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THE CURRENT PICTURE AND THE FUTURE VISION OF THE SHIP RECYCLING INDUSTRY

The contributions of Japan to achieving sustainable, safe and environmentally sound recycling of ships

By

YASUHIRO URANO
Japan

A dissertation submitted to the World Maritime University in partial Fulfillment of the requirements for the award of the degree of

MASTER OF SCIENCE
In
MARITIME AFFAIRS
(MARITIME SAFETY AND ENVIRONMENTAL ADMINISTRATION)

2012

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DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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ACKNOWLEDGEMENT

First of all, I would like to express my sincere gratitude to Mr. Yohei Sasakawa, the Chairman of the Nippon Foundation, who gave me this valuable opportunity to study and research at the World Maritime University.

I would like to extend my deepest appreciation to my esteemed and distinguished dissertation supervisor, Dr. Raphael Baumler, who kindly guided me in my dissertation work and provided me with valuable advice, suggestions and resources for my accomplishment of the dissertation.

I wish to thank Dr. Kazumichi Shimizu, Muroran Institute of Technology and Mr. Yasuo Nakajo, Executive General Manager, Overseas Business Group, Japan Marine Science Inc. for providing me with valuable data related to their responsible projects.

I also wish to thank Dr. Shinichiro Otsubo, Director for International Affairs Office, Shipbuilding and Ship Machinery Division, and many other officials in Maritime Bureau, Ministry of Land, Infrastructure, Transport and Tourism for giving me valuable advice and a lot of official data available for this dissertation.

I would like to express sincere appreciation to Ms. Anne Pazaver, English Lecturer of World Maritime University, who helped me with comments on my language in this dissertation.

I further wish to thank Mr. Eisuke Kudo and Mr. Shinichi Ichikawa of Ocean Policy Research Foundation, who always supported my study and life in Malmö.

Sincere appreciation also goes to Dr. Takeshi Nakazawa and Dr. Momoko Kitada, World Maritime University, who kindly supported my study and life in Malmö.

Last, but not the least, I wish to extend my deepest appreciation to my father for his emotional support to me and his patience during my absence.
ABSTRACT


Degree: MSc

First of all, as a basis of the discussion in this dissertation, the international regulatory instruments which cover ship recycling industry, namely, the Basel Convention, 1989 and the Hong Kong Convention, 2009, are examined focusing on their essential principles and limitations.

Second, the present conditions of the ship recycling industry in the Indian subcontinent are investigated in order to make clear the problems to be addressed. The focus of the investigation is set on ships’ potential hazards, environmental risks of the beaching method, hazardous waste flow, workers’ occupational safety and health, and causes of substandard recycling operations.

Furthermore, the key efforts made by other regions to reform the whole industry are examined. Specifically, the European Union’s proposal of a new regulation on ship recycling is examined. In addition, the present actions taken by advanced recycling countries, that is, China and Turkey are investigated.

Finally, the relevance of Japan in the ship recycling industry is clarified based on its specification in the maritime field. Then, Japan’s fundamental policies on ship recycling are introduced and analyzed to conclude how it will contribute to achieving sustainable, safe and environmentally sound ship recycling in the whole industry under the above regimes and industry’s conditions.

KEYWORDS: beaching, Japan, safe and environmentally sound, ship recycling, the Basel Convention, the Hong Kong Convention.
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<tbody>
<tr>
<td>AFS Convention</td>
<td>International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001</td>
</tr>
<tr>
<td>CFCs</td>
<td>Chlorofluorocarbons</td>
</tr>
<tr>
<td>COP</td>
<td>Conference of the Parties to the Basel Convention</td>
</tr>
<tr>
<td>ClassNK</td>
<td>Nippon Kaiji Kyokai</td>
</tr>
<tr>
<td>DWT</td>
<td>Deadweight Tonnage</td>
</tr>
<tr>
<td>EIA</td>
<td>Environment Impact Assessment</td>
</tr>
<tr>
<td>ENGOs</td>
<td>Environmental Non-governmental Organizations</td>
</tr>
<tr>
<td>ESM</td>
<td>Environmentally Sound Management</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>GEPIL</td>
<td>Gujarat Enviro Protection and Infrastructure Limited</td>
</tr>
<tr>
<td>GMB</td>
<td>Gujarat Maritime Board</td>
</tr>
<tr>
<td>Hong Kong Convention</td>
<td>Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009</td>
</tr>
<tr>
<td>ICIHM</td>
<td>International Certificate on Inventory of Hazardous Materials</td>
</tr>
<tr>
<td>IHM</td>
<td>Inventory of Hazardous Materials</td>
</tr>
<tr>
<td>IHM Guidelines</td>
<td>Guidelines for the Development of the Inventory of Hazardous Materials</td>
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<tr>
<td>ILO</td>
<td>International Labour Organization</td>
</tr>
<tr>
<td>IMO</td>
<td>International Maritime Organization</td>
</tr>
<tr>
<td>IRRC</td>
<td>International Ready for Recycling Certificate</td>
</tr>
<tr>
<td>JICA</td>
<td>Japan International Cooperation Agency</td>
</tr>
<tr>
<td>LDT</td>
<td>Light Displacement Tonnage</td>
</tr>
<tr>
<td>MD</td>
<td>Material Declaration</td>
</tr>
<tr>
<td>Acronym</td>
<td>Full Form</td>
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<tr>
<td>MEPC</td>
<td>Marine Environment Protection Committee</td>
</tr>
<tr>
<td>MSRSG</td>
<td>Muroran Ship Recycling Study Group</td>
</tr>
<tr>
<td>NPO</td>
<td>Non-Profit Organization</td>
</tr>
<tr>
<td>ODS</td>
<td>Ozone-depleting substances</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
</tr>
<tr>
<td>PCB</td>
<td>Polychlorinated Biphenyls</td>
</tr>
<tr>
<td>PCC</td>
<td>Pure Car Carrier</td>
</tr>
<tr>
<td>PIC</td>
<td>Prior Informed Consent</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal protective equipment</td>
</tr>
<tr>
<td>PU</td>
<td>Polyurethane</td>
</tr>
<tr>
<td>RO</td>
<td>Recognized Organization</td>
</tr>
<tr>
<td>Rio Declaration</td>
<td>Rio Declaration on Environment and Development</td>
</tr>
<tr>
<td>SBC</td>
<td>Secretariat of the Basel Convention</td>
</tr>
<tr>
<td>SBRR</td>
<td>Ship Breaking and Recycling Rules, 2011</td>
</tr>
<tr>
<td>SBSRB</td>
<td>Ship Building and Ship Recycling Board</td>
</tr>
<tr>
<td>SDoC</td>
<td>Supplier’s Declaration of Conformity</td>
</tr>
<tr>
<td>SOC</td>
<td>Statement of Compliance</td>
</tr>
<tr>
<td>SOF</td>
<td>Statement of Fact</td>
</tr>
<tr>
<td>SRFP</td>
<td>Ship Recycling Facility Plan</td>
</tr>
<tr>
<td>SRP</td>
<td>Ship Recycling Plan</td>
</tr>
<tr>
<td>TGDS</td>
<td>Technical Guidelines on the Environmentally Sound Management of the Full and Partial Dismantling of Ships</td>
</tr>
<tr>
<td>UNCED</td>
<td>United Nations Conference on Environment and Development</td>
</tr>
<tr>
<td>UNCTAD</td>
<td>United Nations Conference on Trade and Development</td>
</tr>
<tr>
<td>UNEP</td>
<td>United Nations Environmental Programme</td>
</tr>
<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
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CHAPTER I  INTRODUCTION

1.1. Background

Ship demolition is one of the basic markets that comprise the shipping industry together with ship building, freight and second hand markets. It plays an important role in adjusting the market balance of the shipping industry which fluctuates depending largely on the world economy.

Furthermore, ship recycling is an environmentally friendly way to dispose of ships which have ended their operational lives from the perspective of re-using materials and equipment involved in ships, providing that ships being recycled do not present any danger to human health and safety or to the environment (BIMCO, 2011; Mikelis, 2012). Compared to other modes of transport such as car and aircraft, the shipping industry generally produces much more reusable materials and equipment, which are worth over 95% of a ship by weight (Lloyd’s Register, 2011).

Shipbreaking was conducted by large shipbuilding yards in the United States and European countries until the 1970s. However, high costs for scrapping ships in a safe and environmentally sound way and the development of stringent environmental regulations discouraged these industrialized countries from shipbreaking (Puthucherril, 2010; World Bank, 2010).

Accordingly, the main locations of the industry were shifted to Taiwan and South Korea where there was a strong demand for steel for development at that time. After recognizing the potential hazards of ship dismantling activities, these two countries also gave up shipbreaking by the early 1990s (Puthucherril, 2010). Now the world’s ship recycling industry is led by five countries, namely, Bangladesh, China, India, Pakistan and Turkey which scrap about 97% of the world’s recycled gross tonnage (Mikelis, 2012).

Although recently there seem to be some improvements in the industry conditions such as the establishment of new ship recycling rules in Bangladesh, most shipbreaking yards in the Indian subcontinent are still practicing the beaching
method in an inappropriate way without sufficient safety and environmental protection tools and facilities or preprocessing (Chowdhury, 2011; Lloyd’s Register, 2011). Workers in the shipbreaking yards are likely to do their jobs without sufficient instructions and personal protective equipment (PPE) such as safety glasses and protective shoes and are exposed to life-threatening substances generated from scrapped ships and the danger of explosion, fire and fall. Furthermore, ships being scrapped on the beach without appropriate removal of hazardous materials such as residual oil, chemicals and asbestos often pose serious pollution risks to the soil, the coastal water and the natural habitats around the yards.

In order to address these issues, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1989 (Basel Convention) was firstly considered for application to end-of-life ships ready for recycling; and the voluntary guidelines for the ship recycling industry were developed in December 2002. The Basel Convention, however, does not effectively regulate the transboundary movement of ships to be scrapped since it was not developed in consideration of end-of-life ships. Therefore, in the Conference of the Parties to the Basel Convention held in October 2004 (COP 7), the International Maritime Organization (IMO) was invited to establish a new mandatory instrument that provides an equivalent level of control and environmentally sound management of ship recycling established under the Basel Convention. Then, the IMO directed its Marine Environment Protection Committee (MEPC) to make a “new legally-binding instrument on ship recycling.” Following discussions in the Joint Working Group with the International Labour Organization (ILO) and the Parties to the Basel Convention, and the drafting processes in the MEPC, the IMO finally adopted the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships in May 2009 (Hong Kong Convention) (Mikelis, 2012; Wingfield, 2012).

Japan is one of the world’s leading maritime powers, which has the world’s second-largest shipping tonnage and is the world’s third-largest shipbuilding nation (UNCTAD, 2011; Maritime Bureau, 2012). Thus, Japan is required to play a crucial
role in addressing these global issues in the ship recycling industry, and has so far contributed to drafting the Hong Kong Convention and the relevant guidelines in a proactive way. During the transitional period, Japan is going to make continuous and intensive efforts for the early ratification of the Convention by major shipping and ship recycling states including Japan itself and the promotion of sustainable, safe and environmentally sound ship recycling before its entry into force (Maritime Bureau, 2012).

1.2. Objectives and Structure

On the basis of this background, this dissertation reviews the current international regulations which could be applied to the ship recycling industry, namely the Basel Convention and the Hong Kong Convention, and examines the current issues related to the conditions of the industry, specifically, the potential dangers of ships to be recycled, the environmental risks, the flow of hazardous wastes generated through ship recycling processes, the occupational safety and health, and the main causes of substandard operations in South Asian ship recycling yards.

Furthermore, key regional efforts which will contribute to accomplishing the development of a sustainable and environmentally sound ship recycling industry are also examined. Finally, Japan’s fundamental policies and efforts related to ship recycling are analyzed to conclude how Japan is contributing to addressing ship recycling issues and will further play an active role in achieving sustainable, safe and environmentally sound ship recycling in the world. Chapters of this dissertation are organized in an orderly sequence through answering the following key questions.

1. How and in what aspects could the ship recycling industry be regulated by the Basel Convention and the Hong Kong Convention? (Chapter II)

2. What are the issues related to the current conditions of the ship recycling industry in the leading countries in South Asia? (Chapter III)
3. What efforts are being made by key regions other than the Indian subcontinent to cope with the coming new regulations? (Chapter IV)

4. What kinds of efforts have been and will be made by Japan in order to achieve a sustainable, safe and environmentally sound recycling of ships? (Chapter V)

1.3. Delimitation

This dissertation does not describe all regulations and features of the Basel Convention and the Hong Kong Convention in detail, but reviews their essential principles which are, at least, relevant to the issues discussed here.

In addition, the issues of further improvement or development of regulatory regimes are not discussed in this dissertation since the Hong Kong Convention has not been put into effect and it is considered to be necessary at this time to consider how early and effectively the ship recycling industry can apply the current regulations.

Furthermore, this dissertation places a strong emphasis on Japan’s policies and practices related to the ship recycling industry, since they not only include an infrastructural reformation of the ship recycling yards in question as a typical option, but also present a brand-new and innovative approach to the issues which seeks new ship recycling techniques and business. These efforts are considered to be key elements for achieving sustainable, safe and environmentally sound recycling of ships.

1.4. Methodologies

Qualitative research was conducted to fulfill the purpose of this research. In order to review and analyze the current issues of the regulatory regimes related to the ship recycling industry, various conventions, resolutions, guidelines, conference papers and other official documents published by international bodies such as the IMO were
studied. Relevant maritime journals, the latest statistics and specialized books were also reviewed to find critical reasonings of the discussion here.

To confirm the policies of the Japanese government on ship recycling, the policy papers, white papers and other official documents available to the public were studied. The reports of major projects on ship recycling discussed in this research were collected from the project-related persons by contacting them directly via e-mail. Their contact addresses were provided by the Japanese government. For more detailed study on the policies and projects, key officials in the Japanese government and project-related persons were interviewed as needed through e-mail.

Since there were, unfortunately, few resources regarding Japan’s policies and projects written in English, due to their brand-new status at this time, most of them were examined based on official papers and reports written in Japanese. The titles of these documents listed in the references were unofficially translated into English by the author.
CHAPTER II THE EXISTING REGULATORY INSTRUMENTS COVERING SHIP RECYCLING AND THEIR LIMITATIONS

Recognizing the problems of the ship recycling industry regarding workers’ safety and health, the ILO has been involved in developing a safety culture in the ship recycling yards as its vital role since the early stage of awareness (Puthucherril, 2010). However, it only provided voluntary guidelines, but never developed a binding regulation.

Considering this fact and the need for regulatory actions against the ship recycling industry, this chapter will introduce the existing mandatory instruments applicable to the industry, which are already in force or expected to enter into force in the near future.


2.1.1. Background

Public awareness of environmental risks posed by hazardous waste disposal and the subsequent strengthening of environmental regulations in the industrialized countries in the 1970s and 1980s caused an increase in disposal costs. Therefore, the location shifted from these countries to less restrictive countries in order to maintain cheap disposal costs.

In order to address this circumstance, the Basel Convention was adopted in March 1989 as the first international legal regime to regulate the transboundary movement of hazardous wastes, and entered into force in May 1992 (Basel Convention, 1989; SBC, 2012b). As of 1 September 2012, the Basel Convention has 179 Parties (SBC, 2012c).
Ship recycling issues have been on the agenda of the Basel Convention since the late 1990s, considering the fact that ships to be recycled contain various hazardous materials such as asbestos, polychlorinated biphenyls (PCB) and oils, and that they will hardly fly the flag of the Recycling State (SBC, 2010). At the COP 5 in December 1999, the Technical Working Group was convened to address ship recycling issues in cooperation with the IMO and to develop technical guidelines on them. Then, the Technical Guidelines on the Environmentally Sound Management of the Full and Partial Dismantling of Ships (TGDS) were adopted at the COP 6 held in December 2002 (Puthucherril, 2010). Furthermore, Decision VII/26 of the COP 7 in October 2004 noted that a ship “may become waste” under the Basel Convention and “at the same time it may be defined as a ship under other international rules”, and invited the IMO to continuously consider the establishment of its mandatory instrument for ensuring “environmentally sound management (ESM) of ship dismantling” (SBC, 2005).

2.1.2. Objectives

The comprehensive objective of the Basel Convention is to “protect, by strict control, human health and the environment against the adverse effects which may result from the generation and management of hazardous wastes and other wastes” as set in the preamble (Basel Convention, 1989). The provisions are set focusing on the following main aims:

- To reduce hazardous waste generation and facilitate Environmentally Sound Management (ESM) of hazardous wastes;
- To restrict transboundary movements of hazardous wastes except for the case that the movements are considered to comply with the ESM principles; and
- To establish a regulatory regime which applies to cases where transboundary movements can be permitted (SBC, 2012b).
2.1.3. Essential principles

First of all, the term “wastes” is defined as “substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law” under the Basel Convention. As mentioned in 2.1.1, a ship may be regarded as waste under the Convention.

Application and exemptions

The Basel Convention applies to the transboundary movement of “hazardous wastes” and “other wastes”. “Hazardous wastes” are wastes listed in Annex I of the Convention like asbestos and PCBs, wastes with any characteristics included in Annex III such as explosive, flammable, poisonous, corrosive and toxic, and wastes recognized as hazardous wastes by the national laws or regulations of the export, import or transit state. On the other hand, “other wastes” are wastes contained in Annex II: “wastes collected from households” and “residues arising from the incineration of household wastes.”

Radioactive materials subject to “other international control systems” are out of the scope of the Convention. In addition, the Convention does not apply to wastes which stem from the normal operation of a ship, the discharge of which is regulated by another international instrument.

Environmentally sound management (ESM)

ESM is one of the most important principles of the Convention, and establishes the basis for confirming whether a transboundary movement or disposal of wastes complies with the requirements under the Convention (Puthucherril, 2010). It is

---

1 Basel Convention, art. 2(1).
2 Ibid., art. 1(1)(a).
3 Ibid., art. 1(1)(b).
4 Ibid., art. 1(2).
5 Ibid., art. 1(3).
defined as “taking all practicable steps to ensure that hazardous wastes or other wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from such wastes” in Article 2, paragraph 8 of the Convention (Basel Convention, 1989). The TGDS further elaborates specific ESM concepts in the context of ship recycling (Wingfield, 2012).

