RINA

INTERNATIONAL CONFERENCE

RECYCLING OF SHIPS
& OTHER MARINE STRUCTURES

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1. INTRODUCTION

The shipping industry has recognised that there are major issues involved in the way ship recycling is carried our in certain facilities in certain countries - issues related to worker safety, worker health and the possibility of environmental damage.

Against those factors have to be balanced the benefits that the activity undoubtedly brings to those same areas.

The workers in the yards want to keep the work; the yards themselves want the business; the local governments want the economic activity; national governments see the operation as being able to deliver cheaper raw materials for construction and a wide range of consumer and other products; shipowners want the facilities to dispose of their end-of-life ships; most reasonable environmentalists want it because 99% or more of the ship is recycled and the steel, and other parts of the ship re-used.

There is also a lack of alternatives. Dumping at sea is no answer nor is merely scrapping and disposal by land fill.

The fact is that this activity is best carried out, from all perspectives, where there is a valid and ready use for the recovered steel and the vast majority of other items removed from a ship when it is demolished. These conditions are fulfilled in the areas where the bulk of the world's ship recycling takes place today.

The Bangladesh Government, in a recent paper to the joint ILO/ILO/Basel Working Group, stated the following:

"In the absence of any domestic source of iron ore, Bangladesh has to depend on steel from scrapped ships…. (which) …. provides about 80% of the country's steel needs. The industry also provides an important source of revenue to the Government and helps, in one way or another, the industries concerned with the production of cement, construction materials, sand, stone, sanitary equipment, re-rolling mills, safety equipment etc.

Ship recycling is an industry that Bangladesh cannot afford to lose."

The objective must not be to force the industry move somewhere else, but to do what we can to ensure that recycling is carried out in a manner acceptable to the workers and employers in the industry - wherever it might be geographically situated - and their governments and people - a partnership.

Again quoting the paper from Bangladesh

"Other items from ships such as engines, generators, boilers, electrical and plumbing items, furniture, refrigerators, air-conditioners etc are mostly re-used. The garment manufacturing factories use the engines and generators: boilers are used mainly in rice mills, garment washing plants, knitting plants and other industries. Wooden planks, bars and furniture are also re-used."

This is not "scrapping", it is not just "dismantling", it is not just "disposal". It is most certainly not "dumping". It is in the truest sense of the word "recycling".

The "World Wide Fund for Nature" defines recycling as "the processing of waste or rubbish back into raw materials so that it can be made into new items" and goes on to state that "It is undoubtedly beneficial - to the individual, the community and the planet."

Ship recycling falls well into this definition.

However, the industry has acknowledged that there are problems related to ship recycling - and that there is a role for the shipping industry to play in addressing those problems.

In 1999, the industry established a Working Party on Ship Recycling involving seven major industry organisations – all with consultative status at the International Maritime Organisation (IMO) (BIMCO, ICS, INTERCARGO, INTERTANKO, ITOPF, ITF and OCIMF) and in 2001 the published its "Code of Practice on Ship Recycling". This was subsequently used by IMO as the basis for parts of its own guidelines.

These guidelines, which we urge all shipowners to adopt, are available on the web at http://www.marisec.org/recycling/index htm.

But that is the past. What about the present and the future? What are the current problems?

Again quoting the position in Bangladesh

"Although basic protection items such as helmets, gloves, goggles etc are provided to workers, unfortunately work-related accidents could not be totally eliminated. However, through the adoption of good practices a great deal of success has been achieved in bringing them to a minimum."

We do not agree with this view. The "minimum" target must be zero work-related accidents.

It is clear that ship recycling, in the way it is carried out in certain countries today, is a hazardous business. But the operations themselves are not new. The fatalities and injuries which occur seem to be largely preventable. Simple safety procedures, which are enforced habits in major ship building and ship repair facilities elsewhere, are either not adopted or not enforced in the recycling yards. This is not acceptable. This is the priority. This is where we must concentrate our efforts. These are the issues we should be discussing.

Not whether the Basel Convention is or is not applicable, not because the ship does not have a "Green Passport", not because the ship doesn't have an inventory of potentially hazardous materials, not because "the role of the flag state" has or has not been defined. The safety of the workers in the industry can only be addressed by the states where the activity takes place. Ample guidance is available on this issue in both the ILO Guidelines and the Guidelines produced by the Parties to the Basel Convention.

Among the current issues being debated in international for a are:

1. Voluntary or mandatory provisions and their application and enforcement;
2. A reporting system (currently being considered within IMO)
3. The Basel Convention and its applicability to ships

2. VOLUNTARY OR MANDATORY PROVISIONS AND THEIR APPLICATION AND ENFORCEMENT;

Should there be international legislation (indeed, can the international community develop and enforce international legislation) - or should existing guidelines be developed and all parties urged to introduce and enforce them?

Regulations, for them to be effective, need to be

a) applicable – to the issues being address
b) acceptable - to the implementing governments concerned
c) enforceable - equally on all

Regulations provide the basic framework for most industries. The shipping industry is regulated, in the main, by international rules, freely agreed by nations, which are enacted into national law - and enforced by national law. Shipping itself is an international industry and has long been a supporter of international regulation and its enforcement.

Shore based industries follow a different path, adapting and adopting rules and regulations which cover national concerns, national interests and national priorities. Such international agreements that do exist, applicable to land based industries, such as the ILO standards and Conventions, would be difficult to enforce other than nationally. Unlike a ship, a factory in one country never visits another where it can be checked!!

The ship recycling industry lies at the very boundary of these two concepts. It is a national industry, regulated by national law, devised, implemented and enforced according to the national priorities of the ship recycling nations. However, its raw materials, the ships themselves, leave an internationally regulated environment the moment they cease to become a ship – generally the moment of grounding on a beach or "Finished with engines" is telegraphed for the last time or a hole is cut in the side.

In respect of developing international regulations on the recycling industry, other countries and NGOs should to think long and hard before seeking to impose restrictions or their own priorities on those countries involved - to assume that their own domestic or parochial concerns should also be the concerns of others. An issue of vital importance to one country's politicians or to one single interest group may have little significance or a lower priority in another.

In any event, the key to developing legislation is surely the ability - or the willingness - to enforce it at the international, national and local level.

An international industry such as shipping should expect any legislation

- To have an international dimension
- To provide equality with other modes of transport
- To be consistent, clear and uniform
- To be appropriate to the issues being addressed
- To be developed in co-operation with the industries involved and in liaison with other stakeholders; and, above all, to be practical - not political

Shipping looks for measures which are proportional, pragmatic and appropriate to probable or perceived problems – not those dreamed up by enthusiastic politicians and introduced on the basis of the classic syllogism: "You (but not me) must do something – this is something – therefore you (not me) must do it."

Shipping is willing to adopt measures that are well explained as to purpose, principle and operation. If prior consultation is impossible, they want an early opportunity for open discussion.

We seek an opportunity to move towards new and more extensive international co-operation with all stakeholders, official and commercial working together. Shipping is ready to play its part - but all stakeholders have vital roles to play.

With the above criteria in mind, the shipping industry has supported the consideration that certain aspects of the IMO guidelines might be given more force. All those aspects relate to practical measures which we believe could have an immediate impact on both worker safety and environmental standards in recycling yards.

The areas which the industry itself has already suggested might be looked at and which are now being given active consideration within IMO, cover

a) the provision of a gas free certificate at handover. Reports show that the biggest single cause of fatalities are explosions due to hot cutting taking place either in or adjacent to compartments containing a volatile atmosphere. This is not a new issue. In shipbuilding and ship repair yards throughout the world there is an established procedure requiring the issuing of a certificate by a qualified chemist before any hot work is carried out in any confined space. Although the certificate needs to be maintained, the delivering shipowner could be tasked to provide for an initial test.

b) the provision of an inventory of potentially hazardous materials on board the ship at delivery. This requirement already forms part of both the industry and IMO Guidelines. What is lacking, however, is a definitive list of what should be on such an inventory.

c) What is also lacking is a list of those recycling facilities which have been approved by the state as being capable of performing the recycling of a ship in accordance with the requirements of the state. Were such a list to exist, shipowners could be required to only do business with those yards meeting a state's criteria for approval.

d) International legislation (IMO's MARPOL Convention) already requires Governments to "ensure the provision of reception facilities" at all appropriate ports, terminals and repair facilities covering the discharge of garbage, sewage, oily residues and other noxious liquid substances. A small amendment to incorporate "recycling facilities" would solve quite a few of any potential environmental problems.

e) the current IMO Guidelines call for the recycling facility to produce a recycling plan in respect of each ship it contracts to dismantle. The shipping industry supports the development of this requirement.

However, without enforcement, there may as well be no mandatory rules

3. A REPORTING SYSTEM (CURRENTLY BEING CONSIDERED WITHIN IMO)

Some countries within IMO are proposing the establishment of a complex certification and reporting system in respect of ships destined for recycling yards. One government proposal involves the identification of three stages

a) preparation
b) pre-cleaning
c) demolition

At each of these stages it is proposed that a certificate is issued by or on behalf of the flag state verifying that the work has been done and a complex reporting procedure carried out. However, no thought has been given as to the processes or requirements such certification might cover.

The shipping industry is not opposed to the establishment of a reporting procedure in respect of ships destined for recycling **provided the purpose of such a procedure is justified, clear and unambiguous, applicable to all and enforced by all.** We have heard no justification for a reporting procedure - only a desire to have one. We believe that recycling states should inform the shipping industry of those recycling yards with which it could legitimately and reliably do business. No other "reporting system" would then be necessary.

A “permit to recycle” procedure on shipowners alone would be unenforceable and, because of this, opposed. The industry believes that any such reporting procedure should:

- fulfil a purpose
- be simple and straightforward
- be universally applicable
- be completed before contract
- place responsibility on both parties to the contract to continue to notify their appropriate administrations (i.e. seller to flag state, buyer to recycling state) of their intentions
- permit no subsequent interference in completion of the contract

The detail to be included in any report to the respective administrations would need to be standardised.

Certification is, we believe, an unnecessary complication and the involvement of Governments as an international norm after the contract had been finalised, an impossible and unnecessary burden - unless enforced by all flag and recycling states.

4. THE BASEL CONVENTION AND ITS APPLICABILITY TO SHIPS

We much regret having to discuss the legal nicety as to whether the Basel Convention is applicable to ships as some countries and certain NGOs continue to claim.

Let us be clear what is being claimed - that ships on their way, under their own power, fully compliant with MARPOL, SOLAS the ISPS Code and other relevant international instruments, because they are on their last voyage rather than the one before it, are now not only "waste" but also "hazardous waste".

The industry is firmly of the view, following an examination of the Basel Convention, and the application of a little logic, that this view is wrong and that IMO was correct when it reported that "IMO would not tend to define the ship delivered for recycling as waste but as a resource containing some contaminants."

We say this because

a) The Basel Convention (Article 1.4) does not apply to items which are covered by another international convention. Ships, while "operating in the marine environment" are covered by the MARPOL Convention. The Basel Convention, therefore, does not apply to ships making their way, under their own power, to a recycling yard.

b) For any substance to be covered by the Basel Convention it not only must be a waste but it must also have one of the following properties.

- Explosive
- Flammable liquids
- Flammable solids
- Substances or wastes liable to spontaneous combustion
- Substances or wastes which, in contact with water emit flammable gases
- Oxidizing
- Organic Peroxides
- Poisonous (Acute)
- Infectious substances
- Corrosives
- Liberation of toxic gases in contact with air or water
- Toxic (Delayed or chronic)
- Ecotoxic
- Capable…. after disposal*, of yielding another material, which possesses any of the characteristics listed above."

*(Annex IV to the Basel Convention contains a list of disposal and recycling methods. It is quite clear that, in the case of a ship sold to recycling yards, with delivery to take place on arrival at, and under the control of, the recycling facility, "disposal", as defined in Basel, is the full responsibility of the recycling yard purchasing the vessel. It is only when a ship ceases to be a "ship" as defined in MARPOL, that certain components of or materials within the ship, when isolated, might fall within the definition of "*Other*", or possess other Annex III characteristics.)

A "ship", defined in MARPOL 78 (Article 2.4) as "a vessel of any type whatsoever operating in the marine environment …", does not possess any of these Basel Convention characteristics. If it did it would not be permitted by IMO Regulations to operate in the marine environment.

The industry submitted a paper outlining these views to the last meeting of the Parties to the Basel Convention. It was not even discussed. We had hoped that our analysis of the Basel Convention would settle the argument or at least show us why our analysis was wrong. This proved impossible as the Parties to the Convention refused even to have the debate.
The shipping industry believes that it is a Government's responsibility to apply and enforce ANY regulation. No Governments have done so.

Despite claims in a press release by two environmental organisations, the last meeting of the Parties to the Basel Convention changed nothing - and this was reported on the Basel Convention's own web site. Unfortunately and regrettably, this was not the first time these environmental organisations have been "economical with the truth". Presumably they have their own constituents to please.

In any event, it has to be recognised in respect of any mandatory regulations, that development takes a long time. The developers need to

a) Identify appropriate recommendations
b) Establish principles
c) Consider appropriate instrument
d) Develop text
e) Adopt text
f) Ratify text

The previous Chairman of IMO's Maritime Environment Protection Committee estimated that it would take some 10 years.

Aren't there more pressing things to do? Will a bureaucratic reporting system save lives? Isn't the problem today - now - rather than in the future?

To argue, as some do, that the whole problem is the responsibility of shipowners, is rather like blaming potatoes for people being overweight.

- It is nations who establish priorities for **their** countries and **their** citizens - not shipowners
- It is nations who set the standards for **their** countries and **their** citizens - not shipowners
- It is nations who develop, introduce and enforce legislation for the benefit of **their** countries and **their** citizens - not shipowners

The vast majority of internationally operating shipowners conform to the law - as do the vast majority involved in any other industry.

Should countries decide that they do not want a ship recycling industry in their country they have the power to stop it or regulate it - not shipowners.

5. SELLING AND BUYING

It is essential that the law makers i.e. Governments have some idea of the process by which ships are bought and sold, especially the way they are bought by and sold to recycling yards.

It comes as a surprise to many that recycling yards compete to buy ships and that recycling nations themselves derive tax income from the activity. How then do the majority of ships move ownership from the shipowner to the recycling yard?

What usually happens is that the shipowner decides that his vessel no longer suits his purpose and he seeks a buyer. For most shipowners, buying or selling a ship is not something he does every day so he employs a broker, an expert in Sale & Purchase, to act on his behalf. The broker will offer the ship on the market and seek a buyer.

One of the categories of buyers on the market is that of “cash buyers”. These are not “shipowners” in the sense that they do not operate trading ships but what they do is offer a guaranteed price to purchase a vessel.

A shipowner with a ship arriving off a beach with little or no fuel on board and probably a minimum crew, is in an extremely vulnerable position if, for example, the recycler seeks to renegotiate the contract. The shipowner has little option but to agree. So, to avoid that risk he is more likely to seek a guaranteed sale, at a guaranteed price, to a “cash buyer”.

The cash buyer then becomes the owner of the ship i.e. the “shipowner”.

While the deal is going through between the cash buyer and the operating shipowner, the cash buyer will be looking out for a buyer for the ship. This can be a recycling yard (who may themselves employ a broker) looking to purchase a ship to recycle. The “selection process”, therefore, is generally not the shipowner selecting a yard, but rather the yard selecting and, in competition with other yards, purchasing a ship.

6. THE WAY AHEAD

The shipping industry believes that there is a way ahead on recycling, a way that is both practical and pragmatic. We must identify the tasks and divide them into short term objectives such as

- Identifying recycling facilities
- Assessing the capabilities of those facilities
- Endorsing their ability to handle the recycling of ships
- Developing a standard "Ship Recycling Plan" outlining the issues which must be covered in it
- Identifying those potentially hazardous materials which should be included in a hand-over inventory
- Providing a "gas free for hot work certificate" at hand-over
- Requiring reception facilities for garbage, sewage, oily residues and other noxious liquids at all authorised recycling facilities
- Endorsing an acceptable "Sale & Purchase" contract which encompasses these requirements such as BIMCO's DEMOLISHCON

In the medium term we must look at ways at enforcing the essential elements of the above list and also look at ways of providing and improving the training and advice available on recycling ships.

In the longer term, and this is perhaps were RINA has a role, we must look at what could be done today in respect of ships still at the planning or building stage to make them more easily (and less hazardously) recyclable. Are there particular problems, for example in draining pipes, marking potentially hazardous materials used in construction? Are there alternative materials which might be used. These and other issues might be addressed at the planning ot construction stages.

There is no doubt that

- Recycling capacity is essential
- Problems have been identified and
- Those problems have to be addressed.

But ships are not “waste” let alone “hazardous waste”. The operation is not scrapping, dismantling or disposal. It is recycling.

Shipping has always had a hard time presenting its case as the safest, most environmentally friendly, most fuel-efficient form of transport. It is the disaster pictures and stories which always catch the eye rather than those of good and efficient ships successfully carrying out their role in international trade and transport.

Similarly, the use of emotive phrases such as “toxic ships” are easy headline grabbers. The truth, as usual, is far more complex and far more difficult to get across in today’s sound bite culture.

7. CONCLUSIONS

The benefits of the recycling process are real - the problems also are real. Let us address them.

Recycling has a positive effect on the national economy and the global environment.

Recycling ships is best carried out where there is a ready market for the recovered materials and items.

There are many stakeholders with a role to play in addressing these issues - national administrations and commercial operators - and it is only by co-operation that the areas of concern to us all will be addressed.

The shipping industry has not adopted a fundamentalist approach to the issues. We have not washed our hands and walked away. We have recognised our ability to have a beneficial impact on the problem areas, have addressed them, and will continue to address them, and will continue to lobby for them. We are willing to consider change and improvement. Are the other stakeholders?

THE IMO'S WORK ON SHIP RECYCLING*

S Dimakopoulos, International Maritime Organization

SUMMARY

The paper provides a brief history of the issue of ship recycling in IMO and a summary of the IMO Guidelines on Ship Recycling. It also provides information on the latest developments in the IMO Marine Environment Protection Committee on a number of issues related to ship recycling, such as the possible mandatory application of certain elements of the Guidelines, the development of a reporting system for ships destined for recycling, the approval of guidelines for the development of the ship recycling plan, the preparation of a "single list" of the on board potentially hazardous materials, the mechanisms to promote the implementation of the Guidelines, the inter-agency co-operation and others.

1. INTRODUCTION

1.1 Ship recycling contributes to sustainable development and is the most environmentally friendly way of disposing of ships with virtually every part of the hull and machinery capable of being re-used. However, while the principle of ship recycling is a sound one, the reported status of working practices and environmental standards in recycling facilities in certain parts of the world often leaves much to be desired.

1.2 Noting the growing concerns about environmental safety, health and welfare matters in the ship recycling industry, and the need to reduce the environmental, occupational health and safety risks related to ship recycling, as well as the need to secure the smooth withdrawal of ships that have reached the end of their operating lives, the International Maritime Organization (IMO) has taken swift action to develop a realistic and effective solution to the problem of ship recycling, which will take into account the particular characteristics of the world of maritime transport.

2. BRIEF HISTORY OF THE ISSUE OF SHIP RECYCLING IN IMO

2.1 The issue of ship recycling was first brought to the attention of the IMO Marine Environment Protection Committee (MEPC) at its forty-second session in 1998 and at the following sessions of the Committee it was generally agreed that IMO has an important role to play in ship recycling, including preparation of a ship before recycling commences, and a co-ordinating role towards the ILO and the Basel Convention in recycling matters. At MEPC 47 (March 2002), the Committee agreed that, for the time being, IMO should develop recommendatory guidelines to be adopted by an Assembly resolution.

2.2 MEPC 49 (July 2003) finalized the IMO Guidelines on Ship Recycling (hereinafter referred to as the "Guidelines"), which were subsequently adopted on 5 December 2003 at the twenty-third regular session of the Assembly by resolution A.962(23). IMO invited Governments to take urgent action to apply these Guidelines, including the dissemination thereof to the shipping and ship recycling industries, and to report to the MEPC on any experience gained in their implementation.

2.3 MEPC 50 (December 2003), realized that the amendments to MARPOL Annex I in the wake of the "Prestige" would increase the number of vessels to be recycled within a specific period of time, which implies an increased need for ship recycling facilities and capabilities. The Committee adopted resolution MEPC.113(50), recommending that initiatives should be taken to maintain adequate ship recycling facilities at world-wide level and to promote research and development programmes to improve environment and safety levels in ship recycling operations.

2.4 Ship recycling remains a high priority item on the work programme of the MEPC and intensive work is currently under way with the objective of promoting the implementation of the Guidelines, assessing their effectiveness, reviewing them if necessary, and, finally, determining any other required solutions, including the identification of those parts of the Guidelines which may be made mandatory. The latest developments in the MEPC on the issue of ship recycling are reported in the following section 4.

3. IMO GUIDELINES ON SHIP RECYCLING

3.1 As mentioned in the above paragraph 2.2, the IMO Guidelines on Ship Recycling were adopted on 5 December 2003 by resolution A.962(23). A copy of the Guidelines is available on the Internet (http://www.imo.org - select Marine Environment/Ship recycling).

Objectives and background

3.2 The Guidelines have been developed to provide guidance to flag, port and recycling States, shipowners, ship recycling facilities, ship builders and marine

* Views expressed in this paper are those of the author and should not be construed as necessarily reflecting the views of IMO or its Secretariat.

equipment suppliers as to “best practice”, which takes into account the ship recycling process throughout the life cycle of the ship. The Guidelines seek to:

- encourage recycling as the best means to dispose of ships at the end of their operating lives;
- provide guidance in respect of the preparation of ships for recycling and minimizing the use of potentially hazardous materials and waste generation during a ship’s operating life;
- foster inter-agency co-operation; and
- encourage all stakeholders to address the issue of ship recycling.

3.3 The Guidelines take into account the "Industry Code of Practice on Ship Recycling"[1] and complement other international guidelines addressing this issue; notably those produced under the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal focusing on issues related to ship recycling facilities[2], and those of the International Labour Organization addressing working conditions at the recycling facilities.[3]

Identification of potentially hazardous materials

3.4 The Guidelines place a significant emphasis on the identification of potentially hazardous materials on board ships prior to recycling and introduce the concept of the **Green Passport**. The Green Passport for ships is a document providing information with regard to materials known to be potentially hazardous utilised in the construction of the ship, its equipment and systems. This document should accompany the ship throughout its operating life and successive owners of the ship should maintain the accuracy of the Green Passport and incorporate into it all relevant design and equipment changes, with the final owner delivering the document, with the ship, to the recycling facility. In identifying potentially hazardous materials on board ships, Appendices 1 and 2 to the Guidelines provide two lists to consider for guidance, while the format contained in Appendix 3 of the Guidelines may be used as a model for the preparation of the inventory of the potentially hazardous materials on board the ship.

Design and construction of ships

3.5 Acknowledging that a number of the problems associated with ship recycling might be addressed at the design and construction stage, the Guidelines encourage ship designers and shipbuilders to take due account of the ship’s ultimate disposal when designing and constructing a ship.

3.6 The use of materials which can be recycled in a safe and environmentally sound manner, the minimization of the use of materials known to be potentially hazardous to health and the environment, the consideration of structural designs that could facilitate ship recycling and the promotion of the use of techniques and designs which, without compromising safety or operational efficiency, contribute towards the facilitation of the recycling operation are some of the recommendations provided by the Guidelines with regard to the design and construction of ships.

3.7 Manufacturers of marine equipment that contains hazardous substances are also encouraged to design the equipment so as to facilitate the safe removal of those substances, or give advice as to how such substances can be safely removed at the end of the working life of the equipment.

Use of potentially hazardous substances

3.8 Minimization of the use of potentially hazardous substances and of waste generation is also recommended for the lifetime of ships and therefore shipowners should:

- make every effort to minimize the amount of potentially hazardous materials on board the ship, including those carried as stores, during routine or major maintenance operations or major conversions; and
- continuously seek to minimize hazardous waste generation and retention during the operating life of a ship and at the end of a ship's life.

Preparation of a ship for recycling

3.9 The Guidelines also provide a number of recommendations with regard to the preparation of a ship for recycling, which should begin before the ship arrives at the recycling facility. These preparations include amongst others:

- the selection by the shipowner of a recycling facility which has the capability to recycle the ships it purchases in a manner consistent with national legislation and relevant international conventions;
- the development of a recycling plan by the recycling facility in consultation with the shipowner, ensuring that a ship has been prepared to the maximum extent possible prior to its recycling and that the safety of the ship, prior to delivery, has been taken into account;
- preparations to protect occupational health and safety, such as issue of gas-free/hot work certificates, marking of any oxygen-deficient compartments onboard and identification of any area of the ship where there may be structural integrity problems or critical support structures; and

- preparations to prevent pollution, such as minimization of the quantities of fuel, diesel, lubricating, hydraulic and other oils and chemicals on board at delivery to the facility, removal of wastes at appropriate port reception facilities, and controlled drainage, by the recycling facility, of potentially harmful liquids from the ship.

Role of stakeholders and other bodies

3.10 The Guidelines provide guidance to all stakeholders in the ship recycling process. This includes flag, port and recycling States, authorities of shipbuilding and maritime equipment supplying countries, as well as relevant intergovernmental organizations and commercial bodies such as shipowners, ship builders, marine equipment manufacturers, repairers and recycling facilities. Additional stakeholders include workers, local communities, and environmental and labour bodies.

3.11 In accordance with the Guidelines:

- **flag State Administrations** should promote the application of the Guidelines, establish criteria to declare a ship "ready for recycling", promote the use of ship recycling sales and purchase contract and co-operate with recycling States to facilitate the implementation of the Guidelines;
- **port States** should promote the widespread use of the Guidelines within the industry and co-operate with flag States and recycling States to facilitate their implementation. It is also stressed that ships destined for recycling are subject to current port State control procedures, as any other ship, in accordance with applicable international regulations;
- **recycling States** should introduce, implement and enforce sound legislation and other requirements concerning the recycling of ships, including measures to authorize or license recycling facilities and regulations in relation to the condition of ships purchased for recycling both at the time of purchase and at the time of delivery. They should check that any potentially hazardous wastes, which might be generated during the recycling operation, can be safely handled prior to the delivery of the ship for recycling, and monitor the safe handling of any hazardous materials generated during the recycling process. Recycling States should also assess the capabilities of their recycling facilities and make available the results of those assessments and ensure that, in authorising a recycling activity, adequate reception facilities are in place;
- **the shipping industry** should continue its co-operation with the other stakeholders towards improving plans to decommission ships in a safe and environmental sound manner and is encouraged to continue the further development of the "Industry Code of Practice on Ship Recycling"; and
- **the ship recycling industry** should take due note of available technical guidance on ship recycling, develop a code of practice appropriate to that industry and improve the quality management system of the recycling facilities. It should also encourage recycling facilities to make available details regarding procedures for the chosen method for the safe handling of hazardous materials and working practices and establish adequate waste management systems.

3.12 The Guidelines also refer to the role of the ILO, the Basel Convention and the London Convention 1972/1996 Protocol, making reference to their relevant provisions and guidelines applicable to ship recycling.

Technical co-operation

3.13 Finally, the Guidelines suggest that national or regional organizations should co-operate with Governments in ship recycling States and other interested parties on projects involving the transfer of technology or aid funding to improve facilities and working practices in the recycling facilities.

4. MEPC'S WORK PROGRAMME ON THE ISSUE OF SHIP RECYCLING

4.1 Ship recycling is one of the high priority items in the agenda of the MEPC. The Committee held its fifty-second session from 11 to 15 October 2004 and taking into account the outcome of that session on ship recycling, the Committee's work programme on this issue could be summarized as follows.

Mandatory application of certain elements of the Guidelines

4.2 MEPC 52, having considered the need for developing mandatory measures for ship recycling, agreed that certain parts of the IMO Guidelines might be given mandatory effect. The Working Group on Ship Recycling (hereinafter referred to as the "Group"), established at that session, developed an initial list of the elements of the Guidelines for which a mandatory scheme might be regarded as the most suitable option for their implementation, as set out in the annex.

4.3 In this respect, the Committee noted that the outcome of this work should be considered as a starting point for the future work that was needed intersessionally in order to develop further this list and to consider issues associated with the possible mandatory application of the identified measures.

4.4 The Committee further noted that the Group, in considering how the implementation of such a possible mandatory scheme could be achieved, discussed briefly whether existing IMO instruments were the appropriate legal framework for the ship recycling provisions or whether these should be developed as a new separate legal mechanism. Whilst it was suggested that existing IMO instruments, such as MARPOL 73/78, could provide an appropriate vehicle for the implementation of some of the identified measures, the Group agreed that **a new IMO instrument could be developed with a view to providing legally binding and globally applicable ship recycling regulations** and that further work was needed before a concrete proposal could be made on this issue.

Reporting system for ships destined for recycling

4.5 Regarding the reporting system for ships destined for recycling, the Group agreed that this system should be developed in accordance with the following basic principles:

- the system should be transparent, effective, ensure uniform application and respect commercially sensitive information;
- the system should be developed in such a way as to facilitate the control and enforcement of any mandatory provisions on ship recycling that may be developed by IMO;
- the system should be implemented by the shipowner, the recycling facility, the flag State and the recycling States with the latter two stakeholders having the primary role for ensuring its proper application;
- the system should be a stand-alone reporting mechanism; and
- although existing notification and reporting procedures under other existing legal instruments could be taken into account, the system should be a workable and effective one, with the minimum required administrative burden and catering for the particular characteristics of world maritime transport.

4.6 MEPC 52 developed, as a starting point, a draft outline of the reporting system for ships destined for recycling in order to identify in a schematic way what should be reported, to where and by whom. In this respect, it was noted that additional work was needed for the further development of this system with the aim of considering, amongst other issues, the appropriate time-frame for the reporting, a harmonized reporting format and the possible need for additional flow of information between the involved stakeholders.

"Single list" of the on board potentially hazardous materials

4.7 MEPC 52 agreed that a "single list" of the on board potentially hazardous materials should be developed replacing the existing Appendices 1, 2 and 3 of the Guidelines. The "single list" would provide guidance on the identification of potentially hazardous materials on board ships and the preparation of the relevant inventories.

4.8 The Committee noted that the Group, having agreed that a standard format should be developed in order to provide for a uniform and consistent application, developed an initial layout of the "single list" for further consideration in the intersessional period.

4.9 The Committee further noted that the Group agreed that:

- the "single list" should be user friendly, workable and practicable, specific for shipboard applications, exclude any generic terms and provide information on all hazards associated with the entries in the list;
- Appendix 3 of the Guidelines should be the basis for the "single list", supplemented as necessary by selective entries from Appendices 1 and 2 of the Guidelines, in order to be as comprehensive as possible; and
- once the "single list" has been developed it might be appropriate, prior to its finalization, to seek input and comments from the Joint ILO/IMO/BC Working Group on Ship Scrapping (see section 5).

Mechanisms to promote the implementation of the Guidelines and Criteria for ships to be declared "Ready for Recycling"

4.10 A set of possible and suitable mechanisms for the promotion of the implementation of the Guidelines and an initial draft set of the criteria for ships to be declared "ready for recycling" were prepared by the intersessional Correspondence Group on Ship Recycling established by MEPC 51 and submitted for consideration and further development to MEPC 52.

4.11 At MEPC 52, it was recognized that the outcome of the work outlined in the above paragraphs 4.2 to 4.9 would have a significant effect on the further consideration of the possible mechanisms for the promotion of the implementation of the Guidelines and on the further development of the criteria for ships to be declared "Ready for Recycling" and, therefore, it was agreed that these issues should be considered at a future session.

4.12 Regarding the promotion of the implementation of the Guidelines, the Committee agreed that a preliminary plan should be developed identifying priorities, achievable deadlines, and input required from other IMO Committees and Sub-Committees.

Proposed amendments to the Guidelines

4.13 The Committee, at its fifty-second session, considered a number of proposals for amendments to the Guidelines submitted by the Industry Working Party on Ship Recycling[4], which was invited to prepare a revised text of the proposed amendments to the Guidelines for further consideration in the intersessional period.

Ship Recycling Fund

4.14 MEPC 52, having considered a proposal by Bangladesh, agreed, in principle, to the need for the establishment of an International Ship Recycling Fund to promote the safe and environmentally-sound management of ship recycling through the IMO's technical co-operation activities. However, it was agreed that the working arrangements and funding mechanism of such a Fund would require further consideration and clarification and the IMO's Technical Co-operation Committee was invited to consider further the arrangements to establish such a dedicated fund.

Future working arrangements

4.15 MEPC 52, taking into account the need to progress the work on ship recycling issues in an expeditious manner:

- agreed to the establishment of a correspondence group to further progress the work in the intersessional period;
- approved a three-day intersessional meeting of the Working Group on Ship Recycling during the week before MEPC 53 (to be held from 18 to 22 July 2005) to consider the issues related to the terms of reference of the Correspondence Group; and
- agreed to re-establish the Working Group on Ship Recycling at the next session of the Committee.

Guidelines for the development of the ship recycling plan

4.16 In accordance with section 8.3.2 of the IMO Guidelines on Ship Recycling, the development and implementation of a recycling plan can help ensure that a ship has been prepared to the maximum extent possible prior to its recycling and that the safety of the ship, prior to delivery, has been taken into account. The ship recycling plan should be developed by the recycling facility in consultation with the shipowner, taking into account the potential hazards which may arise during the recycling operation, the relevant national and international requirements and the facilities available at the recycling facility in terms of materials, handling and the disposal of any wastes generated during the recycling process.

4.17 MEPC 52 approved the Guidelines for the development of the ship recycling plan, aimed at providing technical information and guidance for its preparation. These Guidelines have been circulated by means of MEPC/Circ.419 and are also available on the Internet (http://www.imo.org - select Quick links/Circulars/MEPC).

5. INTERAGENCY CO-OPERATION

5.1 IMO maintains close co-operation with ILO and the Basel Convention on the issue of ship recycling and the establishment by the three Organizations of the Joint ILO/IMO/Basel Convention Working Group on Ship Scrapping is a good example and evidence of this enhanced co-operation at the international level.

5.2 The overall task set by the three Organizations for the Joint Working Group is to act as a platform for consultation, co-ordination and co-operation in relation to their work programmes and activities with regard to issues related to ship recycling. The Joint Working Group aims to promote a co-ordinated approach to the relevant aspects of ship recycling with the aim of avoiding duplication of work and overlapping of roles, responsibilities and competencies between the three Organizations, and identifying further needs.

5.3 The first session of the Joint ILO/IMO/Basel Convention Working Group on Ship Scrapping, hereinafter referred to as the "Joint Working Group", was held at the IMO headquarters in London from 15 to 17 February 2005.

5.4 During the first meeting, the Joint Working Group considered the respective work programmes of the pertinent bodies of ILO, IMO and the Conference of Parties to the Basel Convention on the issue of ship recycling and developed a list of the main items that are being considered by the three Organizations concurrently. This includes the possible development of mandatory requirements, a reporting system for ships destined for recycling, the development of a "single list" of potentially hazardous materials on board, the issue of the abandonment of ships on land or in port, the promotion of the implementation of the Guidelines on ship scrapping, and technical co-operation. For each item identified, a list of work programme activities being carried out or planned by each of the Organizations was developed, and a number of recommendations were proposed to be taken into account by the three Organizations, as appropriate, during their future deliberations on these work items.

5.5 With a view to identifying any possible gaps, overlaps, or ambiguities, the Joint Working Group began a comprehensive initial examination of the relevant IMO, ILO and BC guidelines on ship recycling, based on a comparison of the issues presented in each of the guidelines in the form of a matrix, and a draft overview paper outlining the purpose of each of the guidelines, their respective field of application and main contents. However, it was recognized that this was a large undertaking that was unlikely to be completed at this initial meeting. The Joint Working Group agreed that intersessional work and further work at the second session would be needed.

5.6 The implementation of the guidelines was seen as being of paramount importance for the minimization of the environmental, occupational health and safety hazards related to ship recycling and the improvement of the protection of human health and the environment at ship recycling facilities. In this respect, the Joint Working Group agreed that each Organization should consider the translation of its guidelines into the working languages of the main ship recycling States, and that each should also ensure that a user-friendly web page is established, providing information on ship recycling matters and a link to the other two Organizations' relevant web-pages and guidelines. It also agreed to invite the ship recycling States to make point-of-contact details for the competent authorities responsible for issues related to ship scrapping publicly available, and to invite Governments and all involved stakeholders to provide information to the three Organizations on any experience gained in the implementation of the guidelines.

5.7 It was agreed that the implementation of the guidelines should be also promoted through joint technical co-operation activities, and the Joint Working Group agreed to invite Governments and other stakeholders to provide information to the three Organizations on any technical co-operation activities or other relevant initiatives already launched or planned so that these activities could be taken into account in the future technical co-operation programmes of the Organizations. Each Organization should be asked to invite the other two to participate in any workshops or seminars they organize, and a section providing information on the guidelines of the other two Organizations should be included in the programme of any such activities. It was agreed that the three Organizations should be asked to consider a global technical co-operation programme on ship scrapping.

5.8 The report of the first session of the Joint Working Group will be submitted to the pertinent bodies of the three Organizations. The second session of the Joint Working Group will be hosted by the Basel Convention in Geneva, Switzerland, either in December 2005 or January 2006.

6. CONCLUSIONS

6.1 Recycling is one of the basic principles of sustainable development and ship recycling is, generally, the best option for all time-expired tonnage. IMO, therefore, encourages and promotes ship recycling in compliance with the international standards on safety, health and environment.

6.2 IMO's work on ship recycling aims at the development of a realistic, pragmatic, well-balanced, workable and effective solution to the problem of ship recycling, which should take into account the particular characteristics of world maritime transport and the need for securing the smooth withdrawal of ships from trade at the end of their operating lives.

6.3 Areas where IMO has focused its attention include, but are not limited to:

- the minimization of the use of hazardous materials in the design, construction and maintenance of ships, without compromising their safety and operational efficiency;
- the identification of potentially hazardous materials on board ships and the preparation of the relevant inventories (e.g. Green Passport); and
- the preparation of ships for recycling in such a manner as to reduce environmental and safety risks and health and welfare concerns as far as practicable.

6.4 The issue of ship recycling has been given high priority at the MEPC in order that the promotion of the implementation of the IMO Guidelines on Ship Recycling and the consideration of a possible new legally binding IMO instrument on ship recycling are progressed as efficiently and expeditiously as possible.

6.5 IMO maintains close co-operation with ILO and the appropriate bodies of the Basel Convention, with the aim of avoiding duplication of work and overlapping of responsibilities and competencies between the three Organizations.

ANNEX

INITIAL LIST OF THE ELEMENTS OF THE IMO GUIDELINES ON SHIP RECYCLING IDENTIFIED FOR CONSIDERATION AS AREAS FOR POSSIBLE MANDATORY APPLICATION

Mandatory Requirement	**Guidelines Reference**
Recycling Facilities	
Recycling State to require operational waste reception facilities at recycling facilities	9.4.2.3
Ship Recyclers to be "licensed"	9.4.4.1
Shipowners required to use “approved/licensed” recycling facilities	8.1.6
Shipowners to arrange for removal of materials the recycling facility cannot handle	8.1.5
Reporting	
Ship Recycling Plan	
Recycling facility to prepare a ship recycling plan in consultation with the shipowner	8.3.2.2
Ship Recycling Contract	
Shipowners/Recycling facilities to include elements of the Guidelines such as the Ship Recycling Plan, etc. in recycling contracts	8.3.2.5, 9.2.2, 9.4.3.3, 9.8.2
Potentially Hazardous Materials	
States to prohibit/restrict/minimize the use of potentially hazardous materials in new ships	6.1.1, 6.1.4, 6.1.2
Shipbuilders to provide the first shipowner with Part 1 of the inventory	5.5
States to prohibit/restrict/minimize the use of potentially hazardous materials in existing ships	7.2.1
Shipowners to provide an updated inventory of potentially hazardous materials on board on arrival at the recycling facility	5.6
Shipowners to mark assumed and identified potentially hazardous materials included in the inventory and any potentially hazardous spaces in accordance with the Ship Recycling Plan	8.3.1.1, 8.3.1.2.2, 8.3.3.2.8, 8.3.4.1.2-4
Shipbuilders to seek advice on limiting the use of identified potentially hazardous materials in ships	6.1.6
Green Passport	
Shipbuilders to provide new ships with a “Green Passport”	5.5, 5.5.1, 5.8
Shipowners to maintain Ship Details and Part 1 of Inventory sections of the “Green Passport”	5.1, 5.3
Shipowners to prepare Parts 2 and 3 of the Green Passport prior to the final voyage to the recycling facility	5.6
Shipowner to develop “Green Passport, Part 1” for existing ships as far as is practicable and reasonable	5.5.2
Shipowners to deliver “Green Passport” to recycling facility	5.1
Gas Free for Hot Work Certificate	
Shipowners to arrange with recycling yard for a "gas-free-for-hot-work" certificate covering enclosed cargo and other spaces and empty fuel spaces at handover or in accordance with the Ship Recycling Plan	8.3.4.1, 9.4.3.2, 8.1.3.3
Ship Details	
Shipowners to hand over the Continuous Synopsis Record to the recycling facility	5.2.1 (Pending development of the “Green Passport”)

[1] In co-operation with other industry organizations, ICS has produced the "Industry Code of Practice on Ship Recycling", outlining the measures that shipowners should be prepared to take prior to recycling (see www marisec.org/recycling).

[2] Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships adopted by the Sixth Meeting of the Conference of Parties to the Basel Convention on 13 December 2002 (see http://www.basel.int/ships/techguid.html).

[3] *Safety and Health in Shipbreaking: Guidelines for Asian countries and Turkey,* developed by ILO (see www.ilo.org/public/english/protection/safework/sectors/shipbrk/index htm).

[4] The Industry Working Party on Ship Recycling was established in February 1999 comprising representatives from BIMCO, INTERCARGO, INTERTANKO, ICS, ITOPF, ITF, and OCIMF with active participation, as observers, also from ECSA and IACS.

7. AUTHOR'S BIOGRAPHY

Sokratis Dimakopoulos holds the current position of the Implementation Officer in the Sub-Division of Pollution Prevention in the Marine Environment Division of the International Maritime Organization. He is the responsible officer in the IMO Secretariat for issues related to ship recycling. He is the Secretary of the MEPC's Working group on Ship Recycling and Co-Secretary of the IMO/ILO/Basel Convention Joint Working Group on Ship Scrapping.

RECYCLING IS A SHORE BASED INDUSTRY

F R Chowdhury, Bahamas Maritime Authority, UK

1. IMPORTANCE OF THE SUBJECT

Recycling of ships is also referred to as ship-breaking, ship-scrapping and even demolition of ships. Whatever name we call it by, it involves breaking up a ship at the end of its useful life and then to recycle various components. Most of the steel finds its way to re-rolling mills and various other components get sold for further use. The increase in world trade has resulted in unprecedented growth of the world merchant marine fleet. In a year or two there would be a big increase in the number of ships reaching the end of their useful life and moving on to scrap-yards. This will certainly reach a peak by about 2010 when all the single hull tankers will have to be replaced. The massive growth of oil and gas exploration at sea has generated a huge number of new structures that will also need to be demolished or recycled at the end of their useful life.

Most of the ship-breaking takes place in the third world where labour is cheap and technology is very primitive. The health and safety standards are poor. Accidents and explosions result into death and injury. The industry with no environmental control or protection is causing long term damage to the environment. We still remember the case of "Brent Spar" that dominated news headlines for quite sometime. Then it was the case of "ghost ships" from the United States heading for demolition in the UK. There are possibly about 200 more decommissioned ships tied up in the James River, Virginia. As stated earlier, the process is going to gain momentum in the coming days and yet we do not have any internationally agreed standard to carry-out the re-cycling in a safe manner that would not cause any health, safety or environmental concern.

2. PRESENT INTERNATIONAL INSTRUMENTS

The London Convention (The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter) 1972 has no provision for re-cycling of ships. The OSPAR Convention/ Sintra Statement of 1998 is basically a regional Commission for the Protection of the Marine Environment of the North-East Atlantic. The Basel Convention regulates the transport of hazardous materials to developing countries by making the ship (as the carrier) and the exporter responsible. A disused ship under tow could perhaps be considered as a hazardous material to fall under this Convention but <u>a live operational ship moving on its own power cannot be treated as potentially hazardous waste</u>. Application of the concept of export-import to operational ships will complicate the whole issue. <u>The Basel Convention certainly does not apply to ships.</u> This brings us to the conclusion that there is, till this time, no international instrument to regulate the health, safety and environmental standards relating to re-cycling of ships and other marine structures. What we need is a separate international Convention to provide the necessary frame-work to regulate this industry.

3. THE ROLE OF THE INTERNATIONAL MARITIME ORGANISATION (IMO)

The role of the International Maritime Organisation (IMO) is maritime safety and protection of the marine environment. It uses the slogan "safer ships and cleaner seas". The ISM Code of the SOLAS Convention deals with safe operation of ships and protection of the marine environment. The important part is "safe operation". The IMO and its Member States (acting as Flag States) will have to ensure that the ship, until the last day of its operation, complies with all applicable IMO rules for safe operation and protection of the marine environment. <u>A ship, in the pretext of going for scrap, should not be allowed to compromise safety or environmental concern.</u>

The next important role that IMO can play is to ensure that ships are built with less toxic materials so that at the end of its useful life we have less hazardous materials to deal with. This concept has been referred to as the "Green Passport". To achieve this, IMO will have to suitably amend the SOLAS and MARPOL Conventions so that use of toxic and hazardous substances can be kept to the minimum and ships should be issued with necessary certificate to this effect. An annex to the certificate should contain a list of any hazardous material that had to be used (within permissible limits) with their location and guidance for their disposal.

Nobody can dispute the important role of IMO in trying to build ships and marine structures with less harmful substances and ensuring the operation of the ship, until it reaches the last port of call under its own power, is done in full compliance of the international regulations. <u>However, when the ship is withdrawn from service and no more operational (and perhaps also de-registered) the IMO remit comes to an end. The recycling of such structures ashore is certainly a shore-based industry.</u>

4. SHORE BASED INDUSTRY

Ship recycling is not the only industry ashore. There are hundreds of other industries ashore. They are regulated and supervised by respective national Governments. The United Nations Environment Programme (UNEP) has the supervisory responsibility in respect of environment in the global context. National environment agencies ensure that guidelines set by the UNEP are complied with. The International Labour Organisation (ILO) has similar responsibility in respect of health and safety of the workers including many other aspects of working conditions. At national level it may be the Factory Inspector or Safety Inspector (acting on behalf of the ministry of industry or labour) who will ensure that relevant regulations in respect of occupational safety and environment are complied with.

In the United States the Federal Aviation Authority checks aircrafts under manufacture to ensure that they are built in compliance with safety regulations. The FAA does not determine or regulate the working conditions of the industry. Similarly ships under construction are supervised at various stages by the inspectors/ surveyors of the Flag Administration or the Classification Society to ensure compliance of the IMO requirements because the ship has to eventually operate in the marine environment. Neither the maritime administration nor the classification society has any responsibility as to how the shipyard works. This aspect is looked after by relevant officials who supervise industrial safety and environmental standards.

It is beyond logic to think of IMO setting standards for a shore based industry simply because it is ship-breaking industry. The maritime inspectors and surveyors of an Administration are not expected to oversee the process of ship-breaking and the working conditions in a scrap-yard as it does not relate to their field of expertise. It can instead be better supervised by factory or industry inspectors. <u>If the ship-breaking industry is to be regulated by the IMO, then the obvious question is why not the ship-building industry?</u>

5. WHAT IMO AND ILO HAVE BEEN TRYING TO DO

IMO has been involved in the matter since MEPC 42 in 1998. It has been trying to find a way how it can have a role to play. Finally it joined hands with the Basel Convention and somehow the ILO also joined in. Nothing much has been achieved except the development of some guidelines. The worst thing that happened is the development of "Safety and health in ship-breaking: Guidelines for Asian countries and Turkey" by ILO. I do not know why ILO suddenly decided to become a regional organisation; or do they have a plan to have another set of standards for the rest of the world?

Talking in terms of "Flag State" and "last owner" – are all counter-productive and waste of time. Who is going to declare himself as the last owner until it reaches the breaking yard? The discussion at IMO even referred to agreement between the ship-owner and the scrapping yard as if it is that simple. In practice it is a different world. The ship may pass through five different hands before it ends up in the breaking yard. The breaking yard may not even own the vessel or any part thereof at any time. The breaking yard may merely be taken on lease by a person or a company undertaking the business. References to so many different parties are totally unnecessary and would not provide any practicable solution. If the ship is to be de-contaminated and cleaned in a highly industrialised/ developed country then there would be no need for it to go anywhere else. <u>The imposition of intermediate requirements and barriers may be viewed by the ship-breaking countries as a way of preventing a ship reaching a breaking yard in a third world country.</u>

Initially the UN agencies may work together but finally they have to decide on their respective role and function. This is extremely important to avoid duplication and overlapping. We also have to bear in mind that at the national level there would be different ministries or departments to co-ordinate with different agencies. We cannot carry forward a bundle of confusion.

<u>The best way forward is for IMO to work within its own competence to try to reduce the use of hazardous materials in ship-building and to ensure that the ship until the last day of operation under its own power complies with all IMO requirements.</u>

<u>Similarly for ILO it is better to take the full responsibility for the ship-breaking industry as it is a shore-based industry. Like all other industries ILO should seek assistance and guidance from UNEP on matters relating to the environment.</u>

6. PRESENT IMO-ILO INITIATIVES NOT WORKABLE

The fact that present initiatives by the IMO-ILO-Basle Convention are not workable can be very well confirmed by the headline news item in Lloyds List of 21-April-05. I said it very clearly that there will never be a straight simple agreement between the ship-owner and a breaking yard. There is bound to be involvement of middle men and stages of agreements. That is what happened with the Danish ferry "Kong Frederik IX". The ferry changed name to "Frederik" and apparently sailed for India to be scrapped there (without making any prior declaration to the Danish authorities). The Danish minister for environment has requested her counterpart in India to return the asbestos-lagged ferry to Denmark. It will not be so easy for the Indian minister to comply with such a request. The vessel may only be returned to the rightful owner (that also only by a court of law) and to no one else (and the State of Denmark probably does not own the ship). The best the Indian minister may be able to do is to refuse demolition of the ship in India (which is also very doubtful). The present IMO-ILO-Basle Convention will not take us anywhere. If we really want to achieve environmentally sustainable process of recycling of ships and other marine structures then we have to look for practicable solutions outlined in this paper.

7. SHIPPING AND SHIP-BREAKING ARE TWO DIFFERENT INDUSTRIES

Shipping means transportation of passengers and goods from one place to another. This is exactly what ship-owners and shipping companies do. Ship-breaking is a different industry. The major players in this industry are the metal dealers or scrap dealers. I have never heard of a shipping company being involved in ship-breaking industry nor do I ever expect them to be involved. At the end of useful life of a ship, the ship-owner will sell his ship. From maritime industry's point of view, we must make sure that ship complies with all IMO requirements until the last day of its operation (under a Flag State). The day the ship is de-registered and withdrawn from operation, it becomes a structure within the control of the state where it lies; and let the metal dealers and scrap-yards comply with all ILO requirements. Nobody debates the need for higher standards of health, safety and environment in ship-breaking but it should be enforced by the State where it actually takes place. <u>It is only the ship-breaking country that can have full and effective jurisdiction and control over the matter.</u>

8. WHO SHOULD DO THE SHIP-BREAKING

In the world of free economic activities we should not try to control or dictate the market. Ship-breaking is basically a labour intensive industry and it will thrive in countries where labour is cheap.

However, for the sake of global environment it is necessary to have the facilities spread all over world. Even countries like USA, UK and Australia, who may not find much economic sense, will also have to share the responsibility. It is because:

a) It will never be economically viable for small ships to be taken all the way to China, India or Bangladesh for recycling. These ships will have to be demolished in nearby locations;
b) There will be damaged and disabled (non-operational) ships and it will be too dangerous to take them across to far off places. They will have to be recycled in nearby places;
c) Development of facilities in both developed as well as developing countries will create opportunities for exchange of know-how and technology.

The problem we are likely to face is how to encourage the industrially developed countries to develop ship recycling facilities. This is not to take away the business from the third world countries but to ensure that we do not have to risk the environment by towing disabled ships across the world.

9. THE SOLUTION

Recycling of ships and other marine structures is a serious matter. Mere guidelines produced by IMO will not serve the purpose. The ideal solution is to draw a Convention specifically on "Recycling of Ships and other Marine Structures". The Convention should focus responsibilities on the ship-breaking country. For nearly seven years IMO could not find a solution and now it is time for the maritime community at IMO to adopt a resolution calling upon competent UN agency (ILO/UNEP) to draw a Convention based on the following:

1. Member States should not allow a ship or marine structure to be abandoned, dumped or broken up within its jurisdiction unless it complies with the requirements of this Convention (abandonment of ships are expected to be covered more specifically by the future IMO Convention on Removal of Wrecks);
2. Member States, after necessary verification as required under this Convention, shall grant licence to scrapping yards within its jurisdiction that meet the standards in respect of health, safety and environment as stipulated in the Convention. Special consideration shall be given to see that the yard has the necessary reception facilities (whether of its own or facilities that it can utilise) to deal with any toxic, hazardous or pollutant substance; The Member State shall subject the continuation of the licence to periodic inspection and review to ensure the compliance of the standards at all times;
3. The person or company responsible for the ship/structure intended to be scrapped in a Member State shall apply to a designated authority for a permit. The application shall contain the following details:
    a) particulars of the company or persons involved in the business;
    b) particulars of the ship or the marine structure;
    c) particulars of the licensed breaking yard;
    d) brief description of any pollutant, toxic or hazardous substances still remaining on board and plans for their safe disposal;
    e) an outline of the recycling plan/programme.
4. Once the authority is satisfied with the proposed plan, it shall grant the necessary permit. The authority may attach any clause or condition if considered necessary;
5. The authority while granting such a permit shall keep the State, under whose Flag the vessel arrived the recycling State, informed. (This is to ensure that the ship is de-registered).

Within the framework of such a Convention, ILO should develop a detailed Code to include safe and environmentally sound practice and procedures. If the Code is developed first, then it could be given the mandatory force of law by cross reference in the Convention. The Code has to contain one global standard. The Code could perhaps become an extension (a new chapter on “Recycling of Ships and Marine Structures”) of the recently developed “Code of Safety: Iron and Steel Industry”

10. CONCLUSION

This will be a simple, workable and effective way of dealing with all aspects (health, safety and environment) of the recycling of ships and other marine structures without involving too many parties and certainly without creating any duplication, conflict or overlapping of responsibilities of various agencies. It will not take seven years; we should be able to achieve it within a year or two.

We have only one world and we have to protect it for future generations. Let us not waste any more time and energy in the wrong direction. Let us concentrate our efforts for real solution. I urge upon the Greenpeace, the Friends of the Earth and similar other organisations (who care for the environment) to join hands in developing an international instrument and enforcing the same. Once we have an instrument, we can name and shame those who do not accept or abide by the instrument. Eventually we should succeed in getting everyone on board and move forward together.

11. AUTHOR’S BIOGRAPHY

Capt. Fazlur Chowdhury was born in Bangladesh in 1945. He first obtained the Master (FG) Certificate from the then DOT, UK in 1976. He later obtained M.Sc. degree from the World Maritime University, Sweden in 1988. Prior to coming to the UK, he was the Director General of the Department of Shipping in Bangladesh. In 1991, he joined the Marine Division of the UK - DOT (later renamed as the Maritime & Coastguard Agency) and became the Deputy Chief Examiner in1997. He went to Gibraltar in the year 2000 and spent over 4 years as the Maritime Administrator. Capt. Chowdhury returned to the UK last year and is now a Deputy Director with the Bahamas Maritime Authority.

THE GREEN PASSPORT, IMPLEMENTATION AND IMPORTANT SAFETY ISSUES.

G Reynolds and **R Townsend,** Lloyd's Register, UK

SUMMARY

The Green Passport is one of the fundamental concepts within the IMO Guidelines on Ship Recycling. It forms the bedrock around which the designers and yards build the ship, the Owners operate and maintain the ship, and the Owners and recycling yard agree to scrap the ship. It is also expected to be an important part of the reporting system that is required under waste legislation.

Compared to the size of the global fleet the number of Green Passports in existence is minimal. Experience in these matters is thus severely limited. Until more experience is gained, the contents, usage, and implementation procedures will necessarily be provisional. To aid standardisation and realisation of the full value of the Green Passport, open discussion is essential. This paper discusses Lloyd's Register's approach, experience and emerging procedures.

NOMENCLATURE

Green Passport; The authors believe this is now a technical term under the useage of IMO Resolution A.962(23), and is as defined in that document [1]. Essentially it is a list of the ships principal details, followed by an inventory of hazardous materials.

ODS; Ozone Depleting Substance. A substance that when released into the atmosphere rises up and destroys ozone molecules in the stratosphere, normally as a bromine or chlorine ion acting as a catalyst in the breakdown of ozone. By this action the ozone layer above the planet is thinned allowing more ultra violet radiation to penetrate to the planet surface and lower atmospheres.

GWP. Global Warming Potential GWP is a relative measure of the radiative forcing effect of a substance relative to CO_2. It is properly known as GWP_{100}, where the 100 refers to its relative effect over 100 years. Certain substances (also known as greenhouse gases).contribute to global warming.. CO_2 has a GWP of 1, some CFCs over 10 000.

Recycling / scrapping / dismantling / demolition. This paper does not seek to differentiate technically between these terms. The authors believe that since end of life vessels present valuable resources and have such a high reusability factor by weight, that the term recycling is to be the preferred aim of the IMO.

1. INTRODUCTION

The paper is in several parts. The first part gives a brief recent history and overview of the subject that will be familiar to many people. The second part talks about the Green Passport specifically and goes into detail about Lloyd's Register's procedures. The third part then explores the concept of licensed recycling facilities.

1.1 BRIEF HISTORY

Whilst ship scrapping is as old as the industry itself, it has historically been paid very little attention. Once a ship became economically non-viable, or for any other reason, the Owner simply sold it to a scrap yard, or to a specialist broker who took care of it for him.

An historical example is the Inverkeithing facility in Scotland. This facility, shown in figure 1, would presumably have been regulated by the national authorities and have scrapped the ship in accordance with the highest applicable standards. Around 500 000 tonnes of steel were recycled by this facility after the Second World War.

Indeed, a recent RINA presentation given to the London Branch of the Institution on the recovery and scrapping of the German Fleet scuttled at Scapa Flow, shows that scrapping of steel ships in the early 1900's was not only very lucrative, but was also carried out with an enviable safety record even by today's standards.

Figure 1: Scrapping at Inverkeithing, 1949

However the industry has changed significantly since that time. From the mid 1980's the centre of the ship scrapping industry shifted towards Asia, in particular to India, Bangladesh and Pakistan and, more recently, to China. This industry was, and still is, virtually unregulated and has one of the worst safety records of any industry. Workers are poorly paid and little attention is paid to health and safety or environmental pollution.

For many years there was little awareness in the Western world as to what ship scrapping involved. This was to change following the Brent Spar incident in 1995. The Brent Spar was an offshore storage module; due to be disposed of by sinking in deep ocean waters. However environmental pressure groups launched a very effective campaign against this disposal option, causing considerable financial and reputational damage to Shell and forcing adoption of a markedly different disposal strategy.

Soon after Brent Spar incident, attention began to be paid to the issue of ship scrapping. In order to address the growing awareness of, and concern over, ship scrapping practices, industry working groups, in particular the International Chamber of Shipping (ICS), the Baltic and International Maritime Council (BIMCO) and INTERTANKO, developed the 'Industry Code of Practice on Ship Recycling' [3], the code that first introduced the concept of the hazardous materials inventory or Green Passport.

About the same time, the International Labour Organisation (the ILO) developed guidelines relating to the health and safety of workers in recycling facilities. The existing Basel Convention on the Transfrontier Movement of Hazardous Wastes also began to be applied to ships, although not originally intended for this purpose.

1.2 THE IMO GUIDELINES

Building upon the work of the industry groups, the IMO developed and in December 2003 adopted "The IMO Guidelines on Ship Recycling". These guidelines cover the whole of the ship's lifecycle from design and construction through its operational life to eventual dismantling. Major elements of the IMO guidelines are:

New building contract: This should specify materials not to be used in the ship; Designers should be encouraged to substitute less or non-hazardous materials for hazardous ones, and they should design the ship to make it more readily recyclable. There is no guidance as to how this should be done, nor standards for unacceptable materials nor threshold values for hazards. At this stage they are more philosophical concepts.

Ship construction: The process should be controlled and recorded in such a way that on completion an inventory of hazardous materials, which forms the basis of the so-called 'Green Passport' may be issued to the ship recording known hazardous materials. This Green Passport should be maintained throughout the ship's life.

Disposal.: At disposal the Green Passport forms the basis of the 'Preparation for Scrapping' a document agreed between the stakeholders (the ship owner, the ship's flag state, the recycling facility and the government of the state within which the recycling facility is located) on how and where the ship is to be presented for scrapping and scrapping process. The recycling facility is also to be licensed.

The formal adoption of the voluntary IMO Guidelines on Ship Recycling in December 2003 finally gave authoritative guidance to the marine industry on the issue of ship scrapping. However, it is still very recent and implementation experience is limited.

The Guidelines contain many new concepts and central to these is the Green Passport. Many concepts within the guidelines are contentious and will require much work before they are likely to achieve widespread acceptance and implementation. However the Green Passport is an identifiable, stand alone concept, that can be translated into a product. It has benefits not only at the end of life, but, since it is an inventory of hazardous materials onboard the ship, it has major safety benefits to all onboard or those visiting the ship. It also allows an Owner to assess his financial liability with regard to the hazardous materials onboard the ship.

Whilst the Green Passport is essentially a document giving ship details followed by an inventory of hazardous materials, the implementation is more complex:

- What materials should be on the Green Passport?
- How much detail is required?
- How is it produced?
- Who will approve it?

Lloyd's Register set out to answer these questions through the undertaking of case studies. Collaborative studies were set up with industry. In October 2004, this resulted in the world's first Green Passport to be issued and maintained by a class society for the Shell LNG Tanker 'Granatina'.

Figure 2: Shell LNG Tanker, 'Granatina' – source STASCO.

Based on this experience and on the knowledge and experience gained from working with some of the world's leading shipyards in the development and approval of Green Passports for newly constructed ships, Lloyd's Register has continued to develop procedures and guidance documentation to assist in the uniform implementation of the Green Passport concept. Some of this experience is shared below.

2. THE LLOYD'S REGISTER GREEN PASSPORT

The Green Passport, in accordance with IMO Resolution A.962 (23) paragraph 5, consists of two parts: the first gives the ship's details and is as per the Continual Synopsis Record (CSR). The second part consists of an inventory of hazardous materials onboard the ship. The inventory is also broken down into parts, consisting of hazards within the ship's structure and machinery, and operationally generated hazards and wastes.

The Green Passport in development by Lloyd's Register includes all the above, in compliance with the IMO Guidelines, and also additional details of the ship's Owner and unique company ID number. These are new IMO concepts brought about by concerns resulting from implementation of the ISM (safety management) and ISPS (port security) Codes. These initiatives are still in development at the IMO, but when developed - predicted to be this year - they will be an invaluable aid to the transparency of Ownership that this subject requires.

Lloyds Register has also introduced several new concepts into the Green Passport, some based on our interpretation of legislation, and some at the request of clients with whom we are working.

2.1 COMPILING A GREEN PASSPORT

How is an Owner, crew member or recycling facility to know what constitutes a hazard and which hazards his ship may be reasonably expected to have onboard?

This information needs to be made available to those working in the industry in a manner tailored to them. Untold amounts of data, legislation and information exist on most hazards, but it is unrealistic to expect owners to sift and study such information in detail. A practical simplified approach needs to be adopted so that the task is manageable.

Ideally compilation of the inventory should be broken down into manageable parts and the essential most hazardous elements for immediate attention identified.

The recommendation is as follows;

- Identify the most hazardous materials
- Identify relevant legislation affecting its use and date(s) of entry into force
- Add a suitable margin for uncertainty, lax implementation of legislation and use of old stock
- Impose a reasonable date past which the hazard is no longer expected to be present.

The inventory as laid out in the IMO guidelines provides guidance on what are considered to be the major hazards facing the industry today: asbestos, TBT based anti fouling coatings, PCBs and so on.

Lloyd's Register also recommend highlighting certain other hazards in order to facilitate control and pre-empt future developments; in particular with regard to refrigerants, waste electrical and electronic equipment and constructional materials.

International legislation covering international legislation is presently relatively accessible, national legislation somewhat less so, hence Lloyd's Register is currently building a database of applicable legislation and other relevant data.

Essential to considering the impact of national legislation is the date and country of build. This is because national legislation affecting the phase-out of known hazardous materials changes from country to country. Somewhat surprisingly, asbestos is not fully legislated against internationally and is still allowed except where specifically legislated against. For example, asbestos is still allowed in the United States, but is legislated against in South Korea; whilst Australia and France legislate against asbestos in ships under their flags.

2.2 THE GREEN PASSPORT, SECTION BY SECTION

A sample Green Passport is appended. This is not complete, but is included to illustrate what a Green Passport is intended to look like and the major hazards to be included. Data entries for the various sections within the Green Passport are discussed below. Part numbers correspond to those in the appended Green Passport.

Part 1A Asbestos

International legislation banning the use of asbestos is lacking. SOLAS also allows asbestos to be used in ship construction. At the present time, the presence or absence of asbestos in new ships would appear to be dependent upon national legislation in the country of build and/or upon the Owner's specification.

The existence of national legislation prohibiting the use of asbestos varies: South Korea has national legislation that prohibits manufacture using asbestos, whilst the USA has no such legislation. Nor does the USA have legislation that mandates the labelling and tracking of asbestos containing materials. Thus a Korean newbuild may be reasonably expected to be free of asbestos *provided* essential checks have been made on any outside supply, such as windlass linings, sourced from the USA or other countries still allowing use of asbestos.

As regards completing the Green Passport inventory, unless there is specific information to the contrary, the vessel can only declare that all possible asbestos containing materials are "presumed asbestos containing materials" or PACMs. This declaration is intended to cover the fact that it is generally impossible to exclude all items that asbestos may be found in, from the familiar steam pipe insulation and brake linings, to simple concrete floors or hotel decorations which may be contaminated.

Specific information supporting the presumed absence of asbestos includes a certificate that the ship is asbestos free issued by an internationally recognised company or a declaration by the builder – ideally backed up by national legislation that supports this - that the ship is asbestos free. Alternatively, an asbestos book or similar – again issued by an internationally recognised organisation - could be used to accurately identify the asbestos onboard.

If a ship is 'asbestos free', then the vessel should also demonstrate a continuous system of procurement procedures such that asbestos cannot have been introduced onboard the ship. If this cannot be done, then replacements or new inventory should be declared PACM.

1B Paint (on vessel's structure)

It is standard practice for classification society surveyors to be on site during painting at new build or of the underwater portion during normal dry dock. The surveyor accepts the paint manufacturer's representative's written statement based on simple audit. This established practice can provide similar details for the Green Passport.

The International Convention on the Control of Harmful Anti-fouling Systems on Ships, adopted in 2001, will also support the Green Passport initiative. Elements related to compliance with this Convention can be represented in Part 1B, and relevant certificates included in Appendix B.

1C Plastic and Rubber Materials

In addition to the IMO Guidelines category of 'Plastic Materials', it was considered logical to also include 'Rubber' in the Lloyd's Register template.

Plastics and rubber materials do not presently cause hazards under normal situations or handling, and in general, unless contaminated by other hazards such as asbestos, are not considered an operational hazard. As such they are generally considered without a requirement for detailed listing and analysis, and simple summaries may be given as required.

However problems will arise, for example, when plastics are burnt. Unless combustion is carried out under controlled conditions, toxic emissions are likely to result.

Care will also need to be taken for plastics likely to contain asbestos such as synthetic bearings, especially those used in situations of elevated heat and this should be checked carefully. Insulative material, brake or windlass linings or similar will also need careful checking. Similar considerations exist for gaskets, packing and any plastics used in high temperature situations.

It is also recommended that care is taken to ascertain any flame retardant chemicals used in plastics or rubber materials, since brominated flame retardants or similar may have been used. This is especially applicable if the vessel has any enhanced fire fighting characteristics (either active or passive) such as may be found in passenger ships. However, release of such hazards would be dependant on gross misuse, or as a planned part of the recycling process.

1D Materials containing PCBs, PCTs PBBs at levels of 50mg / kg or more

Liquid PCBs were generally phased out around the world by legislation in the mid to late 1970s. A regularly used date is 1976. Due to differing local practices and the use of outdated stock, an effective date after which PCBs and related substances may reasonably be expected not to be found is five years later. Therefore the date of 1981 is the date of build or supply at which point Lloyd's Register would accept with reasonable confidence that a vessel does not present PCBs as a significant hazard.

Standard checks should still be made to identify, for example, whether transformers are air cooled and to examine labels on fluorescent lighting ballasts. However, the key point is that a declaration that the ship is free of PCBs due to date of build after the phase out date plus a five year margin is reasonable. In contrast, asbestos is not legislated against worldwide. Therefore a declaration that a vessel is free of asbestos is not reasonable. It must be backed up by further information of suitable certification or providence.

For vessels built prior to 1981, PCBs and related compounds are likely to exist in transformers, fluorescent lighting ballasts, capacitors (especially electric motor start up capacitors), paints and adhesives (used as plasticizers), fire retardants, carbonless copy paper and wire insulation amongst other things.

The existence in transformers or ballasts can generally be established simply: virtually all ship transformers are air cooled and this can be confirmed and recorded on the checklist. Where liquid cooled transformers are found, the liquid should be confirmed either from the manufacturer's nameplate or by testing. If the transformer was built before 1982 and no details are known, it should be listed as 'presumed containing PCB'.

Fluorescent lighting ballasts should be marked, and their markings can be traced. If ballasts are not marked or untraceable, and built before 1982 then they should be proven free of PCBs or declared 'presumed'.

Paints may also be a significant problem with respect to PCB. Ships built before the early seventies may exhibit PCB content well over the threshold values. In general the outer hull, especially the underwater portion has often had so much attention paid during dry docking that PCB paints have been removed, although they may still be present in the primers. However, deck or accommodation paint probably not only has original layers still intact, but has also had unknown numbers of localised touch up paint from untraceable sources.

Therefore a deck or accommodation bulkhead may be an unquantifiable patchwork of PCB and non PCB paint. Therefore Lloyd's Register would recommend that where the vessel's date of build suggests the likelihood of PCB, the Owner declares the possibility. Testing and quantification may be undertaken at a later date in preparation for scrapping, if necessary.

The situation and action regarding other items potentially containing PCB, such as electrical cable insulation, is similar.

1E Refrigerants, fire-fighting, blowing agents and other gases installed on board.

This section has been expanded and adapted from the equivalent IMO Guidelines section 'Gases sealed in ship's equipment and machinery' such that these gases are more readily identified.

The section should list any fixed systems containing compressed gases, including bottles in dedicated store rooms or areas. For portable systems it is unnecessary to go into great detail since the information is contained in other statutory documents such as the Record of Safety Equipment, but this should be referred to.

Refrigerants and blowing agents are highly likely to be ozone depleting substances and/or possess a high global warming potential and so are highlighted.

For refrigerants, all the private, galley and pantry fridges and freezers, cold stores, free standing AC units, HVAC system and so on should be checked and the refrigerants as recorded on the manufacturers plates listed. If possible, the type of refrigerant gas, that is whether it is, for example, an HCFC, HFC or natural substance should be indicated

Ozone depleting HCFC are commonly used as blowing agents in order to expand foam or plastic, for furniture, insulation or other uses. These gases remain in the expanded matrix and slowly leach out over time, depending on the quality with which the insulation is sealed. For instance a domestic refrigerator with the expanded insulation sealed inside the metal construction may have a leaching rate of 0.25% per year. Due to the fact that insulation needs to be sealed against moisture or other vapour in order to avoid loss of its insulative properties, manufacturers of insulation to be used in critical systems such as LNG tankers go to great lengths to protect the insulation and reduce leaching rates.

Formulae exist which allow estimation of residual quantities of blowing agents in the matrix, based on assumptions of original amount, leaching rate and so on. These can be applied to LNG ships to estimate the quantity of ODS which may be released to the atmosphere during an uncontrolled recycling process.

Non-HCFC blown insulation material is becoming available. Owners wishing to exclude HCFC from their ships will need to specifically specify such non-HCFC blown insulation materials.

1F Chemicals in ship's equipment or machinery

This normally covers item such as anti freeze, engine additives, boiler water treatments, lubricating oils. Since these change regularly, the Owner would be expected to append a typical inventory and update when significant changes occurred. The most up to date inventory would need to be supplied at recycling.

1G Electrical and Electronic Equipment

In the Lloyd's Register Green Passport documentation, this section, which is additional to the IMO Guidelines requirement, has been included for completeness and to show compliance with major international codes such as the Waste Electrical and Electronic Equipment (WEEE). The disposal of these items is potentially very complicated so their inclusion is important. However, most of these items have generic hazards and it is only considered necessary to itemise the pieces of equipment rather than the particular component(s) constituting a hazard.

Care should be taken over items such as extra batteries or radioactive components. Some equipment may also now be made from lead free components. This is useful information and should be included in the table.

1H Constructional materials

This section is also additional to the IMO requirements and is included for the sake of completeness. It is a simple summary, but may highlight such matters as whether the superstructure is aluminium, or if exotic materials such as sandwich plate have been used. The latter in particular will require special consideration during dismantling.

1J Other substances inherent in ship's machinery, equipment or fittings

This is used for items such as inventories not covered elsewhere (oils, batteries), but also for significant hazards such as mercury and any radioactive materials. These are common onboard ship; mercury in thermometers, fluorescent lights and manometers; radioactive materials in ionising smoke detectors, radars and tank ullage systems.

2.3 PREPARATION OF THE INVENTORY

The Inventory of Hazardous Materials should be compiled by people familiar with the vessel, who have the most information readily at hand: the builder, senior ship's crew or their technical superintendent. This has the advantages of the Owner keeping control of the process, and also brings safety issues to the fore in the crew's minds. Lloyd's Register has found a positive attitude from crews asked to do this work; they appear to be genuinely interested and involved in the process and can see the underlying benefits for themselves.

This approach is also cost effective. To subcontract the preparation to a consultative firm would be extremely expensive, and the amount of information the crew would ask to be provided would be almost equivalent to the crew doing it themselves. Maintenance of the inventory can also only be properly carried out if the ship's technical people have had proper input and experience of preparing it.

This may not be an easy process for some ships. Lloyd's Register therefore intend to provide guidance and templates, with step by step instructions to make the process as easy as possible. Lloyd's Register do not believe that the option of owners employing expensive specialists to set up and maintain hazardous materials inventories is a viable option if Green Passports become mandatory.

2.4 SAFETY BENEFITS

The Green Passport tends to be considered in terms of end of life benefits. However, the existence onboard of a formal summary of hazards must assist in the operational safety management of the vessel.

Properly implemented through the ship's safety management system, the Green Passport should help:

- the Owner to establish what hazards are onboard and to ensure appropriate crew training in relation to those hazards
- Crew members to establish what hazards new postings may contain and whether any training is required
- Visitors (ranging from the casual visitor, through port state control, to a surveyor doing a full boiler and steam pipe survey) to be made aware of onboard hazards.

Linked to safety is the question of liability. If an Owner is not able to properly address safety issues, through not knowing what his hazards are – what are his liabilities?

How far does this extend? Is an Owner legally entitled to sell a vessel without informing the next Owner of hazards onboard? Whatever the answer to that question today, it is bound to become a greater issue as the consequences of selling a dangerous ship to a recycling yard filter down through the second hand market. The prudent Owner will see the benefits of ensuring that any vessel he sells, or buys, will have Green Passport to safeguard his liability – and his crew's safety.

What about long term financial liability and planning? In the future Owners will be asked to phase out more materials – HFC refrigerants and copper based antifouling paints are obvious examples. The Green Passport will be invaluable in assessing and minimising financial liability

Properly implemented – preferably at newbuild and maintained through life, for maximum accuracy and security - the Green Passport is an invaluable tool in the safety management of the ship throughout its life.

Knowledge of the environmental risks posed by materials on the ship also facilitates the implementation of proper Environmental Management System. The Green Passport would sit very well within an ISO 14000 system, and would be very useful to a company in demonstrating compliance

2.5 ROLE OF LLOYD'S REGISTER

Involvement of the classification societies in the ship recycling debate has been low key. However, at the first Global Ship Scrapping conference held in Amsterdam in 1999, Lloyd's Register's then Chief Ship Surveyor, Willem De Jong gave a paper, in which he stated:

"The classification societies are frequently contracted to perform statutory work on behalf of national administrations using their world-wide network of surveyors. It would be a natural extension of their mandate to enforce any future international regulations relating to the disposal of ships."

To this end, Lloyd's Register has been working towards world-wide provision of Green Passport approval and verification services. As part of these services, Lloyd's Register will verify that Green Passport documentation provided complies with the minimum requirements set out in IMO Resolution A.962 (23) paragraph 5. In addition Lloyd's Register will verify that it considers the inventory to be a reasonable listing of expected or known hazards for a ship of a particular age and type, based on current knowledge, information provided by the Owner and onboard survey reinforced by annual audits to ensure continued maintenance of the inventory.

2.6 FUTURE DEVELOPMENTS

The concept of the Green Passport is new and knowledge in relation to hazardous materials will change over time. Revolutionary new materials introduced at one time have at times been shown later to have a severe adverse impact on the environment. Halon fire fighting media, CFC refrigerant gases and tributyltin antifouling paints representing high profile examples. There is no evidence to show that these will be the last wonder products introduced, then phased out because of unforeseen environmental consequences, although one would hope that such experiences would lead to caution in the future.

Materials known to be hazardous, but accepted for use today may also be subject to phase out legislation in the future. HFC refrigerant gases and copper based antifouling paints representing well known examples. However, lead, cadmium and PVC are also receiving increasing attention. The Green Passport must be flexible enough to accommodate changes.

3. LICENSED RECYCLING FACILITIES

Whist the ship will enjoy the safety benefits of the Green Passport throughout its life, the recycling operation is presently far more critical in terms of lives lost and environmental damage. By far the greatest gains are to be had by properly controlling recycling practices Not only must recycling facilities be encouraged to become licensed (and the industry refuse to use those which are not), but realistic and internationally recognised standards for recycling (yards) and a means of demonstrating compliance must be developed.

Lloyd's Register, is aware of at least 2000 scrapping facilities worldwide. However many of these facilities, if they have any real details at all, are rather romantically addressed; for example: Plot 59, near first bus stop, Gujarat. Realistically about 500 facilities exist, or have recently traded, with a formal address

Europe and North America have a number of facilities which could be used for ship scrapping and which may be expected to attain high standards, but what standards should they be aiming to comply with? The regulatory situation is unclear.

The IMO Guidelines refer to the ILO standards, the latest of which is 'Safety and Health in Ship Breaking, Guidelines for Asian Countries and Turkey' [5]. The Basel Convention has also produced 'Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships' [6].

To date, no facility is known to demonstrate full compliance with either the ILO or Basel Convention standards/Guidelines. However, a land based recycling facility may demonstrate compliance with local or national legislation.

So called "Green yards" do exist. However, the term Green yard or Green facility appears to be a status awarded to the facility by itself. This is freely admitted to in EC report "Oil Tanker Phase Out and the Ship Scrapping Industry" [7]. This states that its figures for "green" recycling capabilities are based on the yards' own advertising literature. This may have been the only feasible approach at the time, however for practical compliance, the industry requires much more in order to implement the IMO guidance with respect to recycling facilities.

Classification societies act directly as Recognised Organisations for Flag Authorities certifying compliance with statutory marine legislation such as MARPOL, Safety Equipment, Load Line and so on. Subject to certain checks and balances, once authorised, classification societies essentially undertake the work and issue relevant certificates.

At present classification societies issue statements against ILO standards, and so could, in principle, provide the same service against the ILO ship breaking standard.

Alternatively 'Lists' covering approved facilities could be developed. This approach is being considered by Lloyd's Register. The approval would almost certainly incorporate the ILO standards and recommendations within the Basel Convention Guidelines on Environmentally Sound Dismantling and the IMO Guidelines.

4. CONCLUDING REMARKS

The Green Passport is an early step in the long journey of returning the recycling of ships back into an internationally acceptable practice. Detailed procedures and guidance are not agreed and are seldom published. Organisations capable of working to the required standards need to publish, share and agree definitive procedures both in terms of the development and approval of Green Passports and licensing recycling facilities.

The information in this paper is presented in this manner to promote debate and understanding such that clear and reasonable procedures may result. The final benefits will not only be the safety of the recycling yard workers and protection of the environment, but also the safety of those who operate the ship.

5. DISCLAIMER

6. REFERENCES

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7. AUTHORS' BIOGRAPHIES

Robin Townsend is a senior surveyor in the Research and development department of Lloyd's Register.

Gill Reynolds is a principal environmental specialist at Lloyd's Register and is responsible for the development and technical support of Lloyd's Register's marine environmental products and services.

Appendix: Sample Green Passport

Certificate no:

CONCEPTUAL DRAFT

Green Passport

Document of Compliance
IMO Guidelines on Ship Recycling

Issued in the pursuance of IMO Resolution A.962(23), adopted 5 December 2003.
by Lloyd's Register

Particulars of ship

Name of ship	Isabel	Ship Type:	Crude Oil Tanker
IMO number	845321	Classification Society:	Lloyd's Register
Flag State and Port of registry	Bermuda	Date of build:	1992
Shipbuilder.	LHK	New building Yard No:	204
Length (overall)	272	Breadth (Moulded)	47.2
Depth (moulded)	26.5	Lightweight (tonnes)	
Ship Owner		Address:	
Company No; As defined in SOLAS IX/1		Registered Owner. per Res MSC 160 (78)	

This is to certify:

1. That this document complies with the provisions in IMO Resolution A.962(23) for the requirements of a "Green Passport" as laid out in paragraph 5 of that Resolution.

This Document is valid until (5 year harmonisation date)

Date of completion of the survey on which this Document of Compliance is based

Issued at   on

This document is to be accompanied by the 'Inventory of Hazardous Materials Onboard', Certificate number HQR XXXXX , which forms a part of it.

A member of the Lloyd's Register Group

Endorsement for annual surveys

This is to certify that, at a survey

Annual survey

Signed: ____________________

Place of survey

Date

Annual survey

Signed: ____________________

Place of survey

Date

Annual survey

Signed: ____________________

Place of survey

Date

Annual survey

Signed: ____________________

Place of survey

Date

Disclaimer;

INVENTORY OF HAZARDOUS MATERIALS ON BOARD HQR xxxxxx

PART 1; POTENTIALLY DANGEROUS MATERIALS IN THE SHIP'S STRUCTURE AND EQUIPMENT

1A. Asbestos **(Note: All asbestos containing materials (ACMs) or presumed asbestos containing materials (PACMs) should be prominently labelled as such).**

Type of Asbestos Materials (Board, Pipe lagging, Contained)	Location	Type of asbestos fibre		Approximate Quantity			
	Engine Room / Machinery Rooms						
Pipe Lagging	Steam Pipes in ER	chrysotile		1000Kg			
	Accomodation						
	Deck						
	Machinery						

1B. Paint (on vessel's structure)

Type	Location	Manufacturer and product name / spec	Approximate Quantity	Notes
TBT Free Anti fouling	Underwater parts of hull	Interhemp xxx	65 tonnes	

1C. Plastic and Rubber Materials

Type	Location	Manufacturer trade name / designation	Relevant standard / certificate	Approximate Quantity	Hazard Type	Remarks	Equipment / system
	Engine Room/Machinery Rooms						
Pintle and stern tube bearings	Pintle bearings asbestos free synthetic	Thorlot	Ta 24352	300kg			Synthetic Bearings
	Accommodation						
	Deck						

1D. Materials containing PCBs, PCTs, PBBs at levels of 50mg / kg or more

Material	Location	Manufacturer trade name / designation	Relevant standard / certificate	Approximate Quantity	Hazard Type	Remarks	Equipment / system
	None, see certificate, appendix c.						

1E. Refrigerants, firefighting, blowing agents and other gases installed on board.

Note;many of these substances may be ODS or GWP and this should be shown in the remarks column.

