Issues Concerning the

Rules for the Operation of

Autonomous Marine Vehicles (AMVs)

A consultation Paper

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Introduction

In 2000 the Society for Underwater Technology (SUT), after a lengthy development process, published 'The Operation of Autonomous Underwater Vehicles Volume 1 – Recommended Code of Practice'. This drew extensively on established Remotely Operated Vehicle (ROV) practice and what experience had been gained during the early operation of Autonomous Underwater Vehicles (AUVs). This was followed by two volumes which had been commissioned by the Southampton Oceanography Centre (now the National Oceanography, Southampton) on the state of English and international maritime law and published as Volumes 2 and 3 of the SUT series.

Much more experience has now been gained in the practical operation of AUVs in commercial and other usage, but the legal status of the vehicles is still largely undefined and there are growing concerns about liability issues. The SUT therefore established another group to review the way forward, what became known as the Autonomous Marine Vehicle Legal Working Group (the 'Group'). Early on in its deliberations it became apparent that it would have to address the issue of when the AUV was on the surface and there were growing developments in Autonomous Surface Vehicles. It was therefore agreed that the work should consider all autonomous vehicles which operated on and under the surface of the sea, hence the adoption of the AMV descriptor.

This document seeks to outline the Group's views on what they consider to be the major issues that require discussion within the AMV industry. The AMV industry is seen as including those who use AMVs for research and development purposes as well as commercial bodies, covering all those involved in the development and use of AMVs.

Broadly, these issues can be discussed under the following headings:

1. The definition of an AMV;

2. The current legal position; and

3. The need for common recognised operational and legal regimes.

The discussion of the current legal position will cover whether any current legal regimes can be said to apply to the operation of an AMV, including what this means in terms of the potential liabilities of those working with AMVs. This leads into the discussion of the merits of common operational and legal regimes to be applied to the operation of AMVs and of the actions required to achieve these regimes.

The Group wishes to use this document to raise the argument that it would be advantageous for those involved in the AMV industry to seek changes to domestic (English) and potentially international law to create certainty for those involved in developing, operating, funding and insuring the activities of AMVs. The Group wishes to open the question of whether new legislation is required, and, if so, what legislation, to the industry as a whole. If any sectors within the industry do not see any need for new law, the Group would be interested to know what, if any, action they feel is required.

1. **Definition of an AMV**

1.1 Defining Characteristics

The Group submits that the defining characteristics of an AMV are that it is:

a) An unmanned vehicle which operates in the marine environment;

b) Not mechanically linked to or restrained by operational/launch station (e.g. boat, submarine, shore station);

c) Capable of operating untethered (e.g. no fibre optic or wire communications link) or any other form of direct control (e.g. radio, acoustic) [although they may also be capable of receiving and acting on further instructions];

d) Capable of moving through/relative to surrounding water mass using an on-board power source;

e) Capable of on-board decision making (Autonomy); and

f) Deployed to operate in an autonomous Mode.

g) Man-made;

Within the above definition the following are examples of AMVs for at least part of the time for which they are in operation (i.e. for part of their operating envelope):

- autonomous underwater vehicles (AUVs);
- autonomous surface units, e.g. unmanned surface units (USVs);
[- telerobotic vehicles (primarily operate autonomously but receive periodic mission adjustments via a communications link) e.g. Hugin]
- underwater gliders; and
- seabed crawlers.

The Group does not consider the following to meet the above definition of an AMV:

- deployed overside equipment;
- ROVs;
- PAP remotely controlled mine disposal vehicles /one shot mine disposal vehicles;
- an AMV attached to mother platform (e.g. by crane);

Submarines, diving bells, unpropelled underwater sensors (e.g. bathythermograph, sonar arrays) static mines, drift nets, moorings would also fall outside the definition of an AMV.

Please Note: All units with warheads (destructive weapons of war) are outside the scope of this document and the discussions contained within.

1.2 Levels of Autonomy

The Group considers that an AMV should be viewed in terms of its level of autonomy and the functions of which it is capable.

The greater the level of autonomy of an AMV, the greater its degree of independence and therefore the less control is exercised by either its mother vessel or the operating team. The level of autonomy of an AMV is consequently highly relevant to who will be responsible for any liabilities incurred by the actions of an AMV. This is discussed further in the following section.

A description of the Group's classification of the varying levels of autonomy of an AMV is attached to this document as Annex I.

2. Current Legal Position

2.1 General

In 1999 the Southampton Oceanography Centre (now the National Oceanography Centre, Southampton) commissioned an extensive report into the state of English and international maritime law as it affected the operation of AUVs. The report was published by the Society for Underwater Technology (SUT) in 2000[1] and in general terms still stands as an accurate statement of the law as it applies to what the Group has, in 2006, re-defined as AMVs. Attached as Annex II to this document is a brief summary of the law as it affects AMVs, as reported in 2000, together with a summary of the changes in domestic (English) law and international law in the six years since publication of the SUT Report. In 2000 the Southampton Oceanography Centre commissioned a report from the same lawyers on the same subject, but in the format of Questions and Answers on the legal position as it affected the operation of AUVs[2]. This was envisaged as a more accessible digest intended for use by engineers and administrators concerned with AUVs. Both of these reports should be read in conjunction with the Recommended Code of Practice on the operation of AUVs published by the SUT in 2000[3].