In addition, Watkinson (2006) states that the key features of ESM are practical standards, management control and regulatory compliance, and practically defined ESM as “the combination of regulatory provisions, practical standards and management controls brought to bear on processes that ensures the protection of human health and the environment from the potential impacts of waste management activities.” In practice, the Convention requires each Party to:

- Minimize the generation of hazardous and other wastes;\(^6\)
- Ensure adequate disposal facilities, to the extent possible, inside the nation;\(^7\)
- Ensure that persons who manage hazardous or other wastes take preventive measures against pollution caused by such wastes and minimize the adverse effects on human health and environment in case of such pollution;\(^8\) and
- Minimize the transboundary movement of hazardous and other wastes and conduct it in a safe and environmentally sound manner.\(^9\)

Furthermore, the Convention requires each Party to ensure that hazardous or other wastes to be exported are managed in an ESM manner in the import and transit state. Nonetheless, the obligation of the export state to manage such wastes in an ESM manner may not be transferred to the import and transit state.\(^10\)

\(^6\) *Ibid.*., art. 4(2)(a).
\(^7\) *Ibid.*., art. 4(2)(b).
\(^8\) *Ibid.*., art. 4(2)(c).
\(^10\) *Ibid.*., art. 4(8), (10).
General rules for the transboundary movement of hazardous and other wastes

The Convention gives each Party the sovereign right to prohibit the import of hazardous or other wastes. When a Party exercises this right and properly notifies other Parties, they must prohibit the export of such wastes to the Party.\textsuperscript{11} It also requires Parties to prohibit the export of hazardous or other wastes to “a State or group of States developing to an economic and/or political integration organization that are Parties, particularly developing countries.”\textsuperscript{12}

Moreover, a Party must prohibit the export of hazardous or other wastes to a non-Party and the import of such wastes from a non-Party without bilateral, multilateral or regional agreements between them which ensure the ESM of such wastes under proper provisions equivalent to the Convention.\textsuperscript{13}

The transboundary movement of hazardous wastes and other wastes can be carried out only in the case that:

- The export state lacks the technical capacity, adequate facilities, capacity or disposal places to ensure the ESM of such wastes;
- The import state needs such wastes as raw materials for “recycling or recovery industries”; and
- There are other criteria for the movement adopted by the export and import states and compatible with the aims of the Convention.\textsuperscript{14}

Figure 1 depicts how transboundary movements are regulated under the Convention excluding the specific cases of prohibition in the first paragraph.

\textsuperscript{11} Ibid., art. 4(1)(a)-(b).
\textsuperscript{12} Ibid., art. 4(2)(e).
\textsuperscript{13} Ibid., arts. 4(5), 11.
\textsuperscript{14} Ibid., art. 4(9).
Prior informed consent (PIC)

The transboundary movement of hazardous wastes or other wastes must be carried out in accordance with the following steps based on the PIC procedures, another significant principle of the Convention. A transboundary movement without following these procedures is regarded as illegal traffic under the Convention.

Step 1: Notification

The generator or exporter must notify in writing the import and transit state through the competent authority of the export state of any proposed transboundary movement of hazardous or other wastes (Figure 2). This notification has to include the information on a proposed transboundary movement, *inter alia*, declarations by the generator and exporter on the correctness of the information, wastes to be moved,
suggested measures to transport and dispose of them, and a contract between generator/exporter and disposer ensuring ESM.\textsuperscript{15}

![Diagram of PIC procedures]

**Figure 2 – Step 1 of the PIC procedures: Notification**


**Step 2: Consent and issuance of movement document**

The import and transit state must notify in writing the export state of its consent or refusal to the movement. The export state can allow the generator or exporter to start the export of hazardous and other wastes when it has received the written response from the import and transit state on the their consent to the movement and, additionally from the import state, on the confirmation of a contract specifying ESM of the wastes to be moved (Figure 3).\textsuperscript{16} A “movement document” must accompany hazardous and other wastes from the start to the end of the movement.\textsuperscript{17}

\textsuperscript{15} *Ibid.*, arts. 4(2)(f), 6(1). See also *Ibid.*, annex V A.


\textsuperscript{17} *Ibid.*, arts. 4(7)(c). See also *Ibid.*, annex V B.
Figure 3 – Step 2 of the PIC procedures: Consent and issuance of movement document


Step 3: Transboundary movement

When the transboundary movement is completed, the disposer has to notify the generator/exporter and the export state of receipt of the transported wastes with a copy of the movement document including signatures given by respective persons in charge of the movement (Figure 4).

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18 Ibid., art. 6(9).
Figure 4 – Step 3 of the PIC procedures: Transboundary movement


Step 4: Confirmation of disposal

After the completion of the disposal, the disposer must inform the generator/exporter and the export state of the completion. In case of no confirmation from the disposer, the export state or the generator/exporter must notify the import state of that condition for follow-up (Figure 5).  

\[19\] Ibid., art. 6(9).
Figure 5 – Step 4 of the PIC procedures: Confirmation of disposal


Control and enforcement

The Convention sets up the mechanisms to effectively control and enforce the PIC procedures and ESM in the transboundary movement of hazardous wastes and other wastes. First, Parties and interested organizations are obliged to cooperate together in actions such as information sharing about the transboundary movements so that they can improve the ESM of wastes and prevent illegal traffic which Parties consider is criminal.\(^{20}\)

Secondly, in each Party, proper measures must be taken with legal, administrative or other tools to ensure the implementation and enforcement of the Convention.\(^{21}\) It must ensure that all persons in its jurisdiction cannot transport or dispose of hazardous or other wastes without authorization or permission, and that these wastes

\(^{20}\) Ibid., art. 4(2)(h), 4(3).
\(^{21}\) Ibid., art. 4(4).
are properly packaged, labeled and transported in compliance with other relevant international regimes and standards.\textsuperscript{22}

Third, Parties shall assign or create one focal point and one or more competent authorities, and inform the Secretariat of the Convention of the determined focal point and competent authorities. They must also inform the Secretariat of any change regarding their focal point and competent authorities.\textsuperscript{23}

Furthermore, Parties must cooperate with each other to achieve ESM of wastes in:

- Sharing technical standards and appropriate practices, upon request;
- Monitoring the effects of waste management on human health and the environment;
- The development and implementation of new technologies as well as the improvement of existing technologies;
- Transferring technology and management systems;
- Building technical capacity; and
- The development of technical guidelines and codes of practice.\textsuperscript{24}

Especially for developing countries, Parties have to take appropriate measures to help them with capacity building related to disposal facilities and waste managers, minimizing the generation and transboundary movement of hazardous and other wastes. Cooperation among Parties and proper international organizations is also recommended specifically for public awareness, developing ESM and adopting new technologies.\textsuperscript{25}

Finally, a Conference of the Parties (COP) will be held at a regular basis, or extraordinarily held as needed, in order to: continuously review and evaluate whether the Convention is effectively implemented; harmonize policies, strategies and

\textsuperscript{22} \textit{Ibid.}, art. 4-7 (a)-(b).
\textsuperscript{23} \textit{Ibid.}, art. 5.
\textsuperscript{24} \textit{Ibid.}, art. 10(1)-(2).
\textsuperscript{25} \textit{Ibid.}, art. 10(3)-(4).
measures to minimize adverse effects caused by hazardous and other wastes; and consider and adopt further amendments to the Convention and protocols as well as take any other actions necessary for the implementation of the Convention. The Secretariat arranges the COP and plays an important role to help Parties with their implementation of the Convention by gathering and delivering relevant information, communicating with focal points and competent authorities, coordinating with international bodies and assisting their identification of illegal traffic and emergency responses.

**Protocol on liability and compensation: polluter pays principle**

The Basel Protocol on Liability and Compensation for Damage Resulting from Transboundary Movements of Hazardous Wastes and their Disposal (Basel Protocol) was adopted on 10 December 1999. This Protocol covers liability and compensation for “damage due to an incident occurring during a transboundary movement of hazardous wastes and other wastes and their disposal, including illegal traffic” (Basel Protocol, 1999). It places a strict liability on the waste generator/exporter or export state until the disposer has received the wastes and on the disposer after the receipt, which clearly demonstrates “polluter pays principle”, defined as one of the principles of international environmental law in Principle 16 of the Rio Declaration on Environment and Development (Rio Declaration).

**The ban amendment**

On 22 September 1995, COP 3 adopted by decision III/1 the amendment to the Convention that prohibits all transboundary movements of hazardous wastes from

27 *Ibid.*, art. 16.
28 See “Polluter pays principle” in Appendix A (Glossary).
Parties belonging to EU, OECD and Liechtenstein to the other Parties, known as the “ban amendment” (SBC, 1995). However, the amendment is not yet in force as of 1 September 2012, since the number of ratifications (73 Parties) is far from the required condition, specifically, that three fourths of Parties to the Convention have ratified it (SBC, 2012a).

The Basel Convention basically prohibits the transboundary movement of hazardous wastes including ships destined for recycling, except in the case where the export state lacks technical or infrastructural capacity or there is a need for such wastes as an important resource in the import state. The transboundary movement of hazardous wastes, if permitted, shall be conducted following the PIC procedures to ensure the ESM of the wastes in the export, transit and import states. The PIC and ESM are introduced into the Hong Kong Convention (see 2.2) as well in a different way in order to achieve safe and environmentally sound recycling of ships.

2.1.4. Limitations in the Basel Convention related to the recycling of ships

Detection of shipowners’ intention to dispose of ships

As explained in 2.1.1, a ship destined for recycling can be regarded as “waste” but at the same time keep its status as a “ship” under other international rules. However, it has been argued that it is difficult in practice to identify when and by whom a ship is determined to be recycled. This underlying problem occurs because shipowners rarely declare their intention to decommission a ship and send it to a recycling country (Lloyd’s Register, 2011). Without detection of the shipowner’s intention to scrap a ship, the Basel Convention cannot be applied to its final voyage for recycling.
Identification of the export state

It is difficult to identify the export state regarding end-of-life ships. In the perspective of international maritime law, ships are to be under the control of their flag state. Currently, there are a lot of flags of convenience or open registers. Under such flags, ships can easily be registered or deregistered irrespective of the shipowners’ nationality or place of residence; which will not ensure the genuine link between the flag state and the export state. This specific feature of the shipping industry will consequently cause a critical problem in applying the notification requirements for an export state to the final voyage of a ship destined for recycling from a certain industrialized country to a developing country (Puthucherril, 2010).

2.2. The Hong Kong Convention for the Safe and Environmentally Sound Recycling of Ships, 2009

2.2.1. Background

As explained in the section 2.1.5, the application of the Basel Convention to end-of-life ships entails pragmatic limitations due to the particularity of the shipping and ship recycling industries. Therefore, COP 7 held in October 2004 requested the IMO to build a new mandatory legal regime for controlling the ship recycling industry in a safe and environmentally sound manner with equivalence to the level of control of the Basel Convention (Mikelis, 2012; Puthucherril, 2010).

Following the request by COP 7, the Assembly of the IMO at its 24th regular session adopted Resolution A.981(24) to direct MEPC to develop “a new legally-binding instrument on ship recycling” (Mikelis, 2012). The resolution stated that the new instrument will regulate the whole life of ships, the operation of ship recycling yards and the development of a proper “enforcement mechanism” for ship recycling so as to ensure safe and environmentally sound recycling of ships (IMO, 2005). Then, MEPC at its 54th session in March 2006 (MEPC 54) started a working group to draft the instrument texts. After the drafting procedures through MEPC 55 (October 2006)
to MEPC 58 (October 2008), the IMO finally adopted the Hong Kong Convention at the Diplomatic Conference held in Hong Kong in May 2009 (Mikelis, 2012).

2.2.2. Objectives

The Hong Kong Convention set its objectives in the preamble as:

- To take the “precautionary approach” set out in Principle 15 of the Rio Declaration\(^{29}\) and referred to in resolution MEPC.67(37)’;
- To “promote the substitution of hazardous materials in the construction and maintenance of ships by less hazardous, or preferably, non-hazardous materials\(^{30}\), without compromising the ships’ safety, the safety and health of seafarers and the ships’ operational efficiency”; and
- To “effectively address … the environmental, occupational health and safety risks related to ship recycling” (Hong Kong Convention, 2009).

2.2.3. Essential principles

**Application and exemptions**

The Convention applies to the following entities.\(^{31}\)

- Ships flying the flag of a Party or operating under the authority of the Party
- Ship Recycling Facilities operating under the jurisdiction of a Party

“Warships, naval auxiliary, or other ships owned or operated by a Party and used, for the time being, only on government non-commercial service” as well as ships less than 500 GT or operating only in waters of each Flag State are exempt from the

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\(^{29}\) See “Precautionary approach” in Appendix A (Glossary).

\(^{30}\) This objective is following the COP decision IX/30 in 2008.

\(^{31}\) *Hong Kong Convention*, art. 3(1).
scope of the Convention. However, the operation and recycling of these ships shall be controlled in a way which complies with the Convention by each Party.\textsuperscript{32}

\textit{Flag State obligations}

A Flag State has to ensure that a ship flying its flag carries on board an Inventory of Hazardous Materials (IHM) for the ship recycling facility to be able to determine the specific recycling processes in a safe and environmentally sound manner.\textsuperscript{33}

The IHM consists of three parts:

- Part I – the list of hazardous materials\textsuperscript{34} in the structure and equipment of the ship, with their location and quantity;
- Part II – operationally generated wastes; and
- Part III – stores.

Part I must be developed: in the construction phase for new ships;\textsuperscript{35} and not later than 5 years after the entry into force of the Convention or before the recycling, whichever comes first, for existing ships.\textsuperscript{36} It shall also be maintained and updated during their operational lifetime.\textsuperscript{37} The latter two parts are only required to be developed by the shipowner and checked by the Administration or the authorized person/organization before the recycling, if these wastes and stores still exist onboard the ship when recycled.\textsuperscript{38}

Several surveys shall be conducted in order to verify whether Part I of the IHM complies with the Convention: an initial survey before the start of the ship’s

\textsuperscript{32} \textit{Ibid.}, art. 3(2)-(3).
\textsuperscript{33} \textit{Ibid.}, reg. 5(1)-(2), appendices 1-2.
\textsuperscript{34} See “Hazardous materials included in Part I of the IHM” in Appendix A (Glossary).
\textsuperscript{35} \textit{Hong Kong Convention}, reg. 5(1).
\textsuperscript{36} \textit{Ibid.}, reg. 5(2).
\textsuperscript{37} \textit{Ibid.}, reg. 5(3).
\textsuperscript{38} \textit{Ibid.}, reg. 5(4).
operation or before the development of the IHM;\textsuperscript{39} renewal surveys “at intervals specified by the Administration, but not exceeding five years”;\textsuperscript{40} and additional surveys in general or partial if the shipowner requests for a certain structural change, modification, or repair.\textsuperscript{41} Upon the successful completion of these initial, renewal and additional surveys, the International Certificate on Inventory of Hazardous Materials (ICIHM) will be issued.\textsuperscript{42}

Then, a final survey must be carried out before the start of recycling to check whether the IHM finalized by the shipowner is in compliance with the Convention\textsuperscript{43} and confirm that the Ship Recycling Plan (SRP) developed by the ship recycling facility contains the IHM and information relevant to “Safe-for-entry and Safe-for-hot work conditions.”\textsuperscript{44} The final survey also verifies the validity of authorization of the ship recycling facility.\textsuperscript{45}

After the successful completion of the final survey, the International Ready for Recycling Certificate (IRRC) will be issued.\textsuperscript{46} All these surveys and issuance of certificates are to be conducted by the Administration or the authorized surveyors or recognized organizations.\textsuperscript{47}

\textit{Shipowner obligations}

The Convention requires a shipowner to notify the Administration of the intention to recycle his/her ship for its final survey.\textsuperscript{48} A shipowner has to maintain and update

\textsuperscript{39} Ibid., reg. 10(1)(1).
\textsuperscript{40} Ibid., reg. 10(1)(2).
\textsuperscript{41} Ibid., reg. 10(1)(3).
\textsuperscript{42} Ibid., reg. 11(1).
\textsuperscript{43} Ibid., reg. 10(1)(4)(1).
\textsuperscript{44} Ibid., reg. 10(1)(4)(2).
\textsuperscript{45} Ibid., reg. 10(1)(4)(3).
\textsuperscript{46} Ibid., reg. 11(11).
\textsuperscript{47} Ibid., regs. 10(2)-(4), 11(1), 11(11).
\textsuperscript{48} Ibid., reg. 24(1).
the IHM throughout the ship’s lifetime,\textsuperscript{49} and finalize it for the certification by the Administration before recycling.\textsuperscript{50} The shipowner must also ensure that cargo residues, fuel and wastes on board a ship to be recycled are minimized before entry to the ship recycling facility,\textsuperscript{51} and that, in tanker cases, the cargo tanks and pump rooms are in the condition of safe-for-entry and safe-for-hot-work.\textsuperscript{52} Furthermore, the shipowner has to provide the ship recycling facility with all the information necessary for its completion of the SRP.\textsuperscript{53}

**Recycling State obligations**

Parties under the jurisdiction of which ship recycling facilities intend to operate (hereinafter referred to as “Recycling State”) must authorize them by “verification of documentation” and “site inspection” before their operation.\textsuperscript{54} They shall give the IMO or other Parties, if requested, relevant information on the grounds of their decision to authorize recycling facilities.\textsuperscript{55} Though the Competent Authority can delegate its Recognized Organizations (ROs) to authorize ship recycling facilities, it is ultimately accountable for the authorization.\textsuperscript{56} The period of the authorization can be specified by the Competent Authority, but must not exceed five years.\textsuperscript{57} To ensure ship recycling facilities comply with the requirements under the Convention, a Recycling State has to establish and effectively use control systems over ship recycling facilities in its jurisdiction, including “inspection, monitoring and enforcement” as well as an “audit scheme” the results of which are to be sent to the

\textsuperscript{49} Ibid., reg. 5(3).
\textsuperscript{50} Ibid., regs. 5(4), 8(1)(5).
\textsuperscript{51} Ibid., reg. 8(1)(2).
\textsuperscript{52} Ibid., reg. 8(1)(3).
\textsuperscript{53} Ibid., reg. 8(1)(4).
\textsuperscript{54} Ibid., art. 6, reg. 16(2).
\textsuperscript{55} Ibid., art. 7.
\textsuperscript{56} Ibid., reg. 16(3).
\textsuperscript{57} Ibid., reg. 16(5).
IMO.\textsuperscript{58} They must also make national legal regimes to ensure these facilities are “designed, constructed, and operated in a safe and environmentally sound manner.”\textsuperscript{59}

\textit{Ship recycling facility obligations}

First of all, ship recycling facilities must be authorized by a Party in whose jurisdiction they operate. Authorized ship recycling facilities have to create “management systems, procedures and techniques” for safeguarding the health of workers in the facilities and the residents around the facilities and for decreasing the environmental risks caused by the recycling activities.\textsuperscript{60} They must also make the documentation about their authorization available to a shipowner considering the recycling of his/her ship.\textsuperscript{61}

Second, they shall develop a Ship Recycling Facility Plan (SRFP) which the board or the proper governing entity of the recycling company must adopt.\textsuperscript{62} The SRFP has to include:

\begin{itemize}
  \item A policy for occupational safety and protection of human health and the environment;
  \item A system for implementing the requirements under the Convention, attaining the objectives of the company policy, and continuously improving recycling procedures and standards;
  \item Roles and responsibilities for employers and workers in operating the recycling activities;
  \item A program to give proper information and training to workers;
  \item A plan for emergency preparedness and response;
  \item A monitoring system for recycling performance;
\end{itemize}

\textsuperscript{58} Ibid., reg. 15(3).
\textsuperscript{59} Ibid., reg. 15(1).
\textsuperscript{60} Ibid., reg. 17(1).
\textsuperscript{61} Ibid., reg. 17(2)(3).
\textsuperscript{62} Ibid., reg. 18(1).
• A system for keeping records about how the recycling operation is conducted; and
• Reporting systems regarding various events and accidents causing adverse impacts on human health and the environment.63

In addition, they have to develop a ship-specific SRP, and notify the Competent Authority of their intention to recycle a ship before the recycling.64 The SRP shall be developed in a language accepted by both the Recycling State and the Administration, considering the information given by the shipowner.65 It must establish how the materials including those identified in the IHM will be handled during the recycling process and provide information on ensuring safe-for-entry and safe-for-hot-work.66

Furthermore, authorized ship recycling facilities have to:

• Create and take preventive measures against adverse effects to human health and the environment caused by unsafe conditions, accidents, spills, emissions, etc.;67
• Ensure the safe and environmentally friendly removal of hazardous materials present in a ship;68
• Develop and maintain an emergency preparedness and response plan,69 and
• Ensure workers’ safety by providing equipment for personal protection, initial and refresher training for all workers conducted by Competent officials.70

63 Ibid., reg. 18(1)(1)-(9).
64 Ibid., reg. 9.
65 Ibid., reg. 9(1)(1)-(2).
66 Ibid., reg. 9(1)(3).
67 Ibid., reg. 19.
68 Ibid., reg. 20.
69 Ibid., reg. 21.
70 Ibid., reg. 22.
**Port State rights**

A Party may inspect a ship entering its ports or offshore terminals regarding the holding and validity of necessary certificates onboard (ICIHM or IRRC) to confirm whether the ship complies with the Convention.\(^{71}\) Additionally, detailed inspection may be conducted if the ship does not have a valid certificate or there are clear grounds that show its inappropriate condition(s) related to its certificate or the maintenance of its IHM.\(^{72}\)

**Technical assistance and co-operation**

Parties provide technical assistance, if requested by any other Party, in terms of: training personnel; making relevant technology; joint research and development programs; equipment and facilities available; and promotion of the effective implementation of the Convention and the relevant guidelines.\(^{73}\) They also cooperate proactively to transfer systems or technology for ensuring safe and environmentally sound ship recycling.\(^{74}\)

**Entry into force**

The Convention shall be put into force two years after the date when the following conditions are all satisfied:\(^{75}\)

- Not less than 15 States have signed, ratified, accepted, approved or acceded to it.