Type	Location	Manufacturer trade name / designation	Relevant standard / certificate	Approximate Quantity during operation stage	Hazard Type	Remarks	Equipment / system
Refrigerants .							
R134a	Cold store refrigeration, Galley fridges and cooling locker	R134a		100kg			Refrigeration
Fire fighting							
CO_2	CO2 Room, main deck stbd af			200 X 65litre bottles			Fixed Fire Fighting
Blowing Agents							
HCFC	blowing agent in all expanded plastics and insulation materials.	Several	Several	150 tonnes (est weight of insulating material)			Fire Insulation / Thermal insulation / furniture

1F. Chemicals in ship's equipment or machinery

Type	Location	Manufacturer trade name / designation	Relevant standard / certificate	Approximate Quantity during operation stage	Hazard Type	Remarks	Equipment / system
Anti-seize Compounds	Engine room and machinery spaces	various		50KG			chemicals

1G. Electrical and Electronic Equipment

Type	Location	Manufacturer trade name / designation	Relevant standard / certificate	Approximate Quantity during operation stage	Hazard Type	Remarks	Equipment / system
Switchboards / distribution boards	Engine Control Room, Bridge, Cargo control room, switchboard and distribution rooms thoroughout vessel			18 000 kg			EE

1H. Constructional Materials

Type	Location	Manufacturer trade name / designation	Relevant standard / certificate	Approximate Quantity during operation stage	Hazard Type	Remarks	Equipment / system
Constructional steel	Hull and fittings, machinery, superstructure generally			15 000 000kg			

1G. Other Substances inherent in ship’s machinery, equipment or fittings

Type	Location	Manufacturer trade name / designation	Relevant standard / certificate	Approximate Quantity during operation stage	Hazard Type	Remarks	Equipment / system
Lubricating Oil	See attached inventory						
Radioactive Materials	Ionising smoke detectors. Throughout accommodation, ER, deckhouses	Americium		132 units			

Bulk (non-oily) tanks

Type	Location	Manufacturer trade name / designation	Relevant standard / certificate	Total capacity tanks	Hazard Type	Remarks	Equipment / system
Ballast water	Aft Peak tank, Nos 3 port and stbd, Nos 5 port and stbd, fore peak tank.			35 000 tonnes			

Oily Tanks

Type	Location	Manufacturer trade name / designation	Relevant standard / certificate	Total capacity tanks (tones)	Hazard Type	Remarks	Equipment / system
Bunkers:							
Fuel Oil tk 1	ER Stbd			1500			

PART 2 OPERATIONALLY GENERATED WASTES

2A. Dry Tank Residues

Description of Residues	Location	Manufacturer trade name / designation	Relevant standard / certificate	Approximate Quantity	Hazard Type	Remarks	Equipment / system

2B. Bulk (non-oily) waste

Type	Location	Manufacturer trade name / designation	Relevant standard / certificate	Approximate Quantity	Hazard Type	Remarks	Equipment / system

2C. Oily Waste/Oily Residues

Type	Location	Manufacturer trade name / designation	Relevant standard / certificate	Approximate Quantity	Hazard Type	Remarks	Equipment / system

PART 3 **Stores during vessels operation stage**

3A. Gases in store

Type	No. and size of Cylinders	Location	Manufacturer trade name / designation	Relevant standard / certificate	Approximate Quantity		

3B. Chemicals in store

Type	Location	Manufacturer trade name / designation	Relevant standard / certificate	Approximate Quantity	Hazard Type	Remarks	Equipment / system

3C. Other Packaged items in store

Type	Location	Manufacturer trade name / designation	Relevant standard / certificate	Approximate Quantity	Hazard Type	Remarks	Equipment / system

Appendices and Inventory Lists

Appendices;

Appendix A; Asbestos Register

Appendix B; Newbuild Paint Specifications and Data Sheets

Appendix C: PCB / PCT / PBB Free Certificate

Chemical Inventory

Paint Stock Inventory

Lube oil / grease Inventory

Battery List

Other Inventory

GREEN PASSPORT – PUTTING PROCEDURES INTO PRACTICE

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SUMMARY

With background from a number of decommissioning assessments undertaken for the oil and gas industry, Det Norske Veritas (DNV) developed recommendations for shipowners in 1998 in order to allow onboard preparative actions to be undertaken improving the suitability of the ship as a recycling candidate. This tool, GUIDEC, was later supplemented by a procedural survey, ENVER, which represents the base for the DNV inspection methodology for the Green Passport surveys for sips in operation (SIO).

This paper presents our approach on the establishment of necessary documentation in conjunction with the decommissioning of a vessel from operational service for deconstruction, recycling and disposal – ship recycling. It also reports on experiences gained following some 10 Green Passport surveys on SIO. The paper highlights relevant requirements related to the concept of a Green Passport as referred to by the three international guidelines on ship recycling and elaborate on the necessity to harmonise these in order to establish a basis for successful implementation of improvements to the ship recycling industry.

1. INTRODUCTION

Det Norske Veritas (DNV) has since the beginning of the 1990s made efforts to assist stakeholders in the oil industry regarding hazardous materials in redundant offshore installation. In the later part of the 1990s this experience was transferred to the maritime industry and to the ship recycling industry. Typical projects that have been carried out are:

- Brent Spar, first third party inventory on hazardous materials prepared for the offshore industry [1].
- Following the Brent Spar study DNV has prepared inventories on hazardous materials on close to 50 redundant offshore installations.
- Verification of cleaning procedures and cleaning of different offshore installations such as e.g. Maureen Alpha [2].
- Development of a ship inventory scheme for ships prepared for recycling ((Clean) Green Passport) [3].
- Preparing ship inventories using the Green Passport scheme on a number of ships.

The DNV developed guidance tools aimed at the shipowner for the preparation of his ship for recycling (GUIDEC) [3]. This work was co-funded by the Norwegian Shipowners' Association (NSA) and was the forerunner to the preparative actions as contained in the Industry Code on Ship Recycling as well as those of the IMO guidelines. This work was based on another DNV instrument; Ship Decommissioning – Third party Environmental Verification (ENVER) [3] – which again is really the forerunner of the inventory-concepts (such as the Green Passport) as referred to by the international guidelines on ship recycling issues.

DNV's first Green Passport survey was undertaken in 2000 and following this about 10 Green Passports have been carried out. Four of these have been carried out in 2005. Prior to 2000, desktop studies supported by case studies were undertaken.

DNV was also involved in the ship recycling matters as handled by the international community including the industry itself represented by ICS, IMO, ILO, UNEP and UNDP as well as by some national governments (e.g. Norway, Bangladesh). DNV has assisted in the development of the *Guidelines on Ship Recycling* (IMO) in correspondence-groups as well as in working-groups representing IACS and Norwegian authorities. At present we are participating in a correspondence group looking at mandatory requirements related to ship recycling, based on the amended IMO Guidelines.

DNV has also been a member of the technical review group under ILO who has been developing *Guidelines on Safety and Health in Ship Breaking.* Further, DNV was contracted to develop the guidelines of the Basel Convention (UNEP) [5].

The ship-breaking practice has also been studied in detail through case studies and on site assessments. A comprehensive study initiated and lead by DNV was carried out at Chittagong, Bangladesh in 2000 [3]. Experiences from these studies are incorporated in the recommendations of the ILO and UNEP tools.

Finally DNV has also assisted ship operators/owners such as e.g. MARAD with proposed plans related to preparations, prioritisations, selection of strategies, etc.

Based on our experience from ships in operation projects and in cooperation with ship owners, DNV has also developed Green Passport services for newbuilding and further generic concepts for the establishment of ship Recycling Plans as an instrument for facilitating the process between the ship recycling facility and the shipowner. However this paper will focus on DNV's experiences with Green Passports for ships in operation.

2. GUIDELINES AND PROCEDURES

The growing focus on the inadequacies related to ship disposal practices in the mid 1990s, revealed a situation that was unacceptable. Both the industry as well as relevant international bodies appreciated that measures was urgently required in order to bring the disposal-of ships into line with acceptable disposal practices. The industry developed recommendations primarily aimed at the ship-owner already in 1999 (Industry Code on Ship Recycling). Since then, we have seen comprehensive work materialising in recommendations through international guidelines from UNDP (Secretariat of the Basel Convention); *Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships,* ILO; *Safety and Health in Shipbreaking* and lastly from the IMO; *Guidelines on Ship Recycling*.

2.1 UNDP (BC) GUIDELINES

The development of the *Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships (2003)* was initiated by the Technical Working Group of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

The main objective of this was to provide guidance to countries which have or wish to establish facilities for ship recycling. The guidelines provide recommendations on procedures, processes and practices in order to secure environmentally sound management at such facilities. Thus they focus on the facilitation of proper environmental precautions related to operations undertaken on land under national jurisdiction.

The guidelines focus on the need to establish a national framework to include ship recycling as a recognised industry. Furthermore, it presents actual recommendations on good practice at ship dismantling facilities and further recommendations on the design and construction of a model-facility.

2.2 ILO GUIDELINES

These guidelines were developed to provide assistance in ensuring safe work practices in shipbreaking within the framework of the ILO's Decent Work Agenda. In so doing, they provide advice on the transforming of a mainly informal economy activity into a more formal and organized one. Guidelines on *Safety and health in shipbreaking (2004)* aim to assist both shipbreakers as well as national competent authorities and contain provisions on;

1. the protection of shipbreaking workers from workplace hazards and on elimination and control of work related injuries and diseases, ill health, and incidents;
2. assisting and facilitating the improved management of occupational safety and health issues in or about the workplace.

The recommendations may assist in;

- establishing coherent national policies and principles on occupational safety and health as well as welfare of persons employed in the shipbreaking industry and on the protection of the environment;
- establish areas of duties and responsibilities of the authorities, employers, workers and further bodies involved and make arrangements for a structured cooperation between them;
- competence improvement;
- promoting implementation and integration of consistent occupational safety and health management systems with a view to improve working conditions.

The ILO guideline has a practical approach and provides simple tools enabling prioritised focus on most safety and health issues. ILO have developed implementation projects aiming at "putting procedures into practice" and have recently succeeded in motivating the UNDP to fund such a project in Chittagong, Bangladesh (September 2004).

2.3 IMO GUIDELINES

IMO discussed the ship recycling issue within the Marine Environmental Protection Committee for the first time in 1998. The IMO *Guidelines on Ship Recycling* were adopted in 2004. These have since been amended and unlike the other guidelines, continuous work is still going on for the purpose of improving the guidelines. Note should also be made on the more recent development, that of assessing the necessity of making elements of the guidelines mandatory.

The IMO guidelines aim among others to;

- encourage recycling as best means of disposal of obsolete tonnage;
- provide guidance on preparative measures (of the ship) for recycling;
- minimize the use of potentially hazardous materials and wastes and waste generation during a ship's operating life;

The guideline "accept" that the obligation for environmental and workers protection in ship recycling facilities must rest within the recycling facility itself and with the regulatory bodies of the country in which the recycling facility operates.

2.4 GUIDELINES INTERRELATIONS

Not surprisingly, these three guidelines covering interrelated matters have overlaps. Furthermore, as a consequence of these being developed independent from each other within different professional environments, they communicate badly. However, the respective inter-agencies behind the guidelines are all supporting the implementation and use of these and thus, the lack of coordinating qualities are becoming an issue. Examples in relation to this beside divergences in terminology may be illustrated by the mutual requirements consistent in all the guidelines, namely the need for detailed information regarding onboard substances and associated potential hazards represented by these. At present the guidelines communicate this inconsistently.

IMO is at present prioritising work on identifying means of promoting the use of the IMO guideline. Measures that may trigger a more comprehensive use are investigated while shipowners who have undertaken measures in compliance with the recommendations in the IMO guideline are reporting back confirming above mentioned inconsistencies and/or lack of capability at the recycling point to take advantage by the precautions undertaken to improve the local conditions. Again, this highlights the need to;

1 address the inconsistencies of the three guidelines;
2 coordinate the implementation of the guidelines.

The ongoing IMO-process that may result in the development of a mandatory instrument, most likely in the shape of a new convention, would benefit tremendously if the recommendations inherent within the three guidelines could be extracted in some way. The main differences between the three guidelines is that two of them are primarily dealing with land-based issues often regulated nationally sometimes resting upon international agreements (or not regulated at all), whilst the IMO guideline aim to improve the feasibility of a ship for it to be recycled in accordance to the other two. A logic development may therefore be to assess the two “land-based” guidelines for the purpose of establishing one instrument, *an International Code on Occupational Safety, Health and the Environment in Ship Recycling*. In coordinated cooperation with the IMO process, this work would identify requirements to the ship in order to achieve safe and environmentally friendly recycling and thus the content of an IMO *Code on preparative measures for Ship recycling.* This would rest heavily on the existing IMO guideline. A new legal instrument in the shape of e.g. a new IMO convention could be procedural in the sense that it would establish the process to be followed for ships to be recycled (or disposed off) using references to the established codes for actual execution.

3. EXPERIENCE FROM PRACTICE

The DNV Green Passport service is destined for newbuildings, vessels for sale as well as for obsolete tonnage for disposal or recycling.

The Green Passport service is a third party material and waste account balance declaration which is in line with the IMO guidelines and the conceptual Green Passport.

The following addresses the procedures adopted when applying the Green Passport service to ships in operation and include;

- review of available documentation;
- onboard survey including sampling of substances/ materials possibly containing hazardous materials;
- analysis;
- reporting

3.1 PLANNING OF THE DNV GREEN PASSPORT SURVEY–SHIPS IN OPERATION (SIO)

Prior to the survey, the DNV archive or other class society’s archives and other sources of information including managers/ owners, yards, suppliers, etc. are reviewed for specific documentation about the vessel. In parallel, a survey plan is prepared including a preliminary sampling plan.

3.2 THE GREEN PASSPORT SURVEY (SIO)

The DNV Green Passport survey is carried out based on the pre-prepared survey plan, the IMO Guidelines on Ship Recycling, and the DNV methodology on the Green Passport survey [6], [7]. The survey is carried out by personnel having long experience on identification and quantification of hazardous materials. Because the vessel is in operational mode, the survey has to facilitate for this and hence some areas/spaces may not be accessible such as cargo spaces and storage tanks.

3.2(a) The onboard survey

The actual survey includes the following tasks:

- Interviews with onboard personnel;
- Review of onboard archives;
- Visual inspection of all accessible areas;
- Sampling of components and/or materials potentially containing hazardous substances;
- Identification of hazardous materials.

Onboard personnel may give valuable input regarding the history of the vessel and also input with regard to potential hazardous materials on the vessel. The master and crew are therefore interviewed. In addition the onboard archive is reviewed for supplementary information. Following this the vessel is inspected by DNV with assistance from the crew. The inspection of the vessel is carried out focusing on the materials defined in the IMO Guideline i.e.:

- Potential dangerous materials in the ship's structure and equipment;
- Operationally generated wastes;
- Stores

During the inspection, all information of importance with regard to the above is documented by notes and photos/video. Furthermore a detailed sampling program based on the preliminary sampling plan is set up and a representative number of samples are taken in accordance to the sampling priority identified in the plan. Samples may be taken in order to document/ verify;

- presence of a *target* material already known to be onboard the vessel (e.g. verification of findings from documentation);
- components or materials that may contain such targeted substances (e.g. insulation for asbestos analysis)
- components or materials where the chemical composition is uncertain (e.g. gaskets, seals, etc).

The survey plan has a systematic procedural approach where the different ship systems are subsequently the subject of audits. Based on experience related to the system (and associated sub-systems, components, materials, substances and so on), samples are taken in order to verify experience and to identify hazardous materials. In the following, some simple examples are presented to illustrate this approach.

Asbestos are naturally occurring silicate fibers that is extremely heat resistant. Asbestos may lead to asbestosis i.e. cancer of the lung as well as other medical conditions. Asbestos was with few exceptions prohibited in Norway from 1986. However there is no general/ global prohibition regarding the manufacturing of this material and thus, it is considered a legal commodity in some nations, e.g. some countries in Asia.

Asbestos may be found as lagging around different types of pipelines in the engine room, in ceiling- and wall plates in accommodation areas or on brake linings. In these cases the asbestos is relatively easily detectable and thus accessible.

However asbestos may also be found as insulation material in floors. Here the asbestos may be found underneath several different layers of different materials, e.g. concrete and tiles and the asbestos is neither easily detectable nor accessible. In all cases when dealing with asbestos there has to be strict procedures compliant to regulations relevant on how to sample the material in order to avoid the spreading of asbestos fibres and cross contamination between samples.

Figure 1: Typical use of asbestos as lagging on pipelines

Polychlorinated biphenyls (PCB) are mixtures of synthetic organic chemicals that have qualities such as non-flammability, chemical stability, high boiling point and electrical insulating properties. Because of these qualities PCBs were used in hundreds of industrial and commercial applications including e.g. capacitors, hydraulic oils, coatings, plastics and mastics.

Figure 2: Typical capacitor that may contain PCB

Studies in humans provide supportive evidence for potential carcinogenic and non-carcinogenic effects of PCBs [8]. In Norway PCBs were forbidden in 1980 [9]. Actual year of year of prohibition/regulation may vary from different countries.

Generally speaking, only analyses of samples can verify the presence of PCB in a component or product. In some cases however, a PCB-containing product may be marked detailing its PCB content. This is often the case for electrical components such as capacitors. Again, the same precautions have to be taken when sampling in order to avoid cross contamination of samples.

Radioactive isotopes are used for different purposes including among other ionising smoke detectors and luminous emergency exit plates.

Figure 3: Typical ionising smoke detector with a radioactive source

Radioactive radiation may among other give cancer, genetically injuries and mutation [8]. Radioactive smoke detectors and exit signs are normally marked containing a radioactive source and are therefore fairly easy to identify on a vessel.

Heavy metals may occur in ships structure and in different equipment on a vessel. Paint and anodes may contain several types of heavy metals such as Copper, Lead, Cadmium and Zinc. In addition fluorescent light tubes, thermometers and level switches may contain mercury, while lead acid batteries obviously contain lead (in addition to battery acid). Paint may also contain tributyltin (TBT). It should be noted that after the introduction of the antifouling convention one would expect that occurrence of TBT will be dramatically reduced. However on some vessels a sealer is utilised in order to avoid TBT release. On these vessels the TBT will be found under the new paint.

Figure 4: Typical level switch that may contain an ampoule with mercury

Determination of the heavy metals content of the above mentioned items is carried out as a combination of analyses, verification with manufacturers and experience.

In addition to the above examples that are mainly materials inherent to the ship's structure and equipment, the survey also includes inspection of operationally generated wastes and stores. An overview representative of the condition on the day of inspection is therefore provided for items such as:

- Ballast water
- Sewage
- Garbage
- Bunkers diesel oil
- Lube oil/grease
- Slop/washing water
- Gases in store such as CO_2, acetylene, nitrogen, propane and spare bottles of refrigerants
- Chemicals in store such as paint, solvents, antifreeze fluids, engine additives, water treatment chemicals and lube oil.

3.2(b) Analysis of the samples

All samples taken are labelled and stored according to instructions specific for the sample in question and the type of analysis it is intended to be subjected to. All samples are then delivered for analyses to an independent and accredited laboratory. Typical analyses carried out are:

- Asbestos analyses by microscope defines the different types of asbestos;
- Heavy metals analyses in e.g. paint;
- Polychlorinated biphenyls (PCB) in e.g. paint and mastic;
- Tributyltin (TBT) in paint;
- Flame retardants in plastics;
- Organic screening of substances with "unknown" content.

After the analyses are carried out DNV and the accredited laboratory evaluates the results from the analyses.

3.2(c) Reporting of findings

Based on the onboard survey and the results form the analysis, a Ship Inventory Dossier-Environment (SIDE) report is prepared. The report is a third party hazardous waste account that outlines the findings of the survey and includes the three parts:

- Potential dangerous materials in the ship's structure and equipment;
- Operationally generated wastes;
- Stores.

Based on DNV's experience from about 10 different vessels, some typical findings are addressed in the following to illustrate what may be found onboard a vessel that is ready for recycling.

Asbestos
Typical data are as follows:

- Materials positively identified as asbestos summarised to approximately 110 m^3. In addition there are the materials that will be contaminated by asbestos when removal is carried out, giving a total sum of 125 m^3
- On one vessel the volume of asbestos was identified to 26 m^3, of this 80 % was found as insulation in floors.
- Asbestos has been found onboard relatively new vessels as spares, e.g. brake linings.

PCB
Typical data are as follows:

- Typical number of capacitors possibly containing PCB is in the range 500-600 items. The PCB content in each capacitor is typically 30 mg.
- DNV analyses have never indicated PCB values in cables, gaskets etc. that are exceeding the threshold value for classifying PCB containing materials as toxic waste i.e. 50 mg/kg.

Radioactive sources
Typical data are as follows:

- 10-20 ionising smoke detectors with a radioactive source
- Level detectors containing a radioactive source are seldom found
- Luminous emergency exit plates are normally not of the type containing a radioactive source

Heavy Metals
Typical data are as follows:

- 10-15 grams of mercury in fluorescent light tubes
- 200-300 kg lead in lead acid batteries
- Paint samples contain heavy metals. An example of analyses are given in Table 1

Hydrocarbons, chemicals, refrigerants, gases, sewage and garbage
Hydrocarbons, chemicals, refrigerants and gases may be found inherent in ships systems, as stores or as operationally generated wastes, while sewage and garbage is operationally generated waste. The volumes vary considerably e.g. based on type of vessel, time since last bunkering or since chemicals was supplied. A general list of findings is therefore difficult to give. However some examples are listed below:

- Bunker (heavy fuel oil and marine gas oil): 250-1,500 m^3
- Lubrication oil: 30-40 m^3
- Sludge (heavy fuel oil and lube oil): 1-5 m^3
- Oily bilge water: 4-40 m^3
- Chemicals for tank cleaning: 4-20 m^3
- Foam: 1,000-2,000 kg
- Refrigerant R22: 400-500 kg

Material	**Floor on top of wheel house**	**Bridge wing bulwark, starboard side**	**Accommodation building wall**	**Fore peak, anchor winch foundation**	**LOD [1]**
	mg/kg				
Arsenic	<10	62	<30	73	30
Cadmium	0,5	<1	<1	2	1
Cobalt	203	97	169	20	2
Chromium	49	576	39	11,100	1
Copper	29.2	434.3	21.6	69.3	3
Mercury	0.03	0.04	0.06	0.05	0.02
Molybdenum	<0.5	87	4	1,640	2
Nickel	28	215	18	5	1
Lead	1,280	2,010	1,300	53,800	1
Tin	7	51	23	28	2
Zinc	13,900	5,290	10,300	57,600	5

1: LOD = level of detection. LOD is related to the weight of the samples.

Table 1. Typical heavy metal content of paint samples

Figure 4: Typical paint storage

When the SIDE report is compiled, a Green Passport Statement of compliance is also issued. This has the form of a leaflet that summarises the findings reported in the SIDE report.

5. CONCLUSIONS

In context of risks represented by materials and substances in light of the methods applied when a ship is recycled, existing vessels, SIO, differs from new - buildings primarily because;

- they reflect the building standards of their time when many of the hazardous materials now known where considered acceptable;
- significant number of SIO are queuing up for recycling now, not in 25 years time.

Thus, it is important to bear in mind that even if the concept of the Green Passport was developed on basis of being implemented into the new-building process, practical use of the Green Passport information is already in demand. Consequently, experience from the Green Passport as an instrument in improving the recycling process at recycling yards will first arrive from those undertaken for SIO and not from vessels where the Green Passport is materialised as a consequence of inventory reporting schemes integrated with the new-building documentation hierocracy.

In contradiction to a Green Passport for a new ship, the issuance of such a statement for an existing ship will require an onboard survey. We believe we have demonstrated that this can be undertaken with a high level of accuracy at a defendable level of cost.

It is not possible to conclude on presence of hazardous materials by the vessels age. A number of materials of concern was prohibited in different parts of the world at different points in time. Some nation has yet to implement such bans. Thus, as a rule of thumb, it is not possible to "declare" a vessel free from hazardous materials without undertaking an onboard survey. Furthermore, the procedures on purchase of spare parts can represent a "leakage" of such unwanted substances onto the vessel since some spares are available in some regions of the world containing these substances.

Provided that this practice continues, it follows that even a vessel delivered with a Green Passport, should be inspected in order to verify the validity of the Green Passport when time has arrived for its disposal.

International efforts are visualised by the guidelines developed by ILO, IMO and UNEP (Bacel Convention). IMO is currently considering the need to establish a mandatory instrument for regulating ship recycling. This development will bring the issue of the applicability of the Basel Convention to the issue of ship recycling on the top of the agenda. It seems that this issue needs to be decided before the development work of an IMO mandatory instrument proceeds. It is unquestionable that the Basel Convention in its present form is unsuited to manage the ship recycling issue, thus, a future regime can not rest on the present convention. Whether or not a new instrument is developed by IMO or under the Basel Convention umbrella, it should be appreciated that the three guidelines will contribute significantly and their recommendations should be carefully assessed and implemented.

6. ACKNOWLEDGEMENTS

The DNV strategy on ship recycling has been supported by both the Norwegian Ministry of the Environment, Norwegian Maritime Directorate as well as the Norwegian Shipowners' Association. Their contribution has opened up opportunities that have allowed us to benchmark our procedural thoughts both onboard ships as well as in the recycling yards. The engagement shown is highly appreciated.

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8. AUTHORS' BIOGRAPHIES

Aage Bjørn Andersen is a MSc., naval architecture, with some 18 years of experience from various segments of both the offshore and shipping industry. He has spent the last 12 years working on issues concerning environmental impacts from these with particular focus on emissions to air, ship recycling and ballast water management. Mr. Andersen has worked on issues of bridging between industry and regulators and has been engaged by various national as well as international authorities on the development of regulations as well as that of implementing these. He has also been involved in environmental technology development and the implementation of such.

Terje Sverud holds the current position of Senior Consultant in Det Norske Veritas Maritime Solutions. He is responsible for Ship Recycling in Maritime Solutions in DNV. Sverud has a Master of Science degree from Norges Tekniske Høyskole, 1992. He has 12 years of experience from a wide range of environmental projects including e.g. ship/offshore installation recycling. Sverud was member of the Brent Spar evaluation team (1994) and has since then carried out several inventories of offshore installations. Sverud has been involved in the ship recycling work in DNV since it started in the late 1990s and has carried out 7 different Green Passports on ships in operation. He is currently also involved in DNVs work on Green Passport for newbuilding.

DEMOLISHCON – THE STANDARD CONTRACT FOR RECYCLING OF SHIPS

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SUMMARY

The recycling market has undergone a number of basic structural changes over the last decades, and BIMCO recently developed a new standard form that takes into account current business practices in the highly specialised recycling trade. The revision has also been politically expedient following the launch of the "Industry Code of Practice on Ship Recycling" in August 2001. Perhaps more importantly, the contract includes an undertaking by the parties to comply with the "IMO Guidelines on Ship Recycling" adopted in December 2003. This paper aims to take delegates through the document and also to explain the chain of communication between the ship owner and the recycling yard, as well as explaining the complex nature of sales negotiations, the role of brokers, the commercial risk and payment terms often involving an intermediate buyer.

1. INTRODUCTION

1.1 SALESCRAP 87 CONTRACT REVISED AND RE-NAMED DEMOLISHCON

BIMCO introduced the first standard contract for the sale of vessels for recycling in 1987 at a time when the shipping industry was experiencing a significant growth in the number of vessels sold for demolition.

Prior to the development of SALESCRAP 87, commercial parties had either drafted their own private form of contracts or made use of the SALEFORM Memorandum of Agreement. However, as SALEFORM was not specifically designed for this type of vessel sale, SALESCRAP 87 filled a gap in an industry where there was no generally accepted standard contract for the sale of vessels for recycling available.

SALESCRAP 87 was considered a well-drafted document, setting out the contractual terms and conditions in a legally clear and concise way. Expectations were therefore high that it would appeal to the recycling market and assist the commercial parties in any sale of a vessel for recycling. However, as time went by, it became apparent that the market had not adopted SALESCRAP 87. It was, nevertheless, still the firm view of BIMCO's Documentary Committee and the trade that the industry was in need of a clearly formulated and balanced standard contract tailored to the needs of the recycling trade. Consequently, it was decided to undertake an early revision of SALESCRAP 87 to bring it into line with current trade practice.

Part of BIMCO's development strategy to produce a standard contract that would gain widespread international acceptance was to engage in dialogue parties actively involved in the trade. The drafting committee consisted of representatives from among owners, brokers, cash buyers and clubs, working in consultation with organisations representing recycling yards.

The most important issue facing the drafting committee was whether the revision should follow the existing structure and format of SALESCRAP 87 or take a more flexible approach reflecting the structure and format of existing private forms in the recycling market. To fail for a second time to introduce a recognised standard form of sales contract would be wholly unacceptable to BIMCO.

The committee spent some time trying to ascertain why SALESCRAP 87 never gained widespread appeal in the recycling market. First of all, account was taken of the fact that SALESCRAP 87 had the market reputation of being biased towards the sellers' interest. To avoid the balance of responsibilities acting as a deterrent in the use of the revised SALESCRAP 87 great care had to be exercised in developing a contract with a clear and balanced delineation of the sellers and the buyers' rights and obligations. Furthermore, SALESCRAP 87 was designed as a dual-purpose document to be used either between the registered owners of the vessel and intermediaries or directly between the owners and the recycling yards. However, this dual functionality ultimately inhibited its widespread adoption since the trade felt SALESCRAP 87 to be unduly complex with regard to the operation of the document.

Last but not least SALESCRAP 87 was structured and worded in a format unfamiliar to the recycling industry. It was realised that to reintroduce into the market a standard form of contract materially different from existing forms could have a very negative impact in this specialised industry, no matter how reasoned the new structure and wording might be. Therefore, while carrying over the box layout from SALESCRAP 87, it was agreed that the wording of the standard terms and conditions should be aligned with those of SALEFORM where appropriate.

1.2 THE POLITICAL IMPERATIVE

The recycling industry has in the past been subject to increasing scrutiny by governments and environmental groups where growing concern has been expressed in respect of safety and health for workers, and environmental conditions at the recycling yards.

To meet those concerns, it was agreed to establish a working group on ship recycling that would look into ways and means of promoting safe and environmentally friendly practices in the recycling of vessels. The working group, which included representatives from BIMCO, the International Chamber of Shipping, and other industry bodies agreed to develop a Code of Practice outlining a series of recommendations, which would constitute "best practice" in respect of vessels destined for recycling.

One of the problems faced by the working group was how to produce a code of practice with the right balance between placing an obligation on the sellers that was possible for them to meet and to produce a text with enough political impact to encourage governments to leave it to the industry to deal with safety and environment. Realising that the revised SALESCRAP 87 was going to be an important tool in the practical implementation of the industry recommendations internationally, it was critical for the drafting committee to pursue the political imperative while giving due recognition to the theoretical obligations of the sellers of vessels for recycling; although such obligations would not always be feasible in practice.

The Industry Code of Practice on Ship Recycling, as it became, was launched in August 2001. As part of its commitment to promote safe and environmentally friendly practices, the Code of Practice suggests that representative shipping organisations should encourage the use of a standard ship recycling contract, such as the BIMCO form, to ensure that full account is taken of all relevant safety, health and environmental considerations.

BIMCO's Documentary Committee adopted the revised SALESCRAP 87 in November 2001. In view of the fact that the revised document for the sale of vessels for demolition and recycling is wholly different from its predecessor, the code name has been changed to DEMOLISHCON.

There is no such thing as a perfect sales contract and DEMOLISHCON does not pretend to be one. BIMCO is confident, however, that DEMOLISHCON is a significant improvement over existing sales contracts used in the recycling industry. It is a thoroughly workable document that the commercial parties can safely rely upon as a basis for negotiation whenever a vessel is to be sold for recycling.

The following explanatory notes are designed to provide some background information on the clauses of the various parts of the contract and a general overview of the amendments made in this revision.

UPDATE

In December 2003, the IMO Assembly adopted their "IMO Guidelines on Ship Recycling". As mentioned above, the BIMCO recycling contract DEMOLISHCON refers to the Industry Code of Practice and includes an inventory as part of the required delivery documents.

During a UNEP (United Nations Environment Programme) meeting in Geneva, in which BIMCO participated, the "waste" problem was discussed as well as the possibility of a system involving reporting/ notification procedures for exporting and importing by states before a ship can be sold for recycling.

A joint IMO/ILO/Basel Convention Working Group has now been established to undertake a comprehensive initial examination of the Guidelines developed by the three bodies with a view to identifying any possible gap, overlap, or ambiguities and to consider mechanisms that jointly promote the implementation of the relevant Guidelines on ship recycling. BIMCO will be represented in this joint working group as has been the case in other meetings of IMO and UNEP (Basel Convention) in respect of ship recycling.

It is BIMCO's view that the IMO Guidelines can be supported in principle, although we have concerns with a number of details and aspects. The shipping industry is urging IMO to consider these issues to ensure that the Guidelines will be fully supported by the industry. Furthermore, BIMCO strongly believes that recycling issues should be dealt with by the IMO rather than accepting that the Basel Convention is applicable to ships.

In order to lend support to the IMO Guidelines BIMCO has decided to amend DEMOLISHCON to change the references to the "Industry Code of Practice on Ship Recycling" to the "IMO Guidelines on Ship Recycling". This work has now been completed and a revised edition of DEMOLISHCON has been published. BIMCO recommends that anyone contemplating the sale of a vessel for recycling purposes uses the latest edition of BIMCO's DEMOLISHCON.

It is important that the industry's views are made known to IMO and UNEP, and any input from members on problems experienced in connection with using the DEMOLISHCON contract as well as other information you find pertinent to the matter in hand would be very welcome in our attempts to safeguard the interests of our industry.

2. EXPLANATORY NOTES

2.1 PART I

As mentioned, the DEMOLISHCON Standard Contract for the sale of Vessels for Demolition and Recycling follows the traditional box layout used by BIMCO. Part I of the form consists of boxes used to insert into the contract variable information pertaining to Part II. The recycling industry is a highly specialised trade and since it is common practice that vessels are sold without inspection, it is critical for the buyers to be told of the exact details of the vessel. The vessel must conform to her description as per the pertinent details provided in Part I, although it is clear that a vessel sold for recycling need not meet the same overall standard as that of a vessel sold for further trading. Therefore, to avoid that a buyer may try to renegotiate the price simply because of the overall condition of the vessel upon arrival at the delivery place, it has been provided that "The Sellers shall not be held responsible for any errors, omissions and/or the overall condition of the Vessel upon arrival at the place of delivery except for the items specified in this Part I".

2.2 PART II

2.2(a) Preamble

The Preamble includes an express undertaking by both parties to comply with the Industry Code of Practice on Ship Recycling in accordance with the provisions of Clause 17. The Code establishes the procedures to be adhered to in the selling of a vessel for recycling and provides a framework of "best practice" for the contractual parties involved in the sale of a vessel for recycling. Reference is made to Clause 17 (Safety and Environment).

2.2(b) Clause 1 (Outright Sale)

It is common practice in the recycling trade that no inspection of the vessel is carried out by the buyers. Clause 1 of DEMOLISHCON reflects such practice by providing that no inspection has taken place and that the sale is outright and definite.

2.2(c) Clause 2 (Purchase Price)

This Clause has been drafted on the basis that it is common practice within the recycling trade to contract on the basis of a price per long ton lightweight. Reference is made to Box 37, which requires the parties to state both the lump sum price and the equivalent price per long ton light displacement.

2.2(d) Clause 3 (Deposit)

As security for the due fulfilment of the contract the buyers are required to lodge a deposit with the bank stated in Box 38. It was considered whether sub-clause 3.1 should provide a prescribed percentage of the purchase price. However, it was agreed to leave it to the parties to decide individually upon the size of the deposit and state accordingly in Box 38. This is important to note since the deposit will be forfeited to the sellers if the purchase price is not paid in the manner specified in the contract. Reference is made to Clause 19 (Buyers' Default).

According to sub-clause 3.2 the deposit shall be made latest three banking days, as defined, after the signing of the contract. This is in accordance with general trade practice and notably different from SALESCRAP 87 which made the date of the contract the payment date for the deposit. Following trade practice in respect of the payment of the deposit involves the potential risk that a buyer may try to price the seller down by holding him to the contract although in some cases the buyers will pay the deposit before the parties sign the contract.

2.2(e) Clause 4 (Payment)

Clause 4 provides clear provisions as regards the payment of the purchase price. It is stated that the deposit shall be released and the balance of the purchase price be paid latest within three banking days following the sellers tendering notice of readiness of delivery. It should be noted that the payment has to be made in full, i.e., including bank charges. If the buyers do not pay the full purchase price the sellers have the right to cancel the contract in accordance with Clause 19.

2.2(f) Clause 5 (Financial Documentation)

Clause 5 lists a range of documents that the sellers must present to the buyers in exchange for the payment of the purchase price. It is appreciated that the documents that are required in connection with the sale of a vessel for recycling may vary depending on the relevant jurisdiction. The contractual parties may therefore wish to amend this Clause as appropriate.

It will be seen that according to sub-clause 5.1 (vii) the sellers shall provide a certificate according to which the sellers guarantee that at the time of delivery the vessel is free from all encumbrances and maritime liens or any other debts whatsoever. Although a duplication of the requirements in sub-clause 5.1 (i), it is a firm requirement by a number of recycling yards that the sellers provide such undertaking to avoid the situation that non-registered debts incur between the date of the bill of sale and the physical delivery of the vessel. Nevertheless, it may happen that a claim arises immediately prior to the time of delivery, which cannot always be guarded against and provisions have therefore been included in Clause 13 (Encumbrances and Maritime Liens, etc.) according to which the sellers shall indemnify the buyers against all consequences that arise from such claims.

Both parties have an interest in the smooth taking over of the vessel by the buyers and therefore sub-clause 5.2 provides that the sellers shall make available to the buyers copies of the documents listed in sub-clauses 5.1 (i) to (vii). The intention is to provide the buyers with copies of the relevant documents in the form they are supposed to have at the time of closing.

2.2(g) Clause 6 (Advance Notice of Arrival)

To enable the buyers to make the necessary arrangements for taking delivery the sellers are required to keep the buyers continuously advised about the vessel's position and expected time of arrival.

2.2(h) Clause 7 (Notice of Readiness for Delivery)

This Clause provides important provisions in respect of the tendering of notice of readiness (NOR) and the documents, which must accompany the NOR. The documents vary a great deal depending on the jurisdiction in which the recycling yard is located. However, Clause 7 has been structured to list only the requirements common to the main recycling nations. Where the vessel is to be delivered in a jurisdiction with less stringent documentation requirements the parties will have to make amendments by deleting from the list the relevant items.

Particular attention is called to the provisions of sub-clause 7.4, which prescribe that the NOR shall be accompanied by an inventory in the form as recommended by the Industry Code of Practice on Ship Recycling. The inventory, which is to be completed by the Master or his authorised representatives, provides an estimate of all potentially hazardous or contaminating materials or substances on board the vessel, inherent in its structure, or as an integral part of the machinery and/or equipment at the time of the sale. It is recommended to make use of the standard form of inventory referred to which clearly exonerates the shipowners or any of their representatives from liability as a result of errors or omissions on their part in completing the inventory. Having no contractual force the inventory is meant as a guide to the recycling facility and its workforce in connection with the dismantling of the vessels.

Tanker vessels have to be delivered with their tanks cleaned and certified for hot work in accordance with the standards laid down in sub-clause 7.6. This is a very important provision since the explosion risk from non-gas freed tanks when vessels are being dismantled represents the biggest single safety issue.

2.2(i) Clause 8 (Delivery)

Sub-clause 8.1 sets out the conditions in which the vessel must be delivered. The Clause takes into account that in some areas there may be no breaking up berth and that delivery may be effected at the outer anchorage prior to beaching.

The provisions of sub-clause 8.2 emphasise the buyers' obligation to designate another safe berth or anchorage if the original place of delivery agreed is inaccessible for any reason whatsoever.

Sub-clause 8.3 provides that if the sellers have been instructed to and deliver the vessel at a place other than that originally agreed they have fulfilled their contractual obligations with the same legal consequences as if delivery had taken place in accordance with the provisions of sub-clause 8.1.

Sub-clause 8.5 is a straightforward risk sharing provision according to which all risks and expenses fall upon the sellers until the vessel has been delivered. After delivery all such risks and expenses are transferred to the buyers.

2.2(j) Clause 9 (Time of Delivery/Cancelling Date)

This Clause provides very important provisions in respect of the buyers' right to cancel should the sellers not be able to effect timely delivery of the vessel.

Sub-clause 9.1 provides a period within which the vessel should be delivered. However, the crucial date is, of course, the one stated in Box 43, i.e., the cancelling date. If the vessel has not tendered NOR for delivery by the date stated in Box 43 then, no matter what the reason may be, the buyers may cancel the contract.

Sub-clause 9.2 (i) includes the so-called interpellation provisions. It has become common practice for BIMCO to include such provisions in its standard documents be it charter parties or other types of contracts. The purpose of the provisions is that the vessel shall not be required to proceed on a voyage to the place of delivery if it is clear to the sellers that despite their exercising due diligence, the vessel will not be able to arrive by the cancelling date, not knowing whether the buyers will maintain or cancel the contract once the vessel arrives. The provisions are particularly relevant in trades involving long ballast voyages and resulting high costs.

Sub-clause 9.2 contains provisions in respect of the new cancelling date in the event the interpellation provisions come into operation. It should be noted that whether or not the buyers decide to cancel the contract following the owners' interpellation is without prejudice to their right to claim damages for any loss or damage incurred as a result of the sellers not being able to meet the original cancelling date.

2.2(k) Clause 10 (Beaching)

This Clause takes into account that not all places of delivery are of equal sophistication and that in some places the vessel may be required to beach. It is important to note, however, that where the vessel is required to beach, delivery will be deemed to already have taken place for all legal purposes. Reference is made to sub-clause 8.1 and Box 41. Thus, beaching of the vessel is entirely at the buyers' risk and expense.

It is important to BIMCO that the beaching of the vessel does not in any way impact upon the safety of the crew. Therefore, specific provisions have been included to provide that the buyers shall use their best endeavours to assist in the safe disembarkation of the crew after beaching.

2.2(l) Clause 11 (Bunkers, Equipment etc.)

It should be stated clearly in Box 22 those items which are not to be included in the sale.

In some countries the buying and selling of bunkers are monopolised with no rights for the buyers to buy any remaining bunkers on board the vessel at the time of delivery. Sub-clause 11.2 therefore provides that any remaining bunkers together with lubricating oils, stores, etc. shall become the buyers' property, it being left to the parties to agree otherwise where possible and if so wished.

Sub-clause 11.4 states clearly which items are always excluded from the sale.

2.2(m) Clause 12 (Light Displacement Tonnage (LDT))

The sellers shall provide the buyers with the documents listed in this Clause as evidence of the vessel's light displacement tonnage. Proof of the vessel's light displacement tonnage is of utmost importance to the buyers when purchasing tonnage for recycling.

2.2(n) Clause 13 (Encumbrances and Maritime Liens, etc.)

Reference is made to sub-clause 5(vii) providing that the sellers in exchange for the purchase price shall furnish the buyers with a certificate according to which the sellers guarantee that at the time of delivery the vessel is free from all encumbrances and maritime liens or any other debts whatsoever. As mentioned earlier there may nevertheless be situations where non-registered encumbrances, claims or debts arise prior to delivery. To cater for those situations Clause 13 provides that the sellers shall indemnify the buyers against all consequences that may arise out of such claims.

2.2(o) Clause 14 (Taxes, Dues and Charges, etc.)

This Clause is self-explanatory.

2.2(p) Clause 15 (Buyers' Watchmen)

It is common practice in the recycling trade to give the buyers the right to place watchmen on board the vessel on her arrival at the place of delivery. The number of watchmen is to be clearly stated in Box 44. Since the watchmen are on board at the sole risk and expense of the buyers it is important that they sign the sellers' letter of indemnity prior to their embarkation. It should be noted that the watchmen must not interfere with the operation of the vessel.

2.2(q) Clause 16 (Purpose of Sale)

When selling a vessel for recycling, the sellers want to make sure that the vessel is sold for recycling only and that the buyers do not continue trading the vessel for their own account and thereby become competitor to the sellers, or resell the vessel to a third party for further trading.

The provisions of Clause 16 are aimed at protecting the sellers against such events. Should the buyers decide to continue trading the vessel or resell to a third party this will amount to breach of contract against which the sellers will have a claim for damages.

2.2(r) Clause 17 (Safety and Environment)

As mentioned in the introduction it was important to underpin in DEMOLISHCON the political imperative of the Code of Practice on Ship Recycling as regards safety and environment while taking into account the obligations it may be feasible for the sellers to adhere to.

It was felt that this was best achieved by a general reference to the Code of Practice as set out in the first paragraph of Clause 17 whereby both the sellers and the buyers declare themselves to be familiar with the Code; the sellers use their best endeavours to give information to the buyers in respect of its recommendations and the buyers, likewise, use their best endeavours to comply with those recommendations. The obligation to undertake their best endeavours suggests that neither the sellers nor the buyers should be held accountable for information that is provided or relied upon in good faith but which may appear not to be entirely correct.

The Code of Practice urges those entities entering into a contract for the sale of a vessel for recycling to consider the working practices and facilities in the recycling yard to ascertain that safe and environmentally sound practices are being conducted in respect of recycling. This may be possible where the sale is between the registered owners of the vessel and the yard. However, where intermediaries are involved, which is most often the case, the owners are unlikely to know the final destination of the vessel at the time of the sale and will, therefore, be unable to ascertain that appropriate standards are conducted in the yard as regards safety and environment.

The drafting committee realised that the only way to overcome this problem would be if the sellers were allowed to visit the relevant ship recycling facility. However, the question remained whether the sellers should be allowed to do so before or after delivery. Before delivery, would presuppose that the sellers always know of the buyers' choice of recycling yard and therefore be in a position to influence such choice – which is seldom the case. It was therefore agreed that the second paragraph of Clause 17 should provide for the buyers to ensure that after delivery the sellers shall be allowed to visit the yard to ascertain that appropriate standards in respect of safety and environment are complied with. This should avoid any grey areas as regards what may be known to the sellers between the interval of them signing the contract and the delivery of the vessel.

2.2(s) Clause 18 (Exemptions)

This is a general exemptions clause exonerating both the buyers and the sellers from any liability in the event delivery is prevented as a result of events outside the parties' control. It was agreed that events might occur, which make it impossible for the buyers to take delivery of the vessel. Therefore, unlike some exemption provisions, Clause 18 applies both ways. It should be noted that the contract will be terminated automatically in the event of a force majeure event preventing either party from fulfilling its obligations, although this is not clearly stated in Clause 18.

2.2(t) Clause 19 (Buyers' Default) and Clause 20 (Sellers' Default)

In line with the drafting committee's general policy to produce an equitable form of contract with clear and balanced terms, much care has been taken in the drafting of Clauses 19 and 20. In case of default or non-execution by either the sellers or the buyers, a right to cancel or claim compensation is vested in both parties together with interest at LIBOR plus 3%. It should be noted however, that for the buyers to claim compensation together with interest under Clause 20 as a result of the sellers' non-compliance with its provisions, they must prove negligence on the part of the sellers.

2.2(u) Clause 21 (Dispute Resolution Clause)

This Clause, previously the "Law and Arbitration Clause", is the latest edition of BIMCO's standard suite of dispute resolution provisions. In addition to BIMCO's Law and Arbitration Clause 1998, the provision incorporates a new mediation clause. The mediation clause is designed to function in conjunction with the chosen arbitration option, whether that is English law, London arbitration, US law, New York arbitration, or law and arbitration as agreed. Mediation is a technique that is recognised as offering savings in costs and time over traditional methods of dispute resolution for certain types of disputes. BIMCO's mediation clause is only triggered once arbitration proceedings have commenced and then runs in parallel with those proceedings, if the parties so choose. This has been done to ensure that one party cannot invoke mediation as a delaying technique.

For further description of the BIMCO Standard Dispute Resolution Clause, please see BIMCO Bulletin No. 1/2002.

2.2(v) Clause 22 (Notices)

The Notices provision is designed to provide a single point of reference establishing the agreed method of communication between the parties for the duration of the contract period.

3. COPYRIGHT

Copyright in DEMOLISHCON is held by BIMCO.

4. BIOGRAPHY

Torben C. Strand holds the current position of Senior Manager at BIMCO and has over 40 years experience in the shipping industry. He is involved in the IMO Marine Environment Protection Committee's work on ship recycling as well as attending UNEP meetings in Geneva pertaining to Basel Convention regulations. His work on recycling issues also includes participation in the working groups responsible for the development of the Industry Code of Practice on Ship Recycling as well as the IMO Guidelines on Ship Recycling. In addition, he participated in BIMCO's Documentary Sub-committee undertaking the development of the DEMOLISHCON contract.

1. Place and Date of Contract	**BIMCO STANDARD CONTRACT FOR THE SALE OF VESSELS FOR DEMOLITION AND RECYCLING** **CODE NAME: "DEMOLISHCON"** PART I
2. Sellers/Place of business (state full style and address)	3. Buyers/Place of business (state full style and address)
4. Managers of the Vessel (state full style and address)	5. Registered Owners' P&I Club 6. Name of Vessel (state also previous names, if any)
7. Type of Vessel	8. Year and place built

9. Flag	10. Place of registry	11. IMO number

12. Class	13. Hull construction
14. GT/NT (as per registry certificate)	15. Loa/Lbp (as per registry certificate)
16. Breadth moulded (as per registry certificate)	17. Depth moulded (as per registry certificate)
18. Deadweight max. SSW (state metric or long tons)	19. Approximate arrival draft fore/aft (Cl. 8.1)
20. Light Displacement Tonnage in long tons (Cl. 12)	21. Permanent ballast, if any
22. Removals (state removals including hired items, if any)(Cl. 11)	23. Generators (number, make, model, power, voltage, frequency)
24. Main engine (make, model, power)	25. Working propeller(s) (number and material)

26. Spare propeller (number and material)	27. Spare tail shaft	28. Spare anchor/chain

For Dry Cargo Vessels:	**For Tankers:**
29. Reefer space (type of insulation)	30. Heating coils (place and material)
31. Cargo gear	32. Deck/Steam/Cargo lines (material)
33. Hold/Hatches	34. Cargo tanks coating (condition)
35. Ballast tanks coating (condition)	

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continued

BIMCO STANDARD CONTRACT FOR THE SALE OF VESSELS FOR DEMOLITION AND RECYCLING
CODE NAME: "DEMOLISHCON"

PART I

1. Place and Date of Contract	
2. Sellers/Place of business (state full style and address)	3. Buyers/Place of business (state full style and address)
4. Managers of the Vessel (state full style and address)	5. Registered Owners' P&I Club
	6. Name of Vessel (state also previous names, if any)
7. Type of Vessel	8. Year and place built
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33. Hold/Hatches	34. Cargo tanks coating (condition)
35. Ballast tanks coating (condition)	

continued

36. Trading history and last five cargoes	
37. Purchase Price in figures and letters (state both lump sum price and the equivalent price per long ton light displacement)(Cl. 2) (a) Lump sum price	(b) Equivalent price per long ton light displacement
38. Deposit (Cl. 3) (a) State percentage of purchase price (b) State name and place of bank to which the deposit shall be paid	39. Sellers' bank (state name and place and bank account details to which the balance of the purchase price shall be paid) (Cl. 4)
40. Financial Documentation (Cl. 5) (a) State place of closing (b) State by whom bill of sale shall be legalised or apostilled (c) State number of commercial invoice(s)	41. Place of delivery (Cl. 8.1) 42. Time of delivery (Cl. 9.1) 43. Cancelling date (Cl. 9.1)
44. Buyers' watchmen (Cl. 15)	45. Dispute Resolution (state 21.1, 21.2 or 21.3; if 21.3 agreed place of arbitration <u>must</u> be stated)(Cl. 21)
46. Notices (state postal and cable address, e-mail and telefax number for serving notice and communication <u>to the Sellers</u>)(Cl. 22.2)	47. Notices (state postal and cable address, e-mail and telefax number for serving notice and communication <u>to the Buyers</u>)(Cl. 22.2)
48. Numbers of additional clauses covering special provisions, if agreed	

The Sellers shall not be held responsible for any errors, omissions and/or overall condition of the Vessel upon arrival at the place of delivery except for the items specified in this PART I

It is mutually agreed between the party named in Box 2 (hereinafter referred to as "the Sellers") and the party named in Box 3 (hereinafter referred to as "the Buyers") that on the date of this Contract the Sellers have sold and the Buyers have bought the Vessel described in PART I hereof (hereinafter referred to as "the Vessel") on the terms and conditions contained in this Contract consisting of PART I including additional clauses, if any agreed and stated in Box 48, and PART II. In the event of a conflict of conditions, the provisions of PART I shall prevail over those of PART II to the extent of such conflict but no further.

Signature (Sellers)	Signature (Buyers)

PART II

"DEMOLISHCON" Standard Contract for the Sale of Vessels for Demolition and Recycling

Preamble

The party stated in Box 2 (hereinafter "the Sellers") has agreed to sell and the party stated in Box 3 (hereinafter "the Buyers") has agreed to buy the Vessel stated in Box 6 on the following terms and conditions which, in particular, include an undertaking to comply with IMO Resolution A.962(23) IMO Guidelines on Ship Recycling (hereinafter the "IMO Guidelines" in accordance with Clause 17 (Safety and Environment).

Definition

"Banking Days" are days on which banks are open both in the country of the currency stipulated for the purchase price in Clause 2 and at the place of closing.

1. Outright Sale

The Vessel has been accepted by the Buyers without inspection and the sale is outright and definite subject only to the terms and conditions of this Contract.

2. Purchase Price

The purchase price is the sum stated in Box 37(a) payable in United States Dollars based upon a price per long ton Light Displacement Tonnage (LDT) (see Clause 12) as stated in Box 37(b) calculated on the basis of the Vessel's LDT as stated in Box 20.

3. Deposit

3.1 As a security for the due fulfilment of this Contract, the Buyers shall pay a deposit as stated in Box 38 to be placed with the bank stated in Box 38 in the joint names of the Sellers and the Buyers.

3.2 Such deposit shall be made latest within 3 banking days after the date of signing this Contract.

3.3 Interest, if any, on such deposit shall be credited to the Buyers.

3.4 Any fees or charges for establishing and holding such deposit shall be borne equally by the Sellers and the Buyers.

4. Payment

The Buyers shall release the deposit stated in Box 38 to the Sellers and shall pay the balance of the said purchase price in full to the Sellers' bank stated in Box 39 on delivery latest within 3 banking days from the time the Sellers have tendered notice of readiness for delivery in accordance with the terms and conditions of this Contract.

5. Financial Documentation

5.1 In exchange for the payment of the purchase price the Sellers shall furnish the Buyers with the following documents at the place of closing stated in Box 40(a), which shall be in English or with a certified English translation if in a language other than English:

(i) a legal bill of sale transferring title of the Vessel and stating that the said Vessel is free from all encumbrances and maritime liens or any other debts whatsoever, notarially attested, legalised or apostilled as appropriate by the Consul or other competent authority stated in Box 40(b);

(ii) the number of commercial invoices mentioned in Box 40(c) signed by the Sellers, stating the purchase price of the Vessel and her particulars as mentioned in Boxes 6-36 as applicable;

(iii) a certificate or transcript of registry evidencing the ownership of the Vessel and that the Vessel is free from registered encumbrances, taxes and mortgages. Such certificate or transcript of registry shall be dated not earlier than 5 days prior to the date of the Sellers tendering notice of readiness for delivery;

(iv) a written undertaking from the Sellers to apply for and supply to the Buyers a certificate of deletion or closed transcript of registry latest 4 weeks after delivery of the Vessel;

(v) a written undertaking by the Sellers to instruct the Master or their agents to promptly release and deliver the Vessel to the Buyers;

(vi) a certified copy of the minutes of the Board of Directors and/or shareholders resolution, as appropriate, according to which they decide the sale of the Vessel and a copy of the power of attorney authorizing the signature of the bill of sale;

(vii) a certificate according to which the Sellers guarantee that at the time of delivery the Vessel is free from all encumbrances and maritime liens or any other debts whatsoever.

5.2 At the time of delivery the Buyers and the Sellers shall sign a protocol of delivery and acceptance confirming the date and time of delivery of the Vessel. The Sellers shall make available to the Buyers copies of the documents listed in sub-clauses 5.1 (i) to (vii) as soon as possible after the signing of this Contract, but no later than 3 days prior to the date of the Sellers tendering notice of readiness for delivery.

6. Advance Notice of Arrival

The Sellers shall keep the Buyers fully informed about the Vessel's position and of any alteration in expected time of arrival and shall give to the Buyers 15, 10, 7, and 3 days notice of the expected time of arrival of the Vessel.

7. Notice of Readiness for Delivery

When the Vessel is ready for delivery, the Sellers shall give to the Buyers a written notice of readiness for delivery. The notice of readiness shall be tendered during normal office hours at the Place of Delivery and, unless otherwise specifically provided elsewhere in this Contract, be accompanied by the following documents to the extent necessary:

7.1 a certificate issued by a local marine surveyor confirming the LDT of the Vessel as stated in Box 20 as per the builders' original trim and stability booklet or the builders' capacity plan on board the Vessel, which has been sighted;

7.2 a letter from the Sellers' local agents at the Place of Delivery stating that there are no pending dues against the Vessel at the time of delivery;

7.3 a letter signed and stamped by the Master stating that neither he nor the crew have any outstanding claims against the Vessel;

7.4 an inventory, in the form as recommended by the IMO Guidelines as applicable;

7.5 a portworthy certificate issued by a local marine surveyor confirming the material of the working propeller(s) as stated in Box 25;

7.6 a valid gasfree certificate for hotwork. Such certificate shall be issued by the relevant authorities on arrival at the Place of Delivery and shall specify that all the Vessel's cargo tanks, pump rooms and cofferdams are gasfree, safe for men, safe for fire and are free of slops, sludge and residues;

7.7 a letter from the Sellers stating that the Vessel has not carried any nuclear waste or industrial waste or chemicals prior to the time of notice of readiness being tendered;

7.8 a letter from the Master confirming that there have been no removals from the Vessel other than those stated in Box 22;

7.9 a letter of undertaking from the Sellers' agents that they will arrange for the filing of the inward general manifest;

7.10 a valid deratisation exemption certificate issued by the relevant authorities.

7.1 – 7.10. Delete as appropriate.

8. Delivery

8.1 The Vessel shall be delivered by the Sellers to the Buyers under her own power, safely afloat, substantially intact, free of any fire and/or explosion damage, free of cargo, free from all charters, with anchors in place and, where applicable, with hatches closed and derricks lowered and gasfree for hotwork (see sub-clause 7.6), as appropriate, with the approximate arrival draft stated in Box 19 at the place stated in Box 41 (hereinafter "the Place of Delivery").

8.2 If, on the Vessel's arrival, the Place of Delivery is inaccessible for any reason whatsoever including but not limited to port congestion, the Vessel shall be delivered and taken over by the Buyers as near thereto as she may safely get at a safe and accessible berth or at a safe anchorage which shall be designated by the Buyers, always provided that such berth or anchorage shall be subject to the approval of the Sellers and the Master which shall not be unreasonably withheld. If the Buyers fail to nominate such place within 24 hours of arrival, the place at which it is customary for vessels to wait shall constitute the Place of Delivery.

8.3 The delivery of the Vessel according to the provisions of sub-clause 8.2 shall constitute a full performance of the Sellers' obligations according to sub-clause 8.1 and all other terms and conditions of this Contract shall apply as if delivery had taken place according to sub-clause 8.1.

8.4 All expenses incurred prior to delivery of the Vessel and all local fees/port disbursements relating to the Vessel, including repatriation of the crew shall be for the Sellers' account while all expenses after delivery of the Vessel, including import duties and other local taxes, if any, shall be for the Buyers' account.

8.5 The Vessel with everything belonging to her shall be at the Sellers' risk and expense until she is delivered to the Buyers.

8.6 The Sellers shall deliver the Vessel to the Buyers with the minimum amount of ballast water on board without prejudicing the safety of the Vessel.

8.7 The Vessel shall be delivered without any stowaways, contraband or arms and ammunition on board, otherwise the Buyers shall have the option not to accept the Vessel, without prejudice to any claim for loss and/or damages the Buyers may have against the Sellers under this Contract.

9. Time of Delivery/Cancelling Date

9.1 The Vessel shall be ready for delivery between the dates (both inclusive) stated in Box 42 but latest on the date stated in Box 43 (hereinafter "the Cancelling Date").

9.2 **(i)** Should the Sellers anticipate that notwithstanding the exercise of due diligence, the Vessel will not be ready for delivery by the Cancelling Date they may notify the Buyers in writing stating the date when they anticipate that the Vessel will be ready for delivery and propose a new date for the Cancelling Date. Upon receipt of such notification the Buyers shall have the option either to cancel the Contract according to Clause 20 within 2 working days of receipt of such notice or of accepting the new date as the Cancelling Date. If the Buyers have not declared their option within 2 working days of receipt of the Sellers' notification or, if the Buyers accept the new date, the date proposed by the Sellers shall be deemed the Cancelling Date.

(ii) If this Contract is maintained with the new Cancelling Date, all other terms and conditions hereof shall remain in full force and effect. Cancellation or non-cancellation by the Buyers in accordance with the provisions of sub-clause 9.2 (i) shall be without prejudice to any claim for loss and/or damages the Buyers may have against the Sellers under this Contract.

10. Beaching

Following payment and delivery of the Vessel the Sellers shall assist the Buyers in the beaching of the Vessel at the Buyers' designated demolition plot. The Vessel shall be delivered with sufficient useable/pumpable fuel, water and provisions for one day's steaming and nine days' idling. The Sellers shall arrange for crew according to the safe manning certificate to remain with the Vessel for a period of up to 10 days after delivery in order to assist with the aforesaid beaching.

The beaching of the Vessel, which shall include the moving of the Vessel from the outer anchorage to the beaching plot, shall be for the Buyers' risk and expense. However, the Master shall co-operate with the Buyers in achieving the best possible draft and trim for beaching.

The Buyers shall use their best endeavours to assist in the safe disembarkation of the crew after beaching. The Sellers shall pay the wages and arrange P&I insurance cover on their crew involved in the beaching operation.

11. Bunkers, Equipment etc.

11.1 The Vessel shall be delivered with everything belonging to her on board without removals other than those stated in Box 22. However, the Sellers shall have the right to take ashore without compensation the following items: crockery, cutlery, linen and other articles bearing the Sellers' flag or name, as well as library, forms, etc., exclusively for use in the Sellers' vessels. Master's, Officers' and crew's personal belongings including slop chest and the Vessel's log book shall be excluded from the sale.

11.2 Unless otherwise agreed, any remaining bunkers, lubricating oils, stores, equipment and spares used or unused on board at the time of delivery shall become the Buyers' property without extra payment.

11.3 The Sellers shall, at the time of delivery, hand to the Buyers all plans, specifications and certificates, or copies hereof, as available and whether valid or invalid.

11.4 The Sellers are not required to replace such material, spare parts or stores including spare propeller(s), if any, which may be consumed or taken out of spare and used as replacement prior to delivery, but all replaced spares shall be retained on board and shall become the property of the Buyers.

12. Light Displacement Tonnage (LDT)

The purchase price of the Vessel shall be based on the Vessel's LDT in long tons as stated in Box 20

excluding any permanent ballast. The Vessel's LDT shall be verified by the builders' original trim and stability booklet stamped and approved by Class which shall be on board the Vessel and made available to the Buyers' representatives at the time of tendering the Vessel's notice of readiness in accordance with Clause 7. The Sellers shall also make available to the Buyers an original or copy of the builders' capacity plan with a deadweight scale and/or builders' letter.
The Sellers shall make copies of the above documents available to the Buyers as soon as possible after the signing of this Contract.

13. Encumbrances and Maritime Liens, etc.
The Sellers warrant that the Vessel, at the time of delivery, is free from all charters, encumbrances and maritime liens or any other debts whatsoever. Should any claims, which have been incurred prior to the time of delivery, be made against the Vessel, the Sellers hereby undertake to indemnify the Buyers against all consequences of such claims.

14. Taxes, Dues and Charges, etc.
Any taxes, fees and expenses connected with the purchase of the Vessel under the Buyers' ownership shall be for the Buyers' account, and charges connected with the closing of the Sellers' register shall be for the Sellers' account.

15. Buyers' Watchmen
The Sellers agree to allow the Buyers to place the number of watchmen stated in Box 44 on board the Vessel on her arrival at the Place of Delivery.
Whilst on board the Vessel, such watchmen shall be at the sole risk, liability and expense of the Buyers and the Buyers shall indemnify the Sellers against any claim for loss and/or damages in this respect. The Buyers' watchmen must not interfere with the operation of the Vessel and they shall sign the Sellers' letter of indemnity prior to their embarkation.

16. Purpose of Sale
The Vessel is sold for the purpose of demolition and recycling only and the Buyers undertake that they will neither trade the Vessel for their own account nor sell the Vessel to a third party for any purpose other than demolition and recycling. The Buyers shall procure that this obligation is made a term of any and every subsequent agreement for the resale of the Vessel.

17. Safety and Environment
Both the Sellers and the Buyers are familiar with the IMO Guidelines and the Sellers shall use their best endeavours to give information to the Buyers in respect of the recommendations of the IMO Guidelines and the Buyers likewise shall use their best endeavours to comply with such recommendations.
The Buyers shall ensure that after delivery the Sellers' representatives are allowed to visit the ship recycling facility to ascertain that safe and environmentally sound practices are being conducted in respect of the recycling of the Vessel.

18. Exemptions
Neither the Sellers nor the Buyers shall be under any liability if the Vessel should become an actual, constructive or compromised total loss before delivery, or if delivery of the Vessel by the Cancelling Date should otherwise be prevented or delayed due to outbreak of war, restraint of Government, Princes, Rulers or People of any Nation or the United Nations, Act of God, or any other cause whatsoever beyond the Buyers' or the Sellers' control.

19. Buyers' Default
Should the deposit not be paid in accordance with the provisions of Clause 3, the Sellers shall have the right to cancel this Contract, and they shall be entitled to claim compensation for their losses and for all expenses incurred together with interest at LIBOR plus 3% per annum.
Should the purchase price not be paid in the manner provided for in this Contract the Sellers shall have the right to cancel the Contract, in which case the amount deposited together with interest earned, if any, shall be forfeited to the Sellers. If the deposit does not cover the Sellers' losses, they shall be entitled to claim further compensation for their losses and for all expenses together with interest at LIBOR plus 3% per annum.

20. Sellers' Default
Should the Sellers fail to give notice of readiness in accordance with Clause 7 or fail to execute a legal transfer or to deliver the Vessel with everything belonging to her by the Cancelling Date, the Buyers shall have the right to cancel the Contract, in which case the deposit in full shall be returned to the Buyers together with interest at LIBOR plus 3% per annum.
Whether or not the Buyers cancel this Contract the Sellers shall make due compensation to the Buyers for any loss and for all expenses incurred together with interest by their failure to give notice of readiness, to execute a legal transfer or to deliver the Vessel with everything belonging to her by the Cancelling Date, if such failure is due to the proven negligence of the Sellers.

21. Dispute Resolution Clause
21.1* This Contract shall be governed by and construed in accordance with English law and any dispute arising out of or in connection with this Contract shall be referred to arbitration in London in accordance with the Arbitration Act 1996 or any statutory modification or re-enactment thereof save to the extent necessary to give effect to the provisions of this Clause.
The arbitration shall be conducted in accordance with the London Maritime Arbitrators Association (LMAA) Terms current at the time when the arbitration proceedings are commenced.
The reference shall be to three arbitrators. A party wishing to refer a dispute to arbitration shall appoint its arbitrator and send notice of such appointment in writing to the other party requiring the other party to appoint its own arbitrator within 14 calendar days of that notice and stating that it will appoint its arbitrator as sole arbitrator unless the other party appoints its own arbitrator and gives notice that it has done so within the 14 days specified. If the other party does not appoint its own arbitrator and give notice that it has done so within the 14 days specified, the party referring a dispute to arbitration may, without the requirement of any further prior notice to the other party, appoint its arbitrator as sole arbitrator and shall advise the other party accordingly. The award of a sole arbitrator shall be binding on both parties as if he had been appointed

by agreement.

Nothing herein shall prevent the parties agreeing in writing to vary these provisions to provide for the appointment of a sole arbitrator.

In cases where neither the claim nor any counterclaim exceeds the sum of US$50,000 (or such other sum as the parties may agree) the arbitration shall be conducted in accordance with the LMAA Small Claims Procedure current at the time when the arbitration proceedings are commenced.

21.2* This Contract shall be governed by and construed in accordance with Title 9 of the United States Code and the Maritime Law of the United States and any dispute arising out of or in connection with this Contract shall be referred to three persons at New York, one to be appointed by each of the parties hereto, and the third by the two so chosen; their decision or that of any two of them shall be final, and for the purposes of enforcing any award, judgement may be entered on an award by any court of competent jurisdiction. The proceedings shall be conducted in accordance with the rules of the Society of Maritime Arbitrators, Inc.

In cases where neither the claim nor any counterclaim exceeds the sum of US$50,000 (or such other sum as the parties may agree) the arbitration shall be conducted in accordance with the Shortened Arbitration Procedure of the Society of Maritime Arbitrators, Inc. current at the time when the arbitration proceedings are commenced.

21.3* This Contract shall be governed by and construed in accordance with the laws of the place mutually agreed by the parties and any dispute arising out of or in connection with this Contract shall be referred to arbitration at a mutually agreed place, subject to the procedures applicable there.

21.4 Notwithstanding 21.1, 21.2 or 21.3 above, the parties may agree at any time to refer to mediation any difference and/or dispute arising out of or in connection with this Contract.

In the case of a dispute in respect of which arbitration has been commenced under 21.1, 21.2 or 21.3 above, the following shall apply:-

(i) Either party may at any time and from time to time elect to refer the dispute or part of the dispute to mediation by service on the other party of a written notice (the "Mediation Notice") calling on the other party to agree to mediation.

(ii) The other party shall thereupon within 14 calendar days of receipt of the Mediation Notice confirm that they agree to mediation, in which case the parties shall thereafter agree a mediator within a further 14 calendar days, failing which on the application of either party a mediator will be appointed promptly by the Arbitration Tribunal ("the Tribunal") or such person as the Tribunal may designate for that purpose. The mediation shall be conducted in such place and in accordance with such procedure and on such terms as the parties may agree or, in the event of disagreement, as may be set by the mediator.

(iii) If the other party does not agree to mediate, that fact may be brought to the attention of the Tribunal and may be taken into account by the Tribunal when allocating the costs of the arbitration as between the parties.

(iv) The mediation shall not affect the right of either party to seek such relief or take such steps as it considers necessary to protect its interest.

(v) Either party may advise the Tribunal that they have agreed to mediation. The arbitration procedure shall continue during the conduct of the mediation but the Tribunal may take the mediation timetable into account when setting the timetable for steps in the arbitration.

(vi) Unless otherwise agreed or specified in the mediation terms, each party shall bear its own costs incurred in the mediation and the parties shall share equally the mediator's costs and expenses.

(vii) The mediation process shall be without prejudice and confidential and no information or documents disclosed during it shall be revealed to the Tribunal except to the extent that they are disclosable under the law and procedure governing the arbitration.

(*Note: The parties should be aware that the mediation process may not necessarily interrupt time limits.)*

21.5 If Box 45 in PART I is not appropriately filled in, sub-clause 21.1 of this Clause shall apply. Sub-clause 21.4 shall apply in all cases.

21.1, 21.2 and 21.3 are alternatives; indicate alternative agreed in Box 45.

22. Notices

22.1 Any notice to be given by either party to the other party shall be in writing and may be sent by fax, e-mail, registered or recorded mail or by personal service.

22.2 The address of the Parties for service of such communication shall be as stated in Boxes 46 and 47 respectively.

SHIP RECYCLING IN PAKISTAN – ENVIRONMENT & ECONOMICS

M Shahid, Binary Systems & Engineering, Pakistan

SUMMARY

The history of shipbreaking in Pakistan is described along with typical yard facilities and organisation. The shipbreaking process starting from import of ship, beaching, removal of machinery, equipment, outfitting items and recovery of steel and handling of liquid and solid waste are stated. Issues of occupational safety and environment protection at Gaddani are looked into. Economic viability, in view of total yearly steel consumption and contribution from shipbreaking steel, for rehabilitation and upgrading of industry to comply with international standards of Environmentally Sound Management (ESM) of shipbreaking is considered. The paper is concluded highlighting needs of effective management of tax system, development of resources including workers training on occupational health and environment protection, and upgrading of yard facilities for ESM.

NOMENCLATURE

BDA	Baluchestan Development Authority
BDB	Baluchestan Development Board
ESM	Environmentally Sound Management
FSB	Federal Statistics Bureau
LTD	Light Tonnage Displacement
LPG	Liquefied Propane Gas
LUSB	Labour Union of Ship Breakers
MOE	Ministry of Environment
PCB	Poly Chlorinated Biphenyls
PSBA	Pakistan Ship Breakers' Association
PSM	Pakistan Steel Mills
Rs	Rupee, Pakistani Currency (US$ 1 = Rs 59.5)
TBT	Tri Butyl Tin
US$	United States Dollar
USD	United States Dollar
UNEP	United Nations Environment Programme

1. INTRODUCTION

Pakistan is among the countries having considerable contribution in recycling of old ships. The ship breaking industries in Pakistan was in deep recession in last years and has managed to resurface recently with tax-cut announced by the government. Renewed activities in the industry brought relieve for poor labour getting again employment opportunities. Environmental groups however fear disaster impact on the ecosystem along the Arabian Sea Coast and labour organizations are more concerned about working conditions.

The implementation of environment friendly approach to ship recycling and, provisioning of safe working conditions needs thorough technological and economic analysis of the process in context of local market dynamics and resources. It is considered important to establish feasibility of enhancement required to existing ship breaking facility for Environmentally Sound Management (ESM) of the business in accordance to international standards.

2. HISTORY

The ship breaking started in Pakistan at a limited scale in 1968 at Ghass Bunder adjacent to Keamari in Karachi harbour. Lake of space was among the major reasons for the business to soon search for alternate place. Gaddani having ideal beach gradient, large space for future expansion and proximity to Karachi, the main Pakistani market, became a preferred choice and the business was shifted to the area in around 1972.

Gaddani is a small coastal village in Lasbela District of Baluchestan, easily accessible from Karachi by road. Baluchestan Development Authority (BDA) recognising employment potential of the labour intensive industry offered 314 plots of 200 x 80 meters to the ship breakers along the Gaddani beach. BDA also developed requisite infrastructure/facilities including 10KM of approach road, electricity, water supply, telephone lines and First Aid medical unit etc to support setting up of the industry in the area. So far, 150 plots have been developed and are being used for ship breaking by 27 companies registered with BDA.

Shipbreaking industry has displayed credible performance through production of steel from imports and scrapping of various types of vessels such as cargo tankers, bulk carriers, cattle carriers, oil rigs, tugs, naval crafts and other floating structures. The industry reached at its peak in Pakistan in 1984-85 importing 160 vessels that involved scraping of 1.02 million LTD in one year. Shipbreaking yards at Gaddani thus started bursting with business activities ranking itself among the leading countries in this sector and emerging then as the second largest ship breaking country in the world after Taiwan. The industry then provided around 20000 direct employments to skilled, semi skilled and unskilled workers on yards and around 150000 indirectly in down stream industries [3]. Soon after 1985, the ship breaking industry in Pakistan was made to undergo setback mainly because of increased international competition and inconsistent government policies of governance and taxation. The figure-1 graphically depicts the history of shipbreaking industry in Pakistan for last 25 years [3].

Important parameters of shipbreaking at Gaddani are:

- Lat: 25 07N, Long: 66 44E
- Climate tropical, winter & summer warm (21^{o}C to 32^{o}C),
- Typical Maximum Tide available 3.5 meter.
- 150 Plot developed, 48% of planned space
- Maximum achieved LTD/years, 1.025 million
- Average LTD/years over 25years, 0.501 million
- Largest ship scraped, 74087 LTD
- Estimated yearly LTD capacity of developed plots around, 1.5 million

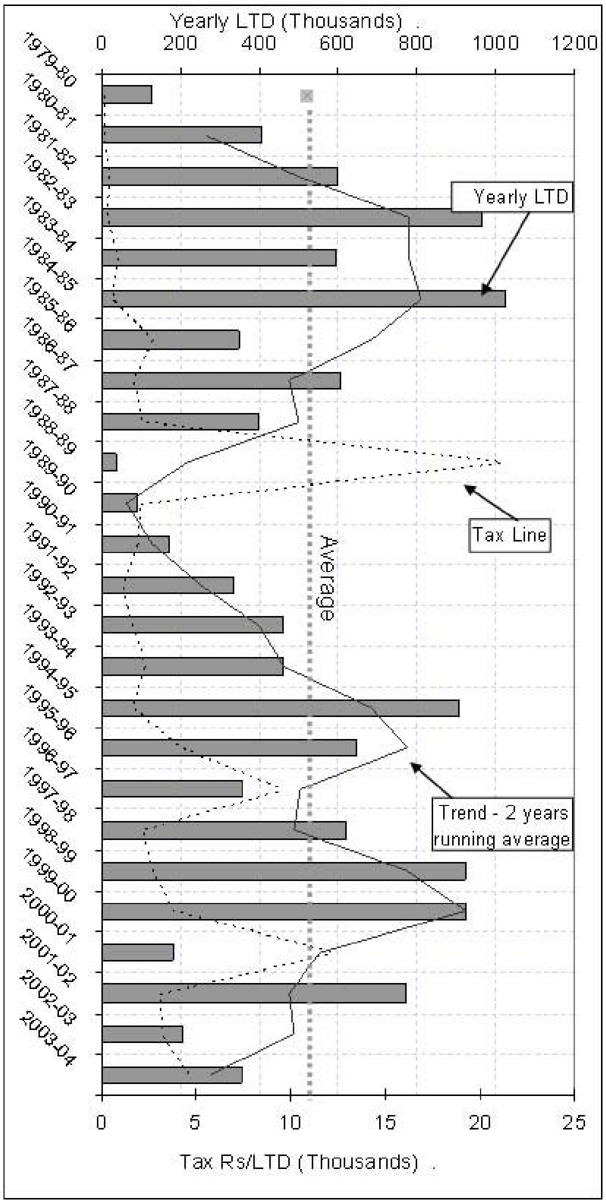


Figure 1: History of ship breaking in Pakistan

3. SHIPBREAKING YARDS

All the yards at Gaddani are open air and are more or less similar in layout, organisation and management. The typical layout of a yard at Gaddani is shows in Figure 2 [4]. The Inter-tidal area receives the ship for breaking. Beach at Gaddani is sandy and has a gradient suitable to bring ship ashore smoothly. The figure 3 shows ship beached and ready for breaking. The same place was used earlier to scrap perhaps more than 50 other ships, some of those much larger than the ship shown in the picture.

Panel yard is the area used to keep large pieces of steel structure cut from ship and winched across the inter-tidal zone. Cranes transfers the panel to cutting yard where stiffeners and other attachments, if any, are cut from the ship plates. The Figure 4 shows the panel being transferred from inter-tidal area to panel area and then to cutting area. The Figure 5 shows cutting performed to separate stiffeners from steel plates. The cut materials are segregated and is fork lifted to Graded material area as shown in Figure 6. Materials from this area are transferred to market according to demand.

Other important areas in the yard are to keep the solid and liquid wastes. The snaps at Figure 7 & 8 show these places in a yard at Gaddani.

Mostly labour accommodation and administration offices are located in rear of yard. All yards are well protected by boundary walls and security staff at main entrance and on beach sides.

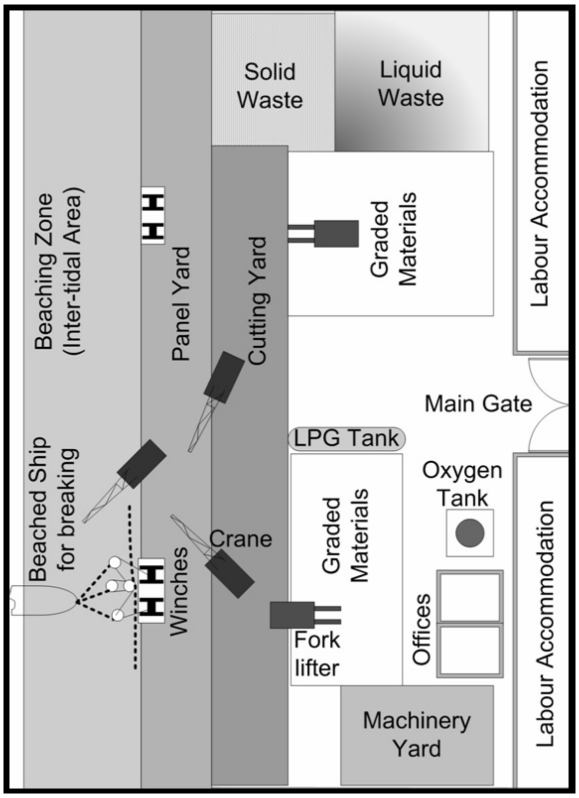


Figure 2: Typical yard layout at Gaddani

Figure 3: Ship at Gaddani beached for scraping.

Figure 4: Panels transfer from Inter-tidal to cutting area.

Figure 5: Cutting yard

Figure 6: Graded materials

Figure 7: Liquid waste area

Figure 8: Solid waste area

3.1 YARD ORGANISATION

Typical organisation of a yard at Gaddani is shown in the Figure 9 [3,5]. A Yard Manager is the administrative in-charge whereas Yard Commander is responsible for all the work done concerning scraping of ships. The Sarangs are assistant commanders of the yard, who on site manage the shipbreaking activities and get the job done through skilled workers such as welders/cutters, winch operators, crane operators etc. All these trades only deal in maintaining ships position on beach and removal of structural material mainly steel from ship. Onboard machinery, equipments and out fittings are removed by Agreewalla, a contractor who purchase a tonnage from the ship breaker through an open bidding process.

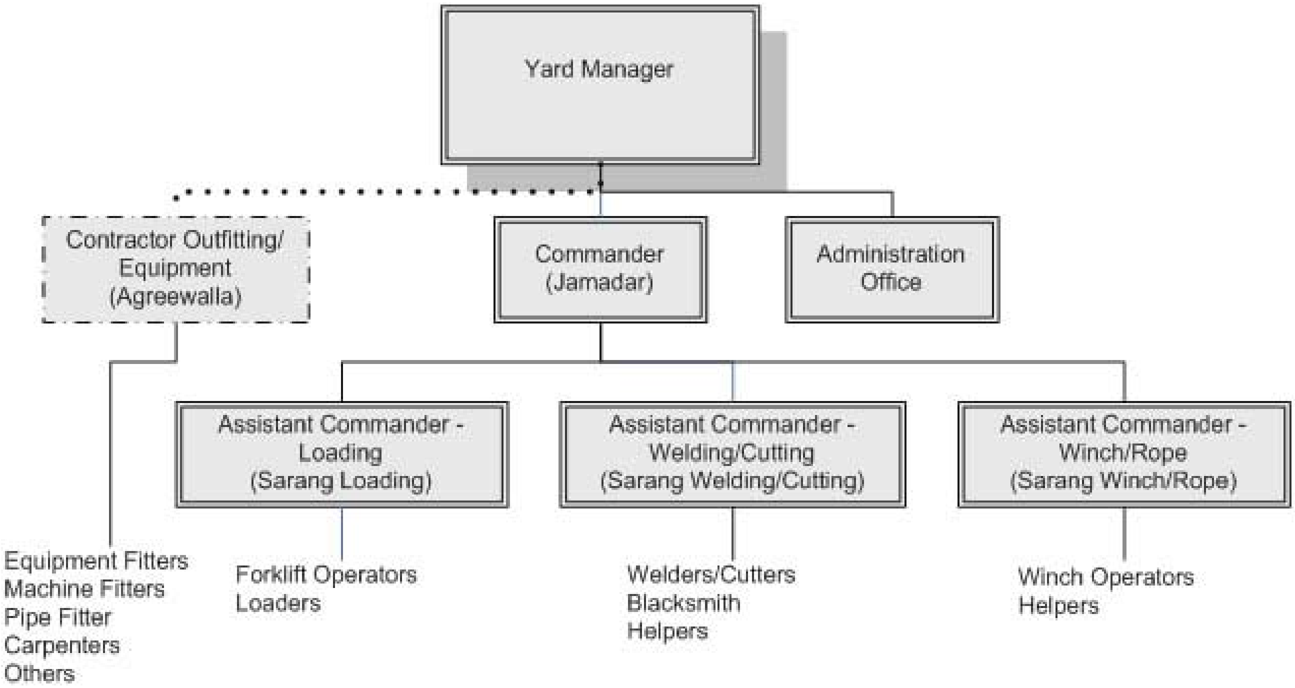


Figure 9: Typical Shipbreaking yard organisation

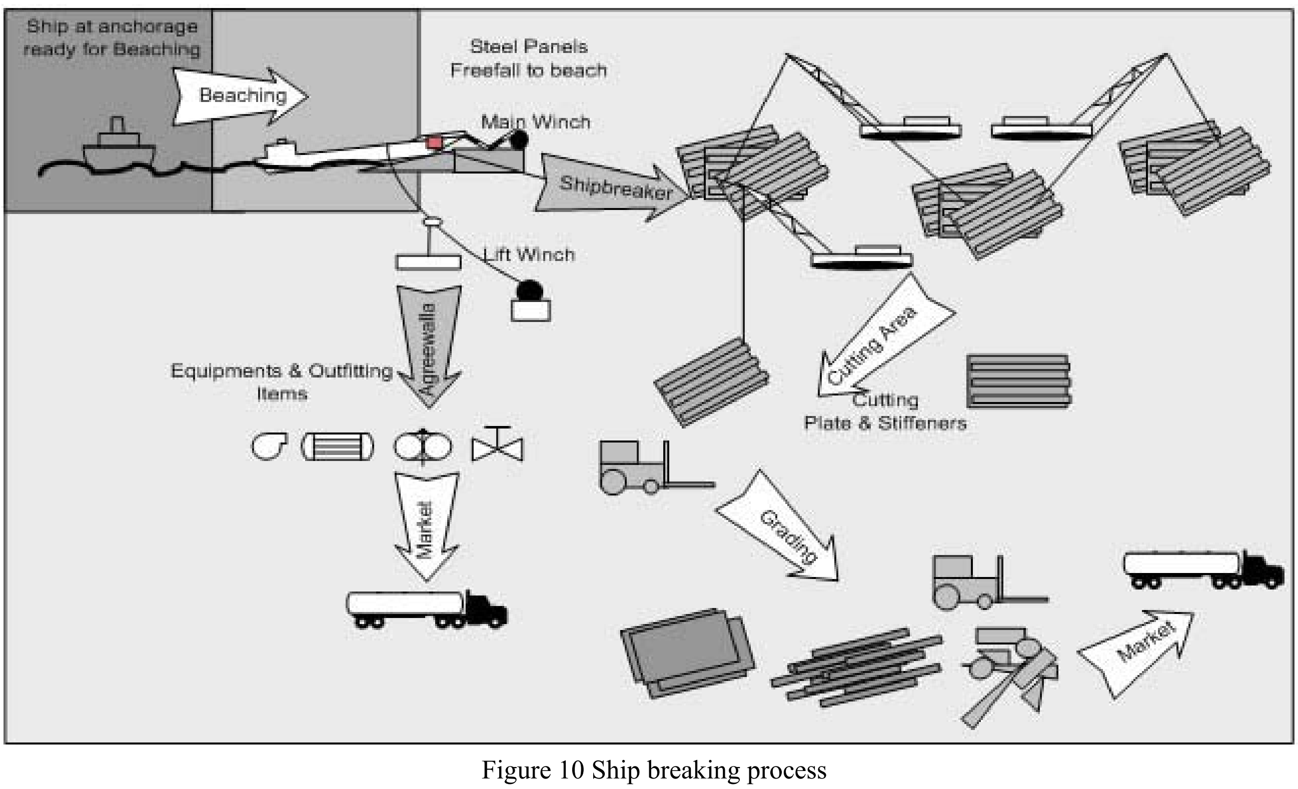


Figure 10 Ship breaking process

Agreewalla is allowed to remove all items he may choose from ship to complete his purchased tonnage. He seldom removes ship's items himself. He has roots in local industries and invites professionals from relevant field to visit the ship and bid for the items pertaining to their trade. These professional traders have requisite skilled labour to safely remove the items from ship and sell in local market for reuse.

