EUROFLEETS WP3.2 – Research Vessel Environmental Management Plan [RVEMP]

The application of Environmental Management Plan [EMP] principles to Research Vessels, Marine Scientific Research Equipment and Marine Scientific Research Operations in the European Context

31st August 2011

Version 2 [Final]

Grant Agreement n° 228344

Acronym : EUROFLEETS

Title: Towards an alliance of European research fleets

Activity type: NA
WP N°: 3
Task N°: 3.2
Deliverable N°: 3.2

Document information	
Document Name	EUROFLEETS WP3.2 – Research Vessel Environmental Management Plan [RVEMP] - The application of Environmental Management Plan [EMP] principles to Research Vessels, Marine Scientific Research Equipment and Marine Scientific Research Operations in the European Context
Document ID	EUROFLEETS-WP3-D3.2-310811-V2 [Final]
Revision	Final
Revision Date	31 August 2011
Author	R J Rogers NERC
Security	Public

Approvals				
	Name	Organisation	Date	Visa
Coordinator	Per W Nieuwejaar	IMR	31st August 2011	
Activity Coordinator	Per W Nieuwejaar	IMR	31st August 2011	
WP Leader	Geraint West	NERC		
WP Members	Roland Rogers	NERC		
	Sarah Duduyer	IFREMER		
	Roy Klepsvik	IMR		
	Jose I D Guerrero	IEO		
	Jan Piechura	IOPAS		
	Katrin Schroeder	CNR		
	Aodhan Fitzgerald	MI		
	Andre Cattrijsse	VLIZ		

History			
Revision	Date	Modification	Author
1	29th July 2011	Draft	R Rogers
2	31st August 2011	Final	R Rogers

Diffusion list				
Public			31st August 2011	

[This Page Is Intentionally Blank]

The EUROFLEETS Work Package 3 beneficiaries on board the University of Southampton's Research Vessel Callista [27th January 2010].

Contents

1. Introduction

1.1. EUROFLEETS

This report is a deliverable made under the Eurofleets research programme. Eurofleets is a European Union (EU) 7th Framework Programme (FP7) Research Infrastructures project. A summary of the Eurofleets programme is given below.

Aim: to bring together the European Research Fleets to enhance their coordination and promote the cost effective use of their facilities.

Objective: To bring together the European Research Fleets operators and/or owners, to enhance the coordination and cost-effective use of the vessels and equipment in order to support the most efficient provision of essential research support services for the monitoring and sustainable management of the ocean, and enhance access to the European Research Vessel Fleets for all European marine scientists.

Project Acronym: Eurofleets

Funding Scheme (FP7): Integrating Activities (IA)

EU Financial Contribution: 7.2 M Euro

Start Date: 1st September 2009

Finish Date: 31st August 2013

Number of Countries: 16 [at the start of the Project]

Number of Beneficiaries: 24 Institutions [at the start of the Project]

Number of Vessels: 18.

Web Site: http://www.eurofleets.eu

The programme aims through its three activities:

(a) Networking Activities [NA]
(b) Trans National Access [TNA]
(c) Joint Research Activities [JRA]

To:

- Define a common strategic vision for European Research Fleets and associated heavy equipment;
- Promote a more cost-efficient use of the existing European Ocean/Global and Regional Class research vessels and develop their interoperability capacities;
- Facilitate sharing of knowledge and technologies across fields, between academia and industry;
- Provide all European scientists with access to high performing research vessels and equipment on the sole condition of scientific excellence;

- Foster joint and coordinated development of European Research Vessel fleets in terms of capacity and capabilities;
- *Promote 'greener' and more 'sustainable"' research vessel operations*[1].

It is in support of achieving this last goal that this second report has been prepared by the Eurofleets Consortium.

1.2. NA3 - Work Package (WP) 3 – Eco-Responsibility and Eco-Design for existing and new Research Vessels (RV)

Work Package 3 (WP3) is a National Activity [NA] which is due to complete in the middle of 2013. Full details of WP3 can be found in the Description of Work (DOW) [1]. The WP has been divided into two themes. The first of these themes is entitled '*Eco-responsibility*' which is made up of three related tasks which are:

Task 3.1 – *Research Vessel – Life Cycle Assessment (RVLCA)*

Task 3.2 – *Research Vessel Environmental Management Plan (RVEMP*)

Task 3.3 – *Research Vessel Environmental Management System (RVEMS)*

The second of these themes is entitled 'Vessel *Eco-design'* which is made up of one task broken down into three sub-tasks which are as follows:

Task 3.4 – *Guidelines towards future new buildings and innovative eco-design for Regional Vessels.*

Task 3.4.1 – *Description of current vessel performance*

Task 3.4.2 – *Current vessel eco-performance*

Task 3.4.3 – *Establishment of guidelines for Regional vessel eco-design*

A short (bullet point) statement summarising the deliverables for each of the two themes contained in the WP is given below:

- Develop an eco-responsibility capability for existing RV [Theme 1]
- Define design guidelines [Theme 2]

1.3. WP3 Task 3.2 – Research Vessel Environmental Management Plan [RVEMP]

WP3 commenced September 2009 [M1] with a Kick Off Meeting [KOM] for Task 3.1 and Sub-Task 3.4.1. Task 3.1 was due to complete at the end of August 2010[M12][2] but completed at the end of February 2011with the delivery of the Task 3.1 report [D3.1] [2]. The deliverable for Sub-Task 3.4.1 [D3.4.1] was also made in the early part of 2011.

[1] Emphasis added

[2][Due to illness of the primary author the delivery date was deferred with the agreement of the Eurofleets Project Team until the 28th February 2011]

The following Eurofleets Consortium members are participants in the WP3 research. Those highlighted in yellow have been involved with the specific research undertaken in support of Task 3.2.

Per W Nieuwejaar	Havforskningsinstituttet	[IMR]
Geraint West	Natural Environment Research Council	[NERC]
Roland Rogers	NERC	
Sarah Duduyer	Institut francais de recherché pour l'expoitation de la mer	[FREMER]
Roy Klepsvik	IMR	
Jose I D Guerrero	Instituto Espanol de Oceanografia	[IEO]
Jan Piechura	Instytut Oceanologii-Polskiej Akademii Nauk	[IOPAS]
Katrin Schroeder	Consiglio Nazionale delle Ricerche	[CNR]
Aodhan Fitzgerald	Marine Institute	[MI]
Andre Cattrijsse	Vlaams Instituut voor de Zee vzw	[VLIZ]

The DOW for this WP states with respect to European research vessels, both planned [new build] and current in service [legacy] vessels - that a capability should be developed that allows the Eurofleets vessel operators/owners to discharge their eco-responsibilities under current European and international applicable legislation.

The deliverable from Task 3.1 [D3.1] [2] provided guidance in the form of outline principles on how to apply Life Cycle Analysis (LCA) to Research Vessels (RV), Research Equipment (RE) and Research Operations (RO) when operated in support of State funded Marine Scientific Research (MSR).

This report which forms the deliverable for this task is based on the research undertaken within Task 3.2 and is intended to provide guidance on the application of Environmental Management Plan [EMP] principles for the Consortium Members to adopt in support of both 'Traditional' [RV, RE and RO] and 'Autonomous'[3] [RE and RO] marine scientific research.

The guidance developed and delivered in the first WP3 report [D3.1] and its sister report [D3.2] reflect the national composition of RVs, RE and the types of RO undertaken by the Eurofleets Consortium members. The output from the Task 3.1 on RVLCA has been used to inform Task 3.2 RVEMP.

1.4. Relationship between Task 3.2 and the on-going Task 3.4

Task 3.4 and its associated sub tasks under the leadership of Andre Cattrijsse, VLIZ, is being run concurrently with Task 3.2. Task 3.4 is scheduled to complete after three years [M36] with a deliverable that provides guidelines for RV eco-design. The guidance being provided in this report will defer; where appropriate to do so, to that being developed and delivered under Task 3.4 with respect to any EMP issues associated with the eco design for new build RV.

1.5. Relationship between Tasks 3.1, 3.2 and 3.3

These three tasks are interrelated with the RVLCA [Task 3.1 - D3.1] informing the development of the RVEMP [Task 3.2 – D3.2] that then informs the production of the RVEMS [Task 3.3 – D3.3].

[3] The use of the term 'Autonomous' in this report will be explained fully in Section 2.4

1.6. Aim of the Report

The aim of this report is to develop high level guidance on the application of EMP principles in support of both 'Traditional' [RV, RE and RO] and 'Autonomous' [RE and RO] marine scientific research. The proposed guidance contained in this report is offered up for consideration and adoption by the Eurofleets Consortium Members.

1.7. Scope of Report

The following is the report scope and it is based on the scope contained in the first WP3 report and has been modified and updated to reflect the aim and objectives relating to Task 3.2 and its associated deliverable D3.2:

Geographical Scope

- All European Member States that operate research vessels in support of Government funded Marine Scientific Research [MSR].
- Global operation of European Member States research vessels including science cruises by these vessels in third party States maritime zones undertaken within the legal context of the framework of Part XIII of the United Nations Convention on the Law of the Sea (UNCLOS) [3] [4].

Legal Scope

- Only legislation that was in force at the end of 2010 was considered when formulating this guidance on the application of EMP principles:
- European Legislation;
- International Legislation.

The following legislation has not been used to inform the research on the RVEMP:

- The implementation by European Member States of the above two sources into their national legislation:
- The European Member States own legislation: and
- Applicable 3rd party Coastal State legislation.

Research Vessel [RV] Categories

- All vessels operated by European Member States that fall under the legal scope.

Research Equipment [RE]

- All equipment operated by European Member States that fall under the legal scope.

Research Operations [RO]

- All MSR operations undertaken by European Member States that fall under the legal scope.

1.8. Case Study

This report will use 'Case Study' examples to illustrate; where it is pertinent to do so and there exists illustrative material, certain aspects of the proposed RVEMP research and its associated deliverable that would be made more accessible to the Eurofleets Consortium members by doing so.

The chosen Case Study is:

- *The emission of anthropogenic underwater sound and its associated environmental risks*.

1.9. Research Methodology

The research methodology adopted in support of this task was based on the following key activities.

E-Mailed Notifications the author subscribes to a number of environmental marine/maritime information subscription services. These were used to keep the RVEMP research current. They are:

- International Maritime Contractors Association (IMCA) - www.imca-int.com/
- Regs4Ships - www.regs4ships.com/
- Earth Negotiations Bulletin (ENB) - www.iisd.ca/
- Lloyd's Loading List
- Environmental Expert - http://www.environmental-expert.com/

Attendance at Meetings and Conferences the author attended the following meetings and conferences in support of the RVEMP research.

- Arctic Marine Science, International Law and Climate Protection – Legal Aspects of Marine Science in the Arctic Ocean. Berlin Germany. March 2011. http://eu-arctic-forum.org/news/arctic-conference-opened-by-german-foreign-minister-westerwelle-and-commissioner-damanaki-in-berlin-on-17-march-2011/ [UK Delegation].
- European Marine and Maritime Research [EMA2RES] 3rd Workshop – Ostend Belgium. April 2011. http://www.waterborne-tp.org/index.php/emar2es. [Speaker].
- International Research Ship Organisation [IRSO] 24th Meeting - Seattle USA. May 2011. http://depts.washington.edu/uwconf/irso/ [Speaker].
- Safer Seas Conference - Brest France. May 2011. http://www.saferseas-brest.org [Speaker].
- International Oceanographic Commission [IOC] 26th General Assembly [GA] – Paris France. June 2011. http://ioc-unesco.org/ [UK Delegation].
- International Maritime Organisation [IMO] Marine Environmental Protection Committee [MEPC] 62nd Meeting - London UK. July 2011.www.imo.org [Observer].