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\(^{71}\) *Ibid.*, art. 8(1).

\(^{72}\) *Ibid.*, art. 8(2).

\(^{73}\) *Ibid.*, art. 13(1).

\(^{74}\) *Ibid.*, art. 13(2).

\(^{75}\) *Ibid.*, art. 17(1).
• The combined merchant fleets of the Member States have reached not less than 40% of the total gross tonnage of the world merchant fleets.
• The combined maximum volume of annual ship recycling in the Member States during the preceding 10 years composes not less than 3% of the total gross tonnage of the merchant fleets of the same States.

2.2.4. Limitations in the Hong Kong Convention

Some limits in the Hong Kong Convention have been argued among experts and international organizations related to the ship recycling industry.

First, Chang et al. (2010) state that although the Hong Kong Convention prescribes regulations relevant to waste management after the dismantling of ships, it does not deal with management procedures during the final stage when the wastes generated from scrapped ships are transported from the recycling facilities. For this reason, the Hong Kong Convention seems not to fully satisfy the requirements of the Basel Convention about the control of transboundary movement of hazardous wastes, which led to the disagreement in COP 10 held in October 2011 that the Hong Kong Convention creates an equivalent level of control and enforcement to the Basel Convention (Wingfield, 2012).

Secondly, some critics including the ILO argue that scrapping ships on the beach, the most problematic method which prevents a majority of ship recycling sites from combating safety and environmental risks, is not expressly prohibited or restricted under the Hong Kong Convention (Chang et al., 2010; Seligson, 2012). In this regard, the NGO Platform on Shipbreaking (2009) stresses that the beaching method cannot satisfy the ESM standards which was originally established by the Basel Convention and introduced in the Hong Kong Convention as well.

Another argument is that, as long as the requirements of the Hong Kong Convention are satisfied, ships with hazardous materials can be dismantled in the ship recycling
yards in developing countries, which means the ship owners can escape the responsibility for bearing the costs for cleaning pollution, that is, the “polluter pays principle”\textsuperscript{76}. Thus the Hong Kong Convention does not appropriately allot the responsibility of paying costs for managing hazardous wastes caused by ship recycling (Hong Kong Convention, 2009; UNCED, 1992; Sundelin, 2008).

Furthermore, some critics emphasize that the Hong Kong Convention does not require all ships entering recycling yards in developing countries to be pre-cleaned as to all hazardous materials. This will lead to the continuous export of hazardous materials from OECD to non-OECD countries (Mikelis, 2012).

Finally, a majority of ships like war ships, non-commercial ships, ships for domestic transportation, and small ships are still exempt from the requirements of the Hong Kong Convention. Though the equivalent level of control is required in recycling these ships under the Convention, its actual implementation and enforcement are left to the discretion of Parties. Therefore, it is questionable whether the Convention can ensure global success to control and develop the ship recycling industry (Chang \textit{et al.}, 2010).

2.3. Summary and remarks

This chapter described the essence of the Basel Convention and the Hong Kong Convention as the key international regulatory instruments covering the ship recycling industry, focusing on their background, objectives, key principles and flaws.

Firstly, the Basel Convention strictly controls the transboundary movements of hazardous wastes and other wastes, especially from industrialized countries to developing countries. Its control measures are designed on the basis of the ESM

\textsuperscript{76} See \textit{supra} note 28.
concept to prevent the adverse effects of these wastes on human health and the environment, and enforced in combination with the PIC procedures for adequate preparedness and operation in waste disposal facilities. In the context of maritime shipping, the application of the Basel Convention is considered to be quite difficult due to the problems in detecting shipowners’ intentions to dispose of their ships and identifying the export state.

On the other hand, the Hong Kong Convention focuses on the regulation of two major objects in the ship recycling industry, namely, ship and ship recycling yard. As a precautionary approach, hazardous materials contained in a ship are strictly managed by the IHM onboard, which is developed in its construction stage, maintained during its operation and finalized prior to its recycling under several surveys and certifications by the flag state, authorized surveyors or ROs. This approach is another way of practicing the PIC principle as seen in the Basel Convention. Besides, a ship recycling yard must be authorized by the recycling state to ensure safe and environmentally friendly operation based on the ESM concepts. The yard is also required to develop SRFP for its self-control and make a ship-specific SRP before the recycling in cooperation with the shipowner. Whereas a flag state has responsibility for authorizing the IHM of a ship flying its flag and issuing the ICIHM and the IRRC, a port state can inspect a ship calling at its ports and verify these certificates onboard.

When it comes to the argued limits and flaws of these two Conventions, there are counter-arguments against most of them. To begin with, after the entry into force of the Hong Kong Convention, shipowners are obliged to inform the flag state of the intention to recycle their ships for final survey, as mentioned in 2.2.4. This will not only solve the problem of detecting the shipowners’ intention, but will also improve the identification of the export state under the Basel Convention.

Secondly, as for the absence of detailed prescriptions on the management of waste disposal facilities, Mikelis (2012) stresses that the requirements of the Basel Convention still have consistency with and are supplementary to the requirements of
the Hong Kong Convention, not being replaced by the Hong Kong Convention. The same is true for the ILO conventions. Actually, the preamble of the Hong Kong Convention clearly notes the respective roles of the Basel Convention and the ILO in the field of ship recycling. Additionally, the Hong Kong Convention critically stipulates that “waste management and disposal sites shall be identified to provide for the further safe and environmentally sound management of materials” under Regulation 20, paragraph 3. These notes and provision will lead to ensuring the proper management of waste disposal facilities in combination with the requirements under other legal instruments.

Third, to ban the beaching method is indeed the best and ideal way to achieve safe and environmentally friendly ship recycling. However, as Grey (2012) criticizes, this option implies the European-based NGOs’ ignorance of the reality that there is a serious shortage of jobs in Asian ship recycling countries. The IMO counter-argues as well that it is quite difficult and meaningless to ban the beaching method, which most ship recycling countries rely on. Therefore, it is rather reasonable to say, as the IMO states, that the Hong Kong Convention can ensure environmental protection as well as workers’ safety and health by becoming a universal standard and regulating ship recycling facilities no matter how they conduct recycling operations (Mikelis, 2012).

Furthermore, if the Basel Protocol is applied to a ship destined for recycling, the liability can be placed on the shipowner as the generator/exporter during the ship’s final voyage to the recycling state, and on the recycling yard and/or disposal facilities as the disposer after the arrival at the yard. Even though the Hong Kong Convention does not incorporate the liability on shipowners, their liability for oil or chemical pollution damage during the final voyage will be covered by other IMO Conventions such as CLC 92\(^77\) and HNS Convention 2010\(^78\); and after reaching the recycling

\(^77\) International Convention on Civil Liability for Oil Pollution Damage, 1992. See also “CLC 92” in Appendix A (Glossary).
yard the liability will be shifted to the yard and/or disposal facilities under the Basel Protocol. Considering these interpretations, the “polluter pays principle” in the context of ship recycling can be achieved by the entry into force of the Basel Protocol and its proper application to the industry, irrespective of the Hong Kong Convention. What should be stressed here is that the “polluter pays principle” does not necessarily justify the concentration of liability on shipowners for damage caused by ship recycling activities.

Finally, in light of the pre-cleaning of a ship before its export to recycling yards, the IMO insists that it will make the ships unseaworthy because necessary equipment like electrical cables is removed. This will probably cause difficulties for developing countries to tow these unseaworthy ships due to costs, dangers and utilities (Mikelis, 2012). It also states that the Hong Kong Convention allows recycling states including non-OECDs to authorize, restrict or even prohibit the treatment of hazardous materials in recycling facilities depending on their capabilities (Mikelis, 2012).

Considering all the above, although there still remains the problem of exemptions, it could be said that the early entry into force and enforcement of the Hong Kong Convention and the Basel Protocol are, in practice, reasonable directions. It would be necessary to achieve safe and environmentally friendly ship recycling in Asian countries without simply prohibiting the beaching method or compromising its reformation under the Hong Kong Convention, and to effectively apply the Basel Convention to the ship recycling industry for further control of hazardous materials generated by ships to be recycled.

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78 International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea, 1996 as revised by the Protocol of 2010 to the Convention. See also “HNS 2010” in Appendix A (Glossary).
CHAPTER III   ISSUES ON PRESENT CONDITIONS OF THE SHIP RECYCLING INDUSTRY IN THE INDIAN SUBCONTINENT

To clarify the problems to be solved under the mandatory instruments described in Chapter II, this chapter will look into the current condition of the ship recycling industry in the Indian sub-continent. The focus is to be placed on the potential dangers of recycled ships, the impacts on the environment, the issues of workers’ occupational safety and health, and the material flow throughout the whole recycling processes.

3.1. Potential hazards of ships destined for recycling

Ships to be recycled, which were mostly built 20-30 years ago or even very young ships such as the 13-year-old container ship “Ocean Producer” sent to an Indian ship breaking yard in 2012 (Berg, et al., 2012), contain various hazardous substances defined in international laws. The most well-known hazardous substances on board these ships are:

- Asbestos;
- Lead and other heavy materials;
- Organic tin compounds such as tributyltin (TBT); and
- Oily wastes containing toxic and persistent organic compounds such as polychlorinated biphenyls (PCBs) (NGO Platform, 2009).

Asbestos had been recognized as the best insulative and fireproof material before its harmful characteristics became apparent. In the case of ship construction, it was generally utilized as a fire and thermal insulator, and often found in bulkheads, gaskets, pipes, walls, noise/vibration absorbers and intensively in the engine room.
Although it is already prohibited to newly install asbestos on board under the International Convention for the Safety of Life at Sea, 1974 (SOLAS), obsolete ships to be recycled still include a significant amount of asbestos. Exposure to asbestos will cause serious damage to human health, especially leading to asbestosis, lung cancer and mesothelioma (Puthucherril, 2010).

Lead is a noxious heavy metal which is generally used in batteries, cables, generators, motors, paints and piping built into ships. It causes “lead poisoning” which has a harmful impact on the human nervous system, audibility, eyesight and muscles. It also leads to intellectual disability and delays in physical and neuronal development in children. Mercury is another heavy metal often found in electric equipment, light fittings and thermometers in ships, which causes various nervous diseases in humans (Puthucherril, 2010).

TBT is an organic tin compound, which has been utilized in paints as anti-fouling systems on ships. It functions as a biocide to prevent algae, barnacles and other sea fauna and flora from growing on the ships’ hulls. However, since it is extremely stable and resistant to biodegradation, it is likely to remain in the sea waters and cause serious harm to hormonal actions of marine organisms and even humans who eat them (Puthucherril, 2010). The use of organic compounds including TBT as anti-fouling systems is now prohibited by the International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS Convention) (IMO, 2012). Yet TBT still seems to remain in existing merchant and navy ships according to research by the World Bank (2010).

PCBs have been widely used in various industries due to their flexible physical forms and remarkable merits in insulative property, thermal resistance and flame-proofness. However, it was recognized that they cause serious adverse effects on human health and the environment by entering the ecological chain. When humans are exposed to

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79 SOLAS, regulation II-1/3-5.2.
80 See “Anti-fouling system” in Appendix A (Glossary).
PCBs, they are more likely to get a variety of cancers and impair the endocrine, immune, nervous and reproductive systems. PCBs are often used as coatings for electric wiring and other electrical goods on ships. If these coatings are simply burned to extract the inside copper wires, PCBs will change their physical forms and easily spread into coastal waters and accumulate in marine habitats (Puthucherril, 2010). In addition, when PCBs are burned in the open air, they also generate carcinogenic pollutants such as dioxins and furans (NGO Platform, 2009).

Other than the materials listed above, ships destined for recycling contain various kinds of hazardous materials and pollutants such as cadmium, ozone-depleting substances (ODS) and radioactive substances. The results of research conducted by the World Bank (2010) show representative hazardous materials included in merchant and navy ships.81

These hazardous substances and pollutants must be extracted, controlled and disposed of in a safe and environmentally sound manner during and after ship breaking. Otherwise, ship recycling activities would cause serious damage to workers’ safety and health as well as the surrounding environment.

3.2. Environmental impacts of the beaching method

The beaching method has been used in key areas of the current ship recycling industry in South Asia, namely, Alang in India, Chittagong in Bangladesh and Gadani in Pakistan, which dominated about 69 percent of the world total recycled volume by gross tonnage in 2010 (IHS Fairplay, 2011; Lloyd’s Register, 2011). This method causes severe damage to the environment around the breaking site, specifically, the soils on the beach, the coastal waters and habitats, the groundwater, and the air.

81 See Appendix B.
Land and marine pollution

Oils, chemicals and hazardous substances spill directly into the soil when ships are broken in inter-tidal zones. In many cases, ship breakers create holes in the ships’ hulls to remove residual oils. Pollutants extracted from broken ships, which cannot be biodegraded, are dumped into pits without any seal, where they will easily spread (Lloyd’s Register, 2011; NGO Platform, 2009).

While spilled oils, which cannot be degraded naturally, contaminate coastal waters and soils, heavy metals like lead and mercury, TBT and PCBs spilled or dumped in breaking ships remain without decomposition and accumulate in the waters and soils. They have serious impacts not only on marine habitats but also on groundwater and coastal aquifers due to their toxic characteristics explained in 3.1.

Around the ship breaking sites in Alang, India, whereas heavy metals and plastics have contaminated the sites at a high level, the level of the groundwater layer has sharply dropped from 15 meters to 130 meters since the breaking activities started there (Puthucherril, 2010). Worse yet, there is still no facility which can control a large spill on the intertidal zone (Lloyd’s Register, 2010).

As a result of research by the World Bank on soil contamination in ship breaking sites in Chittagong, Bangladesh and Gadani, Pakistan, contamination by cadmium, chromium, lead, mercury and oil was detected widely at various levels as shown in Table 1. They fall within the levels of threat to the environment, especially raising concerns about lead and oil concentrations (World Bank, 2010).

Besides the pollutants from scrapped ships, human activities such as washing clothes, bathing and cleaning vehicles increase to some extent, which would result in the contamination of rivers and ponds around the yards (UNESCO, 2004).
Table 1 – Soil contamination detected in the ship breaking sites in Bangladesh and Pakistan

<table>
<thead>
<tr>
<th>Substance</th>
<th>Contamination Level (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadmium</td>
<td>0.6 - 2.2</td>
</tr>
<tr>
<td>Chromium</td>
<td>2.42 - 22.12</td>
</tr>
<tr>
<td>Lead</td>
<td>11.3 - 197.7</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.078 - 0.158</td>
</tr>
<tr>
<td>Oil</td>
<td>485 - 4,430</td>
</tr>
</tbody>
</table>


**Air pollution**

Asbestos exists in the atmosphere all around the yards because of the breaking of ship constructions containing it, and will remain for a long time due to its slow phase-out. According to research by the World Bank, the estimated amount of accumulated asbestos around the sites in Bangladesh and Pakistan during the period from 2010 to 2030 is expected to be over 40,000 tons, quite a large volume posing serious threat to human health (World Bank, 2010).

The burning of wastes in the open air releases harmful chemical compounds into the air. When the burned wastes are electric cables or hydraulic oil including PCBs, they generate hazardous pollutants like dioxins and furans, and discharge them directly into the atmosphere (Puthucherril, 2010).

Ozone-depleting substances (ODS) such as chlorofluorocarbons (CFCs) included in refrigerators and fire distinguishers are released into the air if they are not properly collected and managed. In particular, polyurethane (PU) foams including CFCs, which are used as insulation, must be managed and disposed of in an appropriate manner to prevent their release into the air. ODS are generally considered to participate in global warming (World Bank, 2010).
When using steel re-rolling mills, the steel plates removed from the ship are directly put into furnaces without first cleaning the paints and coatings on the plates. This generates various noxious substances and gases such as dioxins, and releases them into the air (Puthucherril, 2010; World Bank, 2010).

### 3.3. Hazardous waste stream extracted from a ship during and after scrapping

In Bangladesh and Pakistan, besides the steel plates, various other materials and equipment removed from scrapped ships are transported to other industries or societies for reselling or reuse, since there are strong demands to seek further economic benefits from ship breaking activities in both countries (Puthucherril, 2010). However, these materials and equipment are likely to include hazardous substances in their construction. For example, furniture made of panels including asbestos, electric equipment including PCBs, and thermometers with mercury are sold by re-sellers along the roads outside the yards without any treatment (World Bank, 2010).

Some hazardous materials which cannot be treated in the facilities of the yards are disposed of at waste disposal facilities outside the yards. Since both Bangladesh and Pakistan lack such facilities capable of treating specific hazardous wastes from ships, tremendous amounts of untreated hazardous wastes will be dumped on the beaches of the yard, unused plots or other places in an informal manner (World Bank, 2010).