3.2 SHIPBREAKING PROCESS – SAFTY AND ENVIRONMENT

The basic shipbreaking process adopted by yards at Gaddani is almost similar to other countries in this region. Details in how various task and activities are performed and managed is likely to differ depending local factors including policies of respective governments and cultural aspects. The shipbreaking process is graphically depicted in the Figure 10 and following paragraphs elaborates the process in context of occupational safety and environmental protection.

3.2(a) Beaching Ship to Scrap

The ships, certified gas free, are only allowed to beach at Gaddani under BDA rules. The beaching is performed by experienced beaching captain along with his team during highest high tide period at lowest possible draft of the ship. When asked, a beaching captain told about four or five accidents during his career spanning over 20 years. Complete data on beaching accidents was however not available. The present beaching method mainly relies on experience only and is considered inherently unsafe. It may be of help if the beaching process is analysed taking into account the various physical parameters such as ship stability, draft, trim and speed at beaching, and beach gradient, beach soil, wind & tide etc. The beaching guided by analysis, may be through computer simulation, can ensure safety of operation and may considerably improve the beaching performance especially for site having limited tide.

The ships brought for beaching are mostly protected using antifouling paints at bottom containing toxic TBT or other chemical composition. The chaffing action with soil during beaching removes paint from bottom that mixes up with soil and sea water. This can be detrimental for marine life in the area. An environmental survey can provide information on state of pollution because of this factor. Presently no information is available in this regard. In case of pollution level detrimental to marine life, removal of paint from bottom before ship is brought for beaching may be made mandatory.

3.2(b) Inter-Tidal processes

Because of small tidal difference available at Gaddani, only a small portion of ship comes out at beach to work. Ship dismantling is performed from bow to stern and top to bottom in a sequence allowing ship to float and drift forward on almost each tidal cycle where it is hold in position by winch ashore.

Prior to start of dismantling of ship structure, Agreewalla removes ships items up to his purchased tonnage on a schedule agreed with the Shipbreaker. Most of the machinery, equipment and other items, have considerable resale value, are removed with care. Following are important feature of this process:

- All items are removed by the skilled workers from the relevant trade of down stream industry.
- Deck-lift used for transfer of items to top deck.
- Winch-lift is used for transfer of items to ashore.
- Crane or fork lifter loads the items on truck for transfer to market.

Many materials needing special skills for removal such as working fluids and gases inside machinery/ equipment and thermal insulation like asbestos, are handled by these skilled workers coming from downstream industries. The Agreewalla and chain of other sub-contractors down the line relief the Shipbreaker from maintaining a large skilled work force to deals with onboard machinery, equipments etc. It however left little control with the Shipbreaker to enforce safety and precaution during the work onboard. There is no formal record or certification of skill levels of these workers. These workers may not be trained well to deal with the hazardous material found onboard. A suitable procedure is required to be devised and adopted to ensure that only appropriately trained personnel are allowed to work onboard.

Before start of cutting operation, tanks are again checked and arranged to be gas freed. Onboard oil remains and dirty bilges are cleaned and collected into oil-drums and transferred to liquid waste area. Solid remains/wastes from the part of the ship where found are collected and transferred to solid waste area of the yard.

Liquefied Propane Gas (LPG) and oxygen flame is used for cutting process. Paint where need to be removed before cutting; is chipped away by hand hammer. Cut structural blocks' free fall to beach. These big blocks are winched to the Panel Yard.

The workers appeared to be quite concerned to visible polluting factors such as oil spills, solid wastes etc. They however don't have much knowledge of toxic effects of asbestos, TBT, PCB and other hazardous materials encounter during their work. Lack of awareness is attributed to their reluctance in use of hard-helmet and breathing mask made available by the yard administration. The eye protection, hand gloves and protective shoes are routinely used by the workers involved in cutting.

3.2(c) Panel and Cutting Yard Processes

The structure blocks winched to Panel Yard are transferred to Cutting Yard for removal of stiffeners and other projection from plate, and cutting to size for grading and sale as already described. The Panel and Cutting Yard area are open air and floor is natural sand bed turn almost into red because of debris arising from cutting operation. Some locations also show oil stains. The mixing up and penetration of other hazardous material such as TBT containing paint chips etc cannot be ruled out. The ship breakers are therefore required to build yard floor in concrete or asphalt as per technical guidelines at reference [1]. And shade may also be provided in the cutting area to improve working conditions.

3.2(d) Liquid and Solid Wastes

The Liquid and Solid Waste storage area are also open air and have natural sand bed. These areas also need to be provided with impermeable concrete or asphalt bed. Boundary wall with covered top shall ensure containments with in boundary of the store.

The waste from this area is sold to down stream industries where waste material is utilised in various ways depending on nature of the waste. The processing of materials in down stream industries also needs evaluation with regard to safety of men and environment.

3.2(e) Lifting Gears

Cranes, fork lifters and winch lifts are used for transfer of weight from ship to yard and within the yard work areas. The safety precautions such as periodic load testing of lifting gears etc are being ignored. Practice in use of lifting gears needs improvement to enhance safety at work.

3.2(f) Labour Accommodation and Amenities

Shelter to some of the permanent labour is provided by the yard administration in bachelor quarters constructed in rare part of the yard. Other find places to live in nearby villages and Gaddani town. There are a number of cheap restaurants along the road to provide for catering needs of the labour. The standard of living and cooking/food does need considerable improvement.

Clean drinking water in the area is provided by BDA. There is also a small health care centre, a post office, and telephone & telegraph office provided for the use of labour. One ambulance is available with labour union to meet emergencies. Many facilities at private level like public transport, health clinics, schools, shops, restaurants etc comes up as business activities accelerate. The basic facilities though available are not of satisfactory level and improvements are definitely required.

4. GOVERNMENTAL CONTROLS

The Governmental control on shipbreaking business is exercised through following departments:

- Baluchestan Development Authority (BDA) – Baluchestan Development Board formulated "Shipbreaking Industries Rules" under Baluchestan Development Authority Act of 1974. The rules do not fully cover the ESM of shipbreaking industries inline of technical guidelines of Basel Convention [1]. Ships brought for breaking at Gaddani are however required to be Gas Free for hot working and a certification to the effect is rendered by ship breakers to BDA prior beaching of ship.
- Central Board of Revenue & Pakistan Customs – formulate and implement taxation policies providing adequate protection to allied inland industries and generate revenue stream for Pakistan Government. Also exercise control on import of contraband items/materials, the materials identified hazardous and toxic in relation to shipbreaking industries are not, however, put on ban list in the "Ship-Breaking Industry (Special Procedure) Rules, 1997".
- Environment Protection Agency (EPA) – Environment monitoring is responsibility of the EPA, Baluchestan. The EPA is in a process to set up survey facilities in the area to continuously monitor the environmental changes brought about by the shipbreaking industries in the region.
- Ministry of Labour & Manpower – responsible for occupational safety and health. The rules for other industrial sectors are applicable to shipbreaking industry as well.

Present state of affairs managing shipbreaking sector by government departments is far from satisfactory. Poor policy making has many a time pushed this industry into deep recession. Comprehensive planning for development of resources and infrastructure to ensure ESM of shipbreaking is required. Ministry of Environment of Pakistan is actively working [6] in coordination with other departments to bring about essential changes ensuring implementation of the guidelines at reference [1].

5. SHIPBREAKER ASSOCIATION

The Pakistan Ship Breakers' Association is a forum representing the industry at national level. The association struggle to influence government in policy making for uplifting of this industrial sector. The association is working hard with government departments to improve taxation policy to recover industries from present recession.

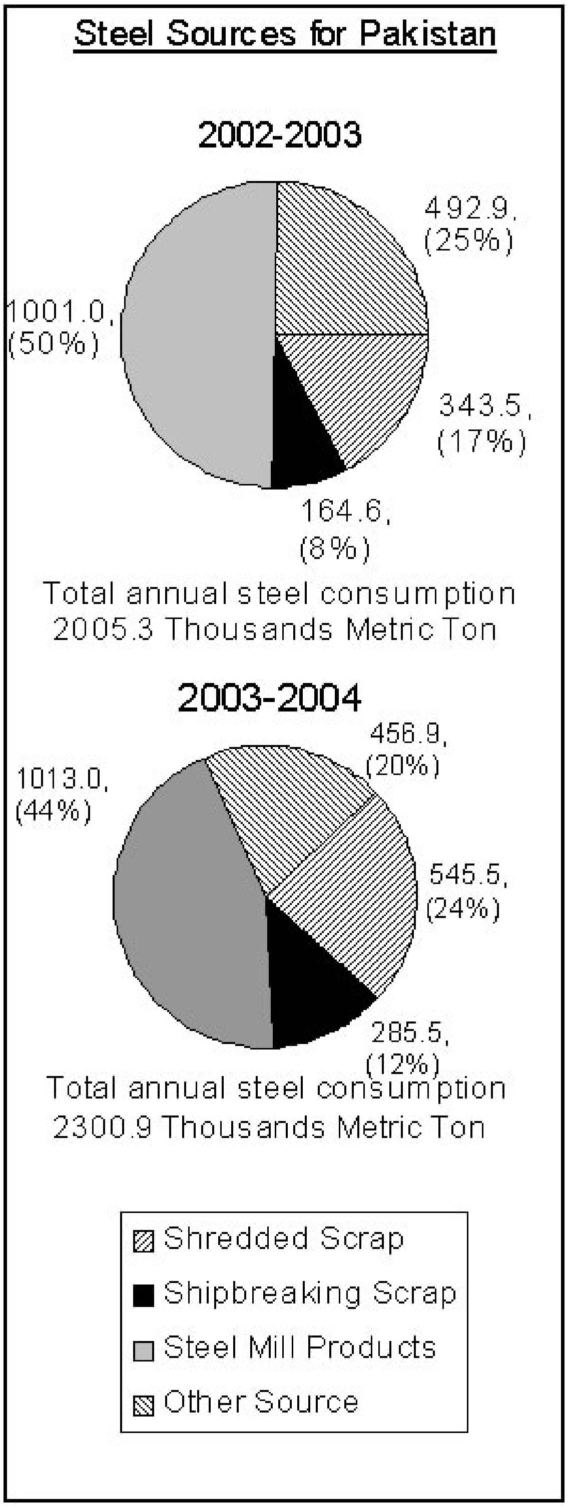
With reference to environment and safety at work, the association in general term indicated following development plans to improve the situation:

- Construction of concrete flooring in yards
- Construction of shades in cutting area
- Construction of covered stowage of liquid and solid waste materials
- Fire fighting arrangements for beached ships
- First aid centres in each yard
- A 25-bed hospital near yard area
- Workers colony with all civic facilities
- Training of workers to improve occupational safety and health, and protection of environment.

6. ECONOMICS OF STEEL IN PAKISTAN

The average yearly steel consumption of Pakistan over last ten years is 2.12 million metric tons [7]. There are three main sources of steel supply:

- Pakistan Steel Mills – base on iron ore
- Re-melt Steel Industries - based on shredded /bundled scrape, imported or of local origin
- Shipbreaking Steel – mainly re-rolled



The contribution of each source identified above, to the steel input of Pakistan's economy is shown in figure 11 for years 2002 to 2004. The Pakistan Steel Mills have production capability to meet around 40 to 50% of the total demand [8] and remaining comes from shipbreaking, import of shredded scrap and other sources. Contribution from ship recycled steel was only 8% in 2002-03 and 12% in 2003-04 that is almost half of rival re-melt steel industries based on imported shredded/bundled scrape. Other sources such as imported steel products, local scrape, and perhaps smuggled products etc provide for 20 to 25% to local steel market.

Over 14% growth in steel demand from year 2002-2003 to 2003-2004 has been recorded. Similar trend in growth is expect to prevail over next few years as economic activities, especially in construction industries, are likely to accelerate following the peace process in Afghanistan and diffusing of tension between Pakistan and India.

Capturing at least half of steel inputs from unidentified sources and making fifty-fifty shares between re-melt industries and shipbreaking, the estimated target output from ship recycling comes to about 529 thousands metric tons per year which is likely to expand in future.

7. SHIP FOR SRCAP – FUTURE OUTLOOK

The total global tonnage of ships available for scrap over next 10 years is estimated to be more than 6 million LTD per year with a peak scraping demand occurring around years 2010 or 2015 because of phasing out of single hull oil tankers raising additional scraping demand of around 7 to 11 million LTD [2]. Pakistan scrapes around 13% of the total global scraped tonnage each year [3,12]. Pakistan may therefore expect over 0.78 million LTD available to her shipbreaking industries for next 10 years.

During the last two years, the scrap prices have tripled from a level of 125 USD/LDT in the beginning of 2002, to a level close to 400 USD/LDT in the beginning of 2004 [2]. The trend is attributed to increased demand of steel in China and high freight rate prevailing during this period. This trend is not likely to sustain for long especially in view of single hull tankers phasing out between year 2010 and 2015 as described above.

8. REHABILITATION OF SHIPBREAKING

The shipbreaking industries in Pakistan have suffered considerably due to lack of suitable taxation policies and planning for development of human resources and infrastructure for this important industrial base with potential of 15000 to 20000 direct and other 150000 indirect employments. An average over last 25 years indicates Rs1181.41 million per year of revenue collected by the government from shipbreaking industries [9]. This shows considerable potential in this industrial sector to payback investment made in rehabilitation for ESM of shipbreaking and recovery from present recession. The tax line in Figure 1 shows thousand of Rs per LDT collected in revenue by the government. The lowest tax level in last three years was Rs 3028 per LDT.

It has become clear in the proceeding paragraphs that steel output from shipbreaking industry to the tone of 0.53 million metric tons per year can easily be absorbed by developing economy of Pakistan without any damage to other allied industries. As estimated, 0.78 million LTD per year ships for scrape are expected to be available for Pakistani shipbreaking industries. Additional steel output from this sector can perhaps be channelled to Afghanistan. A yearly revenue stream of about Rs 400 million at a production level of 0.53 millions of metric ton per year that represent only 25% of the lowest tax level in last three years can easily be spared for development of the industrial base. The government shall still have considerable revenue after tax cut to overcome recession and to promote activities in this industrial sector.

In order to accrue timely economic benefit from this sector, it is important to take expeditious measures by the government as well as industrial units. The identifiable areas needing improvement may clearly be classified into two groups:

- Taxation
- Resources development

The main contributing factor for recession in Pakistani shipbreaking industry is inadequate resilience in tax formulation. There is a need for taxing system responsive to international and local market dynamics. A tax structure providing level playing ground to all three key players of steel input to Pakistani economy should be developed and implemented, taking into account all the relevant variables representing the local and international market dynamics. The government needs to support R&D effort for careful evaluation and resolution of this problem on long term basis.

The other vital area needing improvement is resources including human resources satisfactorily trained to safely perform ship dismantling functions and infrastructure ensuring safety of workers and environment friendly processing and disposal of materials meeting international standards. Some of the short comings of present yard facilities and working procedures are apparent from proceeding paragraphs. An elaborate study is required to clearly identify all the areas needing improvements and to develop an action plan for implementation at all levels to uplift this industry in line with international standards to ensure Green Recycling of ships in Pakistan.

Rehabilitated and reactivated industries shall have financial momentum of around Rs 400 million (US$ 6.67 million) per annum or more when performing to her normal capacity supportable by local steel economy of Pakistan. This can repay the investment made in uplifting resources for Green Recycling of ships. The uplifting process shall however need a massive initial investment on development of human resources and infrastructure.

The shipbreaking business is mainly concentrated in developing countries facing similar problems. The solutions also have many common dimensions providing basis for collective efforts to overcome impediments in implementation of Green Recycling of ships. International effort beyond making of standards toward support for systematic development of essential resources to achieve ESM of ship breaking business is considered of paramount importance. A common denominator is shortage of capital to undertake this task expeditiously. International donor agencies may come forward to set up funds to establish development programme in this sector.

The classification societies also have a vital role to play in classifying of Shipbreaking facilities in view of compliance to relevant standards at works and Environmentally Sound Management of this business. The classification societies may setup procedures and rules to classify shipbreaking yards that shall help in satisfactory compliance of relevant standards internationally.

9. CONCLUSIONS

The shipbreaking industry in Pakistan at Gaddani has matured over last 30 years. It has well established organisational structure. The work procedures and work flow managements reveal considerable skills developed through experience. Mechanised support in transfer of heavy work is available at every stage. The quality of work procedures, yard facilities, occupational safety and health are however not inline with international standards. The ship breaking yards need upgrading to comply with international standards for ESM of ship breaking business.

The tax system imposed by government is responsible for recession of this industry in Pakistan, which requires revision to make it responsive to local and international market dynamics providing requisite resilience to the industry against cost variations.

The steel economy of Pakistan has sufficient capacity to absorb output from shipbreaking industry without harming allied industries. Uplifting of facilities for ESM of shipbreaking business may be repaid by an estimated yearly stream of Rs400 million when output level of 0.53 million metric ton of steel per year is achieved. Lack of initial capital is probably a major impediment in uplifting of facilities for Green Recycling of ships in Pakistan.

Setting up of an international programme with suitable funding support from donor agencies shall help to achieve Green Recycling of ships world over, expeditiously. International classification societies may setup procedures and rules to classify shipbreaking yards on the basis of their capabilities for ESM of this business.

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- Federal Bureau of Statistics, Karachi, Pakistan
- Pakistan Institute of Development Economics, Islamabad, Pakistan

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ASSESSMENT OF THE FUTURE MARKET FOR DISPOSAL OF SHIPS USING ARTIFICIAL INTELLIGENCE

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SUMMARY

Demolition of ships is influenced by various factors which determine the time, price and the rate of demolition. Some of these factors are internal and dependent on physical and technical criteria, but there are also external factors, related for example to economic policies, inflation and political issues. Collating all the factors into a model to predict demolition is complicated and difficult because some of the factors, like political issues are unpredictable. Despite the difficulties the ability to forecast future demolition is important.

Past demolition data provides the most accurate information on which an assessment can be based. By studying the past data and finding how different factors affect each other, some relationships have been found. However accurate the relations are, assessment of the future remains difficult and use of artificial intelligence provides a powerful computing system which can be used to determine the different connections.

Using monthly time series over a ten year period a Feed-forward Neural Network has been trained in the logic of interaction between the different factors affecting demolition. A model has been developed which gives some useful results, assuming no sudden or unexpected events occur. The model is believed to have some potential for predicting future demolition patterns.

1. SHIP DEMOLITION

When a ship becomes obsolete in the market it serves, or is non-compliant with regulations or for other reasons, and hence reaches the end of its useful life, there are few alternatives at the end of its useful life. Options are:

- lay up the ship
- convert to another use
- sell for disposal

Lay up only postpones the issue, and the conversion to other uses may not be feasible, so disposal at a scrap yard, and recycling materials, is usually the most profitable and common option. In the 1970s shipbreaking was concentrated in Europe. This was a highly organised industrial operation. But the costs of labour and of upholding environmental, health and safety standards increased. So the ship disposal industry moved to poorer Asian states, which have lower health and safety standards (Greenpeace, 2004). Firstly to regions such as Taiwan and South Korea, but then moving on to areas within the same region where labour costs are even lower (DNV, 1999). The choice of location for the establishment of scrapping sites is based upon some prerequisites. These may be summarized as follows (Andersen, 2001):

- A long uniform inter-tidal zone and sufficient tidal difference allowing vessels of a range of sizes to be dry-beached;
- Minimum exposure (coastal protection) and stable weather conditions;
- Availability of low-cost labour;
- A certain level of infrastructure.

Nation/Year	1991	1992	1993	1994	1995	1996	1997	1998*
Bangladesh	940	2284	2594	3947	4915	4231	2978	3163
	20%	13%	14 %	19 %	33 %	26 %	22 %	21 %
China	374	8921	9318	3397	676	1331	164	979
	8%	52%	52%	16 %	5 %	8 %	1 %	7 %
India	1079	3140	2949	5917	4868	7851	7577	7427
	23%	18 %	16%	29 %	33 %	48 %	55 %	49 %
Pakistan	1280	1609	1921	5301	3623	2043	1630	1962
	27%	9%	11 %	26 %	25 %	13 %	12 %	13 %
Others	22 %	8 %	7 %	10 %	4 %	5 %	10 %	10 %
Total	4685	17228	17982	20714	14677	16313	13744	15021

Table 1: Ship demolition by location, 1991-1998* (Jan-Sep 98), (000dwt).
Source: Drewry Shipping Consultant, 1998.

Table 1 shows changes in scrapping location during the 1990s. According to the statistics for the year 2001, India breaks 42% of the vessels that are dismantled every year, Bangladesh 7%, Pakistan 6%, China 4% and the rest of the world 41% (UNEP, 2001). During the period of 1992 - 1999, an average of 363 vessels were scrapped each year of deadweight 19,570,000 tonnes. The tankers' share was 50% and the bulk carriers' share was 31% either (Table 2). This represents a high percentage of the scrapping market, about 81% of the total sum of demolition of vessels. Therefore, bulk carriers and tankers are dominant in the scrapping industry.

2. DEMOLITION MARKET

Ship demolition provides a large amount of recyclable materials. Some 95% of an average merchant ship will be re-used, from the steel to the non-ferrous metals and pipework of the ship which will be re-used. The scrap price of ships is volatile and depends upon the demand for steel from this source (BIMCO).

The ship type is important in determining the price offered by the ship breaker. Further, large ships such as tankers with easily accessible surfaces are easier to cut in pieces and are therefore more valuable and profitable. Steel scrap obtained from shipbreaking process is of comparatively high quality, especially from tankers that have large flat panels. The price is also affected by the availability of ships for demolition, which itself is governed by the freight market conditions. If, for instance, the freight market is good, a shipowner will be reluctant to take an elderly ship out of service, keeping the ship earning as long as possible. Only when the freight market has turned and the relatively high operating costs of an old ship, the shipowner will decide to scrap the vessel. He will hope that this decision will coincide with a relatively high scrap price as well. This will also be affected by the availability of ships being offered for demolition. If freights are high, few ships will be available for scrap, and prices will be at their highest. If there are many vessels being offered at a time of poor freight rates, then the scrap prices will also be low. It is all a matter of supply and demand (BIMCO).

Year	No. DWT Age	Tankers	Bulk Carriers	Combos	Gas vessels	Other dry	All Vessels
1992	**No.**	94	67	11	4	64	240
	DWT	10,22	3,913	1,296	0,011	0,775	16,215
	Age	23,8	23,6	20,8	26,8	24,7	23,9
1993	**No.**	110	50	15	10	129	314
	DWT	10,685	2,557	2,27	0,111	1,398	17,021
	Age	23,1	24,2	21,9	24,9	29,4	25,9
1994	**No.**	87	70	18	7	112	294
	DWT	12,558	4,351	2,421	0,018	1,234	20,582
	Age	22,6	24	21,9	26,3	26,5	24,5
1995	**No.**	93	33	9	1	91	227
	DWT	10,794	2,093	1,229	0,002	1,195	15,313
	Age	25,2	25,2	22,4	30	27,2	25,9
1996	**No.**	72	128	15	5	168	388
	DWT	6,829	7,297	1,904	0,021	1,967	18,018
	Age	25,3	25	23,1	27,9	27,2	26
1997	**No.**	40	161	6	6	187	400
	DWT	3,611	7,707	0,746	0,075	2,596	14,735
	Age	28,3	25,5	23,6	28,4	26,5	26,3
1998	**No.**	52	236	10	6	191	495
	DWT	7,547	11,666	1,416	0,028	3,181	23,838
	Age	25	25	22.8	27.5	25.5	25.2
1999	**No.**	113	194	9	6	226	548
	DWT	17,114	9,385	1,130	0,019	3,185	30,833
	Age	24.9	24.9	24.3	31.4	25.2	25.1
2000*	**No.**	55	29	4	1	45	134
	DWT	7,234	1,353	393	18	641	9,639
	Age	26.1	27.1	25	31.7	25.7	26.2
Average	**No.**	83	117	12	6	146	363
92-99	**DWT**	9,920	6,120	1,550	40	1,940	19,570
	Age	24.4	24.8	22.4	26.9	26.3	25.3

Table 2: Vessels (> 10,000 dwt) sold for scrapping 1992 -2000* (Jan-Mar), (000 dwt).
Source: DNV, 2001

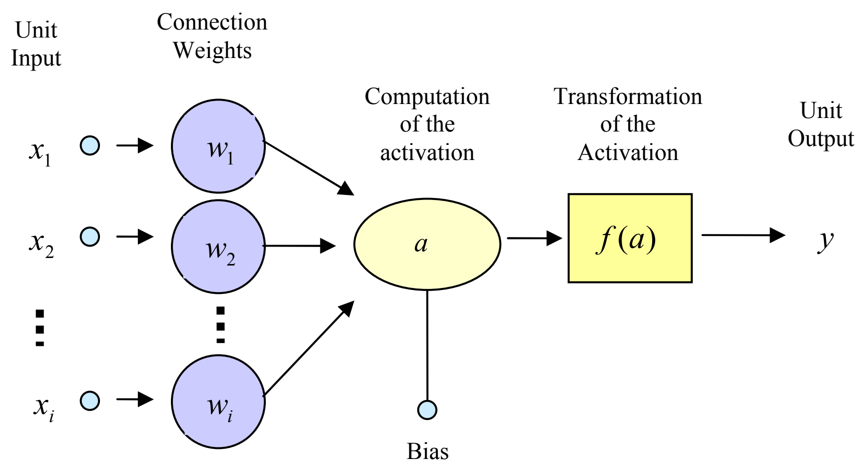


Figure 1: Schematic ANN Architecture.

Some of the factors which might encourage demolition, such as increased steel scrap price, may themselves be the result of improved trade, which would increase freight rates and therefore inhibit demolition. The factors may be contradictory, which causes difficulties in formulating a satisfactory model of the scrapping market

3. ARTIFICIAL NEURAL NETWORKS

Artificial Neural Networks exploit an analogy to the human brain. The idea behind artificial neural networks was to transfer the idea of parallel distributed processing, as found in the brain, to the computer in order to take advantage of the processing features of the brain (Magnani and Nersessian, 2002).

The brain consists of large numbers of neurons connected to each other by synapses. The output from the neuron is a function of its inputs from many other neurons, which are 'weighted' at the receiving synapses. This output is a nonlinear function of its input and the strength of the connection in the synapses can be modified by activity; in other words, the brain (the collection of neurons) learns (changes its synaptic weights) from experience. It is the behaviour which an artificial neural network attempts to model algorithmically. The assumption that learning occurs in the brain when modifications are made to the effective coupling between one cell and another at a synaptic junction is simulated mathematically in artificial systems through positive or negative reinforcement of connections (Bailer-Jones, 2001). This forms the basis of the analogy exploited in artificial neural networks. Schematic pattern of the artificial neural network architecture has shown in Figure 1 (Haykin, 1994).

Neural network units receive weighted inputs from original data or from an adjoining unit. Each unit integrate incoming information, usually by computing the weighted sum of all inputs to determine the level of activation. Formally, if each input is denoted x_i, and each weight w_i then the activation is equal to:

$$a = \sum_{i=1}^{n} x_i w_i + Bias \qquad (1)$$

Where n is the dimension of input space. The response of the unit is then determined by an activation function *f(a)*. This transformation involves two steps: First, the activation of the neuron is computed as the weighted sum of it inputs, and second this activation is transformed into a response by using a transfer function, therefore the output from each unit is based on the weighted sum of all inputs, and is ultimately defined by an activation function. Any function whose domain is the real numbers can be used as a transfer function (Abdi, 1999), which can be a linear, logistic, Gaussian, hyperbolic or sigmoid functions.

Many NN models are similar or identical to popular statistical techniques i.e. generalised linear models or polynomial regression, especially where the emphasis is on prediction of complicated matters rather than on explanation. NNs can be trained more efficiently by standard numerical optimisation algorithms such as those used for nonlinear regression.

4. ANN APPLICATIONS

Artificial Neural Networks are used to attack many different kinds of problems such as classification, approximation, pattern recognition, signal processing, prediction, feature extraction, etc. Most of them are solved with ANN by learning of the mapping between the input and output space for given data sets $(x_1, y_1), (x_2, y_2), \ldots, (x_n, y_n)$, where (x_i, y_i) is input-output pair (Jankowski, 1999). The underlying mapping can be written as:

$$F(x_i) = y_i + \eta$$
$$for\ i=1,\ldots,n$$

Where η is a zero mean white noise with variance σ_{ns}^2.

Statistical methods and neural networks are commonly used for time series prediction. Neural networks are reliable for modelling nonlinear and dynamic signals (Guido, 1994), it attempts to capture the dynamics of the system which underlies the data series by training a neural network to take as input a representation of the current state of the system and to output a prediction of the state of the system at some point in the future. A neural network has concentrated on forecasting future developments of the time series from values of x up to the current time. Formally this can be stated as: find a function f to obtain an estimate of x at time $t + d$, from the N time steps back from time t, so that (Frank, Davey and Hunt, 1997):

$$x(t+d) = f(x(t), x(t-1), ..., x(t-N+1)) \qquad (2)$$

For d is equal to 1, f will forecast the next value of x.

Function approximation methods fall into two broad categories: global and local. Global approximations can be made with many different function representations, e.g. polynomials, rational approximation, and MLP (Farmer and Sidorowich, 1988). To approximate a function f, a model must be able to represent its many possible variations. The dependence on representation can be reduced using local approximation where the domain of f is broken into local neighbourhoods and a separate model is used for each neighbourhood (Farmer and Sidorowich, 1988).

Neural networks can be used as a function approximation system which tries to produce the desired output for each training input, the task performed by a network trained to respond to inputs with an approximation of a desired function.

Neural network creates map through input data sets to desired data. This map can be call function between data groups. In the test phase, this map produces function approximation using adjusted weight coefficients and transfer functions (Quing, Xueqin, Quingxin and Weilli, 1997). As with other transfer functions the sigmoid function provides linear, near-linear, and non-linear approximations for a given set of inputs (Berry and Linoff, 1997). In the field of supervised learning, the most popular form of the feed-forward neural networks, the multi-layer perceptrons have been proven to approximate smooth functions very well (Barron, Yang, and Yu, 1994), then many application problems use the MLPs as a model for identifying and controlling nonlinear complex dynamic systems (Fausett,1994). MLPs are suitable for high-dimensional function approximation, a MPL network can be used for a function approximation problem in which the inputs to the network are equivalent to the predictor variables in the regression model and the output of the network is equivalent to the predicted value. For a given problem, there is a cost function ε_T (Haykin, 1994), which is similar to the error sum of squares (Equation 3) for the regression model, as the measure of training set learning performance.

$$\sum_{i=1}^{n} (y_i - (\beta_0 + \beta_1 x_{i1} + ... + \beta_k x_{ik}))^2 \qquad (3)$$

The objective of the learning process is to adjust the weights of the network so as to minimise ε_T. A highly popular training algorithm known as the back-propagation algorithm is generally used to adjust the network weights until a stop criterion is reached (Hush and Horne, 1993).

5. MONTHLY BULK CARRIER SCRAPPING PREDICTION FOR 2003

Several networks have been implemented to identify the combination of different factors which can determine the monthly scrapping market. In general, networks are Feed Forward with a hidden layer and using sigmoid transfer function. The number of epochs and running of the networks vary.

The main focus at the market is the amount of 'bulk carriers sold for scrapping' (M DWT); therefore it has been considered as the network output. In addition, inputs of the networks are including:

1. Steel Price ($/Ton)
2. Demolition Prices (Pakistan & India) ($/LDW)
3. Demolition Prices (Far East) ($/LDW)
4. Capesize Building Price (Mill. $)
5. Bunker Price ($/Ton)
6. Capesize Freight Rate ($/Day)

A monthly time series between January 1995 and December 2003 has been acquired for every individual inputs and the output, to train and test the networks. Each network has been trained so that recent data have more weight that older data.

Several different NNs have been trained, using different input combinations, and of these one has shown more promise.

Neural Network No: 5

Inputs:

1. Steel Price
2. Bunker Price
3. Capesize Freight Rate

Output:

1. Bulk Carriers Sold For Scrapping

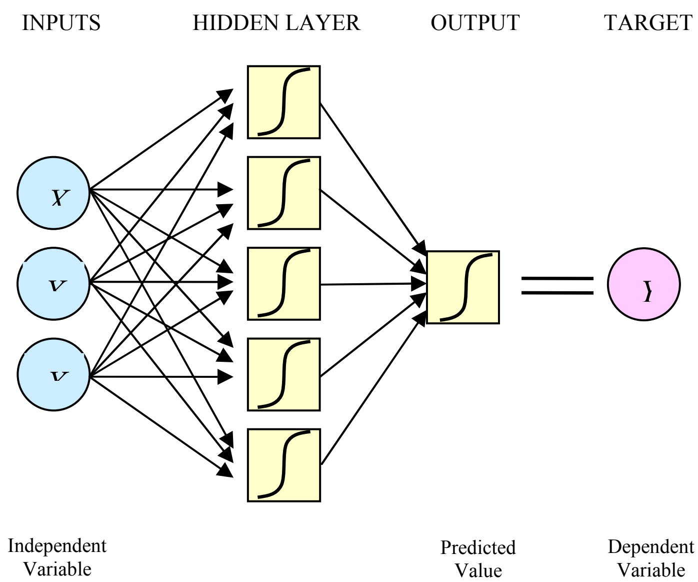
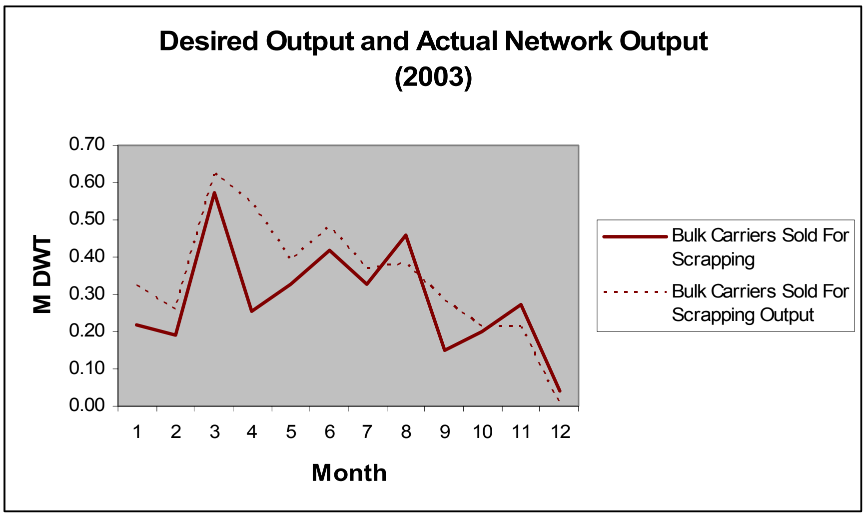


Figure 2: Schematic FF Neural Networks



Year 2003	Bulk Carriers Sold For Scrapping	Bulk Carriers Sold For Scrapping Output
January	0.22	0.32
February	0.19	0.26
March	0.57	0.62
April	0.25	0.55
May	0.33	0.39
June	0.42	0.48
July	0.33	0.37
August	0.46	0.38
September	0.15	0.28
October	0.20	0.22
November	0.27	0.21
December	0.04	0.0

6. CONCLUSIONS:

It has been seen that one of the Neural Networks, number five, which has been implemented based on the steel price, the bunker price and the freight rate as inputs, and the amount of bulk carriers sold for scrapping as output, shows an acceptable fit between the actual data and the network output. It suggests that this neural network may have found a logical and mathematical relation between these factors as inputs to predict the proper output. In other neural networks such a relationship could not be found and it may be that different factors neutralise each other and guide the network to a wrong way.

Further development is in progress, considering different markets (tankers, bulk carriers, cargo ships, of different size ranges). From the initial results, it seems that it may not be appropriate to consider every input to predict the monthly scrapping rate in the bulk carrier market.

The use of NN for the market prediction is showing encouraging results in dealing with a complex cause and effect relationship.

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ESTABLISHMENT OF A KNOWLEDGE DATA BASE TO SUPPORT SHIP RECYCLING

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SUMMARY

Most shipbreaking today takes place in Asia due to the low costs involved, and during the past demolition of European vessels has also moved from local yards to Asia. In future, the establishment of highly specialised world recycling centres for marine vehicles, (including ships and offshore units) will be required in different areas of the World to meet environmental standards. Some of these will be in Europe. For ecological and environmental reasons, in contrast to what happens to-day at the Indian Subcontinent, such Ship Recycling Factories of to-morrow must have at their disposal the most advanced technologies available.

A Knowledge Data Base (KDB) is an essential pre-requisite for the concept, and is required, sooner rather than later, through the close collaboration of EU industry, institutions and universities, and by members of CESA.

The KDB should encompass the following key areas of ship recycling, which are discussed in this paper.

- EU Policy Issues Initiatives
- Regulations at international, EU and national level;
- Financial Aspects
  - Ship decommissioning operations, decision making and their financial structure,
  - Shipbreaking/ship recycling processes cost modelling;
- Management & Organisation Aspects including environment protection polices;
- Marketing Analyses
  - Shipbreaking demand forecasting on national, EU and world market basis,
  - Yard capacities state-of-the-art & prospects;
- Human Factors
- Technical Aspects
  - Efficient, not labour intensive, steel processing methods in a high volume scenario,
  - Design for recycling concepts, including adoption of new materials,
  - Environment protection technical measures, facilities, tools and procedures.

The overall objective is to identify recycling technologies that are potentially available and would help to revive the European ship recycling industry, on an economic basis.

1. INTRODUCTION

Most shipbreaking today takes place in Asia due to the low costs involved, and during the past demolition of European vessels has also moved from local yards to Asia. The situation is generally regarded as unsatisfactory, initially by environmental organisations, in particular Greenpeace, and subsequently by much of the international community.

In the 1970s shipbreaking was concentrated in Europe. Performed in docks, it was a highly mechanised industrial operation. But the costs of upholding environmental, health and safety standards increased. So the shipping industry moved to poorer Asian states, which have few health and safety standards (Greenpeace, 2004). Firstly to regions such as Taiwan and South Korea, but then moving on to areas within the same region where labour costs traditionally have been even lower (DNV, 1999). The choice of location for the establishment of scrapping sites is based upon some prerequisites. These may be summarized as follows (Andersen, 2001):

A long uniform inter-tidal zone/sufficient tidal difference allowing vessels of a range of sizes to be dry-beached;

- Minimum exposure (coastal protection) and stable weather conditions;
- Availability of low-cost labour;
- A certain level of infrastructure.

In 1992 and 1993, half of all ocean going ships were being scrapped in China (Table1), but after couple of years later, it dramatically decreased to only 1 per cent in 1997 and China was nearly eliminated from the market. On the contrary, India had a growth in scrapping rate during this period, and 7,577,000 dwt were being scraped in 1997 that it was 55% of the whole world fleet. According to the statistics for the year 2001, India breaks 42% of the vessels that are dismantled every year, Bangladesh 7%, Pakistan 6%, China 4% and the rest of the world 41% (UNEP, 2001). During the period of 1992 - 1999, on average 363 vessels have been scrapped each year, and 19,570 in terms of dead weight, tankers' share was 50% and the bulk carriers' share was 31% either (Green Peace 2004). It represents a high percentage of the scrapping market about 81% of the total sum of demolition of vessels. Therefore, bulk carriers and tankers are dominant in the scrapping industry.

The forecast of annual production for some of the waste materials due to the scrapping over the period of 2001 – 2015 in OECD countries has been shown in Table 2.

Nation/Year	1991	1992	1993	1994	1995	1996	1997	1998*
Bangladesh	940	2284	2594	3947	4915	4231	2978	3163
	20%	13%	14 %	19 %	33 %	26 %	22 %	21 %
China	374	8921	9318	3397	676	1331	164	979
	8%	52%	52%	16 %	5 %	8 %	1 %	7 %
India	1079	3140	2949	5917	4868	7851	7577	7427
	23%	18 %	16%	29 %	33 %	48 %	55 %	49 %
Pakistan	1280	1609	1921	5301	3623	2043	1630	1962
	27%	9%	11 %	26 %	25 %	13 %	12 %	13 %
Others	22 %	8 %	7 %	10 %	4 %	5 %	10 %	10 %
Total	4685	17228	17982	20714	14677	16313	13744	15021

Table 1: Ship demolition by location, 1991-1998* (Jan-Sep 98), (000dwt).
Source: Drewry Shipping Consultant, 1998.

Waste Stream	OECD Europe	Geographical Europe
Steel	860,000	1,480,000
Copper	115	197
Zinc	345	591
Special Bronze	345	591
Machinery	161,000	275,800
Electrical/Electronic Equipment	28,750	49,250
Joinery – related products	57,500	98,500
Minerals	5,750	9,850
Plastics	5,750	9,850
Liquids	23,000	39,400
Chemicals and gases	345	591
Other miscellaneous	11,500	19,700
Total	1,154,400	1,984,320

Table 2: Forecasted annual waste stream volumes (tonnes).
Source: DNV, 2001.

2. REGULATIONS

In addition to the national statutory and regulation, there are numbers of international agencies to monitoring the demolition process, and addressing the topic of ship scrapping, including:

- IMO
- ILO
- United Nation Commission on Human Rights
- United Nation Environment Programme – The Basel Convention
- Commission of European community

IMO is responsible for coordinating issues associated with ship recycling and responsibility for monitoring issues arising during ship design, building and operation which might impact on recycling, including preparations for recycling on board. And ILO has the responsibility for establishing standards of operation in shore-based industries involved in ship recycling, concentrating on considering the application of its already existing standards and recommendations to ship recycling and developing guidance for the ship recycling industry in these and other areas – to take the lead on working conditions in and around vessels once they have been beached (Andersen, 2001).

To tackle the current problem of shipbreaking in non environmental friendly way & to monitor the safe disposal of hazards materials an important international agreement is formed by the Basel Convention, which entered into force in 1992. This convention regulates the international trade in hazardous waste. This convention forms the basis for other regulation, e.g. EU regulation. In 1995 the Basel Ban Amendment was added to the Convention prohibiting the export of hazardous waste from developed (OECD) countries to developing (non-OECD) countries. Although it has always been debated that whether a ship is can be considered as waste or still referred as a ship when it is scheduled for recycling.

In October 2004 the Basel Convention adopted a decision which notes that: "a ship may become waste as defined in article 2 of the Basel convention and that at the same time it may be defined as a ship under other international rules". IMO & the Technical Working Group of the Basel Convention have developed international guidelines for ship recycling; the guidelines identify the Industry Code on Ship Recycling and complement on the other international guidelines related to shipbreaking.

3. POLICY ISSUES

In a business which is extremely cost sensitive the migration of the recycling of ships to regions of low labour cost seems to be inevitable. In a global business which is notoriously difficult to regulate, changing this situation will require a concentrated effort.

The first requirement is that there is a will to improve, by changing the way in which ships are dismantled. It is unlikely that existing locations will change methods, since that implies investment and losing the advantages offered by low labour costs and limited regulations on environmental pollution. An objective should therefore be to create a safe, environmentally friendly ship recycling industry in EU countries.

Technological solutions to reducing costs are discussed below, but it is unlikely at first sight that a competitive and safe business can be developed. If others are able to operate in a way which pollutes and creates a dangerous working environment, then being competitive is almost if not completely impossible.

Possible solutions include legislation, although securing this internationally is often a contentious and time-consuming business. There are also potential issues of enforcement, even if an agreement is reached and ratified by a majority of states.

An EU directive is also a possibility, requiring EU-owned ships to be dismantled with in the EU. This could disadvantage EU shipowners and others in the market, where competitors remain free to recycle their ships in the traditional locations

The solution in the motor car industry, requiring manufacturers to build–in recycling at their cost is not a real option, again because of the international market. This is also a potential cause of competitive disadvantage to shipbuilders who are required to comply with the rules which would be put in place.

Requiring a levy on disposal of the ships, to cover the additional costs of safe recycling in specialised facilities, is also a potential disadvantage to compliant owners.

A solution, or at least a partial solution might be found in specialised facilities and these are discussed in the next section.

4. TECHNICAL ASPECTS

4.1 CURRENT DEMOLITION PROCESS

In principle, the process of ship scrapping consists of a sequential chain of operations undertaken at different location of a scrap yard (Andersen, 2001).

Offshore: Prior to beaching tanks are discharged and valuables (uncontaminated oil product and saleable's such as electronic equipment) are removed.

Inter-tidal zone: The vessel is beached under its own power and demolition is initiated (in a certain sequence).

The beach: Further cutting into manageable sizes, extraction of components and sorting for transport to respective receivers are carried out.

Shore: Supply of second-hand equipment and components to market and remanufacturing/recycling into new products/components.

Shipbreaking is physically difficult, labour intensive work, and it has proven to be a risky business. Most of the ship scrapping industry uses manual labour to break ships. Although it is possible to increase profitability by using mechanised shipbreaking methods, but it requires special investment which is not easy to manage. There are different shipbreaking methods, including use of dry docks, afloat or beaching. A combination of methods can be used as well.

Dry docks provide somewhat more flexibility and better containment of debris. However, they are also an expensive capital asset and were designed primarily for ship construction and repair. Using the dry dock method, workers immediately begin to remove large sections or modules of the ship, transferring them to other project areas for environmental abatement, separation, and cutting.

Both afloat and beaching result in lower facility cost, but presents the greatest challenge in containing debris and controlling ship stability. With the ship in the water, workers begin by moving through doors and hatches to extract interior parts and strip out compartments. Then they cut and remove the ship's structure above the waterline. As the work progresses the ship gets lighter and it is gradually pulled onto a beach, or earth ramp, for final dismantling of the bottom hull (Association of scientists and engineers, 2000).

In environmental terms the hierarchy of demolition waste is (DNV, 2001):

Re-use is preferable or failing that recycles materials and if that is not possible safe disposal.

Reusables are extracted, including pumps, motors and engines, repair parts, electronic equipment, cables and any other interference. Scrap steel is the most important in recyclables; Steel production from scrap is a sustainable process in that it achieves a far better environmental performance in light of energy efficiency and the preservation of non-renewable resources in comparison with the alternative ore-based production. The energy balance between the two approaches may differ by up to 70% (DNV, 1999).

Disposals including asbestos, batteries, plastics, radiation sources, lead and minerals can cause a threat to human health and the environment.

Many of the vessels currently designated for scrapping were built in the 1950s, 1960s, and 1970s using some kind of materials in their construction. Many of these materials are currently classified as hazardous, e.g. asbestos, PCBs, lead, chromates, mercury, and cadmium.

The current practice in dismantling ocean-going ships thus poses serious safety and environmental concerns. In summary these are related to:

- The disposal of and contamination of the environment with toxic and hazardous wastes;
- Unfavorable, unsafe working and scrapping conditions for the workers involved in shipbreaking and exposure to hazardous waste;
- Frequent, undocumented technical changes of the ship, in combination with frequent changes of ownership result in a lack of information on hazards and difficulty in developing a safe and environmentally friendly shipbreaking plan. This is enhanced by the fact that mostly there is no direct contact between the last operator and scrapping yard

4.2 FUTURE DEMOLITION POSSIBILITIES

The primary requirements are for efficient, not labour intensive, steel processing methods which can deal with a high volume of materials. Current research (the EU funded SHIPMATES project) is reviewing the methods which are available, considering other industries, but also looking at a reversal of the ship construction process. Handling structures similar to those found in new construction implies a high investment cost, in buildings and particularly cranes and other materials handling. Utilising second hand equipment or even the use of a redundant shipyard may allow this problem to be overcome.

A number of specific technological requirements can be set out.

Hazardous or Harmful Factors in Ship Scrapping
Asbestos
Polychlorinated Biphenyls (PCBs)
Lead
Chromates
Mercury
Fumes of welding & cuffing
Radiation
Noise
Vibration
Air pollution
Low-level radium sources
Organic liquids (Benzene etc.)
Battery, Compressed gas cylinders, fire fighting liquids, etc.
Chemical materials
Work using plasma and gas torches
Explosive(s)
Work using cranes and lifting equipment
Saws, Grinders and Abrasive cutting wheels
Accident factors: falling, upsetting, electric shock, etc.

Table 3: Identifiable hazards associated with ship-breaking and existing ILO standards.
Source: Bailey, 2000.

Any steel processing technology must be able to work continuously, to make the investment worthwhile.

The technology must be automated, both to reduce labour costs to a minimum and to avoid the presence of human beings in a dangerous environment.

The technology must be flexible to deal with the high variety of structures and shapes. An alternative is to create a technology which is specific to a single ship type, although this will be potentially vulnerable to the variations in the recycling market.

Solutions being considered include the use of tele-operated cutting systems, semi-automatic devices which move over the ship surfaces and autonomous robots which can operate very much as human recyclers do at present. The robots would be programmed to move over the steel surfaces of the ship, continuously cutting. It is likely that the robots would to some extent have to be regarded as expendable, given the inherent dangers of cutting up a structure which is also being used for support by the cutting system. However this would be a major improvement on the use of people for the same purpose.

Programming of such robotic devices can be achieved using state of the art measurement systems, for example digital photogrammetry, which can establish the precise geometry of large structures and make this information available digitally for a CAD system. Using such techniques, the remotely operated systems may be accurately positioned on the structure.

Design for recycling is a useful concept, which has been applied to motor vehicles and some consumer goods. In principle it has applications in the marine world, although the issues of standardisation and compliance which have been raised earlier would possibly apply. The concept would clearly only apply to new ships, so for at least twenty-five years the world recycling industry will have to deal with existing ships which have no account of final disposal built into their design.

There is potential for the adoption of new materials, and novel configurations of existing materials

Technical measures must also be taken to provide environment protection during the recycling process. As a minimum, the process will have to take place in a dock, or other enclosed work area which creates a barrier between the waste processing and the environment. Keeping clear of the water is obvious, and it would be preferable to enclose the processing in a building. This raises immediate questions of cost.

Attention will have to be paid to all of the facilities, tools and procedures which may be proposed for the recycling operations.

5. HUMAN FACTORS

One of the key motivations for an improved ship recycling business is the protection of people. This paper is proposing a Knowledge Data Base, established in a research environment, which will include all the elements necessary to underpin a recycling operation in the EU. The human factors in this are of great importance.

As has been emphasised in the discussion of new technologies a key requirement is the removal of the workers from the proximity to danger which is a feature of the current recycling processes. Currently the recycling process that takes place in the Far East presents dangers from two sources. First is the danger of accidents, which regularly cause death or serious injury. Second is the longer term danger from pollutants, which affects not only the workers directly engaged in the recycling but also all the people living and working in the area of the recycling facilities.

Working on the open beach is the primary cause, as ships which have not been cleaned sufficiently are cut up and any waste oils and other materials can escape.

6. MARKET FOR SCRAPPING

Ship demolition provides a large amount of recyclable materials. Some 95% of an average merchant ship will be re-used, from the steel to the non-ferrous metals and pipe work of the ship which will be re-used. The scrap price of ships is volatile and depends upon the demand for steel from this source (BIMCO).

The ship type is important in determining the price offered by the ship breaker. Large ships with easily accessible surfaces, such as tankers are easier to cut in pieces and are therefore more valuable and profitable. Steel scrap obtained from shipbreaking process is of comparatively high quality, especially from tankers that have large flat panels. The price is also affected by the availability of ships for demolition, which itself is governed by the freight market conditions. If, for instance, the freight market is good, a shipowner will be reluctant to take an elderly ship out of service, keeping the ship earning as long as possible. Only when the freight market has turned and the relatively high operating costs of an old ship, the shipowner will decide to scrap the vessel. He will hope that this decision will coincide with a relatively high scrap price as well. This will also be affected by the availability of ships being offered for demolition. If freights are high, few ships will be available for scrap, and prices will be at their highest. If there are many vessels being offered at a time of poor freight rates, then the scrap prices will also be low. It is all a matter of supply and demand (BIMCO).

Year	No. DWT Age	Tankers	Bulk Carriers	Combos	Gas vessels	Other dry	All Vessels
1992	No.	94	67	11	4	64	240
	DWT	10,22	3,913	1,296	0,011	0,775	16,215
	Age	23,8	23,6	20,8	26,8	24,7	23,9
1993	No.	110	50	15	10	129	314
	DWT	10,685	2,557	2,27	0,111	1,398	17,021
	Age	23,1	24,2	21,9	24,9	29,4	25,9
1994	No.	87	70	18	7	112	294
	DWT	12,558	4,351	2,421	0,018	1,234	20,582
	Age	22,6	24	21,9	26,3	26,5	24,5
1995	No.	93	33	9	1	91	227
	DWT	10,794	2,093	1,229	0,002	1,195	15,313
	Age	25,2	25,2	22,4	30	27,2	25,9
1996	No.	72	128	15	5	168	388
	DWT	6,829	7,297	1,904	0,021	1,967	18,018
	Age	25,3	25	23,1	27,9	27,2	26
1997	No.	40	161	6	6	187	400
	DWT	3,611	7,707	0,746	0,075	2,596	14,735
	Age	28,3	25,5	23,6	28,4	26,5	26,3
1998	No.	52	236	10	6	191	495
	DWT	7,547	11,666	1,416	0,028	3,181	23,838
	Age	25	25	22.8	27.5	25.5	25.2
1999	No.	113	194	9	6	226	548
	DWT	17,114	9,385	1,130	0,019	3,185	30,833
	Age	24.9	24.9	24.3	31.4	25.2	25.1
2000*	No.	55	29	4	1	45	134
	DWT	7,234	1,353	393	18	641	9,639
	Age	26.1	27.1	25	31.7	25.7	26.2
Average 92-99	No.	83	117	12	6	146	363
	DWT	9,920	6,120	1,550	40	1,940	19,570
	Age	24.4	24.8	22.4	26.9	26.3	25.3

Table 4: Vessels (> 10,000 dwt) sold for scrapping 1992 -2000* (Jan-Mar), (000 dwt).
Source: DNV, 2001

The scrap steel provides most of the value of the ship. The percentage of the steel varies and it depending on ship type and size, but there has been an estimate of roughly 74.4% for a standard tanker with 120,000 dwt, and 63.15% dwt for a standard bulk carrier with 52,000 dwt (Table 5).

7. A KNOWLEDGE DATA BASE FOR SHIP DISPOSAL

So far this paper has addressed the major factors in the ship scrapping business. It is apparent that the current disposal process has flaws, and there is general agreement that an improved process is required, for all the reasons stated. However, it is also apparent that there is incomplete information on the current business and particularly there are gaps in the technology which might be employed to secure the required improvement. Without technological change, the current processes will remain too dangerous and expensive to allow the operations to be carried out in the European Union.

A KDB is believed to be an essential pre-requisite for the concept, and is required, sooner rather than later, through the close collaboration of EU industry, institutions and universities, and by members of CESA. What is therefore proposed is the establishment of a database, with the structure proposed inn Table 6. It would require a multidisciplinary team according to the KDB structure outlined in the table.

Element	Standard Tanker	Standard Bulk Carrier
Steel	74.4	63.15
Copper	0.01	0.04
Zinc	0.03	0.04
Special Bronze	0.03	0.04
Machinery	14	19
Electrical/Electronic Equipment	2.5	5
Joinery - Related products	5	6
Minerals	0.5	2.5
Plastics	0.5	1.2
Liquids	2	1
Chemicals and gases	0.03	0.03
Other miscellaneous	1	2
Total	100	100

Table 5: Percentage of various elements of a standard ship (in %).

EU SHIP RECYCLING KDB STRUCTURE		Profile of Professional Competence Required for KDB Build-up
1st Level Subdivision	2nd Level Subdivision	
1. Relevant EU Policy Issues	1.1 Long term strategies; 1.2 New initiatives and trends.	EU representation
2. Applicable Regulatory Bases	2.1 International regulations (UN, IMO, EU); 2.2 National and regional regulations.	Legal experts
3. Financial Aspects	3.1 Ship decommissioning operations decision making and their financial structure; 3.2 Shipbreaking/ship recycling processes cost modelling.	Shipping/Shipbuilding Economist
4. Ship Recycling Management & Organisation	4.1 Optimisation of yard organisational structure.	Yard Management & Organisation
5. Environment Protection	5.1 Polices; 5.2 Measures.	Ecologist
6. Marketing Analyses	6.1 Shipbreaking demand forecasting on national, EU and world market basis; 6.2 Shipbreaking yards capacities state-of-the-art & prospects.	Shipping & Shipbuilding Marketing / Market Research
7. Human Factors	7.1 Ship Recycling Specialised Yard personnel education and training; 7.2 Safety and Health Executive issues.	Personnel and/or Human Relations
8. Technical Aspects	8.1 Design for recycling concepts, new materials adoption included; 8.2 Specialised Ship Recycling Yard production process definition; 8.3 Theoretical calculations of disassembling process (hull strength, hull stability, risk analysis, etc.); 8.4 Low labour intensity steel processing methods development; 8.5 Technical measures of environment protection (facilities, tools and procedures).	Naval Architect (NA) – Design NA – Production Process NA – Design NA – Production Process
9. IT Issues	9.1 KDB management & maintenance; 9.2 Computer aided cost effective production planning simulation; 9.3 Computer aided simulation of disassembling processes.	IT Specialist + NA – Production Process

Table 6: KDB structure outline

8. CONCLUSIONS

Ship recycling is an integral part of the life cycle management of ships. Ships have to be recycled at the end of their operational life in a responsible way.

A long term solution for the ship recycling industry has to be based on an international legal framework, based upon the guide lines set by the International Maritime Organization (IMO), the International Labour Organization (ILO), and the Basel Convention.

An effective, economic and industry in the developed world, ideally in the EU is the most suitable route to environmentally responsible recycling.

New ships should be designed in such a way that they can be recycled easily.

A Knowledge Data Base is an essential means of underpinning responsible recycling

9. ACKNOWLEDGEMENT

The work being undertaken within the SHIPMATES project is addressing some of the issues for the KDB, particularly the technologies required which are seen as a major gap. The input of all the project partners is gratefully acknowledged.

The partners involved in SHIPMATES are

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- University of Patras, Laboratory for Manufacturing Systems, Greece
- University of Hertfordshire, Dept. of Aerospace, Civil & Mechanical Engineering, UK
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- Choren Design & Consulting, Poland

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Dr. Karpowicz is the Managing director of BERTECH a technical consultancy based in Gdansk, Poland he holds a Doctor of Science in Naval Architecture from Rijeka University, Yugoslavia & Univ. of Newcastle upon Tyne (spec.), 1989, and has been actively working for the maritime industry across Europe. Dr. Karpowicz is still active in R&D having published several papers for International Conferences.

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SAFETY AND HEALTH IN SHIPBREAKING

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1. WHAT IS SHIPBREAKING?

Shipbreaking is the process of dismantling a vessel's structure for scrapping or disposal whether conducted at a beach, pier, dry dock or dismantling slip. It includes a wide range of activities, from removing all gear and equipment to cutting down and recycling the ship's infrastructure. Shipbreaking is a challenging process, due to the structural complexity of the ships and the many environmental, safety, and health issues involved. While ship scrapping in dry docks of industrialised countries is regulated, shipbreaking on beaches or alongside piers is less subject to control and inspection. Although the ILO guidelines - *Safety and health in shipbreaking: Guidelines for Asian countries and Turkey* - represent good practices for all, they are more particularly aimed at the step-by-step improvement of the more hazardous situation with respect to the dismantling of ships on beaches.

2. DOES SHIPBREAKING CONTRIBUTE TO SUSTAINABLE DEVELOPMENT

Breaking old or redundant ships – rather than scuttling or using them as artificial reefs – enables steel (and other parts of the ship) to be re-cycled at a much lower cost than importing and processing iron ore. Less energy is also needed. It also provides for the timely removal of outdated tonnage from international waters. Hundreds of vessels are scrapped each year, a trend which will continue. With the advanced phase out of single hull vessels sooner than scheduled there is a question of capacity, thus increasing the danger that more countries will resort to scrapping by beaching[1].

3. SPECIFIC PROBLEMS OF THE INDUSTRY

3.1 SHIPBREAKING IS ONE OF THE MOST HAZARDOUS OCCUPATIONS

Over the last decades, shipbreaking, which is recognised as a very hazardous occupation, has been concentrated in a few Asian countries (Bangladesh, China, India and Pakistan) and Turkey on account of low wages and a lower level of compliance with international standards on safety, health and environment and where working and environmental conditions are relatively poor. Recent feasibility studies commissioned by the European Union have concluded that shipbreaking is unlikely to be carried out in Europe due to its hazardous nature, its relatively high cost and the lack of demand for scrap steel.

3.2 SHIPBREAKING IS HAZARDOUS WASTE MANAGEMENT

Although many of the hazardous materials used to build a ship - asbestos, Polychlorinated Biphenyls (PCB), toxic paint such as Tributyltin (TBT) and other heavy metals – are restricted or banned today, a ship built 20-30 years ago still contains these materials. It also carries hazardous and flammable chemicals used for painting, repair and maintenance, etc. Cables and electrical and other control systems contain hazardous material and emit hazardous gases, if burned. The paint coat, contaminated air, soil and water when torched or scraped, is hazardous for human beings and the environment. The protection and safety and health of the workers handling this hazardous waste is of crucial importance.

3.3 SHIPBREAKING IS NOT ALWAYS COVERED BY LABOUR LAW AND SOCIAL PROTECTION

Shipbreaking is often not recognised as an industry in some countries. Although facing more hazards than in an average industry, shipbreaking in some countries is neither covered by the maritime legislative framework nor by normal safety and health legislation and inspection, nor by social protection. This leaves the workers more vulnerable.

3.4 SHIPBREAKING LOCATIONS MAKE THE ENFORCEMENT OF LAWS AND REGULATIONS DIFFICULT

Shipbreaking operations are frequently carried out at difficult to reach sites, which are dispersed and can change location. Casual, contract or migrant workers typically undertake the work. These factors combine to make the enforcement of laws and regulations more difficult than in other industrial sectors. Many hazards may be attributed to a hostile environment rather than to inadequate requirements compounded by negligent behaviour. Other work practices are based on an opinion as to what is safe and what is not. Laws and regulations cannot be expected to cater for every variable; however, laws should provide a sound basis for safe and healthy work practices. The informal nature and - in some countries or locations - the temporary establishment of shipbreaking sites emphasises the difficulty of implementing all relevant ILO labour standards immediately.

[1] It is understood that the Indian state of Andhra Pradesh, has recently decided to locate a ship breaking yard on the Kakinada coast.

3.5 LACK OF AN INVENTORY OF HAZARDOUS MATERIAL; DECONTAMINATION AND GAS-FREEING; PLANNING FOR SAFE DEMOLITION; AND RECYCLING AND SAFE WASTE MANAGEMENT

A ship contains hazardous material, the removal, handling and waste management of which is hazardous both for humans and nature. The demolition process consists of hazardous work–tasks. Recycling requires information on the properties of the material handled. Information on hazards and safety measures from international, national and shipping sources are needed at the work site level for safe performance. In the future, all ships will carry a "green passport" which would follow a ship from the day it was built. At the moment, some form authorization for dismantling exists, in the future this should only be given to ships which are safe for breaking on arrival.

This "Certificate for Dismantling" would include:

(a) an updated list of hazardous substances and wastes on the ship to be dismantled provided by the ship owner in accordance with the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal and the Industry Code of Practice of the International Chamber of Shipping (ICS);
(b) ensuring on the part of owners, brokers and breakers that a ship to be dismantled is decontaminated and gas free for hot work;
(c) the relevant information (drawings, etc.) necessary for the development of a safe shipbreaking plan. Information, planning, pro-active actions and safe management of the demolition process can increase safety substantially. The development of a safe shipbreaking plan is not costly, but can save lives and improve productivity.
(d) OSH management systems covering continuous safe operations in the ship, the breaking facility and the surrounding area;
(e) implementation in the shipbreaking industry of relevant Conventions and documents on OSH, working and living conditions and the environment;
(f) provision of appropriate housing, welfare and sanitary facilities for all workers.

3.6 OCCUPATIONAL HAZARDS

Shipbreaking operations expose workers to a wide range of hazards or workplace activities or conditions likely to cause injuries and death, ill health, diseases and incidents. These include:

(a) hazardous exposures generated, in particular, by asbestos, polychlorinated biphenyls (PCBs), heavy metals and hazardous material and chemicals, excess noise and fire;
(b) hazardous working conditions (inadequate worker training and fire protection measures, lack of or improper personal protective equipment (PPE) and lack of appropriate emergency response, rescue, and first aid) and a high number of hazardous work activities.

A high number of hazards (as shown in Table 1 below, as a minimum but not limited to these) are likely to cause work-related injuries and death, ill health, diseases and incidents among shipbreakers. They can be grouped as follows:
(a) hazards with the potential of causing accidents;
(b) hazardous substances and wastes;
(c) physical hazards
(d) mechanical hazards;
(e) biological hazards;
(f) ergonomic and psychosocial hazards;
(g) general concerns.

The document entitled *Safety and health in shipbreaking: Guidelines for Asian countries and Turkey* (hereafter the ILO Guidelines) goes on to deal with each of these hazards in specific chapters.

4. NATIONAL FRAMEWORK

In accordance with the general practice for codes of practice on occupational safety and health, ILO codes assign specific responsibilities and duties to national governments, employers and workers.

4.1 RESPONSIBILITIES AND DUTIES OF COMPETENT AUTHORITIES

The ILO Guidelines recommend that each government should nominate a competent authority or authorities[2], which should, in consultation with the representative organizations of employers and workers, formulate, implement and periodically review a coherent national policy and principles for safe shipbreaking. Such policy should include:

(a) the control of the import and preparation of ships for breaking;
(b) employment and working conditions, occupational safety and health, workers rights and workers welfare;
(c) the protection of both persons and the environment in the vicinity of a shipbreaking work site.

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[2] A competent authority is a minister, government department or other public authority with the power to issue regulations, orders or other instructions having the force of law. Under national laws or regulations, competent authorities may be appointed with responsibilities for specific activities, such as for the implementation of national policy and procedures for the protection of shipbreaking workers.

Frequent causes of accidents
- Fire and explosion: explosives,flammable materials
- Falls from height inside ship structures or on the ground
- Falling objects
- Moving objects
- Trapping or compression
- Wet surfaces
- Snapping of cables, ropes, chains, slings
- Heavy objects
- Sharp objects
- Oxygen deficiency in confined spaces
- Access in progressively dismantled vessels (floors, stairs, passageways)
- Electricity (electrocution)
- Poor illumination
- Lack of PPE, housekeeping practices, safety signs
- Shackles, hooks, chains
- Cranes, winches, hoisting and hauling equipment

Hazardous substances and wastes
- Asbestos fibres, dusts
- Heavy and toxic metals (lead, mercury, cadmium, copper, zinc, etc.)
- Organometallic substances (tributyltin, etc.)
- Lack of hazard communication (storage, labelling, material safety data sheets)
- Batteries, fire-fighting liquids
- PCBs and polyvinyl chloride (PVC) (combustion products)
- Welding fumes
- Volatile organic compounds (solvents)
- Inhalation in confined and enclosed spaces
- Compressed gas

Physical hazards
- Noise
- Vibration
- Extreme temperatures
- Radiation (ultraviolet, radioactive materials)

Mechanical hazards
- Trucks and transport vehicles
- Scaffolding, fixed and portable ladders
- Sharp-edged and other tools
- Power-driven hand tools, saws, grinders and abrasive cutting wheels
- Failure of machinery and equipment
- Poor maintenance of machinery and equipment
- Lack of safety guards in machines
- Structural failure in the ship

Biological hazards
- Toxic marine organisms
- Animal bites
- Risk of communicable diseases transmitted by pests, vermin, rodents, insects and other animals that may infest the ship
- Vectors of infectious diseases (TB, malaria, dengue fever, hepatitis, respiratory infections, others)

Ergonomic and psychosocial hazards
- Repetitive strain, awkward postures, repetitive and monotonous work, excessive workload
- Mental stress, anti-social behaviour (aggressive behaviour, alcohol and drug abuse, violence)
- Long working hours, shift work, night work, temporary employment
- Poverty, low wages, under-age workers, lack of education and social environment

General concerns
- Lack of safety and health training
- Inadequate accident prevention and inspection
- Poor work organization
- Inadequate housing and sanitation
- Inadequate emergency, first-aid and rescue facilities
- Lack of medical facilities and social protection

Table 1: Common hazards that are likely to cause work-related injuries and death, ill health, diseases and incidents among shipbreakers

The ILO Guidelines further state that this policy should:

(a) recognise shipbreaking as an official occupation of the national economy;
(b) aim at preventing illness and injury to health arising from shipbreaking activities through the identification of hazards and the elimination of or exercising control over risks from all existing situations in the working environment;
(c) be supported by specific laws and regulations and have an effective mechanism of inspection for their enforcement.

4.2 LEGAL FRAMEWORK

The ILO Guidelines recommend that national laws and regulations should:

(a) ensure the safety and health of workers employed in shipbreaking activities; and
(b) support the practical implementation of the obligations placed on the competent authority as referred to above.
(c) reflect the relevant applicable provisions of documents and information made available by the International Labour Office (ILO), the International Maritime Organization (IMO) and the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal;
(d) be so constructed that they take into account technological developments, and new situations and standards;
(e) specify that the employer of a shipbreaking facility has overall responsibility for the protection of the workers in respect of their safety and health andprovides leadership for OSH activities.

4.3 DUTIES OF LABOUR INSPECTORATES

Labour inspectorates should:

(a) periodically carry out inspections in the presence of the employers' and workers' representatives, and monitor compliance with and enforce all relevant laws and regulations at shipbreaking facilities;
(b) advise employers and their workers on the safe performance of activities, particularly on the choice and use of safe working methods and appropriate personal protective equipment;
(c) monitor the safety requirements and performance of comparable national or international shipbreaking facilities to provide feedback for further development and improvement of safety measures;
(d) participate, in co-operation with the recognised organizations of employers and workers, in formulating and updating safety rules and measures to be adopted at national and enterprise levels.

4.4 GENERAL RESPONSIBILITIES OF EMPLOYERS

According to the ILO Guidelines, occupational safety and health and the protection of the working and living environment should be the overall responsibility and duty of the employer of the shipbreaking facility, as prescribed by national laws and regulation. The employer is expected to show strong leadership and commitment for OSH activities that may be exercised through the establishment of an OSH management system specifically designed for the shipbreaking facility.

Furthermore employers should:

(a) make arrangements for the identification and periodic assessment of the hazards and risks to safety and health from hazardous ambient factors at each permanent or temporary workplace, generated by the use of different operations, tools, machines, equipment and substances;
(b) implement appropriate preventive and protective measures required to prevent those hazards and risks, or to reduce them to the lowest reasonable and practicable level, in conformity with national laws and regulations.

In addition these arrangements should:

(a) be in conformity with the provisions of national laws and regulations and recommendations contained in these guidelines;
(b) be specific to the facility and appropriate to its size and nature of its activities;
(c) form the essential elements of a successful occupational safety and health management system in the shipbreaking facility.

Finally employers should comply with the safety and health measures identified or arising from:

(a) international conventions, codes of practice or guidelines, as appropriate;
(b) national laws and regulations, technical standards, codes of practice and authoritative guidance (see paragraphs 3.2.1 and 3.2.2 of these guidelines), and
(c) any voluntary programmes or agreements, to which the enterprise subscribes,as prescribed, approved or recognised by the competent authority.

4.5 GENERAL DUTIES OF WORKERS

The ILO Guidelines go on to state that workers should have the duty, in accordance with their training, the instructions and the means given by their employers:

(a) to comply with prescribed safety and health measures;
(b) to take all reasonable steps to:
   (i) secure their personal safety and that of any other person who may be at risk as a result of their acts or omissions at work,

(ii) take all reasonable steps to eliminate or control hazards or risks to themselves and to others, including proper care and use of personal protective equipment and clothing, facilities and equipment placed at their disposal for this purpose;

(c) to report forthwith to their immediate supervisor, without detriment to themselves, any situation which they have reasonable justification to believe presents an imminent and serious danger to their life or health or that of other persons, and which they cannot properly deal with themselves;

(d) to report any accident or injury to health which arises in the course of or in connection with work to the responsible supervisor or manager ;

(e) to co-operate with the employer and other workers to permit compliance with the duties and responsibilities placed on the employer and workers pursuant to national laws and regulations.

4.6 GENERAL RESPONSIBILITIES OF SUPPLIERS, MANUFACTURERS AND DESIGNERS

In accordance with the ILO Guidelines measures should be taken, in accordance with national laws and regulations to ensure that those who design, manufacture, import, provide or transfer machinery, equipment or substances for use in shipbreaking operations:

(a) satisfy themselves that the machinery, equipment or substance do not entail dangers for the safety and health of those using it correctly;

(b) make available:
   (i) information concerning the correct installation and use of machinery and equipment and the correct use of substances;
   (ii) information concerning hazards of machinery and equipment; dangerous properties of hazardous substances; and physical agents or products;
   (iii) instructions on how known hazards are to be avoided.

Those responsible for the design and construction of shipbreaking facilities and workplaces should ensure, in close co-operation with specialists, that:

(a) the levels of hazardous ambient factors from shipbreaking facility and processes are minimized and they conform to nationally recognized standards; and

(b) their design promote a safe and healthy working environment.

4.7 GENERAL RESPONSIBILITIES AND RIGHTS OF CONTRACTORS

Contractors should comply with the arrangements established by the shipbreaking facility.

4.8 COOPERATION BETWEEN ALL THE PARTIES

In accordance with national laws and regulations, measures for cooperation relating to the elimination or control of risks to safety and health from hazardous ambient factors should be taken, including the following:

(a) employers, in discharging their responsibilities, should cooperate as closely as possible with workers and/or their representatives;

(b) workers should cooperate as closely as possible with their fellow workers and their employers in the discharge by the latter of their responsibilities and should comply with all prescribed procedures and practices;

(c) suppliers should provide employers with such information as is available and required for the evaluation of any unusual hazards or risks to safety and health which might result from a particular hazardous ambient factor at work.

5. SAFE SHIPBREAKING OPERATIONS

5.1 GENERAL REQUIREMENTS

The breaking of a ship can be divided into the three core phases - *Preparation*, *Deconstruction* and *Material (Scrap) Stream Management* - these may be further sub divided to identify the constituent work processes. By segmenting the shipbreaking process, individual tasks and consequently the tasks hazardous to the safety and health of workers can be more easily identified and quantified. The breaking of a ship using this approach can therefore be undertaken in a controlled and managed manner so that the safety and health of workers can be protected by eliminating or minimising any risks involved with the work to be undertaken. An example of this type of approach is shown in the Model Safe Shipbreaking Plan - Figure 1 below. The example shown in Figure 1 becomes ship-specific when a particular ship's details are applied to it.

The safe execution of each core phase is dependent on safe working practises and processes being adopted and the provision of advanced information concerning the physical characteristics of the ship and the dangers presented by wastes - hazardous and otherwise - remaining on board or inherent in the vessel when presented for breaking. In this regard, an inventory of materials together with details of the ship in the form of drawings, plans, log-books detailing tank dispositions, etc., are essential if the deconstruction is to be planned and conducted in a safe manner. The 'Green Passport' system (see below) would provide some of the information required but reliance solely on this information may lead to other aspects of the work plan being overlooked.

With regard to the model as shown in Figure 1, the first stage of developing a Safe Shipbreaking Plan begins with obtaining ship-specific details and a materials inventory. In this respect, two documents should be obtained prior to the arrival of a vessel, *viz*:

(a) Certificate for Dismantling – as described in above, and

(b) The 'Green Passport' – adopted by IMO Assembly Resolution No. A.962(23) – which consists of an inventory of all the materials potentially hazardous to human health or the environment on board the vessel when it arrives at the shipbreaking facility. It would be compiled during building (and maintained during the life of the ship) or following an inspection while the vessel is in-service (see Glossary).

Whether or not a Certificate for Dismantling and/or Green Passport is available, as a minimum the ship breaker should, in every case, before any physical breaking takes place: obtain an updated list of hazardous substances on the ship to be dismantled provided by the ship owner in accordance with the provisions of the Basel Convention and the Industry Code of Practice of the International Chamber of Shipping (ICS);

5.2 HAZARD IDENTIFICATION AND RISK ASSESSMENT

Hazards are present in virtually all work processes and practices. Many hazards can be identified through knowledge of the processes and skills gained by experience. However, a considerable number of hazards are not so self evident and these require a detailed analysis of the process to reveal or identify them and their potential to cause injuries. Notwithstanding the mere perceived nature of a hazard, each process should be examined in detail to quantify its possible effect on the safety and health of workers.

Risk is generally accepted as being a function of hazard in that it gives the term 'hazard' a dimension. When a hazard is identified it must be put into perspective and quantified since some hazards present no concerns for the safety and health of workers whereas others possess varying injurious effects ranging from slight to fatal. Risk of damage to workers in the workplace can be assessed using a number of techniques providing they include criteria that relates to the potential cause damage to humans.

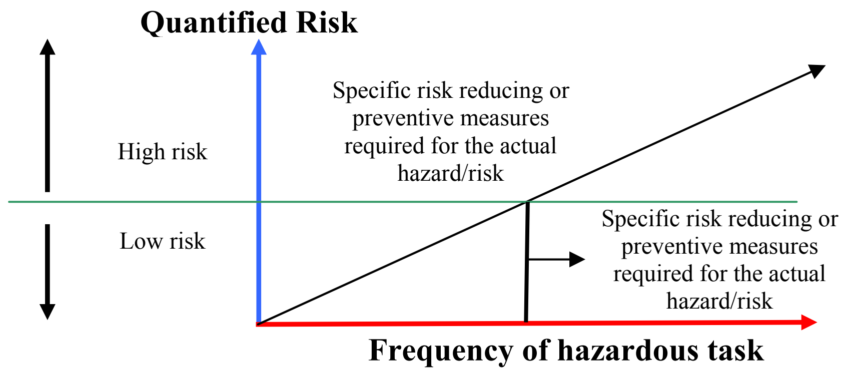
Risk is also affected by the frequency of carrying out a hazardous task. Generally and for a variety of reasons including fatigue and poor health, risk may increase through the repetition of the task as indicated in the following diagram:

Risk assessments should be carried out by employers or by persons acting on their behalf that are competent and have the necessary information, instruction and training, in consultation with workers and their representatives. Where the outcome of the assessment indicates a potential injury or risk to safety and health, the results should be recorded and made available for inspection by the competent authority, and to workers exposed to the hazardous ambient factors and the workers' representatives.

If a new source of hazard is introduced, the assessment should be made before workers are exposed to the hazard. The assessment should gather information on the hazardous ambient factors present at the workplace, the degree of exposure and risk, appropriate control measures, health surveillance and training. Reviews should be carried out as detailed below.

5.3 REVIEW OF RISK ASSESSMENTS

The identification of hazards and assessment of risks in each phase of the shipbreaking plan is not a one-off exercise. Indeed, reviews should be carried out regularly, if not daily of the protective and preventive measures implemented. Further, reported incidents or the occurrence of accidents should serve as feedback into the review process to indicate the success or failure of the safety and health protection measures taken or proposed.



6. GENERAL PREVENTIVE AND PROTECTIVE MEASURES

6.1 GENERAL PROVISIONS

All appropriate precautions should be taken:

(a) to ensure that all workplaces are safe and without risk to the safety and health of workers;

(b) to protect persons present at or in the vicinity of a deconstruction facility from all risks which may arise from the site or associated shipbreaking operations.

6.2 MEANS OF ACCESS AND EGRESS

Adequate and safe means of access and egress should be provided for all workplaces during all ship breaking operations. These means should be maintained in a safe condition. Means of escape should be kept clear at all times. Escape routes should be frequently inspected and modified on the ship continuously according to the breaking progress. Where appropriate, suitable visual signs should be provided to clearly indicate the direction of escape in case of fire.

6.3 MANAGEMENT OF HAZARDOUS SUBSTANCES

The competent authority should ensure that criteria are established on measures which provide for safety and health, in particular:

(a) in the handling, storage and transport of hazardous substances;

(b) in the disposal and treatment of hazardous chemicals and hazardous waste products, consistent with national or international regulations.

As a basis for eliminating or controlling exposure to hazardous substances (including dusts, fumes and gases), the provisions of the ILO Code of practice *Ambient factors in the workplace* should be consulted. Where the workers are exposed to hazardous chemicals, the provisions of the ILO Code of practice *Safety in the use of chemicals at work* should apply.

6.4 MONITORING IN THE WORKPLACE FOR CHEMICAL HAZARDS

The ILO Guidelines recommend a number of techniques for this risk assessment which may include:

(a) information on the intrinsic health and physical hazards, obtained from the ships *Inventory list of hazardous substances* and chemical safety data sheets which correspond to the requirements established in chapter 5 of the ILO Code of practice *Safety in the use of chemicals at work,* in particular the International Chemical Safety Cards provided by IPCS;

(b) estimation of exposure based on the method of work and work pattern;

(c) experience of exposure in the workplace or of other users; and

(d) simple qualitative tests (such as the use of smoke tubes or pellets to determine ventilation characteristics, and of the dust lamp for illuminating dust emissions.

6.5 CONTROL MEASURES

Appropriate preventive and protective measures should be taken against the following most common hazards:

(a) asbestos removal and disposal;

(b) polychlorinated biphenyl (PCB);

(c) bilge and ballast water removal

(d) oil and fuel removal;

(e) paint removal and disposal;

(f) metal cutting and metal disposal;

(g) removal and disposal of miscellaneous ship machinery.

Specific control measures should be carried out for:

(a) chemicals hazards to health;

(b) flammable, dangerously reactive or explosive chemicals;

(c) the storage of hazardous chemicals;

(d) the transport of chemicals;

(e) the disposal and treatment of chemicals,

6.6 HEALTH SURVEILLANCE

Exposure to the following types of hazardous substances may require appropriate health surveillance:

(a) substances (dusts, fibres, solids, liquids, fumes, gases) that have a recognized systemic toxicity (i.e. an insidious poisonous effect);

(b) substances known to cause chronic effects;

(c) substances known to be sensitizers, irritants or allergens;

(d) substances that are known or suspected carcinogens, teratogens, mutagens or harmful to reproductive health;

(e) other substances likely to have adverse health effects under particular work conditions or in case of fluctuations in ambient conditions.

6.7 MEASURES AGAINST PHYSICAL HAZARDS

For eliminating or controlling exposure to physical hazards, the ILO Guidelines on *Safety and health in shipbreaking* refer to the provisions of the ILO Code of practice on *Ambient factors in the workplace* with respect to noise, vibration, optical radiation,, heat stress, wet conditions, lighting and electricity.

6.8 MEASURES AGAINST BIOLOGICAL HAZARDS

In areas where biological agents pose a hazard (sludge evacuation, bilge- and sediment-clearing operations, etc.), the ILO Guidelines recommend that preventive measures should be taken which take account of the mode of transmission; in particular:

(a) the provision of sanitation and information for workers;

(b) action against vectors, such as rats and insects;

(c) chemical prophylaxis and immunization;

(d) the provision of first aid, antidotes, other emergency procedures in case of contact with poisonous animals, insects or plants, and suitable preventive and curative medicine, mainly in rural areas;

(e) the supply of adequate protective equipment and clothing and other appropriate precautions

6.9 ERGONOMIC AND PSYCHOSOCIAL HAZARDS

Measures should be taken to ensure the appropriate selection or adaptation of tools, machines and equipment, including personal protective equipment, taking into account local conditions in user countries and, in particular, ergonomic implications and the effect of climate.

The competent authority, after consulting the representative organizations of employers and workers concerned, should establish safety and health requirements for the handling and transport of materials, particularly on manual handling. Such requirements should be based on risk assessment, technical standards and medical opinion, taking account of all the relevant conditions under which the work is performed in accordance with national law and practice.

Workers should not be required or permitted to engage in the manual handling or transport of a load which by reason of its weight, size, shape and nature is likely to jeopardize their safety or health. Where appropriate, mechanization of work processes should be introduced progressively to replace manual lifting and handling.

6.10 SAFETY REQUIREMENTS FOR TOOLS, MACHINES AND EQUIPMENT

All tools, machines and equipment used in shipbreaking, including hand tools, both manual and power-driven, should be handled in accordance with the provisions of the ILO *Guarding of Machinery Convention,* 1963 (No. 119). These include flame cutters, gas cylinders, power generators, lifting appliances and gear, lifting ropes and transportation facilities for materials and persons.

6.11 COMPETENCE AND TRAINING

The necessary OSH competence requirements should be defined by the employer based on the provisions of the national laws or regulations or in the absence thereof, in consultation with workers' representatives and appropriate training arrangements established and maintained to ensure that all persons are competent to perform the safety and health aspects of their present or planned duties and responsibilities.

6.12 PERSONAL PROTECTIVE EQUIPMENT AND PROTECTIVE CLOTHING

Suitable personal protective equipment (PPE) and protective clothing should be provided and maintained by the employer, only where adequate protection against exposure to hazardous ambient factors by the elimination of hazards/risks, their control at source, minimization by the design of safe work system and collective measures cannot be ensured and all other measures are either impracticable or could not secure safe and healthy working conditions.

PPE and protective clothing should comply with standards set by the competent authority, or recognized by national or international bodies, taking ergonomic principles into account, and be provided, as prescribed by national laws and regulations:

(a) without cost to the workers,

(b) having regard to the type of work and risks,

(c) in consultation with workers and their representatives.

This should relate to head protection, face anf eye protection, hand and foot protection, repiratory protective equipment, hearing protection, protectors against radioactive contamination, protection from falls and appropriate clothing.

6.13 CONTINGENCY AND EMERGENCY PREPAREDNESS

Emergency planning, prevention, preparedness and response arrangements for every type of ship, all shipbreaking operations and related handling of hazardous chemicals should be established and maintained. These arrangements should identify the potential for accidents and emergency situations, and address the prevention of OSH risks associated with them. Emergency planning, prevention, preparedness and response arrangements should be established in cooperation with external emergency services and other bodies where applicable. This also applies to first aid and rescue.

6.14 SPECIAL PROTECTION

The ILO guidelines recommend special protective measures with respect to employment and social insurance, working hours, child labour, alcohol and drug-related problems and HIv/AIDS.