1.10. Report Structure

The structure of this report is as follows:

Section 1 - Introduction. This provides both a summary of the background to the Eurofleets programme and details of Task 3.2 for which this report is a deliverable [D3.2- Report Research Vessel Environmental Management Plan [RVEMP]]. It also provides an over view of the research methodology adopted.

Section 2 – Links to Work Package 3.1 - Research Vessel Life Cycle Analysis [RVLCA] Report. This section of the report pulls through the salient information from the RVLCA report to enable the development of the RVEMP in the same vain. It identifies pertinent conclusions and recommendations made in the first report that inform the RVEMP research in this report. It then looks at any uplift to the RVLCA report findings that have arisen since its delivery that have been identified as necessary to keep the RVEMP current.

Section 3 - The Environmental Management Plan [EMP]. This section looks at a range of definitions for what constitutes an EMP. It then looks forward to the likely RVEMS that the RVEMP will be required to service and support. It then considers the key EMP elements contained within the listed applicable definitions and derives a definition for the RVEMP.

Section 4 – The Research Vessel Environmental Management Plan [RVEMP]. This section of the report takes the defined RVEMP from Section 3 and goes on to propose and discuss the key planning elements necessary to service the future RVEMS being developed in WP 3.3 and delivered in the D3.3 report. The output of the discussion will be in the form of targeted generic high level guiding principles to allow Eurofleets Consortium members to establish a tailored RVEMP for their use in support of their funded MSR programmes and to service their RVEMS. Where applicable the aforementioned discussions will highlight necessary variations to the guidance to reflect the differences in the two MSR delivery models [Traditional and Autonomous].

Section 5 - Conclusions and Recommendations. This section provides a number of summary conclusions and recommendations relating to guidance on the application of the derived RVEMP principles to Research Vessels [RV], Marine Scientific Research Equipment [RE] and Research Operations [RO].

Section 6 – Bibliography. This continues to build on the bibliography contained in the first WP3 report [1] which provided and continues to provide a list of books, articles, papers, reports and web sites that will allow Eurofleets RV operators and owners to apply the guidance on the application of LCA and EMP principles to their RV, Marine Scientific [MSR] RE and RO.

Section 7 – References. This section provides details of the references cited in support of the research contained in this report. There will be some overlap with respect to the materials cited in the Bibliography and the References sections contained in the proceeding RVLCA report.

Section 8 – Acronyms. This contains details of the key acronyms used in this report.

Section 9 - Annex A – Conclusions and Recommendations from the RVLCA Report [1]. This Annex contains the Conclusions and Recommendations that were made in the first WP3 report [2] [D3.1] which aimed to provide high level guidance to the EUROFLEETS Consortium Members on the application of Life Cycle Analysis principles to their research vessels, equipment and operations within the European context. The use of which would enable them to produce populated RVLCA inventories for the three indentified RVLCA domains.

Section 10 - Annex B. This Annex contains the adopted definitions for the RVLCA Scope and Goal as they will be used in the development of the RVEMP.

Section 11 - Annex C. This contains an example of a published maritime Environmental Management Vision Statement and associated Green Policy Statement for the NYK Line.

Section 12 - Annex D. This contains an Example of an Organisational Environmental Policy - UK NERC.

Section 13 - Annex E. This contains the National Marine Facilities Sea Systems Safety and Environment Policy.

Section 14 – Annex F. This contains the Code of Conduct for Marine Scientific Research Vessels - International Ship Operators Meeting (ISOM).

This report's distribution, format and its preparation have been made in accordance with the Eurofleets Quality Assurance Plan [QAP] [Version 4] [5]. Under the QAP the required distribution/delivery category is '*Public*'.

2. Links to Work Package 3.1 - Research Vessel Life Cycle Analysis [RVLCA] Report

2.1. Introduction

This section of the report pulls through the salient information from the RVLCA report. In particular the three proposed RVLCA Inventory Tables [RVLCA [RV], RVLCA [RE] and RVLCA [RO]].

It then goes on to further discuss the key pertinent conclusions and recommendations made in the first report that have been identified as necessary to inform the development of guiding principles for a Eurofleets RVEMP.

The next sub-section considers any significant uplift to the RVLCA report findings that have been identified during the course of the research for this report that are considered necessary to keep the RVEMP current.

Finally the last sub-section provides a short discussion aimed at drawing down key facts and information that will inform the following sections of the report.

2.2. RVLCA Report - Salient Information to RVEMP Study

The RVLCA report proposed an approach to dealing with the environmental consequences arising from funded MSR undertaken by Eurofleets Consortium research vessels by deconstructing the 'capability' into three distinct but related elements for the purposes of determining environmental risks via the LCA process. The three elements are:

- *RVLCA (RV)* – captures *the impacts from Eurofleets research vessels [RV] operating in the global marine environment;*
- *RVLCA (RE) – captures the impacts arising from deploying both 'commercial off the shelf' (COTS) marine scientific research equipment [RE] as well as bespoke MSR equipment designed and built 'in house';*
- *RVLCA (RO) – captures the impacts arising directly from the nature of research operation [RO].*

The following Figures 2.1, 2.2 and 2.3 show the outline RVLCA Inventory Tables that were proposed in the RVLCA. Annexes A, B and C of the RVLCA report provide working examples of the three tables that can be used by the European Consortium to determine environmental risks.

[RVLCA][RV] – LCA Inventory Table		
Life Cycle Stage	Environmental Aspect	Environmental Impact
Requirements		
Design		
Build & Mid Life Update		
Operation Normal		
Operation Laid Up		
Operation Refit, Recertification & Upgrade		
Disposal / End of Life		

Figure 2.1 RVLCA (RV) LCA Inventory Table.

[RVLCA] [RE] – LCA Inventory Table		
Life Cycle Stage	Environmental Aspect	Environmental Impact
Requirements		
Build / Procure		
Operation Normal		
Operation Modification		
Operation Autonomous		
Operation Loss		
Operation Non Recoverable		
Operation Logistics		
Disposal / End of Life		

Figure 2.2 RVLCA (RE) LCA Inventory Table.

[RVLCA][RO] – LCA Inventory Table		
Life Cycle Stage	Environmental Aspect	Environmental Impact
Science Proposal		
Peer Review		
Cruise Planning		
Cruise Passage		
Cruise On Station		
Post Cruise Disposal of Scientific Sample		
Post Cruise Disposal of Scientific Waste		

Figure 2.3 RVLCA (RO) LCA Inventory Table.

The final column of the proposed three RVLCA Inventory Tables contained in the RVLCA report [2] requires the Eurofleets Consortium user to assess the 'Environmental Impact' of each of the identified Life Cycle Stages.

As this Eurofleets activity is set within the European Context then it is strongly recommended that the Consortium members adopt the EIA process detailed in the relevant EU Directives [6]. This EIA process requires the derived document to contain seven areas of information. These are in summary:

- Description of the Project;
- List of Alternatives Considered;
- Description of the Aspects Environmental Effected;
- Description of the Likely Significant Environmental Effects;
- Description of Proposed Mitigation Measures;
- Non Technical Summary;
- List of Missing or Incomplete Information.

Full details of the pertinent EU EIA policy and legislation can be found at the following web site:

http://ec.europa.eu/environment/eia/home.htm

Advice and some approved impact assessment tools can be found at:

http://iatools.jrc.ec.europa.eu/bin/view/IQTool/WebHome.html

Case Study Example [1] – The cited reference is an example of a USA Draft Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey. Though a US EIA the elements contained in this document are similar to the EU EIA information format [7].

2.3. Discussion of Key Conclusions and Recommendations from the RVLCA

Annex A to this report contains a complete list of the Conclusions and Recommendations from the RVLCA.

This sub-section discusses a limited number of key pertinent conclusions and recommendations that were made in the first report. These selected conclusions and recommendations were identified as necessary to inform the development of guiding principles for a Eurofleets RVEMP.

The selected conclusions are listed below and their relevance to the RVEMP explained:

Conclusion [1]

- *That due to the growing complexity of the nature of marine scientific research, one single RVLCA is not an appropriate approach to delivering this capability to the EUROFLEETS Consortium members and a three inventory approach would be more suitable.*

This three element inventory approach to understanding the combined environmental risk footprint of the established MSR delivery mechanism is classified here as the 'Traditional Model' for the purposes of determining appropriate guidance on the application of EMP principles.

Figure 2.4 is a schematic of the designated 'Traditional Model' for research operations.

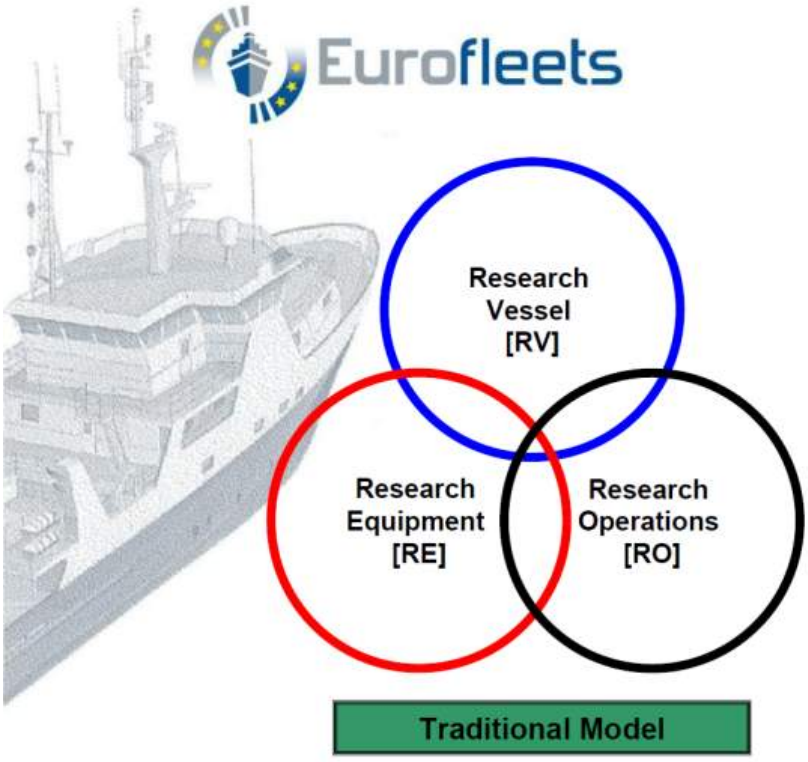

Figure 2.4 the 'Traditional Model' for delivery of MSR.

Case Study Example [2] – A third-party Research Vessel with hull mounted 'Swath Bathymetry' survey sonar undertaking seabed soundings in Irish waters [8]

Conclusion [2]

- *That the scale of the applicable environmental legislation and how EU Member States vary in how they enact and enforce that legislation will mean that the development of any Eurofleets research vessel environmental management plans and environmental management systems will have to be generic in approach.*

Since the completion of the research undertaken for the WP3 deliverable D3.1 and the completion of the research that underpins this report, there has been no consolidation or focusing within European Member States on the legislation that would be applicable to the development of a State specific RVEMP. Therefore this conclusion and its implications for the RVEMP continue to be valid for this work.