Considering these facts, the World Bank estimated the principle disposal amount of hazardous wastes from ship recycling yards and other recycling industries during the period from 2010 to 2030 as shown in Table 2. The estimation was conducted based on the actual performance of these industries in 2008, assuming that their practices will not change and that no additional facilities will be established (World Bank, 2010).
Table 2 – Principle disposal amount of hazardous wastes from ship recycling yards and other recycling industries, 2010 – 2030

<table>
<thead>
<tr>
<th>Hazardous material (unit)</th>
<th>Remain at yard/ in beach sediment</th>
<th>Sold with equipment or as item</th>
<th>Re-rolling mills</th>
<th>Waste disposal site (formal)</th>
<th>Unknown or informal waste disposal site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asbestos (t)</td>
<td>37,525</td>
<td>3,950</td>
<td>0</td>
<td>0</td>
<td>37,525</td>
</tr>
<tr>
<td>PCB mainly in cables (t)</td>
<td>24,000</td>
<td>216,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ODS (PU foam) (t)</td>
<td>42,000</td>
<td>2,100</td>
<td>0</td>
<td>0</td>
<td>165,900</td>
</tr>
<tr>
<td>Paints (metals, TBT, PCB) (t)</td>
<td>3,460</td>
<td>3,460</td>
<td>58,820</td>
<td>0</td>
<td>3,460</td>
</tr>
<tr>
<td>Heavy metals (t)</td>
<td>169.5</td>
<td>169.5</td>
<td>339</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Waste liquid organic (m³)</td>
<td>1,978,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Miscellaneous (sewage) (m³)</td>
<td>107,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Waste liquids inorganic (t)</td>
<td>193</td>
<td>389</td>
<td>0</td>
<td>0</td>
<td>193</td>
</tr>
<tr>
<td>Reusable liquids organics (t)</td>
<td>33,750</td>
<td>607,500</td>
<td>0</td>
<td>0</td>
<td>33,750</td>
</tr>
</tbody>
</table>


In India, on the other hand, the material flow in and after scrapping ships is basically the same as that of Bangladesh and Pakistan, except that there are authorized disposal facilities for hazardous wastes. In Alang-Sosiya ship recycling plots, Gujarat Enviro Protection and Infrastructure Limited (GEPIL), authorized by the State Pollution Control Board, is requested to remove hazardous wastes from ships and send them to its disposal facilities for final treatment (GMB, 2012; METI, 2010). The principle disposal procedures are as follows.

- Asbestos is removed by a wet process, compacted in a tightly-sealed container and dumped in an authorized disposal facility.
• Materials including PCBs are divided into recyclable and unrecyclable parts. The unrecyclable part is determined to be burned or dumped depending on its carbon content.
• TBT is determined to be burned or dumped depending on its carbon content.

In addition, Table 3 shows the wastes and their amounts treated by GEPIL from January 2006 to January 2007 (METI, 2010).

| Table 3 – Performance of GEPIL, January 2006 – January 2007 |
|--------------------------------|----------------|
| Asbestos                  | 4,883 t        |
| Industrial wastes and solid wastes of chemical products | 1,464 t        |
| Non-industrial wastes     | 2,094 t        |
| Scrapping ships (amount of wastes) | 498 vessels (12-13 t/vessel) |


3.4. Occupational safety and health of workers under the beaching method

Workers in South Asian ship recycling yards using the beaching method are likely to have little or no training and work without sufficient protective equipment mainly due to the lack of essential capacity and resources. Thus, they are more exposed to hazardous materials contained in ships and accident risks such as explosion, falling steel plates, fire and suffocation depending on their working conditions (Misra, et al., 2009).

In this regard, the ILO adopted the guidelines named “Safety and health in shipbreaking: Guidelines for Asian countries and Turkey” in 2003 to protect workers in ship breaking yards from occupational hazards, ensure their safety and health and improve occupational safety and health problems related to ship breaking activities (ILO, 2004).
According to the guidelines, hazards involved in ship breaking activities can basically be divided into two categories, namely, “hazardous exposures generated” and “hazardous working conditions.” Whereas the former includes exposures to hazardous materials introduced in 3.1.1, excessive noise and fire, the latter means improper training and fire-safety measures, inappropriate or no personal protective equipment (PPE), no proper emergency response, rescue and first aid, and a number of dangerous activities.

Taking these elements into account, the ILO also categorizes common hazards which are often found in South Asian shipbreaking yards and tend to cause workers’ injuries, death, health disorders, diseases and incidents, as shown in Table 4 (ILO, 2004).

Table 4 – Common hazards that tend to cause workers’ injuries, death, health disorders, diseases and incidents

<table>
<thead>
<tr>
<th>Frequent causes of accidents</th>
<th>Mechanical hazards</th>
<th>Biological hazards</th>
<th>Ergonomic and psychosocial hazards</th>
<th>General concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire and explosion: explosives, flammable materials</td>
<td>Falls from height inside ship structures or on the ground</td>
<td>Trucks and transport vehicles</td>
<td>Failure of machinery and equipment</td>
<td>Lack of safety guards in machines</td>
</tr>
<tr>
<td>Falling objects</td>
<td>Moving objects</td>
<td>Scaffolding, fixed and portable ladders</td>
<td>Poor maintenance of machinery and equipment</td>
<td>Structural failure in the ship</td>
</tr>
<tr>
<td>Trapping or compression</td>
<td>Wet surfaces</td>
<td>Sharp-edged and other tools</td>
<td>Lack of safety guards in machines</td>
<td></td>
</tr>
<tr>
<td>Snapping of cables, ropes, chains, slings</td>
<td>Sharp objects</td>
<td>Power-driven hand tools, saws, grinders and abrasive cutting wheels</td>
<td>Structural failure in the ship</td>
<td></td>
</tr>
<tr>
<td>Heavy objects</td>
<td>Oxygen deficiency in confined spaces</td>
<td>Impairment and disintegration of materials</td>
<td>Structural failure in the ship</td>
<td></td>
</tr>
<tr>
<td>Access in progressively dismantled vessels (ribs, frames, panageways)</td>
<td>Lack of PPE, housekeeping practices, safety signs</td>
<td>Toxic marine organisms</td>
<td>Animal bites</td>
<td></td>
</tr>
<tr>
<td>Electricity (electrocution)</td>
<td>Shackles, hooks, chains</td>
<td>Risk of communicable diseases transmitted by pests, vermin, rodents, insects and other animals that may infest the ship</td>
<td>Vectors of infectious diseases (TB, malaria, dengue fever, hepatitis, respiratory infections, others)</td>
<td></td>
</tr>
<tr>
<td>Potential fire</td>
<td>Cranes, winches, hoisting and handling equipment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor illumination</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazards substances and wastes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asbestos fibres, dusts</td>
<td>PCBs and polyvinyl chloride (PVC) (combustion products)</td>
<td>Repetitive strain, awkward postures, repetitive and monotonous work, excessive workload</td>
<td>Mental stress, anti-social behaviour (aggressive behaviour, alcohol and drug abuse, violence)</td>
<td></td>
</tr>
<tr>
<td>Heavy and toxic metals (lead, mercury, cadmium, copper, zinc, etc.)</td>
<td>Welding fumes</td>
<td>Long working hours, shift work, night work, temporary employment</td>
<td>Poverty, low wages, under-age workers, lack of education and social environment</td>
<td></td>
</tr>
<tr>
<td>Organometallic substances (thiobutylin, etc.)</td>
<td>Volatile organic compounds (solvents)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of hazard communication (storage, labelling, material safety data sheets)</td>
<td>Inhalation in confined and enclosed spaces</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Batteries, fire-fighting liquids</td>
<td>Compressed gas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical hazards</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise</td>
<td>Vibration</td>
<td>Lack of safety and health training</td>
<td>Inadequate accident prevention and inspection</td>
<td></td>
</tr>
<tr>
<td>Extreme temperatures</td>
<td>Radiation (ultraviolet, radioactive materials)</td>
<td>Poor work organization</td>
<td>Inadequate emergency, first-aid and rescue facilities</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inadequate housing and sanitation</td>
<td>Lack of medical facilities and social protection</td>
<td></td>
</tr>
</tbody>
</table>

Despite the publication of the ILO guidelines, the working conditions in South Asian ship recycling yards have not yet been dramatically improved. There are some relevant observations provided from field investigations by experts in India and Bangladesh.

When Professor Okechukwu Ibeanu, the United Nations Special Rapporteur, observed ship breaking yards in Alang, India in January 2010, most facilities utilized gravity in an extremely dangerous and uncontrollable way to scrap ships. Training for workers was inadequate or non-existent. Improperly skilled workers lived in makeshift facilities which lacked essential sanitation facilities, electricity and safe water for drinking.

There is still no facility which allows emergency vehicles to access all working areas. Furthermore, only four medical doctors are responsible for caring for 30,000 workers in the Alang Red Cross facility (Lloyd’s Register, 2010).

The visit of Lloyd’s Register to Bangladesh in January 2008, as part of the United Nations Environmental Programme (UNEP) initiative on the improvement of the world ship breaking standards, revealed that the situation around the working conditions there was still a serious cause for concern. Most workers were barefoot, carrying steel plates to large trucks, climbing up steel piled up high, walking in mud. The breaking activities were disorganized and confusing. There were very few precautions which could be seen for workers. Workers were washing in dirty pools or puddles (Lloyd’s Register, 2011).

3.5. Causes of substandard operations in South Asian ship recycling yards

A lot of disadvantaged people, especially migrants from poor villages, living in South Asian countries have no choice but to join the recycling of ships whether it abuses their human rights and has serious risks to their safety and health or not, since they hardly get an alternative job (NGO Platform, 2009; Puthucherril, 2010). So the
yards can easily employ a number of cheap workers, which results in minimizing the operation costs, in turn, maximizing the profits.

In addition, there is still strong demand for steel plates and other reusable materials extracted from scrapped ships for continuous economic development (Puthucherril, 2010). Moreover, these countries have not yet ratified some ILO Conventions relevant to working conditions as shown in Table 5 (ILO, 2012).

These conditions might encourage these countries not to stop or strictly regulate the primitive operation of ship recycling yards according to environmental and labor laws. Even when there are some common national laws applicable to this industry, they are not proactively enforced. Moreover, the absence of accurate and reliable statistics on accidental deaths and injuries indicates the yards’ ignorance of workers’ occupational safety and health, and makes it difficult to assess to what extent the beaching method is linked to them (NGO Platform, 2009).

Consequently, shipowners and ship recycling yards can avoid their responsibilities to ensure the occupational safety and health of workers in the yards and to preserve the environment. Furthermore, since they are not liable for any damage caused by their ship recycling activities, they are unlikely to make a substantial investment in technical development to achieve safe and environmentally sound ship recycling (Puthucherril, 2010).

Table 5 – Ratification status of major ILO Conventions in Bangladesh, India and Pakistan, as of 1 September 2012

<table>
<thead>
<tr>
<th>Convention number and title</th>
<th>Bangladesh</th>
<th>India</th>
<th>Pakistan</th>
</tr>
</thead>
<tbody>
<tr>
<td>C081 Labour Inspection</td>
<td>X</td>
<td>X (excl. Part II*)</td>
<td>X</td>
</tr>
<tr>
<td>C087 Freedom of Association and Protection of the Right to Organise</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C095 Protection of Wages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C138 Minimum Age</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C155 Occupational Safety and Health</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>C182 Worst Forms of Child Labour</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

As at 1 September 2012

C081 Part II: Labour inspection in commerce

<table>
<thead>
<tr>
<th>Convention number and title</th>
<th>Bangladesh</th>
<th>India</th>
<th>Pakistan</th>
</tr>
</thead>
<tbody>
<tr>
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<td>X</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>C155 Occupational Safety and Health</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>C182 Worst Forms of Child Labour</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

X: ratified

3.6. Summary and remarks

Ship recycling activities using the beaching method have serious impacts on workers’ safety and health as well as the environment. Shipbreakers in South Asian ship recycling yards tend to lack training and PPE; which results in exposure to harmful substances such as asbestos, heavy metals, TBT, PCBs and oils extracted from scrapped ships and to accident hazards such as explosion, falling, fire and suffocation. On the other hand, the inadequate management and disposal of hazardous materials during and after ship breaking causes the severe contamination of soils, groundwater, coastal waters and the air around the sites.

In Bangladesh and Pakistan, considerable amounts of hazardous materials remain at the ship recycling yards and in the beach sediments due to the lack of disposal facilities for such wastes. While steel plates with toxic paints extracted from scrapped ships cause air pollution during the re-rolling process, other materials and equipment reused or resold without eliminating harmful contaminants have serious adverse effects on the health of people living outside the yards.

In contrast, the ship recycling industry in India has waste disposal facilities authorized by the State although the basic material flow is almost the same as that of Bangladesh and Pakistan. There still exist some risks of secondary pollution caused by reused or resold goods. However, a large amount of hazardous wastes are considered to be properly removed and disposed of by authorized waste disposal facilities.

The main causes of these substandard operations in South Asian ship recycling yards are:

- The yard companies’ tendency to seek cheaper labor costs and larger profits;
- The strong demand for recycled steel plates, materials and equipment to support their business; and
- The lack of strict environmental and labor regulations or their weak enforcement.
Nonetheless, a lot of positive changes have recently been brought about in the ship recycling industry on the Indian subcontinent. In Bangladesh, in particular, the Ship Breaking and Recycling Rules (2011) (SBRR) were enacted in December 2011. The SBRR strictly regulate the industry under the auspices of the Ship Building and Ship Recycling Board (SBSRB) under the Ministry of Industries so as to ensure safe and environmentally sound ship recycling. This eventually led to the development of infrastructures such as on-site disposal facilities and medical centers as well as the reformation of labor management schemes in the majority of ship recycling yards there (Shameem, 2012). Although training materials and human resources such as trainers and doctors are still insufficient to cover all workers, these changes are an important first step toward the reformation of the industry’s conditions.

Positive local efforts such as the case in Bangladesh would be a significant basis for the industry’s reformation. In order to further facilitate the reconstruction of the entire industry structure in a safer and cleaner way, strong incentives to confront the issues must be given to substandard ship recycling yards, governments responsible for managing them, and shipowners selling their ships at a good price. The early entry into force of the Hong Kong Convention and the enforcement of the Basel Convention could be the significant basis of such incentives.
CHAPTER IV    KEY REGIONAL EFFORTS TO REFORM THE SHIP RECYCLING INDUSTRY

In this chapter, the European Union’s actions on ship recycling issues and the current approaches to the domestic ship recycling industry in advanced leading countries, namely China and Turkey, will be discussed. They are considered to be the key regional efforts, other than those in the Indian subcontinent, to achieve the reformation of the ship recycling industry.

4.1. The European Union

In 2011, the size of the merchant fleet flying the European Union (EU) members’ flags was about 287 million deadweight tons (DWT) equivalent to about 20.6% of the world total (about 1,396 million DWT) (UNCTAD, 2012). Moreover, only about 10% of EU-flagged ships were recycled within OECD countries in 2009, and most of the rest were sent to major ship recycling countries in the Indian subcontinent (McCarthy, 2012). Thus, the control of EU-flagged ships destined for recycling under the EU legislations would largely impact on the ship recycling.

The EU has the Waste Shipment Regulation\(^82\) established for implementing the requirements of the Basel Convention and the provisions of the ban amendment. This regulation puts emphasis on the necessity to “ensure the safe and environmentally sound management of ship dismantling in order to protect human health and the environment” and recalls the collaborative efforts of the ILO, IMO and the Secretariat of the Basel Convention to make mandatory international regulations to solve the problems of ship breaking efficiently and effectively.\(^83\) It prohibits EU-

\(^{83}\) Ibid., preamble (35).
flagged vessels from being dismantled outside the OECD countries since they are classified as hazardous waste under the Regulation.

In spite of the Regulation, owners of EU-flagged ships are still likely to circumvent it and send their obsolete ships to South Asian countries. There are several reasons for them to behave like that.

Firstly, as is the case in the Basel Convention, it is quite difficult or impossible to apply the Waste Shipment Regulation to an EU-flagged ship destined for recycling due to the difficulty in identifying the shipowner’s intention to dispose of it and the possibility for it to change its flag just before recycling. Thus, shipowners can easily avoid the enforcement of the regulation.

Another reason is that the OECD countries lack facilities to recycle enough ships to cover all EU-flagged ships. The existing shipbreaking capacity in the EU is 0.2 million light displacement tons (LDT) per year, which is only about 12% of the estimated annual volume of EU flagged ships destined for scrapping (1.64 million LDT) from 2012 to 2030.

Moreover, most of the shipbreaking yards in the EU are not adapted to VLCC and ULCC class vessels, and focus on dismantling navy ships, other government-owned ships and small vessels such as fishery boats (European Commission, 2012a).

Considering these problems and following the adoption of the Hong Kong Convention, the European Commission proposed in March 2012 a new regulation on ship recycling (hereinafter referred to as “Ship Recycling Regulation”) to reduce the adverse impacts caused by recycling EU-flagged vessels and implement the requirements under the Hong Kong Convention before its entry into force (European Commission, 2012b).

The Ship Recycling Regulation covers the entire life time of EU-flagged vessels, implements some requirements prescribed under the Hong Kong Convention and incorporates more strict environmental regulations as endorsed under Article 1,
paragraph 2 of the Convention. In order to avoid overlapping of regulatory regimes with the same objectives, ships destined for recycling covered by the Ship Recycling Regulation are exempted from the application of the Waste Shipment Regulation. The Ship Recycling Regulation contains the following EU-specific provisions.

- All hazardous wastes have to be managed following the ESM both in ship recycling yards and waste disposal facilities.
- EU-flagged ships must be scrapped in ship recycling facilities included in a European list to ensure safe and environmentally sound recycling.
- Ship recycling facilities outside the OECD member countries are allowed to recycle EU-flagged ships, providing that they conform to the requirements of the Regulation and are included in the European list.
- EU member states shall be notified of a shipowner’s intention to dispose of a ship and informed of the planned schedule including the start and end of recycling.
- Dissuasive penalties will be imposed on shipowners who breach the requirements of the Regulation; especially in case that a ship destined for recycling is sold and sent to a recycling yard within six months after the sale, the penalties shall be imposed on the penultimate owner of the ship.

The first two provisions will contribute to ensuring more strict control of the recycling process and accurate detection of illegal exports of obsolete ships. The third provision is to set an alternative solution to the problem of the limitation of scrapping capacity in OECD countries. Consequently, it will leave the possibility that current leading nations in the Indian subcontinent can continue their ship recycling industry after successful reformations in compliance with the Hong Kong Convention and the Ship Recycling Regulation. The last two provisions are intended

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84 Article 1, paragraph 2 – “No provision of this Convention shall be interpreted as preventing a Party from taking, individually or jointly, more stringent measures consistent with international law, with respect to the safe and environmentally sound recycling of ships, in order to prevent, reduce or minimize any adverse effects on human health and the environment.”
to properly identify when ships become waste and discourage shipowners from reflagging their ships before recycling.

Now this proposal is under consideration, and there is an argument that more strict measures should be taken such as regulating all ships entering EU waters instead of only EU-flagged vessels (McCarthy, 2012). However, it could be said that, if the original provisions remain without substantial changes, the Ship Recycling Regulation will facilitate the application of the Basel Convention to the ship recycling industry and the development of a safe and environmentally sound industry under the Hong Kong Convention, without ignoring the future improvements of substandard yards in the Indian subcontinent.

On the other hand, it is not only the European Union that is promoting safer and greener ship recycling processes. Several industrialized countries have so far developed their own advanced ship recycling systems with high-quality standards. In this regard, two countries are particularly worthy of being investigated because they created their own standards focusing on specific demands based on their locations and high level of performance.