6.14 WELFARE

At or within reasonable access of every shipbreaking location or premises, the following facilities should be provided, kept clean and maintained:

(a) sanitary and washing facilities or showers;

(b) facilities for changing and for the storage and drying of clothing;

(c) accommodation for taking meals and for taking shelter during interruption of work due to adverse weather conditions.

The ILO *Guidelines on safety and health in shipbreaking* are issued in concert with other international instruments, including those of the International Maritime Organization[3], the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal[4], the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention 1972 and Protocol 1996), and the Industry Code of Practice of the International Chamber of Shipping (ICS).

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[3] IMO *Guidelines on Ship Recycling* (twenty-third session of the Assembly, 5 December 2003 Resolution A.962(23).

[4] Especially the *Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships* (Sixth Meeting of the Conference of the Parties to the Basel Convention, 13 Dec. 2002, Decision VI/24);

SAFER SHIP DISMANTLING FACILITIES

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SUMMARY

Ship dismantling is thriving in South Asian countries. Alang in India is world's largest centre of shipbreaking activities. Working habits on beach plots and onboard stranded ships utilize a maximum of manual labour. Many accidents occur at the yards, with numerous fatalities and injuries. Safety improvement is the need of the hour. A Safety Manual has been compiled for the shipbreaking industry at Alang, followed by a training course for Training of Safety Trainers. An industrial Oil Reception Facility and jetty is an economical proposition, and beneficial to safety and environment. The impact of international ship dismantling standards will be substantial. Building an Integrated Management System is recommended for the shipbreaking industry. Development of alternative facilities will attract a better share of the demolition market, whilst complying with upcoming international standards. Two novel types of infrastructure for ship dismantling are presented. One concept is based upon early separation of the vessel in a front and aft part, using a floating drydock. The other concept comprises a jetty for stagewise ship dismantling into transportable large blocks.

Figure 1: Dismantling of an LPG carrier at Alang beach

NOMENCLATURE

GMB	Gujarat Maritime Board
HFO	Heavy Fuel Oil
HSE	Health Safety Environment
ILO	International Labour Organization
IMO	International Maritime Organization
ISO	International Organization for Standardization
LDT	Light Displacement Tonnage
LPG	Liquified Petroleum Gas
MDO	Marine Diesel Oil
OHSAS	Occupational Health and Safety Assessment Series
QHSE	Quality Health Safety Environment
USD	United States Dollar

1. SHIPBREAKING INDUSTRY

Dismantling is necessary for vessels at the end of their economical or technical lifecycle. Whilst many a shiplover may mourn the death of a ship, it is heartening to note that its body will be largely recycled, and its organs may get a new lease of life elsewhere.

Ship dismantling is a global industry, and its business is thriving in South Asian countries. In the process of recycling ships, virtually nothing goes waste. However, the working practices and environmental standards at the breaking yards often leave much to be desired [1].

During the second half of the last century, shipbreaking operations have shifted from Europe and the United States to Asia. Amongst the five big players in the industry are three South Asian countries: India, Bangladesh and Pakistan. Figure 2 illustrates the utilized shipbreaking capacities of main countries in recent years.

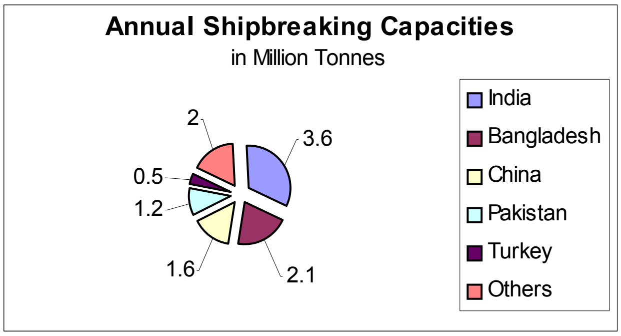

Figure 2: Main shipbreaking countries

India has become the market leader from the mid-nineties. China has recently increased its share of the utilized worldwide capacity.

On a world scale, there is a fairly constant substitution cycle of old ships by modern units. Volumewise, the market of ships for demolition has remained rather steady over the years. Pricewise, it is a different story. Shipbreaking is not always a good business. In the past decades, market rates have been fluctuating wildly between 50 and 250 USD per tonne Lightweight. This factor of 5 can be glanced from figure 3. Last year, purchasing prices of scrap ships hit an all-time high of 400 USD per tonne.

Alang in the Indian state of Gujarat is world's largest centre of shipbreaking activities. On average, three hundred ships per year are beached for dismantling there. The main revenues come from steel deliveries to local re-rolling mills. Around 70 % of a ship's weight is transported as flat steel plates and strips to the mills. A harvest of 6,500 Tonnes of steel pieces on a working day means that more than 400 trucks are loaded manually. Cranes are not used at Alang to lift steel plates onto trucks. The Alang performance statistics given in table 1 have been compiled from a variety of public sources and field investigations. Operational data of this volatile industry have been averaged over a number of years.

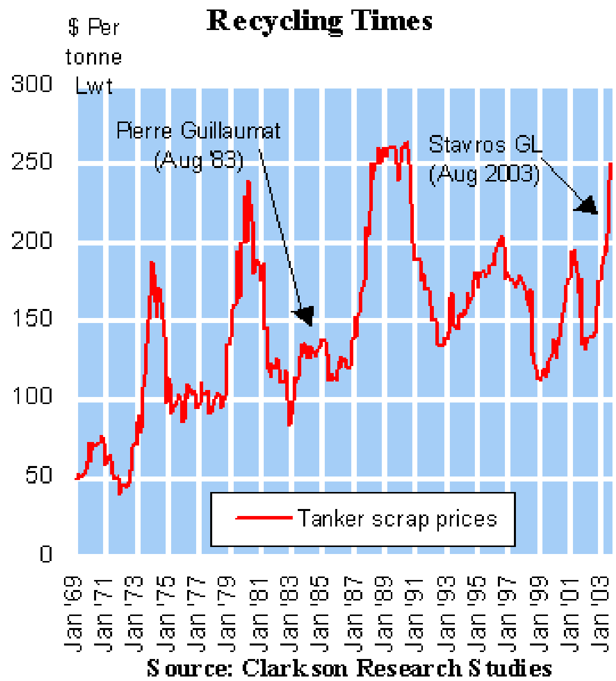

Figure 3: Cyclic fluctuation of demolition rates

Working habits on beach plots and onboard stranded ships feature a maximum utilization of manual labour. Massive indirect employment is generated in dependent industries, trades and services. However, the downside of the shipbreaking industry is reflected in the large amount of waste generated and the many accidental deaths.

The shipbreaking industry is suffering from a bad reputation, as the human and environmental costs are high [2]. Safety improvement is the need of the hour.

2. SAFETY AT SHIPBREAKING YARDS

Shipbreaking operations expose workers to a wide range of ambient hazards. To combat the hazardous work conditions, priority should be given to accident prevention and accident response.

Many accidents are happening at the yards, with a large number of fatalities and injuries. Main causes are fires, explosions, crushing, suffocation and falling.

The Alang yards are in operation for a good twenty years now. The official annual safety and production records are presented in figure 4. What can be glanced from this safety graph is a strong correlation between the occupancy of the yards, and the number of deaths due to accidents. And unfortunately, the ratio of deaths per tonne of processed ship material has not improved much over time.

Performance Indicator	Frequency	Quantity	Unit
Tonnage received	Annual	2.8 million	LDT
Ships received	Annual	300	Ships
Average ship size received	Annual	9,300	LDT
Breaking yards	Constant	173	Plots
Beach length	Constant	10.5	Km
Average yard width	Constant	60	m
Direct employment	Constant	30,000	Persons
Re-rollable steel output	Annual	2.0 million	Tonnes
Steel plates/strips loaded	Daily	6,500	Tonnes
Truck shipments of flat steel	Daily	430	Trucks
Industry turnover	Annual	520 million	USD
Government tax revenue	Annual	83 million	USD
Gujarat Maritime Board revenue	Annual	17 million	USD
Waste (hazardous & non-hazardous)	Annual	5,800	Tonnes
Accidental deaths	Annual	19	Persons

Table 1: Performance statistics of Alang Shipbreaking Yards

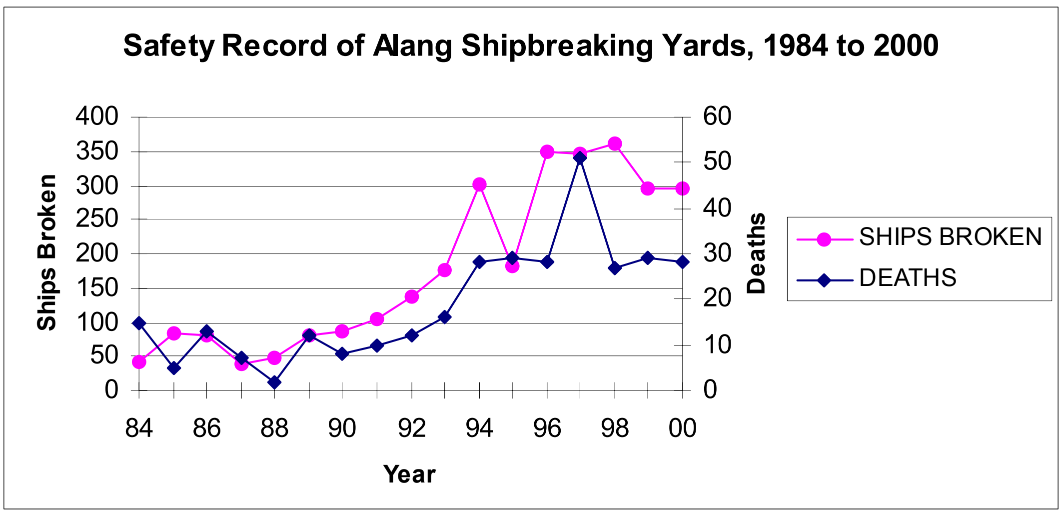

Figure 4: Alang annual safety and production records

A series of major accidents occurring early 2003 at Alang has highlighted, once again, the dangerous practice of starting ship cutting before flammable materials and explosive vapours have been removed.

Only by learning from accidents, one can prevent them from repeating. Records of accidents and injuries, along with their analysis and learning effects, should be published widely. This is the road to accident prevention. Safety improvements at the Alang yards have been supported by the leadership of the Gujarat Maritime Board [3].

3. SAFETY INITIATIVES FOR ALANG

A tailor made Safety Manual has been compiled, outlining the current best practice of shipbreaking safety.

It addresses two distinct levels in any organisation, management and workforce. Therefore, the Manual was issued in two parts. The subdivision into five sections is common to both parts of the Manual, see table 2. A Trainer Manual and an Instructor Manual were produced as well. The training courseware has been developed for the same two levels of organisation, management and workforce. Further, a dedicated training course was developed for Training of Safety Trainers, and conducted by Anglo-Eastern Maritime Training Centre in Mumbai.

ALANG SAFETY MANUAL PART 1 – SAFETY CODES OF PRACTICE PART 2 – SAFETY INSTRUCTIONS		
SUBJECT	**PART 1**	**PART 2**
A. SAFE WORKPLACE PRECAUTIONS		
1. Housekeeping and workplace protection	√	√
2. Personal protective equipment	√	√
3. Fire prevention and fire fighting	√	√
4. Risk reduction	√	
5. Supervision and communication	√	
6. Safety training	√	
7. Safety promotion	√	
B. SAFE SHIP ACCESS AND EXIT		
1. Degasification	√	
2. Personnel transfers	√	√
3. Machinery spaces and oil tanks	√	√
4. Confined spaces	√	√
5. Working at height	√	√
6. Hull spaces	√	√
C. SAFE SHIP DISMANTLING		
1. Beaching of ships	√	
2. Dragging of heavy pieces	√	√
3. CO2 Removal	√	√
4. Flame cutting	√	√
5. LP Gas and oxygen cylinders	√	√
6. Hand tools	√	√
D. SAFE MATERIAL TRANSPORT		
1. Cranes	√	√
2. Winches	√	√
3. Hoisting and pulling gear	√	√
4. Manual handling	√	√
5. Transport vehicles	√	√
E. SAFE WORKPLACE RESPONSE		
1. Emergencies	√	√
2. Evacuation	√	√
3. Medical facilities and first aid	√	√
4. Reporting and feedback	√	
5. Safety improvements	√	

Table 2: Topics covered in the Alang Safety Manual

4. OIL RECEPTION FACILITY

The present slow and cumbersome method of oil extraction from ships at beaches is quite unsatisfactory and dangerous. Current practice is to continue with draining oil tanks, pipelines, and engine room compartments whilst flame cutting the ship's hull, see figure 5. Ventilation of spaces in a dead ship is insufficient to remove explosive vapours.

A techno-economical feasibility study has been conducted for a basic Oil Reception Facility at Alang. Three jetty options have been investigated: a short one, involving shuttling barges; a long one for direct mooring and oil offtake from the ships; and a long one with additional facilities for steel and scrap export.

An industrial Oil Reception Facility and jetty is proposed at Alang, to receive excess fuel oil and oily waste from the end-of-life ships before they are beached for scrapping. As outlined in figure 6, the Facility receives four streams of excess fuel oil and oily waste from scrap ships, and feeds these to local markets after basic processing and storage.

An early start of operations can be realized by building the onshore receiving facility with a short jetty first.

Feasibility analysis shows a high rate of return on investment, whilst the facility offers substantial safety and environmental benefits. Provision of this Oil Reception Facility can be undertaken on Build-Operate-Transfer basis.

Figure 5: Oil extraction from ship on beach

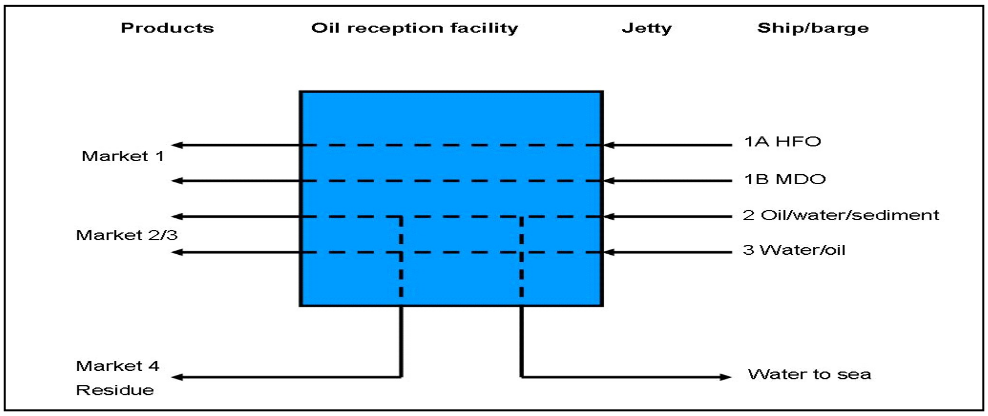

Figure 6: Main liquid flows through Oil Reception Facility for Alang

5. INTEGRATED MANAGEMENT SYSTEM

International development of standards for Health, Safety and Environment (HSE) management of shipbreaking activities is ongoing. This will result in a harmonized set of guidelines issued by three major international agencies: Basel Convention, IMO and ILO.

The impact of these upcoming guidelines and standards on the ship owners selling ships for demolition, and on existing shipbreaking operations in many countries, will be substantial.

Shipbreaking countries should now seize the opportunity to develop their own HSE guidelines, to international standards.

To enhance their business, industries across the world are moving rapidly into a regime of voluntary certification for their Quality, Health, Safety, and Environment (QHSE) management systems against the global ISO and OHSAS standards. A stepwise and modular approach for building an Integrated QHSE Management System is advocated as the roadmap for the shipbreaking industry. Integration of the HSE components can be arranged around the Safety Manual as a centrepiece, as illustrated in figure 7.

The GMB Ship Recycling Regulations [4] have been heavily criticized [5] for being non-effective. In short, adding more penalty clauses to regulations that can not be upheld, will not be meaningful.

Instead, a collaborative regime with incentives will be needed. An open safety reporting culture encourages learning from mishaps, to the benefit of the entire industry.

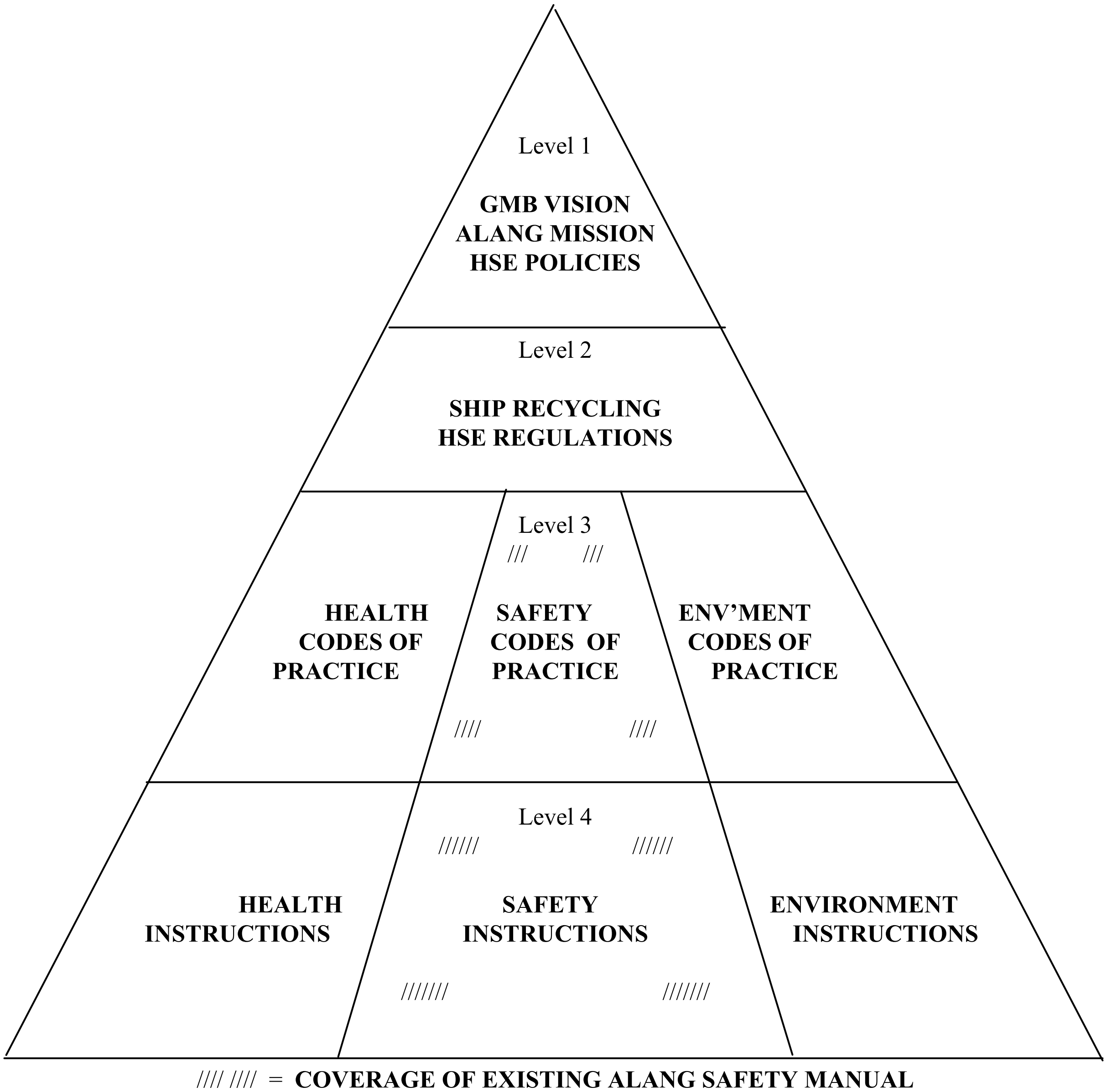

Figure 7: Integrated HSE Management System

6. NOVEL INFRASTRUCTURE CONCEPTS

To attract a better share of the demolition market, and to comply with upcoming international standards, alternative facilities need to be developed. Two novel and economical concepts are presented.

This Early Vessel Separation Method has a good potential to become an acceptable and profitable ship dismantling method for conventional cargo vessels.

First a ship will be pre-cleaned. Then it is cut into two parts, whilst afloat, with the aft part supported by a floating drydock, see figure 8. The front part contains the cargo holds and tanks, consisting almost entirely of steel. This part can be sold to an existing ship dismantling facility, pulled up the beach and dismantled in the conventional way, with negligible pollution.

The aftship part consists of the engine room and the deckhouse, containing both valuable equipment, non-ferrous metals, and polluting substances.

One concept is based upon early separation of the vessel in a front and aft part. The aftship will be supported by a floating drydock. Two separate dismantling processes can then be performed in parallel, each with its own appropriate facilities and safeguards.

This part can be supported in a floating drydock after the separation. The dock is then shifted to a quayside yard. This yard will have industrial facilities for dismantling, such as power, cranes, pumps and pollution containment facilities. Valuable ships' equipment can then be taken ashore in one piece, fetching better market prices.

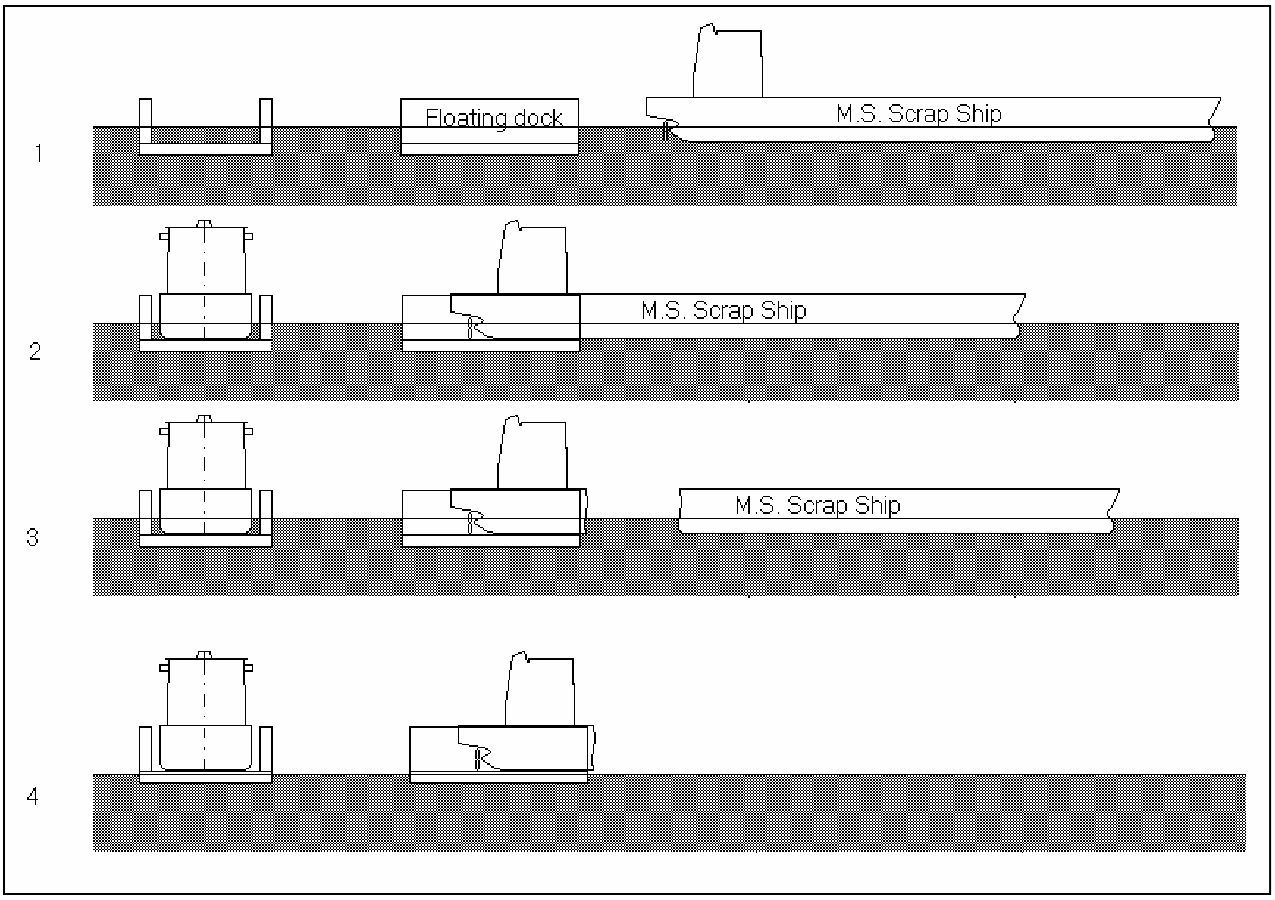

Figure 8: Early Vessel Separation Method, side views and cross sections

7. STAGEWISE DISMANTLING CONCEPT

Another concept for stagewise ship dismantling entails a common jetty for pre-cleaning and rapid first-stage dismantling of multiple ships. Only deckhouses and engine rooms will be dismantled there, into transportable big blocks of 20-30 T each. These blocks are distributed over processing yards at the jetty base. The steel hulls will be towed away by tugs and be broken on beachside yards along the same coast. These scrapyards will have mechanized facilities, improved logistics, safer working practices and better environmental protection.

Upon arrival of a ship, a full investigation of waste materials is carried out on board. Each vessel is relieved of all fuel oil and pumpable oily waste at a dedicated Oil Reception Facility nearby. Next, the ship is shifted to the pre-cleaning and dismantling jetty.

These yards will have a higher throughput of processed materials and ships' equipment than presently achieved in the trade. Their layouts make efficient use of space for processing, segregating, and intermediate storage. They are equipped with adequate material handling and transport facilities.

The stagewise dismantling method requires only moderate investments. Through increased productivity and additional sales revenues this new facility will be competitive to current low-grade shipbreaking operations. As it offers compliance to upcoming international requirements it may capture an attractive market share.

Many suitable coastal locations can be found for establishing novel infrastructure for ship dismantling. Funding offered through sales of first-class ships to qualified contractors will be an incentive to the ship dismantling industry to attain higher standards.

Pre-cleaning of harmful solids, fluids and gases is a vital condition to comply with upcoming international legislation. The jetty will be sited in a tidal area and can be constructed of invulnerable and relatively cheap main elements: an earthen bund and flat-bottom steel pontoons, see figure 9.

Once ship and material handling facilities are established, the dismantling operations can be conducted at an efficient scale. Safety and environmental standards will be met, with a maximum re-use and recycling of materials and equipment. For handling larger deckhouse modules and engine room equipment, a floating crane may be used. Feasibility analysis shows that a four-berth jetty will keep 6-7 dismantling yards on land fully occupied.

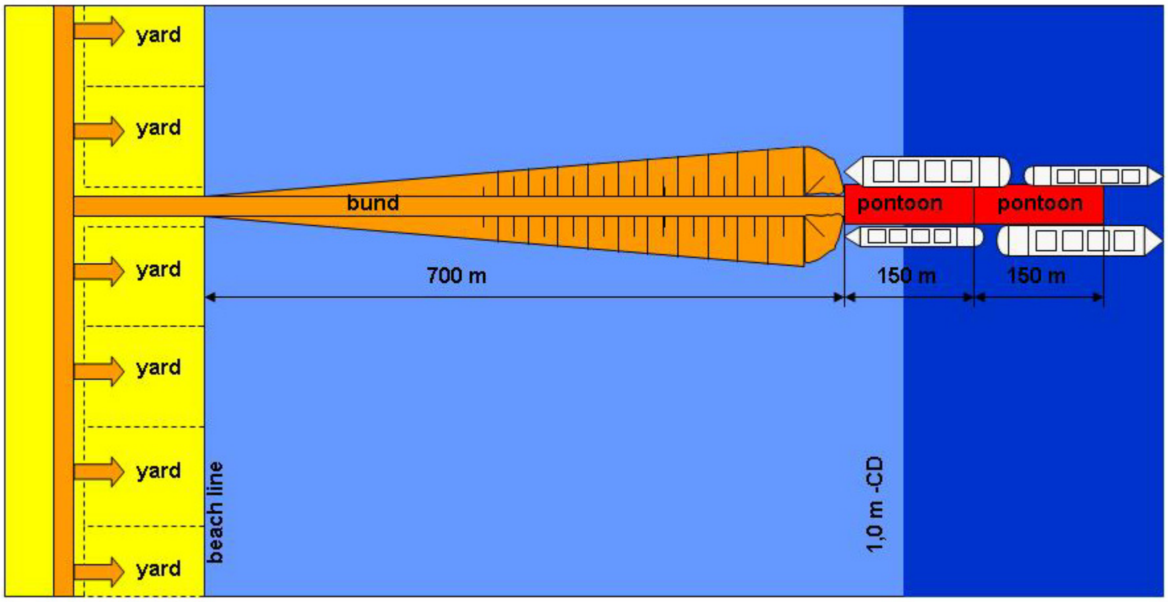

Figure 9: Stagewise ship cleaning and dismantling facility, plan view on coast

8. CONCLUSIONS

Initiatives for safety improvements in the Indian shipbreaking industry have resulted in the Safety Manual and a safety training course for Alang. An industrial Oil Reception Facility and jetty is an economical proposition for shipbreaking yards, and beneficial to safety and environment. An Integrated Management System is recommended for the shipbreaking industry. Improved infrastructure facilities for ship dismantling need to be developed. Two novel and economical concepts are presented. Many suitable coastal locations can be found for establishing new types of infrastructure for ship dismantling.

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5. ABDI, R., 'Ship Breaking at Alang, Problems, Initiatives and the Way Ahead', *IIAS/Greenpeace Seminar on scrapping ships in Asia and the liability regime*, Amsterdam, June 2003.

10. WEBSITES

For a balanced view on issues and working practices in shipbreaking, a field visit to breaking yards in South Asia is highly recommended. The next best thing is to consult the various public sources of information on the internet. News on shipbreaking spreads fast around the globe in today's well-connected world. Table 3 collects a non-exhaustive list of useful websites covering international and local aspects of ship dismantling.

www.shipbreaking net
www.clarksons.net/sin2003
www.alangtoday.com
www.gmbports.org/alangship
www.vibrantgujarat.com/pp/pd006
www moxon net/india/alang
www.basel.int/ships
www.imo.org
www marisec.org/recycling
www.ilo.org/safework/shipbreaking
www.greenpeaceweb.org/shipbreak
www neetc.iup/edu/cgi-bin/biblio.pl
www marad.dot.gov
www.ecodock nl

Table 3: Useful websites on ship dismantling

Some of these sites provide stakeholders with an open platform for exchanging information and airing of views. This modern forum has become a facilitator for tracking international developments and raising of standards in the global quest for a safer ship dismantling industry.

11. AUTHOR'S BIOGRAPHY

Martijn van Wijngaarden is an independent marine consultant, now based in The Netherlands. This paper reflects his field experience in India, where he was based until last year. In his career, he has served maritime and energy industries across Europe and Asia, in various capacities. For two years he has been associated with shipbreaking activities in India. He examined partially dismantled ships on the Alang beach, prepared the Alang Safety Manual and analysed the feasibility of an Oil Reception Facility. He visited the Darukhana yards in Mumbai port and the wet dock facilities in Pipavav port. Based on his fact-finding missions, and against the backdrop of international developments in ship recycling, he expresses his personal views on the way ahead for the South-Asian ship dismantling industry.

SHIPLIFT AND TRANSFER SYSTEM TECHNOLOGY

M Palmer, Rolls Royce Marine Electrical Systems, UK

SUMMARY

Pivotal to the process of ship recycling is the provision of docking facilities that can safely and cost-effectively remove the ship from the water safely and efficiently. This paper considers various docking systems and the impact on the suitability of these systems by current and proposed requirements to implement environmental and safety legislation. Shiplift systems are recognized as a proven and favoured system for the launch and docking of ships within their capacity range in association with shipbuilding and ship repair. Improvements in design and technology now permit shiplift designs of even greater capacity. The paper considers the use of shiplift technology to facilitate cost-effective compliance with the requirements for ship recycling.

1. INTRODUCTION

Ships are generally constructed on land prior to launch. Periodically, in service they must be removed from the water periodically for maintenance and repairs. Finally they must be dismantled at the end of their working life. A system is required to transfer the ship between the water and land for all of these activities. Whilst afloat, the buoyancy acts normal to the hull and is well distributed over its hull form. Any system for transfer between the water and land must aim to simulate the support to the hull that is provided to the ship whilst afloat.

For the purposes of this paper, docking is defined as the means of isolating the underwater portion of the ship from the afloat condition to permit inspection, maintenance, repair and recycling. Additionally, the docking system may function as a launching system for new-build.

Usually, the single most capital-intensive asset in any shipyard is the docking facility. Conventionally, in order to maximize its use, only activities that must be carried out in a dry environment are undertaken in the docking facility. In turn, this places increased reliance on the provision and use of afloat/alongside facilities (wet berths). Hence the traditional shipyard incorporates significant water-frontage and/or piers and jetties, and maximizes the volume of work that can be conducted afloat.

This paper summarizes the various docking systems. The shiplift concept and associated transfer system is considered in more detail as a solution with the flexibility to conduct any or all of docking requirements.

2. TYPES OF DOCKING SYSTEMS

Generally speaking, docking systems can be categorized into five types:

- mobile marine hoists
- slipways/marine railways
- floating docks
- graving docks
- shiplifts.

It is recognized that other innovative docking systems have been designed and built. However, these are generally derivatives of the types listed above

Each system has its place in the world docking market.

For general use in small boatyards, the optimum system is probably the Marine hoist (basically, a mobile overhead travelling crane or straddle lift). For docking, the vessel enters a narrow wet dock. The Marine hoist has wheeled bogie units which span the dock sides, with lifting slings which are lowered into the water. When lifted out of the water and supported by the slings, the self-propelled Marine hoist has flexibility of movement to transfer around the shore area to any free location. Marine hoists combine the capabilities of ship recovery and launching with that of vessel transfer. Generally, they are limited in capacity to about 500 tonnes, albeit there are a limited number in service of higher capacity. However, at these higher capacities there is a significant potential hazard to the vessel structure when using straps to support the hulls of larger and longer vessels. Additionally, the high cost of good quality foundations slab for the transfer area of these larger installations can result in a high overall capital cost.

Marine railways consist of structural docking cradles that move on rollers or wheels over inclined groundways (slipways) which extend into the water from the shore. The docking cradle is normally connected to a winch system that hauls the ship out of the water up the slipway for docking or allows the ship to move down the slipway for undocking. They are generally considered to be limited in capacity to about 8000 tonnes. Marine railways are well-suited to solve the problem of docking in an environment where there is a large difference between the yard elevation and the water level. End-haul groundways project at right angles to the shore-line; side-haul groundways are parallel to the shore-line. The side-haul feature has an important application where there are river or harbour restrictions which force the vessel to be handled parallel to the shore-line. The docking operation in association with a marine railway occurs some distance from the shore-line, with the potential for wind and/or current to impact adversely on the activity.

Furthermore, the lower part of the groundways and the lower sheaves are permanently immersed in water inhibiting maintenance and requiring periodic replacement.

Floating docks are barge-like floating structures with sufficient displacement, dimension and stability for physically lifting a vessel from the water. The through-life operating and maintenance costs are comparatively high (including the requirement to self-dock for periodic survey with extended periods of down-time at regular intervals). Generally, a separate floating dock is required for each vessel to be docked, albeit multiple vessel dockings can be conducted subject to the application of stringent controls. Their principal advantages are the minimal requirement for supporting civil works and their portability. However, if designed for use in conjunction with transfer ashore stability during transfer between the floating dock and shore requires careful consideration, special arrangements and a skilled operating team. Floating docks with capacity for ships of more than 150,000 tonnes have been built.

Graving docks are large fixed basins built into the ground adjacent to the water's edge. A watertight gate is closed after the ship has been floated into the dock and positioned above the hull blocking supports that will support it in the dry condition. Once the gate and ship are in position, the water is pumped out, causing the vessel to settle onto the blocks. Docking operations are relatively slow and maintenance costs become high as the docks grow old. This is the only system which does not physically lift the ship from the water, with the ship remaining in a below-water-level chamber once docked. Generally if is not cost-effective to consider transfer arrangements. However, graving docks have the exclusive market for ships in excess of the capacity of the largest floating docks.

Shiplifts are mechanically operated elevators for lifting the ships vertically from the water, to a level where they can be serviced or transferred onshore for maintenance, repair or recycling (figure 1).

Until the 1950's, the installations conceived and built were limited in size and they proved to be slow in operation.

The principal shortcoming in designs to that date was the inability to co-ordinate multiple lifting mechanisms. In small installations, limited success was achieved by using a common continuous shaft driving all of the hoisting drums.

In 1954, Raymond Pearlson, an American Naval Architect, achieved success with a design, which combined three basic but crucial elements:

- Robust hoists with wire ropes and synchronous electric motors, which operate at a constant speed regardless of the load
- An articulated structural steel platform, which provides a compliant lifting surface and allows loads to be accurately measured
- A load monitoring based control system to protect the vessel and the shiplift from overloads.

Today's shiplift design (figure 2) is based generally on the interaction of the critical features associated with Pearlson's design.

The shiplift combines most of the advantages of the other systems, avoids some of their shortcomings and provide some additional benefits. In particular they are specifically designed for use with transfer systems and are highly suited to this arrangement.

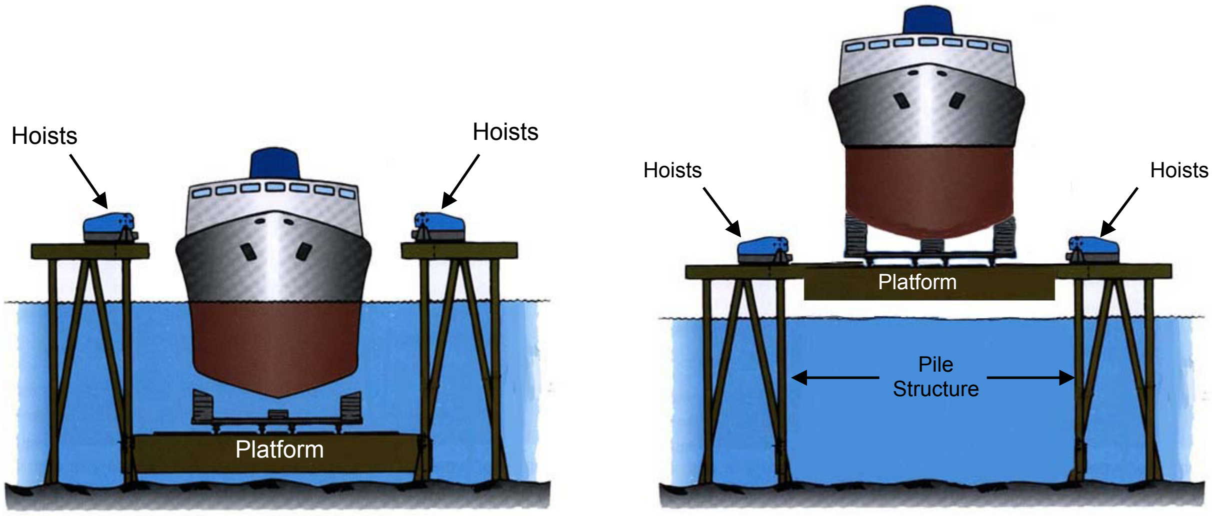

Figure 1: Syncrolift Concept

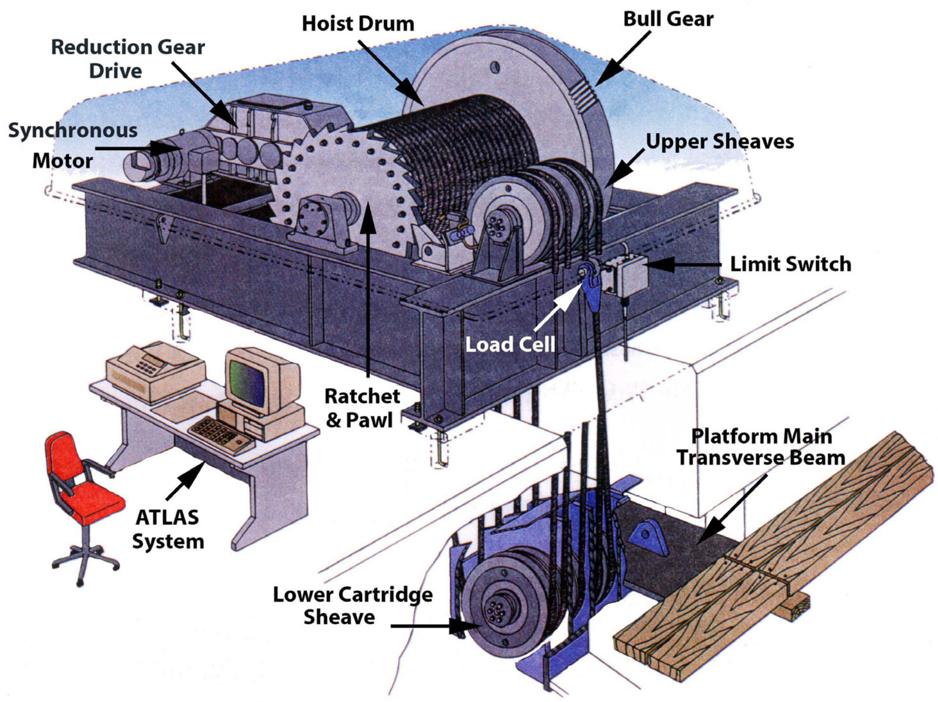

Figure 2: Syncrolift – Main Components

3. SHIPLIFT FEATURES

The shiplift is a steel structural platform, generally wood-decked, capable of raising or lowering whilst supporting the weight of a ship. The ship can be docked either directly on the platform using blocks placed on the structure of the platform, or via a modular transfer system with blocks mounted on the transfer cradle modules. The blocks are configured to the shape of the hull as with any drydock system.

The shiplift platform is supported by the mechanical lifting mechanisms (generally called hoists), which are located on pile-supported piers, either side of the platform. These piers can be increased in width cost-efficiently in order to provide alongside wet berths, which will further reduce the extent of water frontage.

The design and construction of shiplifts is governed by regulatory body rules or codes such as the 'Lloyds Code of Practice for Lifting Appliances in a Marine Environment'. This Lloyd's Register (LR) code has become the industry standard and is used for the vast majority of installations worldwide.

There are options for approval of design plans, certification or classification according to the Code:

- Plan approval provides LR independent review and approval of the structural, electrical, and mechanical drawings for the shiplift and / or transfer system
- System certification provides plan approval; together with survey and certification of material, manufacture / fabrication, installation and testing of the equipment and the completed platform and / or transfer system.
- System classification provides plan approval and system certification; together with periodic in-service surveys and tests.

3.1 ARTICULATED PLATFORM

An articulated platform, in conjunction with the docking cradle, minimizes point loading along the hull as it is lifted from the water.

Supporting a ship along an articulated platform can be compared with a human body lying on a mattress with independent springs, rather than on a hard board. The compliance of the articulated platform best simulates the waterborne condition.

The articulated design also converts the platform from an indeterminate continuous structure into a determinate simple structure where each member carries its share of the load and transmits that load to respective hoists. High point loads are reduced and support is greatly improved. This design also ensures that the shipload is distributed determinately to the respective hoists; therefore the load transferred to each hoist is an accurate reflection of the ship- loads supported by that hoist.

3.1(a) Structure

Typically, the platform structure is a grid of steel beams framed transversely such that hoist pairs can support the structure from the side piers. A series of Main Transverse Beams (MTBs) are spaced along the length of the platform. Each MTB is supported by two hoist assemblies. The MTBs support intermediate platform structure comprising intercostal Longitudinal Beams (LBs) and Intermediate Transverse Beams (ITBs).

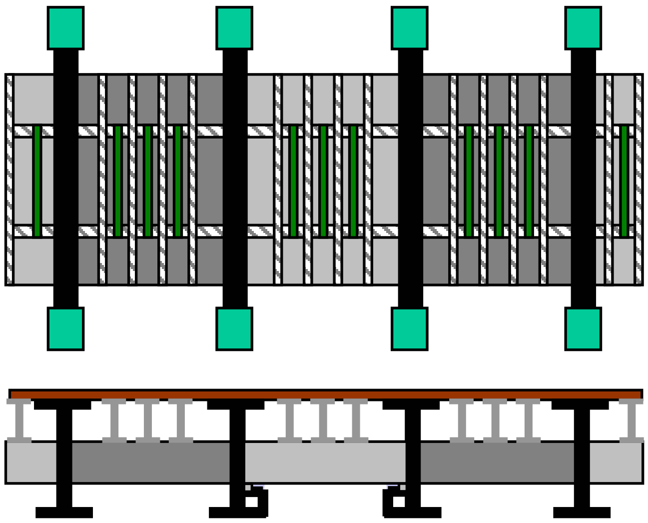

Figure 3: Typical Platform Structure

Decking covers the steel gridwork thus created. The platform is connected to the hoists by wire ropes via upper and lower sheave sets (figure 3).

It is the design of the MTB/LB connections that provides the articulation, which in turn minimize the bending and torsion moments along the platform to adjacent MTBs.

The platform can be designed and constructed in two or more sections allowing the options either for the platform to operate as a single unit or to be decoupled for independent operation of each section.

3,1(b) Secondary Benefits of Articulated Design

The modular design of the articulated platform allows modular fabrication of the shiplift platform. This means fabricators can build the platform in a controlled environment such as a fabrication shed. Installation on-site onto the support piers requires no structural welding. It can be achieved using crane(s) to lift the modules in serried into position, or even more efficiently floated into position using barges.

Furthermore, subsequent expansion in platform length and/or capacity is also facilitated by the articulated design and it's modular construction. New length is simply achieved by adding more platform modules and hoist pairs.

3.1(c) Other Platform Design Features

Articulated platforms are periodically designed with dual capacity, whereby the shoreward section (say one third of the platform length) is designed and constructed for greater capacity (MDL) than the seaward end. This is of particular benefit with larger installations. Ships are then docked stern first so that the heavy section of the ship (generally the aft portion of the ship) is supported and transferred over the shoreward section of the platform only. The majority of the ship is supported by the lower capacity seaward section of the platform. The dual capacity design can achieve significant cost savings in steel weight and a reduced number of hoists.

Platforms are generally designed for end or longitudinal transfer. However, in shipyards where space or other constraints exist, platforms have been designed and installed for direct side or transverse transfer. In this instance, the length of the ship is transferred from the platform centre sideways and over the hoists. Accordingly, the platform design and construction must take into account the off-centre loading that will occur during side transfer and the hoists must be partially or fully recessed into the pier to allow the ship to pass over them.

3.2 HOISTS

The design of the electro-mechanical hoists is robust but highly refined. Syncrolift shiplifts utilize an AC synchronous electric induction motor to drive each hoist through a gearbox driving a bull gear, which is integral to the wire rope drum. The drum is grooved to accept the full length of the wire rope wrapped on the drum in a single layer. The hoists operate in perfect synchronization just as though the drums were mounted on a continuous common shaft. The motors operate at the same speed regardless of load on the hoist. That speed is a direct function of the cyclic characteristics of electric power provided. As long as all motors receive their power from the same source, they must run at the same speed.

Alternative lifting mechanisms have been provided in limited number, including hydraulic driven hoists and hoists driven by asynchronous electric motors. However, these are prone to problems associated with non-synchronous lifting and / or slow or uneven lifting action.

The fundamental requirement to achieve synchronised lifting at all lift points regardless of load variation is also a requirement of the Lloyds Code. The synchronous AC motors achieve this without the need for complex variable speed motor feedback control systems that is otherwise required and provided in a small number of installations.

3.3 WIRE ROPES

Wire ropes designed and manufactured specifically for shiplift application are high strength, suitable for multi-part reeving onto sheaves and hoist drums, and have a long service life in a marine environment. They are generally Langs Lay and opposite-handed to suit the hoists, which are mirror-imaged on opposite sides of the support piers. They are consistent in dimension and characteristics, making them well suited to synchronous lifting.

The use of chains in conjunction with multiple jack lifting mechanisms has not proved successful in shiplift application with only a handful of installations. The principal disadvantages of chains are the slow speed of lift, the difficulty to achieve synchronised lifting, and the isolated wear areas on the chain links caused by the unusual contact of the chain by the lifting device.

3.4 LOAD MONITORING

Load monitoring is required by Lloyd's Register in order to help ensure the safety of the shiplift system. Load monitoring must read and monitor the load on each hoist. This is done using strain gauge type load cells including a transducer and signal conditioner. Most load cells are incorporated into the pin attaching the wire rope to the hoist frame. The shiplift control system must continuously monitor the individual hoist loadings. A Programmable Logic Controller (PLC) constantly monitors the signal conditioners, scales the values and sends the results to the operator's workstation where they are then displayed at the control console. The control system is fail-safe such that a hoist overload at any hoist will shut down the entire shiplift. Once the overload is detected and corrected, the operation can continue.

3.5 SHIPLIFT CONTROL SYSTEM

The shiplift control system generally consists of one or more Motor Control Centres (MCC) and an Operators Work Station (OWS). The MCC houses the PLC unit, breakers, switches, motor starters, control power and transformer. The OWS generally consists of a custom operation keypad, a CPU, monitor and printer. The shiplift operations are normally controlled from the OWS, which provides user-friendly single point operation. However, the apparent simplicity of a custom keyboard incorporating the start, up and down and stop operating switches is supported by modern computer technology linked to a colour video monitor that can display information of tremendous value during lifting and lowering operations. The control features and information displayed will generally include:

- Display of individual loads and load distribution profile
- Calculation of vessel Longitudinal Centre of Gravity (LCG)
- Automatic high and low load detection and trips
- Automatic high and low current detection and trips
- Analysis of differential transverse loading
- Analysis of wire rope efficiency

4. TRANSFER SYSTEMS

The benefit of a shiplift is maximized when combined with a transfer system for moving vessels on shore for safe and controlled work activities. The investment in a shiplift is best returned by the provision of as many shore berths as the business prospects and real estate will justify.

One shiplift with say 5 dry berths on shore is the equivalent of 5-6 slipways floating docks ,graving docks.

An efficient and safe transfer system is needed to realize this benefit. The most popular is the rail-mounted system, which moves the vessel on shore over a grid of transfer rails using low profile, high capacity ductile iron or steel wheels. This arrangement restricts the loads imposed on the civil works to directly under the rails.

Other systems using hydraulic walkers, rubber tyres, air or fluid bearings, or rollers have also been used. These systems do not need rails and are ideally suited to shipyards with limited space or unusual layouts.

4.1 RAIL-MOUNTED TRANSFER SYSTEMS

A grid of rails is arranged to suit shipyard operations and to provide the desired number of shore berths in the space available. The simple in-line transfer berth is the easiest to provide, simplistically it involves a set of rails on the shiplift platform and a matching set of rails onshore. Using a wheeled cradle upon which ships can be directly docked, they can be very quickly moved ashore, leaving the platform free for additional dockings. Extension of the rails on shore enables more ships to be transferred to the shore berths thereby created.

Once the requirement has been identified to have more than the initial single in-line position, a choice must be made between a "single-level" system and a "two-level" system.

Figure 4: Dual Level System at Astican, Las Palmas

4.1(a) Two-Level Transfer Systems

When there is sufficient space and the yard arrangement is suitable, the two-level transfer system is usually selected (figure 4). This is because its capital cost is competitive with most other systems, it is easy and fast to use and the through life costs are the least expensive by comparison with the single-level alternative.

The two-level system consists of two basic elements – End Transfer Cradles (ETCs) used for longitudinal transfer and a Side Transfer Carriage (STC) used for transverse transfer. ETCs are structural steel modules supported by ductile iron wheels. Docking blocks are mounted on the modular structures upon which the ship can be directly docked once in position on the shiplift platform. After the shiplift is raised to shipyard rail elevation, it is ready for longitudinal transfer from the shiplift platform to the selected shore berth.

The STC is also a wheel-supported structure, which travels laterally in a recessed area of the shipyard such that its upper surface, equipped with rails which match the gauge of the ETC, are at the same level as the yard rail elevation.

For transfer, the ship, on its ETC, is towed from the platform onto the STC. Once in this position the STC is moved laterally to align with rails in the selected shore berth, enabling the ship to be easily towed into its berth. It remains on its ETC during the course of repairs. After repair/maintenance, the ship can be moved easily and quickly back to the platform for launching.

A separate prime mover (which can be a yard utility vehicle like a mobile crane or a designated vehicle such as an airport tow vehicle) provides longitudinal movement for transfer, whilst winches usually power the STC.

4.1(b) Single-Level Transfer System

Where space is limited and in shipyards involved in modular ship construction, single-level transfer systems can provide the optimum solution. Single-level systems operate without a recessed area (figure 5). The rails in the grid are all at the same elevation. With this arrangement, vessels can be parked in the shore berths or they can be parked temporarily within the side-transfer area.

Figure 5: Single Level Transfer at US Coastguard

Single-level transfer systems can also be offered in many different design arrangements and operational variations. In some cases, they may serve as more than just ship transfer devices, being used also for moving and aligning partial ship modules during the construction or conversion process. Common to all single level transfer systems is a bi-directional grid of rails. At the intersection of each rail, a crossover is provided. This crossover permits the wheels to traverse the crossing while maintaining their share of the vessel load. The crossovers also allow the wheels of the transfer system to be rotated 90 degrees for transfer in the new direction.

Single-level transfer systems generally consist of either wheel mounted docking and transfer cradles with rotatable wheel housings, or docking cradles with separate 4-wheel transfer trolleys. For either system, hydraulic lifting cylinders or mechanical screw jacks must be used to unload the wheels prior to rotation.

Single-level transfer begins in the usual fashion by docking the ship on the modular cradles. The ship, on its cradles, is then towed to the side transfer area of the rail grid until the wheels are over the crossovers. At that point, wheel rotation occurs in one or two ways depending upon the type of system.

The docking and transfer cradles with rotatable wheel housings use portable jacks to unload the wheels in groups for rotation. Once rotated 90 degrees to align with the second direction rails, lateral transfer can begin. The ship on its cradle is then moved laterally to align with a shore berth. Once in alignment, the wheels are again rotated to permit end transfer into the work berth.

The docking cradles used with separate 4-wheel trolleys generally have the jacks built into the trolleys. Once in position, the jacks lift the trolley clear of the longitudinal rails, and the entire trolley is rotated 90 degrees. It is then lowered back down on the transverse rails to be ready for lateral transfer. Upon reaching and aligning with the shore berth, the operation is repeated so the trolleys again rotate and lower onto the end rails for final transfer into the work position.

4.2 NON RAIL TRANSFER SYSTEMS

Systems that avoid the use of rails entirely have been and continue to be developed as an alternative to rail-mounted systems. These systems, with omni-directional movement, provide a solution when the shipyard layout or other considerations preclude rectilinear transfer on rails. The principal advantage is their flexibility because they are not confined to a fixed grid of rails. Vessels can be parked in any location within the shipyard with a sufficient strong slab or surface. There is also the savings in not having to supply rails. The principal disadvantage is that generally the entire shipyard must then be able to support the loaded transfer system on it's slab / surface.

4.2(a) Dual Walking Beams

The Dual Walking Beam (DWB) system was developed to meet the requirements from shipyards and offshore construction yards for a trackless transport system, with the ability to move heavy sections and modules on the building site and to perform load out of finished modules on to barges.

The first DWB units were used to load out offshore modules.

The French Navy uses DWB units for the transfer of nuclear submarines prior to launch.

Each DWB unit comprises 3 major parts:

- The load support structure:
    - Contains a hydraulic top cylinder for support of the load. The cylinder is resting in a spherical bearing to allow for specified tolerances and irregularities of the ground surface.
- The walking beam unit:
    - Contains hydraulic cylinders for lifting, lowering and horizontal movements as well as allowing for turning of the load and for the side shift motion (without load).
- The rail structure:
    - Contains an integral rail system for movement and guiding of the walking beam unit in the different motions.

The DWB units will move across any smooth to rough graded surface that has adequate bearing capacity, including gravel or soil. They can traverse slight grades and steps. They are used with docking cradles and can be set up in a hydraulic fluid bed system similar to that described above. However, they cannot be submerged and are therefore removed from the shiplift prior to lowering into the water.

4.2(b) Multi-Wheel Transporters

These self-propelled units using rubber tyres have been designed primarily for transfer of large heavy units either within the shipyard environment or for transfers between shipyards or other locations. The transporter uses a series of double-tyre, rotatable assemblies to support a hydraulically powered flat or other surface used to raise or support the load or docking cradle. This system has the advantage of being omni-directional as well as multi-purpose.

Its principal disadvantages are that it is heavy, high in profile and its large wheelbase is difficult to accommodate on a shiplift. However, new systems coming to market are designed for shiplift use and show promise.

4.2(c) Air or Fluid Bearing Systems

These systems have found limited applications in shipyards. They are often useful for moving loads or small vessels where omni-directional transfer is desirable. Modular 'pallets' are arrayed beneath a cradle in a pattern that aims to equal the distributed weight of the vessel. When energized with fluid or compressed air, the pallets lift the load and fluid/air bleeds out from the cushion, providing a thin film upon which the load floats. A near frictionless surface permits the load to be moved with minimal effort. However, their use requires a smooth and clear transfer surface, which is usually not practical in shipyard environments. Furthermore, a ramification of the near frictionless movement is the effect of wind loads and momentum. The vessel must often be constrained and controlled during transfer. Maintenance is high and they rarely find favour where other systems can be used.

4.2(d) Roller Systems

These systems range from the simple use of pipes or logs, in conjunction with basic cradles to fully engineered 'caged rollers. They are slow and difficult to use. Generally, their use is limited to small vessels because the coefficients of friction require towing draw bar pulls in the range of 4-8% of the vessel weight.

5. SHIPLIFT APPLICATION FOR RECYCLING

Ship recycling is the process by which materials onboard a ship, along with those comprising its structure, are recovered for further use. This includes breaking the ship, recovering equipment for use in alternative environments, and selling the scrap metal for profit.

The challenge is disposing of these inoperable ships in a safe, environmentally friendly, and cost-effective manner. Cutting apart a ship is in itself a hazardous operation. Furthermore, older ships are frequently contaminated with hazardous materials such asbestos and PCBs. The international attention given to these hazards over the last few years has resulted in a push to devise safe ways of dismantling ships and recycling their materials.

The principal concerns are working practices, health & safety and environmental protection standards which are considered to be unacceptably low by developed world standards.

The generic benefits of the shiplift and transfer system provide not only a cost-efficient solution for removing the ship from the water for recycling but also facilitate improvements in all of the above concerns.

The principal benefit is the ability to quickly and safely lift the ship from the water. However, equally important are:

- The speed and ease of transfer. Ships can be lifted and transferred to a shore berth in less than one and a half hours. Furthermore, once transfer is completed, the shiplift platform is available for another docking, whereas with a floating or graving dock, once occupied, the facility is tied up.
- The ability to maximize the capacity of a yard. Typically, some of the smaller shiplift units will be operated 6 – 10 times daily. One Syncrolift shiplift platform in Dubai Ship Docking Yard services 40 shore maintenance berths.
- The shore berths facilitate improved access for personnel and equipment and for the subsequent transfer of materials from the berth for recycling.
- Shiplifts minimize space requirements at the waterfront. By removal of the ship away from the docking medium, activities are carried out in an environment more conducive to minimizing the discharge of hazardous materials into the water.
- Unlike most other docking systems, there is no requirement for a prolonged periodic shut down period for self-maintenance. A shiplift spends most of its time out of the water.
- The modular design of an articulated platform permits future expansion of the original installation through life to achieve increased capacity and/or increased vessel docking length.
- One shiplift with its associated transfer system and shore berths takes the place of several slipways, floating docks, and/or dry docks.
- The system is applicable equally to new build, ship repair, ship recycling or a combination.

6. SUMMARY OF SAFETY CONSIDERATIONS

- Simplicity of concept
- Articulated platform minimizes potential for overloading of the ship and platform structure.
- Load-monitoring at all hoists with high and low load cutouts eliminates overload of system design capacity.
- Electro-mechanical hoist design includes motor brake with fail-safe back-up ratchet and pawl on drum.
- Control system incorporates a range of fail-safe cutouts providing automatic system shutdown in the event of component failure.
- Benefits of nuclear related applications applied to all facilities
- Lloyds Code of Practice sets out design and construction safety standards

7. CONCLUSION

This paper has provided an overview of docking systems and has discussed the principles of shiplift and transfer system technology in more detail.

With more than 45 years of experience, the shiplift system is now well proven for naval and commercial ship-repair and new-build applications worldwide.

The system can be applied effectively for ship recycling, particularly of the facility is intended to carry out a combination of ship recycling, new-build and/or ship repair.

8. REFERENCE

Lloyds Code of Practice for Lifting Appliances in a Marine Environment'

9. AUTHORS BIOGRAPHY

Mike Palmer is the Business Development and Marketing Manager for Rolls Royce Marine Electrical Systems, into which Syncrolift Inc was integrated on 2 May 2005 in order to enhance Rolls Royce capability and capacity in this specialist market.

Prior to joining Syncrolift Inc in 1997, he completed a career of 35 years in the Royal Navy, culminating as the Senior Hull Engineering Officer. Appointments included sea service in HMY BRITANNIA and a range of engineering, support and management shore appointments for the operation, maintenance and repair of naval warship hull structures, equipments and systems.

In 1989, he was appointed to manage the docking facilities at the Clyde Naval base and he was responsible for bringing into operational use the Syncrolift, which was designed and constructed with the capacity for the new Vanguard class of SSBNs. He is an Associate Member of RINA and was awarded the MBE in the 1993 New Years Honours List for services to Naval Marine Engineering.

RECYCLING OF MARINE STRUCTURES AND SHIPS IN THE UK

P M Stephenson, Able UK Ltd., UK

SUMMARY

This paper has been written to support a presentation at a Conference organised by the RINA on the 5th & 6th May 2005 in London, entitled 'Recycling Ships and other Marine Structures'.

The paper provides an overview of ABLE's experience in recycling, a review of requirements for a green recycling facility, details of ABLE's purpose-developed facility TERRC, their experience in recycling marine structures and ships and a summary of wastes that are a main concern. Development of ABLE's TERRC facility has been ongoing since ABLE purchased the site in 1996 and it has been used for the load-in of numerous redundant structures from the oil and gas offshore industry. The specifications that ABLE have developed for recycling complies with all known current World requirements and recommendations as at the date of this paper.

This paper also provides an update of the UK Government's current position with regard to ship recycling and details of the situation that developed with the ABLE/MARAD Ship Recycling Contract, due to scaremongering, including notes on lessons to be learned from the experience.

"RECYCLING MARINE STRUCTURES INCLUDING SHIPS CORRECTLY PROVIDES A POSITIVE BENEFIT TO THE ENVIRONMENT"

NOMENCLATURE

ABLE	Able UK Ltd
BAT	Best Available Techniques
BPEO	Best Practicable Environmental Option
COMAH	Control of Major Accidents and Hazards
EA	UK Environment Agency
EFRAC	The Environment, Food and Rural Affairs Committee
EIS	Environmental Impact Statement
EPA	US Environment Protection Agency
FOE	Friends of the Earth
LSA	Low Specific Activity
Marine Structures	All types of structures ships, barges, vessels, platforms, etc that operate or travel in the marine environment
Ships	All types of ships, barges, vessels, etc
TEAG	TERRC Ecological Advisory Group
TERRC	Teesside Environmental Reclamation & Recycling Centre
UK	United Kingdom

ASSUMPTIONS

The following assumptions have been used when writing this paper, although the Author is aware that some points are not accepted/agreed by some parties.

- That a ship when received at a dismantling facility is classified as waste.
- That scrap material, even though it is to be recycled, is classed as waste.

Please note that the Author does not agree with the above assumptions but thought it prudent to make such assumptions when writing this paper as these reflect the classification by the UK Environment Agency.

This paper was written particularly for operations in the UK however the same principles should be applied (and the same regulations should be applicable anywhere in the world) to achieve the objective of recycling marine structures and ships to the BPEO.

Figure 1: TERRC, Hartlepool showing 25-acre dry dock with 4 MARAD ships 48,000 ld and 2 UK vessels.

1. INTRODUCTION

This paper is aimed particularly at ship recycling, the majority of the same practices and principles apply to marine structures but theses are mostly recycled in an acceptable manner in the dry in the UK whereas the majority of ships are being recycled in an unacceptable manner in other parts of the world, such as Asia. In this paper I have therefore, in the main, referred to ships.

2. WHY ARE WE HERE?

The reason for the spate of activity and high profile of the ship recycling industry has occurred because of the following main reasons:-

- The majority of ships are **not** being recycled (particularly in Asia) in a manner that provides the BPEO and, in particular, they are being dismantled in a way that is detrimental to people's health and safety in both the local and world environments.
- Due to scaremongering (caused in the main by Friends of the Earth in the UK) when ABLE brought ships from the US to the UK for recycling even though it was in the best and greenest facility available in the world and **provided the BPEO**.
- Acceptance by the shipping industry in general that the existing third world practices used for ship breaking cannot continue.

3. ABLE UK LTD AND GROUP OF COMPANIES

The Group which is privately owned has been involved in the construction, dismantling and demolition industry for nearly 40 years, with contracts involving hazardous material management, decommissioning, dismantling and demolition of petrochemical plants, power stations, marine structures and nuclear industry related works.

During this period ABLE have become experienced in all known forms of dismantling and demolition methods including the use of explosives and more traditional methods, innovating and developing new systems, some of which have become accepted practice within the industry. All works are undertaken in a manner that provides the BPEO.

ABLE own and operate four facilities on the River Tees in the UK two of which have been developed for the receipt and disposal of marine structures in a manner to provide the BPEO. The largest facility - TERRC at Seaton Port, Hartlepool - was acquired in 1996 and has also been designed and developed to receive and decommission ships. A new shipyard named Graythorp was developed by Sir William Gray in Hartlepool in 1913 and operated as such until 1970 when it was developed by Laings Offshore as a large dry dock (355m x 285m -6.5m LAT 12.35m water), where large jackets were built for the Forties and Thistle Fields. The last structure constructed in the dry dock (in 1988) was the Ravenspurn Concrete Gravity Based Structure.

The main advantage that the ABLE Group/TERRC offer for decommissioning marine structures and ships is that all recycling is done in a manner that provides the BPEO. Operations are completed by in-house Companies, including hazardous waste removal/processing/disposal, dismantling/disposal of reusable equipment/materials and demolition/disposal of recyclable materials - all of which are undertaken within a dry and stable environment.

The majority of the waste is processed onsite and any material that cannot be reused or recycled is landfilled at the Group's waste disposal facility ('Seaton Meadows'), which is 200m from TERRC and has a capacity of 6,000,000 tonnes, with planning permission until the year 2030.

Since 1985 to date, ABLE have received over 50 No. marine structures and reused/recycled in excess of 98% of all weights received. It is worth noting that the types and quantities of wastes on offshore oil and gas platforms are very similar to those found on ships.

All works comply with the latest quality assurance specifications and recommendations that have been provided to the marine structures and shipping industry worldwide.

In April 2005, ABLE was proud to be awarded the Remediation Management HSSE Diamond Award by BP. This prestigious award covers all of the Western Hemisphere – Europe, Middle East, Africa and Asia Pacific – and took into account leadership, innovation, subcontractor's management and HSSE performance metrics.

4. MARINE STRUCTURES –HISTORY

In 1985, and with the experience ABLE had gained over the previous 20 years carrying out decommissioning (which included large industrial facilities such as power stations, gas works, steel works etc), ABLE became involved in the disposal of marine structures and have since that time successfully reused or recycled over 50 structures from the offshore oil and gas industry (including steel jackets and topsides), becoming the market leader to receive and dispose marine structures in the North Sea with Clients including most major oil and gas producers.

ABLE's first platform modules where recycled at TERRC in 1985.

Figure 2: Load in of a 1,644tonne topside module from a barge (1996)

5. FACILITIES

With the experience ABLE has gained over the 30 year period, ABLE have compiled a list of essential requirements for a decommissioning facility.

To enable the work to be completed in a safe, professional, economic and most environmentally friendly manner, thus providing the BPEO, the decommissioning facility needs to meet the following criteria:-

5.1 LOCATION

- To be situated at a location which can readily work on a 7x24 hr basis without detrimentally affecting the local ecology.
- To be located so that marine structures and ships can be received during poor weather. This will reduce potential risk and energy requirement and avoid transport delays whilst awaiting favourable conditions to gain access.
- To be situated at a location where the delivery does not have to pass other river frontage operations, e.g. working docks etc. (i.e. no inconvenience to third parties and reduces the potential risk of incidents).
- The facility will ideally be located in an industrial area with a good local supply of labour and consumables.
- It should be located a minimum of 2 km from residential areas particularly taking into account the following:-
  - The marine structures and ships may arrive at any time, day or night throughout the year, which may include weekends, holidays etc.
  - Light pollution from floodlights during night-time working.
  - Noise pollution.
  - Ground vibration.
  - It will be necessary for various types of special and hazardous waste to be removed during the operations and stored on site until disposal. This may include asbestos and radioactive contaminated materials and smells may be emitted, e.g. from marine growth.

Figure 3: TERRC Dry Dock – Construction of Ravespurn GBS.

- The facility should be as close as possible to waste disposal facilities, thus reducing the distance of travel, therefore reducing the environmental, pollution and cost implication in addition to further reducing risks.
- It needs to be in a location where a permanent trained and skilled workforce is available locally, thus helping to achieve the BPEO by minimising distance travelled by employees, saving on time and energy thus reducing pollution.
- To be situated where it can receive the necessary constant supply of consumables e.g. gases for processing etc. thus helping to achieve the BPEO by reducing the travel distance for the supplies.
- To be close to waste disposal facilities (not transfer stations) to enable proper disposal of solid and liquid waste materials, with the minimum of danger and inconvenience to the public. In particular, to minimise the distance that needs to be travelled on the public highway. This reduces the risk potential and energy requirement thus helping to achieve the BPEO.
- The facility should be suitably licensed and capable of storing and handling radioactive materials.
- The facility should be located so that materials can be disposed of economically to provide the minimum amount of disruption and inconvenience to the general public, ideally a short distance preferably by sea, river or rail, thus helping to achieve the BPEO.

5.2 ACCESS

- To have deep water unrestricted access to receive marine structures and ships at any state of tide.
- No capacity or impediment restrictions thereby the facility would be able to receive large marine structures and ships.
- The facility needs to have reasonable access to public transport, airports etc and be readily accessible to Clients and third party inspection organisations for quality validation and environmental monitoring, i.e. air, surface and drainage, (to provide comfort to the public) thus helping to achieve the BPEO by reducing the costs, energy and pollution elements from travel and time.
- To be able to berth marine structures and ships without affecting other river users.

5.3 CAPABILITY

To be of sufficient size to allow the safe storage of structures and numerous items and equipment over a period thus achieving the BPEO by allowing maximum re-utilisation of equipment and materials in their existing or refurbished/re-engineered form.

5.4 ENVIRONMENTAL

- Ship recycling might, on first glance, appear to look a simple process in terms of the current recycling methods of beaching vessels in Asia. However, in the US and Europe the business of ship recycling has quite rightly become heavily regulated and consequently more costly.
- Prior to works commencing the facility should have an Environmental Impact Assessment undertaken to ensure that works will not have a significant detrimental impact on the local ecology and to identify any steps that may be taken to reduce any detrimental impacts.
- A base contamination study should also be undertaken to determine if there is any existing site contamination prior to works commencing, so that the operator can prove if necessary that the operations have not contaminated the ground or ground water.
- The facility should have the capacity to carry out other operations and to maximise the re-processing of redundant materials, such as crushing, processing and recycling of concrete ballast for re-use. This helps achieve the BPEO by reducing transportation, energy and pollution and avoids landfilling of recyclable materials.
- To be situated in a location of a market need where the processed concrete and ballast material can be readily sold for reuse.
- To have drainage infrastructure to ensure that all potential contaminated liquids are contained, tested and treated as necessary before disposal so that no contaminated liquids are allowed to contaminate the local ecology.
- Particular care should be taken with regard to any properties that lie downwind of the site to ensure that minimum nuisance is caused from noise and smells that can be atmospherically conveyed.
- The operators should have a transparent open relationship with local authorities and environmental bodies.

5.5 PERMISSIONS AND LICENCES

- The facility needs to have all relevant planning permissions and waste management licences to carry out the operations including processing and storage of all types of wastes including, for instance, asbestos, radioactive and mercury contaminated wastes that may be found in marine structures and ships.

- **CoMAH**

CoMAH Regulations are now being applied at TERRC for the first time in the UK for recycling of marine structures and ships. The CoMAH Report has been written in accordance with the requirements of The Control of Major Accident Hazards Regulations 1999. The prime consideration of CoMAH Report is the identification of dangerous substances, analysis of associated risks and the methods of accident prevention, control and containment within the confines of the Teesside Environmental Reclamation and Recycling Centre (TERRC).

- **Hazardous Substance Consent**

Again Hazardous Substances Consent is now being applied at TERRC for the first time in the UK for recycling of marine structures and ships. This is in accordance with the requirements of The Planning (Hazardous Substances) Act 1990 and The Planning (Hazardous Substances) Regulations 1992. The prime consideration of Consent is the identification of all of the hazardous materials, the manner in which they are kept and their location on TERRC.

- **Discharge Consents**

Discharge consents are required for 3 main effluents; sewage, surface water and treated effluent. The consents must be approved before any effluents (including treated ballast waters) can be discharged from the facility. As with most discharge consents all of the discharges are monitored and tested on a regular basis to ensure they remain within the compliance levels. The remaining discharge is to the atmosphere and should easily comply with current regulations but should still be minimised to achieve the BPEO i.e. minimise exhaust and emissions from burning operations as much as is reasonably possible.

6. HAND-OVER

The Hand-Over is the terminology used for the transfer of responsibility of the marine structure or ship between Client and Purchaser/Contractor. It does not necessarily include transfer of ownership, however, in the majority of cases, this is included.

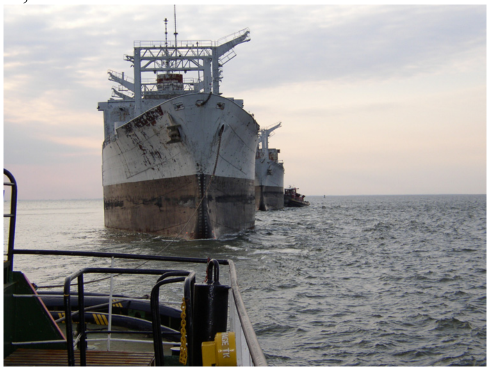

Figure 4: Two ships setting off from US to the UK for recycling in October 2003.

7. WASTE REMOVAL, PROCESSING AND DISPOSAL

As with all demolition contracts, one of the first requirements is the identification of risks and this includes the identification of waste materials and material contaminated with waste. Marine structures and ships destined to be recycled within the UK are no different. The owner should provide a Hazardous Waste Inventory with the enquiry for disposal. This inventory (called the green passport for ships!) should cover all possible waste materials and their locations from bedding to Asbestos. The disposal contractor should carry out an inspection upon receipt to check the validity of the Waste Inventory.

The waste streams that cause most concern includes Asbestos, CFC's, Lead, Oils, PAH's, PCB's, PVC. TBT and Toxic Metals including Cadmium, Mercury and Lead.

The wastes that are currently attracting the most interest within the UK are Asbestos and PCBs.

There is minimal risk for the ecology if protection and procedures currently available are complied with, (ABLE comply with all such recognised practices). Providing such practices are complied with then the end result for recycling marine structures including ships will be a **POSITIVE BENEFIT** to the environment.

The waste removal and disposal operation is a very important part of the decommissioning process and great care must be taken to ensure these works are carried out correctly, particularly taking into account the local ecology, new knowledge, industry recommendations and the rapidly changing statutory requirements of various countries.

The facility and operators should comply with all regulations of the developed nations, ensuring the client has the comfort and cannot be criticised for going to a particular country that has less onerous requirements than others to reduce costs.

First and foremost, where practical, easily accessible oils liquids and wastes should to be removed. To carry out this operation, it is extremely important the facility is in a suitable location, particularly taking into account the recommendations described earlier.

ABLE are of the opinion that prime considerations for this operation are:-

- The suitable location of the facility taking into account the recommendations detailed earlier.
- If possible, all of the waste removal and disposal and dismantling works should be carried out by one contractor, thus maintaining full control and removing any potential interface problem.
- A trained experienced local labour force.

7.1 ASBESTOS CONTAMINATED WASTE

Asbestos contaminated waste can be found in various forms and locations on marine structures and ships including in boilers, steam pipework, hanger liners, mastic under insulation, insulation cloth, gaskets, valve packing etc. The two main forms are in Asbestos insulation products and in Asbestos cement board products.

The Asbestos Insulation is the greater risk as the fibres become airborne more easily.

All Asbestos contaminated materials are classed as 'hazardous waste' and both the removal facility, transportation and disposal site must be suitably licensed. The control limit is that any material containing in excess of 0.1% in the UK is classed as hazardous.

Asbestos removal should, wherever possible, be undertaken in a negative pressure enclosure in accordance with recommended guidelines.

Asbestos Disposal
There are a number of options for disposal but landfill is the solution that provides the BPEO for the disposal of Asbestos contaminated materials.

There are numerous methods of removing Asbestos contaminated materials, the most common is when the area is sealed off and, using special extraction fans with Hepa filters, a negative air pressure is created in the work area, thus minimising the potential of escaping fibres from the encapsulation into the atmosphere.

7.2 MERCURY CONTAMINATED MATERIALS

Mercury is found in a number of locations primarily in gauges, thermometers, switches and light fittings.

In general, any mercury or items contaminated with Mercury should be removed from the structure where practically possible prior to dismantling and be transferred to a specially constructed storage facility on site where the mercury can either be stored awaiting reclamation, treatment or disposal.

Mercury Disposal
There are currently two options for disposal:

- to a recycling facility for refining; and
- landfill.

7.3 PCBS

PCB's can be found in various products and locations including cables, rubber products, hoses, foam insulation, paint, felt and oils etc. The problems we have encountered with PCBs within ships have been from public misconception that all PCB's (even in a solid state such as in hoses) are a major hazard to health and the environment - this is not the situation.

PCBs are a suspected carcinogen in humans, however, this is not proven and some experts do not consider it to be acutely toxic to humans. Repeated exposure however can cause them to accumulate in the body. Also in some cases exposure to PCBs can cause a skin condition called chloracne.

It is accepted that one of the main risks from PCBs is from them being heated in the presence of oxygen. This process can lead to the formation of dibenzofurans, which may pose a greater risk to human health.

In dealing with PCBs, it is important to identify which form the PCB is in. For instance, if it is in liquid form the risk of spillage or contact with the skin is much greater than if the PCB is in solid form. If the PCB is in solid form, this usually means that any toxic properties are chemically locked into the product i.e. plastic coating on electrical cables etc.

Currently the UK Regulations stipulate that any material containing PCBs above 50 ppm are classed as toxic to the environment, there are two main options for disposal:-

- Disposing of liquid PCB's by high temperature incineration (disposal of liquids to landfill is not allowed).
- Disposal of solid PCBs below 50 ppm can be landfilled as non-hazardous into a conventionally engineered landfill site, however, anything above 50 ppm would also need to be incinerated at high temperatures.

ABLE are currently investigating alternative treatment and disposal methods.

7.4 RADIOACTIVE CONTAMINATED MATERIALS (LSA)

LSA may be found in emergency signage and in control gauges, smoke detectors, etc on marine structures and ships it can also be found in oily sludge or in scale in oil pipework etc

In general, the equipment and any pipework etc contaminated with LSA should be removed from the structure where practically possible prior to dismantling and be transferred to a specially constructed storage and cleaning facility on site where the LSA can be removed, treated and stored, awaiting removal in special containers to a licensed disposal facility. Once the contamination has been removed and tested clean the pipework can be recycled.

LSA Disposal

There are currently two options for disposal:

- Material is processed and pumped out to sea.
  ABLE are not involved with this option, for environmental reasons.
- Materials are landfilled.

NB: There are various opinions and ongoing discussions regarding the control limits, which currently vary significantly.

7.5 INVASIVE SPECIES

In recent years, many people have become increasingly aware that the globalisation of trade, the increased speed of travel, the large volume of cargo movements, and rising tourism have combined to increase the chance of accidental introductions of foreign species into different countries. Aquatic species may be carried by a variety of mechanisms — unintentionally when attached to vessel hulls or carried in vessel ballast water or as live seafood for human consumption.

Invasive species will be the next major concern for recycling of marine structures and ships. The management and handling of Ballast Waters in trading ships is also becoming a concern worldwide. ABLE have been involved in methods of handling, treatment and disposal of ballast waters since our involvement with the Brent Spar in 1997 and marine growth since receiving platform jackets and piles in the late 1990's.

We have found ourselves to be leading the way with regard to the safe handling and treatment of potential invasive species occurring in marine structure decommissioning. This is one of the main reasons for our philosophy and recommendation that demolition of marine structures and ships **should only be undertaken in a dry dock or on land** thus taking maximum reasonable precautions to stop wastes and invasive species having access to the marine environment.

Ballast waters

Ballast Waters can, and often do, contain oils, chromates, heavy metals, invasive species etc and as such should be treated as contaminated unless proven otherwise. When handling contaminated ballast waters we go through a series of procedures, which first identifies any contaminants followed by the safe treatment and disposal. Most contaminants in ballast waters can be treated on-site by specialist treatment technologies.

Non Native Invasive Species

The Pandora's Box is the management of Non-Native Invasive Species. The UK, as with the rest of the World, is in its infancy managing this risk.

ABLE as part of our state of the art ship recycling programme have developed one of the first (if not the first) Non-Native Invasive Species Management Plans in the Europe. This plan not only looks at the potential of species in ballast waters but also looks at the potential pathways offered through other medias such as marine growth. The US estimates the damage caused by Non-Native Invasive Species is as high as $138 billion per year. The management of non-native invasive species will become a major issue in terms of cost and expertise for all marine and ship recycling facilities in the world not just the US and Europe. Our procedures are not discussed here for confidential reasons.

8. REUSE OF EQUIPMENT

Some equipment is readily sold, in particular such items as engines, compressors, generators and cranes.

On receipt of a contract for a marine structure or ship and with the Client's permission, details of all potential saleable items should be determined where possible.

One should be prepared to store equipment for a number of years, the actual time being determined by a number of factors, such as age and condition, how many similar units in stock, market price of scrap material and if other companies are attempting to sell similar units.

Reuse provides the BPEO and significantly affects the costs.

9. MATERIAL FOR REUSE

A large proportion of material from abandoned marine structures and ships can be reused.

Innovative thinking can increase the quantity of material to be reused.

Reuse will include using plate, girders, floor grating and pipework etc.

Some wastes are currently reused in some countries but should not be; such as Asbestos and PCB contaminated materials.

10. RECYCLING

The majority of material that is used to construct marine structures and ships can be reused or recycled. On average around 98% of the received weight can be reused or recycled.

In some instances it is less environmentally friendly and more costly to recycle.

The recycled material is recovered during the dismantling and demolition operations.

11. QUALITY, HEALTH AND SAFETY

All construction/demolition projects require the effective management of health, safety and welfare. This is a prerequisite for compliance with the Health and Safety at Work etc. Act 1974 and the Management of Health and Safety at Work Regulations 1999.

There has been a major increase in health, safety and environmental awareness and legislation in recent years, the Able Group have taken a pro-active approach to these issues.

ABLE have designed a web based Integrated Management System delivering all of the Group's business processes including quality management to BS EN ISO 9000:2000, health and safety to BSI-OHSAS 18001 and environmental management that meets with the requirements of BS EN ISO 14001. The system is accessible to clients and employees and allows individuals (depending on their level of authorisation) to review for example current asbestos legislation and code of practice, current training/medical information and expiry/renewal dates, also individuals training programmes.

ABLE are of the opinion that there should be a system in place that would provide a certificate of compliance so that owners can be assured that the facility meets required world standards, as part of the approval the facility should have the relevant BS such as BS EN ISO 9000:2000, health and safety to OHSAS 18000 and environmental management to ISO 14000.

It also allows, in some instances, the client to view the current progress of their project without the need for a visible site presence.

Although it appears that the Construction (Design and Management) Regulations 1994 do not currently apply to marine structures and ships that have been transported ashore for disposal, ABLE apply these and it is expected that they will apply in the future.

The CDM Regulations are the United Kingdom's response to transpose the Council of the European Communities Directive 92/57 EEC, entitled 'The Minimum Health and Safety Requirements at Temporary or Mobile Construction sites' placed new duties upon Clients, Designers and Contractors to re-think their approach to health and safety so that it is taken into account and then co-ordinated and managed effectively throughout all stages of a construction/dismantling/ demolition project. Additionally, an effective CDM compliant health and safety management project provides and contributes towards:-

- Effective project management
- Risk management
- Commercial viability
- Public relations opportunities
- Added value
- Best practice

We fully support this concept, it establishes the ground rules of achieving the BPEO by carefully considering the stage requirements i.e. concept - feasibility, design and planning, tender/selection and disposal phase thus ensuring that maximum effort is applied to improve safety at work and that disposal is considered at the design stage this providing the best cradle to grave options.

12. SHIP RECYCLING IN THE UK

At present, there is no other facilities in the UK that are able to receive and recycle ships in accordance with required legislation and the latest recommendations. There are a number of establishments that have dealt with smaller vessels, trawlers and the like, but at present UK ship owners have a dilemma. The ship dismantling practices encountered in Asia are not acceptable to responsible ship owners, but at present there are minimum alternatives. The TERRC facility at Teesside, offers a real green alternative for disposal of marine structures and ships that is used by all major oil and gas operators and meets all of the latest legislation and recommendations providing the BPEO.

13. UK GOVERNMENT POSITION

Following the media and public attention to the MARAD/ABLE ship recycling contract EFRAC took oral evidence *(details with ABLE's comments can be found on ABLE's ship recycling web site).*

Following this, a UK Government House of Commons Select Committee was established and, during the last quarter of 2004, reviewed ship recycling in the UK. A report was published by EFRAC on 11th November 2004 "*Dismantling Defunct Ships in the UK*". [1]

On 25th January 2005, the UK Government EFRAC Committee published a reply to the report [2] "*Dismantling Defunct Ships in the UK*" this lists 16 recommendations.

The Committee discussed the issue of ship dismantling in the UK.