The main piece of UK legislation governing the maritime sphere is the Merchant Shipping Act 1995 ("the Act"), which only applies to "ships". It is clear from case law considering the definition of a "ship" that AMVs operating for their usual purposes will not be considered to be ships under the Act. It is likely that at present that if an AMV is under the control of a "mother" vessel, (i.e. operating without any autonomy) the unit would be defined as deployed equipment, irrespective of whether this was a research vessel of some considerable size or some form of deployed boat, and treated for the purposes of the Act as part of the mother vessel. However, once the AMV has progressed to the autonomous mode and becomes remote from the mother vessel, it would be difficult to consider it as deployed equipment. It seems likely that at this

[1] Brown, E.D. and Gaskell, N. J. J., 2000. Report on the law, state practice and procedure relating to autonomous underwater vehicles. Society for Underwater Technology, London. 200pp. + appendices.

[2] Brown, E.D. and Gaskell, N. J. J., 2001. Questions and answers on the law, state practice and procedure relating to autonomous underwater vehicles. Society for Underwater Technology, London. 82pp.

[3] SUT, 2000. A code of practice for the operation of Autonomous Underwater Vehicles. J. Dering (ed.), Society for Underwater Technology, London, 48pp.

point the AMV will not be covered by most existing maritime law (domestic and international) and will have no ability to limit its liability.

The point at which this change over occurs, i.e. when the AMV leaves the control of the mother vessel, is important and the Group believes that it should be defined as the moment at which:-

(i) The vehicle is deployed for an operation, is in an Autonomous mode, is in the water and is powered up.

(ii) Any mechanical linkage has been removed and the direct control link disabled.

It would clearly be beneficial for all maritime users to have a clear understanding of the range of operations of an AMV, what risk assessments are necessary regarding the potential hazards of the operation of an AMV in the same water space as other maritime users and what framework should be used when disputes arise.

The International Rules for the Prevention of Collisions at Sea ("The Colregs") apply to surface navigation and should be used in the operation of AMVs on the surface of the water, since although it is unclear whether an AMV is strictly covered by the Colregs, it is generally agreed that an AMV should follow these "Rules of the Road". For a submerged AMV, anti-collision procedures are determined by common practice. The greatest aid to maritime safety and the requirements of good seamanship is clear water space management. For example, once on the surface an AMV requires clear markings so that it is easily recognisable and other users of the water space can take appropriate action.

At present those AMVs that generally operate submerged do not (as yet), in general, carry the equipment necessary to be able to carry out any form of surface collision avoidance (due to the restrictions of the weight they can carry as well as the limits of the reliability of autonomous avoidance systems). Whilst surface units will have an advantage here, it is best to assume that at present an AMV has no surface collision avoidance capability. The question is whether this lack of autonomous avoidance capability will be fatal to any attempt to agree a limitation of liability regime applicable to AMVs by requiring the placement of prohibitive burdens on operators that would outweigh any benefits.

2.2 Potential Issues of Liability

Once an AMV is acting autonomously there are a number of hazards that can be encountered and also dangers caused to other water users. As discussed above, when an AMV is acting autonomously from its mother vessel the owner/operator of the AMV must take full responsibility for any incidents that may occur and which result in loss of life and/or injury to third parties and loss of, or damage to, third party property. Due to the scope of operations of an AMV this liability could be very significant.

At present, and in contrast to liability regimes associated with merchant vessels, there is no ability for the owner/operator of the AMV to limit their liability to any third party. This means that an owner/operator of an AMV will have to take full financial responsibility for **all** losses and liabilities resulting from any incident for which the AMV was responsible. This responsibility could potentially arise through the fault or negligence of the owner/operator, or may even be incurred under a strict liability regime.

This situation is untenable for those who wish to continue to develop and utilise AMV technology.

At present, it is generally assumed that any rights given to AMVs are determined by the water control authorities, whether these are harbour masters or the national authorities governing use

within territorial waters. It remains a general requirement that the operator of the AMV promulgates a Notice to Mariners or advises other local water space users of any activities that are occurring.

Whilst submerged, an AMV is obliged to avoid other manned or moving vehicles. However, this does not allow the AMV any form of limitation of its liability for damage caused to surface vessels (e.g. operating with overside equipment) or fixed undersea installations.

Once on the surface and controlled by the mother vessel, the liability incurred by an AMV to third parties will be determined subject to any contract/charter party of the third party with the mother vessel and any applicable legal regime (where for example there was negligence on the part of the mother vessel). This liability will be limited by reference to the tonnage of the mother vessel. Other relevant considerations in the context of collision liability are the extent to which the mother vessel can consider itself restricted in its ability to manoeuvre and its duties under the International Rules for the Prevention of Collisions at Sea.