4.2. Advanced leading country: China

China was at one time the number one shipbreaking country. This country was scrapping almost half of all sea-going ships (Puthucherril, 2010). Even now the ship scrapping capacity of China is very large in volume; for instance, shipbreaking yards in China demolished ships of combined 4.72 million GT equal to 25.3 percent of the world total scrapped volume in 2010 (IHS Fairplay, 2011). Ship recycling yards are located mainly in Jiangsu, Fujian and Guangdong provinces (Puthucherril, 2010).

In addition to the capacity, the ship recycling industry in China is developing its capability at a rapid pace. Firstly, environmental concerns related to the industry led to the adoption of strict regulatory systems (Puthucherril, 2010). The recycling
process in the yards is fully managed both onboard ships and in land facilities. The Chinese government strictly controls the yards, whereas the local authorities place them under strong supervision. Under these regulatory regimes, workers’ safety, welfare and environmental issues are very well considered (Lloyd’s Register, 2011). Second, since the beaching method is prohibited by the regulations, the ship recycling yards mainly practice the afloat method (Figure 6), where ships are dismantled alongside a pier (Lloyd’s Register, 2011). They also receive the benefits of a high-level infrastructure based on substantial investment. For example, a ship recycling facility in Guangzhou operates a dedicated plant for removing paints from scrapped steels (Lloyd’s Register, 2011). Thirdly, they attain their high quality standards thanks to remarkable cooperation and participation of ship owners or owners’ associations (Lloyd’s Register, 2011).

Figure 6 – The afloat method

Furthermore, major Chinese yards\textsuperscript{85} were certified by the International Ship Recycling Association (ISRA) and adopted its guidelines, while ship recycling countries in the Indian subcontinent were not attracted by the ISRA (Grinter, 2009; Lloyd’s Register, 2011). The ISRA was established in 2007 as a platform for ship recycling yards which have high quality standards. It could be the most important land mark for achieving safe and environmentally sound recycling of ships (Grinter, 2009).

As remarked above, the ship recycling practices in China are better than those in the Indian subcontinent due to their advanced infrastructures and environmentally friendly recycling methods (Puthucherril, 2010). These practices will be a substantial basis for China’s early ratification of the Hong Kong Convention and its subsequent leadership in the ship recycling industry.

On the other hand, the recent trend of ship demolition price shows that China cannot offer higher prices than major ship recycling countries in the Indian subcontinent regardless of any change in the market condition (Figure 7). This trend is considered to be generated mainly because of the difference in demolition costs between China and the Indian subcontinent. Although both regions currently have strong demands for recycled steels due to their expanding economies, China has to bear higher costs for practicing green ship recycling than countries in the Indian subcontinent (“Downwards price,” 2012).

However, no country can compete with China in terms of the balance among purchase price, capacity and quality at this time (Lloyd’s Register, 2011). Thus, responsible shipowners are likely to have a preference for the yards in China (Puthucherril, 2010). China will probably be a candidate to achieve a sustainable ship recycling industry while keeping its large scale, and can show how responsible ship recycling should be done (Grinter, 2009).

\textsuperscript{85} Five yards belong to the ISRA as of 1 September 2012 according to the ISRA web site: http://www.isranetwork.com/
Figure 7 – Recent demolition prices in China and the Indian subcontinent

Source: Downwards price correction looms but how far will demolition rates fall? (2012, March 8). Lloyd’s List, p.7.

4.3. Advanced leading country: Turkey

In the early 1970s, Turkey regarded ship recycling as a significant industry and established ship recycling yards in Aliaga, Izmir. Throughout the legalization process of the industry over a decade, Turkey achieved the world’s third largest ship recycling volume by the late 1980s (Puthucherril, 2010).

Although Turkey is a member of the OECD, it was once regarded as a place for dumping ships involving hazardous materials by other OECD members (Puthucherril, 2010). A study by Greenpeace in 2002 criticized that Turkey’s shipbreaking industry was severely contaminating the marine environment and disregarding the occupational safety of the yards (Puthucherril, 2010). Accordingly, several ship recycling yards in Aliaga successfully reformed their conditions in a safe and environmentally sound way, while some of them obtained an international certificate for environmental and occupational health (Puthucherril, 2010).
Currently, about twenty ship recycling facilities operate on the west coast in Aliaga, scrapping ships of 0.658 million GT, 3.52 percent of the world total recycling volume in 2010 (IHS Fairplay, 2011). No yard is allowed to operate outside Aliaga. These geographical and political features enable Turkey to unify the management of its ship recycling industry (Lloyd’s Register, 2011). In addition, the location of the yards is an advantageous spot that the EU countries and the Middle East can easily access (Puthucherril, 2010).

Due to its small tidal range (about 60 cm at a maximum), the yards in Aliaga can take control of the inter-tidal zone (Lloyd’s Register, 2011). So, Turkish ship recycling yards are practicing the afloat method like Chinese yards or the landing method (Figure 8) which decreases environmental contamination risks (Puthucherril, 2010; Senturk, 2012). Major features of the landing method are as follows (Lloyd’s Register, 2011).

- Wide areas in the yards are concreted with a sufficient depth to prevent the marine pollution.
- Ships are cut into small pieces by cranes, instead of removed big sections being dropped under gravity.
- Access to ships on shore stays unchanged due to the small tidal range, which allows emergency vehicles to reach the demolishing site.
- Moreover, the yards are urged to set up fire control equipment all around them.86

86 It is impossible for the ship recycling yards in the Indian subcontinent to do the same, because they operate on the wide inter-tidal mudflat zones.
In addition, the ship recycling yards in Turkey are placed under the strict scrutiny of responsible stakeholders and specialists including shipowners, classification societies and European countries. Under the regimes, they are proactively trying to further improve their conditions and achieve a reasonable way of recycling ships, confronting their competitiveness in costs (Lloyd’s Register, 2011).

Turkey cannot offer higher prices for ships destined for scrapping than countries in the Indian subcontinent because of the difference in demolition costs similar to the case in China. Therefore, it has not been able to achieve a demolition volume equal to its actual capacity, like the cases of other OECD countries (Puthucherril, 2010).
However, Turkey has competitiveness in terms of responsible ship recycling due to its strict regulations, advanced protection for workers’ safety, highly mechanized processes, and its status as an OECD member (Puthucherril, 2010). In fact, Turkey is keeping a reasonable balance among several factors of the industry such as the requirements on transboundary movements of toxic ships under the EU regulations, other relevant legal compliance, infrastructural investments, and standards for safety, welfare and the environment (Lloyd’s Register, 2011). Furthermore, the Turkish yards keep shipowners’ deep commitment to their activities for building trust (Lloyd’s Register, 2011). So even though they cannot offer higher prices than the market-leading yards in the Indian subcontinent, they are preferred by responsible shipowners (Lloyd’s Register, 2011).

There are several elements which would be driving forces for Turkey to succeed in leading the future ship recycling market with high quality standards and substantial recycling volume, as follows.

- The active involvement of the Turkish government in developing green ship recycling would be a strong impetus for further enhancement of the domestic industry (“Scrappers blaze,” 2011).
- Turkey is the first country among the industry-leading five nations to sign the Hong Kong Convention. It has proactively contributed to the IMO’s development of the Convention, demonstrating its strong commitment to achieving safe and environmentally sound ship recycling (“Scrappers blaze,” 2011).
- Since the main targets of Turkish yards are EU-flagged vessels, they could join the research programs funded by the EC to find a safe and economical way of recycling (“Scrappers blaze,” 2011).
Like the case in China, several Turkish ship recycling yards have joined the ISRA\(^87\) in order to properly satisfy the requirements for safe and environmentally sound ship recycling under the Hong Kong Convention (“Scrappers blaze,” 2011).

### 4.4. Summary and remarks

To sum up, China and Turkey as advanced leading nations in the ship recycling industry, among others, will achieve the reformation of the domestic ship recycling industry conforming to the requirements under the Hong Kong Convention in a relatively short period. Turkey should probably be the first country to reach these requirements because it already signed the Convention and is under the scrutiny of the EU.

Meanwhile, the successful implementation and enforcement of the Ship Recycling Regulation in the EU will facilitate the shift of ship recycling volume from the Indian subcontinent to China and Turkey, leaving the possibility of continuous business in the Indian subcontinent as well.

In addition, it is estimated that 1.6 million LDT of EU-flagged vessels will need to be scrapped every year until 2030 (McCarthy, 2012). Assuming that the demand of demolishing ships is proportional to the total deadweight tonnage of the merchant fleet, 6.4 million LDT of ships flying flags of non-EU countries will be destined for recycling each year until 2030.\(^88\) Thus, ships equivalent to 8.0 million LDT are estimated to be dismantled each year until 2030.

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\(^87\) Three yards belong to the ISRA as of 1 September 2012 according to the ISRA web site: http://www.isranetwork.com/

\(^88\) Since EU-flagged ships are occupying 20% of the world merchant fleet (DWT), the estimated demand of scrapping ships flying flags of non-EU countries can be four times (80%) as much as that of EU-flagged ships.
However, since the current ship recycling capacity of China and Turkey are 4.0-5.0 million LDT and 0.9 million LDT respectively (total 4.9-5.9 million LDT), they cannot cover the whole demand for ship scrapping (“Calls for China,” 2012; “Business is booming,” 2012). Accordingly, the rest of the demand, about 2.1-3.1 million LDT, must be satisfied by ship recycling yards in other OECD countries or the South Asian countries. Therefore, it would be reasonable to take a “bipolar” approach to building ship recycling capacity and capability in these two regions.

Furthermore, China and Turkey are targeting a specific segment of the ship recycling market which is not dominated by profit but by high-quality processes. In the context of such a variety of shipbreaking market segments, industrial innovations to change the market and new players can be expected in the future ship recycling industry.

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89 China will expand its ship recycling capacity by about 1.0 million LDT until the end of 2012 by developing dedicated facilities in Dalian Shipbuilding Industry Co and China Shipbuilding Industry Co.
CHAPTER V  JAPAN’S CONTRIBUTIONS TO REFORMING THE SHIP RECYCLING INDUSTRY

Previous chapters introduced and analyzed the existing regulatory regimes and the current industry conditions and challenges in major ship recycling countries. This chapter will show the relevance of Japan in the ship recycling industry and how it will contribute to accomplishing the reformation of the industry in a safe and environmentally sound manner under these regimes and conditions.

5.1. Why is Japan relevant to ship recycling issues?

The amount of seaborne trade is almost directly influenced by the situation of the world economy. During the past half century, the rapid growth of industrial economies in Europe and Japan from 1960 to 1970 dramatically increased the seaborne trade by strong demand for raw materials such as iron ore. Subsequently, from the early 1990s, South Korea and other Asian countries followed the same growth pattern causing further increase in the amount of sea trade (Figure 9) (Stopford, 2009).

In the recent decade, the dramatic growth in China’s industrial economy has led to continuous record breaking in the size of the commercial shipping fleet in the world, as it reached 103,392 commercial vessels with 1,396 million DWT in January 2011 (Figure 10) (UNCTAD, 2011). Among these fleets, Japan controlled the world second-largest commercial fleet as of 1 January 2011, recording 3,795 vessels and about 197 million DWT equivalent to about 15.8 % of the world total DWT (Table 6).
Figure 9 – Regional seaborne trade development cycles, 1950 – 2005

Figure 10 – World fleet by principal vessel types, selected years (beginning-of-year figures, million DWT)
Table 6 – The 10 countries and territories with the largest owned fleets (dwt), as of 1 January 2011

<table>
<thead>
<tr>
<th>Country or territory of ownership</th>
<th>Number of vessels</th>
<th>Deedwight tonnage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>National flag</td>
<td>Foreign flag</td>
</tr>
<tr>
<td>Greece</td>
<td>758</td>
<td>2,455</td>
</tr>
<tr>
<td>Japan</td>
<td>724</td>
<td>3,074</td>
</tr>
<tr>
<td>Germany</td>
<td>442</td>
<td>3,356</td>
</tr>
<tr>
<td>China</td>
<td>2,044</td>
<td>1,607</td>
</tr>
<tr>
<td>Republic of Korea</td>
<td>738</td>
<td>453</td>
</tr>
<tr>
<td>United States</td>
<td>971</td>
<td>1,001</td>
</tr>
<tr>
<td>Norway</td>
<td>818</td>
<td>1,152</td>
</tr>
<tr>
<td>China, Hong Kong SAR</td>
<td>399</td>
<td>313</td>
</tr>
<tr>
<td>Denmark</td>
<td>393</td>
<td>592</td>
</tr>
<tr>
<td>China, Taiwan Province of</td>
<td>97</td>
<td>565</td>
</tr>
</tbody>
</table>


On the other hand, the domestic commercial shipping industry in Japan has about 5,400 vessels equivalent to about 3.5 million GT (Maritime Bureau, 2012). Most of the domestic commercial ships have been sold as second hand ones to South East Asian countries, and those which are operating now are expected to be sold in the same way (Maritime Bureau, 2009).

Furthermore, in the shipbuilding industry, Japan has been the number one shipbuilding country for a long time until South Korea took over the number one position around the year 2000. Even though China further overtook these two countries due to the dramatic increase and growth of shipbuilding companies, Japan is still now maintaining the third-largest amount of new ship building in the world, recording about 19.4 million GT equal to 19.1% of the world total 101.5 million GT in 2011 (Figure 11). This strong competitiveness in the shipbuilding industry is supported by high level of technology, productivity, R&D sensitive to supply and demand, and human resources under the accumulated industry structure (in Japan called “Maritime Industrial Cluster”) which contains numerous shipbuilding, ship machinery and shipping companies within the country (Maritime Bureau, 2012).
Considering these facts, it could be said that Japan has been playing key roles in the “building” and “operation” phases of ships. Since ship recycling issues are closely linked to ships’ entire lifetime as introduced in the previous chapters, Japan, as a key player in all phases leading to the recycling of ships, is considered to be highly responsible for addressing the issues related to their “recycling” phase in a safe and environmentally friendly manner. In addition, “Maritime Industry Cluster” supporting Japan’s competitiveness in shipbuilding will also be able to provide a platform for creating a new ship recycling industry with a lot of innovations in Japan.

5.2. Japan’s fundamental policies on ship recycling

Taking into consideration the current conditions of the ship recycling industry (Chapter III), the Japanese government is convinced that governments and private sectors must cooperate together, and all the relevant stakeholders have to address the ship recycling issues with a clear assignment of their respective roles (Maritime
Bureau, 2009). In accordance with this basis, Japan has implemented fundamental policies for achieving sustainable, safe and environmentally sound ship recycling in the world, consisting of short-term policies which show necessary achievements during the transitional period until the entry into force of the Hong Kong Convention and medium- and long- term policies that need a relatively longer time to be addressed, as summarized in Figure 12 (Maritime Bureau, 2009).

5.2.1. Short-term policies

In order to achieve safe and green ship recycling and ensure sufficient recycling capacity in the world, Japan has been promoting several short-term policies such as: making and promulgating international legislation; preparing the national laws and systems for implementing the requirements of the Convention in cooperation; and upgrading present ship recycling yards in the world so that they satisfy the requirements of the Convention. The respective policies are shown in detail below.

**Development of international regulatory regimes and domestic legislation**

Considering its responsible position regarding the ship recycling industry, Japan has so far proactively contributed to drafting the Hong Kong Convention and the relevant guidelines in the IMO MEPC. It is still trying to carry out its responsibility for promulgating the Convention and guidelines in cooperation with other responsible nations and relevant organizations to accomplish early entry into force of the Convention (Maritime Bureau, 2009).

Since not only the European countries sensitive to environmental issues but also all the major ship recycling countries are currently interested in ratifying the Hong Kong Convention, it is expected to enter into force faster than the previous Conventions. So the Japanese government itself is now in a hurry to ratify the Convention and create relevant national laws and ordinances (Maritime Bureau, 2009).
Figure 12 – Summary of Japan’s fundamental policies on ship recycling

Entry into force of the HKC

Short-term

- Prepare national enforcement: Legislation / IHM control system
- Support existing recycling yards in Japan and foreign countries
- Develop a new ship recycling method

Medium- and long-term

- Popularize the method for constructing a new industry in Japan

Promote 3R: “Reduce” “Reuse” “Recycle”

Reuse
- Minimize hazardous materials in ships/ship machineries
- Downsize ship machineries and reduce their weight

Reuse & Recycle
- Design ship structures/equipment for easy disassembling
- Control info on reusable and recyclable materials on board
Preparation of systems for maintaining the IHM of new and existing ships

In order to smoothly enforce the upcoming new regulations, specifically the obligation to control the IHM of new and existing ships, the entire process should be examined by the parties involved to find necessary resources and prepare reasonable systems.

New ships shall have their IHM on board from the start of operation. According to the Guidelines for the Development of the Inventory of Hazardous Materials (IHM Guidelines)\(^90\) adopted by the IMO, Shipbuilders must collect Material Declaration (MD) and Supplier’s Declaration of Conformity (SDoC) from all suppliers which provide products on board, and fill out Part I of the IHM based on the collected MDs. The MD provides information about hazardous materials contained in the product over the threshold prescribed in the IHM Guidelines. The SDoC clarifies the supplier’s responsibility for the MD (Figure 13).

![Development process of Part I of the IHM for new ships](image)

Figure 13 – Development process of Part I of the IHM for new ships


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\(^90\) The IHM Guidelines proposed jointly by Japan and Germany at the MEPC 55 in October 2006 were adopted by the MEPC 59 in July 2009, and revised by the MEPC 62 in July 2011 (Imade, 2011, Naruse, *et al.*, 2010).
On the other hand, existing ships, in principle, must develop their IHM within 5 years after the entry into force of the Convention. In accordance with the IHM Guidelines, Part I of the IHM shall be prepared by third party experts based on an inspection on board including visual and sampling checks (Figure 14).

**Figure 14 – Development process of Part I of the IHM for existing ships**


Considering these requirements for new and existing ships, Nippon Kaiji Kyokai (ClassNK) – the Japanese classification society – has conducted a lot of trial experiments (for about 100 existing ships and about 30 new ships) to develop the IHM so as to clearly articulate the necessary human resources, period of time and costs required (Takano, 2011). As a result, the following measures were revealed to be necessary before the entry into force of the Hong Kong Convention (ClassNK, 2012b; Maritime Bureau, 2009).

- To ensure a sufficient number of experts who can prepare Part I of the IHM of existing ships within 5 years after the entry into force of the Convention;
- To create a system of issuing a Statement of Compliance (SOC) with the Hong Kong Convention, which can be replaced with a conventional certificate, both in the government and its authorized class societies to avoid
intensive demands for the IHM development prior to the enforcement of the Convention; and

- To develop and popularize a common software with standard information formats to assist shipbuilders and suppliers to generate IHMs and MDs electronically and reduce their work loads and costs.
- To create an integrated data base of hazardous materials for their accurate detection and examination in existing ships;
- To ensure international cooperation regarding IHM developing systems in consideration of the global industry structure;

In response to these necessary measures, ClassNK currently offers the following services and software (ClassNK, 2012b, Takano, 2011).