The selected recommendations are listed below and their relevance to the RVEMP explained:

Recommendation [1]

The EUROFLEETS Executive Committee is recommended to:

- *Endorse the drafting, by the WP3 Beneficiaries, of a Eurofleets Environmental Policy Statement as part of the WP3 output. This activity could be subsumed into the existing WP3 tasking at no extra cost to the Project with the agreement of the Beneficiaries – [RVLCA Report Section 3.4].*

This recommendation was forwarded to the Eurofleets Executive Committee [EEF] for their deliberation in March 2011 and subsequently an exchange of e-mails [8] took place in April 2011 between the EEF and the author(s) of this report. The outcome of this short exchange was that it was agreed that an appropriate environmental 'motherhood' policy statement for the Eurofleets Consortium to adopt would be that found in the two key European Commission institutions:

- Maritime Affairs - http://ec.europa.eu/maritimeaffairs/
- European Environmental Agency [EEA] - http://www.eea.europa.eu/

  (See the 2010 EEA Annual Report [9] for the latest policy statement).

It is recommended that the environmental policy statements of both the EC institution of Maritime Affairs and the European Environmental Agency are adopted as the 'overarching' source of environmental policy to be used in the Eurofleets Programme.

Recommendation [2]

The EUROFLEETS Consortium members are recommended to adopt the:

- *two proposed definitions for the RVLCA 'Scope' and 'Goal'. [RVLCA Report Section 3.5].*

For the purposes of the development of the RVEMP these two proposed definitions [See Annex B] have been adopted.

2.4. Post RVLCA Report 'Uplifts'

Sub-section 2.4 provides a consideration of uplifts to the RVLCA report findings that have been identified during the course of the last 12 months research as being necessary to ensure that the RVEMP retains its currency for the life of the Eurofleets.

Article 76 – In Section 4 of the RVLCA report [Life Cycle Analysis – Sources of Law and Policy] a number of relevant legal issues [sub-section 4.5 – Discussion] were highlighted as becoming of relevance to the undertaking of RVLCA.

One of these legal issues remains unresolved. This is the requirement for a dual approach by Researching/Coastal States to the interpretation of UNCLOS Part XIII [MSR] and its associated Part XII [Environmental Protection] with respect to Article 76. The maritime zone[4] in question [See Figure 4.2 *'Application of Part XIII in Relation to Article 76 Claims'* in RVLCA Report] is that which is seaward of the Coastal States 200 n.m. Exclusive Economic Zone [EEZ] to the extent of the

[4] The maritime zone in this context is made up of two distinct, but in this case separate physical elements. These are the 'seabed' and the 'water column'.

extended Continental Shelf [CS] claim that has been internationally approved and then enacted in the Coastal States national legislation. It is generally accepted that the UNCLOS MSR Regime applies to this new maritime zone, in two ways.

Water Column above the Extended Continental Shelf [ECS] – Zone 1 Application of the UNCLOS MSR that is limited to the water column comes under the MSR regime as it defined in Article 256 and 257 which states:

'Article 256

Marine scientific research in the Area

All States, irrespective of their geographical location, and competent international organizations have the right, in conformity with the provisions of Part XI, to conduct marine scientific research in the Area'.

and

'Article 257

Marine scientific research in the water column beyond the exclusive economic zone.

All States, irrespective of their geographical location, and competent international organizations have the right, in conformity with this Convention, to conduct marine scientific research in the water column beyond the limits of the exclusive economic zone.'

Extended Continental Shelf [ECS] – Zone 2 the Coastal State has sovereign rights over the Continental Shelf and as such the full weight of Part X11 applies. See Article 246 ,which states

'Article 246

Marine scientific research in the exclusive economic zone and on the continental shelf

1. Coastal States, in the exercise of their jurisdiction, have the right to regulate, authorize and conduct marine scientific research in their exclusive economic zone and on their continental shelf in accordance with the relevant provisions of this Convention.

2. Marine scientific research in the exclusive economic zone and on the continental shelf shall be conducted with the consent of the coastal State. ……'

At the time of writing there was a lack of clarity over what types of marine science would fall under the Zone 2 regime. For example if a marine scientific acoustic device mounted on a research vessel gathers knowledge of an approved extended CS, is it required to apply for Diplomatic Clearance under Part XII?

To aid clarity in this matter it is recommended that the following definition be adopted for what marine science undertaken in this two zone area would be subject to the requirement for a diplomatic clearance from the CS:

The following types of MSR when undertaken in the area outside of a Coastal States 200nm EEZ but within the zone bounded by the extent of their approved extended Continental Shelf claim:

All marine scientific research that gathers by whatever means for example

- *Physical Intervention – e.g. Drilling, Box Corers or collection of sedentary biological samples;*
- *Electromagnetic – e.g. Seismic;*
- *Electro optic – e.g. Video or still camera images.*

information or data relating to the extended Continental Shelf of the Coastal State.

The proposed definition is of relevance to RVEMP because the two different ways in applying the UNCLOS MSR regime will attract different environmental protection requirements. The Irish environmental requirements already cited in Case Study Example [2] repeated below will almost certainly be extended to cover any new Continental Shelf area that is approved by the international community.

Case Study Example [2] – A third party Research Vessel with hull mounted 'Swath Bathymetry' survey sonar undertaking seabed soundings in Irish waters [8]

'Autonomous' MSR

It has been observed that since the publication of the RVLCA report there has been a tangible growth in a complimentary model to the more 'Traditional' model [See Section 2.3 and Figure 2.4] currently in use within the Eurofleets community for the delivery of State funded MSR. A limited selection of the evidence base to support the adoption by Eurofleets of a new model to compliment the 'Traditional' model is provided here in three selected examples:

Two examples are from the FP7 European research programmes. These are:

Example 1. GROOM [10]

Call:	FP7-INFRASTRUCTURES-2011-1
Funding Scheme:	CP Collaborative project (generic)
Proposal Number:	284321
Proposal Acronym:	GROOM
Duration (months):	36
Proposal Title:	Gliders for Research, Ocean Observation and Management

The objective of this project, which has been approved and is due to start in 2011 is:

'The objective of the GROOM proposal is the design of a new European research infrastructure to use underwater gliders for the benefit of European citizens, researchers, and industry. GROOM will define the scientific, technological and organizational/legal levels, of a European glider capacity for research and sustained observations of the oceans, in line with the other European and international initiatives for marine in-situ observations. The proposal for this new infrastructure strongly relies on EuroARGO and JERICO infrastructures which are emerging and also considers the relevant international coordinating bodies such as GOOS. The proposed technological infrastructures will be based on several dedicated 'glider-ports' to maintain and operate a European fleet of gliders in coordination with US, Canadian, Australian and other similar infrastructures. This new infrastructure would be beneficial for both academic oceanographic research and operational oceanography systems on which a large number of marine activities and societal applications now rely.'

A similar European project is

Example 2. SIDERI [11]

Call:	FP7-INFRASTRUCTURES-2011-1
Funding Scheme:	CSA-CA Coordination (or networking) actions
Proposal Number:	284391
Proposal Acronym:	SIDERI
Duration (months):	24
Proposal Title:	Strengthening International Dimension of Euro-Argo Research Infrastructure

The objective of this project, which has been approved and is due to start in 2011 is:

'To strengthen the links and integration of the Euro-Argo European research infrastructure into the Argo International strategy of global ocean observations, and to seek participation by, and to develop cooperation with, potential participants in the European neighbouring areas which have a maritime interest.

The following activities are planned:

- *Work on the evolution of the Argo core mission together with international partners (O2, bio-geochemical sensors, deep floats, extension to polar and marginal seas);*
- *Work on the evolution of the Argo data centres (DMQC of the North Atlantic ARC and Southern Ocean ARC) and role of the European components;*
- *Refine the float deployment strategy in Europe and international seas and links with international partners;*

- *Making the interfaces with JCOMMOPS and Argo Information Centre (AIC);*
- *Working on legal aspects and policy issues (law of the sea);*
- *Organize scientific and thematic (regional) workshops open to international partners.*

This project will be carried by the Euro-Argo preparatory phase project partners that will form the future partners of the Euro-Argo ERIC.'

These two research programmes featuring Autonomous Underwater Vehicles [AUV] [GROOM] and 'floats' [SIDERI] provide a strong evidence base of the EC's interest in marine scientific autonomy and for the establishment of an 'Autonomous' model to be included in the applicable parts of the WP3 research and its deliverables.

The third and final example of evidence for an 'Autonomous' model is an international one.

Example 3. International Research Ship Organisation [IRSO] 24th Meeting - Seattle USA. May 2011.

A key agenda [12] item at the meeting was the Pre-Conference Workshop, which was entitled:

'Evolving Changes in Seagoing Oceanography: Implications for Research Vessel Operations'

The workshop saw a number of presentations on mature 'Autonomous' marine science capabilities made under the following headings:

- Ocean Observatories;
- Gliders, floats and AUVs.

Figure 2.5 shows a slide from the presentation made by Debbie Kelley – Associate Director of Science for the National Science Foundation Ocean Observatories Initiative. The slide shows the planned extent of these global observatories that will primarily be operated in an autonomous mode when sampling the marine environment.

The requirement [13] for long term observations will see the increased use of ***observatories*** and its 'sister' MSR capability ***moorings.*** This usage further supports the case for an 'Autonomous' model to sit alongside that of the 'Traditional' model currently used in the WP3 research.

The Autonomous Model – the proposed 'Autonomous' model will be made up of a two element [RE and RO] inventory approach to understanding the combined environmental risk footprint of this new MSR delivery mechanism and for the purposes of determining appropriate guidance on the application of EMP principles. Figure 2.6 shows the proposed two-element model for the delivery of 'Autonomous' MSR.

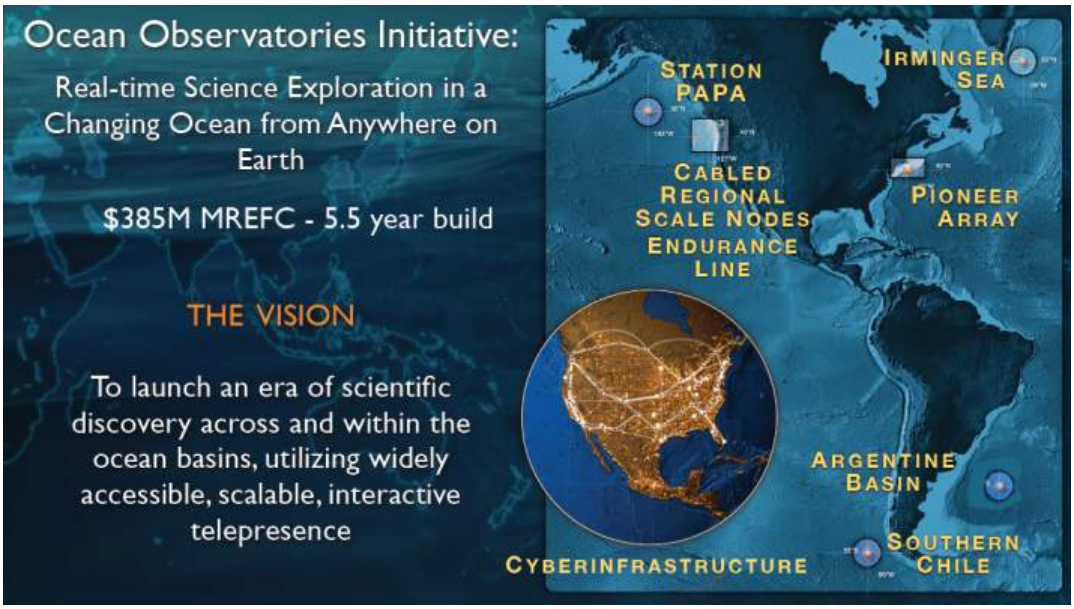

Figure 2.5 The National Science Foundation Global Ocean Observatories Initiative.