In contrast, if the AMV is on the surface and acting autonomously from the mother vessel, there are at present no collision regulations specifically applicable to AMVs irrespective of whether the AMV is distressed or intentionally on the surface to carry out a function of its survey or operation. In this autonomous state the AMV has no AMV specific rights or obligations. If it is potentially going to be caught in a fishing vessel's nets or is spotted by a large surface vessel there is no understood procedure for avoiding it, although other waterspace users must comply with the maritime rules applicable to them as well as the general requirements of good seamanship. These situations would raise some potentially awkward and expensive issues as to the liability of third parties to the owners of the AMV, for example, if an incident results in a survey being aborted or, worse, results in the unit being destroyed, as well as the liability of the owners of the AMV for damage to third party property, with no current regime of the obligations of an AMV in this position.

Consideration must also be given to an unpowered AMV on the surface upon completion of its work and the liabilities to third parties that flow from the AMV. Once on the surface, it is often difficult to control a unit either by acoustic or radio link. AMVs with higher degrees of autonomy can have a limited ability to carry out collision avoidance manoeuvres, but in any event these are not going to be effective unless other water space users are aware of what action they are required to take in order to avoid the AMV. In respect of surface (or near surface operations) there remains a concern regarding recreational craft (many of which are totally unaware of any notice to mariners and/or come under any maritime regulations for their operation) which could easily lead to damage to property and, more significantly, personal injury or loss of life claims.

Likewise consideration needs to be given to other realistic disaster scenarios such as a catastrophic event caused by avoidance measures taken by a large commercial vessel, e.g. whilst on survey in a constricted shipping lane, an AMV surfaces, the surface marker light operates and a tanker approaching it decides to take avoiding action in order to avoid collision with an unknown object. The avoidance action then subsequently results in a collision, with, for example, a large passenger carrying vessel. Whilst there will be liability apportioned to both colliding vessels, the ultimate liability for all damage and losses, including oil pollution, loss of life etc potentially lies with the AMV (analogous with what is known as "putting by cases").

If the AMV is at distance from any mother vessel or any form of control, it is clear that neither the master and/or operator of the ship and/or the ship owners should be held responsible for any liability whatsoever arising from the operation of the AMV. Liability would therefore lie fully with the owner and/or the operator of the AMV.

Within the subsea environment when an AMV is carrying out a survey in either an area of fishing or other subsea activity, it would be the resultant liability of the owner and/or the operator of the AMV if any damage occurs to either fishing equipment or subsea fixed installations. Within the offshore sectors a liability regime containing [a knock-for-knock division of liabilities is usual, yet this would only extend to property owned by those in the contractual relationship, with each party responsible for their own third party liabilities]. Whilst operational it is conceivable that an AMV could cause damage to a subsea matrix or telecommunications operation. In this instance, it would be the responsibility of the owner/operator of the AMV to ensure that they have sufficient insurance cover in order to protect themselves. As AMV technology is still very much in its infancy it may not be possible to purchase the necessary pollution or third party liability insurance, primarily because the current limit of cover that should be arranged (or is available) is presently undetermined. In the current regime, where the division of liabilities towards an incident involving an AMV are unclear and the potential liabilities are huge, an incident involving an AMV could quite easily result in a commercial operator going into liquidation as a result of not being able to cover its liabilities.

Another area of potential risk arises from a wreck situation, that is, in the event that the AMV unit fails and has to be removed. If all means of communication are lost the unit could damage sub-sea structures whilst in its idle/uncontrolled state, resulting in potential loss or damage to third party property which may also extend to consequential losses, for example if the AMV was to damage a sub-sea pipeline etc.

2.3 Salvage

There are various particular problems related to the salvage of an AMV which are discussed in more detail in Annex II. A fundamental question is how those responsible for an AMV can formulate a method of protecting it from malicious interference and/or unnecessary interference.

3. **The need for common, recognised, operational and legal regimes**

If there were to be no more than a few AMV units with a similar purpose and capability developed for commercial and scientific roles there would be little need to have the unit recognised as a legal entity. Whilst, however, the use of AMVs has been slower to increase than first predicted, there is now a sustained growth in the development and operation of different types of AMVs for a variety of roles. All operators, their insurers and end users/purchasers of the data/services provided by AMVs will have contracts of some certainty between them. However, other water users, owners of third party vessels, structures and their supporters (such as their insurers) will not know how an AMV should be viewed, how to approach a conflict or to review their risk assessment when operating in the vicinity of an AMV, or even whether to agree to the operation of an AMV within the vicinity of their equipment, vessels or structures.

3.1 Towards a code of practice for AMVs

With the increased use of AMVs for commercial, scientific and military purposes the Group suggests that it is necessary, in the near future, to develop agreed codes of practice for their use. This should reflect the inherent practicalities of running such vehicles, as well as the views and requirements of other water users and water space management authorities.

The following are the preliminary thoughts of the Group on the necessary content for a code of practice for AMV operations:

(a) Operating, safety, emergency and maintenance procedures should be put in writing and agreed by interested parties (e.g. operator, manufacturer, insurer and owners of seabed installations as well as potentially any hirers).

(b) There should be clear demarcation of responsibilities for all stages of the operational cycle of an AMV, with individual responsibilities identified, with the individuals to be guided by the operating procedures as discussed above.

(c) A risk analysis should be undertaken for all stages of operations (or category of operations) before deployment of any equipment. There should also be third-party liability insurance in place, with operating procedures having been agreed with the insurers. There should be procedures for informing other water users of AMV operations in the area (i.e. water space management).