- Introduction of third party experts to shipowners;
- Establishment of a global network of experts who can prepare Part I of the IHM;
- Provision of consultation for shipowners regarding the development of the IHM;
- Issuance of an SOF for Part I of the IHM before the entry into force of the Convention, and replacement of the Statement of Fact (SOF)91 with a certificate under the Convention;
- Popularization of the software for IHM development named “PrimeShip-INVENTORY” developed by ClassNK, which allows shipbuilders and suppliers to electronically exchange MD/SDoC data and automatically consolidate into the IHM (Figure 15), by distributing the software to parties interested without any charge and providing them with technical assistance; and

91 A SOF issued by ClassNK will be equivalent to a SOC issued by the government after it is authorized as a representative agency.
Research and development of a new web application named “PrimeShip-GREEN/SRM” based on the PrimeShip-INVENTORY, which can be used as a standard system for shipbuilders and suppliers all over the world to develop the IHM with cloud computing technology\(^92\) (Figure 16).

ClassNK has headquarters in Tokyo and Chiba, Japan, and has a lot of branch offices around the world (Figure 17) (ClassNK, 2012c). In addition, as of May 2012, 7,847 vessels equivalent to more than 200 million GT are registered in ClassNK, which covers about 20 percent of the world merchant fleet, the largest share in the world (Figure 18) (ClassNK, 2012c). Therefore, it is highly anticipated that the above efforts by ClassNK in cooperation with the relevant stakeholders will globally contribute to smoothly preparing for the enforcement of the Hong Kong Convention and ensuring efficient systems to control the IHM of the world merchant fleet.

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Figure 15 – Concept of PrimeShip-INVENTORY


\(^{92}\) See “Cloud computing” in Appendix A (Glossary).
Figure 16 – Concept of PrimeShip-GREEN/SRM


Figure 17 – ClassNK world networks

Maintenance of ship recycling yards

If the requirements and norms under the Hong Kong Convention and its Guidelines are too strict, there is the possibility of generating a gap between the increasing demand of scrapping and the volume capacity of the world ship recycling yards conforming to the requirements. Thus, continuous assessment of the world’s recycling capacity and the level of safety and environmental risk in respective yards has been conducted as a basis to determine appropriate standards for ship recycling yards (Maritime Bureau, 2009).

In addition, there are some minor ship recycling yards which deal in public vessels and small merchant ships. So, proper guidance and support for complying with the Convention have been provided to these yards (Maritime Bureau, 2009).

Furthermore, Japan is currently taking the following “bipolar” approach (see 4.4) to ensure sufficient capacity and capability of the world ship recycling industry (Maritime Bureau, 2009).

- Assistance to foreign yards for compliance with the Hong Kong Convention
• Development of an industrialized ship recycling model covering large ocean-going vessels for Japanese yards

The focus of the first approach is currently set on a reconstruction project of ship recycling yards in Alang and Sosiya, India. On the other hand, the second approach has been taken with a pilot project to develop a new ship recycling method conducted in Muroran, Japan in 2009. These projects will be separately discussed in 5.3 and 5.4.

5.2.2. Medium- and long- term policies

In Japan, basic policies on waste disposal and recycling are being implemented in various domestic industries to establish a recycling-oriented society under the Basic Law for Establishing the Recycling-based Society (2000). The principle of these policies is “3R” which means “Reduce”, “Reuse” and “Recycle.” These 3R policies can also be applied to ships that have long lives over 20 years and contain valuable materials and equipment (Maritime Bureau, 2009).

In order to promote the 3R policies and enhance the levels of safety and environmental conservation in the ship recycling industry, all the relevant stakeholders should cooperate together throughout the lifecycle of ships; and implementation of the following medium- and long- term policies is necessary (Maritime Bureau, 2009).

Reduce:

• Shipbuilders and suppliers should reduce hazardous materials included in their products and replace them with substitutable safe materials as much as possible. In parallel, the government is requested to develop certain systems to incentivize these actions.
• For effective use of resources, downsizing and weight reduction of ship machinery should be promoted conforming to the safety and environmental criteria.

**Reuse and Recycle:**

• In order to efficiently reuse and recycle ship structures and equipment, they should be designed to make them easy to disassemble in consideration of work efficiency in the stages of disposal and recycling.

• As well as the case of the IHM, information on reusable and recyclable materials should be controlled to enable their efficient sorting in ship recycling yards.

In addition, the reconstruction of the domestic ship recycling industry will contribute not only to establishing a recycling-based society, but also to securing steel resources, generating employment and boosting local economies in Japan. Thus, the new ship recycling method to be developed in the pilot project should be practiced nationwide to ensure the reasonable capacity of the domestic ship recycling industry (Maritime Bureau, 2009).

The next two sections will show the “bipolar” approach to build the industry’s capacity and capability of the previously mentioned projects in Japan.
5.3. Project of reconstructing ship recycling yards in Gujarat State, India

5.3.1. Background

India is one of the major ship recycling countries as introduced in 1.1. Due to recent awareness of environmental and occupational safety and health issues related to ship recycling and the adoption of the Hong Kong Convention, it is now showing a positive interest in achieving safe and environmentally sound ship recycling at the initiative of the Gujarat Maritime Board (GMB) (METI, 2010). Although some yards have already started practicing green ship recycling by using advanced technologies in the Alang and Sosiya areas, there are still inappropriate industry conditions which are obstacles to compliance with the Convention as stated in Chapter III.

Considering the above, Japan decided to propose a project for reforming ship recycling yards in Alang and Sosiya (Figure 19). This project will be conducted by the GMB with the introduction and licensing of Japanese advanced technologies (METI, 2010).

![Location of the project of reforming ship recycling yards in Alang and Sosiya, India](image)

**Figure 19 – Location of the project of reforming ship recycling yards in Alang and Sosiya, India**

5.3.2. Project overview

The project is intended to achieve the following objectives:

- To construct a safe and environmentally sound ship recycling industry;
- To build technical capacities of existing yards and develop human resources;
- To modernize the recycling market of scrapped materials produced by ship recycling yards; and
- To pursue the sustainable operation of the ship recycling industry under cooperation between the public and private sectors, specifically involving Japanese and Indian companies (METI, 2010).

The project will be implemented by the GMB, and financed by yen loans subject to the use of Japanese technologies. The actual operation of the project is to be left to the private sectors in line with the project objectives. The following items are specifically on the agenda of the project (see also the project overview in Figure 20) (METI, 2010).

A. Reformation of existing ship recycle yards in compliance with the Hong Kong Convention;
B. Establishment of a common facility for disassembling hazardous materials (dry dock);
C. Construction of advanced electric furnaces for scrapped steels;
D. Modernization of the recycling market for disassembled materials and equipment; and
E. Capacity building of human resources
As described in Chapter III, the beaching method used by the yards in Alang and Sosiya has adverse impacts on the surrounding environment. Item A and B are designed to solve these environmental problems based on the requirements of the Hong Kong Convention (METI, 2010).

Scrapped steels brought to electric furnaces are known to be extremely high quality. So the project item C is intended to construct high-performance electric furnaces and the relevant steelmaking facilities so as to provide higher-grade recycled materials available for high-value added products (METI, 2010).
Recycled materials currently have various sizes and are not controlled in a standardized way. Therefore, it is considered necessary to modernize their recycling market by constructing new systems based on stock management and digitalization of sales network in order to address needs around the country (item D) (METI, 2010).

As for item E, training which applies the requirements of the Hong Kong Convention in advance, including the understanding of its contents and practical applications, will be provided to a wide range of persons from political and operational levels to yard and waste disposal engineers. The compliance of ship recyclers and workers in Alang and Sosiya regions with the Convention will be given priority, in parallel with the enhancement of workers’ technical skills (METI, 2010).

The budgetary plan and initial schedule of the project are shown in Table 7 and Figure 21 respectively. Here it is to be noted that the budget for item D and item E were not calculated since another plan similar to item D was under consideration in the framework of a national project; and item E is intended to be conducted on the basis of other international assistance schemes such as Japan International Cooperation Agency (JICA) training courses (METI, 2010).

Table 7 – Budgetary plan of the project of reforming ship recycling yards in Alang and Sosiya, India

<table>
<thead>
<tr>
<th>Component</th>
<th>Budget (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Reformation of existing ship recycle yards (80 yards)</td>
<td>37,836</td>
</tr>
<tr>
<td>Civil engineering works, supplementary facilities/equipment</td>
<td>19,683</td>
</tr>
<tr>
<td>Engineering and EIA (Environment Impact Assessment)</td>
<td>13,477</td>
</tr>
<tr>
<td>Surrounding infrastructure</td>
<td>4,676</td>
</tr>
<tr>
<td>B. Establishment of a common facility for disassembling hazardous materials (dry dock)</td>
<td>64,244</td>
</tr>
<tr>
<td>Civil engineering works</td>
<td>40,805</td>
</tr>
<tr>
<td>Supplementary equipment</td>
<td>22,786</td>
</tr>
<tr>
<td>Engineering</td>
<td>653</td>
</tr>
<tr>
<td>C. Construction of advanced electric furnaces for scrapped steels</td>
<td>287,581</td>
</tr>
<tr>
<td>Electric furnaces</td>
<td>215,983</td>
</tr>
<tr>
<td>Electric power facilities</td>
<td>50,000</td>
</tr>
<tr>
<td>Supplementary facilities/equipment</td>
<td>21,598</td>
</tr>
<tr>
<td>Total</td>
<td>389,661</td>
</tr>
</tbody>
</table>

5.3.3. Current status and further challenges

The latest plan of the project was not open to the public at this time. According to Dave (2012), Japan offered about $22.5 million in loans to initiate this project.

The GMB is showing a willingness to implement this project. However, ship recyclers at Alang are still less convinced of the project’s importance due to their long time experience with the beaching method, their recent compliance with the strict environmental rules by the Supreme Court under the monitoring scheme, and a high-cost “dry dock” method proposed by the project (Dave, 2012).

The Japanese government has to continuously seek their understanding of the necessity of the project in cooperation with the GMB. Otherwise, India would eventually face the worst case scenario where it loses its ship recycling business to a remarkable extent due to its less than eco-friendly conditions after the entry into force of the Hong Kong Convention.
5.4. Development of a new ship recycling method in Japan

5.4.1. Background

The ship recycling industry in Japan once grew up to be the biggest in the world due to a strong demand for steel in the 1950s – 1960s, just after World War II. In addition, the world shipping decline and the subsequent shipbuilding industry downtown from the late 1970s prompted shipbuilders to break excess merchant vessels and simultaneously create jobs (METI, 2010).

However, Japan’s ship recycling industry gradually declined along with the decrease of steel demand and the increase of labor costs based on the economic growth of Japan as well as the tightening of environmental regulations. Although some small recyclers still now break government ships, small domestic vessels and fishing boats or dispose of industrial wastes from other industries, there are very few professional companies that can recycle bigger ships by using a pier or dock (METI, 2010).

Taking into account the possibility of increased demand for ship recycling in the near future and the responsibility of Japan as a major maritime power, the Muroran Ship Recycling Study Group (MSRSG) which aims for the establishment of a new domestic ship recycling industry was initiated at the city of Muroran, Hokkaido, Japan in 2008. The MSRSG consists of various stakeholders such as national/local governments, shipbuilders, steelworks, heavy-equipment manufacturers, and research institutions.93 led by the chairman, Dr. Kazumichi Shimizu, Muroran Institute of Technology (MSRSG, 2010).

In 2010, the MSRSG conducted an initial pilot project including a demonstration test of green ship recycling in compliance with the Hong Kong Convention and the research and development of new shipbreaking techniques. The overview and results of the project and the MSRSG’s recent progress following the project will be discussed here (MSRSG, 2010).

93 See Appendix C for the member list.
5.4.2. Contents of the pilot project

This pilot project consists of the following contents.

- The PCC demolition experiment in compliance with the requirements of the Hong Kong Convention;
- The development of a new technology for ship recycling (water jet cutting machine);
- The research on recycling of extracted materials;
- The research on elimination of hazards of extracted materials;
- The environment impact assessment of the demolition; and
- The feasibility study.

The project was collaboratively conducted mainly by the MSRS members under the implementation structure shown in Figure 22.

Since this pilot project shows reasonable approaches to seek a possible style of future ship recycling yards in Japan, the contents of the project will be introduced in detail. All the contents in this section refer to the pilot project report, MSRS (2010).
Figure 22 – The implementation structure of the pilot project

5.4.2.1. Experiment of recycling a large vessel

In this section, the preparation of the experiment, the demolition experiment (method, process and personnel), the occupational safety and health, the waste stream management, the demolition techniques, and the environment protection measures of the experiment will be explained.

Preparation for a demonstration experiment of recycling a large vessel

In order to conduct the demonstration experiment, 45,706 GT Pure Car Carrier (PCC) “NEW YORK HIGHWAY” (Figure 23) was procured for scrapping from Kawasaki Kisen Kaisha, Ltd. (K-LINE).

The experiment site was explored through much consultation with the city of Muroran so as to ensure safe berthing and dismantling operation. As a result, the city of Muroran lent No.2 pier in the West of Muroran Port for the site (Figure 24).

Then, the IHM was finalized; and the SRFP and SRP were developed to demonstrate the compliance with the requirements of the Hong Kong Convention. ClassNK examined the finalized IHM and issued the SOF to be replaced with a conventional certificate.

It should be noted that “New York Highway” was operated as a chartered ship “Morning Sapphire” by Taiyo Nippon Kisen Co., Ltd. just before being dismantled. The ship was renamed to “New York Highway” as a K-LINE vessel for recycling. The IHM developed before the renaming was ultimately authorized by ClassNK without any arrangement.

94 See Appendix D for the detailed specification of the ship.
95 See Appendix E for the experiment site layout.
96 See Appendix F for the SOF issued by ClassNK.
Figure 23 – M.S. “NEW YORK HIGHWAY”


Figure 24 – Experiment site of the Muroran pilot project

Experiment of recycling a PCC

Here the specification of the PCC demolition experiment is introduced in terms of method, process and human resources.

Demolition method and process

The experiment was conducted from 9 March 2010 to 30 September 2010 (total 206 days) excluding temporal, preliminary and site restoration works. In this experiment, the afloat method was adopted. The primary cutting was carried out by a 200t-crawler crane from the land side, and by a 120t-floating crane from the sea side (Figure 25). The ship was dismantled in order of upper structures, engine chamber, fore side, aft side and central hulls. The whole work procedure and the time spent on each process are shown in Figure 26.

Figure 25 – Primary cutting by the afloat method

Figure 26 – Work procedure and time of the experiment


**Personnel for the demolition works**

The main demolition works were conducted by 35 workers from TERAOKA Co., Ltd., one of the MSRSG member companies, where 15 – 23 of the workers were allocated to the demolition work based on the volume of work. These workers were all properly trained and/or qualified depending on their responsible tasks, acquiring national certificates as necessary. The number of workers by type of work is shown in Table 8.

In addition, some demolition works and industrial waste disposal works such as waste removal of the accommodation interior, extraction of residual oils, and

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97 TERAOKA Co., Ltd. deals in hull blocks and hull assembly, cell guide for container ships, workshops and barges, design and construction of steel structures, asbestos scattering protection and disposal, remedial treatment of industrial waste, etc. (see the official web site: http://www2.ocn.ne.jp/~teraoka/en/company/)
cleaning of the engine room were contracted out mainly to other MSRSG members as seen in Table 9.

Table 8 – The number of workers depending on type of work

<table>
<thead>
<tr>
<th>Type of work</th>
<th>number or workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demolition (gas cutting, etc.)</td>
<td>20</td>
</tr>
<tr>
<td>Crane operation</td>
<td>10</td>
</tr>
<tr>
<td>Transportation</td>
<td>5</td>
</tr>
</tbody>
</table>


Table 9 – Outsourcing of demolition works and waste disposal works

<table>
<thead>
<tr>
<th>Company</th>
<th>Type of work</th>
<th>Man-hour</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;E, Co. Ltd.</td>
<td>Accommodation area, industrial waste disposal, scrap loading, cleaning</td>
<td>810</td>
<td>Mar 12 – Oct 8</td>
</tr>
<tr>
<td>The Sangyo Shinko Co., Ltd.</td>
<td>Residual oil extraction, cleaning</td>
<td>254</td>
<td>Mar 11 – Apr 6</td>
</tr>
<tr>
<td>Hasuike Ltd.</td>
<td>Oil waste removal and disposal</td>
<td>98</td>
<td>Apr 7 – Apr 16</td>
</tr>
<tr>
<td>Fuji Salvage Co., Ltd.</td>
<td>Demolition of the main engine</td>
<td>102</td>
<td>Jun 21 – Jul 9</td>
</tr>
<tr>
<td>Sowa Engineering Co., Ltd.</td>
<td>Cleaning and disposal of oily water in the engine room</td>
<td>152</td>
<td>Aug 17 – Sep 5</td>
</tr>
<tr>
<td>Daisei Electronics Co., Ltd.</td>
<td>Operation of the generator in the engine room</td>
<td>57</td>
<td>Mar 9 – Mar 31</td>
</tr>
<tr>
<td></td>
<td>Residual oil extraction in the engine room</td>
<td>38</td>
<td>Apr 2 – Apr 17</td>
</tr>
<tr>
<td>Sanyo Kosan Co., Ltd.</td>
<td>Removal of paints on the ship’s hull surface</td>
<td>56</td>
<td>Aug 6 – Aug 18</td>
</tr>
<tr>
<td>Tajiri Machine Manufacturing Co., Ltd.</td>
<td>Extraction and disposal of chlorofluorocarbon bas</td>
<td>3</td>
<td>Mar 16</td>
</tr>
<tr>
<td>Suzuki Shokai Inc.</td>
<td>Gas cutting</td>
<td>223</td>
<td>May 6 – Sep 30</td>
</tr>
</tbody>
</table>

**Occupational safety and health**

The demolition works were carried out under the following safety management structure in order to ensure the occupational safety and health (Figure 27).

![Safety management structure of the experimental demolition](image)

**Figure 27 – Safety management structure of the experimental demolition**


A safety management plan was developed as a part of the SRFP. The plan prescribes general rules on works in closed spaces and high places, gas cutting, handling of pressure containers, use of heavy machinery and tools, communication measures, personal protective equipment (PPE), and emergency procedures. Additionally, outsourced works are managed under specific safety management standards and systems provided by respective entrusted companies.

Under these safety management systems, an accident causing a worker’s injury occurred on 29 May 2010. After the accident, a conference on the improvement of safety management was held by the project implementation members under the guidance of the Ministry of Land, Infrastructure, Transport and Tourism, the Muroran Coast Guard Office, and the Muroran Labor Standards Supervision Office. In the conference, the examination of the causes and the revision of the safety management plan were carried out. Furthermore, the revision of the emergency contact system, safety patrols, additional safety training for workers by third-party
experts, and risk assessments of respective works were implemented to prevent any more accidents. As a result, no accident happened after these improvements on the safety management system of the experiment.

**Waste stream management**

Industrial wastes in the ship were properly extracted in accordance with the approved IHM. Especially, asbestos was carefully removed by TERAOKA Co., Ltd in line with a specifically developed removal plan.

All the extracted industrial wastes were collected and delivered to facilities for intermediate treatment and final disposal. Entrusted companies for respective processes by type of waste are shown in Table 10.