The Committee also requested that the Government set out how it will use its forthcoming presidency of the European Union and chairmanship of the G8 to encourage rapid international action to ensure these tankers are dismantled in a responsible way.

The Committee established that *"The UK has the potential to establish an industry in ship dismantling which can be done safely and offer economic benefits to the community. As a starting point, it would welcome the development of a thriving ship dismantling industry in the UK, which dismantled all defunct state-owned vessels to the highest standards of health, safety and environmental protection".*

The position with regards to proper ship recycling is becoming urgent because all remaining single-hulled tankers must be phased out before 2015, many before 2010 and the oldest by the end of 2005.

The full timetable for the phasing out of single-hull tankers can be found on the web:-
http://www.imo.org/Newsroom/mainframe.asp?topic_id=758&doc_id=3341

14. MARAD SHIP RECYCLING CONTRACT

In February 2003, following detailed prequalification submissions from ABLE, MARAD and the US Environmental Protection Agency carried out detailed audits on ABLE (the Company undertaking the recycling works), TERRC (the facility to be used to carry out the works) and a number of waste disposal facilities.

At the same time, ABLE contacted Hartlepool Borough Council and the Environment Agency and informed them of their potential contract in order to seek confirmation that ABLE could undertake the works under their existing permissions and licences at TERRC. ABLE were informed that the existing planning permissions covered the works but they would require a modification to their Waste Management Licence and additions to the Working Plan if the works were to be undertaken in the dry dock. ABLE wished to undertake the works in the dry dock so submitted an application for a modification of the Waste Management Licence to allow this.

MARAD awarded the recycling contract in July 2003.

Immediately after contract award there was a very significant amount of scaremongering, primarily by Friends of the Earth in the UK, and various incorrect information was stated publicly. This included saying that the ships were "full of toxic wastes" and that there were "large quantities of PCBs, oils, asbestos etc onboard" whereas in fact, the total amount of waste on all of the ships (13 No.) to be disposed of was less than 2% of the total lightweight of the ships which is similar to the recovery we have achieved in recycling offshore oil and gas facilities.

There is a lesson to be learned from this for Governments, this case became high profile and continued over a significant period. ABLE can understand how the public would be concerned if the information publicised had been correct, but the problem was that the majority of the information was incorrect - so how does a private contractor get correct information across to the public?

We are of the opinion that the lesson to be learned is that a Government, or its Agencies, should employ an independent body to consider all the facts and publish them to a wide audience as soon as possible thus allowing the public to make a decision based on correct facts, and not on exaggerated scaremongering misinformation.

ABLE have been in the business of demolishing marine structures on Teesside, UK since 1985 and have received over 50 No. structures from various offshore oil and gas fields - all of which have been successfully reused or recycled. Similar to ships, over 98% has been reused or recycled with less than 2% being waste sent to landfill. During all of this time, there have never been any complaints regarding the activities. Following planning approval in October 1997, TEAG was formed which is structured to meet four times per year to discuss any issues which may cause significant detrimental affect on the local ecology. It is also a platform to discuss existing activities and potential future projects, to understand and consider any potential concerns. In particular, these meetings consider if any proposed activities may potentially affect the local ecology in the future and discuss potential mitigation. These minutes are recorded and there have never been any complaints nor has been recorded that there has been any known significant detrimental affect to the local ecology caused by the operations of ABLE at TERRC.

In 1997, ABLE were hopeful of being awarded the contract to receive and recycle the Brent Spar. As part of the public acceptability process with Shell, ABLE held a presentation in the Hartlepool Town Hall, which was fully attended by members of the public together with Statutory Consultees. The process of receiving the Brent Spar with its waste and recycling it within the TERRC dry dock is very similar to the methods used for receiving and recycling ships in the dry dock. Following the Brent Spar presentation, there was a significant amount of support for the project and it is worth noting that all marine structures received to date have been predominantly oil and gas platforms from the North Sea which have similar types and quantities of waste as the ships to be recycled.

Figure 5: LivingQquarters received for recycling in 1985 at TERRC

To summarise, one will hopefully understand the surprise to ABLE when following the scaremongering, they saw that some people were unsupportive of ship recycling at the TERRC facility, even though:-

- ABLE have been successfully recycling marine structures at facilities on the Tees, containing similar types of wastes since 1985.

- ABLE had undertaken a presentation to the public in Hartlepool in May 1997 covering recycling of marine structures including receiving the Brent Spar, which was a larger structure with potentially more complications. This type of work was accepted and approved by all concerned.

- ABLE's original planning application included numerous types of various ships but the planning authority had suggested that ABLE use the words 'marine structures' which would cover all types of structures, ships etc that came from the sea. This wording was therefore changed as per the Planning Authority's suggestion.

- ABLE discussed the planning position with Hartlepool Borough Council who confirmed that the planning would allow ships to be recycled (the planning permission was removed because a High Court Judge ruled that a 'ship' was not a 'marine structure').
- Prior to accepting the order for the MARAD contract ABLE discussed and corresponded with the Environment Agency who wrote to ABLE and confirmed that the activities were allowable under the existing Waste Management Licence.

It was not until the ships were being towed to TERRC from MARAD and were half way across the Atlantic that ABLE received a visit from the Environment Agency who requested that ABLE return the ships back to the US. ABLE asked 'Why?' but were not given any reason and could see no reason why they should as it would put them in breach of contract. ABLE had followed all correct and proper processes, made enquiries with the relevant bodies and had all permissions and licences in place. If the Environment Agency, for whatever reason, wanted the ships to be returned then ABLE asked that they be instructed in writing to return them or confirm that they were going to withdraw the Waste Management Licence from ABLE and therefore would not be able to undertake the works. The Environment Agency did not carry out any of these actions and also did not give ABLE a reason why they were requesting the ships to be returned until some months later.

Friends of the Earth took the Environment Agency to Judicial Review in the High Court of England on 8th December 2003 and the Judge deemed that the Waste Management Licence would not allow ABLE to recycle ships at TERRC.

On 15th December 2003 three members of the public from Hartlepool (with Legal Aid assistance) took Hartlepool Borough Council to Court and the Judge ruled that a 'ship' was not a 'marine structure' and therefore ABLE's planning permission would not allow ships to be recycled at TERRC.

It is worth noting that TERRC was originally constructed (in 1913) as a facility for shipbuilding, repairs and maintenance. A large number of ships had been built and repaired at TERRC over a 50 year period, however the new ruling meant that ABLE could not carry out any activities relating to ship construction, repairs, maintenance or recycling.

15. CURRENT POSITION

Even though in 1996/7 ABLE had an Environmental Impact Assessment carried out to cover all various activities they wished to undertake on site (including recycling of marine structures and ships), it has now been necessary to have another Environmental Impact Statement prepared.

Due to the high profile, the relevant Authorities have considered everything in the finest of detail and this has caused a delay in the process of obtaining decisions and answers on various items. Also, the detail that was required, particularly for the hydrodynamic modelling was such that there was no existing software modelling suitable and we had to use a combination of consultants from the UK, Norway and the US to provide the EIS in the detail that was required. Unfortunately, this took a lot longer than originally anticipated. The current situation is that the Planning Application and EIS were submitted to Hartlepool Borough Council in January 2005 and the new Waste Management Licence Application was submitted to the Environment Agency in March 2005.

Both Authorities have a 16-week period to consider the applications. Taking into account that we have been carrying out similar activities on the site since we purchased it in 1996 with no problems and the EIS confirms (as did the one in 1996) that the operations should not have a detrimental affect on the local ecology, we are very hopeful that we will receive the Planning Permission in May 2005 followed by the Waste Management Licence in June 2005. This will enable the works on the ship recycling business to commence from early July 2005.

16. POINTS TO CONSIDER

- **Proximity Principle**

A topic that keeps being raised by environmental groups is the proximity principle, should a ship be taken back to where it was built to be recycled, or recycled at the location of the owner, or at the flagged state, or its last voyage?

If it is any of the above except where it was built, then this could be manipulated at the end of its useful life. The answer surely is that the marine structure or ship should be recycled at a location that provides the BPEO.

- **Facility Approvals**

There is an urgent requirement to have facility approvals of a standard agreed worldwide. An obvious starting point must be that a facility should be assured to the relevant ISO standards for health and safety, environmental management and quality. This would provide known acceptable standards whilst the relevant worldwide organisations decide on a particular standard of requirement and qualification procedure that would enable an independent organisation to be able provide certification of facilities that comply with the set standards.

17. CONCLUSION

Taking into account the foregoing and other criteria, ABLE hereby offer the following conclusions based on their practical experience.

- All dismantling/demolition works should be undertaken in a dry dock or on dry land (i.e. use of a shiplift etc).
- Do not remove any waste material prior to delivery - it assists the BPEO to remove all of the waste material when the ship is at the recycling facility with full control in a purpose-designed environment.
- Provide external third party monitoring thus providing confidence to environmental groups local authorities and the public.
- Enter into a contract at an early stage, this will help to reduce industry costs.

In order to reduce the cost of ship recycling in Europe, we need a guaranteed quantity of work so that we can invest in the latest equipment and technology. Also by getting a maximum throughput in the facility, reduces the facility cost per tonne.

By undertaking remediation and recycling works within our large dry dock at TERRC, we provide the BPEO and recycle marine structures and ships providing more benefit to the environment than any other current recycling facility in the World.

Any queries, questions, comments, suggestions or recommendations on this document would be appreciated.

Please send comments by email to:
shiprecycling@ableuk.com
Website: www.ableukshiprecycling.com

18. REFERENCES

[1] EFRAC, 'Eighteenth Report of Session 2003-04 - Dismantling Defunct Ships in the UK', Published 11th November 2004. HC834

[2] EFRAC, 'Eighteenth Report of Session 2003-04 - Dismantling Defunct Ships in the UK', Reply to the Report Published 25th January 2005. HC257

[3] http://www.imo.org/Newsroom/mainframe.asp?topic_id=758&doc_id=3341

19. AUTHORS BIOGRAPHY

Peter M Stephenson is the Chairman, Chief Executive and major shareholder of the ABLE Group of Companies, which he founded 40 years ago. He is also responsible for managing the special projects division, which includes expansion of the Group's marine structure and ship recycling activities and development of new port facilities.
He has produced a number of papers covering decommissioning of offshore structures and recently gave a paper on Ship Recycling at a Conference organised by Lloyds List in Holland.

PREPARING ROYAL NAVY SHIPS FOR DISPOSAL

R M Lane, Royal Navy, Disposal and Reserve Ships Organisation., UK

SUMMARY

The disposal of any ship is a complex process and this is particularly true of warships. They have not only to go to sea, but, if necessary, to fight and to survive battle damage. The weapons and detection sensors are frequently constructed of sophisticated components made from a wide variety of materials. These ships are often run for many years after their merchant counterparts would have retired. This can produce problems during disposal including how to deal with asbestos and ancient paint and preservation systems. The Disposal and Reserve Ships Organisation has existed in one form or another for over 100 years. Its present structure is founded on the American procedures adopted after the Second World War when large numbers of ships were to be disposed of. This paper aims to demonstrate that, despite the many contradictions and complexities in warship disposal, the Royal Navy, in the form of the Disposal and Reserve Ships Organisation, has a structured process for the preparation of its obsolete ships for disposal. It will describe how ships are selected for disposal; who is involved in disposal preparations; what the main preparations involve and finally, how the ship is cared for and transferred for sale after crew departure.

NOMENCLATURE

MoD. The UK Ministry of Defence. The owner of UK warships.
DRSO. The Disposal and Reserve Ships Organisation.
DSA. Disposal Services Agency. Who sell surplus warships.
CED. Capital Equipment Disposals – now subsumed by the DSA. The authority which assumes control of disposal list vessels.
SSDC. Surface Ships Disposal Committee. Who decide the sales route for surplus ships.
IPT. Integrated Platform Team. The MoD authorities responsible for ship platform design, safety and equipments.
PCB. Polychlorinated biphenyls. A man-made mixture of chlorinated compounds; now prohibited and declared to be hazardous.
JSP. Joint Service Publication. Written instructions and regulations applicable to all three armed services.
BR. Book of Reference in the Royal Navy.

1. INTRODUCTION

The disposal process for a Royal Navy Warship varies as to its end use. For a ship that is to be sold for breaking and scrap recovery it can be summarised thus:

- Selection – the process of deciding what ship is to be disposed of, when and how.
- Guidance – advising those concerned in a ship's disposal, particularly its crew, what their responsibilities and tasks will be.
- Surveys – establishing the material and environmental condition of a ship for disposal.
- De-equipping and de-classification – removing useful and classified items from a ship.
- Destoring – removing the accountable stores items for further use.
- Final Disposal Preparations – The preparations which render a ship safe, inert, stable and ready for disposal by breaking.
- Handover and custody – the process of relieving the ship's crew of their care and protection duties and thereafter holding the ship in a dormant storage condition.
- Sale and transfer – The marketing and transfer of a ship to a commercial owner.
- Departure – the departure of the ship from UK MOD ownership and site.

These processes are expanded on in the following sections.

2. THE DISPOSAL PROCESS

2.1 SELECTION

The primary consideration when contemplating warship disposal is tasking, both present and future. Maintenance load, usually a function of age and use of the vessel, may also play a part. The MoD HQ Departmental Planning groups consider ship tasking based on current and perceived threats and this will eventually result in the "Navy Plan". Having determined what ships are needed to meet the tasks it will be possible to identify those that are or will become surplus to requirement.

These ships for disposal are announced and discussed at the MoD Surplus Ships Disposal Committee (SSDC), chaired by the Capital Equipments Disposals (CED) section based in the MoD Foxhill site near Bath. At the SSDC all the key players involved in disposal become aware of the requirement to dispose of the ship and start to plan accordingly. First efforts will be made by the Disposal Services Agency (DSA) in London who will usually commence a marketing exercise aimed at gaining a Defence List or Government to Government (GtoG) sale to another country for use as a warship. This process can take up to two years and often involves British industry in both the marketing and refurbishment of vessels. Should a Defence List sale not proceed then the ship may be directed to storage or placed on the "Commercial List" for sale commercially for further use, usually in a non-warship role, or for breaking for recycling and scrap. The latter brings the procedures and guidance of the Capital Equipment Disposals and Disposal and Reserve Ships Organisation (DRSO) to the fore. DRSO is based in HM Naval Base Portsmouth and has an ISO 9001:2000 procedure for preparing warships and auxiliaries for disposal.

2.2 GUIDANCE

Guidance is given to the ship by a variety of agencies: Fleet, for personnel and policy matters; CED for equipment issues; the MoD security agencies and by DRSO for final physical preparations and handover. The latter is embodied in the Disposal and Reserve Ships Manual Volume One (DRSM Vol 1).

2.3 SURVEYS

Amongst the earliest disposal activity is the information trawl used to identify the materials remaining on the ship at the end of the disposal preparation period. This enables remediation tasks to be planned, costed and – where necessary – undertaken. In the MoD there is no shortage of knowledgeable agencies – the real challenge is in drawing the information together to form a definitive picture of what is in and on a particular vessel. An example of the agencies concerned includes, amongst others, the Institute of Naval Medicine (the INM – for chemical and radiation analysis as well as health advice); the Portsmouth Health and Safety Advisory Group (HSAG) for nationally certified radiation surveys and disposal; the Integrated Platform Teams (IPT) for information regarding the structure and composition of the ship.

2.3(a) The “Design Authority”

The Integrated Platform Team includes the Design Authority and they are the first and most important group, to be interrogated. Records for older ships can be difficult to trace, particularly for hazards recognised relatively recently. Nevertheless it is possible to make substantially accurate estimates of quantities in mass – such as the steel and copper content. The key hazardous items receive particular attention and these are detailed below.

2.3(a)i Radioactive Materials

A Radioactive Source Register is maintained for each ship. This is only used as a starting point for the survey which will be conducted by the INM or HSAG. They use extremely sensitive detection equipment to identify the radioactive sources and, if necessary, remove and properly dispose of them. On completion a Radiation Free Certificate is produced.

2.3(a)ii Montreal Protocol Gasses [1]

All are removed from the ship either for recovery or proper disposal. This includes the gas within the large refrigeration plant systems. Smaller plant and domestic refrigerators are either de-gassed or removed complete for proper disposal.

2.3(a)iii Polychlorinated biphenyls (PCB) [2] [3] [4][11]

PCB’s and their associated variants have not been consciously used in RN ships for many years. Nevertheless it is recognised that there is the possibility of trace elements through build or residual contamination from older liquid systems such as transformers. The latter are seldom used in warships – for the battle damage hazard they represent as much as anything else. The MoD declared all known locations of PCB in 1996. Since then there have been only occasional arisings and these have also been declared and removed for proper disposal. It is known that very low levels of PCB are sometimes found in man-made materials and these are surveyed as necessary. Tests may also be carried out, for example, any of the relatively few liquid filled transformers in RN service would be tested for PCB content prior to disposal. Local testing is used on suspected liquids, using (currently) the Chlor-N-Oil product from Quadrex Scientific. This detects Free Chlorines rather than PCB themselves. If this relatively cheap and easy test is positive – indicating levels in excess of 50ppm - then Gas Chromatography may be used to give a definitive reading. The guidelines followed are laid down in the MoD Environmental Manual enhanced by the ever growing body of knowledge to be found in UN, Basel and IMO documentation. The waste threshold limit is that set by UK legislation – currently 50 ppm (50mg/kg).

2.3(a)iv Asbestos. [5][6][7][11]

An Asbestos Register detailing the location and nature of asbestos sources is used where necessary. For the modern build (post 1980) vessels there is seldom any significant quantity. However for older ships there may well be considerable quantities. Even here it is worth noting that the MoD has made consistent efforts to remove asbestos from its vessels since the late 1960’s. Where a large quantity is known or suspected a full survey is conducted by a licensed authority. This is normally of the “Type 2” survey – where the whole of the readily accessible areas are surveyed with selected intrusion in to difficult areas such as behind bulkhead coverings is made. After the survey is received it is policy to make good any hazardous defects. Thereafter a decision will be made whether to remove all asbestos or to sell the ships with the asbestos still in place, declaring it in accordance with current legislation. For the MoD this is effectively contained in EC regulation 259/93 which also lists many other of the “red” waste categories. Clearly, the survey plays a pivotal role in the sale not least enabling the recycler to estimate his disposal costs.

2.3(a)v Paints and Coatings. [8][9]

The IPT are the authority in charge of paints and coatings specifications. As such they are able to give much useful information particularly relating to the policy of usage on warships. Paint records for older ships are often difficult to track down and if this does occur then a "worst case" is assumed – warships are compliant with current regulations regarding tributyltin (TBT) paint coatings in that they are either removed or sealed.

2.3(a)vi Other Chemicals and Substances. [11]

Modern warships have sophisticated weapons systems and – although small in quantity – there are often exotic hazards that could include – Mercury, Beryllium, Thallium, Lithium, Cadmium and Viton® Fluoroelastomer) O rings and seals. Fortunately, these items, because of their cost and nature, are well catalogued – not least on the casing of the equipment in which they are fitted. Another positive factor is that most of the associated equipment will be needed to restock spares and repair other ships. Thus, many of these equipments are removed before the ship enters disposal proper. Items remaining will be catalogued for removal, either of the whole equipment or the hazardous component within. Cadmium can be problematical to remove since is most frequently found as micro level plating on components particularly fastenings. Fortunately this rarely amounts to more than a few grams in total. Nevertheless, because of the hazardous nature of the material every effort is made to fully identify sources.

2.3(b) Hazardous materials removal.

If MoD requires to remove the hazard contracts will be placed to achieve this. This is covered in section 2.4 of this paper.

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2.3(c) Inventory of potential hazards remaining (The "Green Passport"). [10]

DRSO has been using a format of the guidelines for 10 months. MoD has also contracted Qinetic to produce a definitive version as part of its "Green Warrior" project and this – based on a relational database – will have input from the moment a future ship starts building. It will also be retrospectively applied, starting with the Type 23 Frigates. This will take some time to achieve. In the interim passports will continue be produced by DRSO.

2.3(d) Safety and Security Survey

A survey is made of the requirements relating to these items. From this work lists are drawn up – for instance to make good guard rails and hatches for lay-up and prepare to fit external padlocks. At the same time a list of removals required to render the ship unclassified will be carried out. Finally, preparations are made to remove any remaining weapons or to render them unfit for further use usually by mutilation.

2.3(e) Hull state, seaworthiness, towability.

These areas are surveyed carefully, particularly if a controlled sinking is to be carried out where a further lengthy and comprehensive preparations period is involved.

Once the information is known and documented by CED and DRSO it is used to inform the relevant authorities such as DEFRA and the MCA as well as the DSA for informing sales customers. From this a discount or enhancement of the sales value can be measured. It may be that there is a cost to disposal – it greatly depends on the make-up of the ship and whether removal of hazards has already occurred.

2.4 DE-EQUIP and DECLASSIFY

De-equipping is the process used to remove from a warship various component parts such that the ship can be sold commercially or otherwise disposed of. The requirement to do this is driven by the following factors.

- Safety: including the removal or rendering unusable of weapons and specialist equipment such as lasers.

- Security: equipments are removed to bring the ship to an unclassified state.

- Recovery: many useful components can be returned to the operational fleet for further use. This is also very good economics with significant savings involved offsetting the cost of de-equipping. Weapons are removed as part of this process. This work is normally carried out on behalf of the MoD by a contractor.

2.5 DESTORE

Overseen by the MoD logistics authorities this is the planned removal of the accountable Naval Stores. These are the items that will be re-issued to the Fleet for further use. Also removed are the hazardous, perishable and foodstuff items as well as the medical and dental stores. In all approximately 150 tonnes of stores may be removed from a Frigate sized vessel of 4000 tonnes displacement. Associated with this activity is the removal of all ammunition and explosives (De-Ammunitioning) – tightly controlled by the MoD explosives authorities using strict audit and inspection techniques. A 100% removal is achieved.

Many items are not on the accountable list and will be removed for direct transfer to other ships or remain on board to form part of the sale. Ready-use fastenings and light engineering stores are typical examples – particularly when the class of ship is obsolete.

2.6 FINAL DISPOSAL PREPARATIONS

The Disposal Preparation is the final evolution involved in readying a ship for commercial disposal. It is a structured programme of events overseen by DRSO and utilising the procedure laid down in the DRSO Manual Volume 1 "Preparing Ships for Disposal". For a frigate-sized vessel displacing 4000 tonnes it would take approximately 6 weeks to complete.

The aim is to produce a safe, dormant "hulk" ship that has no power or stored energy hazards and has had all major pollutant risks removed, or rendered such that they can be declared in the sale. On completion the vessel should be: Inherently safe, stable, upright, secure and in a dormant condition.

The manual gives instruction and guidance designed to the achieve this aim and includes example plans and logistic support requests to aid planning as well as certificates to confirm the activity has been completed or otherwise. The manual is issued to the ship 6 – 3 months before final arrival at the disposal port to permit the ship's staff to draw up definitive plan – at this stage they will be invited to coordinate the aforementioned de-equip and destore activities in to their final plan.

2.6(a) The physical preparations

The key areas are:

- People: The removal of personal items. Clearing and cleaning of mess-decks including bedding. Closing of personnel and financial accounts. The removal, for archive or disposal, of paper records. Important drawings and certificates are kept to form part of the transfer to the purchaser.

- Foodstuffs, medical items and COSH (Control of Substances Hazardous to Health) items. All foodstuffs are removed. Refrigeration rooms are cleaned and the ship is checked for infestation – rats are rarely found in Royal Navy vessels, cockroaches can occur and extermination is carried out if necessary. Cleaning chemicals and detergents are removed for further use or appropriate disposal.

- Fuel and Oils: All the ship's main fuel tanks contents are recovered for further use after any necessary treatment. Sullage waste is disposed of by an approved MoD contractor. The tanks are then cleaned using hot water (56 degrees Celsius) and a MoD approved detergent. After ship's staff inspection and making good any serious structural defects the tanks are randomly inspected by DRSO and then closed and filled with clean non-estuarine seawater or fresh water. The tank-state records are placed in the hand-over certification and used as part of the recalculation of current stability. It is worth noting that most warships do not run in ballast as merchant ships do; they also use diesel (gas oil) hence there is rarely an issue of ballast water sludges to deal with. Oils and lubricants. These small tanks are emptied and the oil recovered for further use or disposal. The relatively small tanks are normally rag-cleaned and left open to "breathe".

- Sanitary systems including sewage tanks: The system pipe work is repeatedly flushed with clean seawater. Tanks are opened, cleaned as for fuel tanks, and then either filled with clean sea or fresh water or left empty and open to "breathe". WC's and urinals are flushed and cleaned. Often, a small quantity of light engine oil is added to the S-bend water trap to prevent evaporation of the water lock which would permit pipe odours to enter the ship. WC's and urinals are then sealed with polythene.

- Gasses and pressurised air systems: All pressurised air is vented to atmosphere with selected drain valves left open as a safety measure. Montreal protocol gasses, including refrigerants, are recovered for further use or approved disposal. Systems are left opened to atmosphere unless it is known that the system will be bought back in to use in the future when it is pressed up to 1.5 Bar with white-spot nitrogen. Carbon dioxide pressure vessels are normally returned to the manufacturer for reuse.

- Radioactive sources. Following the aforementioned comprehensive survey, all radioactive sources are removed to be dealt with by the MoD approved radiation equipment authorities.

- Batteries, including emergency lighting sources: All batteries are removed for refurbishment and further use or disposal in an approved manner.

Thorough cleaning of the ship occurs throughout the process.

2.6(b) The record of ship preparation

This is in the form of collective certification (known as the DRSO "Form One") that verifies the activities in the DRSO disposal preparation manual have been completed. It forms an accurate statement of the ship on the day it became a dead hulk. It is a live document that is maintained by DRSO.

2.6(c) Handover and Crew Departure

DRSO provides a guidance and advisory service to the ship's staff throughout the final disposal preparation period. At the end of this preparation process DRSO conducts rounds with the ship's staff in which every accessible area of the ship is inspected. This normally takes 3 – 5 hours. On satisfactory completion DRSO formally accepts custody, care and protection of the ship, the crew depart and all power is removed from the ship. The ship is then externally locked and remains in DRSO custody alongside in the harbour or is placed on the moorings pending disposal.

2.6(d) Records and documentation.

In addition to the DRSO "Form 1" which gives a comprehensive statement of ship condition at the point of crew departure, there are other records to be dealt with. The MoD removes those historical and operational documents and records it requires. The remaining balance is either disposed of (the bulk) or retained by DRSO as custodian. The retained records include: Ship stability and construction information including (if available) shell expansion drawings and general arrangements diagrams Records of dockings and paint coatings applied. Surveys and reports relating to known hazards such as asbestos materials are also retained along with important ship certification.

The forgoing is combined with the Green Passport to give a comprehensive picture as possible to a potential purchaser. It can also be used as the starting point for preparations should a deliberate sinking be planned. During custody it forms the basis of an emergency plan to deal with rescue, flooding and fire.

3. CUSTODY AND CARE

DRSO has a complement of Royal Navy sailors who are used to carry out the routine checks, inspections and maintenance of dead ships. The latter includes oiling of anchor chain cable and associated gear. A careful watch is kept on bilge levels in order to detect hull leakage early. A strict visitor control system is in force to reduce the risk of fire or other accident. During this custody phase there are frequent, yet carefully controlled, visits by Royal Navy and MoD personnel to remove further items of equipment in support of operational ships defect repair (currently in excess of 2500 items a year) and this forms a large part of the custody crew work-load. Approved MoD contractors also remove items, usually in support of logistics contract agreements with foreign navies operating former RN ships. Finally, the public sometimes wish to buy ship components – a museum specialising in ships sirens is one such example.

4. CONCLUSIONS

The MoD is a large and diverse department of state. Drawing together the many authorities agencies involved in ship disposal is not easy. Nevertheless there is high motivation and strong desire by all concerned to see a safe disposal that returns the maximum benefit to the taxpayer. The legislation surrounding ship disposal is continuing to rapidly expand and evolve, every effort is being made to ensure former Royal Navy vessels are compliant and fit for disposal. It is hoped that this paper has demonstrated that the aim is largely achieved and that

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6. AUTHOR'S BIOGRAPHY

Lt Bob Lane RN holds the current position of Officer in Charge the Disposal and Reserve Ships Organisation. He is responsible for developing and adapting methods of preparing RN ships for disposal or reserve as well as the care and custody of designated ships. A Marine Engineer, he joined the Royal Navy in 1964 and has served in most classes of surface warships.

RECYCLING OF NUCLEAR FUEL CARRIERS

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SUMMARY

Pacific Nuclear Transport Limited (PNTL), a subsidiary company of British Nuclear Fuels Plc (BNFL) have recently completed the recycling of one of its Nuclear Fuel carriers. This recycling operation was carried out in the Netherlands where Health, Safety and Environmental considerations are of a high standard.

The recycling operation was developed to satisfy the Industry Code of Practice for Ship Recycling as well as industry guidelines. The vessel was recycled in two stages. The first under a service contract where ownership of the vessel was maintained and all hazardous substances were removed, and tanks emptied, cleaned and made gas free. The second stage involved the vessel being sold for recycling where ownership was transferred and the ship was cut up.

To enable the vessel to be exported from the UK to continental Europe the ship was exported in accordance with the Transfrontier Shipment of Waste Regulations 1994 which implements Council Regulation (EEC) No 259/93 on the supervision and control of shipments of waste within, into and out of the European Community.

1. INTRODUCTION

Pacific Nuclear Transport owned and operated five nuclear fuel carriers. This fleet of vessels have safely and successfully transported nuclear fuel and waste between Europe, America and Japan since 1979. Nuclear material transported by sea must be transported on vessels that meet the Irradiated Nuclear Fuel (INF) code of the International Maritime Organisation (IMO). The INF code establishes three design and construction standards for vessels carrying nuclear cargoes. These purpose built dedicated vessels are designated as INF3 carriers, which is related to the amount of radioactivity acrried and equates to the highest standard of safety and protection achievable for the transport of nuclear material.

The MV Pacific Crane was built in 1980 and used to transfer a variety of nuclear materials primarily between Japan and Europe. In 2002 she was withdrawn from service after completing all contractual obligations. After performing an optioneering study into possible alternative uses for the vessel including conversion and decommissioning the decision was made to recycle the vessel.

BNFL having developed detailed specifications for ship decommissioning in conjunction with its ship management company tendered for interested Shipyards to carry out this recycling operation. After failing to find a suitable option within the UK to perform this work BNFL's preferred contractor was based in the Netherlands. Through consultation with the UK Environment Agency (EA) and the Marine Coastguard Agency (MCA) part of the UK Department for Transport (DfT), the decision was made to classify the vessel as 'waste' and export through the applicable waste regulations.

2. RECYCLING METHOD

2.1 BACKGROUND

The recycling method adopted by BNFL was for the vessel to be decommissioned within Northern Europe where health and safety issues, environmental considerations and quality assurance standards are established and can be monitored and controlled.

This approach is not necessarily accepted by all members of the shipping community where vessels can be sold to Third World countries in which standards of worker Health and Safety and environmental considerations are not a priority. Lack of awareness from such yards has led to increased attention from international environmental and workers' rights groups. PNTL and BNFL have determined that vessels will be recycled using the voluntary guidelines developed by the international shipping organisations in the form of the Industry Code of practice on Ship Recycling. This, in conjunction with contracting an established Shipyard with an appreciation of Environmental Health & Safety and Quality Assurance Standards, provided an effective, environmentally sound and publicly acceptable approach to disposal of the fleet of vessels.

2.2 SCOPE OF RECYCLING PROJECT

The scope of this project was to develop a strategy that ensured the vessel was as hazard free as practicable, when being sold to a Shipyard for disposal. This approach was adopted to allow a method that mirrors industry best practice as well as incorporating additional BNFL requirements to ensure that the needs of all internal and external stakeholders (customers, Environmental groups, local authorities, etc.) are satisfied.

The process of decommissioning the vessel was performed in three Phases.

2.2(a) Phase I

The removal of any potentially radiologically contaminated areas of the vessel was performed before the main project and did not involve the recycling contractor commissioned for the final breaking of the ship. Suitably qualified and experienced personnel performed this work in Barrow-in-Furness, Cumbria, prior to the main scope.

2.2(b) Phase II

The majority of the decommissioning process was separated into two distinct stages. The preliminary stage was the clean-up operation of the vessel being performed where identified hazards were removed. These hazards that cannot be recycled were disposed of in an appropriate manner.

2.2(c) Phase III

The final stage involved the vessel being sold for recycling where the contractor took ownership and title and was responsible for the physical 'breaking up' of the vessel.

2.3 DECOMMISSIONING PROJECT ACTIVITIES

The following activities were performed for the project:

- Identification of hazardous materials on board the vessel in line with those documented in the Industry Code of Practice Hazard List
- Identification of any potentially radiologically contaminated areas of the vessel.
- Develop decommissioning specifications for the removal of hazards and the controlled 'breaking up' of the vessel
- Identification of a suitable Shipyard/location for the associated work to be carried out.
- Removal of any potentially radiological contaminated areas under Health Physics supervision
- Removal of non-nuclear hazards at contracted Shipyard in line with the Industry Code of Practice
- Sell vessel under a Standard Ship recycling contract
- Ensure vessel is disposed of in a suitable manner with respect to EH&S

3. APPLICABLE STANDARDS AND REGULATIONS

The standards under which the Pacific Crane was to be decommissioned had to meet the criteria of the BNFL Corporate Policy for the Environment and Health and Safety. All activities undertaken by BNFL were in accordance with the ISO 9001:2000. Those activities undertaken by contractors of BNFL that did not meet the above standards were performed under additional controls and supervision.

In addition to these controls the regulations applicable to the BNFL strategy for Ship Decommissioning were as follows:

3.1 INDUSTRY CODE OF PRACTICE [1]

The Industry Code of Practice for the recycling of ships provides guidelines to ship owners when disposing of vessels. The general overview of the Code is for owners to take responsibility for the impact of selling their vessel for recycling. This involves the removal of all hazardous materials where practicable prior to selling and the de-gassing of all tanks that are not essential for the final voyage. In the event that it would be unreasonable for the owner to remove a particular hazard it is to be clearly identified to the Shipyard accepting the vessel from the owner. The hazardous materials that a responsible ship owner is expected to identify and take responsibility for are outlined in the MARISEC Inventory of Potentially Hazardous Materials.

3.2 BALTIC AND INTERNATIONAL MARITIME COUNCIL (BIMCO) [2]

Once the criteria of the Industry Code of Practice have been met the vessels will be sold under a standard international contract for the recycling of ships. The BIMCO Demolishcon contract is used by the industry to sell end-of-life vessels. This contract was used for the sale of the MV Pacific Crane for recycling. The contract Terms and Conditions were amended and agreed to satisfy certain criteria of the waste regulations (see later) and to give BNFL additional control and supervision of recycling activities whilst the vessel is no longer the owner's asset.

3.3 IMO MARINE ENVIRONMENT PROTECTION COMMITTEE (MEPC) GUIDANCE [3]

The UN body, the International Maritime Organisation (IMO) has developed guidance literature for the recycling of vessels. This literature outlines the measures and controls necessary to ensure a vessel that has been sold for recycling is dealt with in a environmentally acceptable way whilst ensuring the safety and health of the workers involved in the recycling activities. The guidance is primarily tailored for the organisations based in non-OECD (Organisation for Economic Co-operation and Development) countries.

3.4 BASEL CONVENTION [4]

The Basel convention sets out the controls for the transboundary movement of hazardous wastes. Transboundary movements of hazardous wastes are only permitted if prior written notification by the State of export is given to the competent authorities of the States of import and transit (if appropriate). Shipments of hazardous wastes must be accompanied by a movement document from the point of export to the point of disposal. Hazardous waste shipments made without such documents are illegal. In addition, there are outright bans on the export of these wastes to certain countries. Transboundary movements can take place, however, if the state of export does not have the capability of managing or disposing of the hazardous waste in an environmentally sound manner.

3.5 OECD DECISION ON THE CONTROL OF TRANSBOUNDARY MOVEMENTS OF WASTES [5]

The OECD (Organisation for Economic Co-operation and Development) Decision classifies wastes into three categories according to their hazard, green, amber and red. Green listed wastes are classified as non-hazardous and are not subject to controls under the OECD Decision. Red and amber wastes are classified as hazardous and are hence subject to the controls of the OECD Decision.

3.6 WASTE SHIPMENTS REGULATION (WSR) COUNCIL REGULATION (EEC) NO. 259/93 [6]

The WSR is the European Unions' regulations that satisfy the criteria of the international agreements and conventions governing the control of waste movements between boundaries including the Basel convention and the OECD Decision.

3.7 THE TRANSFRONTIER SHIPMENT OF WASTE (TFS) REGULATIONS 1994 [7]

The TFS Regulations 1994 is the UK Statutory Instrument that satisfies the provisions of the WSR. Although it is not commonly accepted that end of life vessels should be classified as waste, the TFS Regulations provide the legal framework that allows waste to be exported out of the UK for recycling only. It is illegal to export waste from the UK for disposal and therefore only genuine recycling operations are permitted. The TFS Regulations satisfies all the controls and recommendations made in the MEPC guidance.

4. EXPORTING AN END-OF-LIFE VESSEL THROUGH WASTE REGULATIONS

4.1 WASTE EXPORT APPLICATION

The application for permission to export the vessel under the Transfrontier Shipment of Waste Regulations 1994 can only be made once a legally binding contract for recycling of the waste is in place. BNFL also have a financial guarantee with the UK Environment Agency (EA) that allows the EA to draw upon funds in the event that the waste needs to be retrieved. This bond is live from the day the waste leaves the Export State until it has been fully processed and the authorities of the Import State are satisfied with the completed work.

The waste export process involves six distinct stages:

4.1(a) Stage 1 – Pre Notification

The Notifier/Exporter (in this case BNFL) has to identify the Consignee (recycling contractor), the amount of waste, the classification of the waste including its European Waste Catalogue (EWC) number, its physical characteristics, its OECD Classification and Hazard type. In addition to the above the Exporter has to identify the mode of transport and the intended carrier, and the type of operation to be undertaken by the Consignee (i.e. Recycling – it is prohibited to export waste for disposal). The Notification is made up of a standard form containing the above data and the supporting information required by the competent authorities (as identified by the Secretariat of the Basel Convention). The Notification is made to the competent authorities of the Export and the Import State, including the financial guarantee, copies of the recycling contracts, evidence that "Genuine recovery" (i.e. the waste is to be recycled and the import country can make more use from the material then the cost of disposing of residue wastes) will take place. The Notification process incurs a nominal fee that has to be paid upon submission.

Once the competent authority of dispatch has reviewed the financial guarantee and accepted its value, they will issue a certificate of satisfaction to all parties. This certificate signifies to the competent authority of the receiving country that a suitable amount of funds in the form of the guarantee have been made available. Upon receipt of this certificate the competent authority of the receiving country will issue a formal acknowledgement of receipt for the Notification package. This signifies the start of a 30-day technical review of the waste export application.

4.1(b) Stage 2 – 30-Day Consent Period

During the 30-day technical review of the waste application, the competent authorities can request any additional information they require at any time. This is to aid them in determining whether or not the waste is going to be processed in an environmentally acceptable manner and that there is clearly defined legal responsibility for the waste at all times. Primarily this process is to allow the competent authorities to investigate the licences of the parties involved ensuring that they have suitable waste management permits.

4.1(c) Stage 3 – Consent

If the competent authorities are satisfied with the application that consent is given at the end of the technical review allowing the waste transfer to take place.

4.1(d) Stage 4 – Movement/Tracking Pre-Notification

To allow the competent authorities to track waste movements between states the Exporter submits a Movement/Tracking pre-notification. This identifies the waste and refers to the consented Notification Package; this has to give the authorities at least three days notice before the waste is transferred. The Movement/Tracking form also identifies the exact amount of waste and the carriers responsible and methods of transport for transferring the waste to the Import State. The Movement/Tracking form travels with the waste at all times.

4.1(e) Stage 5 – Acceptance of Waste by the Consignee

Upon receipt of the waste, the Consignee completes the Movement/Tracking form and informs the competent authorities that they have taken responsibility for the waste.

4.1(f) Stage 6 – Certificate of Completion

Once the recycling operation has been completed the Consignee submits a certificate of completion to the competent authorities informing them that the waste has been fully recycled. The certificate also releases the Exporter from the financial guarantee. In the case where steel is being exported for recycling there is a 180-day time limit to recycle the material from the day of arrival in the Import State.

4.2 EXPERIENCE OF EXPORTING AN END-OF-LIFE VESSEL THROUGH TFS

BNFL located a contractor with experience in ship conversion and repair that had all applicable licenses for processing the wastes identified as being on the vessel. The contractor had also identified a licensed sub-contractor with demonstrated experience in recycling ships of various sizes and tonnage. Contracts were put in place and the process of exporting through the regulations as outlined in section 4.1 was carried out.

At the end of the Technical Review Period [4.1 (b)] BNFL's export application was rejected on the basis that the consignee (Dutch Shipyard) did not have a suitable license for a 4000te quantity of waste (i.e. the ship). The shipyard's licenses only covered the activities for ship repair/'conversion and the wastes associated with such activities. BNFL jointly approached both the competent authorities of the UK and the Netherlands to ensure they were fully aware that the only wastes being processed at the shipyard were those that had been removed in larger quantities during previous contracts at the yard and that the majority of the 'waste' (steel) was to be re-located to the subcontractor who had licenses to process up to 40,000tes of steel a year. This approach unfortunately failed and alternative options had to be developed.

To allow the project to continue and to enable the vessel to be exported in accordance with the waste regulations the contract structure for the decommissioning had to be modified. Through discussions with the Dutch contractor and sub-contractor it was agreed that BNFL would contract the sub-contractor (ship recycling facility) directly who would in turn sub-contract the cleaning/hazard removal work back to the main contractor (the shipyard). This then assured that the new consignee (the recycling contractor) had licenses to receive and process the wastes identified in the export application. The shipyard was then brought into the recycling contractor's facility to carry out the cleaning/hazard removal activities required by BNFL to satisfy the Industry Code of Practice before selling the vessel for recycling. Operationally this was not as ideal as the original system as the shipyard had to work away from its own yard without its own facilities.

A second application was made to the competent authorities using the above structure and this was granted to allow the export to take place through the TFS regulations. In total the process of making the applications to the competent authorities delayed the project by nine months. It also worth noting that once a vessel has been classified as 'waste' it is not necessarily possible for that vessel to be taken into a shipyard for any activities.

5. DECOMMISSISIONING THE MV PACIFIC CRANE

Once export licenses had been granted the vessel was prepared and towed to the Netherlands. Upon arrival in the Netherlands the shipyard performed Phase II the cleaning/hazard removal activities in line with the decommissioning specifications. This was performed under a service contract to BNFL who maintained ownership and liability of the asset. All works carried out were performed under the supervision of BNFL's ship management company. As each identified waste was removed, quantities and type were documented and copies of all certificates and receipts from specialist waste contractors were provided to BNFL. This demonstrated that the wastes identified in the decommissioning specifications were all accounted for and could be shown to be going to licensed facilities, giving BNFL a suitable audit trail.

Upon completion of Phase II (an eight-week process) the vessel was sold for recycling to the ship-recycling contractor. At this point ownership of the vessel was transferred to the contractor, although BNFL still maintained the liability under the TFS regulations. Although the asset was no longer BNFL's the Demolishcon contract allows for site visits by the 'owners' to ascertain that the recycling is being carried out in accordance with environmental legislation. This gave BNFL the confidence that the operation was being carried out in an appropriate manner and that the 180-day time limit for the export and recovery of steel would not be exceeded such that BNFL became liable to the EA for the financial guarantee. The recycling contractor cut the vessel into sections, using a combination of hydraulic pincers and oxy-acetylene torches, and transferred into a neighbouring steel mill for onward recycling.

Once the recycling operation was complete and the contractor fulfilled its obligations under the TFS regulations to provide the competent authorities with a certificate of completion [section 4.1 (f)], BNFL applied to the UK Environment Agency to be released from the financial guarantee and the associated liabilities for the 'waste'. Upon being released from these liabilities BNFL closed out the project on the decommissioning of the MV Pacific Crane.

6. CONCLUSIONS

To enable an end-of-life vessel to be exported through the waste regulations that implicitly satisfy the international conventions and agreements on handling waste is a time consuming and expensive process. It relies on being able to find interested facilities with suitable licences, which are rare within Europe. By exporting through this system it provides the owner of an end-of-life vessel, a legal framework with the backing of environmental competent authorities. Use of these regulations demonstrates that the operation has been fully reviewed and that no local, national nor international laws for waste management are being breached.

BNFL does not advocate that this is the 'correct' way to recycle an end-of-life vessel, merely that it provided BNFL with a solution to ship decommissioning that would be acceptable to a broad range of stakeholders. In addition in the absence of any definitive UK policy or international legislation on the recycling of ships it presented BNFL with a system that was successful and enabled the safe, environmentaly considerate and quality controlled decommissioning of the MV Pacific Crane.

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RECYCLING HIGH SPEED FERRIES AND IDEAS FOR THE FUTURE.

R A Bryce, Consultant, Australia

SUMMARY

The 1970's and 1980's saw a boom in the construction of high-speed passenger ferries, initially in Norway and Australia. Most of these vessels were constructed in aluminium. As increasing numbers of these vessels approach the end of their useful working lives issues as to what to do with them will become important. The options for operators is to see the vessels migrate to less strict maritime regulatory environments or to scrap the vessels.

This paper will consider the financial size of the aluminium fast ferry scrap market, materials, technical and logistical issues relating to their scrapping and suggest commercial approaches to the recycling of these vessels.

The paper will also propose some areas in the construction of these vessels where more ecologically sustainable approaches could be taken to material selection.

1. INTRODUCTION

1.1 BRIEF HISTORICAL PERSPECTIVE

From the 1970's the number of high-speed ferries constructed increased dramatically. This came about due to a number of core factors-

- Increased availability, reliability and efficiency of small high-speed diesel engines,
- Increased affluence opening up markets that supported suitable routes,
- Availability of new lightweight materials,
- The promulgation of the Dynamically Supported Craft (DSC) Code superseded by the High Speed Craft (HSC) Code.

In particular, the increased use of aluminium alloys for building HSC can be put down to a number of factors. Increased material availability and improvements in welding technology all contributed however the fact that these craft could be built with simple power tools, as used in timber boat building. The low infrastructure costs meant these vessels could be built almost anywhere and many were built close to where they were to be operated.

Hydrofoils were constructed commercially from the 1950's in Italy and in Russia. These craft were generally of riveted construction. The late 1970's boom in the construction of aluminium catamarans occurred in Norway and Australia. In Norway the craft were deployed on commuter routes whilst the routes in Australia were tourist operations around The Great Barrier Reef in northern Queensland.

These craft were all small passenger only vessels operating on short coastal, sheltered waters or partially sheltered water routes. Their sizes were up to 30 to 35 metres and carrying up to about 200 passengers. Vessel sizes gradually increased with some up to 50 metres in length, constrained, in some respects, by the DSC Code and Classification Society Rules.

The advent of the 74 metre wavepiercing catamarans in the early 1990's initiated a radical change in the perception of what these vessels were capable of. As a consequence there was a construction boom in large HSC, in lengths exceeding 100metres, as operators sought to get a foothold in the next big thing. The heady boom days have passed as the commercial viability of these craft have proven difficult, especially in Europe, competing against the trend of low cost airfares, the loss of duty free sales and the high price of oil.

Given the commercial challenges of operating large HSC the builders of large HSC are now focusing on the military market. The new military doctrine of rapid deployment envisages craft such as these and there are evaluation projects underway into the efficacy of these vessels.

2. THE SIZE OF THE MARKET

Given that there are only some 1900 HSC and similar types of craft and their average size it is clear that when compared with the scrap market of conventional ships we are considering a small market.

The breakdown in numbers has been given in this way for the following reasons-

- To highlight that the greatest number of craft are small in size, market size
- Identify that smaller craft are easier to scrap, technical issues
- Indicate that the larger vessels are more recent additions to the fleet and their time to scrapping more distant to the fleet reduction now underway.

It should be noted that in the period 1985 to 1994 that the number of new-builds was enhanced, for the first time by the construction of vessels longer than 50m in length. In this period 16 large vessels were built.

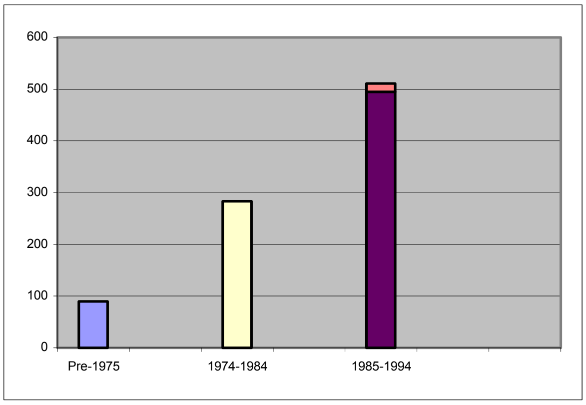

Figure 1: Graph of HSC Presently Operating Indicating When Built [1]

For the purposes of this analysis consideration has only been given to the types of vessel outlined above and constructed in aluminium alloy.

Hovercraft and vessels constructed in fibre re-enforced composite have been excluded. Although composite craft have been built, mainly SES, their numbers have been restricted by the strict environmental conditions required to ensure good results during the laminating process. Additionally cost of disposal has been problematic.

The figures given above include hydrofoils built in the Former Soviet Union (FSU) and exported to Europe and South East Asia. It should be noted that there is a major scrapping programme presently underway in Greece where FSU and Italian hydrofoils are being scrapped at the rate of one every two weeks. Therefore the figures for the oldest category of vessels may be adrift by a small number.

From the data given above it is clear that we are considering a large number of smaller craft.

3. THE LIFE CYCLE

Before considering the issues of scrapping these types of vessels it would be helpful to consider some life cycle issues.

3.1 BACKGROUND

The term HSC is a generic description being applied to vessels, which have a range of hull types/configurations. The hull types include monohulls, catamarans (including wavepiercers) and trimarans. These hulls are often augmented with additional devices that assist in reducing resistance such as lifting foils, i.e. hydrofoils, foil assisted catamarans, and lift fans, i.e. Surface Effect Ships (SES).

Most new HSC are now fitted with some form of motion control system to enhance passenger comfort and assist in reducing dynamic changes in trim to improve speed.

The underlying premise or philosophy of this type of vessel is that they have limitations imposed on their operations. These limitations permit their lightweight construction. These restrictions include wave height weather and route length criteria.

The construction of the 74 metre wavepiercers exposed the limitations of the existing regulatory framework, as defined by the DSC Code. The HSC Code was developed to address the technical and operational issues created by these large vessels that tend to operate on more exposed routes than had previously been the case.

Many, but not all, of these types of vessels are constructed to Classification Standards. Complete certification to Classification standards and full compliance to the HSC Code adds weight, complexity and cost. As a consequence some craft are constructed to domestic standards where their operation is within national boundaries.

3.2 STRUCTURAL ISSUES

The earlier craft, being mainly hydrofoils were of riveted construction along the lines of lightweight aircraft and hovercraft fabrication techniques. Later riveted fabrication gave way to welded construction and now some areas of the superstructures make use of glued bond technology.

The use of welded aluminium alloy construction has an impact on the operational life of HSC. The tempered alloys commonly used are affected by the welding process introduces heat affected zones around the welds. Although the design rules take account of the as weld strength of the materials experience shows that structural failures often propagate from these areas. Repeated welding of damaged areas also reduces material properties and can exacerbate the loss of fatigue life of the structure

The working of these structures in a seaway and induced vibrations from machinery, propellers, waterjets and ride control can seriously affect the fatigue life of the structure of the craft. A number of these craft, those that operate on more exposed routes and, for example, some large catamarans which experience large bending and racking moments, are showing evidence fatigue failures and as a consequence reduce their operational life.

3.3 LIFE EXTENSION

There are number of design features in most of the smaller HSC that have an important influence on the length of their economic life.

The most important of these is easy engine removal. These craft operate un-manned engine rooms and in many instances access for maintenance is restricted. Furthermore these high-speed diesel engines require overhauls after manufacturer designated engine running hours. Engine removal hatches reduce the time taken for engine changeovers, often being done without major disruption to operations.

To re-engine small HSC can be a simpler matter and can offer a viable life extension possibility if the structure of the vessel permits. This is the primary means of life extension.

Additionally, many smaller catamarans have resiliently mounted superstructures. Whilst the original design philosophy may have been driven by the desire to reduce noise and vibration in the passenger space, it also permitted a more modular form of construction.

Instances have occurred where the superstructure has been severely damaged by fire. Rather than precipitating the scrapping of the entire vessel a new superstructure was built and installed. Additionally a serviceable superstructure can be bolted onto new hulls.

These are forms of life extension available for an HSC operator.

4. ISSUES INFLUENCING SCRAPPING

4.1 TECHNICAL ISSUES

If an HSC is operated with prudence and is well maintained an operating/economic life 20-30 years is practical. However technical and commercial factors may contribute to the hastening to scrap vessels

Accelerated decline of the structural integrity of the vessel can easily occur. Factors that exacerbate the aging process include –

- Accelerated electrolytic corrosion stemming from poor electrical installation, inadequate corrosion protection, (anodes or impressed current), poor isolation of dissimilar metals and inappropriate berthing arrangements.
- Accelerating structural decline due to prolonged operation of vessel outside the originally approved Wave Height Restriction criteria leading to increased bending and racking loads as well increased occurrence of sea load damage
- Design and construction deficiencies, which reduce local strength and/or fatigue life. Instances of this may be noted in the first craft of a series built, where later vessels have been modified to address problems that arose during operation.

The movement of aging craft from 1st tier operators to 2nd and 3rd tier operators is standard practice in the aircraft industry and the shipping industry and holds true for HSC.

However it should be remembered that HSC tend to be maintenance intensive vessels.

4.2 MATERIAL USE

The following section provides an overview of the materials used in the construction and outfits these vessels

These craft are constructed from 5000 series and 6000 series aluminium alloys. 5000 series alloys are more corrosion resistant in the marine environment and are used for the plate. Extrusions are usually 6000 series, for ease of extrusion but these alloys are not as resistant to corrosion and as a consequence are generally restricted to internal use. Some extrusions are available in 5000 series alloys.

4.2(a) Hulls

The 5000 series plate material is the predominate alloy used in the hull. 6000 series extrusions are used for longitudinal stiffening of the shell plate. Extrusions are also used in transverse frame web stiffening. Increased use of pressed corrugated plate transverse bulkheads has reduced has further reduced the amount of extruded material in hull construction.

4.2(b) Superstructure

Extruded material is used extensively in the superstructure and ratio of plate to extrusion is probably reversed when compared to the hull.

Increased use of deck extrusions means that the main deck and the superstructure decks are predominantly this material. Integral stiffening in the extrusion reduces the amount of welding greatly simplifying construction. Deck beams, window posts, sills and pillars are usually extruded, as is the plate stiffening. Thin plate is used in the superstructure shell although some designers also use extrusions on large plate panels on superstructure sides and top.

4.2(c) Outfit

The outfit of passenger and crew spaces on HSC differs slightly when compared to conventional ship outfits.

The regulatory framework for small HSC built in accordance with the HSC Code requires use of non-combustible materials reduce fire risk as sprinkler systems are not installed. To achieve this lightweight aluminium panelling finished in light fabric or veneers are often used. Non-combustible composite materials are also utilised.

Those craft built to domestic codes often have a higher level of combustible materials used in their outfits, i.e. plywood.

Larger craft are fitted with sprinkler systems in the passenger spaces and drencher systems on the vehicle decks enabling small amount of combustible material to be used in their outfit

The seating installed is usually of an aircraft style made from extruded aluminium alloy, plastic foam cushioning and fabric.

Floor linings follow the same pattern with large use of woollen carpet and restricted use of rubber/synthetic linings confined to wet spaces.

4.2(d) Windows

These craft have very large window areas, 30 to 50% of the cabin side are might be glass. The practice nowadays is for the glass to be bonded directly to the superstructure side, eliminating heavy and bulky window frames.

4.2(e) Insulation.

Glass fibre/mineral wool sound and fire protection insulation is used. Asbestos is rarely found on any but the oldest of vessels.

4.2(f) Paint.

An advantage aluminium has over steel is that it does not require the same level of protective paint coatings. Many vessels are not painted except for anti-fouling. If the craft is painted it is usually for aesthetic reasons only. Internal coating of tanks is restricted to fresh water tanks, if they are part of the structure. Freestanding tanks are often composite.

4.2(g) Machinery/Electrical.

Machinery and electrical installations are similar to standard ship practice with the proviso that low combustible and low toxicity materials are used.

The differences in machinery installation are probably restricted to the use of composite waterjet inlet ducts, more common on smaller craft and the use of carbon fibre shafting, used to save weight.

4.3 PRACTICAL ISSUES IN SCRAPPING HSC

As noted above the large percentage of these craft are in the smaller category. The scrapping of the smaller vessels requires rather simple infrastructure in the breaking up and sorting of materials processes. To maximise the recovery of material and generate the best financial return the alloys must be efficiently sorted so that re-processing can be undertaken. The value of the different grades of scrap varies. Whilst this scrapping process can be done almost anywhere the commercial advantage will be to those locales where there is a mature aluminium recycling industry that can best re-process the different alloys used in these vessels.

It is obvious that the larger vessels will require more sophisticated infrastructure to facilitate their breaking up.

5. RECYCLING ALUMINIUM

5.1 RECYCLING - ENVIRONMENTAL

The smelting of aluminium from ore to finished product is a very material and energy intensive process. However recycling aluminium is very efficient. Recycling one kilogram saves up to 8 kilograms of bauxite, four kilograms of chemical products and 14-kilowatt hours of electricity. [2] Furthermore, no material is lost in the re-smelting and the processing stages are the same for primary and recycled materials.

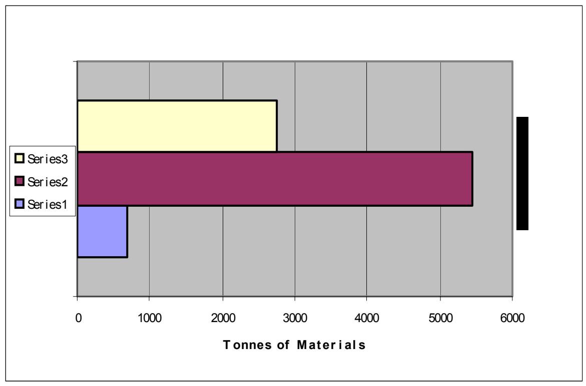

Figure 2: Comparison of Material Usage

Series 1 = 680 tonnes of recycled Aluminium
Series 2 = 5,440 tonnes of Bauxite, saved.
Series 3 = 2,750 Chemical Products, saved.

It should also be noted that this also saves 9,520-megawatt hours of electricity. It consideration is given to amount of coal required to produce this amount of energy and the level of greenhouse gas emissions and released the environmental benefits of recycling aluminium become even more compelling.

5.2 RECYCLING - ECONOMIC

5.2(a) Overview

The value of scrap aluminium, be it new scrap generated during the building process or old scrap fluctuates however the values used in the following analyses offer a fair indicative value.

The value of the scrap depends upon a number of factors. The cleanliness of the scrap, i.e. low ferrous contamination, paint and other residues, extrusions and low copper plate. Contaminated or coated plate will require additional processing prior to recycling and this will reduce the amount paid for this scrap.

Given the reduced need for painting and protective coatings for aluminium craft the percent of contaminated scrap could be reasonably low. The amount of painted material to unpainted material will drop as a percentage of overall material recovered as the vessels increase in size. This factor should affect the value of the overall return on the scrap recovered.

The analysis undertaken above indicating the split between plate and extruded alloys used in the hulls and superstructures of these craft, plus the low copper content of these alloys places these materials at the upper end of the value range for scrap aluminium alloy.

5.2 (b) Analysis of Scrap Value of Craft.

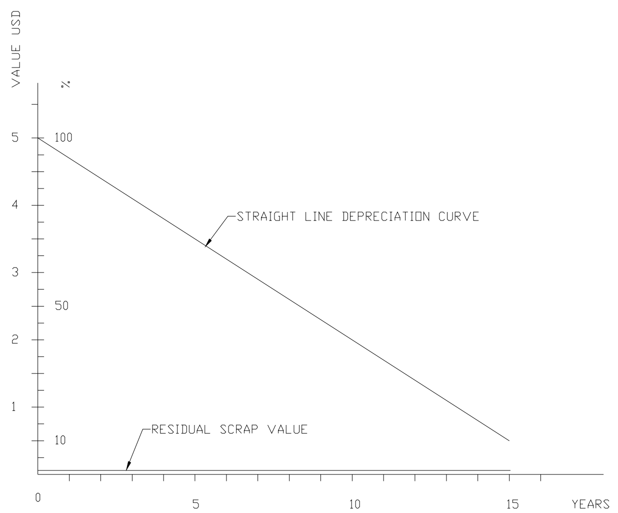

Figure 3 – 40m Catamaran Depreciation/Residual

Value USD	40m Cat.	75m Cat.	100m Mono
New	5,000,000	20,000,000	45,000,000
15yrs	500,000	2,000,000	4,500,000
Scrap	59,400	330,000	897,600

Figure 4 - Depreciation/Residual Values.

The graph and table provide some indication of the comparative values of the vessels at the different stages of their economic life.

Three simple financial cases are presented showing a residual scrap value compared to the depreciated value for different generic sizes of craft. The first is for a 40 metre catamaran, the second for a 70 metre catamaran and the third for a 100 metre monohull. For each case the depreciation is calculated over a 15-year period with a 10% residual and the scrap value calculated on a price per kilo. The value of the scrap has been converted from values presently being paid in Australia. Other sources for scrap prices can be found listed on the website for the London Metal Exchange [3] and others [4]. The scrap value is taken as an average and does not take into account the various alloy content or contamination issues noted above. The scarp values noted above do not include any allowance for additional recoveries from glass, cooper cabling and ferrous products in these vessels.

The figures show that the scrap value is unlikely to reach the depreciated residual value. Therefore the reasons for scrapping will need to be an analysis of whether the cost of a life extension will be recovered within the structural life of the vessel.

5.2(c) Future Scrapping Trends

Figure 1 indicates the age and size groupings for the currently operating HSC. The figure shows 90 vessels older than 30 years. Their age would indicate that they should be retired within the next few years. Additionally, the numbers of vessels in the 20-30 years age bracket show a significant number approaching the end of their economic lives. It is not unreasonable to expect up to 200 craft coming due for disposal in the next five years. This figure can be averaged to 40 vessels per year.

There are other factors that may contribute to the number of vessels being scrapped in the next five years or so. As noted above, in the period 1985 to 1994 there was a considerable increase in number of the smaller craft and the introduction of the first of the larger vessels. This period saw HSC being deployed on longer and more exposed routes. When the larger vessels were first introduced there was a period as Classification Societies and the Regulatory Authorities came to terms with the dynamics of these vessels and the loads their structures were experiencing in a seaway. Towards the end of this time updated and expanded Rules governing these vessels were developed by each of the major Classification Societies and the new HSC Code was introduced.

A consequence of vessels operating on longer and more exposed routes could be a reduction in their overall economic life due to increased structural wear and tear. Also, some of the early examples of the larger vessels experienced a range of structural problems and these could contribute to an increased rate of decline. Therefore, given these factors, some of the vessels built between the years 1985 to 1994 may only have a practical operating life of closer to 20 years or so.

There may be one other factor, not yet discussed, that may have an important impact on the trends in building, operating and scrapping these types of vessels. The business of operating these types of craft is sensitive to changes in fuel costs. Increasing fuel costs will add further pressure to the viability of older less efficient craft and larger vessels operating on marginal routes. Sustained or increasing fuel costs will have an effect on the rate of scrapping.

It should be noted that the attrition rate for HSC due to major structural damage as a result of accidents, i.e. collisions, groundings or fire is low. The regulatory regime for these vessels and the restricted environments they operate in, especially the case for the smaller craft, are contributing factors in the low rate of loss.

5.2(d) Market Possibilities.

It may be useful to briefly consider some prospects that the increase in scrapping may create.

It has been noted that the infrastructure required to scrap these vessels, especially the smaller craft, is low. Whilst low labour costs are an important factor, efficient scrapping techniques may allow a higher labour cost to be considered. A more important issue for scrapping may be the ability for the scrap to be quickly re-introduced in the metal reprocessing industry. Low transportation costs will further increase the environmental and economic benefits of scrap aluminium.

The increasing numbers of vessels being scrapped should also have an effect on the new build market as operators seek replacements. There may be some instances were yards that manufacture these craft might be in a position to scrap craft and send the material back up the supply chain for reprocessing.

6. IDEAS FOR THE FUTURE

6.1 OVERVIEW

Community concerns and governmental regulations are likely to impose more stringent controls on the use of materials and their environmental impact. These environmental economics should provide a stimulus to increase the amount of recoverable materials used in the building and operating of these vessels. The following section of this paper will briefly consider or propose some ways to increase the amount of recoverable materials used in the outfit of these vessels.

There are two areas worth considering when it comes to increasing the use of recoverable materials. The first area is the materials and equipment that are replaced at different periods during the operating life of a vessel or consumerable items. The second area is of materials or equipment that are permanently installed.

6.2 CONSUMABLE ITEMS

Some of the outfit material issues outlined here are applicable to both HSC and conventional vessels.

Small HSC are primarily deployed on either passenger commuter routes or tourist/sightseeing operations. These types of operation subject the passenger space outfit to significant wear and tear. In particular, carpet and other floor linings are subjected to considerable wear due to the high number of passengers. Depending on the type of operation these materials may be replaced on a yearly basis. When the material is removed it usually goes to landfill for disposal. Many countries are introducing or increasing fees for the disposal of materials in landfill sites or through incineration. Given the quantities of carpets and floor linings that a regularly replaced other options for material selection will become necessary.

There are synthetic carpets now being developed that are approaching being 100% recyclable. Because of the strict regulations governing the use of combustible materials on these types of vessels their use may be limited. However, on vessels fitted with sprinkler systems in passenger spaces, primarily larger vessels, the use of these synthetic carpets may be an option.

6.2 PERMANENT ITEMS

Non-structural outfit partitions, bulkheads and deck heads present the area where the increased use of recoverable materials has the greatest scope.

Another area worth considering is that of insulating materials. There are new acoustic insulations that are recyclable and are gaining Class approvals.

Machinery upgrades offer another avenue for improving the environmental efficacy of these craft. This can be achieved by installing more fuel-efficient main engines and gensets. This also offers the possibilities for recycling the machinery.

It is should be noted that some main engine manufacturers offer financing facilities for complete vessels. This financing facility could also be used as leverage to improve the recycling of equipment.

Additionally, the introduction of new technologies into these craft is facilitated by the ability to easily replace machinery. Electric propulsion systems, power management systems and fuel cell technologies can all be retrofitted.

7. CONCLUSION

The high-speed craft sector is a small proportion of the shipping industry. Even though there has been a growth in their numbers it is unlikely that the sector will grow significantly, rather, it will remain an important minor sector.

The future of very large HSC is likely to be restricted to military uses or specialised freight services.

The restricted operating environments of these craft and the good corrosion resistance properties of marine grade aluminium alloys contribute to the longevity recorded for some of these craft. Useful economic and operational lives for these types of vessels of 30 years are feasible.

From the data presented above it is apparent that the number of HSC coming due for scrapping is going to increase over the next five years. The increase in the amount of scrapping presents commercial opportunities for companies willing and able to enter the market.

The infrastructure required to break up these types of craft is minimal. The reduced requirements for painting and coatings, as well as a negligible amount of asbestos used across the industry should lower risks associated with occupational health and safety.

The advantages for recycling aluminium are significant in that the value of the scrap is high and that there are substantial resource and pollution savings for each tonne of material recycled.

8. ACKNOWLEDGEMENTS

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10. AUTHOR'S BIOGRAPHY

Robert Bryce is currently working on contract with North West Bay Ships and assisting another client on a prospective project in Sydney, Australia. He has worked in Australia and the UK in the areas of the design, construction, operation and management of high-speed ferries.

RECYCLING OF SHIPS MADE OF GLASS REINFORCED POLYESTER

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SUMMARY

The Polish Navy owns several non-magnetic ships that are at the end of their life cycle and need disposing of. As they are constructed largely of glass reinforced polyester (90% by weight), the process of their recycling causes a different problem to the recycling process of conventional ships. In this paper the problem of breaking down the ships after exploitation and disposal of the construction material is presented. The glass reinforced polyester wastes were added to fresh polyester resin or epoxy resins in aim to produce some usable structural composite. Then the mechanical properties of the composites were investigated.

NOMENCLATURE

GRP – glass reinforced polyester

1. INTRODUCTION

The Polish Navy has got a problem with recycling the construction of the non-magnetic vessels. There is necessity for the Polish Navy to recycle end-of-life ships, which are made of glass reinforced polyester (GRP) in 90% by their weight. The laminated hull was fabricated by hand lay-up process at 20°C (without pressure) from unsaturated, ortophthalic polyester resin. The hand lay-up process involves curing agents and accelerating agents and also fibreglass plain mat. The thickness of the composite varies from 20 to 50 mm and depends on specific of the hull. At present after nearly 30 years of exploitation, the problem of a purposeful destruction of this type of vessels has come. What to do with big size wastes? At present in Poland there does not exist any recycling shipyard dealing with safe utilization of composites.

Figure1: Vessel made of glass reinforced polyester

It is forbidden from the point of view of natural environment regulations to dump ship's wastes to a landfill. According to The Basle Convention voted on 22nd March 1989 (accepted in Poland from 18 June 1992) any export of overexploited ships is forbidden, if they do not become previously cleaned from all poisonous components. In connection with this problem we decided to perform a research in this area.

The shipbreaking process of a vessel made of glass reinforced polyester consists of:

- removal of toxic remainders (e.g. fuel)
- division into metal and non-metal parts
- removal of metal parts
- reduction of the size of glass reinforced polyester waste
- grinding, shredding, cutting
- recycling (thermal, material or chemical).

The polyesters are difficult to be recycled because the material is fully cured and it contains incorporated glass reinforcement. The curing process of composites is not reversible. Technical advantages of these composites (mainly great durability and resistance to environment) became a serious disadvantage during tests on their utilization. Several studies have reported on solving the problem of utilization by including thermal, material and chemical recycling [1-4].

Thermal recycling with energy recovery is not economic because of relatively low fuel values of polyesters (the calorific value is 25-30 MJ/kg). There also appears too much ash that must later be processed or disposed. Toxic gasses (methane, ethane, ethylene, acetylene, ethylbenzene and carbon monoxide, etc) are emitted during burning of some laminate components.

Chemical recycling involves pyrolysis or degradation in various solvents (ketones, esters, alkalis, and oxidative concentrated acids). Raw materials could be obtained. But this is a rather expensive method.

The mechanical recycling is positively accepted from ecological point of view. The material after recycling should be inexpensive and possess good useful properties and its production should be harmless for natural environment. In general, waste of GRP composite, initially ground into filler material, can then be applied as a filler or reinforcement in new composite products. The possible fields of application are dependent on the final size of the particles of the recyclate. Usually, the comminuted recyclate contains various fractions, from fine particles to long fibres - and every grade can be applied to different purposes. In

Poland the mentioned above method is the best recycling method of scrapped glass-fibre reinforced polyester. This study focuses on material recycling.

2. EXPERIMENTAL

The different kinds of composites were made of the glass reinforced polyester recyclate and the unsaturated polyester resin matrix or the epoxy resin matrix.

2.1. MATERIALS

2.1(a) Recyclate Materials

Waste of the glass fibre reinforced polyester was ground in Hydromega shredder with braking and cutting blades (Figure 2). The size of the scraps were 20-30 mm.

Figure 2: The Hydromega waste shredder

Materials used for the composites:

- Unsaturated ortophthalic polyester resin Polimal 109 – manufactured in Chemical Work " Organika –Sarzyna" S.A. (Poland)
- Unsaturated dicyclo pentadiene polyester Synolite - manufactured in Chemical Work " Organika –Sarzyna" S.A. (Poland)
- Epoxy resin Epidian – manufactured in Chemical Work " Organika –Sarzyna" S.A. (Poland)
- Glass fibre mat 150 or 450 g/ m^2
- Initiator (metyl ethyl keton peroxide or triethyleneteramine or Luperox K-1)
- Accelerator (cobalt naphthenate)

2.2. SAMPLE PREPARATION

Polyester resin or epoxy resin were used as binders. Then 17-30 wt% recyclate feedstock of GRP was added to get the composite (Figure 3). Table 1 shows the experimental design. The laminates with only one of the resins and glass fibre mat was obtained. Each such a sample consisted of 6 layers of glass fibre mat giving a final panel approximately 5 mm thick. Then the mechanical properties of recyclate composites were compared to the properties of glass fibre mat composites. There were also obtained laminates in the form of sandwich with 10 wt % glass fibre mat and 20 wt % scrapped GRP. The composites were fabricated by hand lay-up process at 22°C.

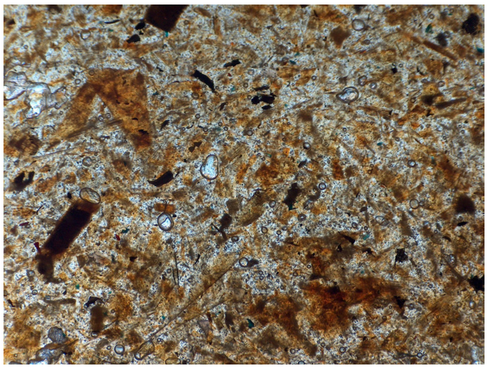

Figure 3: The sample of recyclate feedstock (of GRP in polyester matrix)

Formulation	Matrix Resin	Recycled GRP [%]	Glass fibre mat [%]
1	Unsaturated polyester Polimal	0	0
2	Unsaturated polyester Polimal	0	18.3
3	Unsaturated polyester Polimal	30	0
4	Unsaturated polyester Polimal	10	10
5	Unsaturated polyester Synolite	20	0
6	Epoxy resin	17.5	0
7	Epoxy resin	0	30

Table 1: Experimental Design

The mechanical properties (tensile strength, hardness and notched impact strength) of the composites were measured.

3. RESULTS

Tensile strength, hardness and notched impact strength of the composite are given in Table 2.

- Comparing the virgin polyester resin properties to the properties of composites to the glass reinforced polyester recycled the increase of tensile strength was observed but the impact strength got decreased significantly. The hardnesses of both samples (virgin resin and composite) are nearly similar. The sandwich samples are of higher hardness but the impact strength and the tensile strength were lower.

- Generally, samples containing scrapped glass reinforced polyester in a Synolite resin were of poor quality.
- Laminates containing glass fibre mat (both polyester and epoxy resin) have considerable better tensile strength than samples with the recycled. glass reinforced polyester.

Formulation	Tensile Strength [MPa]	Notched Impact Strength [kJ/m^2]	Hardness [MPa]
1	45.6	8.3	220.0
2	82	8.1	282.5
3	63	2.0	228.1
4	28.2	3.0	312.6
5	10.3	-	203.7
6	14.3	0.6	168.0
7	74.1	4.8	160.8

Table 2: Tensile strength, hardness and notched impact strength of the composite

4. CONCLUSIONS

- The addition of the recycled glass reinforced polyester to a polyester resin matrix resulted in a reduction in notched impact strength and an increase in tensile strength.
- Matrix epoxy resin and Synolite are not so good binders for the glass reinforced polyester recycled as Polimal.
- The work in progress involves usage of the surface activator applied for increasing the adhesion between fibre and resin matrix.

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6. AUTHORS' BIOGRAPHIES

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ENVIRONMENTAL FRIENDLY RECYCLING OF FRP-SANDWICH SHIP HULLS

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SUMMARY

Fibre composite material and sandwich structures are used more extensively especially for transporting structures, vehicles and vessels. This group of materials is young compared to the traditional metallic structural materials. Thus, experience for end of life treatment is missing for these new materials. Increasing environmental demands from customers and authorities forces the manufacturers to act.

In this study a model for assessing possible disposal techniques is demonstrated for a sandwich hull from the Visby Class Corvette. The model is based on waste properties and conditions set by the processes involved in the different disposal techniques. Six different disposal techniques are investigated, from reuse to landfill. For the studied structure they are all possible to carry out.

When considering external factors as market only two of them are possible today, energy recovery by waste incineration and landfill. According to the waste hierarchy set by the authorities for minimising environmental effects these methods are not on top of the list. Hopefully industrially techniques for material recycling will exists when this sandwich hull is actual for disposal.

1. INTRODUCTION

In the 1970-ies building ships with hulls in fibre reinforced plastic, FRP-sandwich started in Sweden. Many of these products are still in service and no experience on the end of life treatment exists.

However, several driving forces act together increasing the pressure on product manufacturers to plan for future waste treatment. These demands are of two types, increased environmental awareness from customers and governmental regulations. In the first case the customer of the ships, the Swedish Defence Material, has strong demands on environmentally friendly end of life treatment. In the second case existing and forthcoming regulations concerning waste disposal is crucial. In Sweden combustible material has been forbidden as landfill since year 2002 and a prohibition against landfill of organic material will occur in 2005.

At present no market exists for recycled composite materials, which limits the present number of possibilities for treatment today.

In this study a number of possible disposal methods are presented. The methods are illustrated in scenario form based on a model where specific conditions are stated for each included process. The aim is to present a general thinking on how to handle a hull manufactured in FRP-sandwich. This knowledge will be useful for both the waste producer when forming waste treatment plans and in contacts with a waste receiver, contractor. The hull of the Visby Class corvette is used as case study, see figure. 1.

Figure 1: The Visby Class Corvette

2. DESCRIPTION OF THE VISBY CLASS CORVETTE

The Visby class corvette is the first vessel in the world with fully developed stealth properties. With the stealth technique all types of signatures are minimized, resulting in the possibility to avoid detection. The vessel is built in sandwich technique. The face material is a carbon fibre composite and the core is a PVC-foam, see figure 2. In the sandwich structure external loads are transformed to tensile and compressive stresses in the composite face and shear stresses in the core material. Compared to older versions of ships built in steel the new sandwich design reduces the structural weight with approximately 50 %. This is explained by the so called "sandwich effect" resulting in a substantially increase in flexural rigidity and strength when compared to a single skin structure, [1]. The decreased weight results in lower fuel consumption, higher payload capacity, higher speed or longer range.

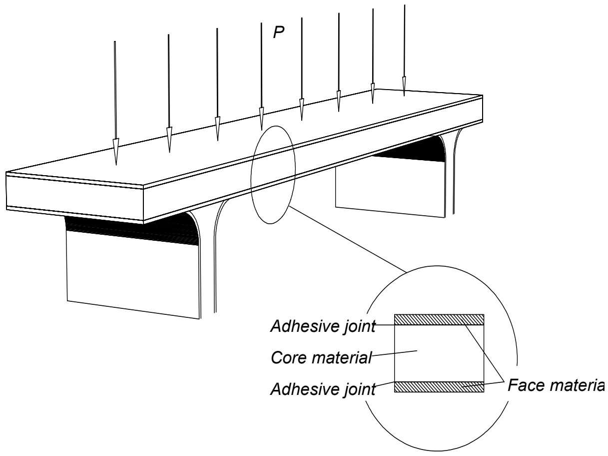

Figure 2: Illustration of a sandwich structure

3. GENERAL ON RECYCLING AND RECOVERY

The following waste hierarchy is suggested for waste management, [2].

- Reduce amount of waste
- Reuse
- Material recycling
- Energy recovery
- Landfill

Several studies have been made for evaluating strategies for waste treatment, [3]. The aim of these system studies is to compare different strategies. Life cycle assessment, LCA, is used for the comparison. The results mainly confirm the waste hierarchy.

This result was also achieved within a Swedish recycling project, [4]. Here cost assumption and LCA was used to compare material recycling and energy recovery for a number of composite materials, sandwich included, [5]. The result generally pointed out material recycling as the best alternative resulting in both decreased cost and environmental impact compared to waste incineration with heat recovery. The result is strongly dependent on the replacement of virgin material. Especially for material recycling of carbon fibre Energy recovery could be considered if non-renewable fuels as coal or oil is replaced.

4. MODEL FOR FORMING OF WASTE HANDLING PLAN

Several factors influence the choice of disposal process. They are divided into external and internal factors, see list below. The internal factors are connected to waste and processes in form of waste properties and process properties. Also influencing the waste treatment are the external factors in form of legislation and existence of a market. Legislation concerns both working environment and external environment. Several processes are included within the scenarios.

- Internal factors
  - Waste properties
  - Process properties
- External factors
  - Legislation
  - Market

Based on the internal factors a model is developed with the aim to assess possible methods for recycling and recovery. Especially the waste properties are of importance since they identify the waste and thereby control the possible future waste treatment. The most important waste properties used in the model are presented in the list below. Each property is provided with a three or four letter shortening and a unit of measurement.

- Size, **SZE,** described either by volume [m^3] and/or weight [kg].
- Fibre, **FIB,** type of fibre and amount in volume [m^3] and/or weight [kg].
- Matrix, **MTX**, type of matrix.
- Hazardous substances, **HAZ**, type, amount in [kg] and position.
- Metallic equipment and inserts, **MET**, type of metal and position.
- Core material, **CORE**, for sandwich structures, type and amount in volume [m^3] and/or weight [kg].
- Putty, **PUT**, for sandwich structures, type and amount in volume [m^3] and/or weight [kg].

From the model presented in fig. 3, scenarios are formed to illustrate the different disposal alternatives resulting in either material and/or energy. Each scenario contains a set of processes dependent on the disposal technique. For each process conditions are formed dependent on the process and type of waste. These conditions must be identified before processing and are checked towards the identified waste properties.

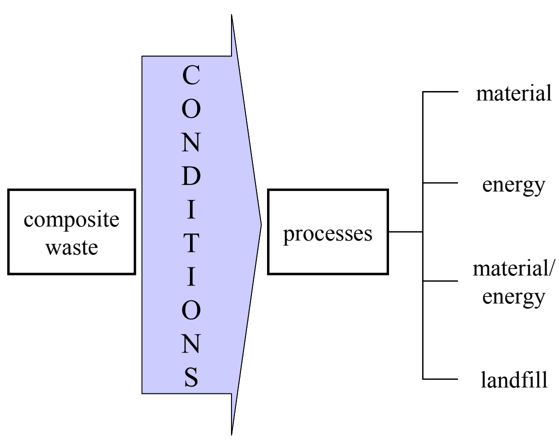

Figure 3: Model for treatment of composite waste.

As an example conditions necessary to fulfil for the cutting process are information on entering size and final size from the process and position of metallic inserts.

A complete product contains several types of materials, machinery and equipment such as electrical devices. In the model the disassembly process is not included. This process is regarded as completed when the waste treatment of the composite material starts. Also insulation against fire protection is included in this first disassembly process. However, the dismantling process of metallic inserts and electric parts within the composite structure itself is included when necessary.

5. WASTE PROPERTIES FOR VISBY HULL

From a material survey the waste properties for the hull of the Visby Class Corvette are the following.

SZE length 72 m, width 10,4 m, weight 150 000 kg
FIB carbon fibre, 50 000 kg
MTX vinylester, 40 000 kg
CORE Divinycell different qualities**,** mixture of PVC and polymer of aromatic polyurea/polyamid, 40 000 kg
PUT thermoseth based, mainly polyester, 20 000kg
MET position through drawing
HAZ chlorine, Cl, approximately 9000 kg in core
lead, Pb, approximately 400 kg in core
copper(I)oxide in bottom color, 56 % by weight
copper in electrical devices

Regarding the hazardous content the potential effects are clarified.

Through heating of chlorine, hydrochloric acid and dioxin is formed.

Accumulation of both lead and copper in the nutrition chain results in effects on health, especially nerve illness.

6. SCENARIOS

Common in almost all scenarios for this large hull structure are the first processes, dismantling, cutting and crushing. During these processes metallic parts and electrical equipment are removed and are sorted for metals recycling and according to the regulations for waste from electrical and electronic equipment, WEEE, [6].

6.1 REUSE

By cutting large panels from the hulls structure reuse of sandwich material is possible. This is illustrated with the scenario in fig. 4.

Conditions necessary to know in order to perform and plan the processing by checking the waste properties are the following:
- position of electrical equipment and metallic inserts, **MET**
- size of origin structure and panels after cutting, **SZE**
- hazardous content and position, **HAZ**

Position of metallic parts is acquired through drawings. Size of the origin structure is known and size of the new panels after cutting is defined by the future application.

Hazardous content and position is also known. Reuse means material continuing to circulate. It is then important to have control on hazardous content avoiding leakage to environment. One possible risk here is the copper content in bottom paint. Then this can be removed through a blasting process. An alternative is to not produce panels from this painted part of the structure. Regarding the lead content, the issue has been discussed with the Swedish Environmental Protection Agency, EPA, with the conclusion that no risks exists since the lead is bound within the core material.

Metallic equipment or inserts not removed during disassembly, this process is not included here as mentioned earlier, are either dismantled or cut away during cutting to final size.

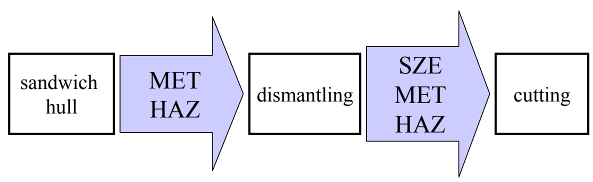

Figure 4: Scenario for reuse of sandwich structure.

The complete hull can presumably not be reused as new sandwich panels. Remaining material can be treated according to one or several of the following methods.

6.2 MECHANICAL MATERIAL RECYCLING

The method mechanical material recycling of fibre composites has been thoroughly investigated. Within a Swedish recycling project, [4], the granulation process was characterized for several types of fibre composites according to a specific methodology, [7].

The approach used here for a sandwich structure, illustrated in the scenario, see figure 5, is to mill the complete sandwich. This method was investigated for a sandwich structure constituting face of glass fibre reinforced polyester and Divinycell core, [8]. The recycled sandwich mixture was blended with polyurethane, 30 % by weight. Plates were manufactured through expansion in a form. Compared to plywood and chipboard with the same strength the new plate showed very low moisture absorption.