The proposed use of a two model approach for the delivery of MSR by Eurofleets Consortium is discussed in the following section [Section 2.5]

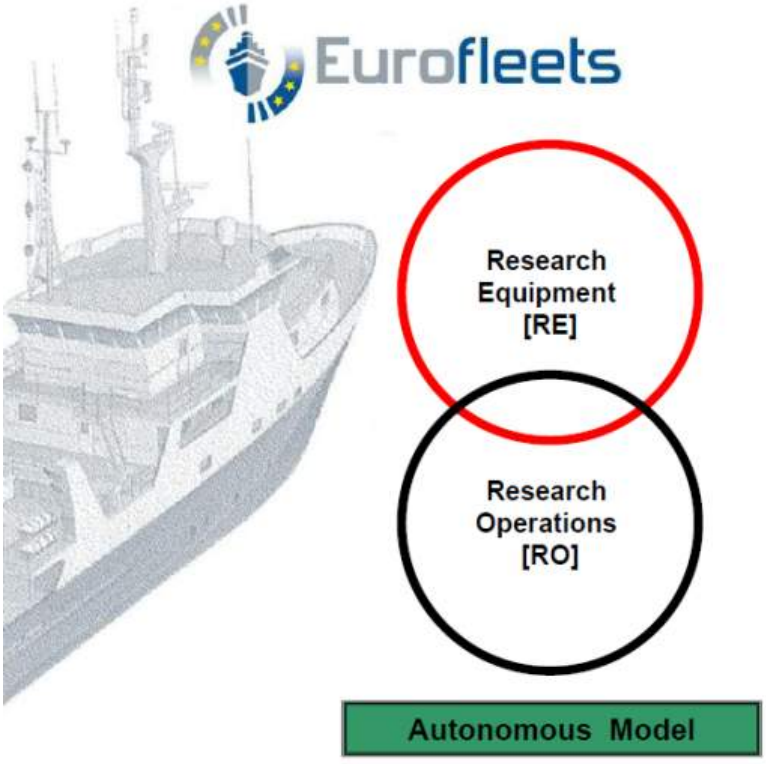

Figure 2.6 the 'Autonomous' MSR Delivery Model.

2.5. Discussion

The use of a proposed two model approach for the development of an applicable RVEMP does not require any retrospective review, update or amendment to the three RVLCA [RO, RE and RO] inventory structures contained in the D3.1 report. The environmental risks derived from the application by the Eurofleets Consortium members of the guidance on applying RVLCA principles to the delivery of State funded MSR remains valid and does not alter when the 'Autonomous' two inventory model is considered. It is assessed that where the difference will arise is how the guidance on the application of EMP principles will be formulated as will be seen in Section 4.

> *It is recommended that a combined two model approach [Traditional and Autonomous] be used to develop suitable RVEMP(s)*

The RV Element – though the RV component has been removed from the 'Autonomous' delivery model leaving only the RE and RO it does not imply that a vessel may not have been involved at all. In certain examples of 'Autonomous', delivery vessels are involved in placing the capability as is the case with long term monitoring moorings. AUVs and floats can also be delivered to the scientific area of operations by vessels but the delivery vessel does not have to be a RV.

In many cases of 'Autonomous' delivery the vessel used to launch and recover the AUV does not remain in the area of scientific operations.

Both floats and AUV's can be delivered [and recovered] by helicopters. In the case of AUV's they can also be 'driven' to the area of operations from the beach by an ashore operational centre.

A key difference between the two models is who is the Responsible / Controlling Authority and where do they reside [at sea or ashore].

Ships of Opportunity [SOO] – There already exists a Ships of Opportunity Programme [SOOP]

> See http://www.jcommops.org/soopip/ .
>
> *'The SOOP is directed primarily towards the continued operational maintenance and co-ordination of the XBT ship of opportunity network but other types of measurements are being made (e.g. TSG, XCTD, CTD, ADCP, pCO2, phytoplankton concentration).'*

This form of delivery of oceanographic measurements is classified here as being 'Autonomous' as the vessels are not RV's and the RE is run automatically and independent of the primary operation of the vessel. The use of SOO's has been primarily championed by SCOR [14], [15] through a programme called 'Ocean Scope' which proposes:

> *'…a new paradigm for the systematic and sustained observation of the ocean through close collaboration with the merchant marine industry. The overall objective is to establish a global network of ocean observation platforms on selected commercial ships.'*

The use of SOO is an example the 'Autonomous' delivery model and will not be included in the development of the RVEMP in this report for the following two reasons:

- The use of SOO to deliver EU Members States funded MSR is not commonplace;

- It is intended by the proponents of SOO to deliver this form of MSR outside of the UNCLOS Part XIII regime.

3. The Environmental Management Plan [EMP]

3.1. Introduction

This Section of the report seeks to bring together an evidence base that is deemed necessary to formulate a RVEMP definition. The evidence base was sourced from the open literature. It then looks forward to the likely RVEMS that the RVEMP will be required to service and support. It goes on to consider the key EMP elements contained within the listed applicable definitions and derive a definition for the RVEMP. Once the RVEMP content is set it will allow RVEMP guiding principles to be postulated in the following Section 4.

3.2. Evidence base for the RVEMP definition

A number of definitions of what constitutes an EMP were examined. Example of the range explored can be found at the following references [17], [18], [19]. Web based searches were used to locate potential candidate definitions along with the Bibliography in Section 6.

All the examples examined had common elements to them but had been written to reflect the context in which the EMP was to be used by the drafting organisation. A number of shipping industry web sites yielded further insight to maritime EMPs, one example being the NYK Line environmental web site. See:

https://www.nyk.com/english/csr/envi/manage/index_03.htm

and

https://www.nyk.com/english/csr/envi/manage/index.htm

`

Annex C contains a copy of the NYK Line Environmental Management Vision and Green Policy.

The EMP definitions examined were not limited to those of European origin with examples being collected from other countries as well as international organisations such as the World Bank [See: http://www.worldbank.org/]. Many of the definitions were complex and overlapped with the content and processes associated with an EMS. The example below is a case in point and was found in a United States Government [17] document. The US definition was as follows:

> *'Environmental Management Plan (EMP)*
>
> *The actions an organization is taking to determine how it affects the environment, complies with regulations, keeps track of environmental management activities, and meets environmental goals and targets. It also documents key elements of environmental management including the environmental policy, responsibilities, environmental manual, applicable standard operating procedures and Best Management Practices, recordkeeping, document control, reports, communication, training, monitoring, and corrective action.'*

The simplest definition came from the World Bank Independent Evaluation Group [IEG]. Further information can be found on the IEG web site at:

http://ieg.worldbankgroup.org/content/ieg/en/home.html

The World Bank IEG definition is as follows:

> '*The synthesis of all proposed mitigative and monitoring actions, set to a timeline, with specific responsibility assigned and follow-up actions defined.'*

The RVEMP definition will be based on the World Bank IEG definition as it is simple and allows for suitable guidance on the application of EMP principles to support the Eurofleets programme.

3.3. The Environmental Management Standards

This section of the report looks forward to the potential nature of the RVEMS to be developed under the WP3.3 research and delivered in the D3.3 report. This forward look at the potential RVEMS is necessary to ensure that the proposed RVEMP will be fit for purpose by containing the correct planning elements to service the RVEMS. To further aid this process the World Banks definition of an EMS taken from its IEG web site is provided below:

> *'An environmental management system (EMS) is a systematic approach to dealing with the environmental aspects of an organization. It is a 'tool' that enables an organization of any size or type to control the impact of its activities, products or services on the natural environment.'*

The maritime community in general and the RV community specifically currently subscribe to two EMS standards when operating their research vessel capability. These are:

- The International Maritime Organisation [IMO] – International Safety Management [ISM] Code [20], [21];
- International Standard Organisation [ISO] 140001 Environmental Management Systems [EMS] [See: http://www.tc207.org/About207.asp].

The following provides a brief synopsis of the background to the two EMS 'standards' likely to form the basis of the RVEMS and the general context in which they are used along with a summary of their key processes and content.

The ISM Code –This IMO code was adopted in 1993 and is known formally as the International Management Code for the Safe Operation of Ships and for Pollution Prevention. The Code provides a set of mandatory rules for the organisation of a ship operator's management of their vessels in relation to ship safety and the prevention of pollution of the marine environment.

The Code requires the organisation operating ships to establish a Ship Management System [SMS] which includes an EMS element. The stated objective of the ISM Code is to underpin the safe and environmentally compliant operation of ships. The Convention and its six associated Annexes are targeted primarily at the core of the global merchant marine 'General Purpose' vessels. A large number of RVs are classified as being 'Special Purpose' vessels. That said MARPOL and its Annexes apply equally to 'Special Purpose' ships that remain subject to all of the IMO conventions relating to environmental protection.

The ISM Code contains the following processes and content [21] that are particularly focused on ensuring compliance with the International Convention for the prevention of Pollution from Ships known as MARPOL. This means that the primary sources of environmental risk have already been

identified and quantified and in some cases the environmental mitigation procedures already designated. The key elements are:

- Publishing Environmental Protection Policy;
- Identification of Organisational Responsibilities;
- Identification of Organisational Authority;
- Quantifying the MARPOL sourced Environmental Risks;
- Identifying and Understanding the Applicable Legislation;
- Establishment of Environmental Training, Awareness and Competence;
- Development of Environmental Emergency Plans;
- Environmental Emergency Preparedness;
- Procedures for identifying Environmental Non-Conformities, Near Misses and Accidents;
- Environmental Documentation Control;
- Internal Audits of Environmental Compliance;
- Independent External Audits of Environmental Compliance;
- Establishment of Certification and Verification of Environmental Compliance;
- Internal and External Environmental Reporting.

The ISO 14001 EMS – This is just one ISO standard in a series of 20 published ISO environmental standards that are all inter-related. ISO 14001 is the only certifiable standard within the ISO 14000 series. However, it is not mandatory for an organisation to participate in the scheme. It is a voluntary scheme that can be adopted by an organisation should it wish to do so. The scope of the applicability of the ISO standard is broader than just ships and is applied to a vast range of environmental issues experienced by all types of organisations undertaking projects or delivering goods or services:

- Define Scope of Project;
- State Organisational Environmental Policy;
- Environmental Impact Assessment;
- Documented Environmental Objectives;
- Documented Environmental Targets;
- Identification of Legal Requirements;
- Establishment of an Environmental Programme to ensure identified Objectives and Targets are achieved by a designated Responsible Person against a published timeline;
- Provision of Environmental Training;
- Communication EMP;
- Controlled Documentation describing EMS;
- Compliance Assessment;
- Non Conformities procedures;
- Collection of Auditable Records;
- Emergency Preparedness and Response Procedures;
- EMS Audits [Internal and Independent External];
- Review of EMS.