<table>
<thead>
<tr>
<th>Type of waste</th>
<th>Collect and delivery</th>
<th>Intermediate treatment</th>
<th>Final disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood debris</td>
<td>R&amp;E, Co. Ltd.</td>
<td>R&amp;E, Co. Ltd.</td>
<td>R&amp;E, Co. Ltd.</td>
</tr>
<tr>
<td>Plastic</td>
<td>R&amp;E, Co. Ltd.</td>
<td>R&amp;E, Co. Ltd.</td>
<td>R&amp;E, Co. Ltd.</td>
</tr>
<tr>
<td>Glass, china and porcelain</td>
<td>R&amp;E, Co. Ltd.</td>
<td>R&amp;E, Co. Ltd.</td>
<td>R&amp;E, Co. Ltd.</td>
</tr>
<tr>
<td>Residual oil</td>
<td>Kankyō Kōhatsu Kogyō, Co. Ltd</td>
<td>Kankyō Kōhatsu Kogyō, Co. Ltd</td>
<td>Taiheiyo Cement Corporation</td>
</tr>
<tr>
<td>Asbestos</td>
<td>Center Cleaner, Co., Ltd</td>
<td></td>
<td>Kyoei Steel, Ltd</td>
</tr>
<tr>
<td>PCB contaminated waste</td>
<td>Stored</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorofluorocarbon gas</td>
<td>R&amp;E, Co. Ltd.</td>
<td></td>
<td>R&amp;E, Co. Ltd.</td>
</tr>
<tr>
<td>Paper waste</td>
<td>R&amp;E, Co. Ltd.</td>
<td>R&amp;E, Co. Ltd.</td>
<td>R&amp;E, Co. Ltd.</td>
</tr>
<tr>
<td>Rubber waste</td>
<td>R&amp;E, Co. Ltd.</td>
<td></td>
<td>R&amp;E, Co. Ltd.</td>
</tr>
<tr>
<td>Textile waste</td>
<td>R&amp;E, Co. Ltd.</td>
<td></td>
<td>R&amp;E, Co. Ltd.</td>
</tr>
<tr>
<td>Rechargeable battery</td>
<td>R&amp;E, Co. Ltd.</td>
<td></td>
<td>R&amp;E, Co. Ltd.</td>
</tr>
<tr>
<td>Dry-cell battery</td>
<td>R&amp;E, Co. Ltd.</td>
<td></td>
<td>R&amp;E, Co. Ltd.</td>
</tr>
</tbody>
</table>

*Disposal measures for PCB contaminated wastes are still not established in Japan. Therefore, the extracted PCB contaminated wastes were stored in hermetically-sealed containers in consultation with Muroran city.

Demolition techniques used in the experiment

Here the demolition techniques adopted in this experiment are introduced.

Gas cutting

Primary cutting on the ship and secondary cutting on land were carried out by gas cutting. Gas tanks dedicated for cutting were installed in the yard with gas pipes around the whole site in order to enhance the work efficiency (Figure 28). In addition, an automatic cutter was used for cutting deck plates to reduce manpower and increase efficiency in cutting (Figure 29).

Figure 28 – Gas tanks for cutting and cutting works on board

Figure 29 – Automatic cutter
Furthermore, the three-layer cutting method was experimented with for cutting upper deck structures to improve work efficiency. The conventional one-layer method is to cut the structures a single deck at a time and move cut plates to secondary cutting areas by a crawler crane. In the three-layer method, three decks are removed at once after making necessary cuts on the structures (Figure 30).

![Conventional one-layer method](image1) ![Three-layer method](image2)

**Figure 30 – The three-layer method**


**Oxygen lance cutting**

To cut the propeller shaft, an oxygen lance cutting technique was used (Figure 31). This technique uses heat obtained by the reaction of a steel lance with oxygen. The temperature of the lance will reach around 4,000 degrees Celsius and melt down the object in a moment, whereas high pressure oxygen blows away the melted object.

However, this technique needed a lot of time and lances to cut the thick shaft (in this experiment, it took about 5 hours to cut the propeller with a diameter of around 400mm while a lance needed to be replaced by 10 minutes). So it was revealed that further development of the technique is necessary to enhance efficiency in cutting thick steel products such as a propeller shafts.
Figure 31 – Oxygen lance cutting for a propeller shaft


Labounty shear cutting

A labounty shear which uses strong shear force to cut hard steel plates was utilized in the secondary cutting in this experiment (Figure 32). This machine contributed to enhancing work efficiency and safety.

Figure 32 – Labounty shear used in the secondary cutting

Saber saw cutting

Since the accommodation interiors include various chemical materials, saber saw cutting was adopted to avoid fire generation (Figure 33). In this experiment, a newly designed cutting blade with a new material was provided by one of the member companies of the MSRSG. Moreover, to cut piping systems inside the engine room where oil might remain, the saber saw was also used by switching cutting blades.

Figure 33 – Saber saw cutting

Caisson dock

In order to ensure safety and prevent marine pollution, the demolition of the ship’s bottom and aft side which might include some pollutants was carried out by using a caisson dock (Figure 34). Though using a dry dock or taking the ship on land by a large floating crane is preferable for these objectives, the experiment site was a public pier and unfortunately had no such equipment.
Environment protection techniques used in the experiment

Taking into consideration the possibility of environmental pollutions by the afloat method, the following techniques were adopted to prevent marine, air and land pollution.

Oil spill prevention

In order to prevent the contamination of soil and ground water, impermeable steel plates were laid on the secondary cutting area. In addition, the landing of equipment containing oils was carried out over oil receivers to avoid oil spills in the sea.
To prevent oil diffusion outside the experiment site in case of accidental oil spill, oil booms were doubly extended around the ship. Additionally, oil dispersants, absorbents and dusters were regularly stocked at the site for emergency.

**Heavy oil extraction**

Extraction of heavy oil inside the double bottom was conducted in line with the following process (Figure 35).

![Heavy oil extraction process](image)

**Figure 35 – Heavy oil extraction process**


**Toxic paint removal**

To prevent toxic paints from falling into the sea and to minimize workers’ health hazards caused by diffused heavy metals, paints on the ship hulls were partially removed by a chemical agent along the preset cutting lines before cutting works (Figure 36). The chemical agent was not directly applied to the hulls. Instead, sheets saturated with the agent were taped on the cutting lines. The used sheets can be disposed of as industrial wastes like the hull paints.
Minimization of the use of fire in cutting plates

A newly developed water jet cutting machine (see the next section, 5.4.2.2) was partially utilized in the primary cutting to avoid the use of fire. Additionally, a labounty shear was adopted for the secondary cutting so as to minimize the use of fire as much as possible. These measures contributed to preventing air pollution caused by burning paints on steel plates.

5.4.2.2. Research and development related to ship recycling process

In parallel with the demolition experiment, the development of a new cutting machine, and research on reusing scrapped steels for high added-value products and on eliminating hazards of extracted materials were conducted as follows.

Development of a new water jet cutting machine

Conventional gas cutting methods will cause explosion in the case that flammable substances such as residual oils remain inside tanks, discharge carbon dioxide during
combustion and generate toxic gases in cutting steel plates with paints. In this project, a water jet cutting machine was developed as an alternative to gas cutting and tested in part of the demolition experiment (Figure 37).

Existing water jet machines generate 300-400 MPa water pressure that is not sufficient to cut thick steel plates. Moreover, these machines weigh 1,500-2,000 kg and are too heavy to be moved to a ship bottom.

Therefore, the new water jet machine was developed and examined to satisfy the following objectives.

- To increase the water pressure to maximum 600 MPa, applicable to 30 mm steel plates, by using a jet nozzle made of metals with high abrasion resistance; and
- To decrease the weight to about 1,000 kg by reducing the number of parts.

![Figure 37 – A new prototype water jet cutting machine](image)

**Research on how to recycle scrapped steels as high value-added products**

The Muroran Institute of Technology sampled 200 kg of steels scrapped from the demolished ship and made several test pieces of cast iron and cast steel. These test pieces were examined by tensile tests and impact tests to verify their quality in consideration of their application to high value-added products (Figure 38).

As a result, this iron and steel had very stable mechanical properties and structures. So they are expected to be reused as materials for high value-added products.

*Figure 38 – Cast irons and steels for quality testing*


**Research on the elimination of hazards in extracted materials**

It is necessary to develop a new technology to minimize environmental risks in treating toxic materials extracted from ships. In this regard, a new method to remove toxic paints by using tapes saturated with a chemical agent was tested in the demolition experiment. This method was introduced in 5.4.1.
5.4.2.3. Environment Impact Assessment (EIA)

In order to assess the impacts of the demolition experiment on the environment, a water quality survey in the sea where the ship was anchored was carried out during the experiment. The sampling of sea water was conducted inside the oil booms extended around the ship at the following four different times during the period of the experimental demolition.

A. 28 July 2010: After the removal of the main engine
B. 19 August 2010: During the demolition by using the caisson dock (breaking the propeller)
C. 2 September 2010: During the breaking of the fore and aft of the ship with the caisson dock
D. 20 September 2010: After the completion of all the demolition works on the sea

As a result, none of the samples exceeded the thresholds of the environmental standards under the Environmental Basic Act and the discharge standards under the Water Quality Pollution Control Act. This means that the experimental demolition was considered to be successfully conducted without contaminating sea water at the experiment site.

5.4.2.4. Feasibility study based on the experiment result

In this experiment, total sales including scrapped steel plates and resale equipment were 420,951,734 JPY, whereas the total demolition costs were 390,599,479 JPY. On the other hand, the PCC vessel of 12,251 LDT recycled in the experiment was obtained at 220 USD per LDT, which totally cost 2,695,220 USD equivalent to 242,570,000 JPY at the exchange rate of about 90 JPY/USD at the time of contract (in February 2010). Consequently, the total costs of the experiment were 633,169,479 JPY which simply means a deficit of 212,217,745 JPY.
Since the experiment was a pilot project, there were various additional costs such as temporal construction costs, equipment lease and transportation costs and workers’ travel expenses compared to operations in fixed facilities. By reducing these additional costs specific to the pilot project, the demolition costs for the case of a fixed recycling yard could be calculated as per the following table (Table 11).

Table 11 – Cost comparison of the Muroran pilot project and a fixed yard case

<table>
<thead>
<tr>
<th></th>
<th>Muroran pilot project</th>
<th>Fixed yard case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility costs</td>
<td>37,969</td>
<td>1,242</td>
</tr>
<tr>
<td>Equipment costs</td>
<td>122,533</td>
<td>35,154</td>
</tr>
<tr>
<td>Direct costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material/Utility costs</td>
<td>21,113</td>
<td>21,113</td>
</tr>
<tr>
<td>Industrial waste disposal costs</td>
<td>62,180</td>
<td>29,759</td>
</tr>
<tr>
<td>Labor/Outsourcing costs</td>
<td>101,055</td>
<td>57,451</td>
</tr>
<tr>
<td>Indirect costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marketing/Administrative costs</td>
<td>45,750</td>
<td>21,027</td>
</tr>
<tr>
<td>Total costs</td>
<td>390,600</td>
<td>165,746</td>
</tr>
<tr>
<td>Total costs per LDT (JPY/LDT)</td>
<td>31,886</td>
<td>13,530</td>
</tr>
<tr>
<td>Direct costs per LDT (JPY/LDT)</td>
<td>15,049</td>
<td>8,843</td>
</tr>
</tbody>
</table>


Furthermore, the benefit-risk analysis by dividing the costs of a fixed yard case into fixed costs and variable costs revealed that the break-even point of total costs and the factor of safety were 338,940,245 JPY and 19.5% respectively. This means that about 20% decline in total sales will be the manageable limit.

However, this result was supported by the lower ship price for the experiment (220 USD/LDT) in comparison with the prices currently offered by yards in China and the Indian subcontinent (around 400-500 USD/LDT, see Figure 7 in Chapter IV – 4.2). These countries are offering high prices made possible by low dismantling costs and significant internal demand for scrapped steel. It is considered not to be easy to compete with these countries by simply using conventional methodologies in the present ship recycling industry. The enhancement of productivity by streamlining
methods to recycle high quality steels and achieve technological innovations will make it possible for Japan to counter these forerunners.

For these reasons, the MSRSG put forward the following proposals based on the pilot project result in order to achieve sustainable business in the future ship recycling industry (Table 12).

Table 12 – Proposals by the MSRSG in the Muroran pilot project

<table>
<thead>
<tr>
<th>Proposal 1 – Give incentives to shipowners and stakeholders</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish procedures completely compatible to the requirements under the Hong Kong Convention</td>
<td>Ship recyclers should support shipowners with the control of the IHM as a &quot;one-stop shop&quot; and develop an SRP making system and an authorization system.</td>
</tr>
<tr>
<td>Ensure &quot;Beyond Ship Recycling Yard&quot; regarding hazardous waste disposal</td>
<td>It is necessary to utilize complete traceability systems from waste discharging companies to final disposal sites already existing in Japan, which can satisfy customers sensitive to environmental requirements.</td>
</tr>
<tr>
<td>Achieve safe and environmentally sound demolition</td>
<td>It is necessary to introduce demolition methods which ensure occupational safety and health as well as environment protection, such as a water jet cutter.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proposal 2 – Reduce demolition costs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Use large demolition machineries</td>
<td>It is necessary to achieve short-term completion by dismantling larger blocks on land, and enhance efficiency by reducing the demolition process.</td>
</tr>
<tr>
<td>Utilize idle port facilities</td>
<td>Ship recyclers will be exempted from facility charges by using idle port facilities.</td>
</tr>
<tr>
<td>Reduce waste disposal volume</td>
<td>It will be possible to reduce waste disposal costs by establishing intermediate treatment facilities inside the yard.</td>
</tr>
<tr>
<td>Enhance productivity</td>
<td>Experienced and skilled workers should pass down their demolition techniques to beginners. Training to build up workers’ skills should also be conducted.</td>
</tr>
</tbody>
</table>
**Improve logistics in the yard**

It is required to increase shipping volume by optimizing shipping routes, to carry in and out large trucks and to set up a pier for receiving materials by a barge.

**Proposal 3 – Promote high value-added production**

<table>
<thead>
<tr>
<th>Proposal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Provide scrapped steels to electric and converter furnaces</strong></td>
<td>Since steel used for ship structures is high-quality iron source material, under the strict management of components, it can be sold at high prices even with additional values. A long-term outlook of the market should be carried out.</td>
</tr>
<tr>
<td><strong>Promote cooperation among industry, academia and government</strong></td>
<td>It is necessary to promote research and study on the effective use of recycled materials by industry-academic-government cooperation.</td>
</tr>
<tr>
<td><strong>Resell certified secondhand equipment</strong></td>
<td>Ship recyclers should resell well-maintained equipment certified by class societies</td>
</tr>
</tbody>
</table>


### 5.4.3. Current status of the MSRSRG

The MSRSRG became a non-profit organization (NPO) named “Ship Recycle Muroran” in September 2012, and is conducting further research and development of a safe and environmentally sound ship recycling process to achieve its commercialization in Japan (Shimizu, 2012).

The substantial works of the MSRSRG are currently carried out separately by the following five working groups in light of the proposals given by the first pilot project above (MSRSRG, 2012).

- Group 1 for yard planning;
- Group 2 for developing demolition techniques (sophistication/shortening work periods);
• Group 3 for developing waste disposal methods (fuel, bilge, asbestos and so on);
• Group 4 for enhancing logistics (scrapped material flow); and
• Group 5 for safety planning in demolishing large vessels.

5.5. Summary and remarks

Japan is playing an active role as a major maritime power in developing effective international regulatory regimes under the Hong Kong Convention and implementation systems for ensuring sustainable, safe and environmentally sound recycling of ships in cooperation with its class society and other stakeholders. Furthermore, its fundamental policies on ship recycling not only aim at facilitating the early ratification and effective implementation of the Hong Kong Convention by itself and other countries such as India, but also target the establishment of its own ship recycling business competitive with major ship recycling countries.

The collaborative project for this target, conducted by the MSRSG, is proactively trying to break through the current difficulties in commercializing the recycling of large vessels due to high demolition costs and high market prices of obsolete ships. After the successful completion of the pilot project in 2010, the MSRSG proposed three methods to overcome these difficulties: generate incentives for shipowners and stakeholders by high-quality standards; reduce the demolition costs; and promote high value-added production.

Besides incentive generation and cost reduction which can also be practiced by other countries, the remarkable focus of this project is the promotion of generating high value-added products, which uses Japan’s own strength. Japan’s accumulated high technologies and highly-qualified human resources in shipbuilding, ship machinery and other industries will contribute to achieving this objective and ensure its competitiveness in the future safe and green ship recycling industry.
CHAPTER VI  CONCLUSION

This dissertation firstly depicted the current picture of the ship recycling industry by introducing and analyzing the international regulatory instruments covering the industry, the safety and environmental issues caused by substandard recycling operations in the Indian subcontinent, and the key efforts by industrialized regions to reform the industry.

As a core international regulatory instrument on ship recycling, the Hong Kong Convention will, after its entry into force, provide for a reasonable basis to ensure safe and environmentally sound recycling of ships in the world by regulating all relevant stakeholders throughout the entire life of ships from the cradle to the grave. It will also contribute to detecting shipowners’ intention to sell their ships for recycling and identifying the export state under the Basel Convention. Consequently, the illegal transportation of obsolete ships to developing countries could be effectively avoided. Furthermore, the Basel Protocol is, when it is enforced, expected to place the strict liability of compensation for pollution damage during ship dismantling or waste disposal operation on ship recyclers or waste disposal facilities in line with the “polluter pays principle” of the Rio Declaration.

In the Indian subcontinent, Bangladesh, India and Pakistan are energetically operating ship recycling yards by using the beaching method which causes serious safety and environmental risks to workers and the operation site. They offer higher prices for old vessels, being backed with a strong domestic demand for scrapped steel and cheap labor costs. The governments in these countries are currently willing to reform the industry in a safe and environmentally friendly way. Most ship recyclers there are, however, still not convinced of that direction due to high profits from the conventional beaching method, continued steel demand based on economic growth, and insufficient national regulations.

On the other hand, China and Turkey, advanced ship recycling countries, are leading the specific market for responsible shipowners based on their safer and greener
recycling processes. Since the recycling yards in China and Turkey will be able to satisfy the requirements under the Hong Kong Convention in the short-term, the enforcement of the Hong Kong Convention and the Ship Recycling Regulation in the EU will cause a remarkable shift of the world ship recycling volume to these two countries. However, the recycling capacity of China and Turkey cannot cover all the demand. The rest of the recycling demand still has to be satisfied by conventional players in the Indian subcontinent or other industrialized countries.

Considering this current picture of the industry, Japan is now proactively taking a bipolar approach to assist countries in the Indian subcontinent and to seek a new ship recycling industry in Japan, in parallel with the facilitation of the entry into force and enforcement of the Hong Kong Convention.

On the former pole, the Japan-funded reformation project in Gujarat, India recently ran aground because of objections by ship recyclers who do not want to increase demolition costs and debt. Of course, the conventional substandard yards will suffer from increasing costs for conforming to the strict requirements under the Hong Kong Convention. However, continuous operations without any improvement will finally make them lose their business in the incoming safer and greener ship recycling industry.