(d) The AMV should only be operated by approved personnel, (e.g. those who have attended appropriate training courses). Allied to this, there should be procedures to cover vehicle programming and system checks. Most AMV operational incidents occur as a result of operator (i.e. human) error. A rigorous independent checking procedure is therefore necessary to minimise/eliminate such errors. (e.g. vehicle programming checked independently with no input from the primary programmer).

(e) Procedures for vehicle repair/upgrade/testing agreed between manufacturer and operator and agreed in writing. Important examples include:
- Maintenance procedures and intervals agreed between operator and manufacturer.
- If vehicle pressure hull is split and remade, how long should the vacuum/positive pressure be monitored before vehicle deployment so as to check the seal?
- Software function testing for software upgrades.

In summary, the development of a code of practice for AMVs requires, as a minimum:

- All procedures to be put in writing.
- Responsible individuals to be identified for all stages of vehicle deployment and given the appropriate authority to act on those responsibilities.
- Clear demarcation (and understanding) of responsibility between operators, deployment vessel, hirers, owners of seabed installations for each of the different stages of operation.
- Rigorous and independent system/programming checking procedures so that any human error on behalf of one individual is identified and rectified.

3.2 Legal Recognition of AMVs

If AMVs are to be legally recognised, the following will need to be covered:

(a) Definition of an AMV.

(b) Rules for operation and marking (including lighting), to include a code of conduct for operators and liaison with other water users (e.g. water space management; Notice to Mariners).

(c) Rules for operating in their vicinity, to include third parties and deployment vessels.

(d) Rules on discovering a unit to determine: i. whether it is operating; ii. what action to take if it is a danger to shipping; iii. a convention on reward/protection of the unit in the event of a salvage dispute.

(e) Protection of data on board and protection from malicious interference.

(f) Conventions for the pursuing of the operator in the event of damage to third parties damaging the unit.

(g) Rules for the operation to include procedures to encourage recognition of section 3.1 above.

These points will need to be agreed by operators and other water users. The need for the definition of an AMV to be agreed is fundamental to allow for their operations to be more widely understood within the maritime community. The Group's immediate goal is to produce a mixture of codes of practice, looking towards regulation (if necessary involving new legislation) derived from ongoing consultation with other water users, regulatory authorities and port authorities. It is believed that sections 3.1 and 3.2 provide a good basis to proceed.

Annex I

Description of Levels of Autonomy

Levels of Autonomy:

None

A vehicle with no autonomy will not have any form of automatic control. All its functions will be directly controlled by a mechanical, electrical, optical, electromagnetic or acoustic control link.

Minimum

A vehicle with a minimum level of autonomy will have a simple "Emergency abort system". This is a device fitted to the vehicle that will react to the failure of a primary vehicle system. The device will initiate a sequence that will abort the vehicle mission putting the vehicle into an emergency recovery mode that will facilitate safe recovery of the vehicle. Primary vehicle systems are considered to be :

- The vehicle power supply.
- Navigation system.
- Control system.

Basic

A vehicle with a "basic", level of autonomy will have the ability to navigate a pre-programmed course, maintain a planned depth or altitude using a self contained control system. The vehicle will include an emergency abort system that will be controlled by a vehicle health monitoring system. The health monitoring system will continuously monitor the critical subsystems of the vehicle to ensure that each system is operating correctly. On detection of a recoverable fault the health monitoring system is to instigate the repair, if the fault is determined not to be recoverable the system will instigate the abort sequence.

Intermediate

A vehicle with an "intermediate", level of autonomy will have the characteristics of the basic level plus an obstacle avoidance system that will change the vehicle trajectory to avoid objects that could damage the vehicle. A vehicle with this level of autonomy may also have control of sensors and their deployment and intelligent interpretation of data gathered.

Advanced

A vehicle with an "advance", level of autonomy will have the characteristics of the intermediate plus the ability to read the data gathered from the onboard sensors and adjust the pre-programmed mission plan to optimise the mission results. It is expected that new trajectories planned will be subject to maximum operational boundaries. These boundaries will be programmed as part of the vehicle mission. The boundary limits will provide some controls to be applied to this type of vehicle. The boundaries to be re-planned trajectories are:-

- Maximum speed TBD.
- Maximum depth TBD.
- Operational area TBD.

Highly Advanced

A vehicle with a “highly advanced” level of autonomy is one which is considered to have a level of independent control that is beyond all other categories. Examples of this are vehicles are:-

- Co-operative behaviour between multiple vehicles.
- Task-based mission planning, where the AUV would determine its course, or its sequence of operations for itself. It may trade efficiency for risk, and it may optimise its work independently of higher command. This implies that the operator/owner may not have prior or current knowledge of where the vehicle would be at any time.

Annex II

Status of the Law/Current Legal Issues
Regarding Autonomous MarineVehicles (AMV)

A: The Law as contained in the Report published by the Society for Underwater Technology in January 2000

1. Does an AMV come within the definition of "ship" under the Merchant Shipping Act 1995?

1.1 In order to see if all or any of the provisions of the Merchant Shipping Act apply to AMVs (as a form of ship) it is necessary to consider the general principles laid down in the case law as to the application of the Merchant Shipping Act definition of "ship" and see how far they would apply by analogy to AMVs. It will then be necessary to continue by examining each particular circumstance (salvage, registration etc) in order to see if any special definition is applicable, so that for some purposes an AMV is to be treated as a ship.

