLAS CH1 Reg 19, implemented by section 23 and 24 of the Navigation Act).

Australia is a member of two regional port State control regimes, in cooperation with other countries: the Tokyo Memorandum of Understanding (TMOU) and the Indian Ocean Memorandum of Understanding (IOMoU). Australia implements IMO guidance for port State control as well as regional guidance in collaboration with our memorandums of understanding. These guidelines are based on the relevant Conventions.

Vessels operating within Australia's EEZ are also subject to the Protection of the Sea (Prevention of pollution from ships) Act and can be subject to inspection and possible prosecution if there are reasonable grounds to believe reckless or negligent actions have caused pollution.

Autonomous and remotely operated vessels operating in Australia will need to comply with all relevant Conventions and regulations applicable to the size and type of vessel, including the *International Regulations for Preventing Collisions at Sea, 1972, as amended*.

Defence vessels

Vessels that fit the definition of "defence vessel" under the National Law, or "naval vessels etc." under the Navigation Act, are not regulated by AMSA. This means vessels that are either:

- a warship or other vessel that:
 - (i) is operated for naval or military purposes by Australia or a foreign country; and
 - (ii) is under the command of a member of the Australian Defence Force or of a member of the armed forces of the foreign country; and
 - (iii) bears external marks of nationality; and
 - (iv) is manned by seafarers under armed forces discipline (however described)

or

- a Government vessel that is used only on government non-commercial service as a naval auxiliary; or
- a vessel used by a foreign country for customs or law enforcement purposes.

AMSA can provide guidance on whether a vessel is likely to be a defence vessel or a naval vessel on a case by case basis, but ultimately it is a question of fact to be determined by the Department of Defence.

4. FUTURE REGULATORY DEVELOPMENT

Vessels capable of autonomous and remote operation present regulatory challenges under the current international and domestic frameworks.

Internationally, the RSE process currently underway at the IMO will assist to determine how safe, secure and environmentally sound MASS operations might be addressed in IMO instruments. At the 101st session of the MSC, the IMO also approved interim guidance for the trials of MASS, which will be released as an MSC circular in due course. The interim guidance sets out how the IMO expects relevant authorities and stakeholders to trial MASS technology in international waters. Until the IMO has progressed its work on addressing MASS through

IMO instruments, there is little that safety regulators can do regarding MASS technology on internationally trading ships.

Domestically, it is possible to address some of the challenges presented by the systems and infrastructure that support autonomous and remotely operated vessels, initially by using established flexibility mechanisms, and then by looking towards regulatory change. As our knowledge of this technology is in its formative stages, and because of the need to ensure any regulatory changes are appropriate for current, emerging, and unknown technology, AMSA is taking a staggered approach to regulatory change.

First steps - short term

AMSA's priority has been, and remains, to obtain more practical, 'hands on' experience in how autonomous and remotely operated vessels operate, what they are being used for, and in what environments; and then to work through how they actually sit inside the current domestic regulatory framework –and what changes may be required to the framework

In order to guide AMSA's everyday work in relation to autonomous and remotely operated vessels, which includes providing regulatory advice, processing applications and conducting compliance and enforcement activities, AMSA has put in place a set of initial policy principles, which outline the way in which decisions will be made under the current regulatory framework. Some of the key principles are:

- autonomous vessels and remotely operated vessels must be as safe as manned vessels;
- risks to the safety of people, other vessels and the environment must be appropriately addressed;
- the owner and/or master is responsible for the safety standards and operations of the vessel; and
- for lower risk operators who have a strong safety compliance history, a 'lighter touch' regulatory approach that focuses on the ultimate safety risk, rather than on certification, may be appropriate.

With the benefit of some experience, and with policy principles in place, AMSA is able to undertake the next step of beginning to identify sub-categories of autonomous and remotely operated vessels. These sub-categories are intended to assist in identifying an appropriate regulatory approach, and include considerations such as vessel size, area and concept of operational use, the ability to comply with collision regulations, environmental impacts and differing levels of autonomy. For example, AMSA is exploring the sub-category of "ultra-small marine equipment", which would apply where a vessel or system is <3m, <100kg, operates <5 knots, and which remains in theoretical line of sight and under the positive control of another vessel.