Earlier research undertaken as part of WP3 showed that there was a mix of usage between the adoption of the ISM Code and the use of ISO 14001. The balance of adoption lay with the ISM Code. The International Maritime Contractors Association [IMCA] has undertaken a gap analysis between the ISM Code and ISO 14001 [23]. This gap analysis will be used in the WP3.3 research to inform the development of a Eurofleets RVEMS.

3.4. Discussion

The RVEMP is one of the most important outputs of the Eurofleets environmental assessment process linking the RVLCA with the RVEMS. It is therefore necessary to try and ensure the formulated RVEMP is suitable for use by all members of the Consortium. To achieve this it will be essential to have a reasonably generic RVEMP that recognises that 'one size' will not fit all the Consortium members' environmental assessment needs. This assertion is supported when you consider one of the elements of an RVEMP which requires the provision of an organisational environmental policy, the content of which is likely to vary significantly between Eurofleets member organisations.

It is recommended that the following definition for the RVEMP be adopted:

The RVEMP is defined as the amalgamation of all environmental issues indentified in the RVLCA inventories along with their derived mitigation and monitoring actions that are then managed via an approved RVEMS within an agreed time frame by trained designated members of the RV Organisation responsible for discharging the environmental compliance.

During the research for this report a third EMS type system was identified that requires explanation at this stage of the report. This is the EC Eco-Management and Audit Scheme [EMAS] [22].

[See http://ec.europa.eu/environment/emas/index.en.htm]

EMAS – is an EC regulation [Regulation 1221/2009/EC] and thus has a legal status. EMAS is akin to ISO 14001 and shares many common elements with this standard.

There is an obligation on all European member States to adopt EMAS. Organisations that operate within the EU have no obligation to participate in EMAS. Any participation in the scheme by these organisations would be voluntary. The obligation on Eurofleets Consortium members to adopt the scheme will vary depending on their status within their own Government organisations. For the purposes of this report it will be assumed that the ECs EMAS system will not generally apply to the majority of the Eurofleets community.

As stated in the previous Sub-Section a significant portion of the Eurofleets Consortium members who operate Research Vessels are already signed up to the ISM Code or the ISO 14002 EMS or a combination of both.

4. The Research Vessel Environmental Management Plan [RVEMP]

4.1. Introduction

This section of the report takes the defined RVEMP from Section 3 and goes on to propose and discuss the key planning elements necessary to service the future RVEMS to be developed in WP 3.3 and delivered in the D3.3 report. The output of the discussion will be in the form of generic high level guiding principles to allow Eurofleets Consortium members to establish a tailored RVEMP for their use in support of their funded MSR programmes and to service their RVEMS. Where applicable the aforementioned discussions will highlight necessary variations to the guidance to reflect the differences in the two MSR delivery models [Traditional and Autonomous].

4.2. RVEMP Elements

It is proposed that the RVEMP contain the following elements:

- An Organisational Environmental Policy Statement;
- An Environmental Requirements Capture [provided here by the completed RVLCA inventories and their associated EIAs];
- The identification of Management Requirements;
- The identification of Environmental Responsibilities;
- The identification of applicable Environmental Operating Procedures;
- A management frame work for:
    - Recordkeeping,
    - Document Control,
    - Production Reports,
    - Communication of Environmental Performance,
    - Undertaking Environmental Training;
- A management process for:
    - Monitoring Environmental Performance,
    - Verification and Control,
    - Corrective Action,
    - Undertaking Internal and External Audits.

4.3. Discussion of Selected RVEMP Elements

Guidance on the application of certain of the RVEMP elements listed above are well documented within the two EMS ‘standards’ listed in Section 3.3 and additional information on their application to the Eurofleets marine scientific research capability will be further expanded on in the D3.3 deliverable on the RVEMS.

However, guidance for three of the key RVEMP elements identified above will not be sufficiently covered in the existing ‘standards’ documentation for differing reasons which will be explained later in the text of this Sub-Section.

The first of three RVEMP elements to be discussed deals with the requirement for an Organisational Environmental Policy Statement and has been included because a generic policy would not be applicable. This is because most of the Eurofleets participating organisations are likely to already have their own environmental policy statements in place and these will generally be sufficient for the purposes of using the RVEMP and subsequent RVEMS.

For those Eurofleets organisations that have yet to formulate their organisational policy, examples of the Natural Environment Research Council [NERC] environmental policy is contained in Annex D. The National Marine Facilities Sea Systems [NMFSS] which is a 'daughter' organisation of the NERC has its own environmental policy which is part of NMFSS joint safety and environmental policy. The NERC policy is part of their ISO 14001 EMS. The NMFSS environmental policy is contained in the Ship Management System [SMS] under the ISM code.

The second RVEMP element discussed here is the identification and use of appropriate *Environmental Operating Procedures.* The completion of the RVLCA [RV] inventories are greatly facilitated due to the existence of a broad and well established legislative framework that applies and operates at State, EU and international levels. The key Convention underpinning the RVLCA [RV] being MARPOL 73/78 and its associated annexes. This Convention and the other major maritime environmental conventions have internationally agreed *Environmental Operating Procedures* and as such guidance on managing vessel-sourced pollution is well documented.

Internationally agreed *Environmental Operational Procedures* for RO and RE are limited or in certain cases non-existent and this will be a significant gap in the Eurofleets community capability to deal with the environmental issues identified in the completed RVLCA [RE] and RVLCA [RO] inventories.

Case Study Example [3] – Eurofleets Consortium Research Vessel towing scientific seismic equipment on the High Seas.

It is recommended that the Eurofleets Consortium address this identified capability gap with the respect to the development of suitable 'Environmental Operational Procedures' applicable to the nature of Eurofleets novel RO and RE.

Annex F shows the International Research Ship Operators 'Code of Conduct for Marine Scientific Research, which was an attempt by this community to put in place limited '*Environmental Operational Procedures'.*

The third and final RVEMP element discussed here relates to the identification of Environmental Responsibilities within the organisation. Figure 4.1 shows a schematic of how the responsibilities currently work for the 'Traditional' MSR delivery model. This allocation has its roots in the application of the ISM Code to the 'Traditional' delivery model which has at its heart the RV and an established SMS. This format for the allocation of Environmental Responsibilities does not work when applied to the 'Autonomous' MSR delivery model as both the RV and its master may not be present during the delivery and subsequent operation of the autonomous capability.

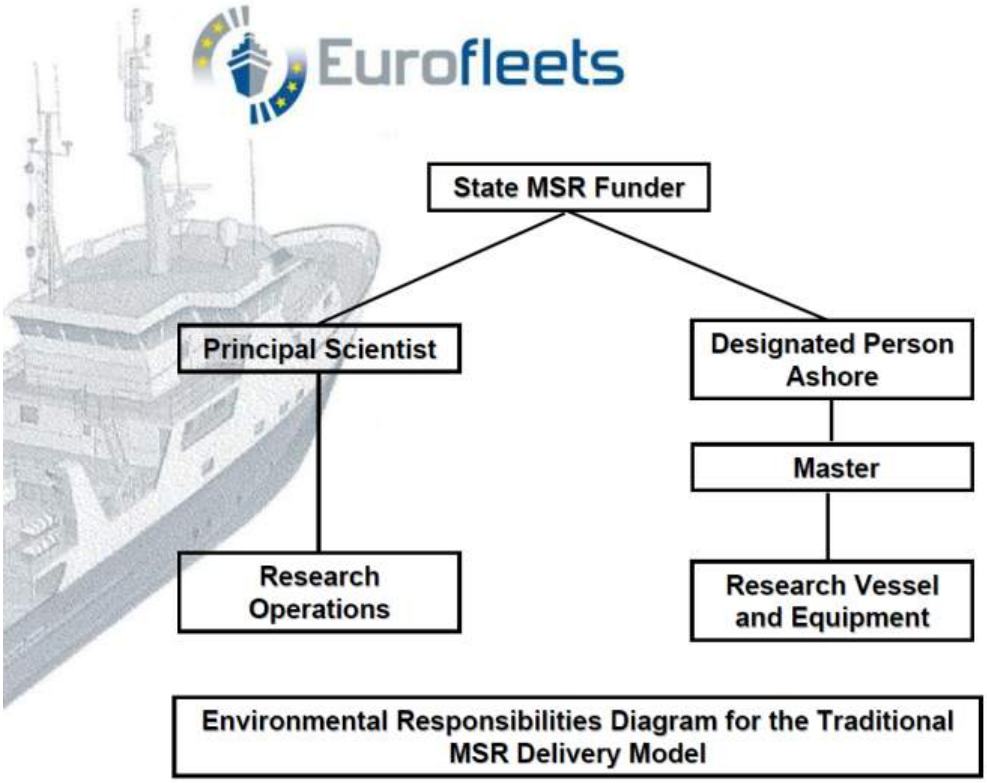

Figure 4.1 Environmental Responsibilities Diagram for the 'Traditional' MSR Delivery Model.

Figure 4.2 shows how the new autonomous oceanographic 'gliders' are operated by principal scientists [PS]. This connectivity does not require the PS to be onboard a research vessel or even in the MSR funding organisations building. The issue of navigational safety with respect to the operation of the 'gliders' has been explored in a number of publications [23]. The bibliography at Section 6 contains a number of books on the legal regime of AUVs including environmental liabilities.

Figure 4.3 shows a proposed solution for the division of Environmental Responsibilities with respect to the 'Autonomous' case for the delivery of MSR. This is based on the approach being adopted by NERC/NMFSS where the Designated Person Ashore will oversee the operation of the 'Autonomous' capability by the PS.

It is recommended that this approach for the allocation of Environmental Responsibilities for the Autonomous model for delivery for MSR be adopted by the Eurofleets members.

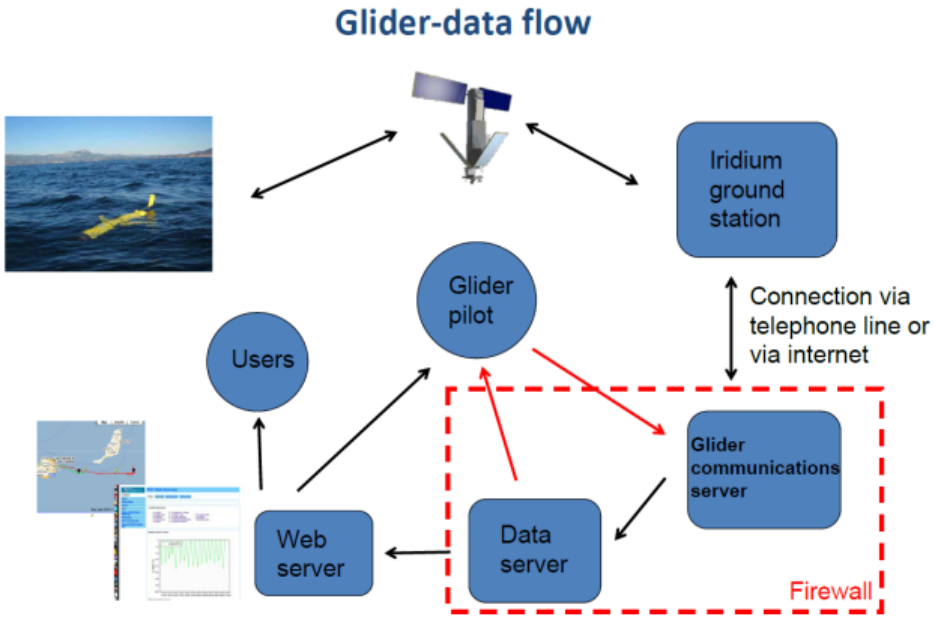

Figure 4.2 shows the operational connectivity used by Principal Scientists to fly gliders in support of their MSR RO.