1.2 S313(1) of the Merchant Shipping Act 1995 provides that 'unless the context otherwise requires…"ship" includes every description of vessel used in navigation'.

1.3 Case law considering whether a vessel can be considered a "ship" has looked to its means of propulsion, its area of work and the object of its work. The case *Steedman v Scofield*[4] emphasised the need for a vessel to be "used in navigation" for it to be considered a "ship" under the Merchant Shipping Act and although this decision been criticised and does not fully rule out the possibility of an AMV being a ship, it does give the impression that a judge may be unlikely to consider it as such. Since there are such a wide variety of AMVs used for very different purposes, it is possible that some may be recognised as ships whereas others are not.

1.4 It appears from the provisions of the Merchant Shipping Act 1995 itself that its regulatory regime for ships will not generally apply to AMVs, unless the context indicates otherwise. Section 88 of the Merchant Shipping Act 1995 was specifically designed to regulate manned submersibles, inferring that submersibles were not included in the definition of a ship, but ignoring the question of whether the Act would apply to AMVs.

1.5 Section 311 of the Merchant Shipping act 1995 recognised the potential definitional problems with "ship" by giving the Secretary of State power to provide that certain structures designed or adapted for use at sea are to be treated as ships. Although these powers have not been exercised, there is no doubt that they could be exercised to apply merchant shipping legislation to AMVs. The question is whether the legislation as a whole should be extended to apply to AMVs or whether it should be decided to what extent each provision should apply to AMVs.

[4] [1992] 2 Lloyd's Rep 163

1.6 There is the potential for delegated legislation made under the Merchant Shipping Act which extends to application to AMVs. So far, however, there are no regulations which have been extended explicitly to unmanned submersibles. There are, however, varying definitions of "ship" contained in existing delegated legislation. For example, the regulations implanting SOLAS on the whole directed to sea going cargo ships whereas the regulations giving effect to MARPOL give a definition of ship extending to "submersible craft".

2. Application of International Maritime Conventions to AMVs

2.1 Each international convention describes the scope of its own application, which will have to be interpreted looking at, including amongst other things, the object and purpose of the convention. Many international maritime conventions are stated to apply to "ships". There is, however, no uniform definition of "ship" in the various international maritime conventions that can be used to decide whether those conventions apply to AMVs. Whether a particular convention can be applied to AMVs depends on the definition within (and therefore scope of) of that particular convention.

2.2 It is further not clear how these definitions will be interpreted when incorporated in national law.

NB: Where a state is involved in an AMV project, there is the potential for the application of state immunity, although this is generally restricted where the state is involved in commercial operations.

SOLAS 1974/1978/1988 and ISM Code 1994

The SOLAS Convention states that it shall apply to "ships entitled to fly the flag of State the Governments of which are contracting Governments". As the Convention gives a very particular list of categories of ship, none of which would easily cover the present generation of AMVs, it may be concluded that its provisions should not apply generally to AMVs.

Load Lines Convention 1966

This Convention is clearly not designed for submersibles such as AMVs.

Tonnage Measurement Convention 1969

It appears that the present generation of AMVs would not be covered by this convention either because they are not ships within its definition or are not long enough.

Convention on the International Regulations for Preventing Collisions at Sea (COLREG 1972)

This applies to "all vessels upon the high seas…". Although the definition of vessel includes the phrase "used as a means of transportation on water" it is arguable that an AMV should be included within the definition of a vessel due to the breadth of the categories of craft to which the Convention appears to be designed to apply, although the rules only apply to surface navigation.

International Convention for the Prevention of Pollution from Ships (MARPOL) 1973/1978

This convention specifically includes submersibles within the definition of "ship" which would seem to cover AMVs, although it is possible to argue that submersibles still have to be a type of vessel, therefore excluding unmanned craft. MARPOL is, in addition, stated to apply to "ships entitled to fly the flag" of a state party – there is a question as to whether AMVs can be flagged at all.

The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (LDC) 1972/1996

It is unclear whether this Convention applies to AMVs – it is stated to apply to waterbourne craft which may or may not include submersibles – however it would not have a great impact since it is not the purpose of an AMV to dump material. (Contrast that MARPOL is specifically stated to apply to submersibles.)

Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR) 1992

The definition of vessels to which this convention applies includes "other man made structures in the maritime area" which could be seen to extend to AMVs, although again the definition does not specifically include submersibles.

International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW Convention) 1978/1995

The critical question here is whether an AMV is a ship to which this convention applies – if it is considered to be such, then its operation on the surface without any watchkeeping arrangements might be an offence.

Memorandum of Understanding on Port State Control (Paris MOU) 1982

If the instruments to which the Paris MOU is related (SOLAS, MARPOL, STCW, COLREG and the Tonnage convention 1969) are found to apply to AMVs then the MOU will apply to their enforcement.

Suppression of Unlawful Acts Convention 1988

This is stated to apply to submersibles and may specifically apply to AMVs since the unlawful acts it covers are those said to jeopardise the safety of persons and property.