In the scenario the conditions to investigate are as follows:

- hazardous substances and position, **HAZ**
- knowledge about the position of electrical equipment and metallic inserts, **MET**
- size of origin structure and size before crushing and milling, **SZE**
- material content in the sandwich structure, **FIB, MTX, CORE, PUT**

An important waste property is content of hazardous substances. For material recycling there is a risk that hazardous substances continue to circulate and in worst case pollute the environment. By being cautious this risk may be eliminated. This is a basic rule in the Swedish Environmental Code when considering environmental risks, [2]. In chapter 6.1 this issue has already been discussed regarding reuse of the structure. For mechanical material recycling the bottom paint including copper is removed with blasting during the dismantling process.

Metallic parts and electric equipment are localized through a drawing of the structure. The material size before crushing and milling is dependent on the type and size of machinery used for processing. If the mill used in the last process is large enough the crushing step can be omitted.

Through information of the material content the material is characterized before the milling process in order to adjust the mill and steer the properties of the recycled material, [4, 8]. Since the thermoset composite is brittle large amounts of dust will be formed when milling. By separation of the dust through a cyclone the value of the recycled material will increase. The value of the milled material also increases with length of fibre. This is achieved when maximizing the inlet size of the mill and keeping the material size uniform.

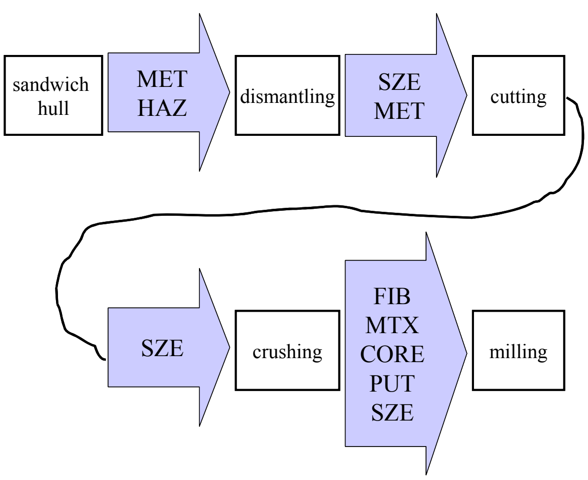

Figure 5: Scenario for mechanical material recycling of sandwich structure.

Since recycled carbon fibre potentially has a high economical value the idea of separating core and face material has been investigated, [4]. This scenario is not presented here since the cost for the separating procedure almost eliminated the profit.

6.3 MATERIAL RECYCLING BY PYROLYSIS

This method is a combination of two recycling methods, chemical and material recycling. The polymeric component is thermally decomposed into smaller hydrocarbon molecules, which can be used as fuel. Remaining material as fibers and metallic parts are then further recycled. In Denmark this method has been developed especially for disposal of wind turbine blades, [9]. This method has also been developed as a fluidised bed were the fibers are released in fluidising air and metallic parts sinks in the bed, [10]. Comparing this method to the former, mechanical material recycling, the advantage with pyrolysis is that the fibers can be kept unbroken to a larger extent. Also the dismantling process of metallic inserts can be left out.

The material properties necessary for controlling the conditions are as follows:

- size of origin structure, size before pyrolysis and milling, **SZE**
- position of electrical equipment and metallic inserts, **MET**
- material content, **FIB, MTX, PUT, CORE, HAZ** in the sandwich structure

The scenario, see figure 6, starts with cutting the origin structure. For the planning of this process knowledge of origin size is necessary. Knowledge about position of large metallic inserts is important for not harming the cutting device. The capacity of the pyrolysis process determines the final size after cutting. Before starting this process the material content must be assessed in relation to the chemical process. The produced hydrochloric acid must be neutralised or separated. The resulting carbon-fibers are further processed by milling were the conditions for this process are set by the type of fibre and final size.

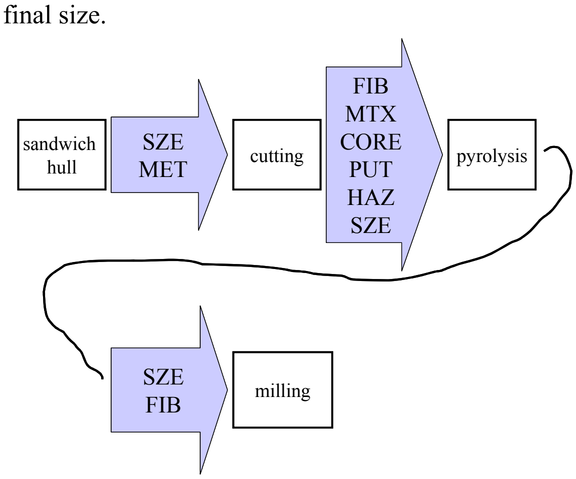

Figure 6: Scenario for material recycling by pyrolysis of sandwich structure.

6.4 CHEMICAL RECYCLING

This disposal alternative is specially aimed for the PVC-core material. There exist several chemical methods as hydrolysis, pyrolysis or gasification. The hydrolysis process exists in full-scale at a plant in Denmark, [11], and is now . This process involves removal of chlorine from the PVC resulting in oil, salt and mineral/coke fractions.

Conditions for going through this process, fig. 7, are knowledge about:

- position of electrical equipment and metallic inserts, **MET**
- size of origin structure, size before crushing and chemical treatment, **SZE**
- material content, **FIB, MTX, PUT, CORE, HAZ**

Metallic parts are dismantled if possible. Otherwise they are cut away in the following process. For the crushing process it is important to receive a high specific surface as possible. This results in higher efficiency of the chemical process.

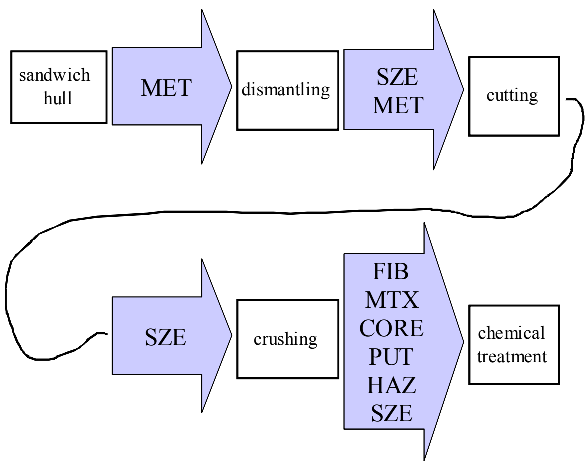

Figure 7: Scenario for chemical recycling of sandwich structure.

The carbon fibre will not be dissolved during the treatment. It will end up in the coke fraction. The heavy metals present are collected by a dust filter.

6.5 ENERGY RECOVERY

By waste incineration the energy from the sandwich structure can be transformed to heat or electricity. The heat value for several types of composite materials was investigated within the Swedish recycling project, [4]. For composites containing carbon fibre the highest heat value was achieved, 35 MJ/kg.

Conditions to know for the incineration scenario, figure 8, are:

- position of electrical equipment and metallic inserts, **MET**
- size of origin structure, size before crushing and incineration, **SZE**
- material content, **FIB, MTX, PUT, CORE, HAZ**

Metal inserts and electrical devices are dismantled or cut for recycling. Information of large importance to present for the incineration plant are content and amount for the material in the sandwich structure. Since incineration plants have high discharge demands for heavy metals and chlorine, information of lead, copper and chlorine content is very important.

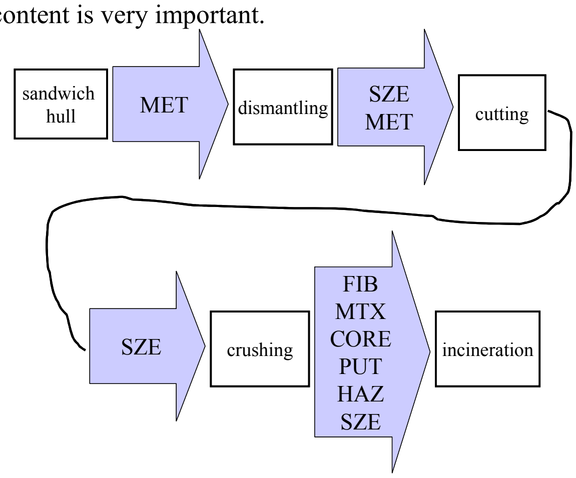

Figure 8: Scenario for energy recovery of sandwich structure.

During the VAMP 18 project, [4], two important condition especially for combustion of carbon fibre composites was learned. In order to effectively utilise the high energy content. the composite must be crushed to a size around 0,1 x 0,1 m and the combustion temperature should be approximately 900 C to ensure complete incineration.

6.6 LANDFILL

The type of composite and sandwich material in the hull structure is regarded as both combustible and organic. This type material is not allowed for landfill. Still, exception is possible if for example there is shortage on incineration capacity. An extra tax is charged for the landfill.

The scenario for landfill of the sandwich structure is illustrated in fig. 9. Conditions to be known are:

- position of electrical equipment and metallic inserts, **MET**
- size of origin structure, size before crushing, **SZE**
- material content, **FIB, MTX, PUT, CORE, HAZ** and leakage properties

As for the other presented disposal alternatives the scenario starts with dismantling and cutting. The metal-based content is then sorted for material recycling. To minimize the volume the sandwich panels are crushed. To allow for landfill the waste producer must characterize the leakage properties according to standardised test methods, [12].

The main problems for this sandwich material is the heavy metals; lead and copper. As already mentioned lead is bound within the core material and the copper in the bottom colour can be removed by blasting during the dismantling process.

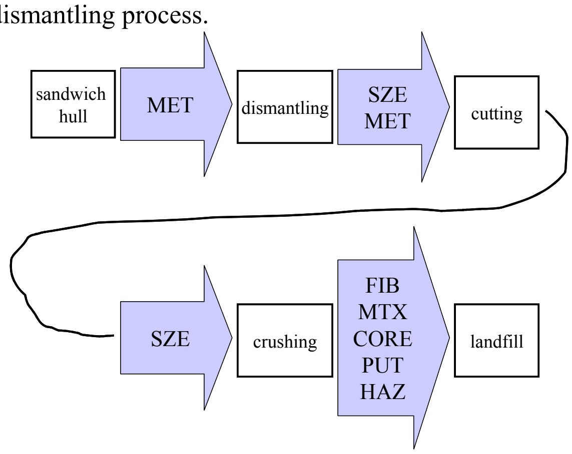

Figure 9: Scenario for landfill of sandwich structure.

7. EXTERNAL FACTORS

Together with knowledge of the internal properties, demonstrated through the model, there are several other factors influencing the disposal. These are the external factors. As already mentioned in paragraph 2 of this paper these factors are market and legislation.

For recycled composite material no market exists yet. To create a market several factors must cooperate. These factors are:

- amount of waste
- infrastructure of collecting, transport, storage
- techniques
- applications

Several techniques have been presented as possible for disposal of the hull. The techniques existing today are incineration and landfill. Also chemical recycling for the PVC-core material is possible. But the most desirable method according to the waste hierarchy, [2], and from results from the Vamp 18-project, [4], is material recycling. Especially for carbon fibre composites the benefits are of both economical and environmental nature. There is still no market for recycled material due to small quantities of waste and a lack of infrastructure.

The second external factor are regulations, concerning both external environment and working environment. Several of these influence the handling of composite waste.

Examples on regulations for external environment are:

- prohibition for landfill of combustible and organic waste
- producers responsibility
  - end of life vehicles, ELV
  - waste from electrical and electronic equipment, WEEE
- ongoing investigation on introduction of tax for waste incineration

All these regulations aims towards material recycling and will therefore act as an initiator for developing a market for material recycling.

In many of the presented processes involved for the disposal health risks will occur. Examples on processes are dismantling, cutting, crushing and milling.
During these processes exposure of the following occur:

- dust from matrix, carbon fibre and core
- smoke, gas
- sharp fibers and other sharp material parts
- noise

Especially for the processes milling and crushing several risks can occur. These are exposure of dust, sharp fibers noise and gases. The gases, hydrochloric acid and isocyanates, are generated when heating the PVC-core material.

These risks can be prevented through design of the workplace and personal protection. This is regulated by working environment laws, [13].

8. CONCLUSION

In this paper a model based on the waste properties has been demonstrated for investigating possible disposal methods for a composite sandwich hull.

The techniques available for disposal today are incineration and landfill. Possible is also the chemical recycling for the PVC-core material.

According to the waste hierarchy material recycling is the most desirable method. Several regulations as producers responsibility, prohibition against landfill and future taxes for incineration aims towards material recycling.

The studied hull structure will probably not be actual for disposal in the near future. When this is actual methods for material recycling will probably exists. Anyway both incineration and chemical recycling can still be competitive alternatives for this type of structure. The sandwich hull can not alone serve as a basis for a market, which is the key for mechanical material recycling. Both energy recovery and chemical recycling represents large scale processes capable of handling different types of waste which in this case is advantageous.

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MANAGING RISK DNV

Det Norske Veritas GREEN Passport

Putting Procedures into Practice

Terje Sverud, Det Norske Veritas AS
Aage Bjørn Andersen, MetaFil AS

RINA Conference – Recycling of Ships, and other Marine Structures
London 4-5 May 2005

Agenda

MANAGING RISK DNV

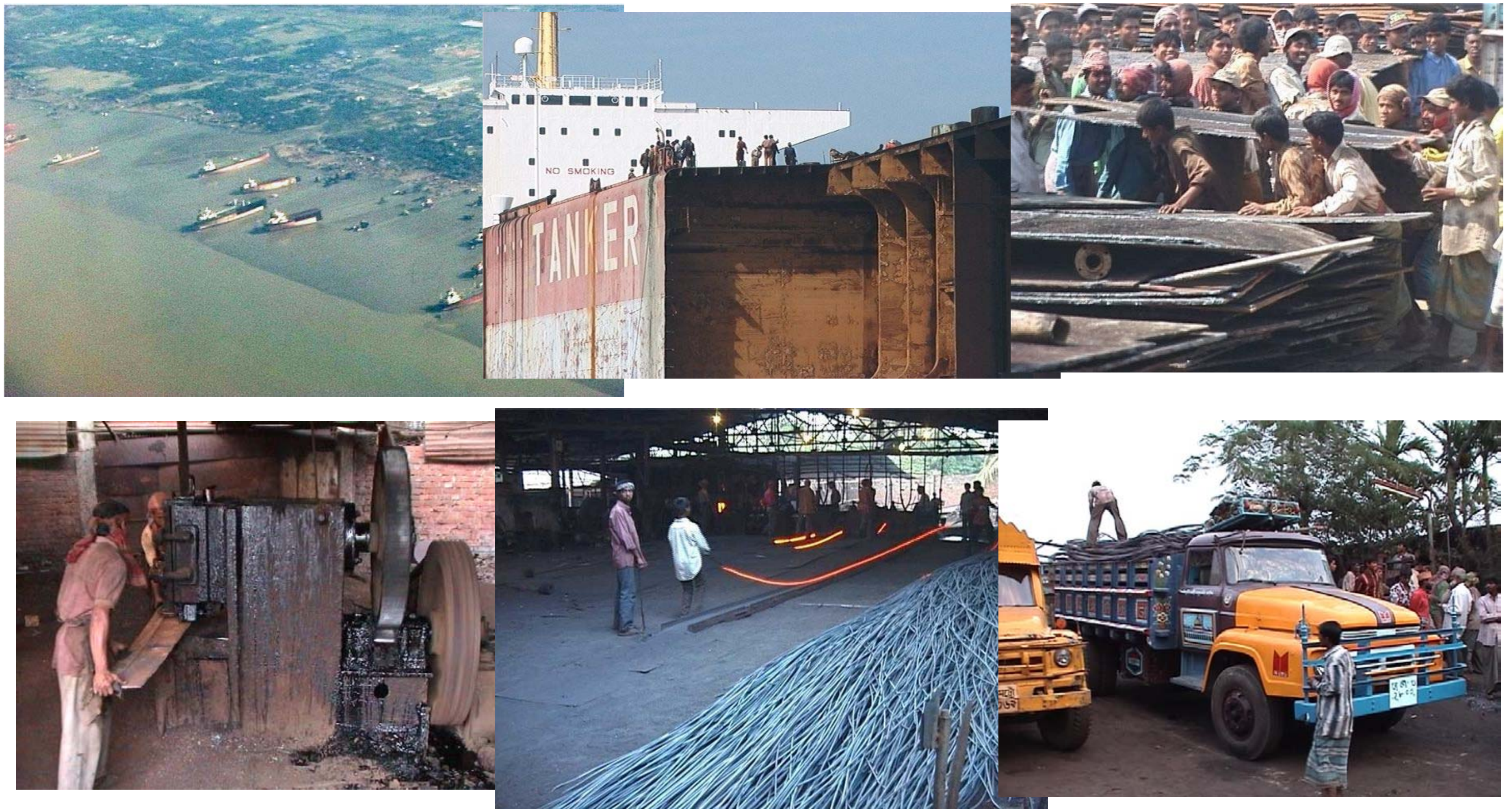
Chittagong, Bangladesh, February 2000

Photo: DNV

Ship Recycling – Current Practices

MANAGING RISK

From beaching to the steel-mills



Photos: DNV

Ship Recycling – Current Practices

MANAGING RISK DNV

Health, safety and environmental issues

Photos: DNV

Introduction

MANAGING RISK DNV

- **Growing awareness in the 1990s';**
  - **Media**
  - **NGO's**
  - **Public in general**
- **Stakeholders response;**
  - **Industry Working Party on Ship Recycling**
    - Industry Code of Practice on Ship Recycling (2001)
  - **UNEP's** Technical Working Group (TWG) of the Basel Convention
    - Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships (Dec. 2002)
  - **International Labour Organisation** (ILO)
    - Safety and health in ship breaking. Guidelines for Asian countries and Turkey (2004)
  - **International Maritime Organisation** (IMO)
    - Guideline on Ship Recycling, Resolution A.962(23) (March 2004)

Photo: DNV

The International Framework

MANAGING RISK DNV

Comparison of the guidelines

	IMO	ILO	BC
Role of stakeholders and other bodies	**X**	x	x
Design and construction of ships	**X**	x	
Operation and maintenance of ships	**X**	x	
Preparations for ship recycling	**X**	x	x
Occupational safety and health in ship scrapping operations	x	**X**	x
Environmentally sound management at ship scrapping facilities	x	x	**X**
Design, construction and operation of ship scrapping facilities	x	x	**X**

Industry code of practice was the first code to be prepared (6 pages). The IMO Guideline (25 pages) is based on this code and incorporates elements of the code

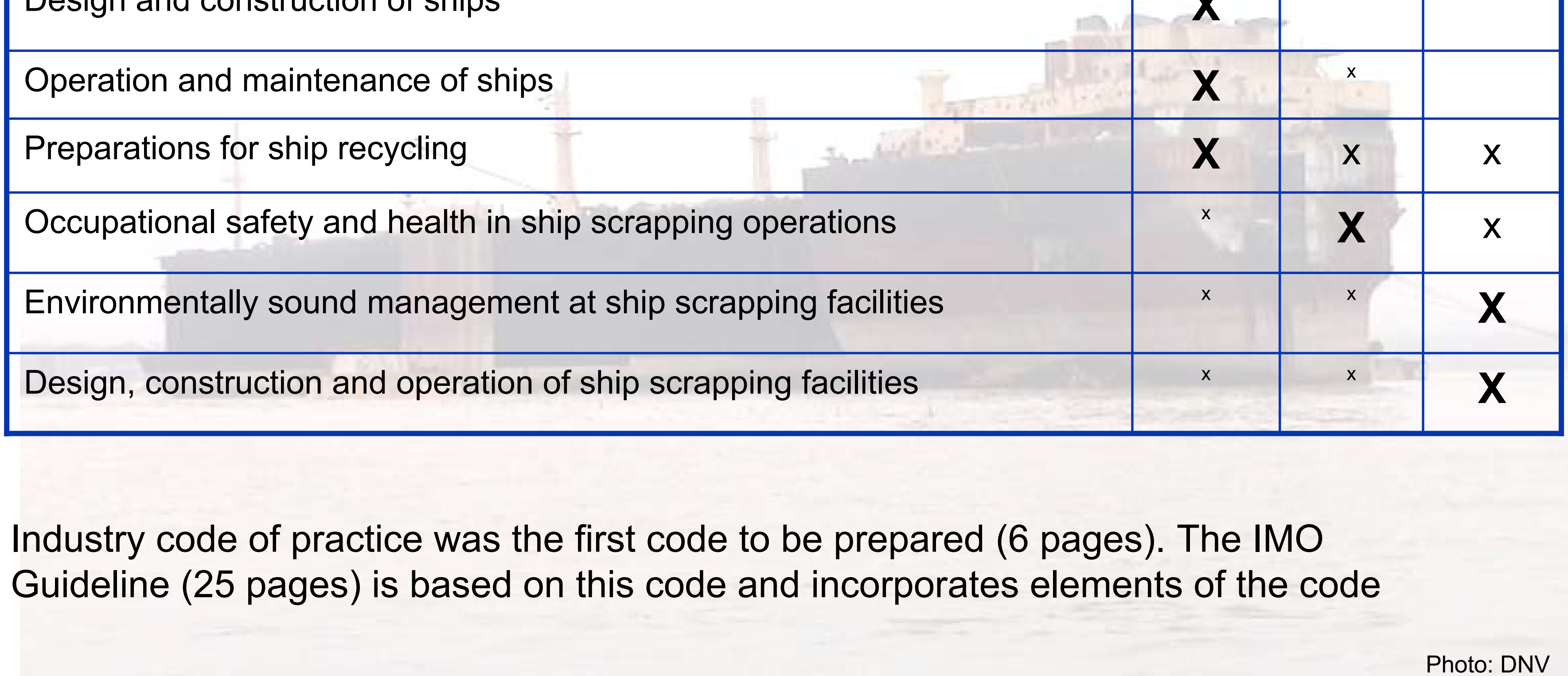


Photo: DNV

DNV Background

MANAGING RISK

Photo: DNV

Brent Spar (1994)

- Third party inventory for the offshore industry (*Inventory Dossier*)

Photo: DNV

DNV Background

MANAGING RISK

- DNV Inventories - approximately 25 offshore installations (1994 – 2005)
  - Several of these have been subjected to additional in-depth assessments

Photo: DNV

Photo: DNV

Transferring offshore experience to ship disposal

- Late 1990s DNV developed a *ship decommissioning for disposal programme* based on experience from offshore decommissioning;
  - Ship Decommissioning Guideline methodology (GUIDEC)
    - GUIdelines for DECommissioning - aimed at the ship and its crew for onboard preparations to be undertaken
  - Third Party Environmental Verification Ship Decommissioning (ENVER)
    - Independent verification protocol
  - Ship Inventory Dossier Environment (SIDE)
    - The for-runner to the *GREEN Passport* concept

- Involved in different projects for e.g.:
  - Guidelines on Ship Recycling (IMO)
  - Guidelines on Safety and Health in Ship Breaking (ILO)
  - Technical Guidelines on Environmentally Sound Management for full and partial Dismantling of Ships (Basel Convention)

Photos: DNV

DNV GREEN Passport

MANAGING RISK

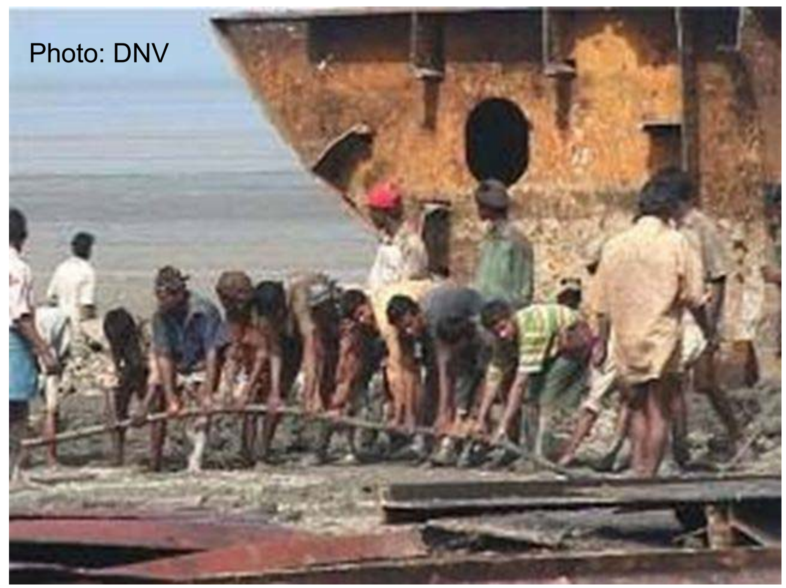
- New tonnage
  - Recycling 2025 – 2035
- Ships in Operation
  - Now – 200??
- DNV Response;
  - Green Passport – SiO
  - Green passport – Newbuilding

Photos: DNV

DNV GREEN Passport - SiO
IMO Guidelines

MANAGING RISK

- The IMO regulation calls for inventory data, a list of potentially hazardous materials onboard, <u>for all ships being delivered</u> to a ship recycling facility (GREEN Passport)
- The GREEN Passport is the <u>responsibility</u> of the ship owner and includes 3 parts:
  - Part 1 - Potentially hazardous materials in the ship's structure and equipment
  - Part 2 - Operationally generated wastes
  - Part 3 - Stores

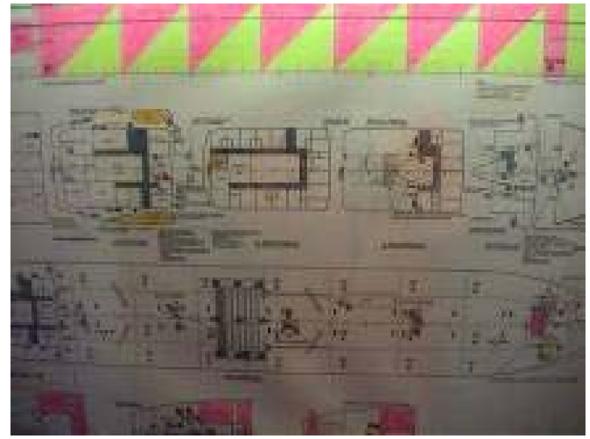


DNV GREEN Passport – SiO (Procedures)

MANAGING RISK

Methodology (Internal instruction-*Inspection Methodology for the GREEN Passport Service*):

- Preparations:
  - Review of available documentation:
    - DNV and or other Class. Soc. archives
    - Managers/ Owners/ Yards/ Suppliers input
  - Preparation of onboard survey to produce:
    - Survey Plan
    - Sampling Plan
- The DNV GREEN Passport for SiO includes part 1, 2 & 3 of the IMO Guideline



Photos: DNV

DNV GREEN Passport – SiO (Survey)

MANAGING RISK DNV

- Survey Plan:
  - Interviewing officers and crew
  - Review onboard archives
  - Visual inspection of all accessible areas/ spaces
  - Sampling of components and/ all materials potentially containing hazardous materials and substances
  - Identification of hazardous materials
- Sampling Plan:
  - *Target* material - already **known** to be onboard (e.g. verification of findings from documentation)
  - Components or materials that **may** contain such targeted substances (e.g. insulation for asbestos analysis)
  - components or materials where the chemical composition is **uncertain** (e.g. gaskets, seals, etc).

Photos: DNV

Survey/Sampling Plan – Examples

MANAGING RISK

Ships may contain environmentally hazardous substances such as:

Asbestos lagging on piping and asbestos gaskets at e.g. hatches

Asbestos in ceiling/wall plates and fire doors

Asbestos insulation in floors underneath e.g. concrete

Asbestos

mainly materials inherent in the ship structure and equipment, part 1– IMO Guideline:

- naturally occurring silicate fibers
- heat resistant
- may lead to asbestosis, cancer of the lung
- forbidden in Norway from 1986

Photos: DNV

Survey/Sampling Plan – Examples

MANAGING RISK

Asbestos being processed for recycling

Asbestos

Still legal to use in e.g. some countries in Asia

Survey/Sampling Plan – Examples

MANAGING RISK

Ships may contain environmentally hazardous substances such as:

PCB used as additive in paint

PCB in capacitors for light fixtures and one phase motors

PCB used as additive in plastic in cables

Poly Chlorinated Biphenyls

mainly materials inherent in the ship structure and equipment, part 1 – IMO Guideline:

- non-flammability, chemical stability, and electrical insulating properties
- hundreds of industrial and commercial applications
- may give liver-, skin- and reproduction injuries
- forbidden in Norway since 1980

Photos: DNV

Survey/Sampling Plan – Examples

MANAGING RISK

Ships may contain environmentally hazardous substances such as:

Radioactive sources in smoke detectors

Radioactive sources in signs

Radioactive isotopes

mainly materials inherent in the ship structure and equipment, part 1– IMO Guideline:

- used for different purposes
- radioactive radiation can cause cancer, genetically injuries and mutation
- in Norway final treatment of smoke detectors depend on quantity of radioactivity

Photos: DNV

Survey/Sampling Plan – Examples

MANAGING RISK

Ships may contain environmentally hazardous substances such as:

Typical level switch that may contain an ampoule of mercury

Fluorescent light tubes may contain mercury

Heavy metals

mainly materials inherent in the ship structure and equipment, part 1– IMO Guideline:

- used in many different commercial appliances
- a range of health effects such as behavioural problems, learning disabilities, seizures and death
- still in use in several types of products all over the world

Photos: DNV

Survey/Sampling Plan – Examples

MANAGING RISK

Ships may contain environmentally hazardous substances such as:

Hydrocarbons in hydraulic systems

Hydrocarbons in slop tank

Operationally generated wastes and stores

part 2 and 3 – IMO 1 Guideline

- bunkers diesel oil
- lube oil/grease
- slop/washing water
- in gas phase hydrocarbons may result in explosions
- hydrocarbons may have long- and short time effects to the environment

Photos: DNV

Survey/Sampling Plan – Examples

MANAGING RISK

Paint storage

Chemical storage

Operationally generated wastes and stores

part 2 and 3 – IMO 1 Guideline

- ballast water
- sewage
- garbage
- Gases in store such as:
  - CO2
  - Acetylene
  - Nitrogen
  - propane
  - spare bottles of refrigerants
- Chemicals in store such as:
  - paint
  - solvents
  - antifreeze fluids
  - engine additives
  - water treatment chemicals
  - lube oil

Photos: DNV

Analysis

MANAGING RISK DNV

- Samples are labelled/stored according to instructions specific for the sample in question and the type of analysis
- Analysed at an independent and accredited laboratory. Typical analyses:
  - asbestos
  - heavy metals analyses in e.g. paint
  - PCB in e.g. plastic, paint, rubber and mastic
  - TBT in paint
  - flame retardants in plastics
  - organic screening of substances with “unknown” content
- DNV and the accredited laboratory evaluates the results from the analyses.

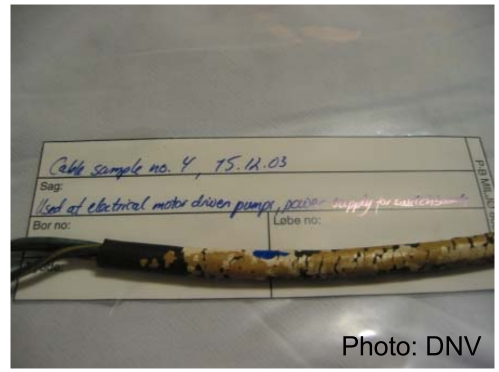
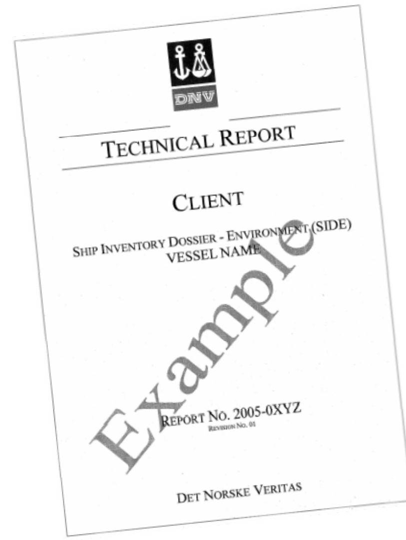


Photo: DNV

Reporting of findings

DNV Ship Inventory Dossier (SIDE) report:

- Potential dangerous materials in the ship's structure and equipment
- Operationally generated wastes
- Stores



TECHNICAL REPORT

CLIENT

SHIP INVENTORY DOSSIER - ENVIRONMENT (SIDE)
VESSEL NAME

Example

REPORT NO. 2005-0XYZ

DET NORSKE VERITAS

Based on compiled SIDE report DNV issues:

- GREEN Passport Statement of compliance (with IMO Guideline)
    - Leaflet summarising the findings reported in the SIDE-report

DET NORSKE VERITAS

Green Passport
Statement of Compliance
IMO Resolution on Ship Recycling, Part 1,2,3

Det Norske Veritas AS

Reporting of findings

MANAGING RISK

Example of findings asbestos:

- 110 m^3 asbestos, mainly in the accommodation module
- Other materials will be contaminated by asbestos when removal is carried out, giving a total sum of 125 m^3
- In one vessel the volume of asbestos was identified to 26 m^3, of this 80 % was found as insulation in floors
- Asbestos has been found onboard relatively new vessels as spares, e.g. in brake linings

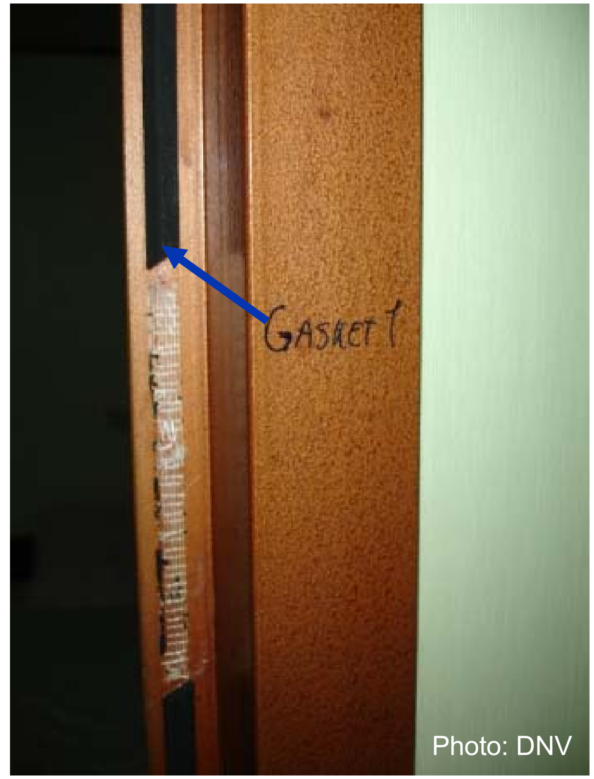

Photo: DNV

Reporting of findings

MANAGING RISK

Typical findings PCB:

- Typical number of capacitors possibly containing PCB is in the range 500-600 items
- The PCB content in each capacitor is typically 30 mg
- DNV analyses have never indicated PCB values in cables, gaskets etc. that are exceeding the threshold value for classifying PCB containing materials as toxic waste i.e. 50 mg/kg



Reporting of findings

MANAGING RISK

Typical findings radioactive sources:

- 10-20 ionising smoke detectors with a radioactive source (engine room)
- Level detectors containing a radioactive source are seldom found
- Luminous emergency exit plates on vessels are normally not of the type containing a radioactive source

Reporting of findings

Typical findings heavy metals:

- Totally 10-15 grams of mercury in fluorescent light tubes
- Totally 200-300 kg lead in lead acid batteries
- A level switch with Hg typically contains 10-15 grams Hg
- Paint samples contain several different types of heavy metals

Photos: DNV

Reporting of findings

Examples of findings hydrocarbons, chemicals, refrigerants and gases:

- Bunker (heavy fuel oil and marine gas oil): 250-1,500 m^3
- Lubrication oil: 30-40 m^3
- Sludge (heavy fuel oil and lube oil): 1-5 m^3
- Oily bilge water: 4-40 m^3
- Chemicals for tank cleaning: 4-20 m^3
- Foam: 1,000-2,000 kg
- Refrigerant R22: 400-500 kg

Photo: DNV

Conclusions based on DNV experience

MANAGING RISK

- SiO differs from newbuildings primarily because:
  - reflect the building standards of their time when many of the hazardous materials now known where considered acceptable
  - significant number of SIO are queuing up for recycling now, not in 25 years time
- For SiO it is not possible to conclude on presence of hazardous materials by the vessels age:
  - years of bans for different materials varies in different parts of the world
- For SiO an onboard survey has to be performed in order to indicate possible hazardous materials
- Spare parts supplied from onshore may contain "hazardous materials"

Photo: DNV

The Future of Ship recycling

MANAGING RISK

DNV

- From Guidelines to a mandatory regime
  - IMO Convention on Ship Recycling (?)
    - Work initiated 2005 (MEPC 53)
    - Adopted by IMO in 200?

- Increased regional and national focus e.g.
  - EU- development of recycling strategy for EU flagged vessels
  - UK/Netherlands national policy development on ship recycling
  - US ghost fleet 140 vessels +, – nationally owned tonnage

- Industry under scrutiny
  - Increased pressure from the cargo owners/general public on government and the industry
  - Highlights needs for response to regulate the ship recycling industry

……In the meantime, implementation of existing guidelines;
  - Coordination
  - Harmonization

Photo: DNV


Questions?
Photo: DNV

Environmental Friendly Recycling of FRP-Sandwich Ship Hulls

Anna Hedlund-Åström, Per Reinholdsson
and Conrad Luttropp

KTH Industrial Engineering and Management

Outline

- Background
- Visby Class Corvette
- Model for assessment of disposal techniques
- External factors
- Results and conclusion

Background

- Young group of materials
- Techniques exist
- No market
- Action due to regulations
  - *–landfill*
  - *–producers responsibility*

VAMP 18 recycling and recovery of fibre composites

Inventory

Environmental demands

Waste streams

Techniques for recycling and recovery

Methods for assessment of costs and environmental effects

Identifying waste receiver

Info

Case studies

1. Carbon fibre
2. Sandwich, PVC-core
3. Thermoset, glass fibre
4. Thermoplastic, glass or flax fibre

Input

Analysis

Cost
Environment

Output

Info

Goal

Guidelines based on cost and environmental effects

General results from VAMP 18

- Material recycling is recommended
- Energy recovery can be considered

“Small” experiences

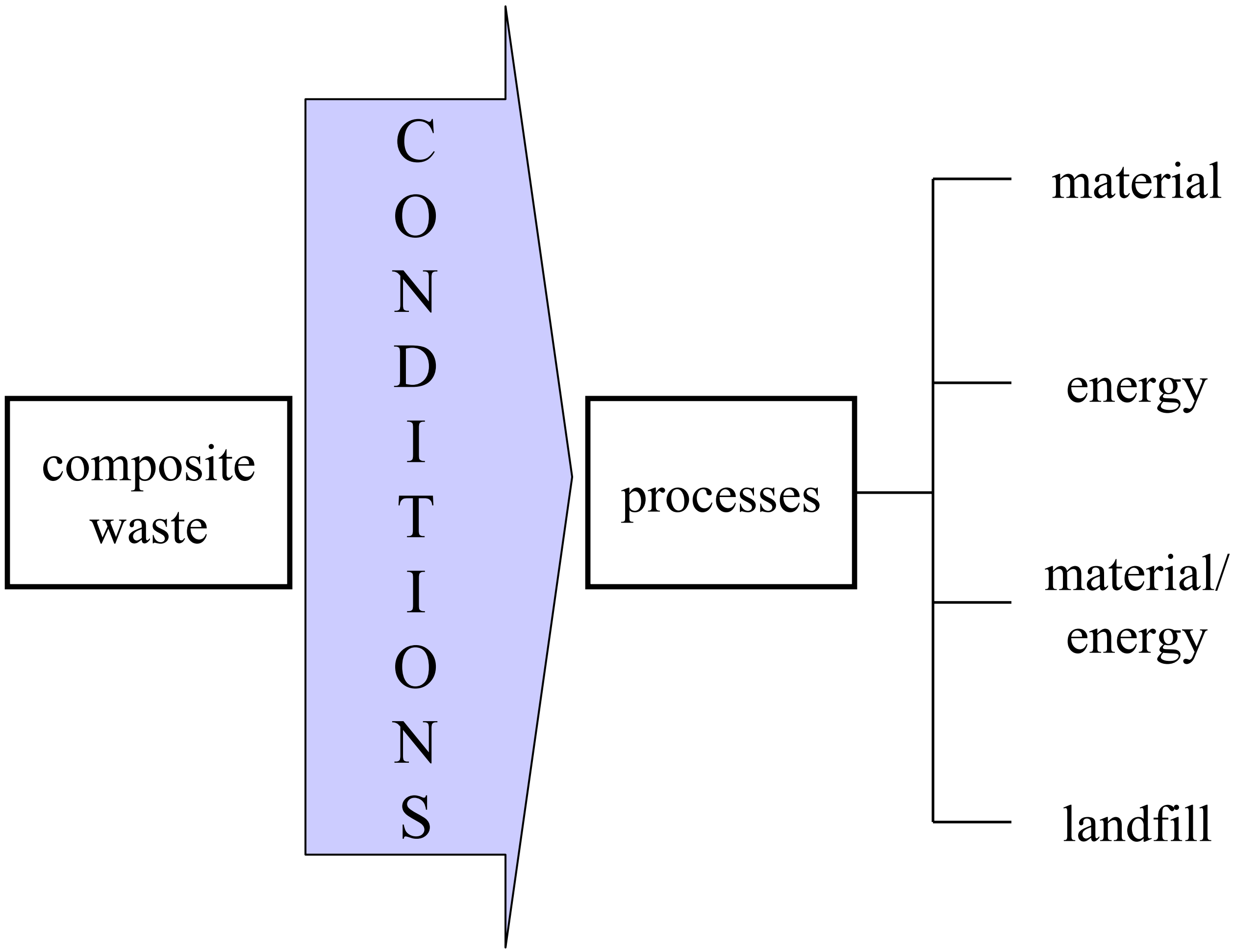
Visby Class Corvette

Model for end of life treatment

Influencing factors for waste handling

- Internal factors
  - *Waste properties*
  - *Process properties*
- External factors
  - *Legislation*
  - *Market*

Model for assessment of disposal



Conditions

- Set by process properties
- Fulfilled by waste properties
  - **SZE** size
  - **FIB** fibre
  - **MTX** matrix
  - **CORE** core material
  - **PUT** putty
  - **MET** metallic inserts
  - **HAZ** hazardous substances

Waste properties for Visby hull

SZE, 72 m, 150 000 kg

FIB, carbon 50 000 kg

MTX, vinylester 40 000 kg

CORE, PVC/PUR foam 40 000 kg

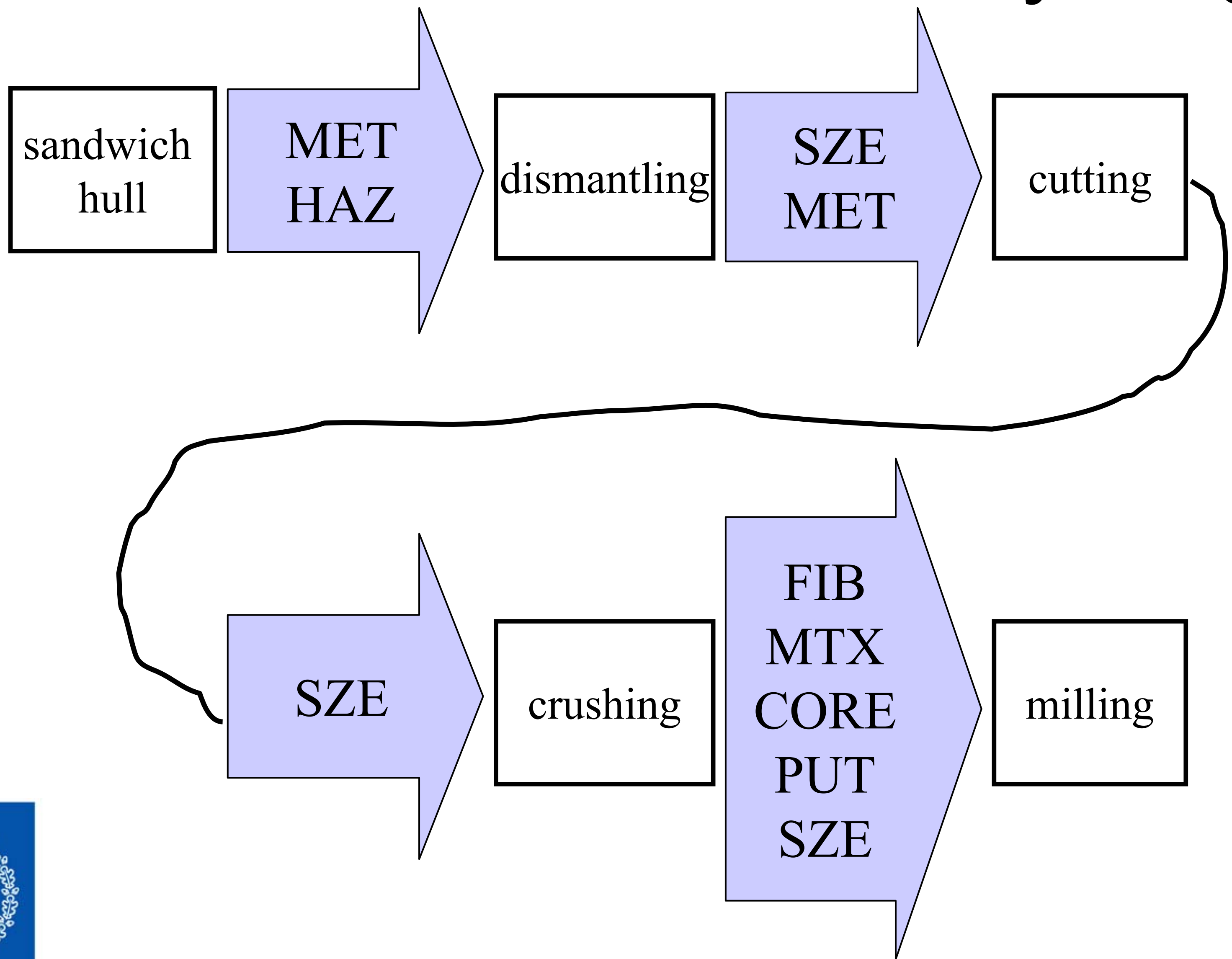
PUT, polyester 20 000 kg

MET, from drawing

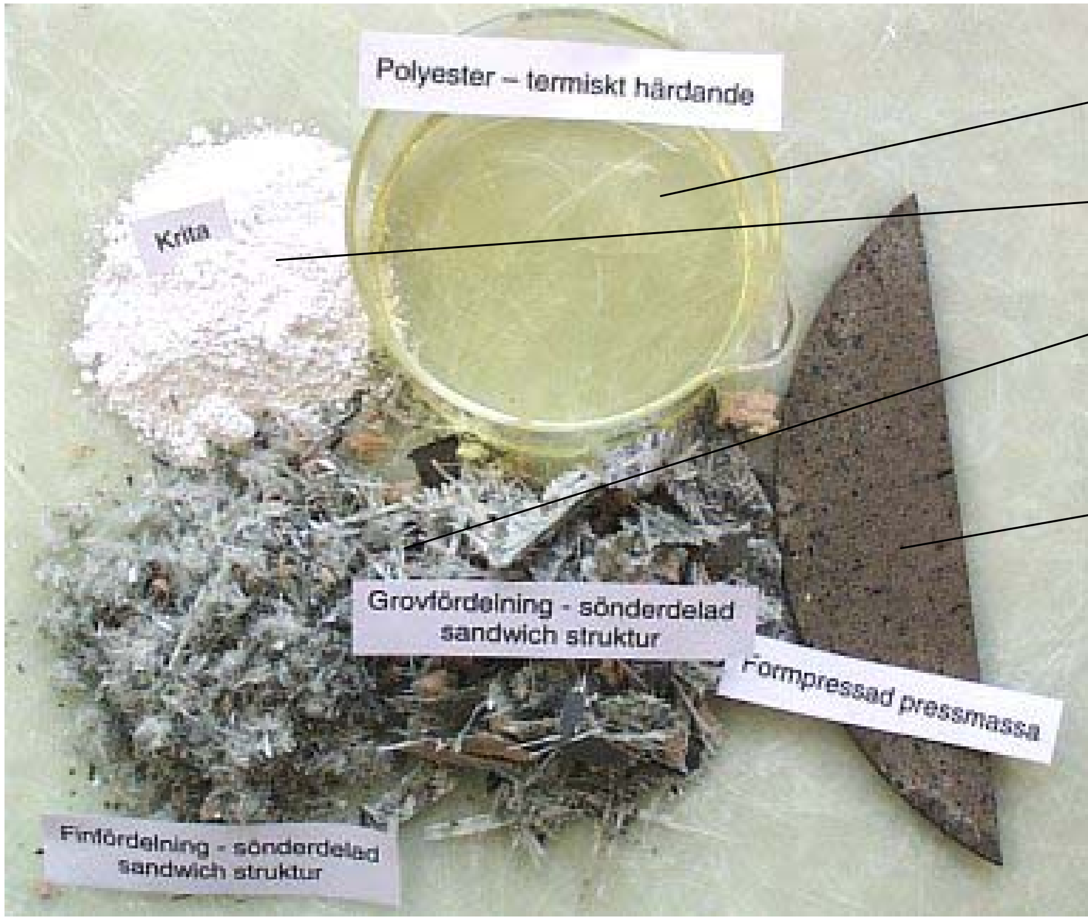
HAZ, Cl, Pb, Cu

- Reuse
- Mechanical material recycling
- Material recycling by pyrolysis (carbon fibre)
- Chemical recycling (PVC from core)
- Energy recovery
- Landfill

Mechanical material recycling



Milled FRP-sandwich



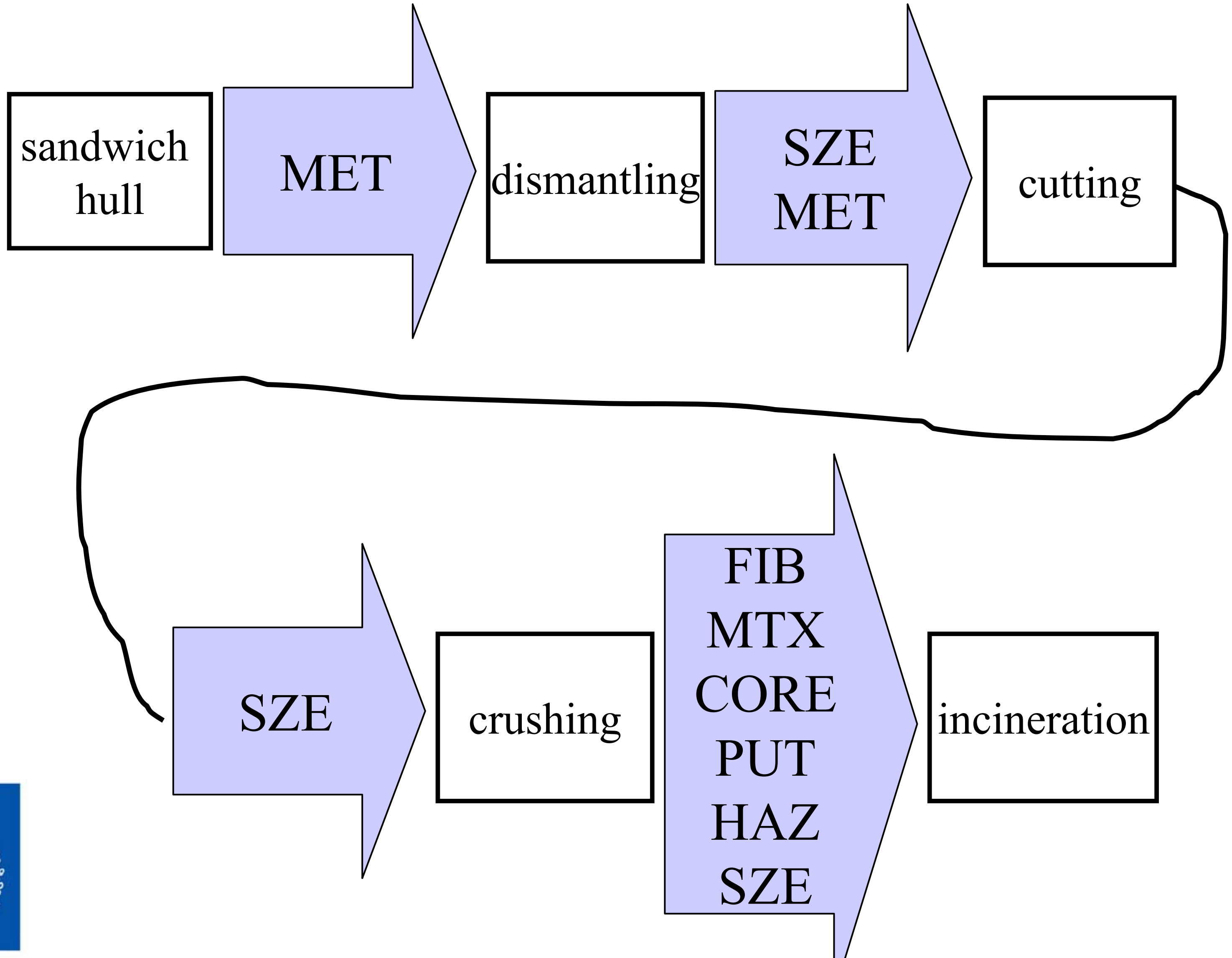
Polyester

Filler

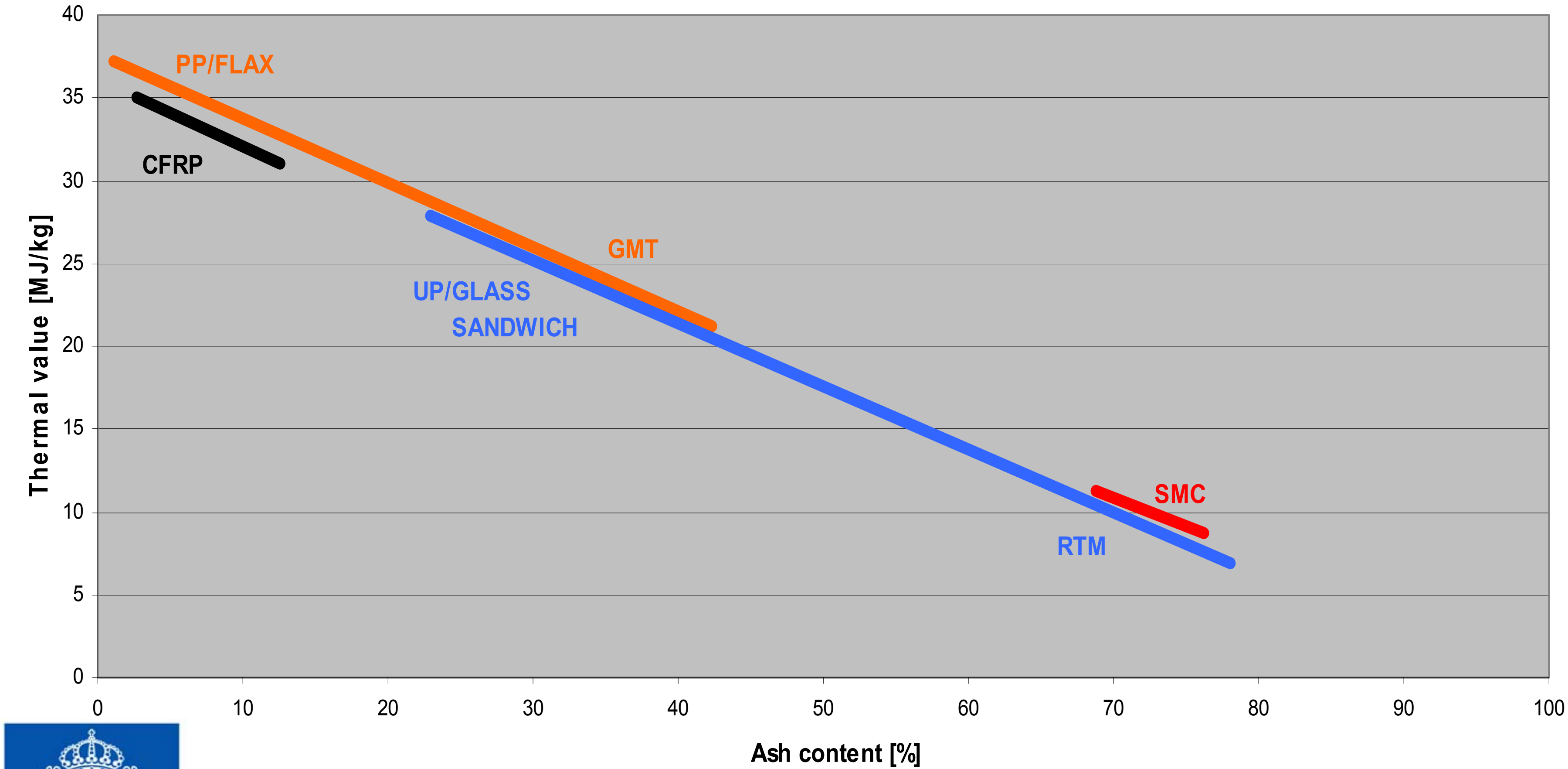
Recycled material

New product

Energy recovery



Thermal Value



KTH Industrial Engineering and Management

External factors

- Market
  - *amount of waste*
  - *infrastructure*
  - *techniques*
  - *applications*
- Regulations
  - *external environment*
  - *working environment*

External environment

- Prohibition against landfill
  - *2002, combustible materials*
  - *2005, organic material*
- Producer responsibility
  - *packaging*
  - *end of life vehicles, ELV*
  - *electrical and electronic equipment, WEEE*
- Taxes for waste incineration

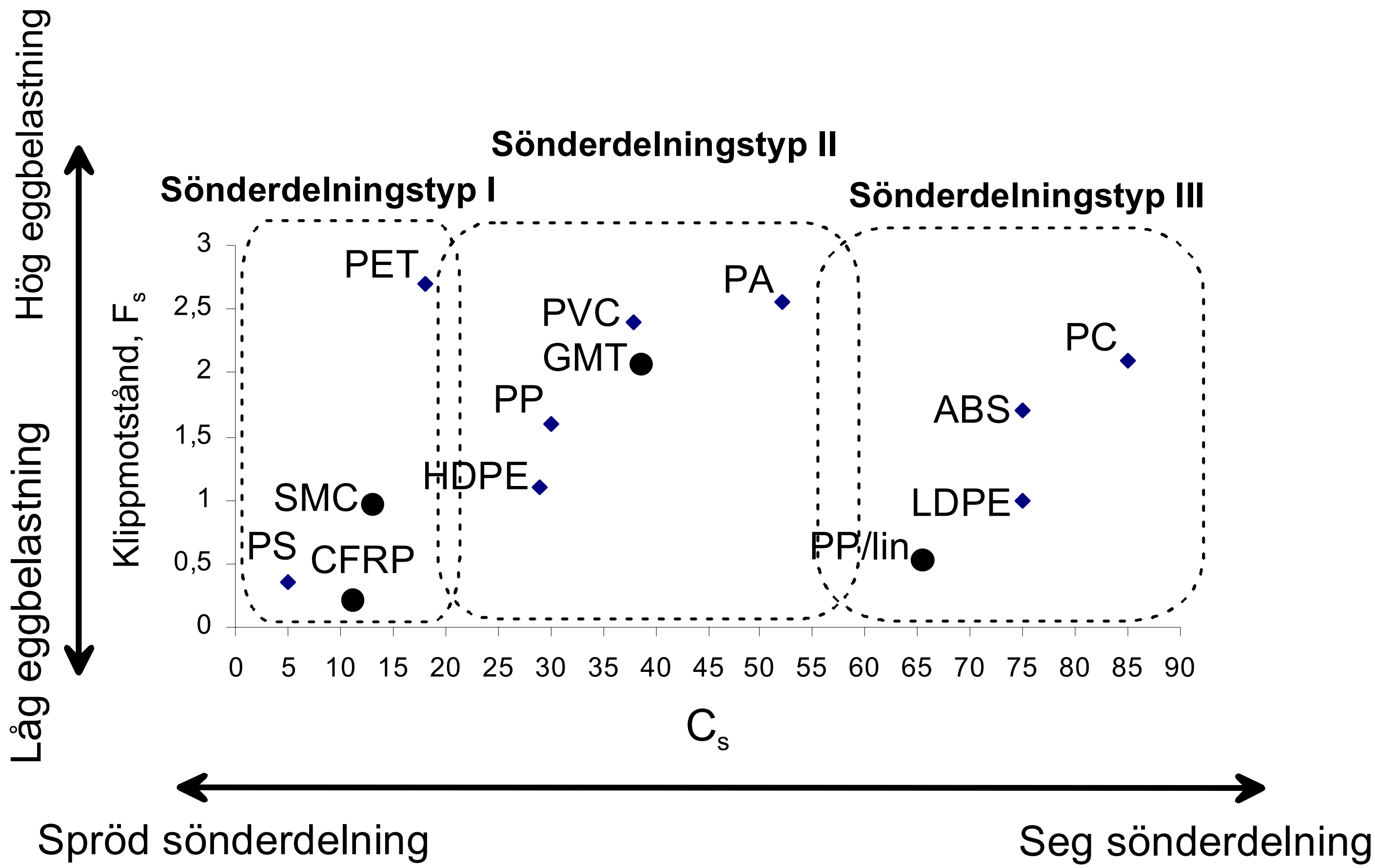
Working environment

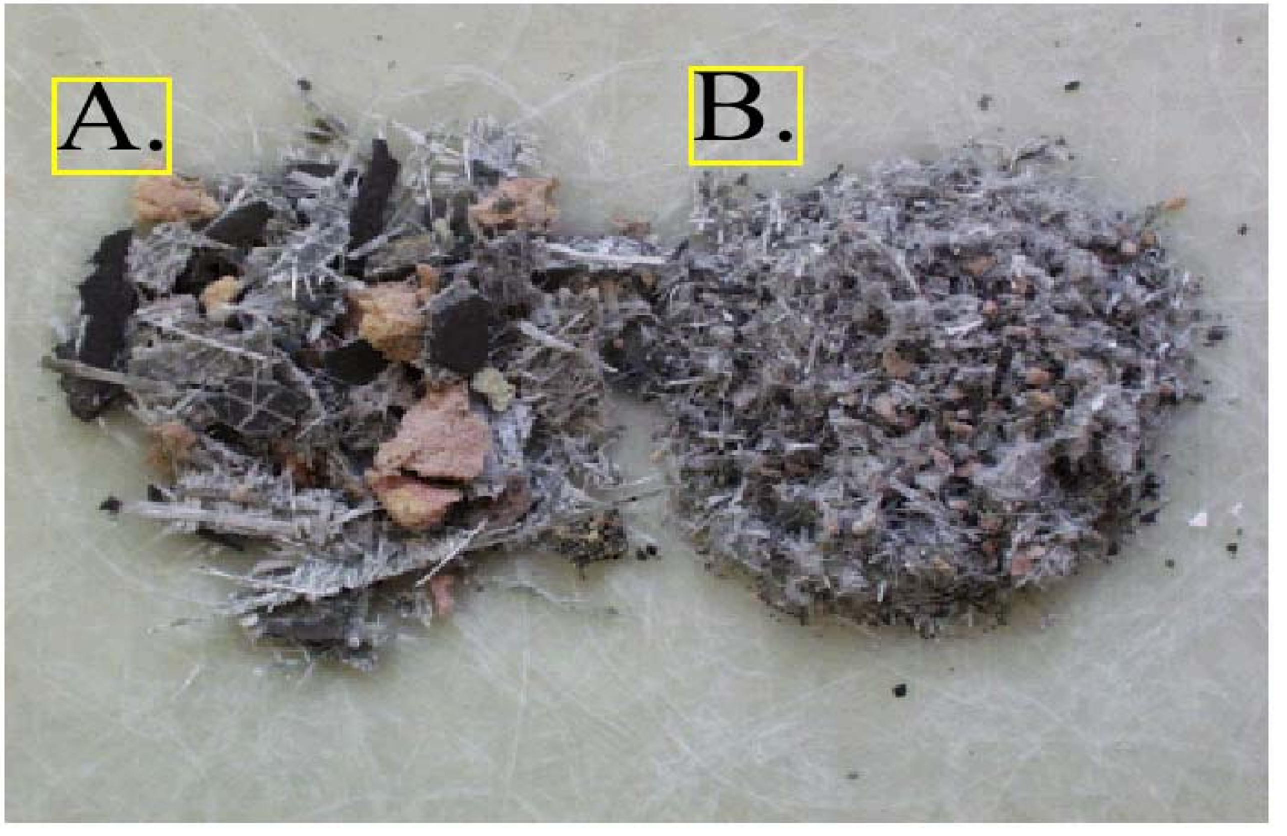
Dismantling, cutting, crushing, milling

- *dust*
- *smoke, gas (hydrochloric acid, icocyanates from PVC/PUR-core)*
- *sharp fibers (carbon)*
- *noise*

Conclusion

- Today landfill and energy recovery
- Model points out several methods as possible
- External factors conclusive


Hög eggbelastning
Låg eggbelastning
Sönderdelningstyp I
Sönderdelningstyp II
Sönderdelningstyp III
Klippmotstånd, F_s
3
2,5
2
1,5
1
0,5
0
PET
PVC
GMT
PA
PC
PP
ABS
HDPE
SMC
LDPE
PS
CFRP
PP/lin
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
C_s
Spröd sönderdelning
Seg sönderdelning


A.
B.

Establishment of a Knowledge Data Base to support Ship Recycling

Dr. Andrezj Karpowicz
Prof. George Bruce
Mr. Ashutosh Sinha

Outline

- Objectives
- Regulations / Policies
- Technical Aspects
- Scrapping Market
- The Project
- A conceptual Knowledge Data Base
- Conclusions

Objectives of the research

- A single source of information
- Comprehensive
- Accessible
- Consistent

- Support an EU recycling industry

Regulations/Policies

- IMO
- ILO
- Basel Convention 1992

Technical Aspect

The principle process of ship scrapping consists of a sequential chain of operations

- Offshore: Prior to beaching tanks are discharged and valuables are removed
- Inter-tidal zone: The vessel is beached under its own power and demolition is initiated
- The beach: Further cutting into manageable sizes
- Shore: Supply of second-hand equipment and components to the market

Scrapping Market

Market Shares (DWT) main ship breaking nations
1996-2000

Country	1996	1997	1999	2000
India	50%	51%	37%	47%
Bangladesh	25%	26%	28%	19%
Pakistan	11%	12%	15%	10%
China	1%	1%	14%	22%
Others	14%	11%	5%	2%

Source: The ship recycling Fund: ECORYS 2005

Scrapping Market Cont.

Average Material composition by ship type (%)

Ship Type	Re-rolling steel	Melting steel	Cast Iron Scrap	Non-Ferro Metal	Machinery	Wood furniture	Waste
General cargo	64.5	11	2.5	0.7-1	6	5	10
Bulk Carrier	71	10	2	0.5-1	4	3	9
Tankers	76.5	8	2	0.5-1	3	1.5	8

Source: The ship recycling Fund: ECORYS 2005

The project

Consortium

SHIPMATES

Shiprepair to Maintain Transport which is Environmentally Sustainable

- Shipbuilders & Shiprepairers Association, UK
- A&P Tyne, UK
- Cantieri Navali Italiani S.p.A, Italy
- Estaleiros Navais de Viana do Castelo S.A., Portugal
- Lisnave-Estaleiros Navais SA, Portugal
- BERTECH, Poland
- CETENA, Italy
- Instituto Superior Tecnico, Portugal
- University of Patras, Laboratory for Manufacturing Systems, Greece
- University of Hertfordshire, Dept. of Aerospace, Civil & Mechanical Engineering, UK
- University of Newcastle upon Tyne, UK
- Choren Design & Consulting, Poland

The project cont.

Key objectives of the project

- Review of the shiprepair, refitting and recycling industry
- Analysis of organisation and methods
- Development of technological solutions

- Application to recycling

The proposed Knowledge Database (KDB)

The KDB should encompass

- Policies
- Regulations
- Economics
- Management & organisation (Operations)
- Environmental Issues
- Market Analyses
- Human Factors
- Technical Aspects

Policy Issues

- Long term strategies
- New Initiatives
- Trends

- Requires
  - EU representation

Regulations

- International regulations (UN, IMO, EU)
- National regulations
- Regional regulations

- Requires
  - Legal experts

Financial Aspects

- Ship decommissioning operations and their financial structures
- Shipbreaking/ ship recycling process cost modelling

- Requires
  - Shipping/Shipbuilding Economist

Management & Technology

- Optimisation of yards technology
  - Dismantling
  - Recycling

- Requires
  - Yards Management & organisation

Environmental

- Policies
- Measures

- Requires
  - Ecologist/ Environmental Lawyer

Market Analysis

- Shipbreaking demand forecasting on national, EU and world market basis;
- Shipbreaking yards capacities state-of-the-art & prospects
- Requires
  - Shipping & Shipbuilding Marketing / Market Research

Human Factors

- Ship Recycling Specialised Yard personnel education and training;
- Safety and Health Executive issues

- Requires
  - Personnel and/or Human Relations

Technical Aspects

- Design for recycling concepts, new materials adoption included;
- Specialised Ship Recycling Yard production process definition;
- Theoretical calculations of disassembling process (hull strength, hull stability, risk analysis, etc.);
- Low labour intensity steel processing methods development;
- Technical measures of environment protection (facilities, tools and procedures)

- Requires
  - Naval Architects & Engineers

Conclusions

Ship recycling is an integral part of the life cycle management of ships.

A long term solution for the ship recycling industry has to be based on an International legal framework, the guide lines being set by

- the International Maritime Organization (IMO),
- the International Labour Organization (ILO),
- and the Basel Convention.

A Knowledge Data Base is an essential means of underpinning responsible recycling.

Thank You!!

Recycling High Speed Ferries

And ideas for the future

Robert Bryce CEng, MIMarEST, MRINA

Introduction

- Historical Perspective
- The Size of the Market
- Life Cycle
- Issues Influencing Scrapping
- Recycling Aluminium
- Ideas for the Future
- Conclusions

Historical Perspective

- 1950’s – Hydrofoils
- 1960’s – Hovercraft
- 1970’s onwards – Monohulls, Catamarans and others
- 1990’s – Large HSC – Catamaran/Wavepiercers, Monohulls

Core Factors in the Development of HSC

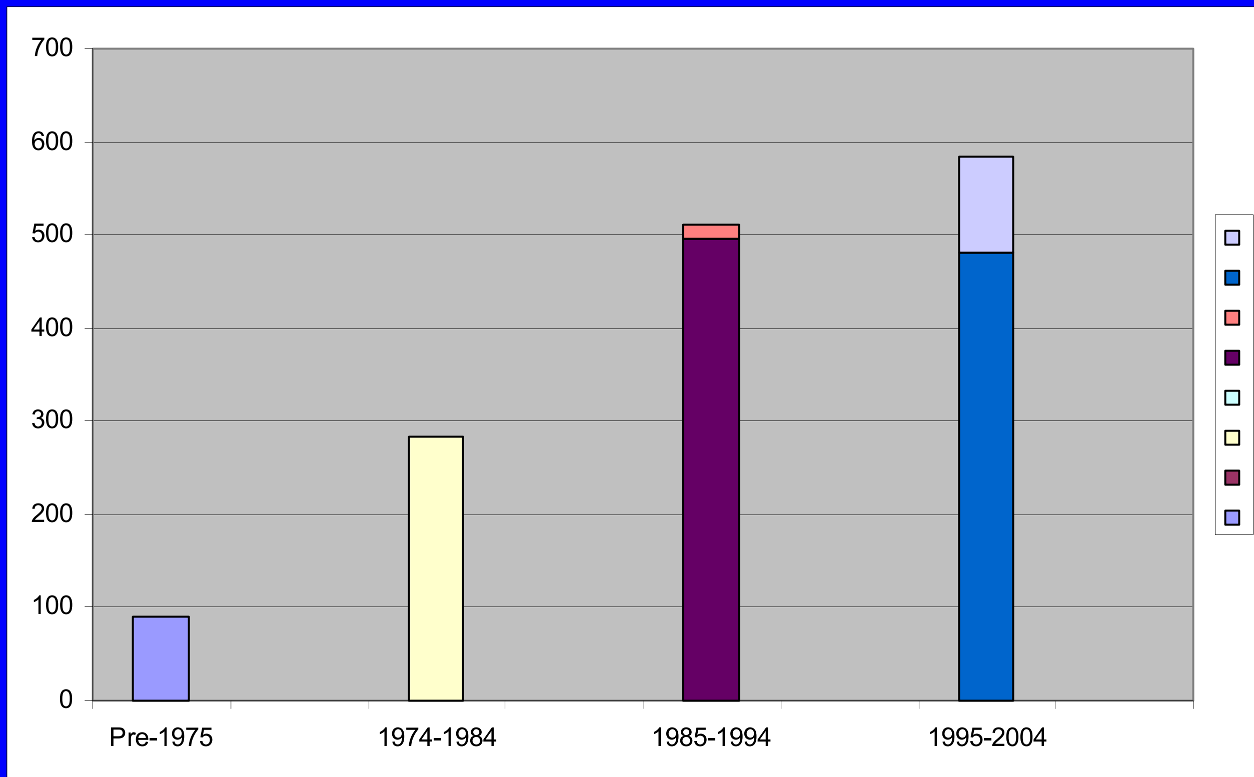
From the 1970's the number of high-speed ferries constructed increased dramatically. This came about due to a number of core factors-

- Increased availability, reliability and efficiency of small high-speed diesel engines,
- Increased affluence opening up markets that supported suitable routes,
- Availability of new lightweight materials,
- The promulgation of the Dynamically Supported Craft (DSC) Code superseded by the High Speed Craft (HSC) Code.

The Size of the Market

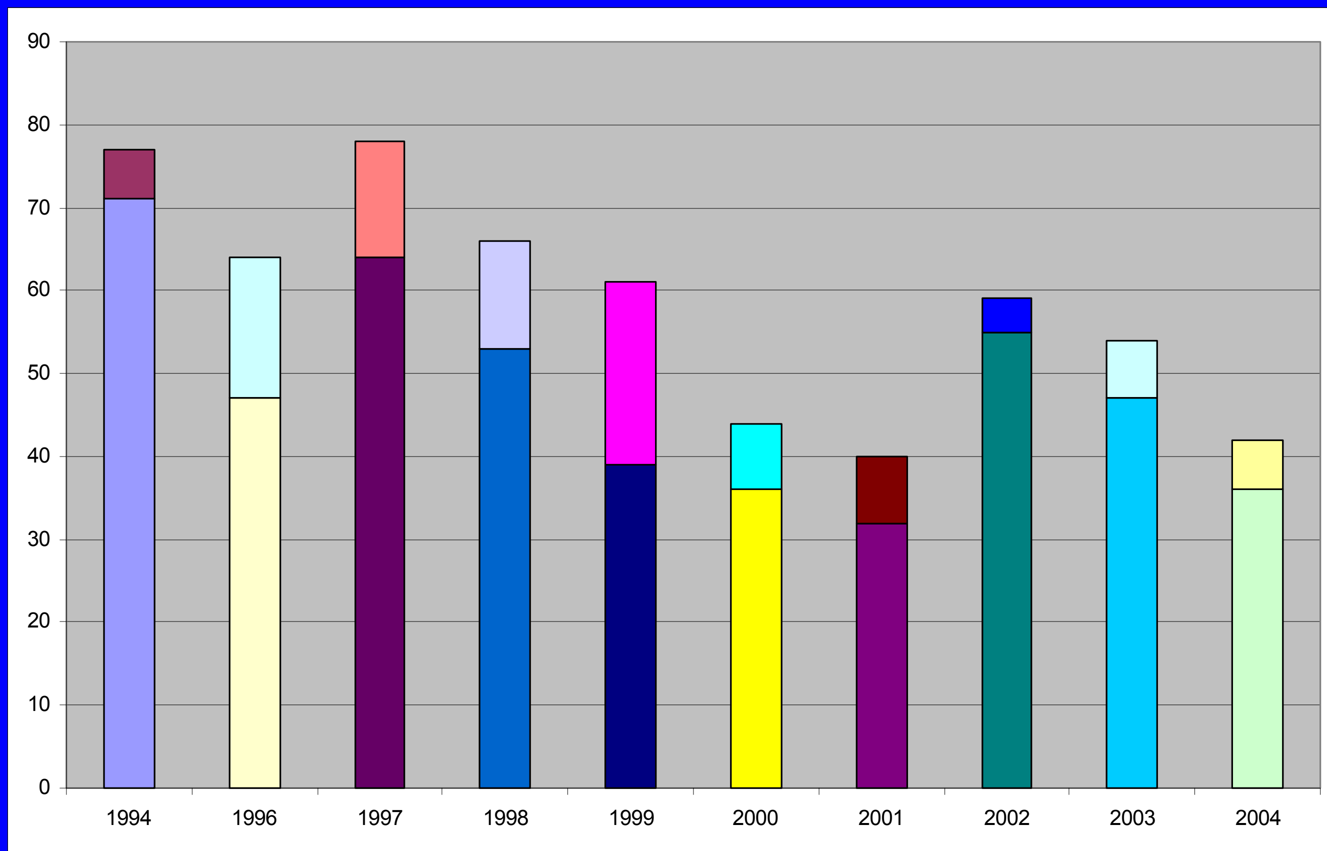
- Aluminium vessels only
- Includes hydrofoils exported from the FSU
- Two categories
  - Less than 50 metres LOA
  - Greater than 50metres LOA

The Size of the Market



Data courtesy of Fast Ferry International

Recent Trends – 1995 to 2004



Data courtesy of Fast Ferry International

Life Cycle

- Background
- Structural Issues
- Life Extension

Background

- HSC include
  - Monohulls
  - Catamarans/Foil Assisted Cats/Wavepiercers/SES
  - Trimarans
- Restrictions placed on operation
  - Wave height /weather
  - Length of route
- Regulatory/Classification
  - Not all vessels built to Class or HSC Code

Structural Issues

- Early Craft were riveted construction
- Tempered Plate/welded construction
  - Repeated welding repairs weakens structure
  - Operation in conditions outside operating permit can hasten structural decline

Life Extension

- Ease of main engine removal/replacement
- Refurbishment costs low due to simple passenger cabin arrangements
- Resiliently mounted superstructures

Life Issues influencing scrapping

- Technical Issues
- Material Use
- Practical Issues in Scrapping HSC

Technical Issues

- 20-30 year operating life very achievable
- Accelerated decline
  – Electrolytic corrosion
    - Poor or degrading electrical installation
    - Inadequate corrosion protection
    - Poor isolation of dissimilar metals
    - Inappropriate berthing arrangements
  – Operation outside operating restrictions
  – Design / Fabrication deficiencies

Material Use

- Hull & Superstructure
- Outfit
- Windows
- Insulation
- Paint
- Machinery/Electrical

Material Use

- Hulls
  - Plate – 5000 Series Aluminium Alloys
  - Extrusions – 6000 Series & 5000 Series
- Superstructures
  - Plate – 5000 Series Aluminium Alloys
  - Extrusions – 6000 Series & 5000 Series
- Ratio of plate to extrusion is higher in hull

Material Use

- Outfit
  - HSC Craft
    - Low combustibility materials/fabrics
    - Aluminium panels/extrusions for bulkheads, internal structure
  - Non-HSC Craft
    - Generally higher levels of combustible materials
  - Aircraft style seating the norm

Material Use

- Windows
  - 30 to 50% of superstructure sides is glass
  - Direct bonding of windows to structure now common
    - Eliminating window frames
- Insulation
  - Glass fibre/mineral wool insulation
    - Sound and structural fire protection
  - Asbestos rarely used

Material Use

- Paint
  - Paint only necessary for aesthetic reasons
  - Internal voids paint generally unpainted
- Machinery/Electrical
  - Equipment as per conventional shipping
    - Lightweight, low combustibility
  - Composite waterjet inlet ducts
  - Carbon fibre shafting
  - Simplified piping systems

Practical Issues in Scrapping

- High % of fleet are smaller than 50 metres LOA
- Required Infrastructure is low
- Recycling industrial infrastructure
- Alloy sorting necessary
- Lower levels of painting reduces toxic risks to scrapping workers
- Lower levels of painting assists in reducing re-processing steps

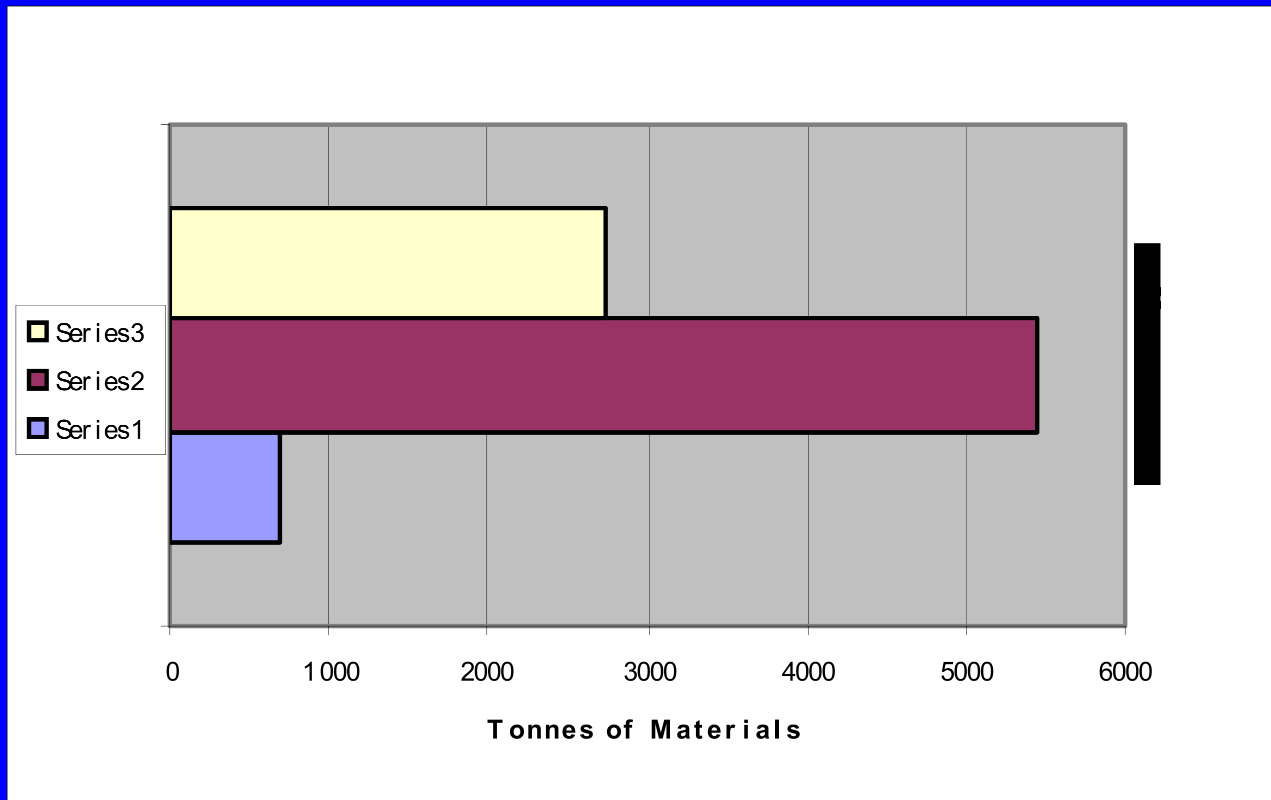
Recycling Aluminium

- Environmental
- Economic

Environmental

- Recycling one kilogram saves up to 8 kilograms of bauxite, four kilograms of chemical products and 14-kilowatt hours of electricity.
- Electricity saving = Reduced Greenhouse Gas Emissions

Environmental



Comparison of materials saved in scrapping 100m Monohull.

Economic

- Alloy series 5000 & 6000 higher scrap value alloys
  - Low copper content plate
- Cleanliness of scrap increases value by reducing re-processing steps
  - Ferrous and paint contamination requires special treatments

Depreciation/Residual Values

	40m Cat	75m Cat	100m Mono
Value - USD			
New	5,000,000	20,000,000	45,000,000
15 Yrs	500,000	2,000,000	4,500,000
Scrap	59,400	330,000	897,000

Indicative Values Only

Future Scrapping Trends

- Life Expectancy
  - 20 to 30 years practical life being achieved
- Scrapping Projections
  - Up to 200 craft to be scrapped over next five years
  - Averaging up to 40 vessels per year
  - Larger vessels not due for scrapping until 2020
    - Some early versions of large vessels may be retired earlier

Ideas for the Future

- Overview
- Conclusions

Overview

- Community concerns and Governmental Regulations shall drive more stringent environmental controls
- Environmental economics should provide stimulus towards greater material recovery
  - Recycling of primary materials
  - Use of recyclable materials in outfit
  - New financing models where manufacturers provide a service, for example
    - Engine supplier contracted to supply machinery that provide a power and fuel consumption requirement

Conclusions

- HSC are a small sector of the main shipping industry
- The boom in the construction of large commercial HSC is over
- Larger HSC likely to be limited to military and specialist uses
- Given the age profile of the HSC fleet the numbers of vessels reaching scrapping is due to increase in the next five years
  - Smaller vessels are predominant.
  - Yearly numbers being scrapped offer market opportunities for scrapping facilities and builders

Recycling is a Shore-based Industry

F R Chowdhury
Bahamas Maritime Authority

Synopsis:

- More global trade and oil and gas exploration lead to more ships and structures that eventually will require recycling; Year 2010 when all single hull tankers will have to be replaced and by then lot of structures will have to be recycled;

- The London Convention 1972 has no reference to ship recycling; The OSPAR Convention/ SINTRA Statement is a regional agreement for North-East Atlantic; The Basel Convention is aimed at restricting export of toxic and harmful substances (to the third world countries) by making the ship (as carrier) and the exporter responsible; - None of them apply to ship recycling;

- The role of IMO: “Safer ships and Cleaner seas” – safe operation of ships and protection of the marine environment from shipboard sources;

Synopsis…Contd.