Most importantly, on the latter pole, Japan is developing its own ship recycling model to achieve sustainable, safe and environmentally sound recycling of larger ships competitive with industrialized forerunners such as China and Turkey. The successful completion of the pilot project conducted by the MSRSG showed the possibility of the achievement. Japan has an integrated maritime industry containing shipbuilding, ship machinery and shipping companies as well as R&D institutions. Therefore, there are potentially engineering, technology, and human/facility resources sufficient to accomplish the goal with the strength of high value-added production.
In the current MSRSG project, there is no clear intention to use existing shipbuilding facilities for a new ship recycling model. However, the shipbuilding industry will face with a decrease in order size in case of a big economic recession as recently seen after Lehman’s fall in 2008. Thus, it is recommended that more and more shipbuilding companies positively join this project to seek alternative jobs in preparation for a shortage of orders. Consequently, the Japanese potential capacity of ship recycling will dramatically expand, whereas the integration of shipbuilding and ship recycling industries will create further efficient methods to control the entire life of ships.

In conclusion, the ideal vision of the future ship recycling industry is considered to be that all the major ship recycling countries and Japan as a new player will achieve compliance with the Hong Kong Convention and compose sufficient capacity and capability to ensure sustainable, safe and environmentally sound recycling. However, there is still the possibility that ship recycling countries in the Indian subcontinent will disappear from the industry due to the rise of industrialized countries and the abandonment of reformation. As the industry’s history shows, a political or economic reason will eventually affect the decision as to whether a country reforms its industry or quits the industry, irrespective of other countries’ support or intentions. Nonetheless, Japan will probably take the bipolar approach to reach the ideal vision without compromising the reformation of substandard yards, proudly and responsibly as a major maritime power in the world.
REFERENCES


### APPENDICES

**APPENDIX A: GLOSSARY**

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-fouling system</td>
<td>In order for ships to sail faster and reduce fuel consumption, they must have smooth and clean hull surfaces without fouling organisms like algae, barnacles or mollusks. To achieve that, lime, arsenical or mercurial compounds/pesticides were applied to ships’ hull paints as anti-fouling systems in the early days. After the development of more effective organic compounds such as TBT by the chemical industry in the 1960s, majority of ocean-going ships have used TBT paints on their hulls as anti-fouling systems until their harmful properties against marine habitats became apparent in the 1980s – 1990s.</td>
</tr>
<tr>
<td>CLC 92</td>
<td>The International Convention for Oil Pollution Damage, 1992 places the strict liability on tanker owners to pay compensation for oil pollution damage caused by their tanker.</td>
</tr>
<tr>
<td>Cloud computing</td>
<td>Cloud computing is to use computer hardware and software which are served through a network such as the internet. In this way, the users do not have to prepare own computing resources and can reduce the initial costs.</td>
</tr>
<tr>
<td>Competent authority</td>
<td>One governmental authority designated by a member state which is responsible, within a specific geographical area, for an assigned task. The Basel Convention places its responsibility on receiving the notification of a transboundary movement of hazardous wastes or other wastes and any relevant information, and on responding to the notification. Under the Hong Kong Convention, it is responsible for obligations relevant to ship recycling</td>
</tr>
</tbody>
</table>
facilities operating in the jurisdiction of the state.

<table>
<thead>
<tr>
<th><strong>DWT</strong></th>
<th>DWT (Deadweight Tonnage) means the total loadable weight of cargo, fuel oil, ballast water, plain water and feed-water, expendable supplies, and persons (passengers and crew), which is equivalent to the maximum weight that the ship can carry safely. DWT is typically used as a standard unit of merchant fleet size.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>European Commission</strong></td>
<td>The European Commission represents the interests of the EU as a whole. It proposes new legislation to the European Parliament and the Council of the European Union (consisting of national ministers) upon request of another EU institution, country, stakeholder or EU citizens, where such a legislative action is more effective at the level of the EU than at a national or regional level. The proposal is generally published with the result of assessment on economic, social and environmental impacts of the proposed legislation, incorporating stakeholders’ perspectives by consultation. After the adoption of the new law, the Commission ensures that member states properly apply it.</td>
</tr>
<tr>
<td><strong>Focal point</strong></td>
<td>The body of a state, defined under the Basel Convention, responsible for receiving and submitting, through the Secretariat of the Convention, information regarding its implementation of the Convention (e.g. relevant national organizations/systems, national definition of hazardous wastes, prohibition or limitation of import/export, disposal options), transboundary movements of hazardous wastes or other wastes, statistics, agreements and arrangements, accidents, development of relevant technologies and so on.</td>
</tr>
<tr>
<td><strong>GT</strong></td>
<td>Gross Tonnage means the volume of the whole enclosed</td>
</tr>
</tbody>
</table>
spaces of a ship (from keel to funnel) measured to the outside of the hull framing.

<table>
<thead>
<tr>
<th><strong>HNS 2010</strong></th>
<th>The International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea, as amended by the 2010 Protocol prescribes that ship owners are strictly liable to compensate for damage caused by hazardous and noxious substances (HNS) which their ships carry on board. This Convention does not cover oil pollution damage applicable to CLC 92.</th>
</tr>
</thead>
</table>
| **Hazardous materials included in Part I of the IHM** | Part I of the IHM specifies hazardous materials which shall be maintained and updated throughout the operational life of a ship. It consists of materials listed in two appendices of the Hong Kong Convention:  
  - Appendix 1 includes hazardous materials which are prohibited to be used in new ships or new installations on ships, specifically, asbestos, ozone-depleting substances, PCBs and anti-fouling compounds; and  
  - Appendix 2 includes hazardous materials contained in new installations, in particular, any hazardous materials in Appendix 1, cadmium, hexavalent chromium, lead, mercury, polybrominated biphenyls (PBBs), polybrominated diphenyl ethers (PBDEs), polychlorinated naphthalenes, radioactive substances and certain shortchain chlorinated paraffins. |
| **JICA** | The Japan International Cooperation Agency (JICA), an aid organization which conducts official development assistance (ODA) in an integrated fashion, engages in international cooperation with developing countries. |
| **LDT** | LDT (Light Displacement Tonnage) stands for the |
combined tonnage of a ship’s structures and engines, which is equal to the weight of water displacement where the ship doesn’t have on board cargo, fuel oil, lubricants, ballast water, plain water and feed-water, expendable supplies, and persons (passengers and crew), but includes fluids in piping. LDT is utilized as a standard weight to determine the price of a ship to be scrapped.

| Polluter pays principle | Polluter pays principle is defined under Principle 16 of the Rio Declaration as “national authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.” |
| Precautionary approach | Precautionary approach is defined under Principle 15 of the Rio Declaration as “in order to protect the environment, the precautionary approach shall be widely applied by States according to their capacities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.” |
## APPENDIX B: AMOUNT OF HAZARDOUS MATERIALS ON MERCHANT AND NAVY SHIPS

<table>
<thead>
<tr>
<th>Hazardous Material</th>
<th>Unit</th>
<th>Merchant Vessels**</th>
<th>Navy Vessel**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Material/ million</td>
<td>Material/ million</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GT</td>
<td>40,000 GT</td>
</tr>
<tr>
<td>Asbestos</td>
<td>ton</td>
<td>510</td>
<td>20</td>
</tr>
<tr>
<td>PCBs</td>
<td>kg</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PCB liquids (transformers, etc.)</td>
<td>kg</td>
<td>1.7</td>
<td>0.07</td>
</tr>
<tr>
<td>PCB solids (capacitors, ballasts, etc.)*</td>
<td></td>
<td>No info. available</td>
<td>No info. available</td>
</tr>
<tr>
<td>Hydraulic oil</td>
<td>ton</td>
<td>110</td>
<td>5.0</td>
</tr>
<tr>
<td>Ozone-depleting substances (ODS)</td>
<td></td>
<td>No info. available</td>
<td>No info. available</td>
</tr>
<tr>
<td>ODS liquids (CFC, Halons, etc.)</td>
<td>ton</td>
<td>7.0</td>
<td>0.3</td>
</tr>
<tr>
<td>ODS solids (e.g., polyurethane (PU))</td>
<td>ton</td>
<td>1800</td>
<td>70</td>
</tr>
<tr>
<td>Paints</td>
<td></td>
<td>No info. available</td>
<td>No info. available</td>
</tr>
<tr>
<td>Paints no info</td>
<td>ton</td>
<td>420</td>
<td>17</td>
</tr>
<tr>
<td>Paints containing tributyltin (TBT)</td>
<td>ton</td>
<td>14</td>
<td>0.56</td>
</tr>
<tr>
<td>Paints containing PCBs</td>
<td>ton</td>
<td>No info. available</td>
<td>No info. available</td>
</tr>
<tr>
<td>Paints containing metals</td>
<td>ton</td>
<td>No info. available</td>
<td>No info. available</td>
</tr>
<tr>
<td>Heavy metals</td>
<td></td>
<td>No info. available</td>
<td>No info. available</td>
</tr>
<tr>
<td>Cadmium (merchant): lead (naval)</td>
<td>ton</td>
<td>1.9</td>
<td>0.08</td>
</tr>
<tr>
<td>Mercury</td>
<td>kg</td>
<td>44</td>
<td>1.8</td>
</tr>
<tr>
<td>Volatile organic substances</td>
<td></td>
<td>No info. available</td>
<td>No info. available</td>
</tr>
<tr>
<td>Waste liquids organic (HFO, diesel)</td>
<td>ton</td>
<td>3200</td>
<td>130</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td></td>
<td>5,650</td>
<td>230</td>
</tr>
<tr>
<td>Ballast water (C-34)</td>
<td>ton</td>
<td>60,000</td>
<td>2,400</td>
</tr>
<tr>
<td>Sewage (C-35)</td>
<td>m³</td>
<td>660</td>
<td>26</td>
</tr>
<tr>
<td>Garbage (C-42)</td>
<td>ton</td>
<td>2.3</td>
<td>0.09</td>
</tr>
<tr>
<td>Incinerator ash (C-41)</td>
<td>ton</td>
<td>1.9</td>
<td>0.08</td>
</tr>
<tr>
<td>Oily rags (C-45)</td>
<td>ton</td>
<td>3.1</td>
<td>0.12</td>
</tr>
<tr>
<td>Batteries nickel/cadmium</td>
<td>units</td>
<td>170</td>
<td>7.0</td>
</tr>
<tr>
<td>Waste liquids inorganic (acids)</td>
<td>m³</td>
<td>0.28</td>
<td>0.01</td>
</tr>
<tr>
<td>Reusable liquids organic (other)</td>
<td>m³</td>
<td>620</td>
<td>25</td>
</tr>
<tr>
<td>Equipment</td>
<td></td>
<td>2.2</td>
<td>0.09</td>
</tr>
<tr>
<td>Batteries lead (C46)</td>
<td></td>
<td>No info. available</td>
<td>No info. available</td>
</tr>
</tbody>
</table>

*Merchant vessel does not estimate PCBs in cables due to lack of data.

**For both categories an example is given for a typical-size vessel. The underlying IHM datasets include 14 merchant and 13 navy vessels.

**All figures are rounded to two significant figures.

## APPENDIX C: MURORAN SHIP RECYCLING STUDY GROUP

Member List (in alphabetical order), as of 1 October 2012

<table>
<thead>
<tr>
<th>Company/Organization</th>
<th>Official website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biken Work Co., Ltd.</td>
<td><a href="http://www2.ocn.ne.jp/~biken-w/">http://www2.ocn.ne.jp/~biken-w/</a></td>
</tr>
<tr>
<td>Denzai-Juki Corporation</td>
<td><a href="http://denzai-j.com/">http://denzai-j.com/</a></td>
</tr>
<tr>
<td>Fuji Salvage Co., Ltd.</td>
<td><a href="http://www.fujisal.com/">http://www.fujisal.com/</a></td>
</tr>
<tr>
<td>Hokkaido Air Water Inc.</td>
<td><a href="http://www.hawi.co.jp/">http://www.hawi.co.jp/</a></td>
</tr>
<tr>
<td>Hokkaido Research Organization / Industrial Research Institute</td>
<td><a href="http://www.iri.hro.or.jp/">http://www.iri.hro.or.jp/</a></td>
</tr>
<tr>
<td>Kana Steel Co., Ltd.</td>
<td>-</td>
</tr>
<tr>
<td>Kantoku Global Corporation</td>
<td><a href="http://www.kantoku.co.jp">http://www.kantoku.co.jp</a></td>
</tr>
<tr>
<td>Kyomei Ltd.</td>
<td>-</td>
</tr>
<tr>
<td>Local Newspaper Muroran Minpo</td>
<td><a href="http://www.muromin.mnw.jp/">http://www.muromin.mnw.jp/</a></td>
</tr>
<tr>
<td>Muroran Advancement Center of Industrial Technology and Management</td>
<td><a href="http://www.murotech.or.jp/">http://www.murotech.or.jp/</a></td>
</tr>
<tr>
<td>Muroran Chamber of Commerce &amp; Industry</td>
<td><a href="http://www.murocci.or.jp/">http://www.murocci.or.jp/</a></td>
</tr>
<tr>
<td>Muroran City</td>
<td><a href="http://www.city.muroran.lg.jp/">http://www.city.muroran.lg.jp/</a></td>
</tr>
<tr>
<td>Muroran Institute of Technology</td>
<td><a href="http://www.muroran-it.ac.jp/">http://www.muroran-it.ac.jp/</a></td>
</tr>
<tr>
<td>Muroran Port Promotion Association</td>
<td><a href="http://www.murocci.or.jp/mppa/">http://www.murocci.or.jp/mppa/</a></td>
</tr>
<tr>
<td>NIKKO TRANSPORTATION, Ltd.</td>
<td>-</td>
</tr>
<tr>
<td>Company</td>
<td>Website</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>National Maritime Research Institute</td>
<td><a href="http://www.nmri.go.jp/">http://www.nmri.go.jp/</a></td>
</tr>
<tr>
<td>Nippon Kaiji Kyokai (ClassNK)</td>
<td><a href="http://www.classnk.or.jp/hp/ja/index.aspx">http://www.classnk.or.jp/hp/ja/index.aspx</a></td>
</tr>
<tr>
<td>Nippon Steel Corporation</td>
<td><a href="http://www.nssmc.com">http://www.nssmc.com</a></td>
</tr>
<tr>
<td>(Nippon Steel &amp; Sumitomo Metal Corporation since 1 October 2012)</td>
<td></td>
</tr>
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<td>R&amp;E, Co. Ltd.</td>
<td><a href="http://www.rande.co.jp/">http://www.rande.co.jp/</a></td>
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<tr>
<td>Sato Chuko Co., Ltd.</td>
<td><a href="http://satochuko.co.jp/">http://satochuko.co.jp/</a></td>
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<tr>
<td>Shipbuilding Research Centre of Japan</td>
<td><a href="http://www.srcj.or.jp/">http://www.srcj.or.jp/</a></td>
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<tr>
<td>Suzuki Consultant Industries Ltd</td>
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<tr>
<td>TERAOKA Co., Ltd.</td>
<td><a href="http://www2.ocn.ne.jp/~teraoka/">http://www2.ocn.ne.jp/~teraoka/</a></td>
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<td>TOKAI Construction Inc.</td>
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<td>TRYTEC Co., Ltd.</td>
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<td>Teramachi Co., Ltd.</td>
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<tr>
<td>The Hakodate Dock Co., Ltd.</td>
<td><a href="http://www.hakodate-dock.co.jp/">http://www.hakodate-dock.co.jp/</a></td>
</tr>
<tr>
<td>The Hokkaido Shimbun Press Muroran Office</td>
<td><a href="http://kk.hokkaido-np.co.jp/">http://kk.hokkaido-np.co.jp/</a></td>
</tr>
<tr>
<td>The Japan Steel Works, Ltd.</td>
<td><a href="http://www.jsw.co.jp/">http://www.jsw.co.jp/</a></td>
</tr>
<tr>
<td>The Sangyo Shinko Co., Ltd.</td>
<td><a href="http://www.sangyoshinko.co.jp/">http://www.sangyoshinko.co.jp/</a></td>
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</tbody>
</table>

APPENDIX D: DETAILED SPECIFICATION OF “NEW YORK HIGHWAY”

<table>
<thead>
<tr>
<th>M.S. &quot;NEW YORK HIGHWAY&quot; PARTICULARS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tonnage</strong></td>
</tr>
<tr>
<td>International (Register)</td>
</tr>
<tr>
<td>Domestic (J.G Basis)</td>
</tr>
<tr>
<td><strong>Speed &amp; Endurance</strong></td>
</tr>
<tr>
<td>F.O. Consumption (for WE)</td>
</tr>
<tr>
<td>Dead Weight (Summer)</td>
</tr>
<tr>
<td>Light Weight</td>
</tr>
<tr>
<td><strong>Tank Capacity</strong></td>
</tr>
<tr>
<td>Type, Class &amp; Port of Registry etc</td>
</tr>
<tr>
<td>Type</td>
</tr>
<tr>
<td>Class</td>
</tr>
<tr>
<td>T/C Owner</td>
</tr>
<tr>
<td>Registered Owner</td>
</tr>
<tr>
<td>Ship Managing Company</td>
</tr>
<tr>
<td>Port of Registry</td>
</tr>
<tr>
<td>Port of Registry</td>
</tr>
<tr>
<td>Date of Keel Laid</td>
</tr>
<tr>
<td>Date of Launching</td>
</tr>
<tr>
<td>Date of Delivery</td>
</tr>
<tr>
<td><strong>Official Number</strong></td>
</tr>
<tr>
<td>Call Sign</td>
</tr>
<tr>
<td><strong>Center Ramp</strong></td>
</tr>
<tr>
<td>Position</td>
</tr>
<tr>
<td><strong>Immersion No</strong></td>
</tr>
<tr>
<td>F tel</td>
</tr>
<tr>
<td>F fax</td>
</tr>
<tr>
<td>F No.</td>
</tr>
<tr>
<td>C tel</td>
</tr>
<tr>
<td><strong>Machinery</strong></td>
</tr>
<tr>
<td><strong>Main Engine</strong></td>
</tr>
<tr>
<td>Output</td>
</tr>
<tr>
<td><strong>Diesel Generator</strong></td>
</tr>
</tbody>
</table>

APPENDIX E: EXPERIMENT SITE LAYOUT

APPENDIX F: STATEMENT OF FACT ISSUED BY CLASSNK

NIPPON KAIJI KYOKAI

Statement of Fact

No. KC10N2-44147
Date: 08 February 2010

THIS IS TO CERTIFY that the undersigned Surveyor did, at the request of Messrs. Japan Ship Technology Research Association, examine the report of "Inventory of Hazardous Materials" of the following vessel:

MV "MORNING SAPPHIRE"

Flag: Japanese
Port of Registry: Kobe
Signal Letters: 8JGU
IMO Number: 9416126
Type of Vessel: Vehicles Carrier
Gross Tonnage (TM69): 45,706 ton
Shipbuilder: Oshima Shipbuilding Co., Ltd., Japan
Name of Owner: Toyo Nippon Kisen Co., Ltd.


( N. Miura )
General Manager of
Marine & Industrial Service Department
NIPPON KAIJI KYOKAI

Attachment:
1. Inventory of Hazardous Materials for MV "MORNING SAPPHIRE"

This report is issued subject to the condition that it is endorsed and agreed by the member of the Surveyor's Committee under any circumstances.