Intervention Convention 1969/1973

The broad definition of ship under this Convention may be wide enough to cover AMVs, although the definition under the implementing UK legislation suggests that AMVs are not covered.

International Convention on Civil Liability for Oil Pollution Damage (CLC) 1992 and Fund Convention 1992

The definition of ships to which these Conventions apply clearly excludes the present generation of AMVs which are not constructed or adapted for the carriage of oil in bulk as cargo.

International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea (HNS Convention) 1996

The definition of ship to which this applies includes "seabourne craft, of any type whatsoever" which would seem to cover an AMV, although it the Convention on applies to pollution from "hazardous and noxious substances" which are "any substances, materials and articles carried on board a ship as cargo". It is unlikely that an AMV would ever have a cargo rather than merely equipment designed for use at sea.

International Convention on Civil Liability for Bunker Oil Pollution Damage 2001 (Still to enter into force)

Since AMVs are electrically driven and do not carry bunker oil, it will not be of relevance.

Draft Wreck Removal Convention [It is currently planned to hold a conference in 2007 to adopt this convention.]

This convention defines "ship" as "a vessel of any type whatsoever operating in the marine environment and includes …submersibles…". "Wreck" means "a sunken or stranded ship, or any part thereof, including anything that is or has been on board such a ship". This appears to be wide enough to include AMVs.

Collision Convention 1910

This convention sets out a two year time bar for claims resulting from collisions. The convention applies to collisions between "sea-going vessels or between seagoing vessels and vessels capable of inland navigation". The convention assumes that there will be a master on board the vessel and it seems unlikely that the convention will apply to AMVs, e.g. if they are in collision with a ship. This means that national rules on the apportionment of liability will apply, as will general national time bars – which in the UK are longer than two years.

Salvage Convention 1989

Under this convention salvage operation means any act or activity undertaken to assist "a vessel or any other property in danger…". This convention may be relevant where an AMV is used to salve other property as well as where it is itself salved. Vessel is defined as "any ship or craft, or any structure capable of navigation". This appears to be broad enough to cover AMVs so long as they are found to be "capable of navigation". In any case an AMV would fall within the definition of "any other property".

LLMC 1976 and 1996 Protocol (See Section 7.2)

Ship Registration Convention 1986

The convention defines "ship" to mean any self propelled sea-going vessel used in international seaborne trade for the transport of goods, passengers, or both with the exception of vessels of less than 500 gross registered tonnes". AMVs would not come within this definition.

Maritime Liens and Mortgages Conventions 1926/1967/1993

It is doubtful that these conventions were designed to apply to AMVs or if they will be of much relevance.

Arrest Conventions 1952/1999

These will only apply if AMV is considered to be a "ship", which is not defined in either convention. It seems unlikely that they will apply to an AMV.

Hague Rules 1924, Hague-Visby Rules 1968, Hamburg Rules 1978

These apply to "goods" carried on a "ship". "Ship" is defined as "any vessel used for the carriage of goods by sea". Even if an AMV did carry cargo it is unlikely that carriage documentation under these conventions would be issued in respect of it. In the unlikely event that carriage in an AMV did occur, it would be likely to qualify under Article 6 of the Hague Visby Rules which allows a non-negotiable receipt to contain any terms whatsoever. The carriage conventions could be relevant where an AMV is itself carried as cargo in a ship.

3. Development of Specific AMV Regime: Draft ODAS Convention 1993

This draft convention was created to set out a regime for "offshore data acquisition systems" which would have dealt specifically with the legal issues relating to AMVs.

This draft convention would include requiring states to establish a special register system for ODAS, provided that any ODAS is not subject to a vessel registry system (as they would not generally be under the Ship Registration Convention 1986).

4. Property Issues and AMVs

Registration and Mortgages

Ships are usually registered, aligning themselves with a flag state which will provide protection as well as imposing various regulations. Registration enables finance to be obtained as the lender can register its mortgage and know that it will be obtain priority over other creditors. The mortgagee is also given rights to enforce its security. In order to be registered in the UK as a ship an AMV would have to meet the definition of ship in S313(1) of the Merchant Shipping Act 1995. It is likely that they would not satisfy this requirement.

There is the potential that maritime liens may exist in relation to an AMV. This again depends on whether or not an AMV is classed as a ship or vessel.

Enforcement of Claims – Civil detention

The Arrest Conventions 1952 and 1999 will only apply to an AMV if it is a ship. However, many national laws allow for the seizure or attachment of property in order to support civil claims – since the restrictions on arrest in the Arrest Conventions would not apply it would be down to the national rules to determine whether an AMV could be detained.

5. Liability and Compensation: Non-contractual Liabilities

5.1 There are various legal basis of non-contractual liability including negligence, strict liability regimes (such as that under the Harbours Docks Piers Clauses Act 1847) and salvage claims that will apply to incidents involving AMVs leading to damage to property and/or persons.

5.2 Even though the maritime standards set out in COLREG, the IMDG Code or the ISM Code might not strictly apply to AMVs, the courts would probably measure the standard of care to be expected from AMV owners against these standards. The AMV Code of Practice may also become significant in assessing any negligence.