- Ship taken out of operation becomes mere structure and recycling of such structures ashore is a shore based industry; IMO role and competence does not extend to that extent;
- IMO is trying to interpret the operation of a ship under its own power as an export of potentially hazardous waste (under Basel Convention) and trying to regulate the matter through the involvement of Flag State and the owner;
- In the real world situation the ship-owner may not sign an agreement with the scrap-yard and then sail the vessel as an export commodity. The ship may change hands/ ownership several times. Let the ship comply with all IMO requirements until arrival at last port and then instead of ship-owner and operator it should be the person dealing with the scrapping business (metal dealer) who should deal with scrap-yard;

Synopsis….Contd.

- The only Party that can exercise effective jurisdiction and control is the country where the recycling will take place;
- For the sake of protection of the global environment it is necessary to have scrapping facilities located all over the world instead of being concentrated only in the third world countries;
- The arrival in India of Danish ferries for scrapping proves beyond doubt that present IMO-ILO initiatives will not work
- Possible solution – a new Convention (Under ILO umbrella) focussing responsibility on the State of jurisdiction;

Synopsis….Contd.

- The scrapping industry should be controlled and regulated as any other shore based industry. IMO does not regulate the health, hygiene and environmental aspects in shipyards where the ships are built;
- IMO should try to amend SOLAS/ MARPOL as necessary to ensure that ships are built with less toxic and hazardous materials;
- The ship-owners, operators, Flag Administrations and the IMO should concentrate on their core business of safer ship and cleaner seas making sure that until the last day of operation the ship complies with all requirements.

Thank you!

RECYCLING OF SHIPS MADE OF GLASS REINFORCED POLYESTER

M Jastrzębska, Gdynia Maritime University, PL
M Rutkowska, Gdynia Maritime University, PL

W Jurczak, Naval University of Gdynia, PL

GDYNIA MARITIME UNIVERSITY

- Faculty of Business Administration
- Faculty of Marine Electrical Engineering
- Faculty of Marine Engineering
- Faculty of Navigation

FACULTY OF BUSINESS ADMINISTRATION

- Department of Commercial Operation of Ships
- Department of Hotel and Tourism Management
- Department of Commodity Science
- Department of Management
- Chair of Information System
- Department of Chemistry

POLISH MINESWEEPERS

Recycling the construction body of the non-magnetic vessels is a crucial task for The Polish Navy. There is necessity for the Polish Navy to recycle end-of-life ships, which are made of glass reinforced polyester (GRP) in 90% by their weight.

The hull of the vessel was built in three sections:

- a midship with deck
- a bow
- a stern.

The laminating process was performed in a steel form installed on a turn-table.

This vessel's displacement is of 208 DTW (dead weight tons). Its dimensions were: 125.7 x 23.6 x 5.9 feet.

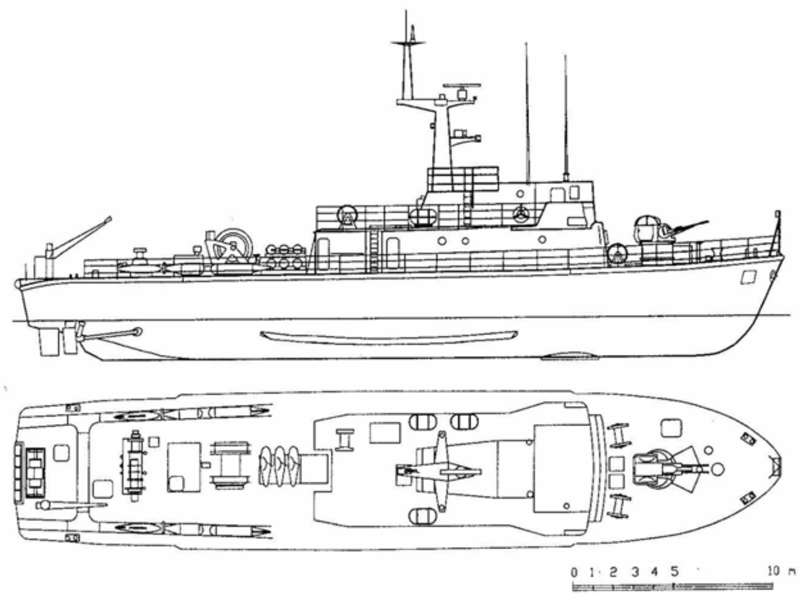
PROPERTIES OF GLASS REINFORCED LAMINATES

- good mechanical properties (high strength and hardness) at relatively low density
- chemical resistance and resistance to corrosion
- easy moulding of great-size products of complicated shapes
- relatively low production cost

GLASS REINFORCED POLYESTERS ARE DIFFICULT TO RECYCLE BECAUSE

- the material is fully cured
- the material contains incorporated glass reinforcement
- the curing process is not reversible
- great durability and resistance to the environment

WHAT TO DO WITH THE BIG SIZE WASTES?



- the export of decommissioned ships to other countries
- scuttling those hulls into marked places in the sea
- using the hulls as targets in naval and air force training attacks

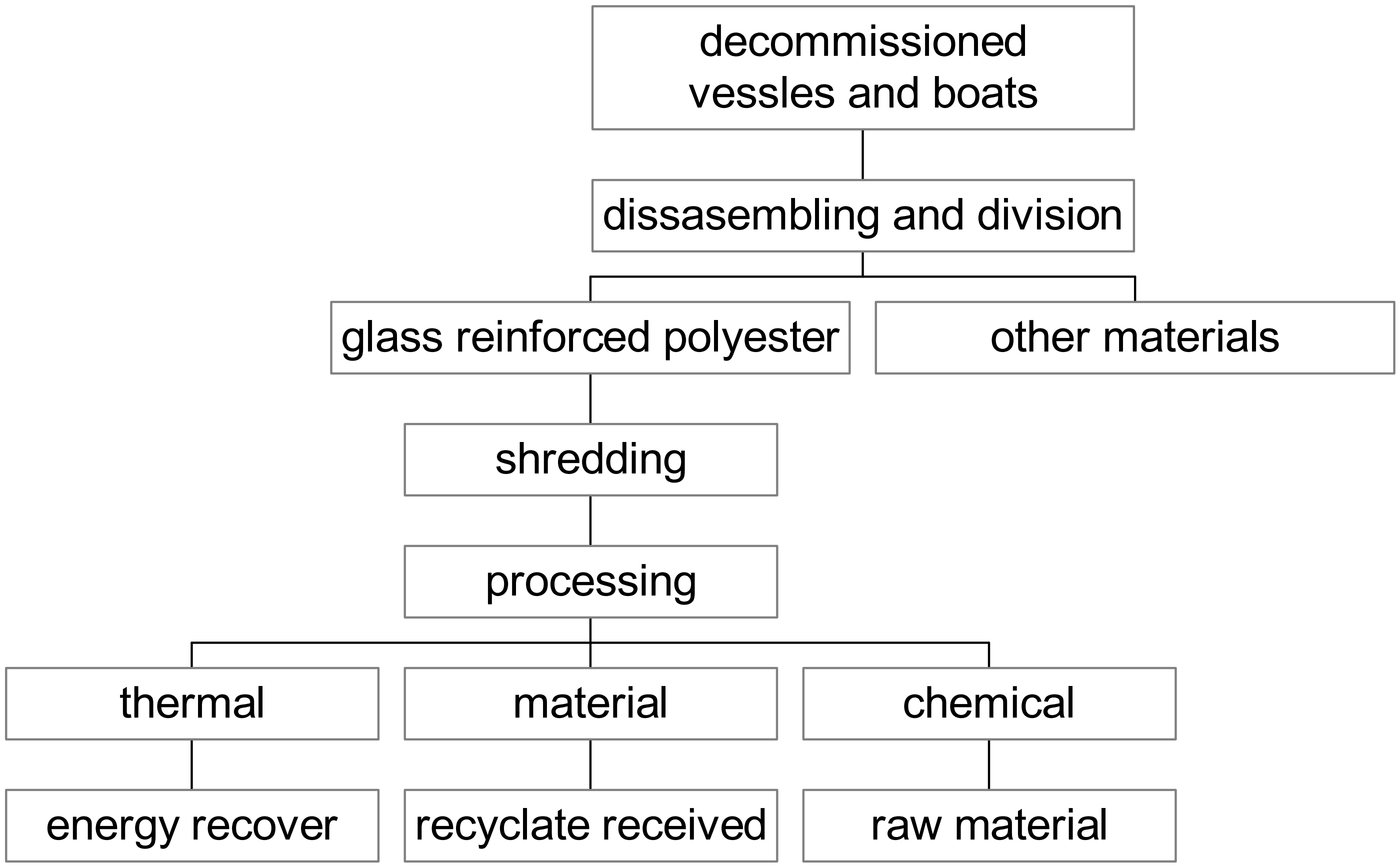
We should avoid leaving the decommissioned hulls in any messy way

Another picturesque landscape

THE BASLE CONVENTION

According to The Basle Convention voted on 22nd March 1989 (accepted in Poland on 18 June 1992) any export of overexploited ships is forbidden, unless they are previously cleaned from all poisonous components. In connection with this problem we decided to perform a research in this area.

DIAGRAM OF GRP WASTE RECYCLING



THERMAL RECYCLING

with energy recover

- relatively low fuel values of GRP
- too much ash
- toxic gasses are emitted
- fibre glass can block fillers in combustion plants
- an incinerator plant is needed
- the method is usually not accepted by the local inhabitants

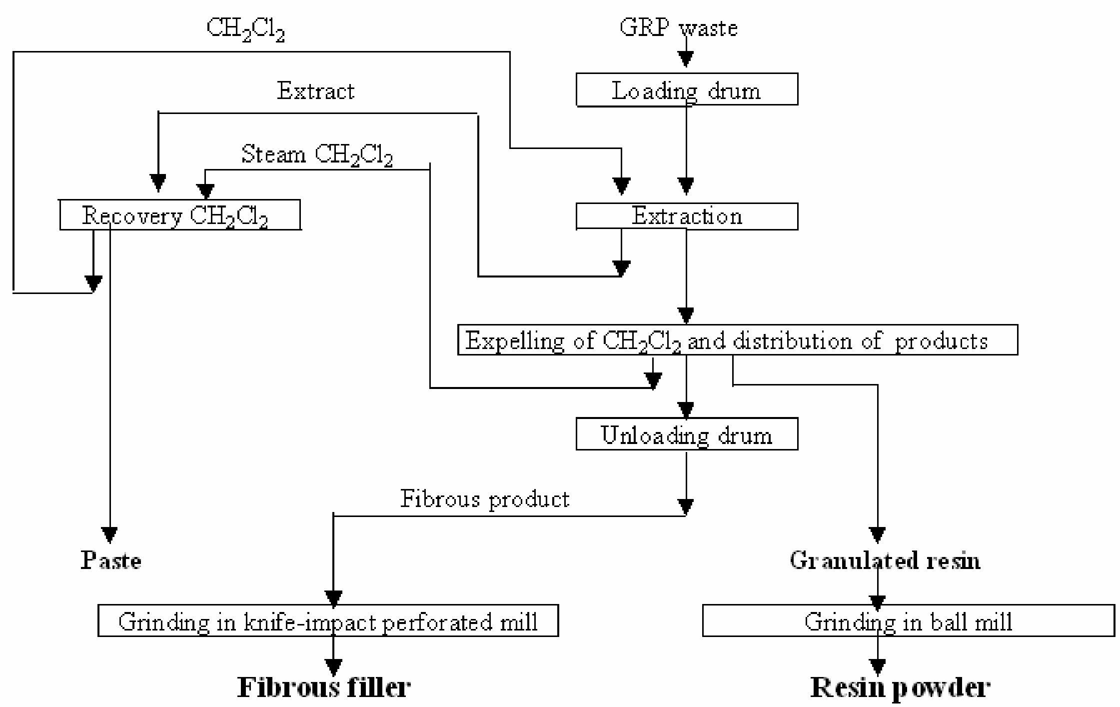
CHEMICAL RECYCLING

involves either degradation in various solvents or pyrolysis

- an expensive method
- requires reducing the size of the wastes (shredding, cutting, grinding)

Flowsheet of utilization of glass-reinforced polyester laminate waste

[E.Kowalska,Z. Wielgosz, T. Bartczak]



MATERIAL RECYCLING

the production of new, commercial raw materials from the old materials

- does not require a lot of investment outlays
- the recyclates are valuable fillers and reinforcements of the new materials
- the properties of the new material depend on the source of the recycled composite material
- this method is ecologically accepted

OUR RESEARCH

- estimation the possibility of recycling the glass reinforced polyesters (GRP)
- GRP shredding
- getting the recyclate filling into a new resin
- testing the properties of the achieved materials (mixture of recyclate and other resin)

RECYCLATE MATERIALS

Waste of the glass fibre reinforced polyester was ground in Hydromega shredder with breaking and cutting blades. The size of the scraps were 20 -30 mm.

MATERIALS USED FOR THE COMPOSITES

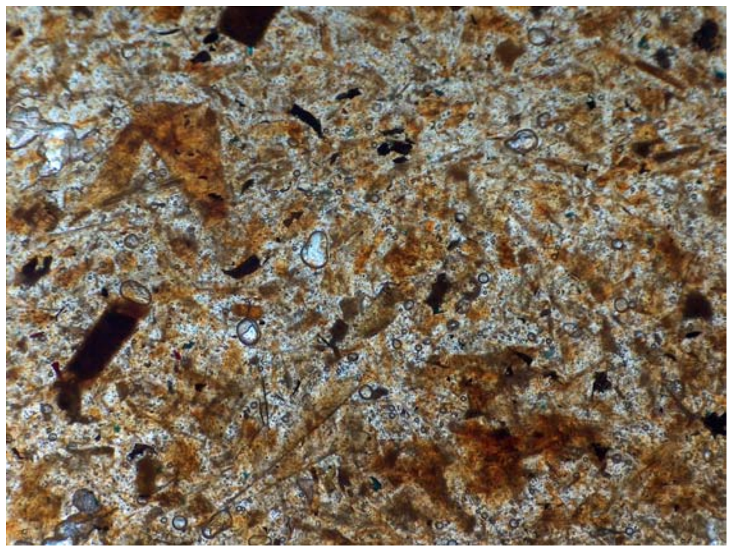
- unsaturated ortophthalic polyester resin Polimal 109 – manufactured in Chemical Work “Organika –Sarzyna” S.A. (Poland)
- unsaturated dicyclo pentadiene polyester Synolite - manufactured in Chemical Work “Organika –Sarzyna” S.A. (Poland)
- epoxy resin Epidian – manufactured in Chemical Work “Organika –Sarzyna” S.A. (Poland)
- glass fibre mat – substance of 150 or 450 g/ m^2
- initiator (metyl ethyl keton peroxide or triethyleneteramine or Luperox K-1)
- accelerator (cobalt naphthenate)

COMPOSITES

- unsaturated polyester Polimal
- unsaturated polyester Polimal with 18.3 wt% glass fibre mat
- unsaturated polyester Polimal with 30 wt% recycled GRP
- unsaturated polyester Polimal with 20 wt% recycled GRP and 10 wt% glass fibre mat
- unsaturated polyester Synolite with 20 wt% recycled GRP
- epoxy resin with 17.5 wt% recycled GRP
- epoxy resin with 30 wt% glass fibre mat

The composites were fabricated by hand lay-up process at room temperature.

The sample of GRP recyclate in polyester matrix



Tensile strength, hardness and notched impact strength of the composites

Formulation	Tensile Strength [MPa]	Notched Impact Strength [kJ/m^2]	Hardness [MPa]
polyester Polimal	45.6	8.3	220.0
polyester Polimal with 18.3 % glass fibre mat	82	8.1	282.5
polyester Polimal with 30 % recycled GRP	63	2.0	228.1
polyester Polimal with 20 % recycled GRP, 10 % glass fibre mat	28.2	3.0	312.6
polyester Synolite with 20 % recycled GRP	10.3	-	203.7
epoxy resin with 17.5 % recycled GRP	14.3	0.6	168.0
epoxy resin with 30 % glass fibre mat	74.1	4.8	160.8

CONCLUSIONS

- The addition of the recycled glass reinforced polyester to a polyester resin matrix resulted in a reduction in notched impact strength and an increase in tensile strength.
- Matrix epoxy resin and Synolite resin are not so good binders for the glass reinforced polyester recycled as Polimal resin.
- Our continuation of the research will involve usage of the surface activator applied for increasing the adhesion between fibre and resin matrix.


Thank you for your attention

Royal Institution of Naval Architects

Recycling of Ships and Other Marine Structures

INTERNATIONAL CHAMBER OF SHIPPING

Ship Recycling

International & National Regulations and their Enforcement

Industry Guidelines and Voluntary Codes of Practice

Important Issues

Worker Safety
Worker Health
Environmental Protection

Important Issues

Worker Safety
Worker Health
Environmental Protection

Economic Benefits
Environmental Benefits
Lack of Alternatives

Bangladesh Government View

"In the absence of any domestic source of iron ore, Bangladesh has to depend on steel from scrapped ships…. (which) …. provides about 80% of the country's steel needs. The industry also provides an important source of revenue to the Government and helps … with the production of cement, construction materials, sand, stone, sanitary equipment, re-rolling mills, safety equipment etc."

"Ship recycling is an industry that Bangladesh cannot afford to lose."

Bangladesh Government View

"Other items from ships such as engines, generators, boilers, electrical and plumbing items, furniture, refrigerators, air-conditioners etc are mostly re-used. The garment manufacturing factories use the engines and generators: boilers are used mainly in rice mills, garment washing plants, knitting plants and other industries. Wooden planks, bars and furniture are also re-used."

Recycling Definition

"the processing of waste or rubbish back into raw materials so that it can be made into new items. It is undoubtedly beneficial - to the individual, the community and the planet."

World Wide Fund for Nature

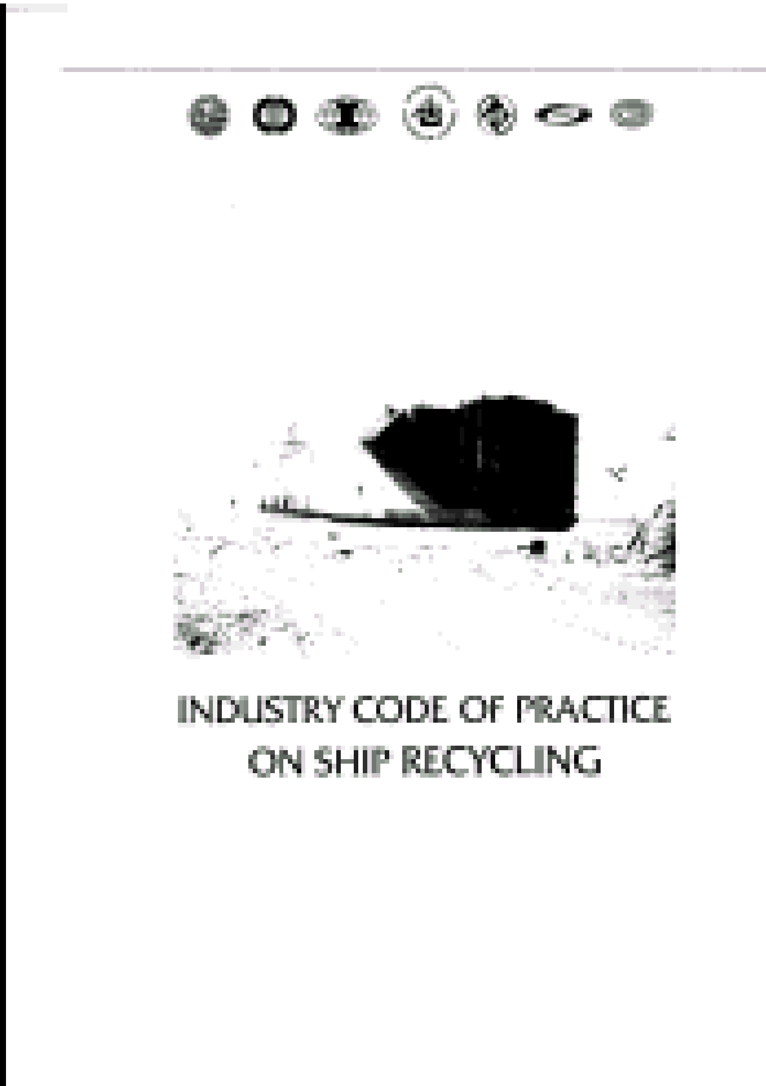
SHIP RECYCLING

INDUSTRY WORKING PARTY

Baltic and Intl. Maritime Council	BIMCO
Intl. Chamber of Shipping	ICS
Intl. Ass. Of Dry Cargo Shipowners	INTERCARGO
Intl. Ass. of Independent Tanker Owners	INTERTANKO
Intl. Tanker Owners Pollution Federation	ITOPF
Intl. Transport Workers Federation	ITF
Oil Companies Intl. Maritime Forum	OCIMF

With Observers from

Intl. Association of Classification Societies	IACS
European Community Shipowners' Ass.	ECSA



Published in 2001

http://www.marisec.org/recycling/index.htm

Current Issues

IMO Guidelines	a)	Voluntary or Mandatory
	b)	Reporting System
Govt. Responsibilities	a)	Yard capabilities
	b)	Material Identification
	c)	Enforcement
Basel Convention	a)	Is it applicable to ships?

Mandatory Provisions

1. Applicable
2. Acceptable
3. Enforceable

INTERNATIONAL CHAMBER OF SHIPPING

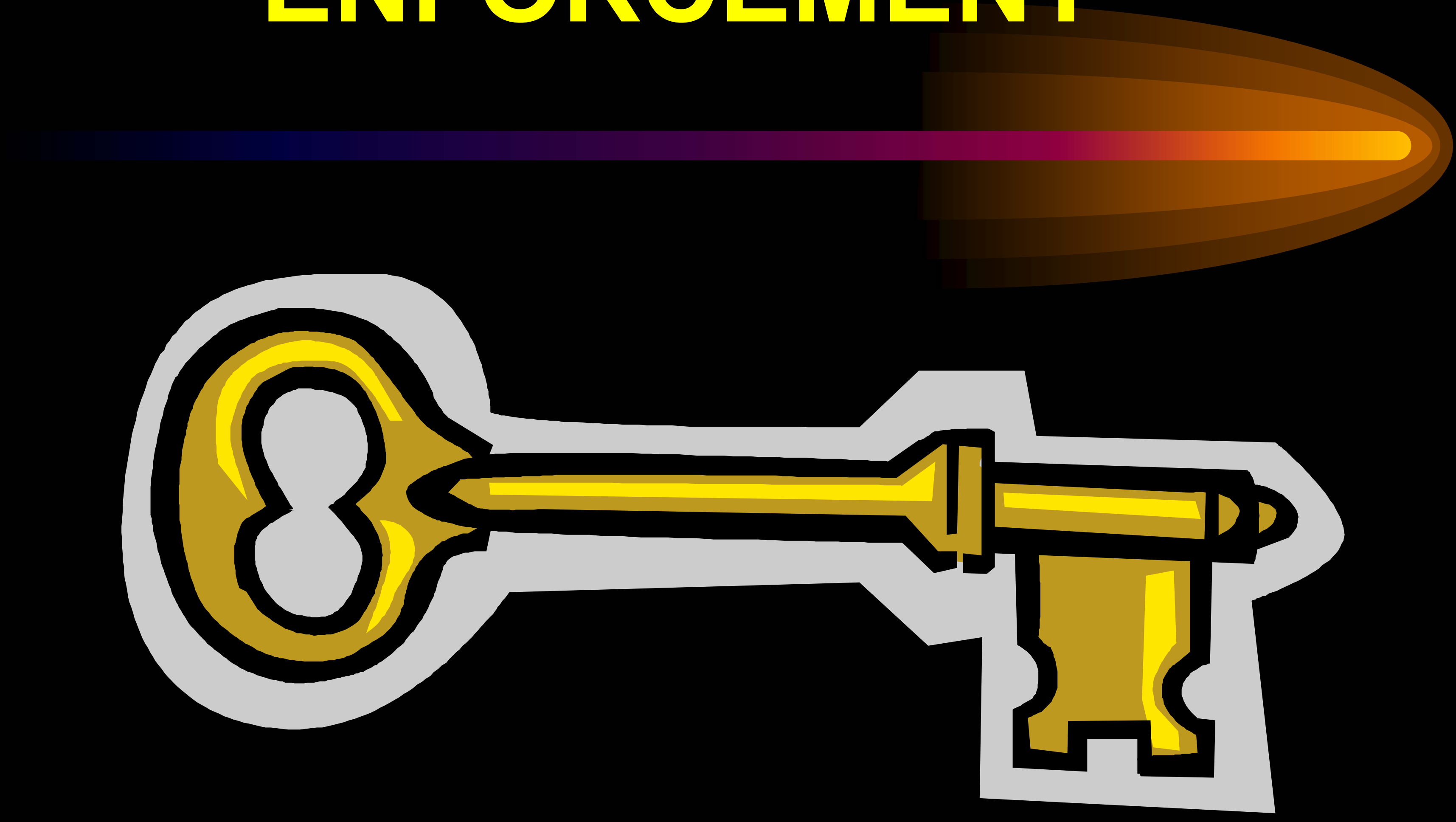
REGULATIONS

INTERNATIONAL

NATIONAL

INTERNATIONAL CHAMBER OF SHIPPING

ENFORCEMENT



INTERNATIONAL CHAMBER OF SHIPPING

Industry View

1. International Dimension
2. Equality with other modes
3. Consistency, Clarity, Uniformity
4. Appropriate to the issues
5. Cooperation with industry
6. Liaison with stakeholders
7. Practical - not Political

Mandatory Provisions

Responsibility	Possible examples
Shipowners	Gas free certificate Inventory
Recycling States	Facility assessment Facility supervision
Facilities	Reception facilities Recycling plan

Reporting System

<u>One Government's Proposal</u>

a) Contract completion	Certification Shipowner notifies flag state Flag notifies recycling state Recycling State approves facility
b) After pre-cleaning	Certification Recycling yard notifies shipowner Recycling yard informs its State Recycling State informs flag State
c) After dismantling	Certification Recycling yard informs shipowner Recycling yard informs its State Recycling State informs flag State Flag state informs shipowner

Acceptable Reporting System

- fulfil a purpose
- simple and straightforward
- universally applicable
- be completed before contract
- place notification responsibility on both parties

Reporting System

<u>Industry Proposal</u> - On contract completion

- Owner notifies flag State
- Recycler notifies recycling State

Mandatory Provisions

Steps

a) Identify appropriate recommendations
b) Establish principles
c) Consider appropriate instrument
d) Develop text
e) Adopt text
f) Ratify text

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal

Is it applicable to ships??

MEPC 49 - "IMO would not tend to define the ship delivered for recycling as waste but as a resource containing some contaminants."

A "Hazardous Waste" must be

- Explosive
- Flammable Liquid
- Flammable solid
- Liable to spontaneous combustion
- When in contact with water, emit flammable gases
- Oxidizing
- Organic Peroxides
- Poisonous (Acute)
- Infectious
- Corrosive
- Liberate toxic gases in contact with air or water
- Toxic (Delayed or chronic)
- Ecotoxic
- Liable to leach hazardous substances after burial

A “ship” exhibits none of these characteristics and cannot be a “hazardous waste” and is not subject to the provisions of the Basel Convention

Government Responsibilities

Setting the priorities

Setting the standards

Setting the law

Enforcing the law

“Obsolete vessels laden with asbestos, PCBs, toxic paint, biocides, fuel residues and other hazardous substances migrate from wealthy shipping companies and nations to some of the poorest communities on earth for extremely hazardous scrapping “on the cheap””.

Basel Action Network/Greenpeace

“Ship recycling is an industry that Bangladesh cannot afford to lose.”

Bangladesh Government

Shipowner - Broker

Cash Buyer

Broker - Recycler

PRIORITY AREAS

1. WORKER SAFETY & HEALTH

2. WORKER SAFETY & HEALTH

3. WORKER SAFETY & HEALTH

4. Environmental Health & Safety

The Way Ahead - Practical & Pragmatic

Short Term

1. Recycling facility identification
2. Recycling facility assessment
3. Recycling facility endorsement
4. Ship Recycling Plan
5. Inventory
6. Gas freeing
7. Reception Facilities
8. Potentially Hazardous Material Identification
9. Endorse acceptable contract

DEMOLISHCON

The Way Ahead - Practical & Pragmatic

Medium Term

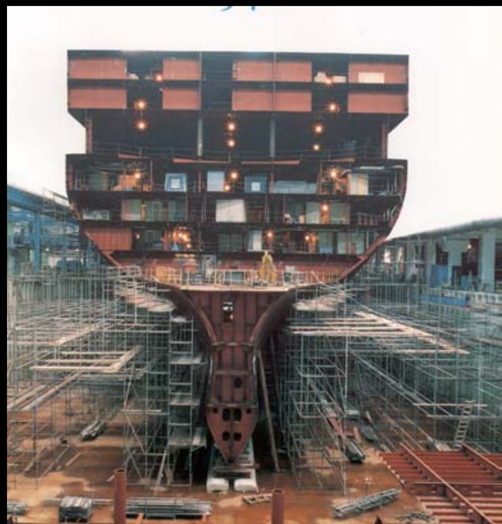
1. Legislation v. Recommendation
2. CSR
3. Training and advice

The Way Ahead - Practical & Pragmatic

Long Term

1. Cradle to Grave
2. Potentially Hazardous Material Substitution

"Cradle to Grave"



Conclusions

1. RECYCLING CAPACITY IS ESSENTIAL
2. PROBLEMS HAVE BEEN IDENTIFIED
3. PROBLEMS HAVE TO BE ADDRESSED

How is shipping viewed?

LIKE THIS????

Or This???

How is shipping viewed?

LIKE THIS????

OR THIS???

How is shipping viewed?
LIKE THIS????

OR THIS???

INTERNATIONAL CHAMBER OF SHIPPING

There must be a better way

There must be a better way

INTERNATIONAL CHAMBER OF SHIPPING

CO-OPERATION

Safer Ship Dismantling Facilities

Martijn van Wijngaarden
Marine Consultant
Vineyards Europe

RINA Conference on Recycling of Ships and other Marine Structures
London, 4-5 May 2005

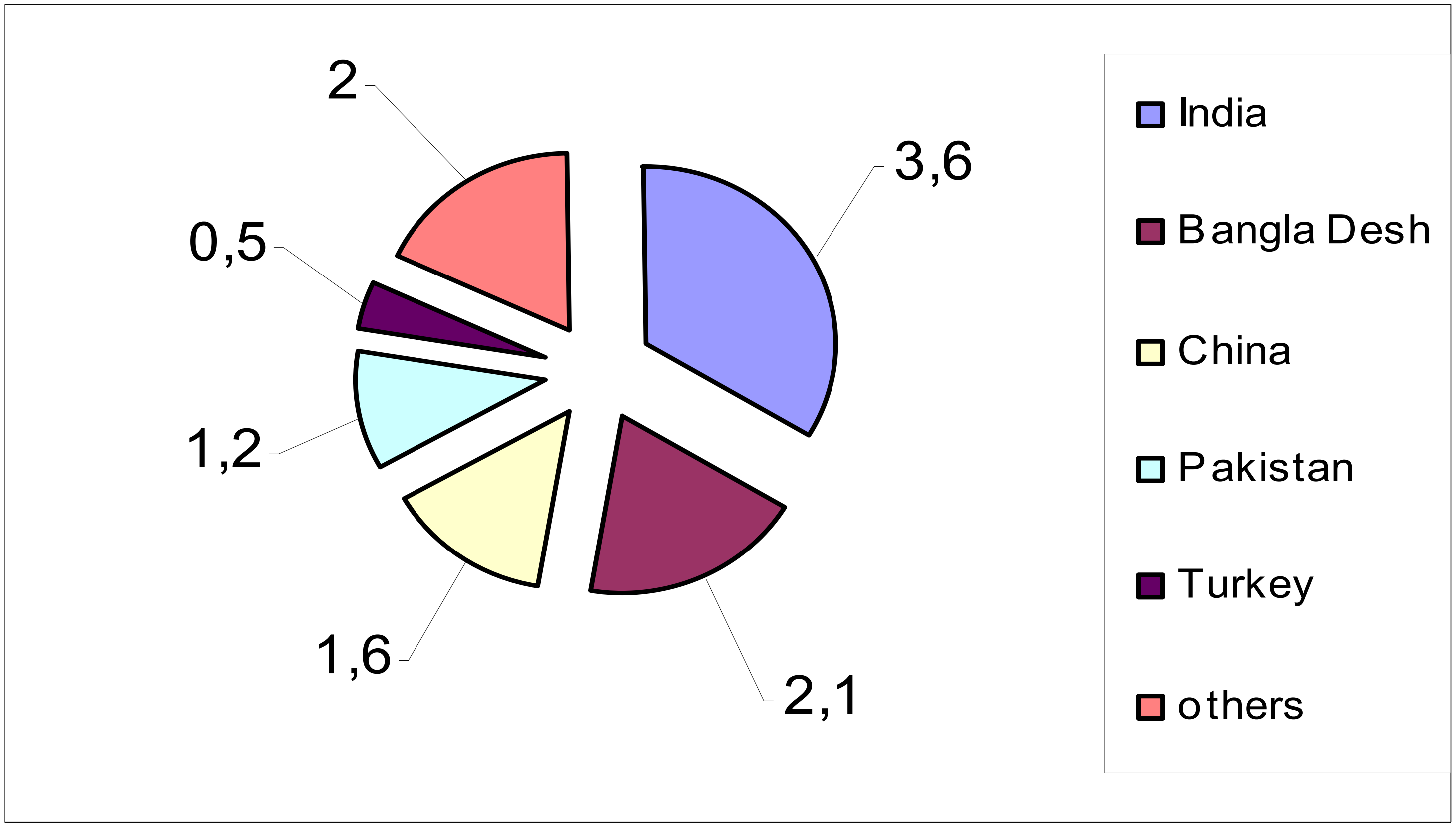
RINA 05

Safer Ship Dismantling Facilities

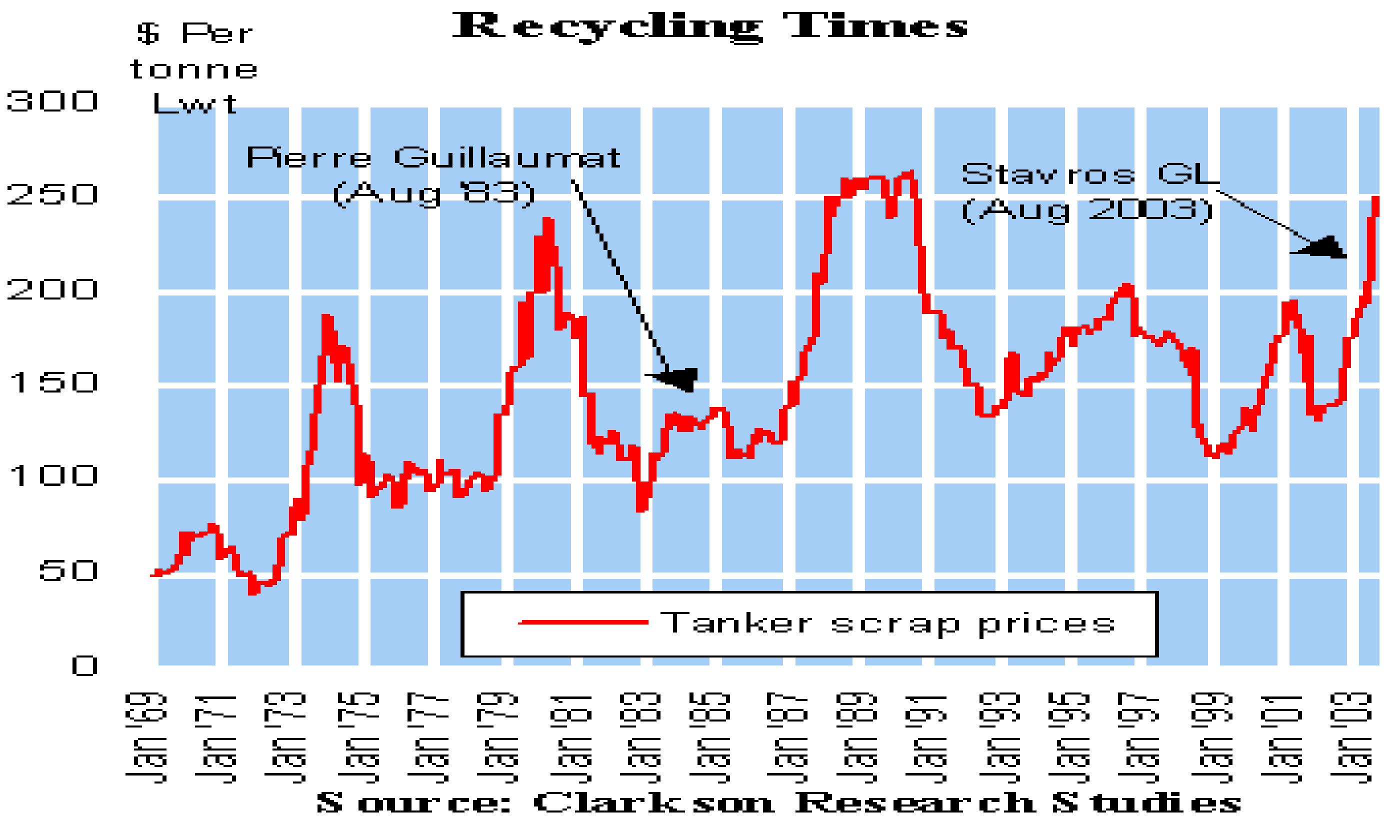
- Safety at Shipbreaking Yards
- Safety Initiatives for Alang
- Oil Reception Facility
- Integrated Management System
- Novel Infrastructure Concepts

RINA 05

Worldwide Industry



Demolition Market Rates



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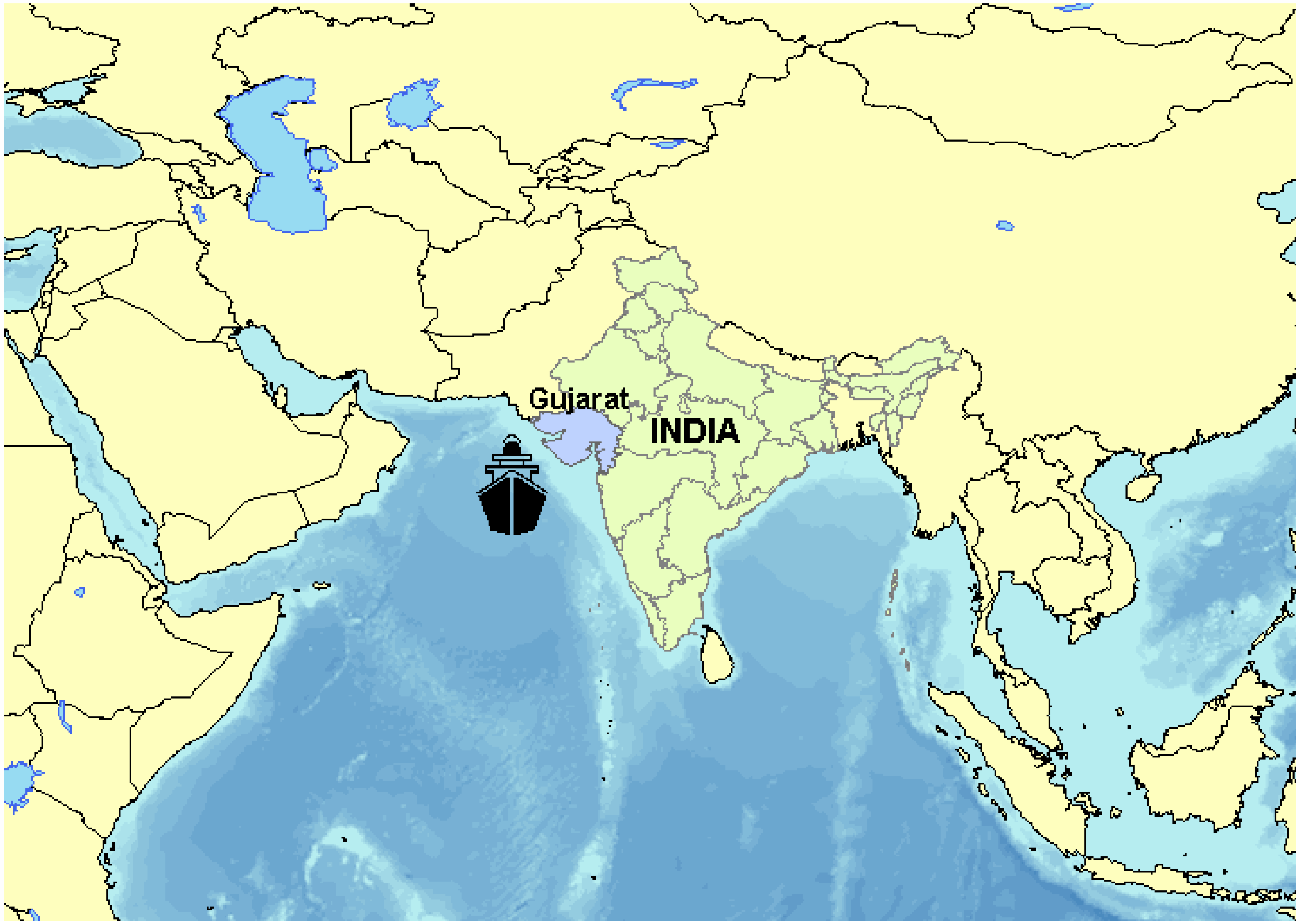
GOLDEN PEACOCK INNOVATIVE PRODUCT/SERVICE AWARD
2003


Gujarat
INDIA

Alang Shipbreaking

Tonnage Received	2.8 million LDT / year
Ships Received	300 Ships / year
Breaking Yards	173 Plots
Beach Length	10.5 Km
Employment	30,000 Workers
Re-rollable Steel Output	2.0 million T / year
Steel Plates/Strips Loaded	6,500 T / day
Industry Turnover	520 million USD / year
GMB Revenue	17 million USD / year
Waste Generated	5,800 T / year
Accidental Deaths	19 Persons / year

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Safety = Loss Prevention

DAMAGES

Injuries

Casualties

Reputation

Credibility

RINA 05

LOSSES

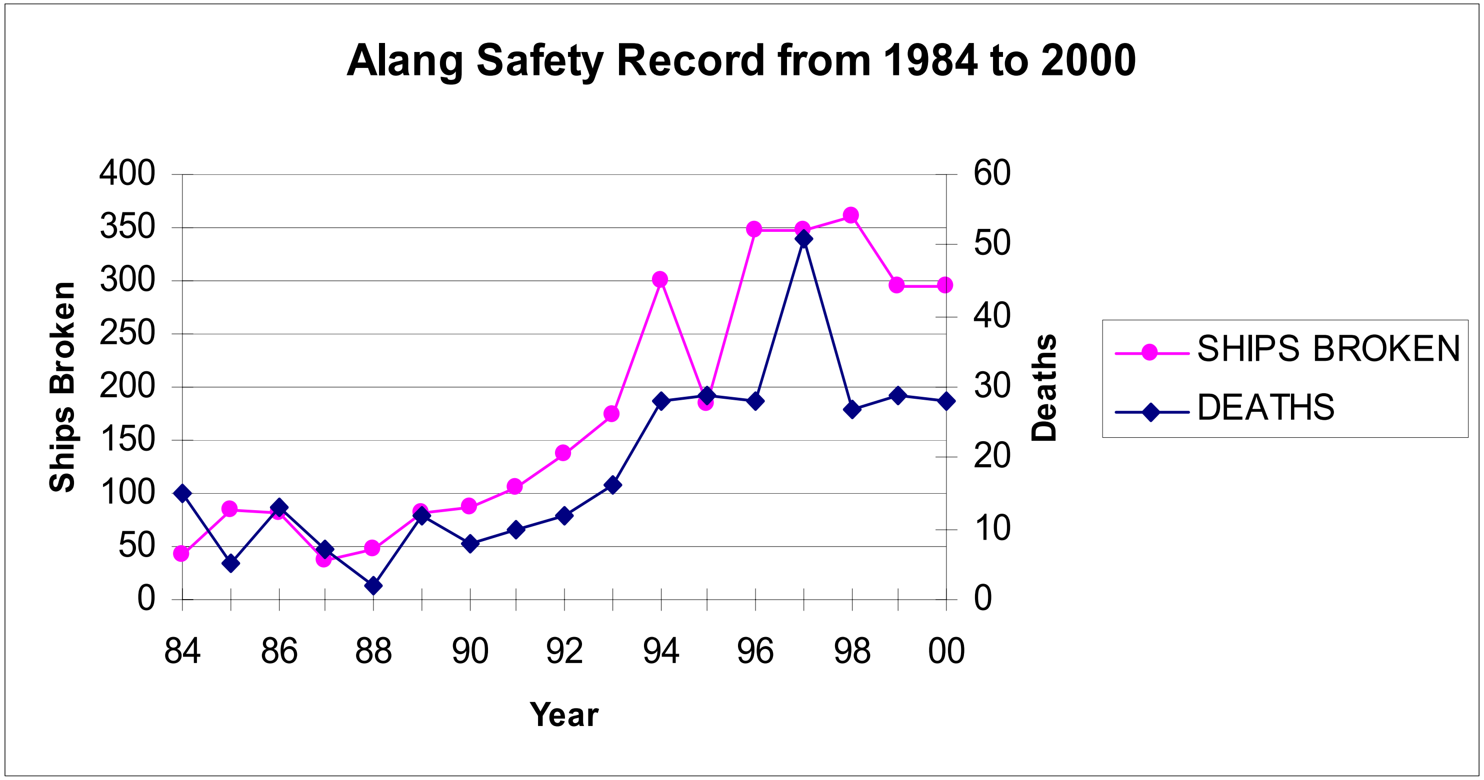
Time Waste

Compensation

Revenue

Bu$iness

Unsafety of Shipbreaking



Main Causes of Accidents

Crane / Winch failures	20
Explosions	16
Fires	77
Suffocation	32
Dropped Objects	57
Falling Down	73
Crushing	39
Total Deaths 1984-2000	319

Safety Initiatives for Alang

➢ Safety Manual	Vineyards
➢ Trainer and Instructor Manuals	Vineyards
➢ Training of Safety Trainers	A-E MTC
➢ Oil Reception Facility cum Jetty	Vineyards-Koco
➢ Novel Infrastructure Concepts	Vineyards-KoCo

Alang Safety Manual

- Safe Workplace Precautions (7)
- Safe Ship Access and Exit (6)
- Safe Ship Dismantling (6)
- Safe Material Transport (5)
- Safe Workplace Response (5)

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TRASMEDITERRANEA

Combating Hazards

Accident Prevention and Accident Response:

- **Safety Training**
- **Personal Protective Equipment**
- **Fire and Explosion Prevention**
- **Workplace Response Training and Equipment**

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Safety Manual and Safety Training

MANUAL

1. Management Level:

- **Codes of Practice**

2. Workforce Level:

- **Instructions**

TRAINING

1. Managers:

- **Courses**

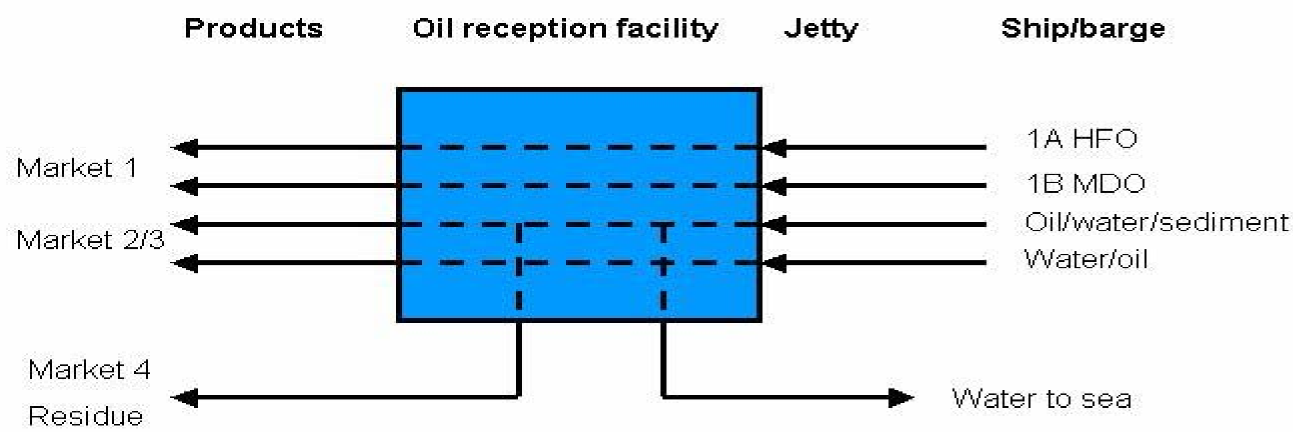
2. Workers:

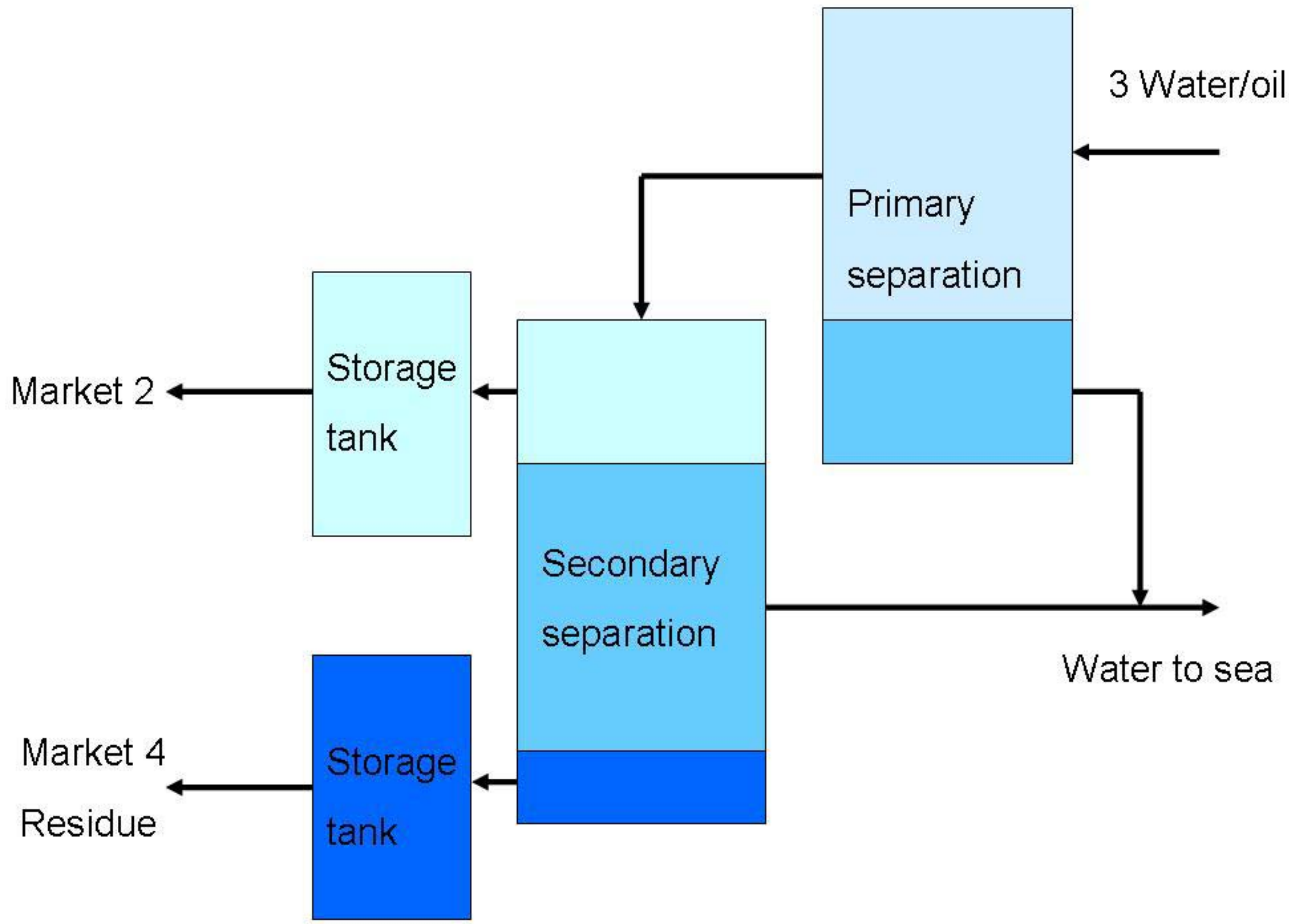
- **Briefings**

Early 2003 Accidents

- Within 3 Months
- 3 Major Accidents
- 15 Deaths, Dozens Injured
- Common Cause:
- Oil and Gas NOT Removed Before Flame Cutting

Oil Reception Facility cum Jetty




3 Water/oil
Primary
separation
Market 2
Storage
tank
Secondary
separation
Water to sea
Market 4
Residue
Storage
tank

Cost Benefit Analysis for ORF

(Crores Rs)	Short Jetty	Long Jetty w/o cargo	Long Jetty with cargo
Investment	9,91	30,50	43,74
Operational Costs	1,05	0,69	0,93
Annual Benefits	13,27	13,27	20,77
NPV @ 15%	51,03	44,07	74,32
IRR (%)	106	41	45

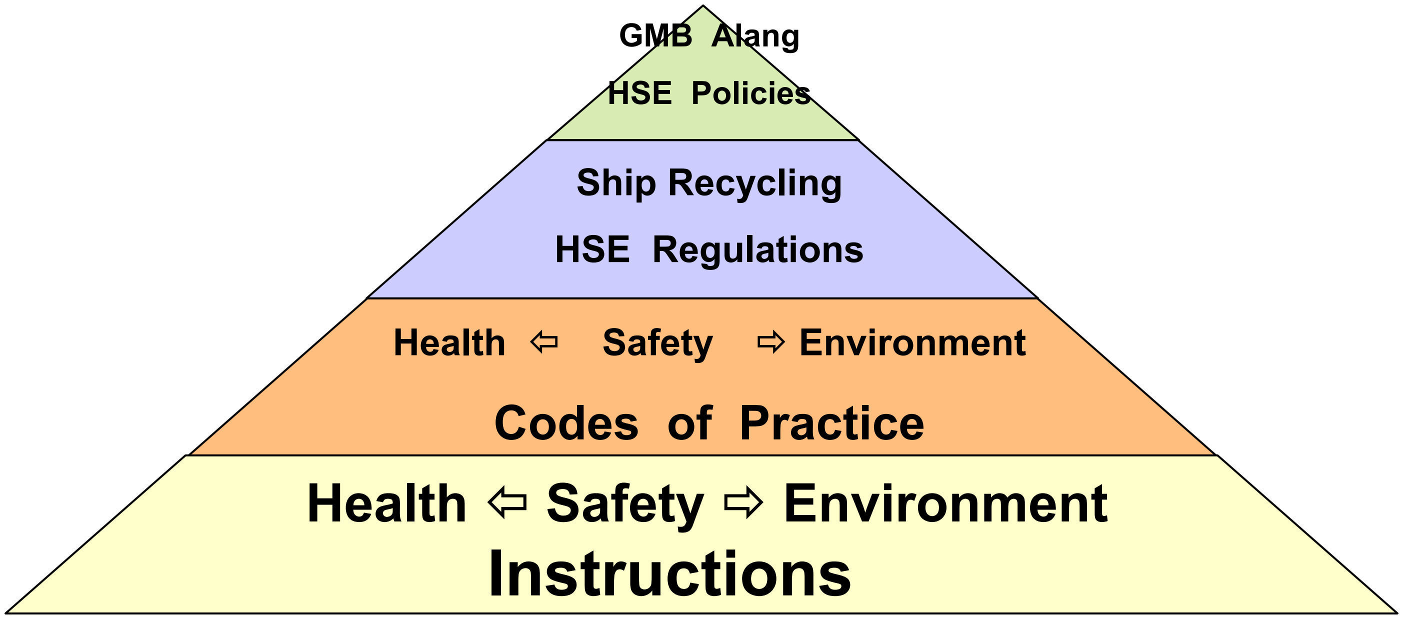
International HSE Guidelines on Ship Recycling

- Basel Convention
- IMO
- ILO
- Harmonization

QHSE Management Systems Industry Standards

- Quality Management: ISO 9000
- Health and Safety Management: OHSAS 18000
- Environmental Management: ISO 14000

Integrated Management System



Novel Infrastructure Concepts for Ship Dismantling

Cost-effective Compliance with Upcoming International Guidelines

- **Early Separation of Ship Hulls**
- **Stagewise Dismantling Facilities**

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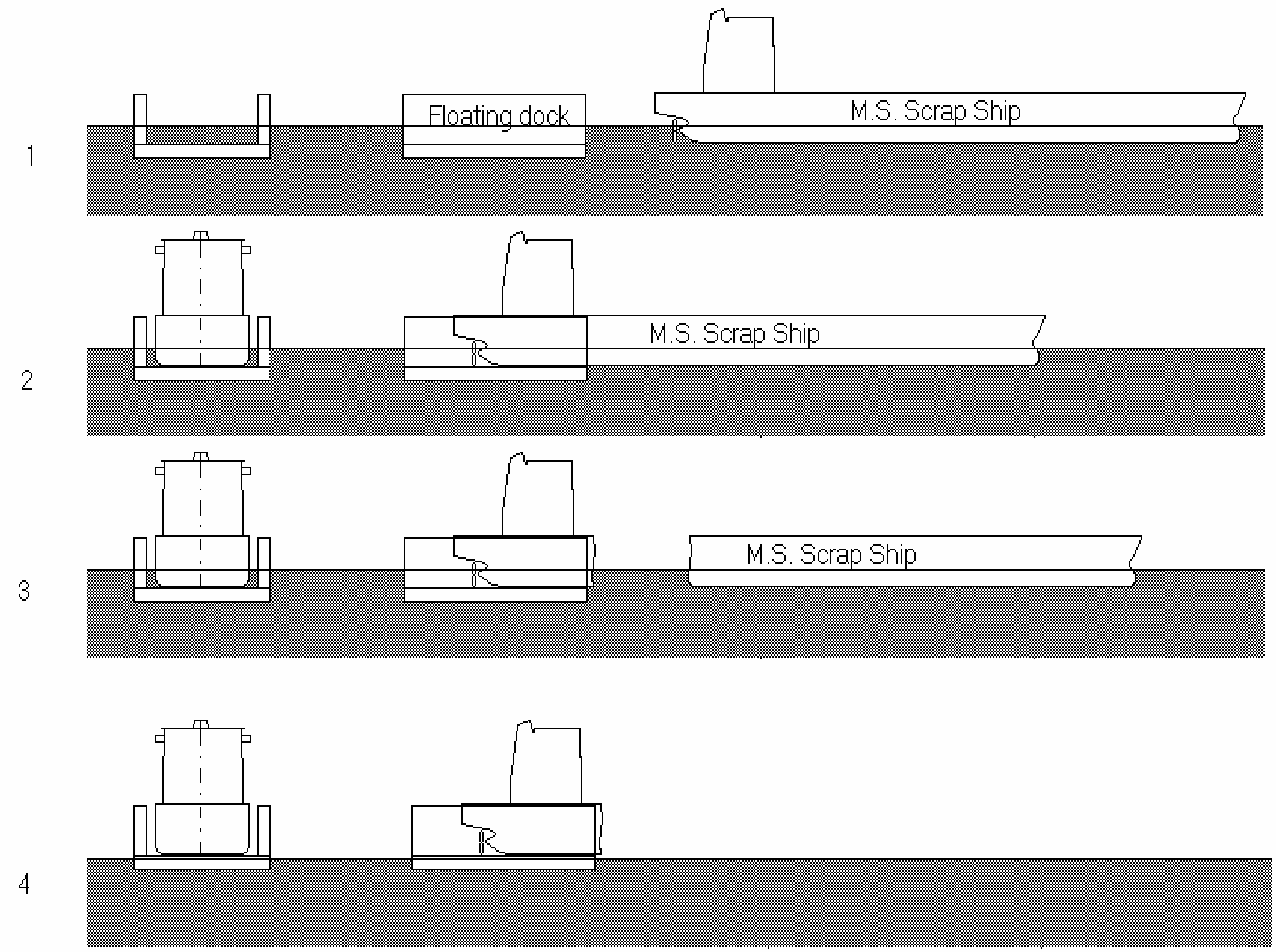
Early Vessel Separation Method

- **Vertical Separation Front and Aft Parts**
- **Two Parallel Dismantling Processes**
- **Foreship is Pure Steel, can be Beached**
- **Aftship has Valuable Equipment, and Waste Materials**
- **Aftship is Dismantled Carefully in Floating Drydock**



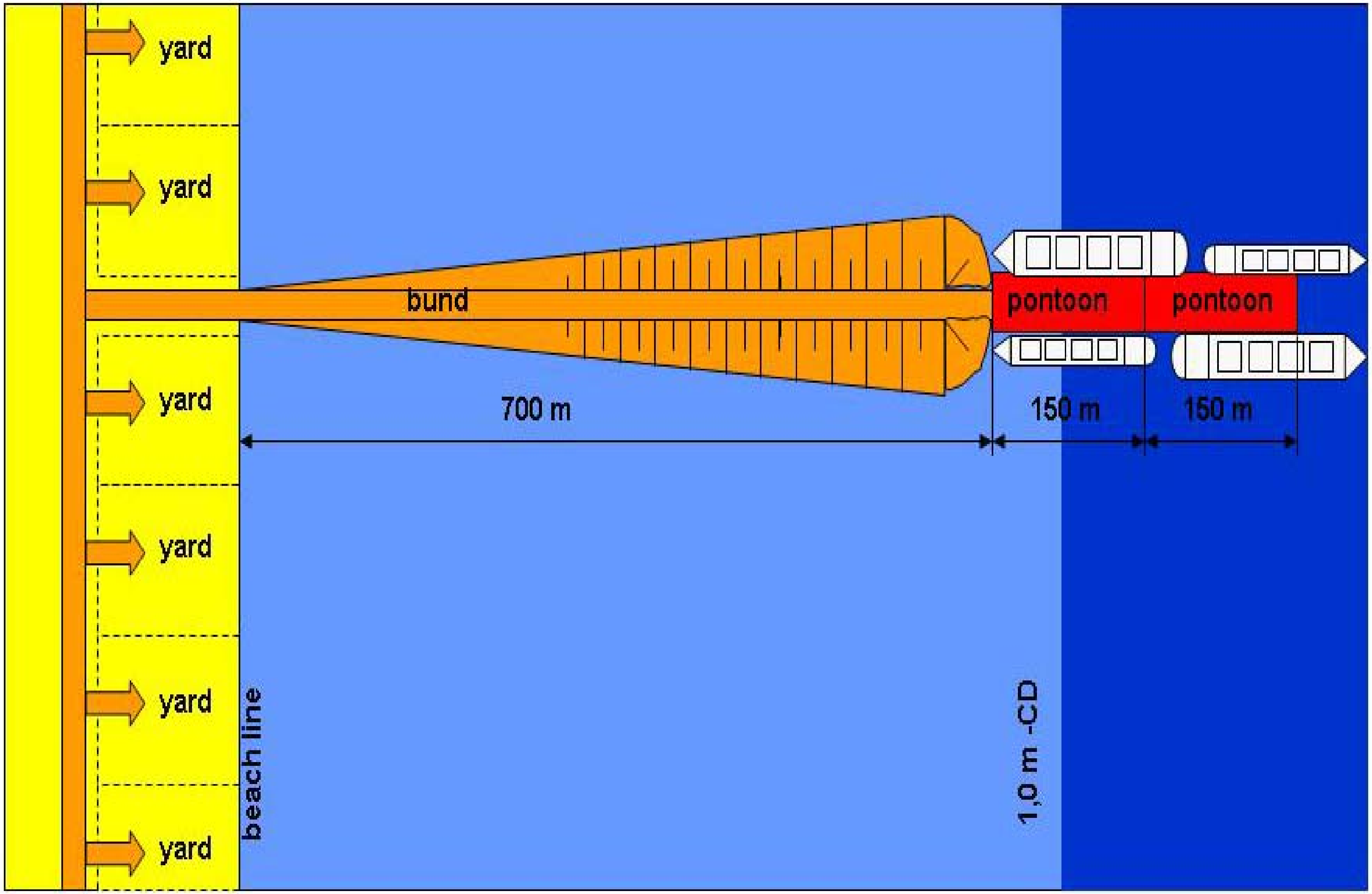
1
Floating dock
M.S. Scrap Ship
2
M.S. Scrap Ship
3
M.S. Scrap Ship
4

Stagewise Ship Dismantling

- Simple Jetty, Bund/Pontoons/Cranes
- 4 Berths, Environment Protected

- Rapid Dismantling in Big Blocks, 40 ships/year
- Transport of 30 T Blocks to Mainland, Sold on Spot

- Competing & Specialised Land Yards Work in Parallel
- Efficient Yard Layouts, ensure Safety and Productivity


yard
yard
yard
yard
yard
yard
bund
pontoon
pontoon
700 m
150 m
150 m
beach line
1,0 m -CD

Investing in New Infrastructure for Ship Dismantling

- Lessons learned at Alang and Darukhana
- Investments in Infrastructure and Management
- Locations not restricted to Gujarat or Mumbai
- Coastal markets in South Asia
- MARAD Incentives

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Finally ….

Message from a gas bottling plant near Ahmedabad:

Accidents Bring Tears

Safety Brings Cheers !

RINA 05

Safety and health in shipbreaking

Royal Institution of Naval Architects
London
4 – 5 May 2005

Introduction

- Overview of ILO Guidelines www.ilo.org/safework/shipbreaking
- Background
- Development
- General philosophy to OSH
- Implementation
- Paul J. Bailey, International Labour Office (ILO), Geneva, Switzerland <baileyp@ilo.org>

The ILO Guidelines

- *Safety and Health in Shipbreaking: Guidelines for Asian countries and Turkey*
- adopted by a Tripartite Meeting of Experts in Bangkok, October 2003
- approved by the Governing Body of the International Labour Office (289th session, March 2004)

Background

- Resolutions introduced by IMF at ILO Metal Trades Committee in 1988 and 1994
- A conclusion adopted at the Transport Equipment Meeting in May 2000
- ILO video « The Shipbreakers » launched in Oct. 2000

On site visits / meetings

- Chittagong (Bgd.), March 2001
- Gadanni Estate (Pak.), March 2001
- Mumbai (India), May 2001
- Rotterdam (June), 2001
- Philadelphia (Sept.), 2001
- China, Oct. & Dec. 2001
- Amsterdam, May 2003
- Aligia, Izmir (Turkey), Sept. 2003
- Meetings of the Basel Convention (Geneva) and the IMO (London)
- WB, GEF, ICS, IMF, ITF, etc.

International labour standards

- Conventions (binding, if ratified)
- Recommendations
- Declarations
- Codes of Practice
- Guidelines
- Technical Guides

Purpose and goal

Provides

- those responsible for shipbreaking with goals to aim at
- guidance on how to achieve safer shipbreaking
- criteria to measure progress
- a yardstick to assess potential facilities to those selling ships

Occupational safety and health

- Division of work/responsibilities (Chapter 3)
- Major hazards/risks (Table 1)
- Prevention and protective measures (Chapter 8)
- OSH as a management system (Chapter 4 and Annex III)

Table 1. Common hazards ... (pp. 8 and 9)

- Frequent causes of accidents
- Hazardous substances and wastes
- Physical hazards
- Mechanical hazards
- Biological hazards
- Ergonomic and psychosocial hazards, and
- General concerns.

Duties and responsibilities of

- Governmental authorities (3.1 – 3.3), including factory inspectors
- Employers/contractors/suppliers (3.4 & 3.7)
- Workers and their representatives (3.5 – 3.6)

Responsibilities and duties of competent authorities

- **Each government should nominate a competent authority**
- … is a minister, government department or other public authority with the power to issue regulations, orders or other instructions having the force of law … for the implementation of national policy and procedures for the protection of shipbreaking workers.

The competent authority should:

- formulate, implement and periodically review a coherent national policy for safe shipbreaking, including:

  a) the control of the import and preparation of ships for breaking;

  b) employment and working conditions, OSH, workers rights and welfare;

  c) the protection of persons and the environment in the vicinity of a shipbreaking work site.

The Guidelines recommend a « legal framework » to:

- ensure the safety and health of workers
- support practical implementation by the competent authority
- reflect the relevant applicable provisions of ILO, IMO and Basel Convention documents
- specify that the employer has overall responsibility

Certificate for dismantling

a) a list of hazardous substances;

b) decontaminated / gas free for hot work;

c) relevant information (drawings, etc.)

d) OSH management system in place;

e) implementation of relevant Conventions and documents on OSH, working and living conditions and the environment;

f) provision of appropriate housing, welfare and sanitary facilities for all workers

Duties of labour inspectorates

- periodically carry out inspections
- advise employers and their workers
- monitor the safety requirements and performance
- participate in formulating and updating safety rules

General responsibilities of employers

- occupational safety and health and the protection of the working and living environment should be the overall responsibility and duty of the employer of the shipbreaking facility, as prescribed by national laws and regulation.
- the employer is expected to show strong leadership and commitment for OSH activities that may be exercised through the establishment of an OSH management system specifically designed for the shipbreaking facility.

General duties of workers

(a) to comply with prescribed safety and health measures;

(b) to take all reasonable steps to:

- secure their personal safety
- eliminate or control hazards or risks;

(c) to report any situation which they have reasonable justification to believe presents an imminent and serious danger;

(d) to report any accident or injury to their life or health or that of other persons, and which they cannot properly deal with themselves;

(e) to co-operate with the employer and other workers

General responsibilities of suppliers, manufacturers and designers

- measures should be taken to ensure that those who design, manufacture, import, provide or transfer machinery, equipment or substances for use in shipbreaking operations satisfy themselves that the machinery, equipment or substance do not entail dangers for the safety and health of those using it correctly

Cooperation between all the parties

- measures should be taken to ensure cooperation – between the government, employers and workers - relating to the elimination or control of risks to safety and health from hazardous ambient factors

Planning for safer shipbreaking (Chapter 7)

- Safe ship-breaking plans and schedules (7.2)
- Hazard identification and risk assessment (7.3)
- Review of risk assessment (7.4)
- Response to hazards and risks (7.5)

General measures (Chapter 8)

- Access and egress
- Roads, quays, yards
- Scaffolds and ladders
- Precautions against falling
- Fire prevention, fire fighting
- Confined spaces
- Signs, notices, colour codes

Which occupational hazards?

- Those causing serious harm
- Hazardous substances (Chapter 9)
- Physical and mechanical hazards (Chapter 10)
- Ergonomic and psycho-social (Chapter 12)
- General concerns
- Biological hazards (Chapter 11)

Safety requirements (Chapter 13)

- for tools
- machines and other equipment

Competence and training for (Chapter 14)

- Managers/supervisors
- Workers
- Contractors

PPE and clothing (Chapter 15)

- Head, face, eye, hand, foot
- Respiratory equipment
- Hearing
- Radioactive contamination
- Protection from falls

Contingency and emergency preparedness (Chapter 16)

- General (16.1)
- First aid (16.2)
- Rescue (16.3)

Special protection (Chapter 17)

- Employment and social insurance
- Working hours
- Night work
- Child labour
- Alcohol and drug abuse
- HIV/AIDS

General welfare provisions (Chapter 18)

- Drinking water
- Sanitary and washing facilities
- Cloakrooms
- Food
- Housing

Further references

- ILO Conventions & Recommendations (p. 68)
- ILO Codes of Practice (p. 69)
- Chemical safety data cards (p. 71)
- Annexes (pp. 72 ff)

Other codes of practice

- *Protection of workers against noise and vibration in the working environmen*t, 1977
- *Safety and health in the iron and steel industr*y, Rev. 2005

  - chapter on recycling
- *Safety in the use of asbestos*, 1984

More CoP

- *Ambient factors in the workplace*, 2001
- *Safety in the use of chemicals at work*, 1993
- *Safety in the use of synthetic vitreous fibre insulation wools (glass wool, rock wool, slag wool)*, 2001
- *HIV/AIDS and the world of work*, 2001
- *Safety and health in the non-ferrous metals industries*, 2003

Other international instruments

- *Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships* (Sixth Meeting of the Conference of the Parties to the Basel Convention, 13 Dec. 2002, Decision VI/24);
- IMO *Guidelines on Ship Recycling* (twenty-third session of the Assembly, 5 December 2003 Resolution A.962(23);
- International Chamber of Shipping Industry Code of Practice (2001)
- London “Dumping” Convention, 1972 and Protocol 1996

Towards a “Global Action Programme”

- Joint ILO-IMO-Basel Convention Working Group
- UNDP Bangladesh $1.2 million
- Inter-agency technical cooperation
- CIDA waste management in India
- Other projects in the pipeline ….

Joint ILO-IMO-Basel Convention Working Group

- Inter-secretariat meeting ILO-IMO-SBC, January 2004
- First meeting: 15 -17 Febr. 2005
- 5 Governments – IMO
- 5 Governments – Basel Conv.
- 5 Employers, 5 Workers - ILO (ICS; IMF & ITF)
- Second session: Dec. 2005

Terms of reference of the Joint Working Group

- Consider respective work plans
- Facilitate exchange of views
- Comprehensive examination of the 3 sets of Guidelines
- Consider mechanisms to implement the Guidelines
- Monitor technical cooperation
- Submit reports to pertinent bodies

Implementation

Translations

- Draft version available in French and Spanish
- Chinese (already available at meeting in Bangkok)
- Hindi (used in Alang in 2004)
- Bangla, Urdu and Turkish

Further steps

- Workshops in Bangladesh, China, India, Pakistan and Turkey – policy level & practical level
- Development of training material: manuals, fact sheets, practical guides, etc.
- Search for donors: NORAD, GTZ, DFID, USAID, DANIDA
- UNDP, GEF, World Bank, EU

Breaking stats - 2003

http://www.cotzias.gr/index1.htm

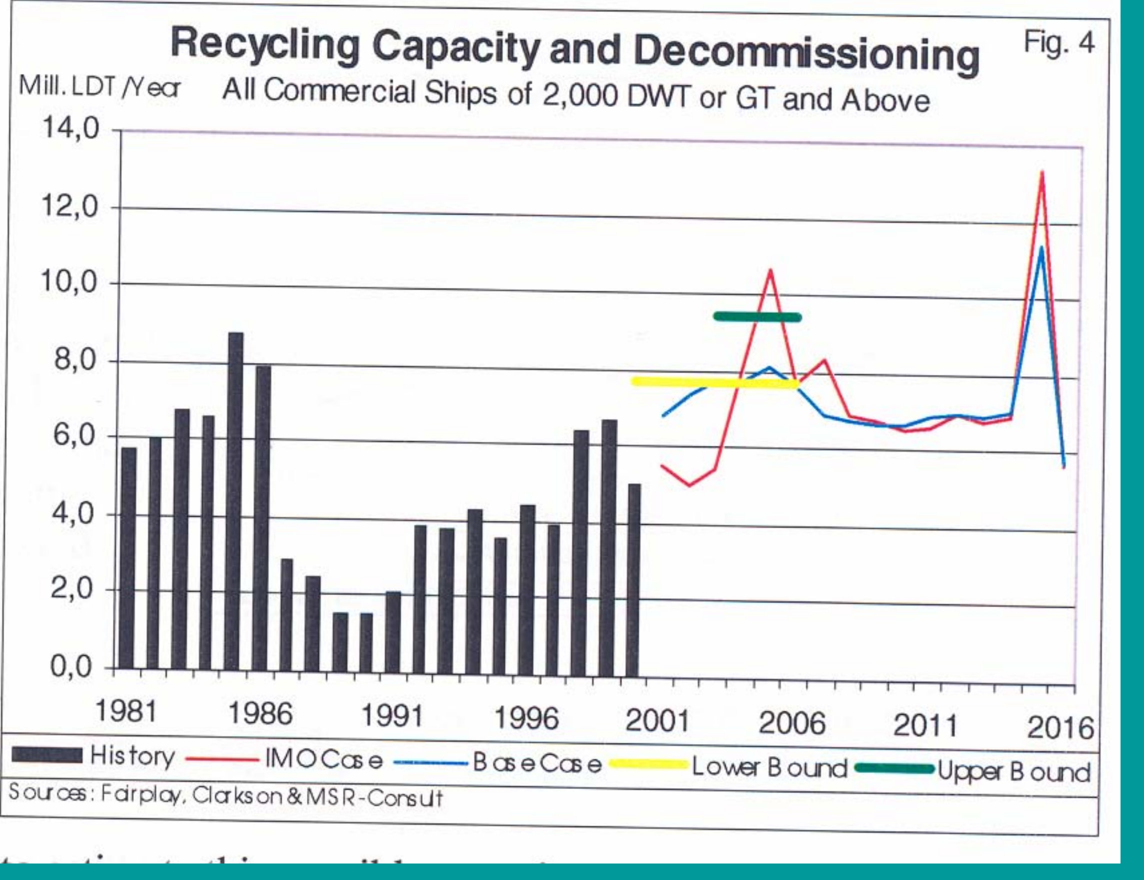
Country	Ships	LDT taken
India	324	2,606,166
China	119	1,985,073
Bangladesh	51	782,014
Pakistan	18	195,521
Turkey	10	56,558
Others	30	260,590
Total 2003	552	5,886,922
Total 2002	601	6,969,735

Demolitions in 2004

www.cotzias.gr/index1.htm

Country	Ships	LDT
India	157	971,712
Bangladesh	105	1,294,411
China	62	716,357
Pakistan	14	77,041
Others	23	126,488
Total	368	3,210,135

Scrapping stats 1981-01



The bottom line

- provide practitioners with detailed advice & models for the safe planning and execution of operations
- identify specific duties and responsibilities of employers, workers, contractors and governments in protecting workers
- helpful to those engaged in defining coherent national, policies and frameworks on OSH and working conditions for the shipbbreaking industry


KONGSGAS

SHIP RECYCLING CONFERENCE

SHIPLIFT TECHNOLOGY

Mike Palmer

5 May 2005

SHIPLIFT TECHNOLOGY

Introduction

Docking Systems

Shiplift Features

Transfer Systems

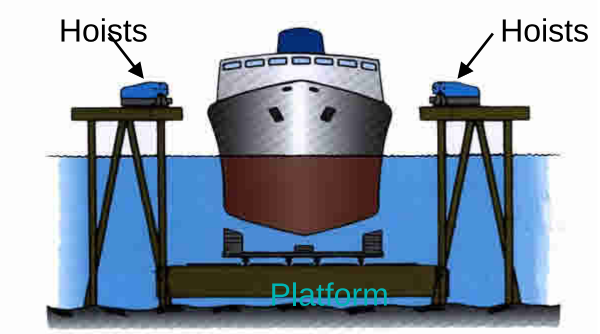
Safety Considerations

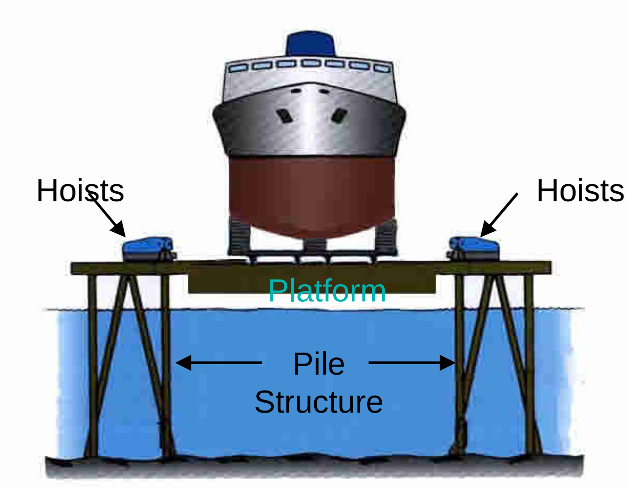
Shiplift Benefits

Docking Systems

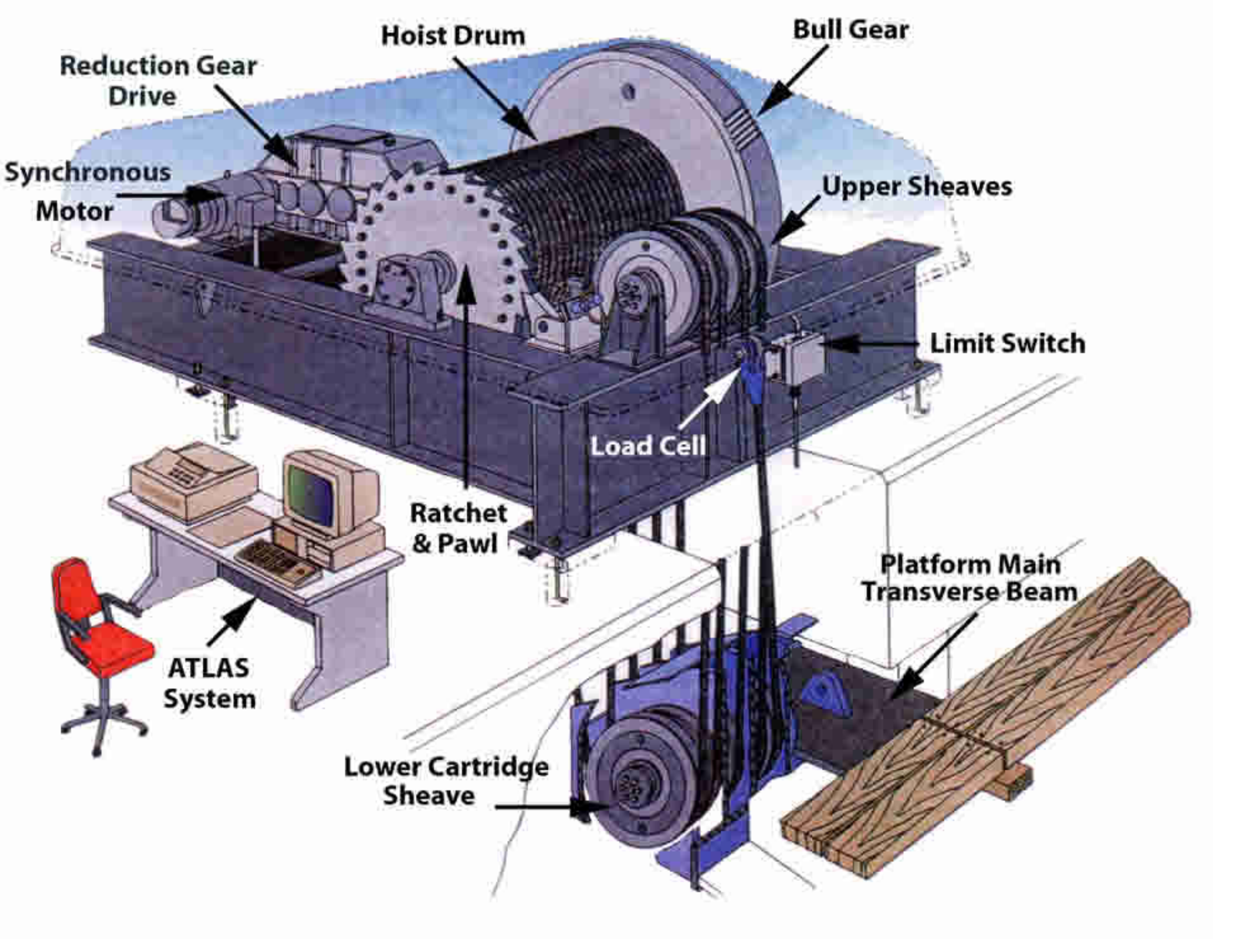
- Mobile Marine Hoists (Straddle Lifts)
- Slipways and Marine Railways
- Floating Docks
- Graving Docks
- Shiplifts

Shiplift Concept

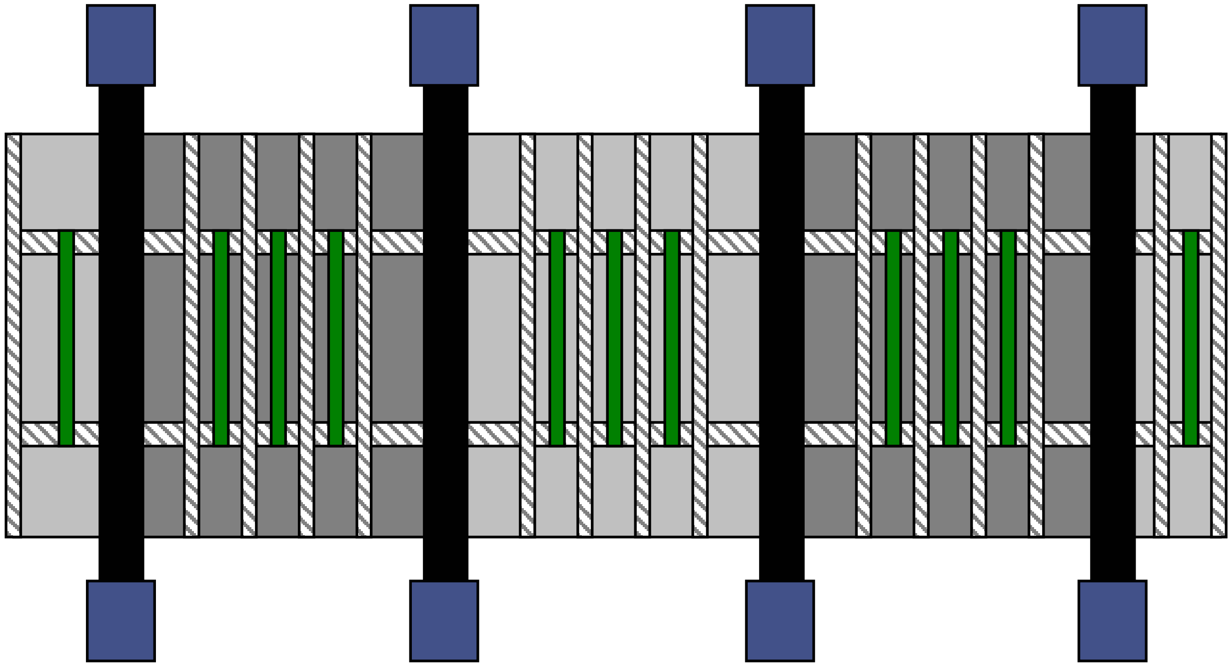


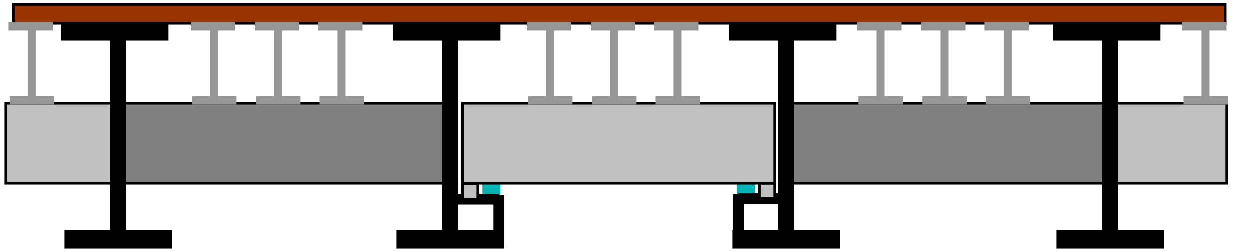


The main components



Typical platform structure



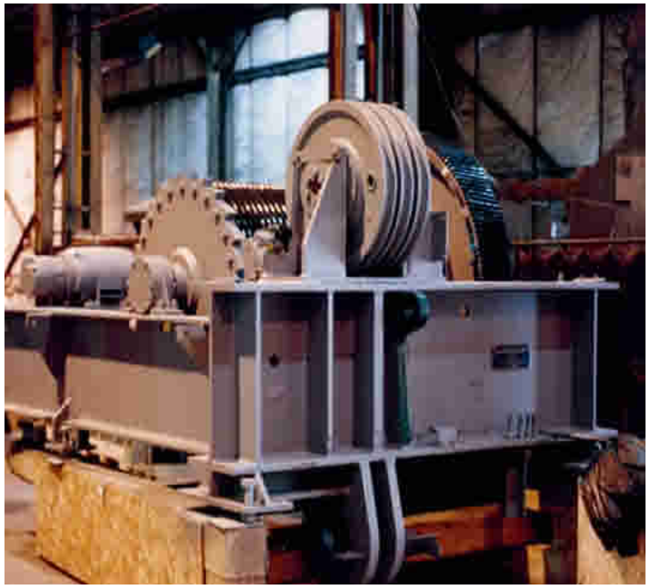


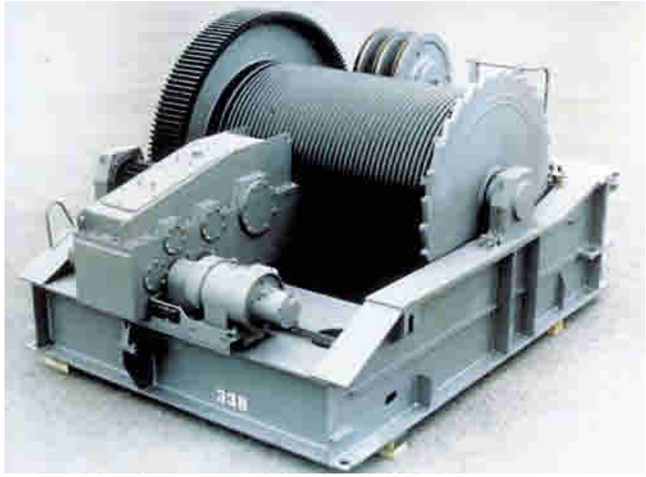
Articulated Platform Benefits

- Modular design helps to achieve quality and cost-control during construction and installation.
- Full wood decking provides low maintenance, long-life platform access.
- Accurate load monitoring at lift points. Compliant support provided by articulation allows peak loads caused by high blocking or concentration of vessel load to be absorbed. Concentrated loads will not result in uplift forces. Risk of local overloading to vessel is minimized
- Modular design allows cost-effective options for future expansion

Features of the Syncrolift® Hoists

- AC synchronous induction motors ensure all lift points raise/lower at exactly the same speed irrespective of load.
- No requirement for feedback control system to compensate for non synchronous lifting and/or load differential.
- Grooved drum of exacting tolerances accepting single layer of wire rope
- Diversity of braking systems with multiple disc brake on motor shaft rake and fail-safe feature of integral pawl and ratchet drum brake.
- Proven in service with more than 3000 hoists installed 1957- to date

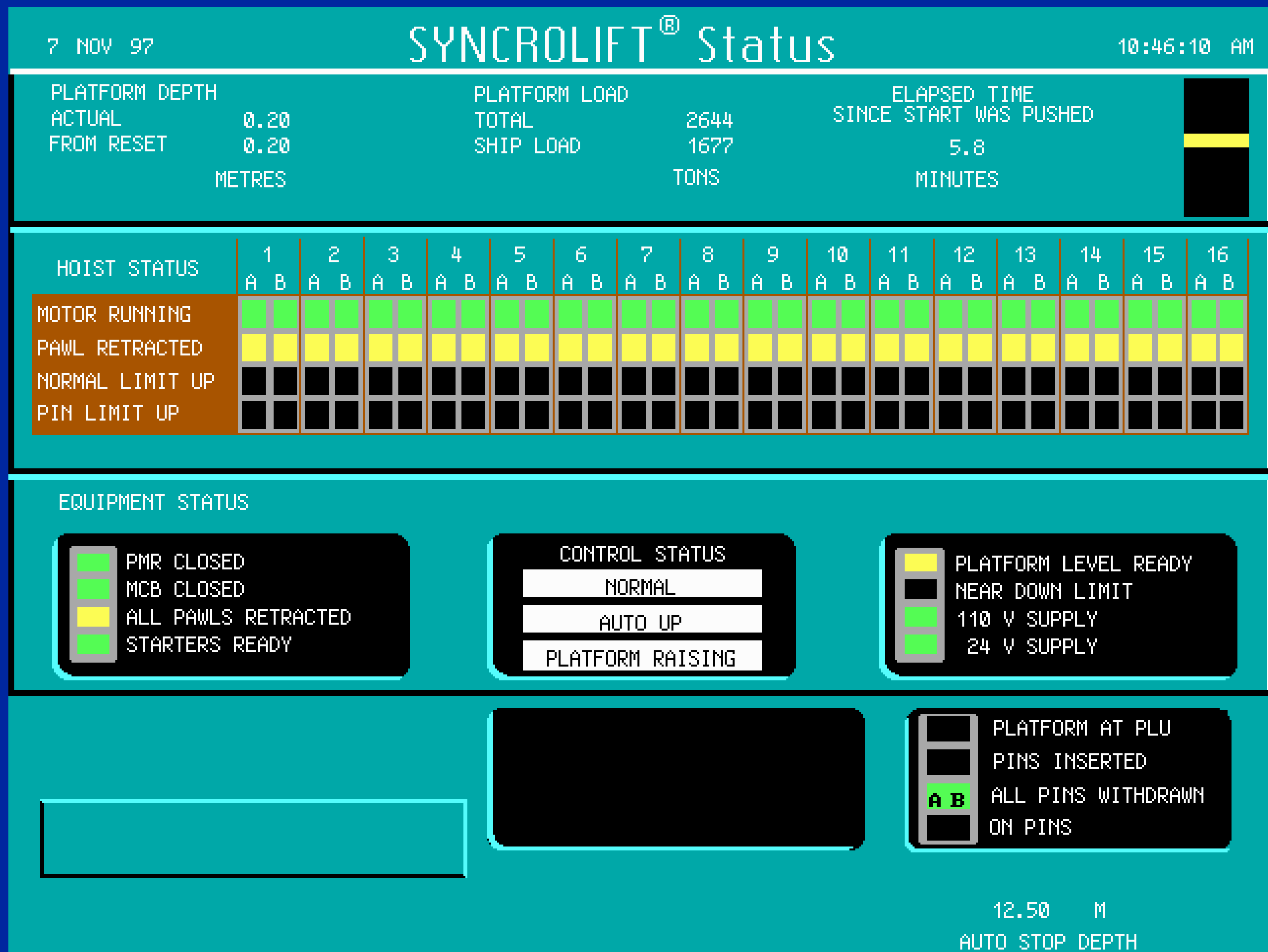




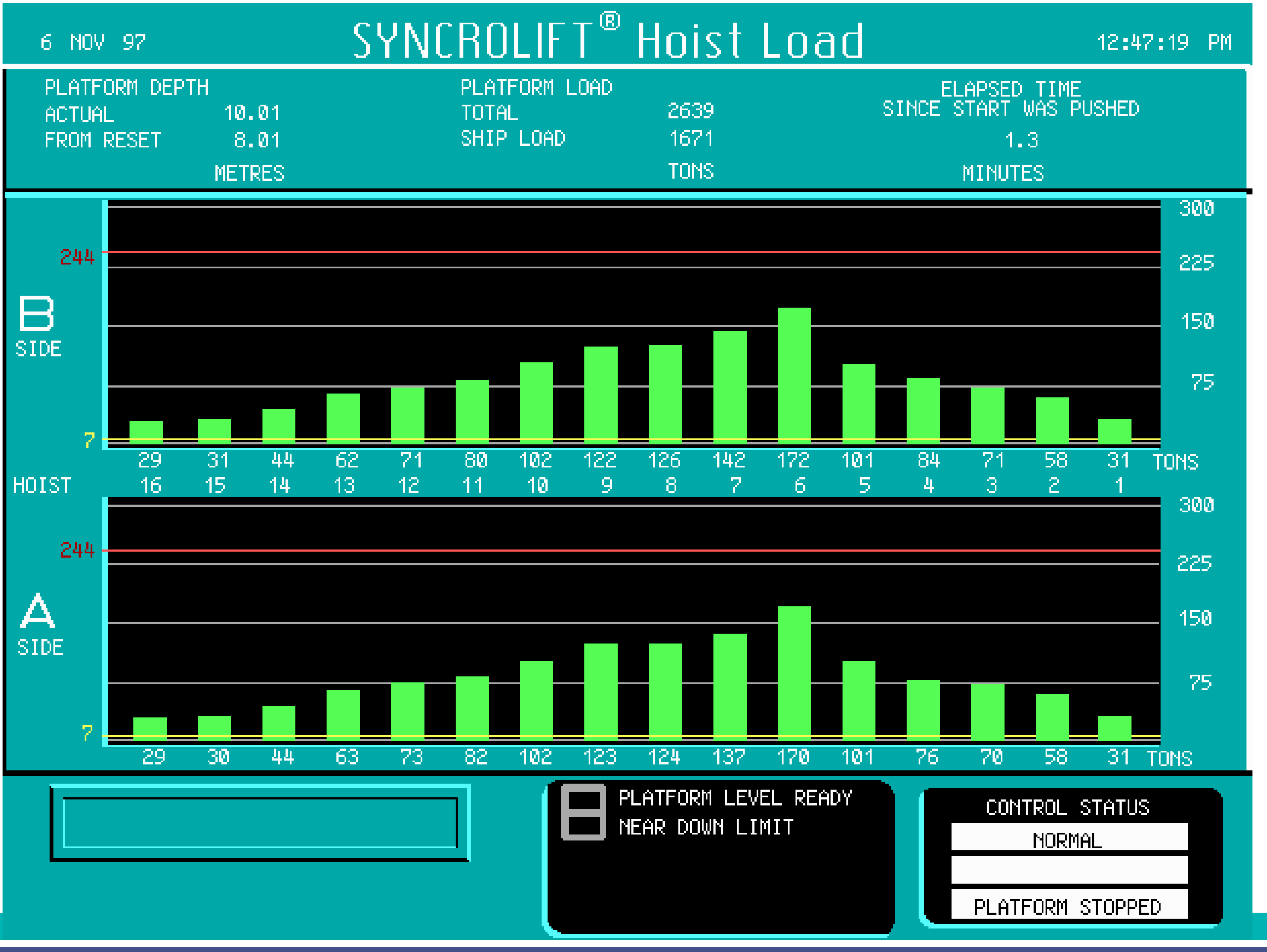
Features of the Syncrolift® Atlas Control System

- Easy to use Custom Keypad with automatic control functions.
- Fail safe protection for both the shiplift AND the vessel.
- Analyze and record vessel load information enabling continuous service record.
- Automatic calculation and display of vessel center of gravity, torsional loads weight distribution and platform sheave efficiency.