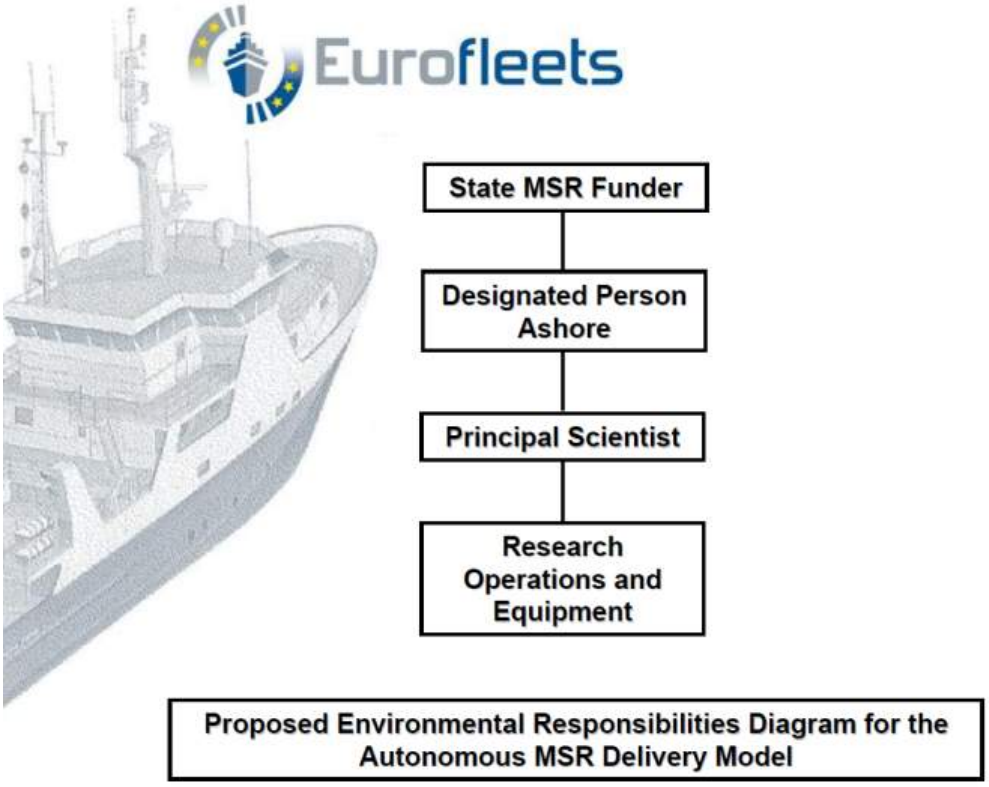

Figure 4.3 shows a proposed solution for the division of Environmental Responsibilities with respect to the 'Autonomous' case for the delivery of MSR.

The general information on the RVEMP and also the development of guidance on the application RVEMP principles highlighted and discussed in this report will be used to inform the WP3.3 research and its deliverable report D3.3.

5. Conclusions and Recommendations

5.1. Introduction

The following two sub-sections contain the summary conclusions and recommendations from this report.

5.2. Conclusions

The following conclusions are made in support of the RVEMP:

- There was a lack of clarity over what types of marine science would fall under the UNCLOS Part XIII MSR regime with respect to approved extended CS claims. [Section 2.4];
- The two programmes that focus on Autonomous Underwater Vehicles [AUV] [GROOM] and 'floats' [SIDERI] respectively provide strong European evidence for the establishment of an 'Autonomous' model to be supported in the applicable parts of the WP3 research and its deliverables. [Section 2.4];
- That on the evidence base considered, the provision of State funded MSR has moved from a single 'Traditional' model of delivery to a two model one with the addition of an 'Autonomous' delivery model [Section 2.5];
- A significant portion of the Eurofleets Consortium members who operate Research Vessels are already signed up to the ISM Code or the ISO 14001 EMS or a combination of both. {Section 3.4];
- The future RVEMS will be based on the use of either the ISM code or ISO 14001. [Section 3.4];
- Environmental Operational Procedures for RO and RE are limited or in certain cases non existent [Section 4.3];
- The 'Traditional' MSR delivery model format for the allocation of Environmental Responsibilities does not work when applied to the 'Autonomous' MSR delivery model as both the RV and its master may not be present during the delivery and subsequent operation of the autonomous capability. [Section 4.3].

5.3. Recommendations

The following recommendations are made in support of the RVEMP:

- That the environmental policy statements of both the EC institutions of Maritime Affairs and the European Environmental Agency be adopted as the 'overarching' source of environmental policy to be used in the Eurofleets Programme. [Section 2.3];
- That the following definition is adopted to aid clarity in what constitutes MSR in the context of Part XIII of UNCLOS in the new extended Continental Shelf areas of a Coastal State:

'The following types of MSR when undertaken in the area outside of a Coastal States 200nm EEZ but within the zone bounded by the extent of their approved extended Continental Shelf claim:

All marine scientific research that gathers by whatever means for example

- *Physical Intervention – e.g. Drilling or Box Corers*
- *Electromagnetic – e.g. Seismic Science Surveys*
- *Electro optic – e.g. Video or still camera images*

information or data relating to the extended Continental Shelf of the Coastal State.' [Section 2.4];

- That a combined two model approach [Traditional and Autonomous] be used to develop suitable RVEMP(s) [Section 2.5];

- The RVEMP be defined as the amalgamation of all environmental issues indentified in the RVLCA inventories along with their derived mitigation and monitoring actions that are then managed via an approved RVEMS within an agreed time frame by trained designated members of the RV Organisation responsible for discharging the environmental compliance. [Section 4.3];

- That the Eurofleets Consortium address the identified capability gap with respect to the development of suitable 'Environmental Operational Procedures' applicable to the nature of Eurofleets novel RO and RE. {Section 4.3];

- It is recommended that the approach shown in Figure 4.3 for the allocation of Environmental Responsibilities for the Autonomous model for delivery for MSR be adopted by the Eurofleets members. [Section 4.3].

6. Bibliography

Books

Baumann, H; Tillman, A-M. [2009]. The Hitch Hikers Guide to LCA – An orientation in life cycle assessment methodology and application. Studentlitteratur.

Collins K, Griffiths G [2008]. Collaborative Autosub Science in Extreme Environments – Workshop on AUV Science in Extreme Environments. 11th to 13th April 2007. Scott Polar Research Institute. SUT Publications.

Croner [2011]. Croner Environmental Practice. A –Z Guide to Environmental Practice. Wolters Kluwer.

De La Rue, C; Anderson, C B. [2009]. Shipping and the Environment – Law and Practice. Informa. 2nd Edition.

Frank, V. [2007]. The European Community and Marine Environmental Protection in the International Law of the Sea. Martinus Nijhoff Publishers.

Freestone; ed. [2006]. The Law of the Sea – Progress and Prospects. Oxford.

Fonseca de Souza Rolim, M H. [2008]. The International Law on Ballast Water – Preventing Bio Pollution. Martinus Nijhoff Publishers.

Gorina-Ysern, M. [2003]. An international Regime for Marine Scientific Research. Transnational Publishers.

Griffiths G, Collins K [2007]. Collaborative Autosub Science in Extreme Environments – Master class in AUV Technology for Polar Science. 28th to 29th March 2006. National Oceanography Centre Southampton. SUT Publications.

IMO[5]. [1982]. Noise Levels Onboard Ships. 1814E. London.

IMO. [2002]. MARPOL 73/78 – Consolidated Edition 2002.IB520E. London.

IMO. [2003]. London Convention 1972 – Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter and the 1996 Protocol. IA532E. London. 2003 Edition.

IMO. [2003]. MARPOL – How to do it. IA636E. London. 2002 Edition.

IMO. [2006]. Guidelines on the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972. 1531E. London. 2006 Edition.

IMO. [2006]. IMO Guidelines on Ship Recycling. 1685E. London. Consolidated Edition 2006.

IMO. [2008]. Code of Safety for Special Purpose Ships (2008 SPS Code). IA820E. London.

[5] It should be noted that not all of the applicable IMO publications are listed in this Bibliography. Please look at the IMO Publications Page on the IMO web site for a more complete list.

IMO. [2009]. Revised MARPOL Annex VI – Regulations for the Prevention of Air Pollution from Ships and NOx Technical Code 2008. IA664E. London. 2009 Edition.

IMO. [2010]. International Safety Management [ISM] Code – and guidelines on the implementation of the ISM Code. London. 2010 Edition.

IMO/UNEP. [2009]. IMO/UNEP Guidance Manual on the Assessment and Restoration of Environmental Damage following Marine Oil Spills. London. 1580E.

ISF/ICS. [1996]. Guidelines on the application of the IMO ISM Code. ICS. London. 3rd Edition.

Khee-Jindan, A. [2000]. Vessel Source Marine Pollution – The Law and Politics of International Regulation. Cambridge University Press.

Lloyds. [2008]. Marine Environmental Law. Lloyd's of London Press Ltd.

Lloyds. [2009]. The Ratification of Maritime Conventions [Parts 1 to 4] – Lloyds Shipping Law Library. Informa. (First published in 1990).

Lowe, A V; Talmon, S A C. [2009]. The Legal Order of the Oceans. Hart Publishing.

Mandaraka-Sheppard, A; [2008] Modern Maritime Law and Risk Management. Informa. 2nd Edition.

Mateos A, Gorina-Ysern M [2010]. Climate Change and Guidelines for Argo Profiling Float Deployment on the High Seas. ASIL April 8, 2010 Volume 14, Issue 8.

McCarthy, e. [2004]. International Regulation of Underwater Sound: Establishing Rules and Standards to Address Ocean Noise Pollution. Kluwer Academic Publishers.

NRC. [2009]. Science at Sea – Meeting Future Oceanographic Goals with a Robust Academic Research Fleet. The National Academies Press.

NRC. [2009]. Oceanography in 2025. - Proceedings of a Workshop. The National Academies Press.

NSTC [2007]. Charting the Course for Ocean Science in the United States for the next decade. An Ocean Research Priorities Plan and Implementation Strategy. NSTC Joint Subcommittee on Ocean Science and Technology. 26th January 2007.

SUT [2000]. The Operation of Autonomous Underwater Vehicles: Volume One: Recommended Code of Practice. SUT Publications.

SUT [2000]. The Operation of Autonomous Underwater Vehicles: Volume Two: Report on the Law. SUT Publications.