6. Liability and Compensation: Contractual Liability

6.1 An AMV operator could enter into many different types of contract, including demise/bareboat charters, time charters, voyage charter, research services contracts, hire of the AMV(with or without team), etc. The basic rules of the law of contract would apply to these contracts, although the contracts themselves would have to be tailored to meet the particular needs of the parties.

7. Limitation of Maritime Liabilities

This is a critical area for those owning and operating AMVs.

7.1 Potential use of limited company to shield from unlimited liability

Limited liability companies have traditionally been used to keep any liability accrued by a company within that company. This is not, however, a solve-all solution. Where a company only has limited resources (such as companies established by universities to develop scientific innovations) any contractor contracting with that company would want security (e.g. a guarantee) from outside that company (e.g. from the research institute) or insurance.

There are occasions where the corporate veil of the company can be broken and those behind the company held liable for sums the company does not have. In addition it may be found that people outside the limited company are responsible in their own right. This makes the limitation of liability by law a very desirable solution.

7.2 International Conventions on Limitation of Liability:

The Convention on Limitation of Liability for Maritime Claims (LLMC), 1976 replaced the International Convention Relating to the Limitation of the Liability of Owners of Seagoing Ships, which was signed in Brussels in 1957, and came into force in 1968 (which is still in force in some states).

The right to limit is a privilege granted to owners, charterers, managers or operators of "ships". The LLMC does not contain a separate definition of "ship" and so it is left to national interpretation.

Where ships are insured, the existence of the principle of limitation of liability enables insurance cover to be offered at lower rates than would otherwise be available as the insurer is effectively able to take the benefits of the limits on behalf of the assured.

This makes it important to establish whether an AMV is covered by the definition of "ship" in the existing limitation conventions and implementing national legislation. Only then will it be necessary to look further at those entitled to limit and the amount of the limit.

The LLMC 1976 was enacted in the UK in the Merchant Shipping Act 1995, Schedule 7. The Merchant Shipping (Convention on Limitation of Liability for Maritime Claims) (Amendment) Order 1998 amended Schedule 7 to implement the 1996 Protocol when it came into force.

Article 1(1) of the LLMC 1976 states that 'shipowners and salvors, as hereinafter defined, may limit their liability in accordance with the rules of this Convention…'. Article 2(2) provides that the 'term 'shipowner' shall mean the owner, charterer, manager or operator of a sea-going ship.' Ship is not otherwise defined under the Convention.

For the purposes of English law, the Merchant Shipping Act 1997 Schedule 7 Part II paragraph 2 provides that the 'right to limit liability under the Convention shall apply in relation to any ship whether seagoing or not, and the definition of “shipowner” in paragraph 2 of article 1 shall be construed accordingly'.

Paragraph 12 on the meaning of ship states that 'references in the Convention and in the preceding provisions of this Part of this Schedule to a ship include references to any structure (whether completed or in course of completion) launched and intended for use in navigation as a ship or part of a ship'.

This again means that the question has to be asked as to whether an AMV comes within the definition of a ship under English law.

Even if an AMV is not found to come within the definition of a ship, if an AMV is being operated from a mother ship, it may be possible to argue that the liability arose out of the operation of the mother ship so the limits of that ship would apply. Any argument along these lines would very much depend on the facts of each particular case.

(NB even if an AMV was covered under a convention there may be a complication with determining the amount of the limit as it appears that no AMV at present will have a registered tonnage (the basis for the calculation of the limit).)

8. Insurance Cover

8.1 There is no international convention which requires an AMV to carry insurance cover. The extent to which insurance cover is required, if at all, will vary according to national law.

Non-binding guidelines on the provision of financial security were approved by the 80th Session of the IMO Legal Committee in October 1999 and were submitted to the IMO Assembly as a resolution. This led to Resolution A.898(21), Guidelines on Shipowners' Responsibilities in Respect of Maritime Claims, being adopted on 25 November 1999. This provides that shipowners should insure themselves for claims for which they are able to limit their liabilities. This is only guidance only, but may result in states applying national law to force shipowners to carry certain forms of insurance.[5] These guidelines are contained in the Maritime and Coastguard Agency's Marine Guidance Note MGN 135 (M).

8.2 Section 192A Merchant Shipping Act 1995 gives the Secretary of State power to make regulations requiring that there must be a contract of insurance in place for a ship while that ship is in UK waters. [No such regulations have been made and in any case it is unlikely that this would apply to AMVs unless the definition of its application was broadened beyond "ship".]

8.3 The appropriate marine insurance for an AMV would be the same as that used for ships, namely for "hull and machinery" (cover for damage to property) and "liability" (cover from claims by third parties). It is necessary to obtain specialist advice from marine insurers on the insurance that should be taken due to the specialist nature of AMV operations.

8.4 If AMV operators/funding bodies/etc are using "hold harmless" clauses to remove rights to claims between the parties, this may have an impact on any insurance policy, or ability to find suitable insurance.