Second step - medium term

AMSA will continue to explore sub-categories of autonomous and remotely operated vessels, to guide an appropriate regulatory approach within the current framework. Where necessary and appropriate, specific exemptions may be granted to enact the preferred approach.

Currently, there is little flexibility in the National Law to determine whether a ‘thing’ is a vessel or not, and if so, what requirements should apply. AMSA will continue to work with the Department of Infrastructure, Transport, Cities and Regional Development, to identify potential changes to the National Law which could remove some of the issues currently being faced, and which could pave the way for a better suited, more flexible regulatory scheme.

AMSA is using industry partnerships to help form our approach. For example, a collaborative relationship has been established with the Trusted Autonomous Systems Defence Collaborative Research Centre (TAS CRC). The TAS CRC is a federal government funded organisation, whose mandate includes providing support to safety regulators who need to gain trust and assurance in the systems, infrastructure and technology that support autonomy in the maritime industry. TAS CRC and AMSA will work collaboratively to explore assurance and trust in automated systems. The TAS CRC assists AMSA by providing subject matter expertise in regulating for a rapidly developing industry.

Third step – long term

AMSA expects that in the longer term, there will be a coherent and appropriate international regulatory framework in place that supports safe operation of MASS. AMSA will work to translate changes occurring at an international level, into the domestic maritime framework where necessary and appropriate, which will help to ensure that all vessels operating commercially in Australia’s waters are meeting the same consistent and appropriate standards.

AMSA will continue to monitor emerging technology and trends in the Australian domestic maritime industry, and internationally.

5. AMSA’S FUTURE PLANS

AMSA has identified a number of actions to progress, in order to ensure the regulatory approach to autonomous and remotely operated vessels is appropriate now and in the future.

Firstly, AMSA will continue to contribute to the work of the IMO. AMSA is proactive in influencing the work of the IMO to ensure that international developments are in line with Australia’s interests. Proactive engagement internationally provides the opportunity to learn from international developments, and to ensure that potential changes and amendments to the international regulatory framework are reflective of the way Australia’s industry will develop and position Australia well for the future.

Secondly, AMSA is committed to consulting and collaborating with industry, including face to face engagement where possible. This consultation and collaboration is a key opportunity to gather information, test proposals for change, and ensure any proposed regulatory solutions are fit for purpose now and into the future.

Thirdly, AMSA is prioritising identifying ways to increase flexibility within the regulatory scheme, for example through amendments to the National Law. These potential changes would allow AMSA to determine what is and is not a vessel, and what requirements should apply at the outset, rather than via exemption down the track.

Finally, AMSA is committed to building internal expertise to respond to enquiries and assess applications for regulating efficiently and effectively. There is a focus on making decisions on a case by case basis, and looking closely at the risk that particular vessels and their operations present to people, the environment, and other vessels. AMSA has a dedicated team who work on these issues, which proactively liaises across different areas of the organisation, steering progress in the right direction, and ensuring proactive progress in some of the more challenging areas.

The Australian maritime industry can expect to see increased engagement from AMSA on these issues in the future.

6. CONCLUSION

AMSA's challenge in the context of autonomous and remotely operated vessels, is to provide safe, effective, and flexible regulation, which appropriately balances safety and protection of the marine environment, and meets the needs of a complex, evolving industry.

The first step, of gaining real experience, and establishing policy principles, has already occurred. The second step, of proactively consulting and collaborating with industry, and exploring potential changes to domestic maritime regulation, is underway, and is positioning AMSA well to successfully undertake the third step, which is designing and enacting regulatory change.

As AMSA looks to the future, we see the growing wave of technological advancements and the changes they will enable, and we see the opportunities for Australia's maritime industry expanding. Whether our stakeholders are involved in scientific research, surveying, or the movement of people or goods, they can be assured that the domestic maritime regulatory framework will be suitable and appropriate to enable a minimum level of safety assurance for them, and the Australian community.