SUT [2001]. The Operation of Autonomous Underwater Vehicles: Volume Three: The Law Governing AUV Operations. SUT Publications.

SUT [2009]. The Operation of Autonomous Underwater Vehicles: Volume One: Recommended Code of Practice – for the Operation of Autonomous Marine Vehicles. 2nd Edition SUT Publications.

UK MoD. [2005]. An Introduction to Environmental Management in the MoD Acquisition Process. UK MoD July 2005 Issue 2.

Wegelein, F H T. [2005]. Marine Scientific Research – The Operation and Status of Research Vessels and other Platforms in International Law. Martinus Nijhoff Publishers.

Articles/Papers/Reports

Arctic Council. [2009]. Arctic Marine Shipping Assessment. A 2009 report of the Arctic Council.

Bork K, et.al. [2008]. The Legal Regulation of Floats and Gliders—In Quest of a New Regime? Ocean Development & International Law. 39:298–328, 2008.

EC. [2004]. Stimulating Technologies for Sustainable Development: An Environmental Technologies Action Plan for the European Union. Brussels, 28.1.2004. COM (2004) 38 Final.

EC. [2008]. European Commission – Maritime Policy Task Force 'Maritime Policy Green Paper' – On a Future Maritime Policy for the EU. J-99 7/12 B- 1049 Brussels.

EC. [2008]. A European Strategy for Marine and Maritime Research – A coherent European Research Strategy framework in support of a sustainable use of the oceans and seas. Brussels, 3.9.2008. COM (2008) 534 Final.

EC/DG ENV. [2010]. European Commission Directorate-General Environment [DG] Management Plan 2010.

Chamber of Shipping. [2009]. A global cap and trade system to reduce carbon emissions from international shipping. The UK Chamber of Shipping.

IOC [2008]. IOC Resolution EC-XLI.4 – Guidelines for the Implementation of Resolution XX-6 of the IOC Assembly Regarding the Deployment of Profiling Floats in the High Seas within the Framework of the Argo Programme. 8th December 2008.

IMO/DE. [2009]. Guidelines for ships operating in Arctic Ice-Covered Waters – Report of the working group. DE 52/WP.2. 19th March 2009.

IMO/MEPC. [2010]. Noise from Commercial Shipping and its Adverse Impacts on Marine Life - Report of the Correspondence Group - Submitted by the United States. MEPC 61/19. 23rd July 2010.

Kraska J [2010]. The Law of Unmanned Naval Systems in War and Peace. Journal of Ocean Technology 2010. Subsea Vehicles, Vol. 5, No. 3, 2010.

Lloyds Register/ UKP&I Club. [2006]. Marine Pollution Prevention – Pocket Checklist – Reducing the risk of Port State Control Detentions. London.

Lloyds Register. [2008]. Ballast Water Treatment Technology – Current Status. September 2008.

RAL gGmbh. [2009]. The Blue Angel – Basic Criteria for the Award of the Environmental Label. – Eco- Friendly Ship. RAL-UZ 141. October 2009 Edition.

USN [2004]. The Navy Unmanned Undersea Vehicle - (UUV) Master Plan. November 9, 2004.

Web Sites

Bureau Veritas [BV]
www.bureauveritas.com/wps/wcm/connect/bv_com/Group

Chamber of Shipping www.british-shipping.org.

Croatian Register of Shipping [CRS] www.crs.hr/

Croner www.croner.co.uk

Det Norske Veritas [DNV] www.dnv.com

Der Blaue Engel www.blauer-engel.de

Directorate-General Environment [DG ENV].
http://ec.europa.eu/dgs/environment/index_en.htm

Directorate-General Maritime Affairs [DG MAR]
http://ec.europa.eu/maritimeaffairs/

Division of Ocean Affairs and the Law of the Sea [DOALOS]
www.un.org/depts/los/index.htm

Earth Negotiations Bulletin [ENB} www.iisd.ca/

European Association of Classification Societies [EurACS]
http://www.emsa.europa.eu/end645d002.html#euclassification

European Community of Shipyards Association [CESA] www.cesa.eu/

EU Environnemental Impact Assesment [EIA]
http://ec.europa.eu/environment/eia/home.htm

Eco-Management and Audit Scheme [EMAS]
http://ec.europa.eu/environment/emas/index.en.htm

European Marine and Maritime Research (EMAR2RES)
www.waterborne-tp.org/index.php/emar2es

European Maritime Safety Agency [EMSA]	www.emsa.europa.eu
European Sea-Ports Organisation [ESPO]	www.espo.be/Home.aspx
Germanischer Lloyd [GL]	www.gl-group.com/
Hellenic Register of Shipping [HR]	www.hrs.gr/
HELCOM	www.helcom.fi/
International Association of Classification Societies [IACS]	www.iacs.org.uk/
International Naval Surveys Bureau [INSB]	www.insb.gr/pub/
International Maritime Contractors Association [IMCA]	www.imca-int.com/
International Maritime Organisation [IMO]	www.imo.org
Lloyds Classification Society [LR]	www.lr.org
OSPAR	www.ospar.org/
Polish Register of Shipping [PRS]	www.prs.pl/
Regs4Ships	www.regs4ships.com/
Registo Internacional Naval [RINAVE]	www.rinave.org/
Russian Maritime Register of Shipping [RS]	www.rs-head.spb.ru
Waterborne	http://www.waterborne-tp.org/

7. References

[1] Eurofleets [2009]. Eurofleets Grant Agreement Annex 1 Description of Work. EUROFLEETS-22834-CP-CSA-Infra. Dated 17th September 2009.

[2] Rogers R J et.al [2011]. Eurofleets WP3.1 Research Vessel Life Cycle Analysis – The application of Life Cycle Analysis to Research Vessels, Marine Scientific Research Equipment and Marine Scientific Research Operations in the European Context. 28th February 2011. EUROFLEETS-WP3-D3.1-280211-V3 [Final]. [Consortium Only].

[3] UN [1997]. The Law of the Sea – United Nations Convention on the Law of the Sea [UNCLOS]. Division for Ocean Affairs and the Law of the Sea – Office of Legal Affairs. New York 1997.

[4] UN [2010]. The Law of the Sea – Marine Scientific Research – A revised guide to the implementation of the relevant provisions of the United Nations Convention on the Law of the Sea. Division for Ocean Affairs and the Law of the Sea – Office of Legal Affairs. New York 2010.

[5] Eurofleets [2010]. Eurofleets Quality Assurance Plan – Version 4. EUROFLEETS-WP0-D0.1-090310-V4. Dated 9th March 2010.

[6] EU [1997]. Amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment. Council Directive 97/11/EC . 3rd March 1997.

[7] NOAA, USG, NSF [2010]. Draft Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey. October 2010.

[8] Binot J [2011]. E-Mail J Binot/P W Nieuwejaar 15th April 2011. [Subject: NA3 – M18].

[9] EEA [2010]. Annual report 2010 and Environmental statement 2011. ISSN 1561-2120.

[10] GROOM [2011]. FP7 Proposal Evaluation Form - Gliders for Research, Ocean Observation and Management. Number 284321. 7th March 2011.

[11] SIDERI [2011]. FP7 Proposal Evaluation Form - Strengthening International Dimension of Euro-Argo Research Infrastructure. Number 284391. 7th March 2011.

[12] ISRO [2011] Agenda for the 24th International Research Ship Operators Meeting. May 2011. Seattle USA. [Restricted Access].

[13] SCOR [2011]. Proposal for a SCOR Working Group – Common Challenges in Establishing Ocean Observatories. Ver 1.0 – Final Proposal. Release date: 14th April 2011.

[14] SCOR/IAPSO [2008]. 'Ocean Scope' – A joint SCOR and IAPSO Proposal.

[15] SCOR [2011]. Point Paper - Global Implementation of Networks for the Collection of Ocean Observations for the Provision of Oceanographic Services. SCOR Working Group 133.

[16] Croner [2011]. Croner Environmental Practice. A –Z Guide to Environmental Practice. Wolters Kluwer.

[17] US EPA [2003]. Documenting Your Environmental Management Plan – A Workbook for Small Business. US Environmental Protection Agency. September 2003

[18] CSIR [2005}. Guidelines for Environmental Management Plans (EMPs). Provincial Government of the Western Cape Department of Environmental Affairs and Development Planning. Edition 1. June 2005.

[19] Landcom [2007}. What is an environmental management plan (emp)? March 2007.

[20] IMO. [2010]. International Safety Management [ISM] Code – and guidelines on the implementation of the ISM Code. IMO London. 2010 Edition.

[21] ICS/ISF. [2010] Guidelines on the application of the IMO International Safety Management (ISM) Code 4th Edition.

[22] Croner [2011]. Croner Environmental Practice. A –Z Guide to Environmental Practice. Wolters Kluwer.

[23] IMCA [2000]. Environmental Management Standards ISO 14,001 – ISM Gap Analysis. IMCA S&L July 2000.

[24] Kraska J [2010]. The Law of Unmanned Naval Systems in War and Peace. Journal of Ocean Technology 2010. Subsea Vehicles, Vol. 5, No. 3, 2010.

8. Acronyms

ABNJ	Areas Beyond National Jurisdiction
CS	Continental Shelf
DOW	Description of Work
EA	Environmental Assessment
EC	European Commission
EEA	European Environmental Agency
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMAR2RES	European Marine and Maritime Research
EMAS	Eco-Management and Audit Scheme
ENB	Earth Negotiations Bulletin
EU	European Union
FP7	7th Framework Programme
GA	General Assembly
IA	Integrating Activities
IEG	International Evaluation Group
ICS	International Chamber of Shipping
IMCA	International Maritime Contractors Association
IMO	International Maritime Organisation
IOC	International Oceanographic Commission
ISF	International Shipping Federation
ISM	International Safety Management
ISO	International Standards Organsiation
ISOM	International Research Ship Operators Meetings

JRA	Joint Research Activities
KOM	Kick Off Meeting
LCA	Life Cycle Analysis
MA	Maritime Affairs
MEPC	Marine Environmental Protection Committee
MPA	Marine Protected Area
MSR	Marine Scientific Research
NA	Networking Activities
NERC	Natural Environmental Research Council
NMFSS	National Marine Facilities Sea Systems
QAP	Quality Assurance Plan
RE	Research Equipment
RO	Research Operations
RV	Research Vessel
RVEMP	Research Vessel Environmental Management Plan
RVEMS	Research Vessel Environmental Management System
RVLCA	Research Vessel Life Cycle Analysis
SOO	Ships of Opportunity
SOOP	SOO Programme
TNA	Trans National Access
UNCLOS	United Nations Convention on the Law of the Sea
WP	Work Package
WP3	Work Package 3

9. Annex A - Conclusions and Recommendations from the RVLCA Report [1]

A1. Introduction

This Annex contains the Conclusions and Recommendations that were made in the first WP3 report [1] [D3.1] which aimed to provide high level guidance to the Eurofleets Consortium Members on the application of Life Cycle Analysis principles to their research vessels, equipment and operations within the European context. The use of which would enable them to produce populated RVLCA inventories for the three indentified RVLCA domains.

A.2 Conclusions

The following is a summary of the conclusions made in the RVLCA report [1].

- That due to the growing complexity of the nature of marine scientific research one single RVLCA is not an appropriate approach to delivering this capability to the Eurofleets Consortium members and a three-inventory approach would be more suitable.