B: Changes in the law from January 2000 up to April 2006

Domestic Law

1. In a recent case, *R v Goodwin*[6], the Court of Appeal had to decide whether a jet ski was a ship. In doing this it considered the construction of the vessel and the term "used in navigation". The Court of Appeal found that for a vessel to be "used in navigation" under the Merchant Shipping Acts, it is not a necessary requirement that it should be used in transporting persons or property by water to an intended destination, distinguishing *Steedman v Scofield*. They considered that what was critical was whether, for the purposes of the Merchant Shipping Act definition of ship, navigation was "the planned or ordered movement from one place to another" or whether it could extend to "messing about in boats" involving no journey at all. They concluded that the correct authorities were those that confined "vessel used in navigation" to "vessels which are used to make ordered progression *over* the water from one place to another". This would, however, still seem to confirm the position

[5] Shipowners are urged to comply with these Guidelines in respect of all seagoing ships of at least 300 gross tonnage. Shipowners are also encouraged to comply with the Guidelines in respect of ships of less than 300 gross tonnage. There is again the question of whether this was intended to apply to owners of AMVs since it is based on the existing limitation of liability regimes.

[6] [2005] EWCA Crim 3184

that an AMV will not be considered a ship for the purposes of the Merchant Shipping Act.

2. There have been no amendments to the Merchant Shipping Act 1995 or new regulations under it or any other domestic legislation which change the 2000 legal analysis.

International Law

1. Development of Specific AMV Regime: Draft ODAS Convention 1993

There does not appear to have been any progress with this draft convention since 2000.

2. Limitation of Liability

The 1996 Protocol to the Convention on Limitation of Liability for Maritime Claims (LLMC 1996) entered into force on 13 May 2004 for the states party to it. This protocol does not, however, extend the scope of application of the Convention.

3. International Conventions

Load Lines Convention 1966

1988 Protocol entered into force 3 February 2000, 2003 amendments entered into force 1 January 2005. These changes have not altered the fact that it was not designed for submersibles such as AMVs.

Maritime Liens and Mortgages Conventions 1926/1967/1993

The International Convention on Maritime Liens and Mortgages 1993 entered into force on 5 September 2004.

It is doubtful that these conventions were designed to apply to AMVs or if they will be of much relevance.

The UNIDROIT Convention on International Interests in Mobile Equipment (November 2001) entered into force on April 1, 2004 and harmonizes the laws of secured transactions where the collateral consists of mobile equipment. Signatories include the United States, France, Germany and the United Kingdom. This might possibly have some relevance to the commercial financing of AMVs but not in the immediate future.

C: Salvage

1. Incidents leading to insurance claims through an AMV causing damage third party property or injury to persons are expected to be rare. However, with their unmanned status, AMVs present a number of interesting issues with regard to salvage law. The limited (but growing) experience of AMV operations available to date suggests two main risk areas. First, damage to vehicle during deployment/recovery from/to the mother platform. Second, vehicle loss during mission, which usually proves to be

temporary with the vehicle later being located (although with varying degrees of damage).

2. With regard to vehicle recovery/deployment, under the draft definition of an AMV (as outlined in the main body of the briefing document), a vehicle which is still mechanically attached to the mother vessel (e.g. by a crane) is not an AMV. Indeed, during deployment operations the risks to the vehicle are not in themselves AMV risks. Instead they are generic risks relevant to all marine overside equipment when in the vicinity of the deployment vessel.

3. The most likely day-to-day risk with AMV operations is likely to be temporary loss of the vehicle. In the case of coastal operations in particular, it is probable that the vehicle will be found by a third party, and thus that the issue of salvage will arise. Salvage case law would appear to be clear in such an instance, although recent incidents concerning Royal Navy overside equipment found and recovered by other water users (PAP vehicle being recovered/taken by a fisherman) must give an AMV operator some concern.

4. AMV operators and their insurers would therefore benefit from clarity on the legal aspects of AMV salvage issues, to be applicable to all water users. Any such clarification should also seek to deal with unnecessary salvage operations (either malicious or with good intent) on an AMV when it is undergoing its normal operation and when, although not in immediate contact with the operator, it is not in any danger.

5. The following key points stand out from this discussion:

   - An AMV needs to be protected from malicious interference and/or unintended interference. (i.e. a ‘salvor’ recovering a correctly functioning/operating unit which is not in distress);
   - This may require the formulation of a method of allowing third parties to know when a unit is in distress and requires assistance; and
   - Agreed principles of AMV salvage should made available to all water users. It could be considered whether it is possible to formulate a standard method of indicating how to make the vehicle safe, including, for example, how to switch it off, where to attach lift points, how heavy it is, presence of hazardous materials, etc.

Annex III

SUT Autonomous Marine Vehicle Legal Working Group

Keith Broughton – Leviathan -Chairman
Ian Gallett – SUT – Secretary
Andy Chamberlain – Holman Fenwick Willan (And Paul Davies)
Jim Jamieson – Subsea 7
Trevor Newman – QinetiQ (And Steve Ray)
Simon Swallow – Shipowners P and I Club (And Captain Ralph Coton)
Alan Thomas – Bateman Chapman Limited

Mission Statement of the Autonomous Marine Vehicle Working Group

The Autonomous Marine Vehicle Working Group ("the Group") is working towards the goal of producing an agreed set of rules for the operation of autonomous marine vehicles (AMVs) of all types and capabilities. These rules will include an agreed definition of what constitutes an AMV. The Group believes that this will benefit all those involved in the development and use of AMVs by creating an equitable and agreed regime under which duties and liabilities can be assessed, creating legal certainty and allowing the eventual incorporation of these principles into law.