- That due to the variability of vessels, research equipment and research operations within the Eurofleets community, it was only practical to go as far as generating RVLCA inventory templates.

- That the scale of the applicable environmental legislation and how EU Member States vary in how they enact and enforce that legislation will mean that the development of any Eurofleets research vessel environmental management plans and environmental management systems will have to be generic in approach.

- That consideration needs to be given to a training programme to underpin the outputs of this work package.

A.3 Recommendations

The following is a summary of the recommendations made in the RVLCA report [1].

The EUROFLEETS Executive Committee is recommended to:

- Endorse the drafting, by the WP3 Beneficiaries, of a EUROFLEETS Environmental Policy Statement as part of the WP3 output. This activity could be subsumed into the existing WP3 tasking at no extra cost to the Project with the agreement of the Beneficiaries – [RVLCA Report Section 3.4]

The EUROFLEETS Consortium members are recommended to adopt the:

- Two proposed definitions for the RVLCA ‘Scope’ and ‘Goal’. [RVLCA Report Section 3.5];

- Three proposed RVLCA inventories. [RVLCA Report Section 3.6];

- Use of the Green Passport capability to support the end of life stage of the RVLCA (RV) for new build research vessels. [RVLCA Report Section 3.7];

- Use retrospectively of the Green Passport capability to support the end of life stage of the RVLCA (RV) for their legacy research vessels. [RVLCA Report Section 3.7];

- Use of the EMCD capability to aid in the completion of their RVLCA (RE) and RVLCA (RO) and also to support the undertaking of any necessary EIA activity. [RVLCA Report Section 3.8];

- the ISOM Code of Practice as the basis of a EUROFLEETS equivalent code.

It is generally recommended that:

- Any subsequent phases of the EUROFLEETS programme consider the development of a tailored LCA training programme for Consortium members - [RVLCA Report Section 3.3];

- The Maritime Police Task Force of the EC is asked if there is any intention by them to update this useful database. [RVLCA Report Section 4.1].

10. Annex B - Definitions for the RVLCA Scope and Goal

This Annex contains the two 'adopted' definitions for the RVLCA Scope and RVLCA Goal.

B.1 RVLCA 'Scope' Definition

- The *Purpose* of the Eurofleets RVLCA is defined as the quantitative determination through the use of detailed Life Cycle inventories, of identified adverse environmental impacts arising from the deployment of research vessel, research equipment and research operations in support of funded marine scientific research.

B.2 RVLCA 'Goal' Definition

- The *Goal* of the Eurofleets RVLCA is defined as providing the Eurofleets Consortium members with the ability to manage[6] through appropriate mitigation the identified adverse environmental impacts and in doing so operate their marine scientific research capabilities in a green and sustainable way according to the applicable legal regimes.

The use of the term manage in the definition of the RVLCA Goal refers to the use of bespoke RV Environmental Management Plans.

[6] Emphasis added.

11. Annex C - The NYK Line Environmental Management Vision and Green Policy Statements

NYK Group Environmental Management Vision

We aim to manage environmental risk and strike an optimal balance between the environment and the economy, with the goal of contributing to a sustainable society.

GREEN POLICY

1. We, the NYK Group, adopt responsible practices with due regard to the environmental impacts of our corporate activities. We set and continually review objectives and targets for achieving our goal to protect our entire global environment.
2. We seek not only to comply with safety and environmental regulations but also to implement in-house standards to improve our environmental performance and prevent pollution.
3. We commit ourselves to the safe operation of all our logistics services via sea, land, and air transport modes, including not only our oceangoing vessels but also our waterfront, inland, and air transport services, as well as terminal and warehouse operations.
4. We seek to reduce environmental loads by efficiently using resources, saving energy, reducing waste, encouraging material recycling, and particularly by minimizing emissions of greenhouse gases, ozone-depleting substances, and toxic matter.
5. We endeavor to minimize environmental loads and adopt environmentally friendly technologies when ordering and purchasing necessary resources, such as vessels and aircraft, for transportation services and cargo operations.
6. We endeavor to use education programs to raise environmental awareness among our employees and to ensure that they recognize the essence of this Green Policy by actively addressing environmental concerns.
7. We make wide-ranging social contributions in close partnership with local communities by disclosing environmental information and supporting environmental conservation initiatives.

President

Constituted on 1st September,2001
Amended on 1st April,2009

NYK LOGISTICS & MEGACARRIER

Green Policy

12. Annex D – Example of an Organisational Environmental Policy - UK NERC

The following is the Natural Environment Research Council's [NERC} Environmental Policy. Full details of the Council's approach to managing their environmental issues can be found at:

http://www.nerc.ac.uk/about/work/policy/green/policy.asp

The delivery of the Natural Environment Research Council [NERC] funded marine scientific research by the National Marine Facilities Sea Systems [NMFSS] is a global activity. NMFSS provides this delivery of MSR capability within the framework of NERC's environmental policy which states that:

NERC is committed to:

- Being a responsible and environmentally conscientious organisation;
- Maintaining and enhancing the quality of the environment wherever it is working, both for people who work there and for the wider community;
- The prevention of pollution;
- The continual improvement of its environmental management and performance;
- Implementation of an Environmental Management System.

NERC is committed to achieving environmental best practice throughout its activities by:

- Integrating environmental sustainability into strategies, policies and operations;
- Complying with and, where appropriate, exceeding applicable legal and other requirements relevant to its operations;
- Promoting the prudent use of natural resources and the elimination of waste;
- Implementing a sustainable buildings policy to design, build and maintain world class research facilities;
- Implementing a transport and travel policy that encourages use of the sustainable transport options available;
- Working with the public sector, the higher education sector, all relevant external authorities, environmental bodies and associations to keep up to date with latest developments and to share best practice;
- Working with suppliers and contractors, where possible, to ensure the best use of natural resources and to minimise the environmental impact of their goods, supplies and services;
- Providing appropriate training to its staff to ensure they are competent to control the activities for which they are responsible, and so support the delivery of this policy;
- Developing awareness of its staff of the impact they have on the environment and helping them to minimise this impact;
- Communicating this policy to NERC's community and beyond;
- Setting targets and objectives; through allocation of capital and resources it will also seek to achieve continual environmental improvement.

13. Annex E - National Marine Facilities Sea Systems Safety and Environment Policy

NMFSS combined safety and environmental policy reflects NERC's and states the following:

The Safety and Environmental Protection objectives of NMFSS are to:

- Ensure safety at sea;
- Prevent human injury or loss of life;
- Avoid damage to the environment.

In pursuance of these objectives NMFSS is committed to:

- Providing for safe practices in operations and a safe working environment;
- Establishing safeguards against all identified risks to its ships, personnel and the environment;
- Continuously improving health and safety management skills of employees including preparing for emergencies related both to safety and environmental protection;
- Continuously improving its health and safety performance through review and analysis of incidents and trends, implementing measures to improve further the effectiveness of the organisation as necessary;
- Striving to maintain a positive health and safety culture with the ultimate goal of reducing ill health and accidents to an absolute minimum, eliminating them where possible;
- Optimising the consumption of non-renewable resources within practical constraints;
- Investing sufficiently in its assets and resources to meet regulatory obligations in respect of safety and the environment.

NMFSS tackles the discharge of these environmental polices by considering the capability to delivery of NERC funded MSR as being made up of three key elements. These being:

- NERC Research Vessels;
- NERC MSR Equipment;
- NERC MSR Operations.

NMFSS applies sustainability and MEP compliance throughout the full life cycle [Procurement – In Service – Disposal] where applicable to three key elements making up its MSR capability.

14. Annex F - Code of Conduct for Marine Scientific Research Vessels - International Ship Operators Meeting (ISOM)

Code of Conduct for Marine Scientific Research Vessels

International Ship Operators Meeting (ISOM)

Qingdao, China 17-20 October, 2007

Authors: John Breslin (Ireland), Prof. Dennis Nixon (USA), Geraint West (UK)

Preamble

Recognising the importance of vessel-based marine scientific research, we strongly encourage the utilisation of environmentally responsible practices. Acknowledging the potential impact that the conduct of marine scientific research may have on the environment, the delegates to ISOM have approved the following guidelines for the conduct of scientific operations at sea. Those subscribing to this code consider preservation of the environment as paramount, and consequently adopt the precautionary approach as the basis for the proposed mitigation measures.

Environmental Impacts and Responsible Research Practices

Every vessel conducting marine science should develop a marine environmental management plan. The following are common areas where certain operations may have an impact and the complexity of these measures will vary on a case-by-case basis depending on such factors as vessel size, duration of voyage, geographical location, and mission type.

A. Ship Operations:

Activities:

- Oil spills
- Exhaust emissions
- Garbage/plastics disposal
- Sewage discharge
- Anchoring
- Hazardous waste release
- Vessel noise emission
- Grounding/collision events
- Ballast water release

Mitigation:

Every research vessel should be operated in compliance with the International Safety Management (ISM) code (or equivalent), which addresses all the above listed potential activities. Where there are special requirements for operations in sensitive areas (including marine protected areas, polar latitudes etc), additional measures such as specialised training, procedures, crew, or equipment may need to be incorporated into the cruise plan.

B. Science:

(1) Physical Impacts:

Activities:

- Dredging
- Grab & core sampling
- Lander operations
- Trawling
- Mooring deployments
- Remotely Operated Vehicle (ROV) sampling
- Jetting system operations for cable burial
- High Intensity lighting for camera operations

Mitigation:

The cruise plan should be designed to employ the most appropriate tool(s) to collect the scientific information while minimising the environmental impact. The number of samples taken should be

Accepted 21st ISOM, 17 – 20 October 2007, Qingdao, China

minimised, and in particular, scientists should consider available existing biological and physical data and/or samples from the target site. Where appropriate a pre-site survey should be conducted to determine possible impacts and suitable mitigation measures. The sampling methodologies should be designed to match the site-specific characteristics of the area, in particular through the use of less intrusive tools in sensitive/protected areas.

(2) Acoustical Impacts:

Activities:

- Seismic surveying
- Sub-bottom profiling
- Multibeam or single-beam surveying
- Sidescan surveying
- Acoustic positioning
- Scanning fish-finding sonar operations
- Acoustic Doppler Current Profiling (ADCP)
- Rock drilling and chipping

Mitigation

The minimum acoustic source level and duration to achieve the desired results should be used and the acoustic frequencies chosen in order to minimise impacts on marine life. In areas where marine mammals are known or are suspected to exist, additional measures may be required including, for example, soft-starts, visual surveillance and acoustic monitoring.

(3) Chemical Impacts

Activities:

- Tracer (dyes, fluorescent beads, SF6 etc.)
- Seeding (CO_2 sequestration)
- Expendable Bathythermograph (XBT) – copper, batteries

Mitigation:

The use of chemical tracers should be discouraged, as well as the use of expendable devices which contain hazardous materials. Where there is no alternative to these techniques, every effort should be taken to minimise their use.

(4) Accidental

Incidents:

- Behavioural impacts on marine life
- Chemical discharge – eg hydraulic fluid leakage from ROV; release of radio-isotopes
- Cross-contamination of biological communities
- Pollution resulting from loss of equipment – e.g. batteries and instruments
- Discharges from drilling or coring into shallow oil/gas


Eurofleets