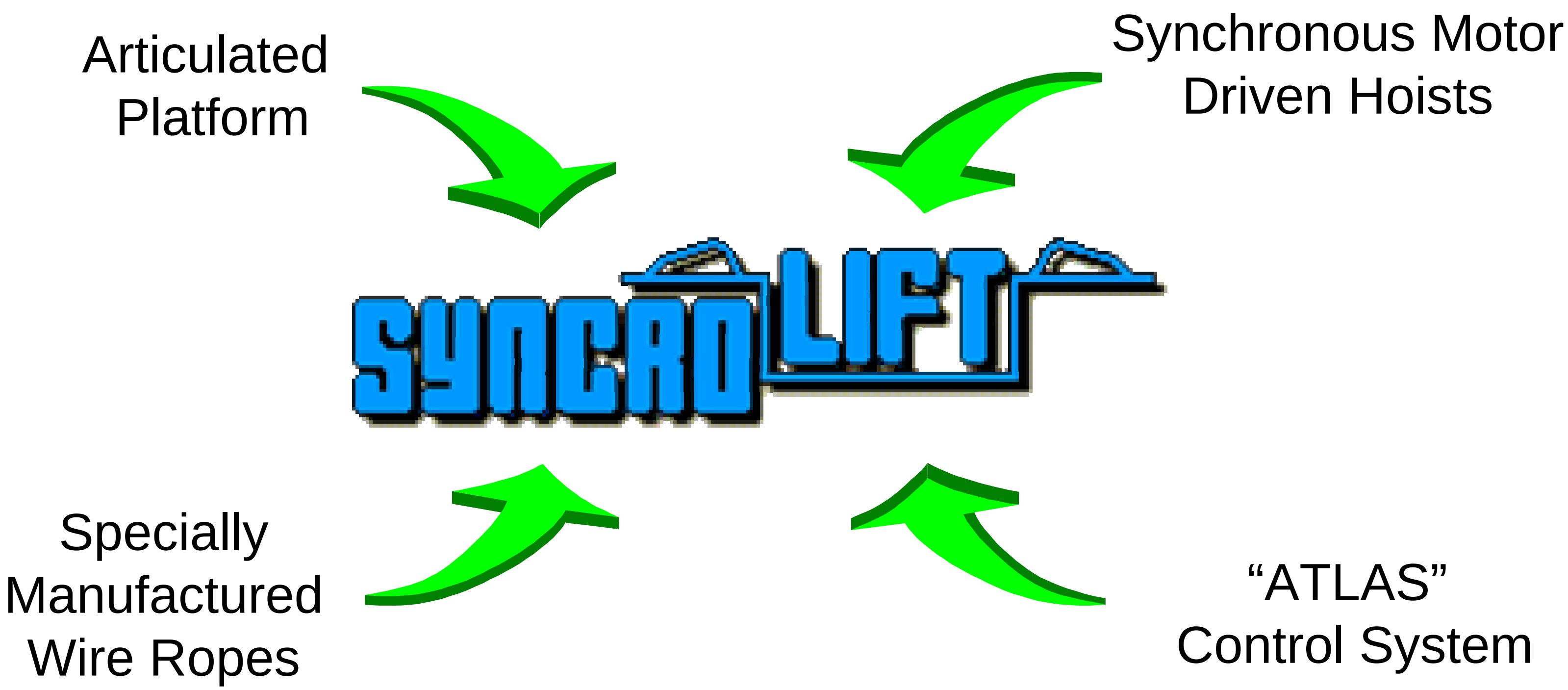
ATLAS Control System
Status Display



ATLAS Control System
Actual Loads During Lift - Load Screen



Syncrolift system features



Transfer Systems

Maximizing Productivity

Improving Flexibility

RAIL- MOUNTED TRANSFER SYSTEMS

Side Transfer Pit

Side Transfer Carriage

Dual Level System at Darwin, Australia

DUBAI SHIP DOCKING YARD

Platform 1 services 12 shore berths

Platform 2 services 40 shore berths

Over 1000 dockings/year

Single Level Transfer Systems

Side transfer both sides in Durban

End Transfer for US Coastguard

Single Level End and Side Transfer in Hong Kong

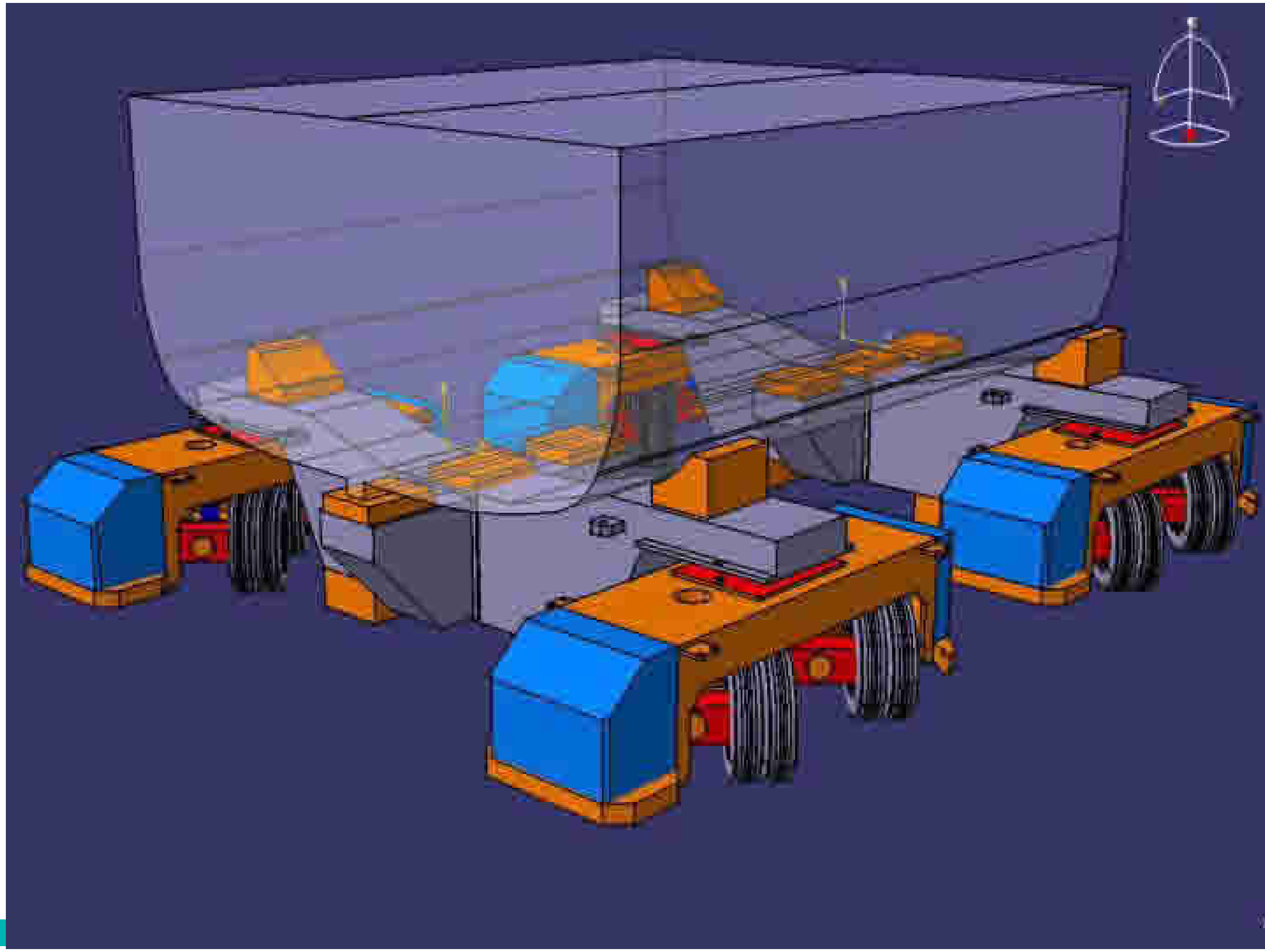
NON RAIL- MOUNTED TRANSFER SYSTEMS

TTS Dual Walking Beam System

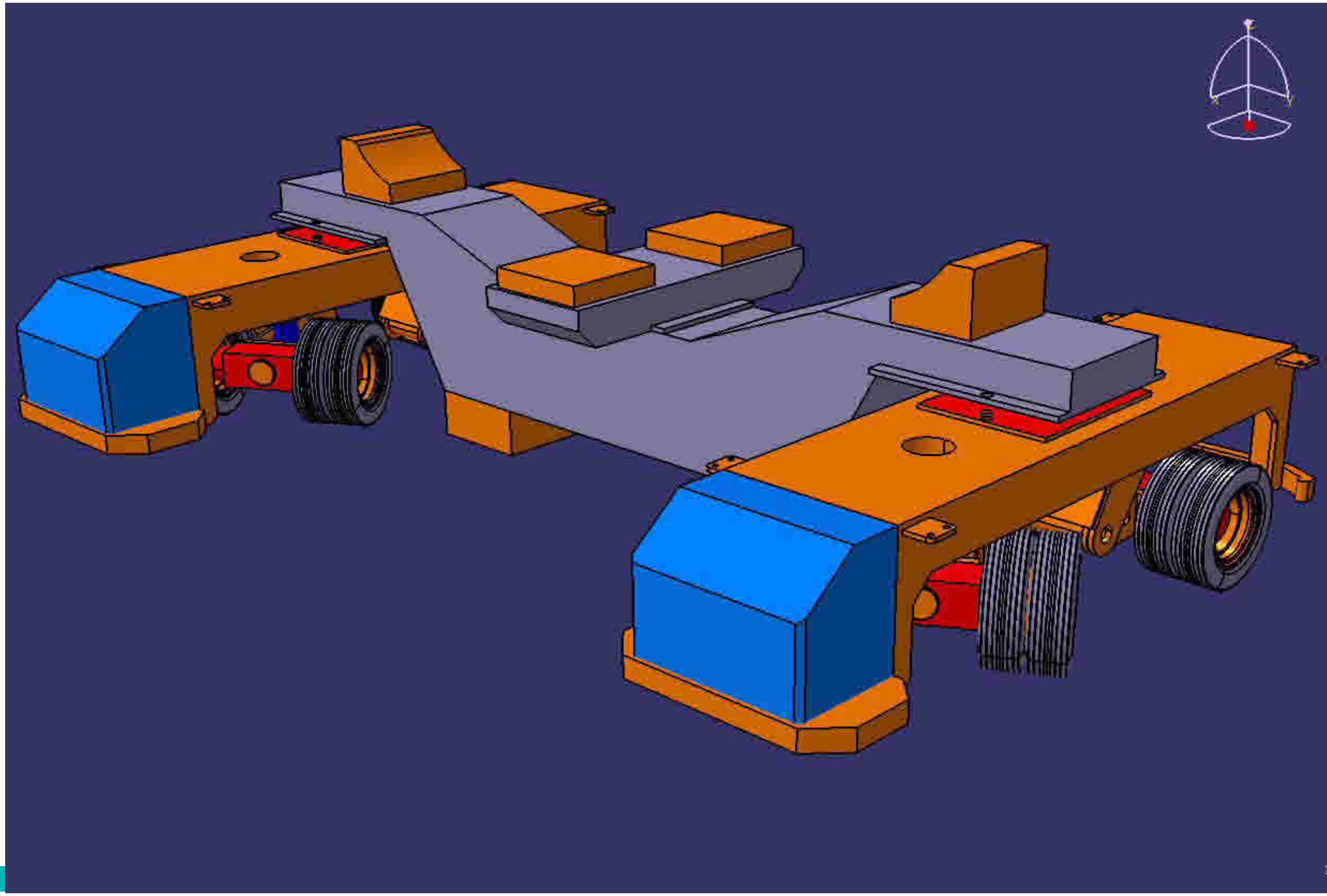
in conjunction with Le Triomphant Class submarine Launch

Dual Walking Beam Units

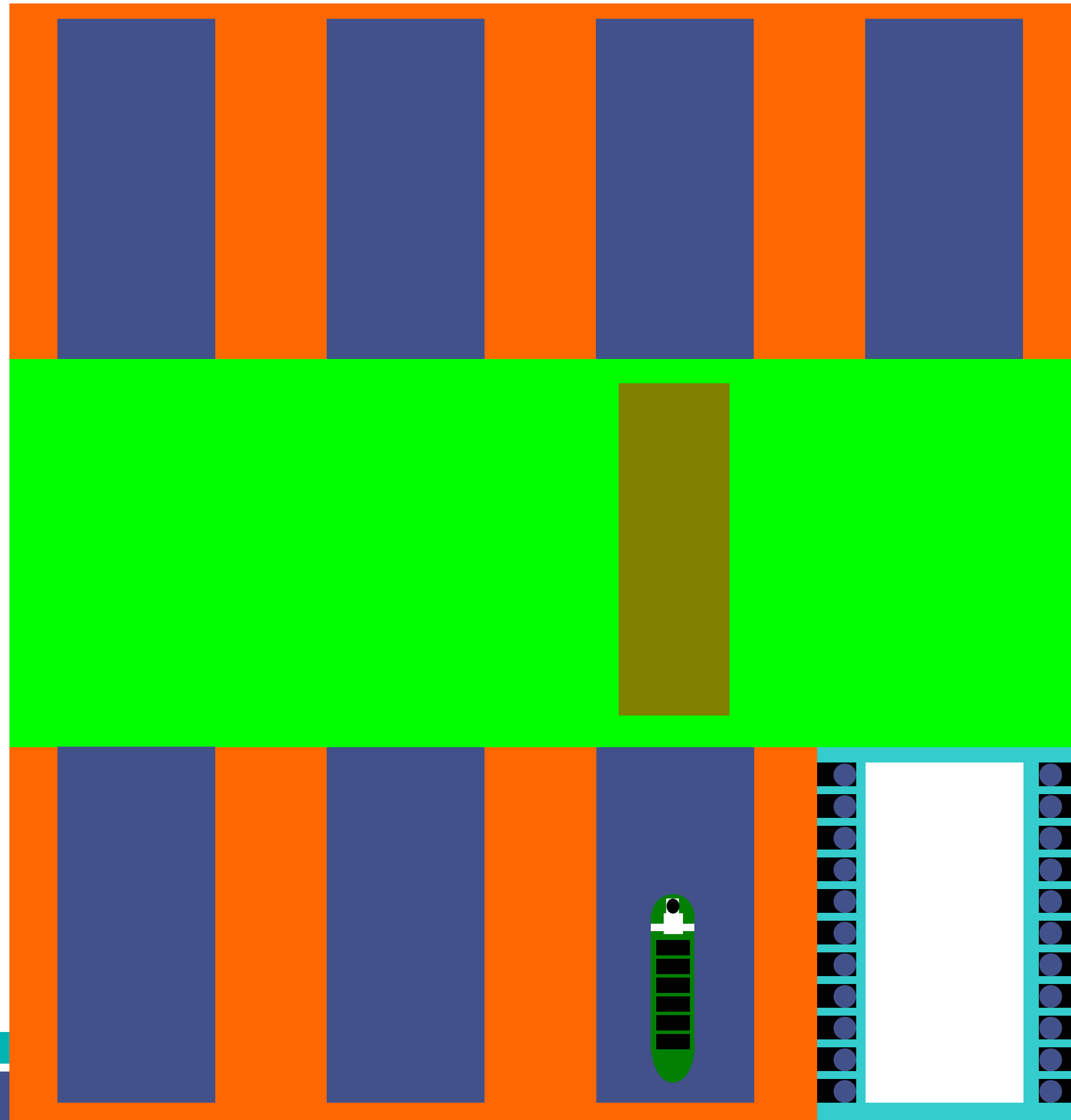
4 x 100 ton PWTs configured for transfer of a ship module



Self Powered Wheeled Transporter Units



Multiple Berth Flexibility



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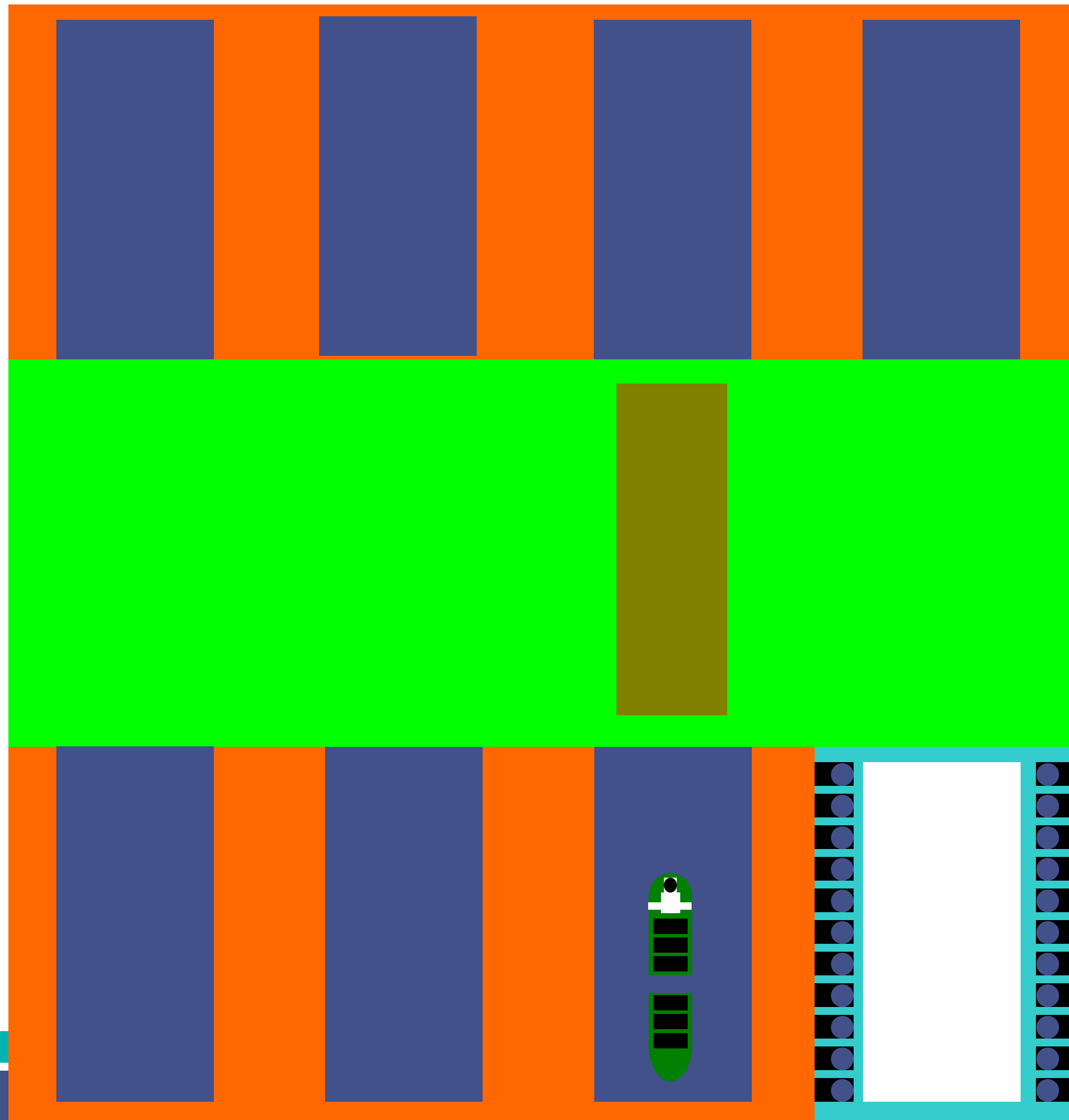

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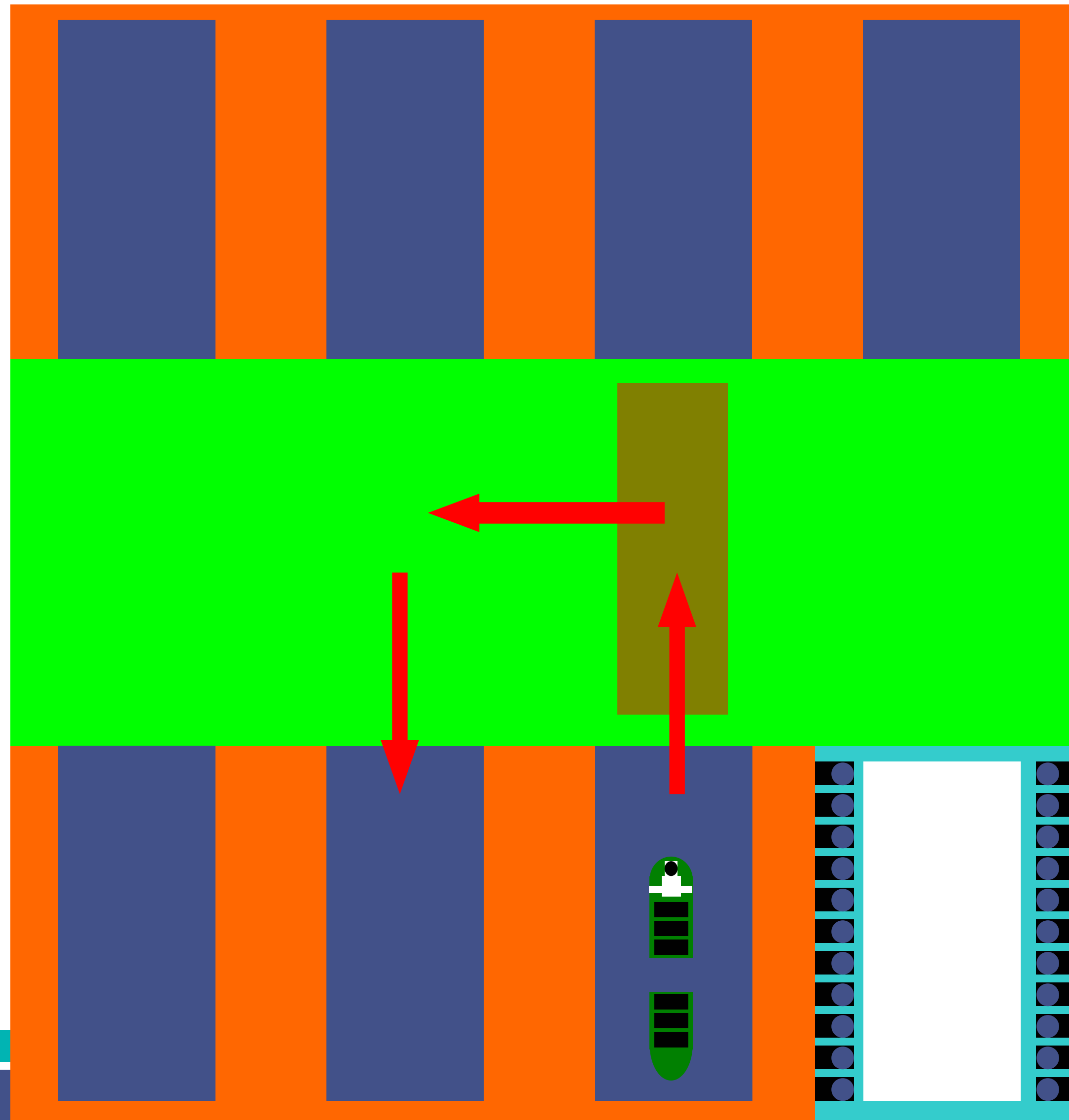

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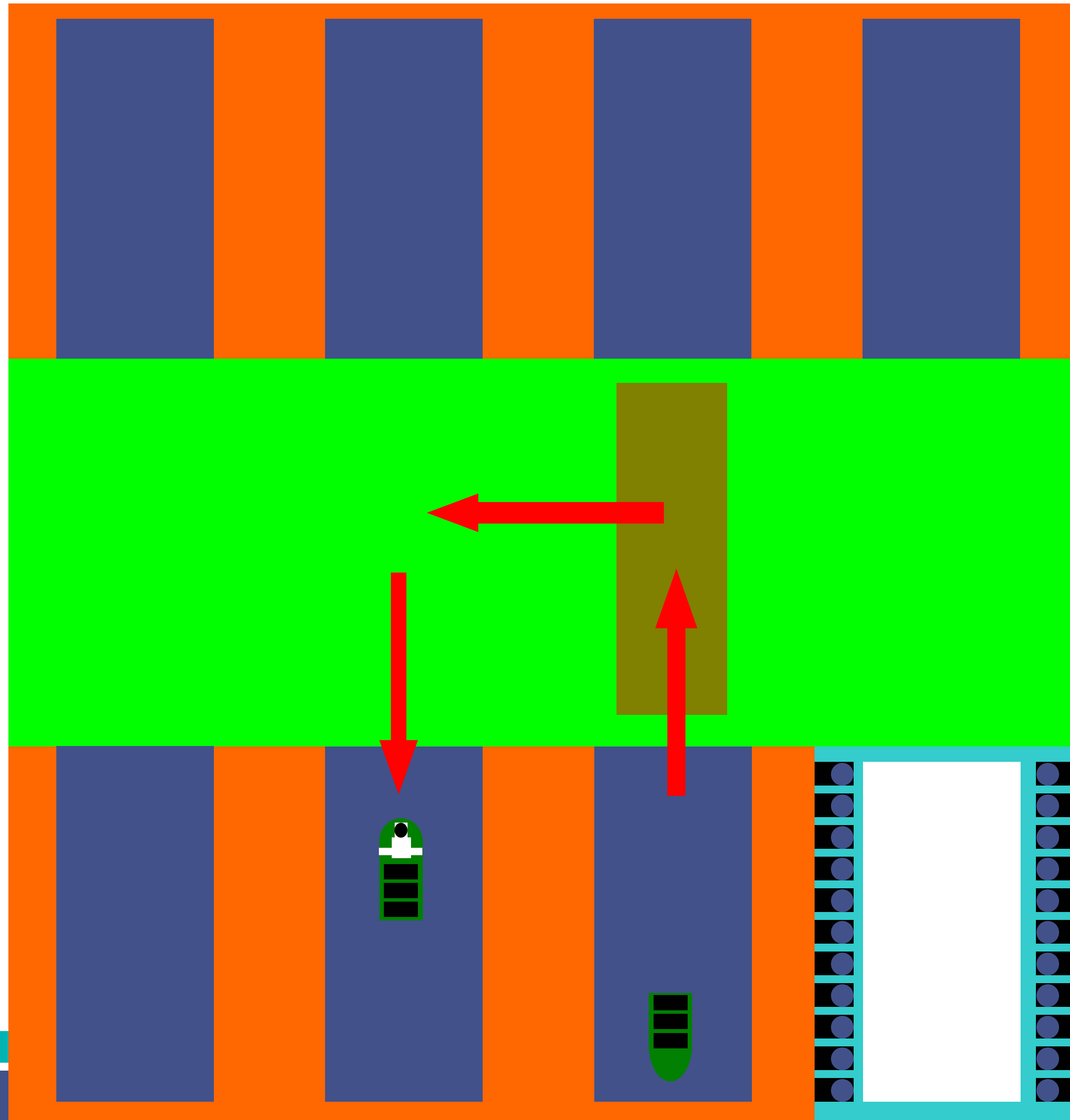
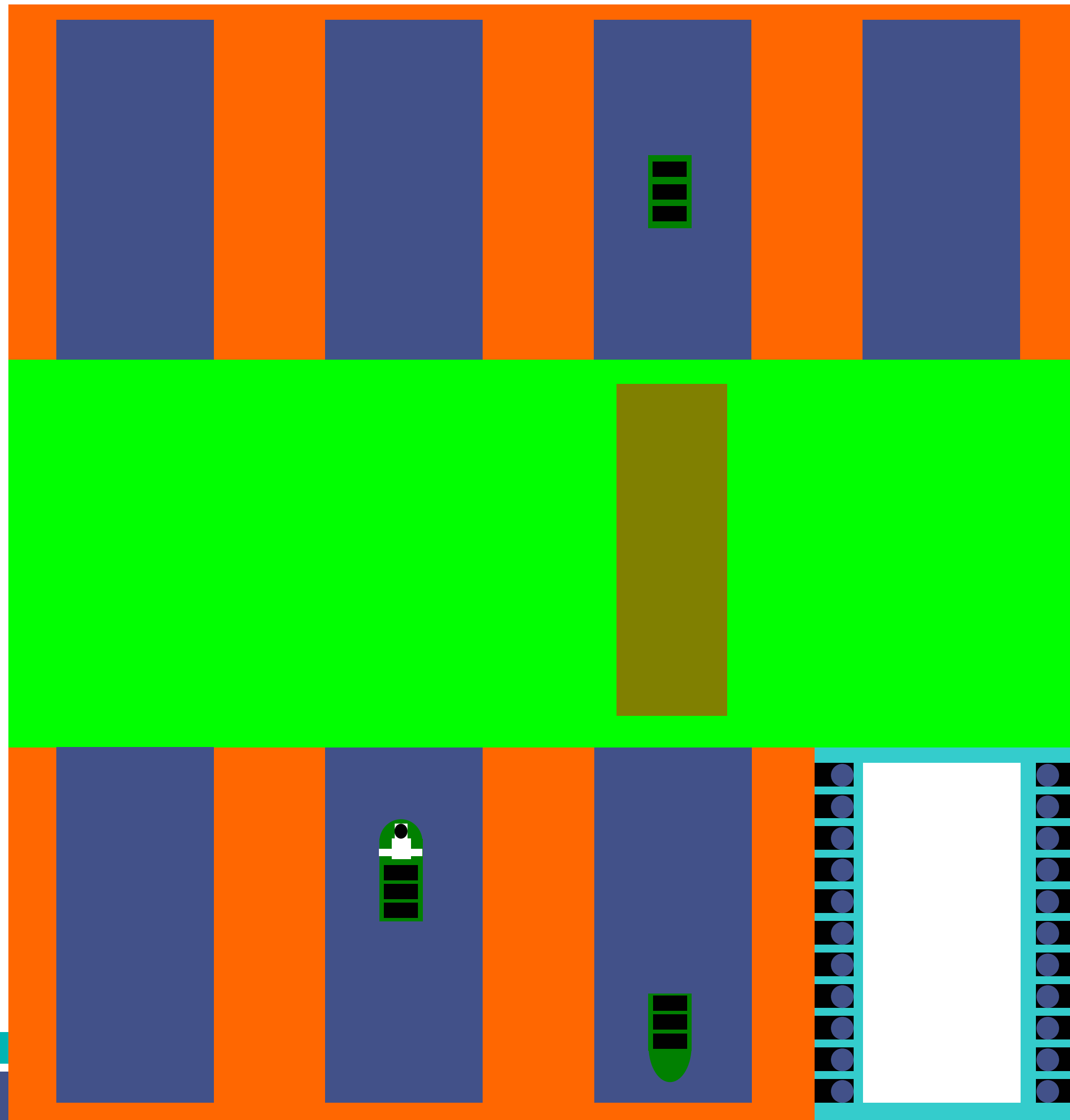
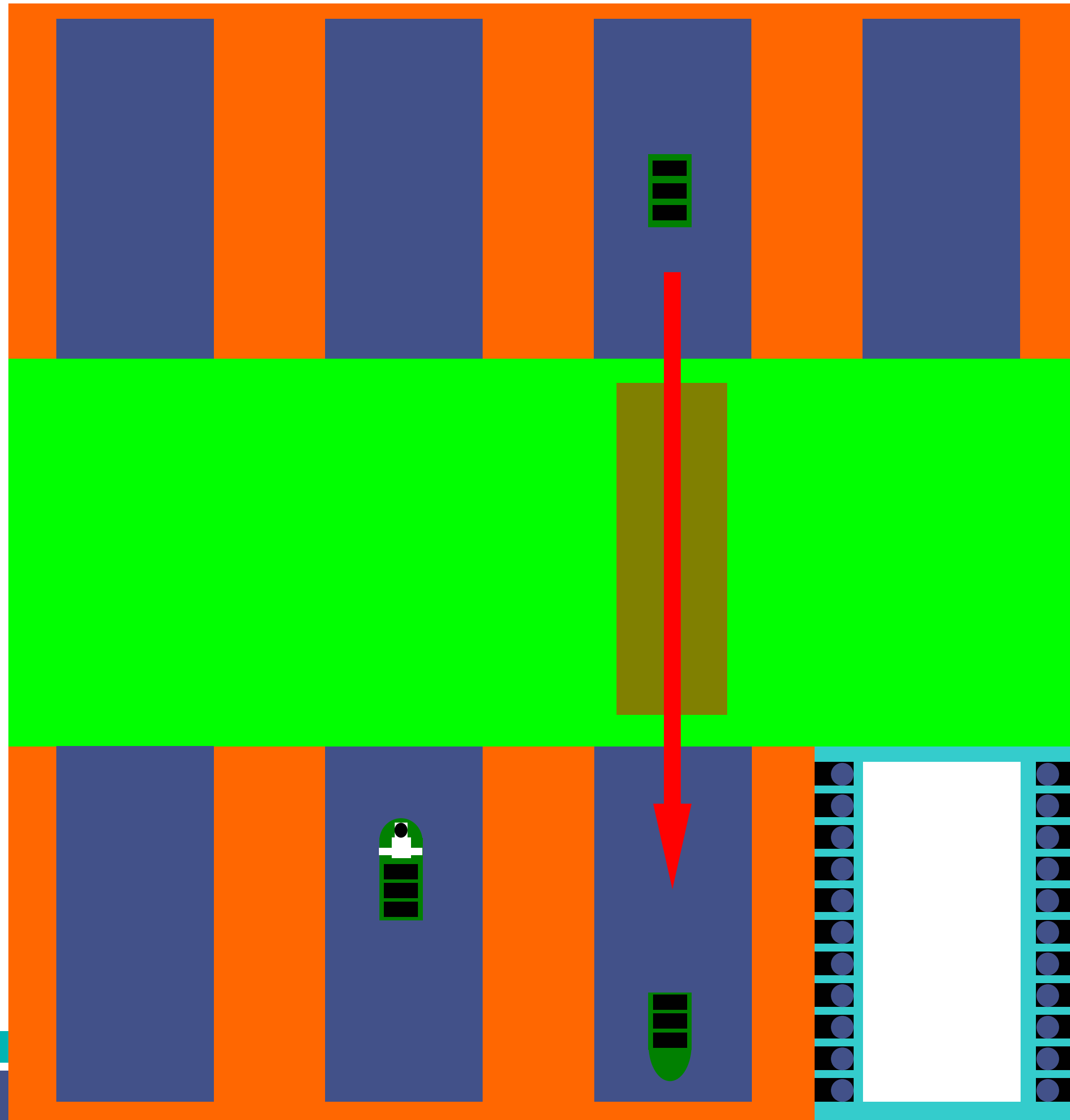


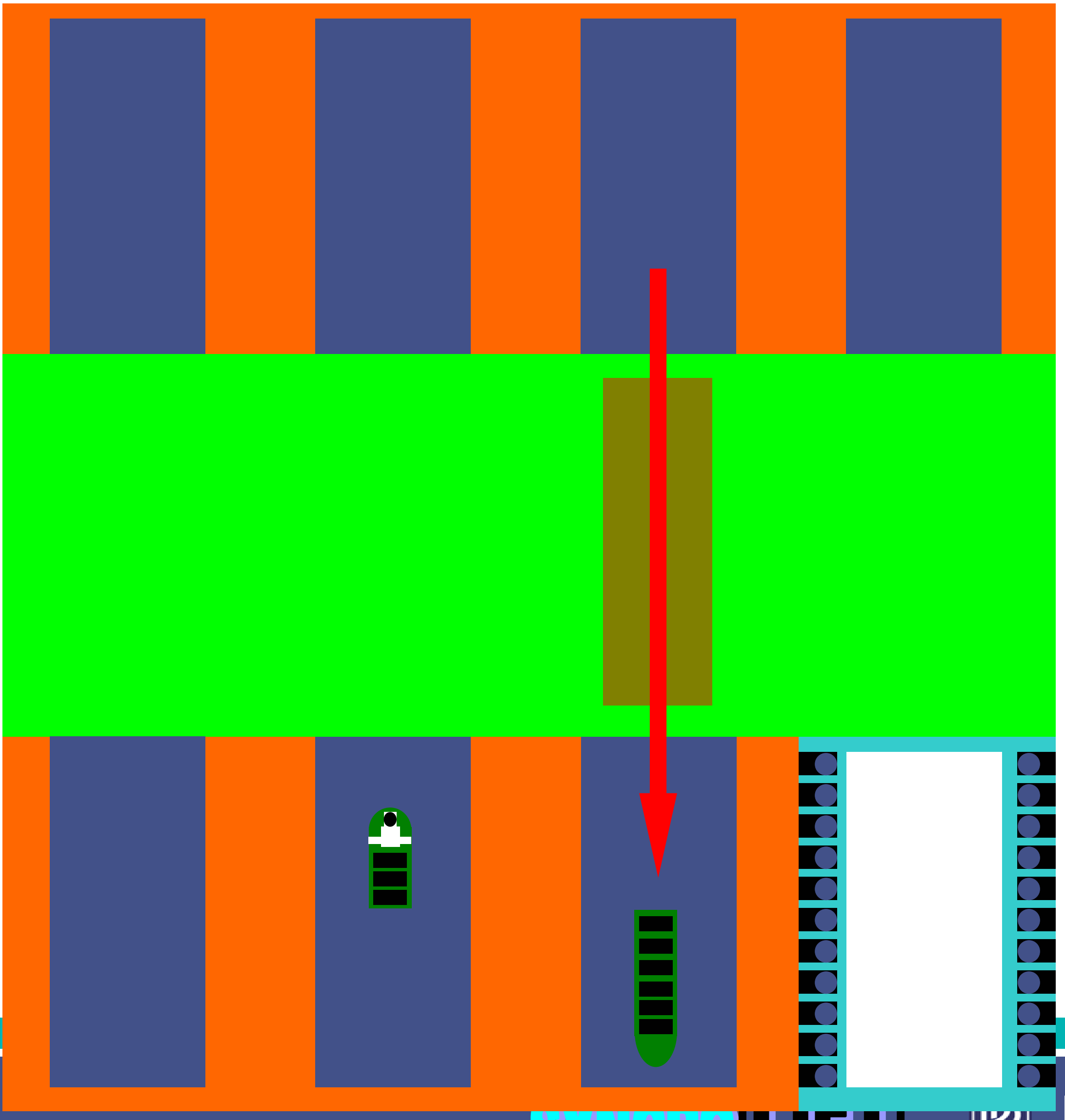
Multiple Berth Flexibility



Multiple Berth Flexibility



Multiple Berth Flexibility



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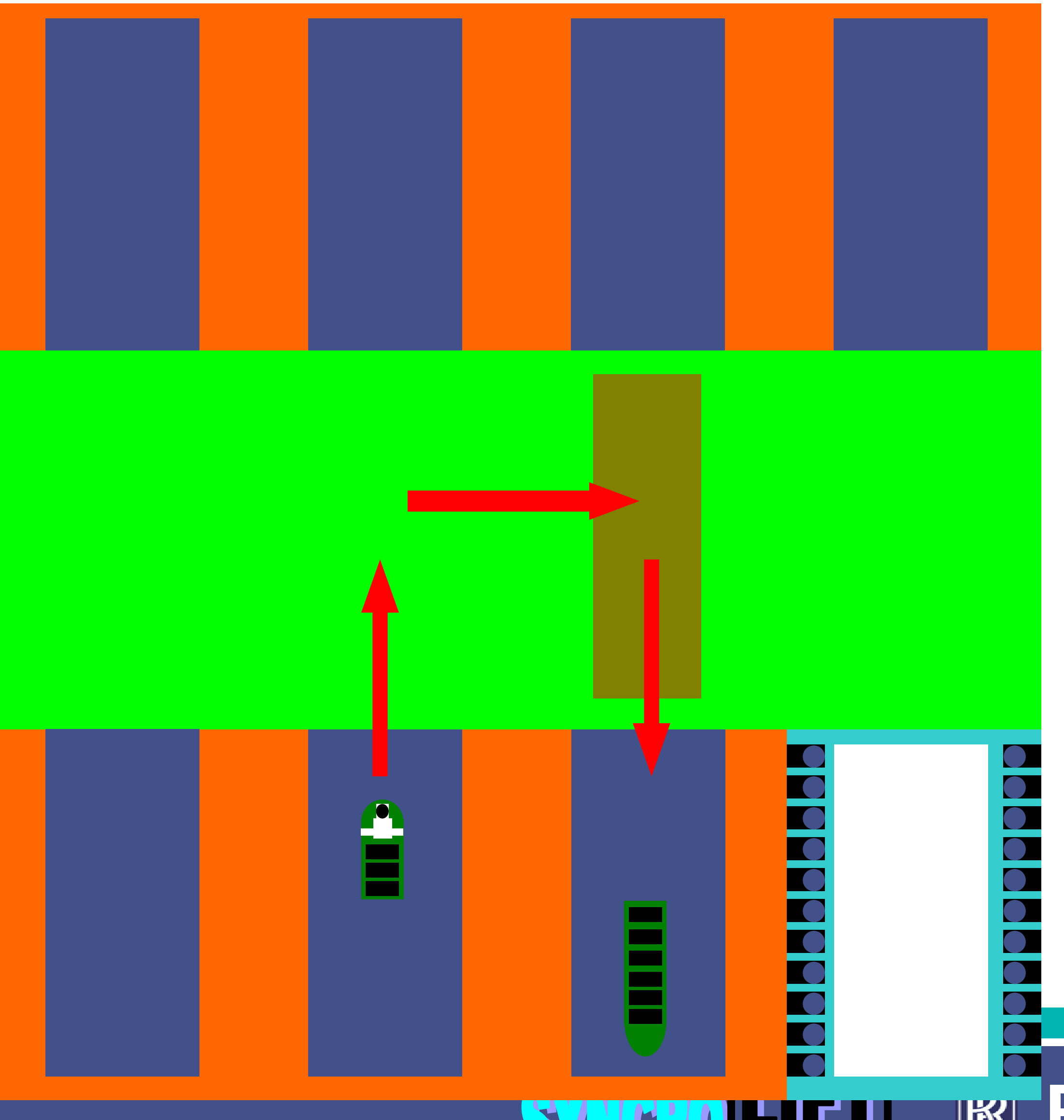
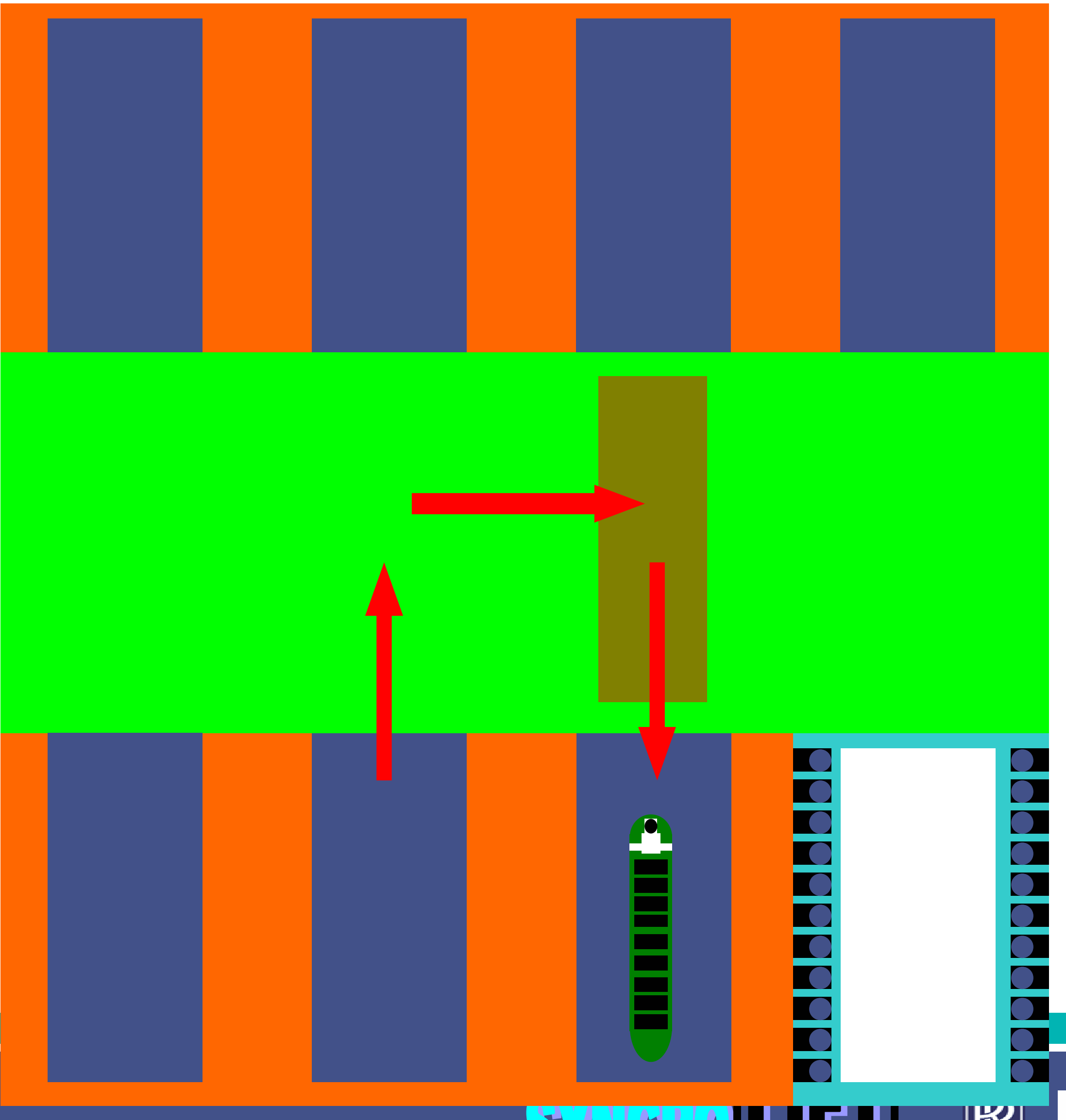


Multiple Berth Flexibility



SAFETY CONSIDERATIONS

Platform articulation: facilitates accurate load monitoring

Load Monitoring at all hoists

Fail-safe Protection at all times:

Proven for nuclear safety requirements

Compliance with Classification Societies Codes of Practice
ie: Lloyds Code for Lifting Appliances in a Marine Environment

Simple, proven concept: over 2 million lifts in almost 50 years service

BENEFITS APPLICABLE TO SHIP RECYCLING

Speed and Ease of Docking and Transfer

Maximizes yard capacity

Maximizes yard productivity and efficiency by improved access

Reduces docking timescale

Minimizes waterfront space

No prolonged self-maintenance

Capability for future expansion

Facilitates improved safety for ship recycling

Effective solution for combination of new-build, ship-repair and ship recycling

World-wide

230 Installations - 69 Countries

Big

Or small

shiplifts lift and transfer all

Including Nuclear Submarines

Spruance class destroyer
Docked on Transfer Cradles at Todd Shipyard, LA

Platform 199.6 metres x 32.3 metres 110 x 240 ton hoists

14,800 tons Nominal Lifting Capacity, mdl 110 tons per metre

MSE Shipyard in Malaysia

188 x 34 metres **110 x 265 ton hoists**

142/118 tons/metre mdl **16500 tons NLC**

Vanguard class submarine
on platform prior to launch

162 m x 22 m 108 x 270 ton hoists

140 tons per metre mdl 15000 tons NLC


DON PEDRO
ISC
MAR

Typical standard scope of supply

- Engineering design of complete system including design plans, detailed installation instructions , operating and maintenance manuals
- Hoists complete with covers, upper and lower sheave assemblies, wire ropes and load cells
- Control system complete with Motor Control Centre, Operators Work Station and Atlas control system
- Transfer system wheel assemblies
- Field engineering to assist with supervision of fabrication and installation and for operational inspection and training
- Design plans, detailed installation instructions, operating and maintenance manuals
- Spare parts

Typical 'Purchaser' scope of work
(Assuming standard Syncrolift scope of supply)

- Civil Works design and construction for the platform and shore transfer area
- Platform fabrication and installation
- Transfer cradle fabrication

Application - the Benefits

Facilitates conversion and Recycling

Ship Recycling in Pakistan

Economics & Environment

By

M. Shahid

GM(Design & Development)

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www.BinarySysEng.com

Introduction

- Pakistan has significant contribution in recycling of ships & other marine structures

- Concerns are:
  - Ecosystem along Arabian Sea coast
  - Occupational safety & health

- Pakistan has ratified international conventions relevant to ESM of Shipbreaking

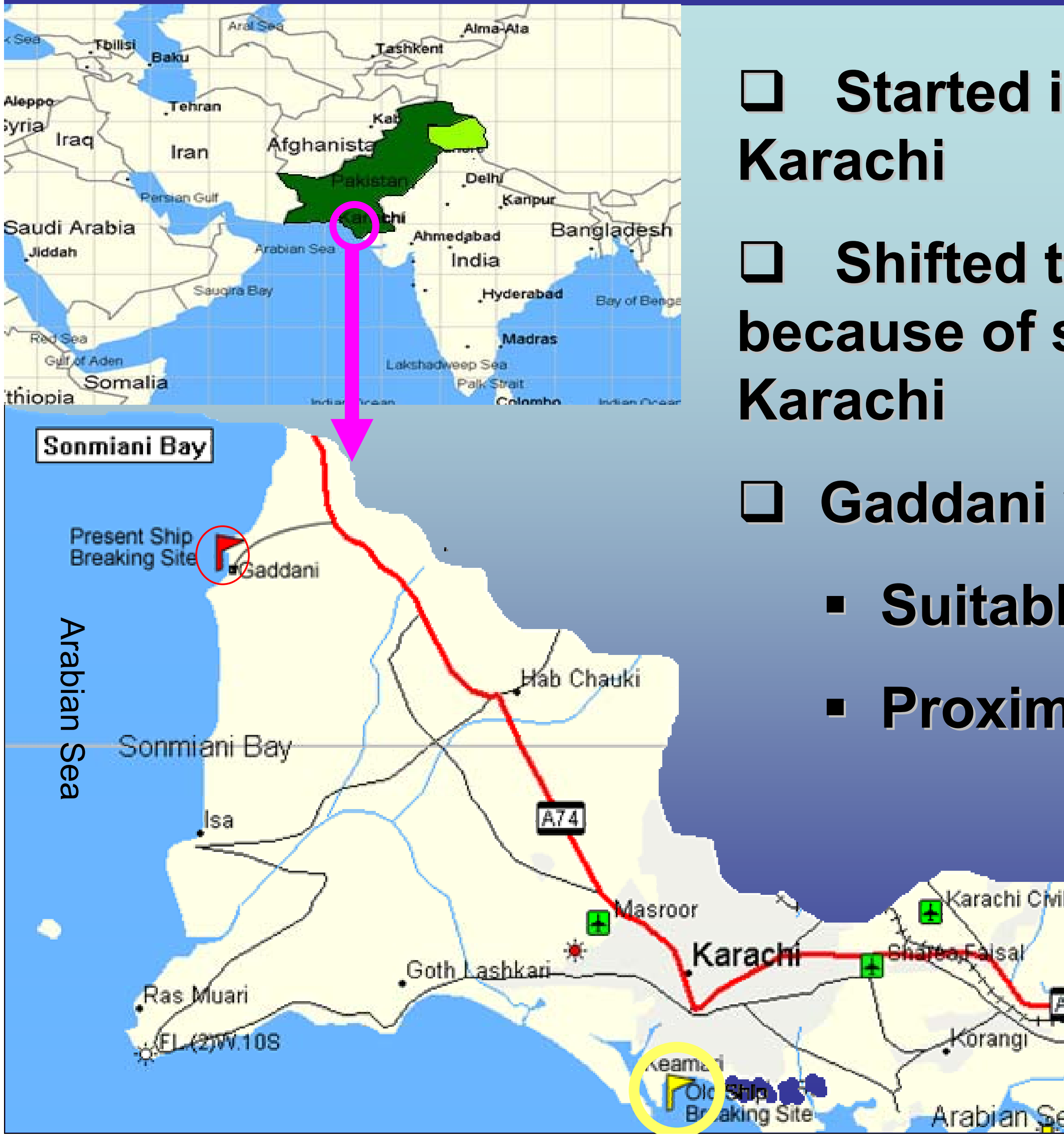
- Improvements & upgrading of industries needs to be financial viable

- Focus on economics mainly in context of local market dynamics

Presentation Scheme

- History of Ship Breaking in Pakistan
- Shipbreaking Yards
- Shipbreaking Process – Safety & Environment
- Governmental Controls
- Pakistan Ship Breakers' Association
- Economics of Steel in Pakistan
- Rehabilitation of Shipbreaking
- Conclusion

History of Ship Breaking in Pakistan

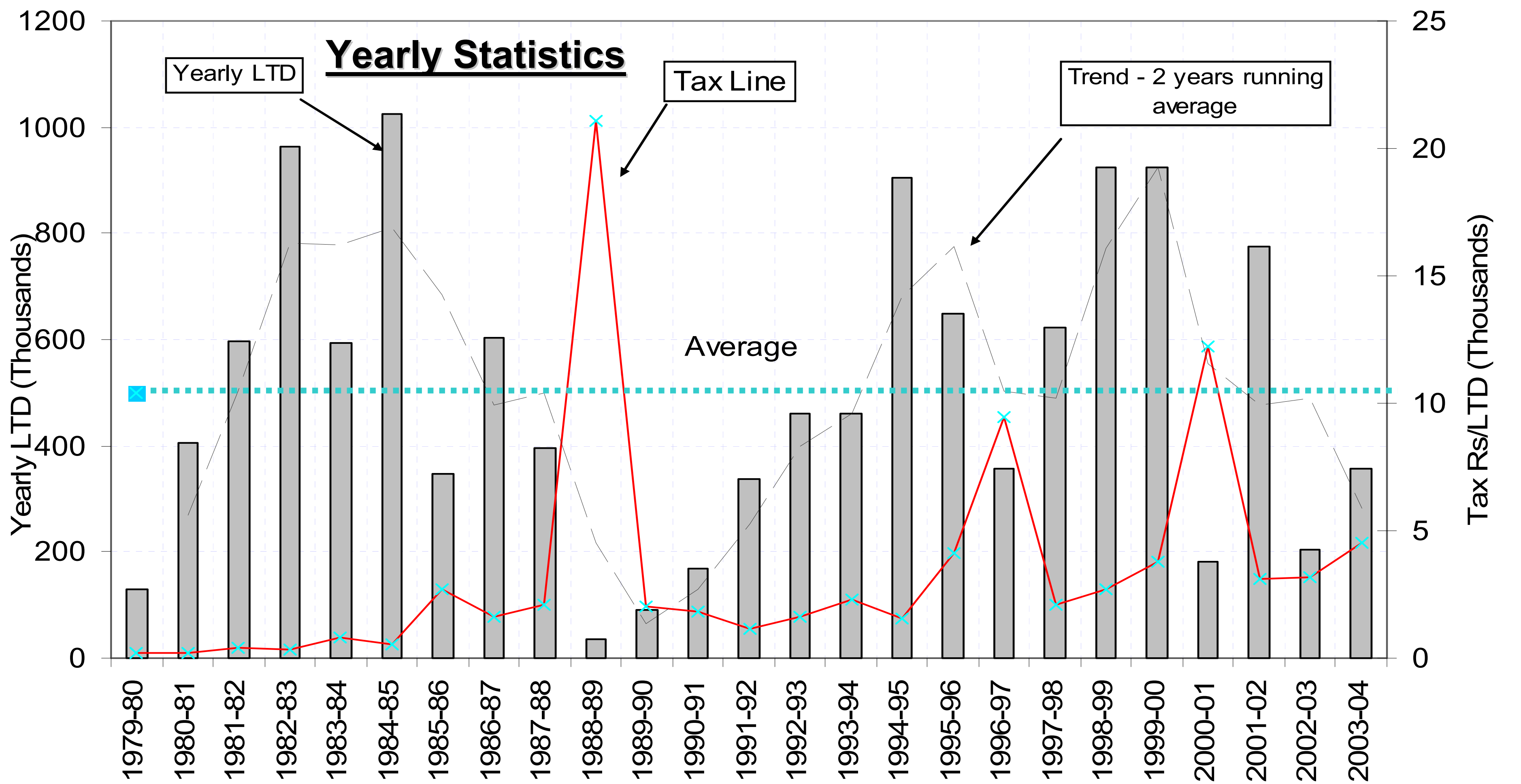


- Started in 1968 at Keamari, Karachi
- Shifted to Gaddani, in 1972 because of shortage of space at Karachi
- Gaddani was chosen having
  - Suitable beach gradient &
  - Proximity to Karachi Market

Important Features

- Total planned plots 314
- Plot size 200 X 80 meters
- Plots developed 150
- Number of Companies 27
- Employment Potential
  - Direct 20000
  - Indirect 150000

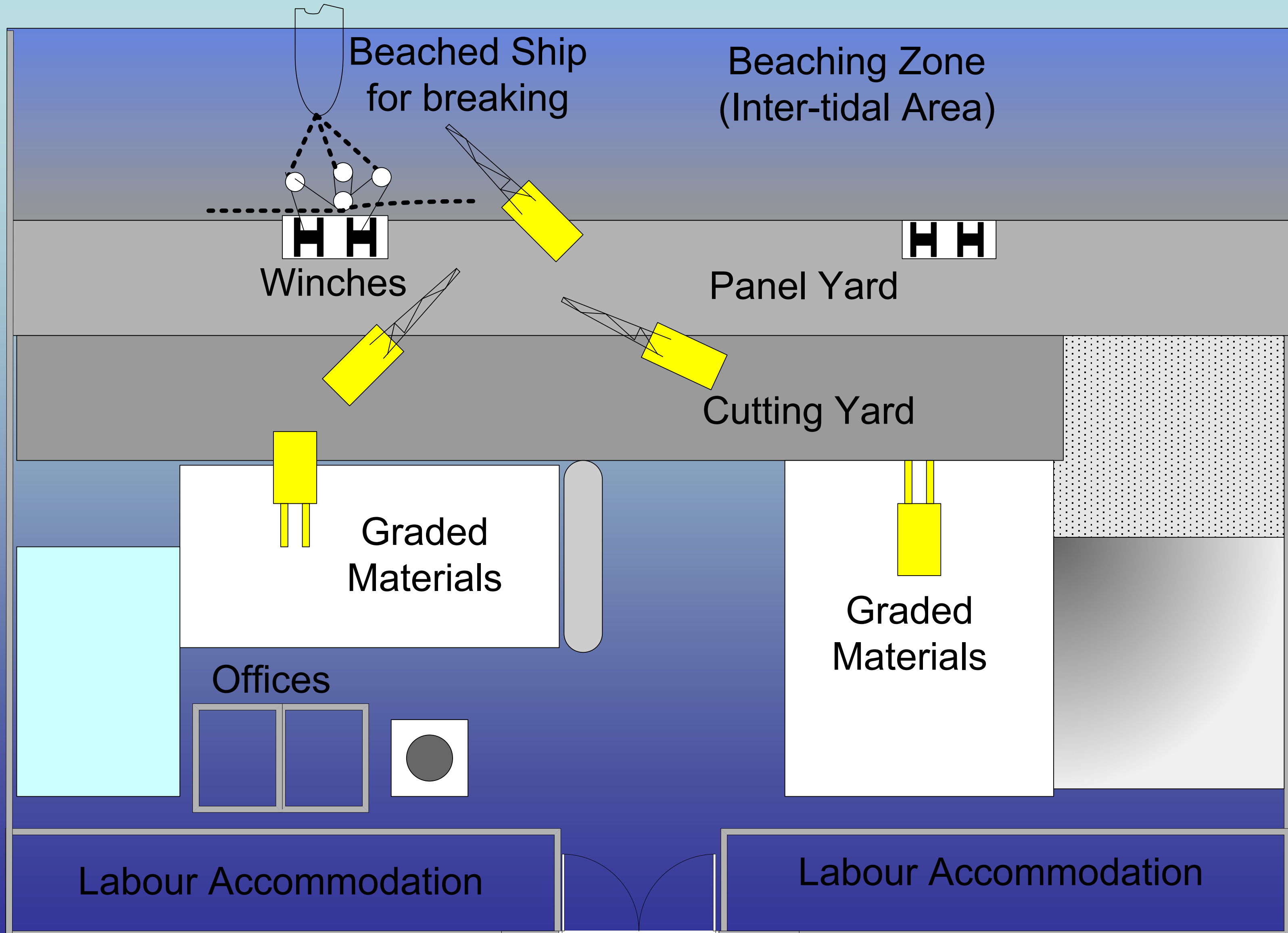
History of Ship Breaking in Pakistan



- Max Capacity yearly LTD 1.5 M
- Average LTD/Years 0.501 M
- Peak LTD/Year, 1.025 M
- Largest ship taken, 74087 LTD

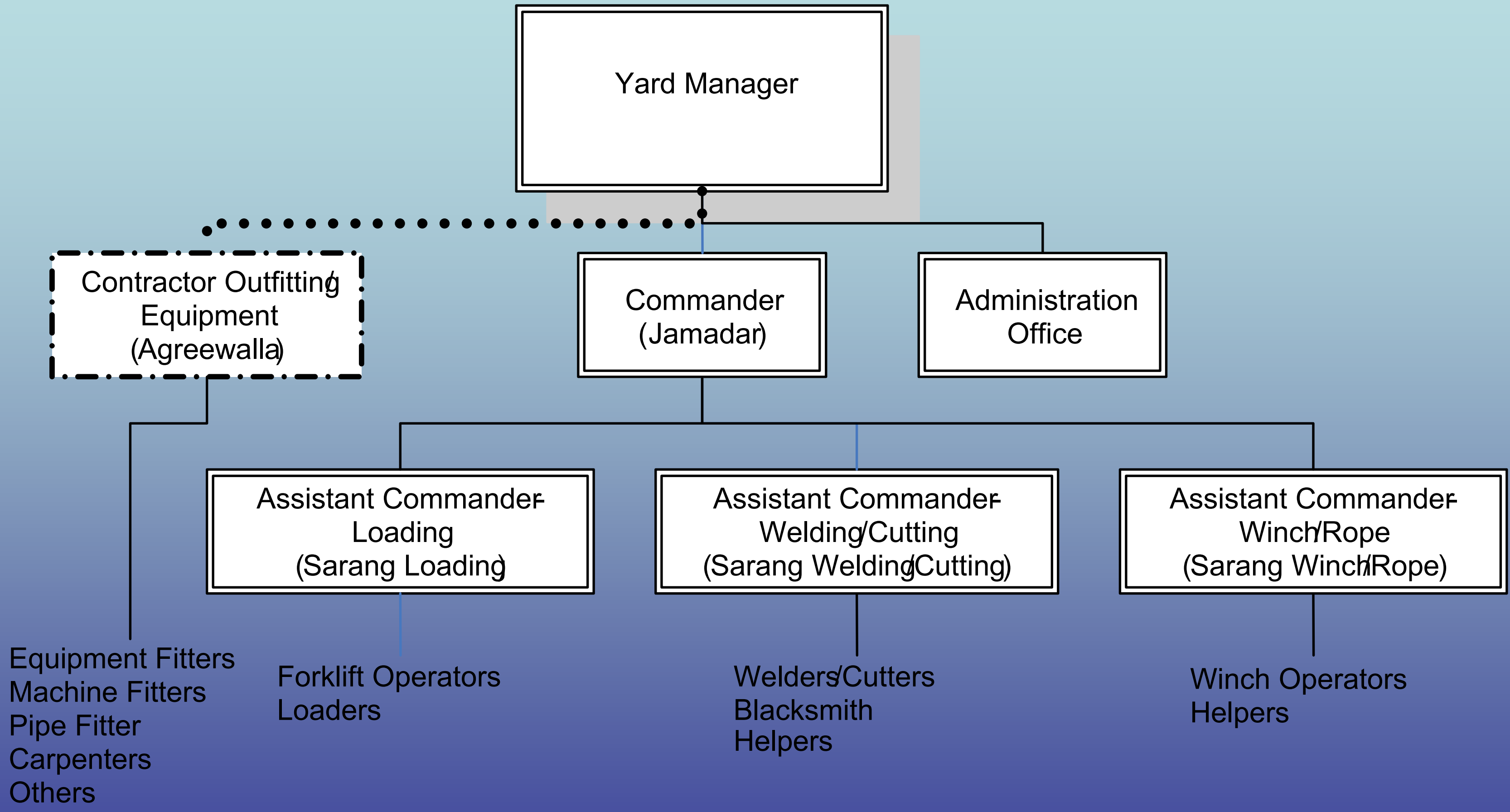
Ship Breaking Yards

Typical Layout

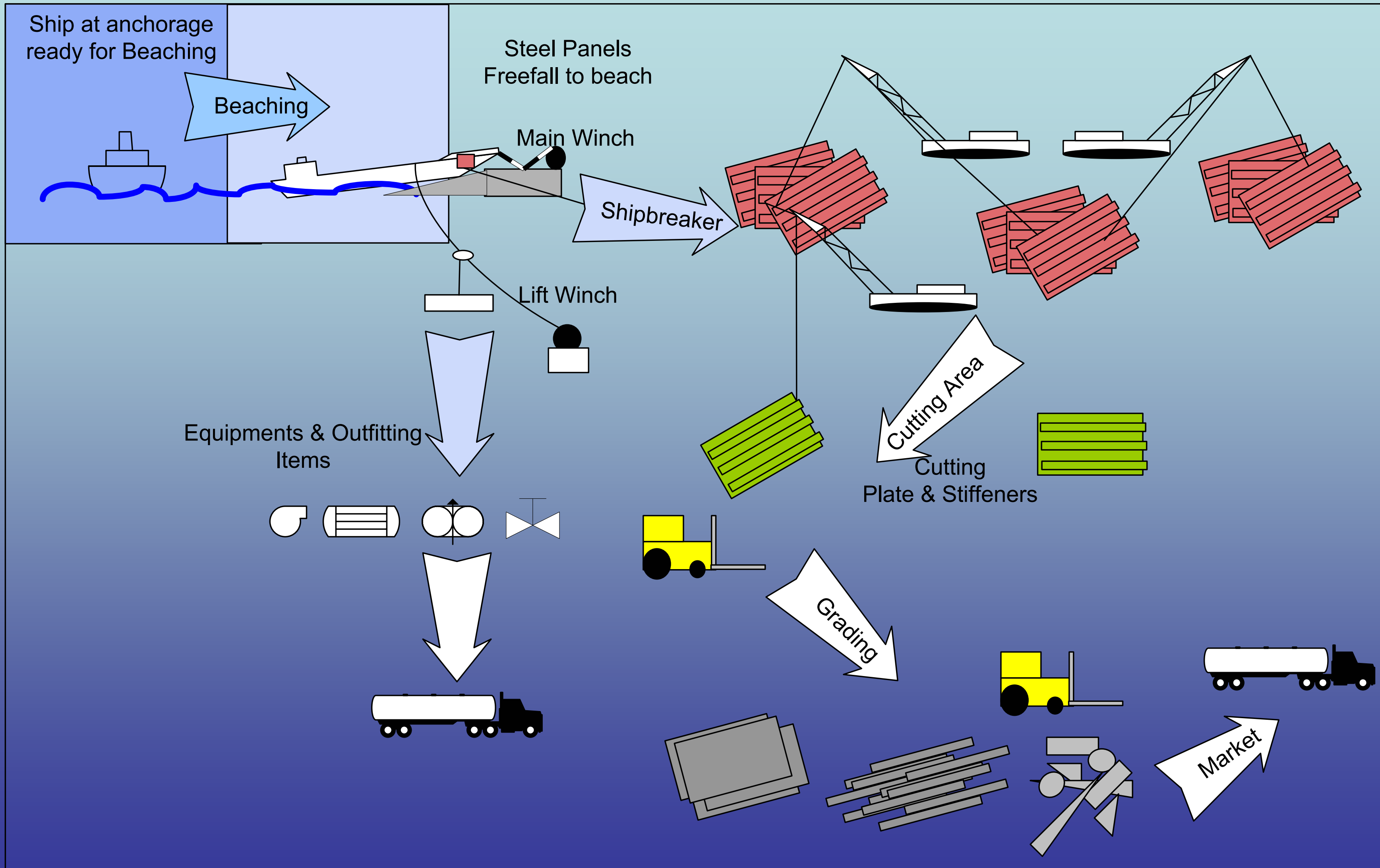


Ship Breaking Yards

Typical Organisation

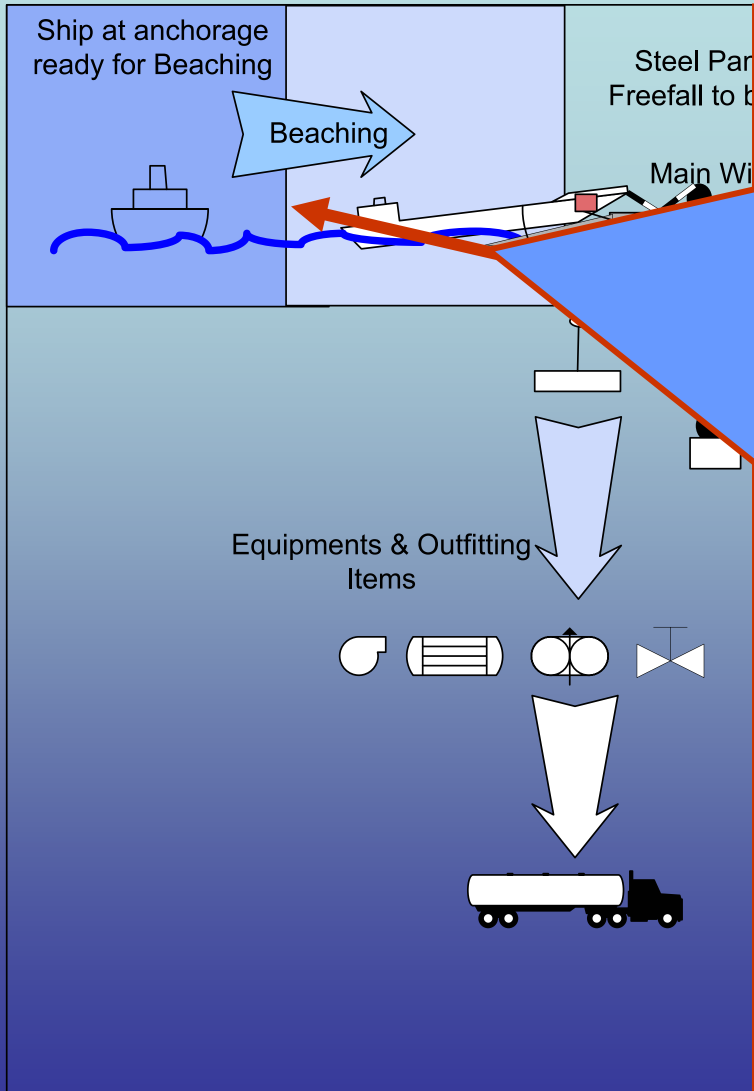


Ship Breaking Process - Safety & Environment



Ship Breaking Process - Safety & Environment

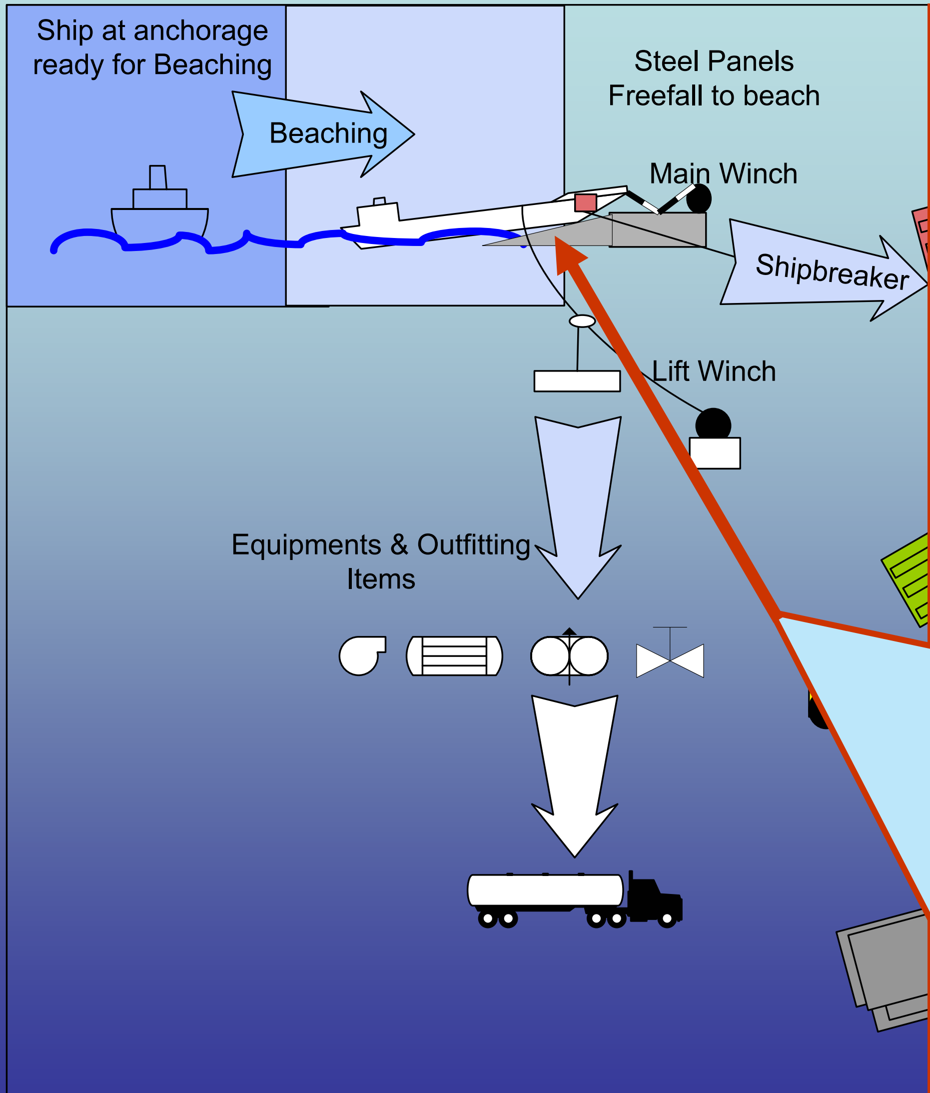
Beaching



- Only Gas Free ships allowed to beach
- Beaching procedures relies more on experience - accidents do occur
- Beaching guided by analysis and simulation likely to improve situation
- Environmental effects – no data available for Gaddani – EPA in process to set up lab
- Removal of TBT or other toxic paint from bottom prior beaching may be made mandatory

Ship Breaking Process - Safety & Environment

Inter Tidal Processes

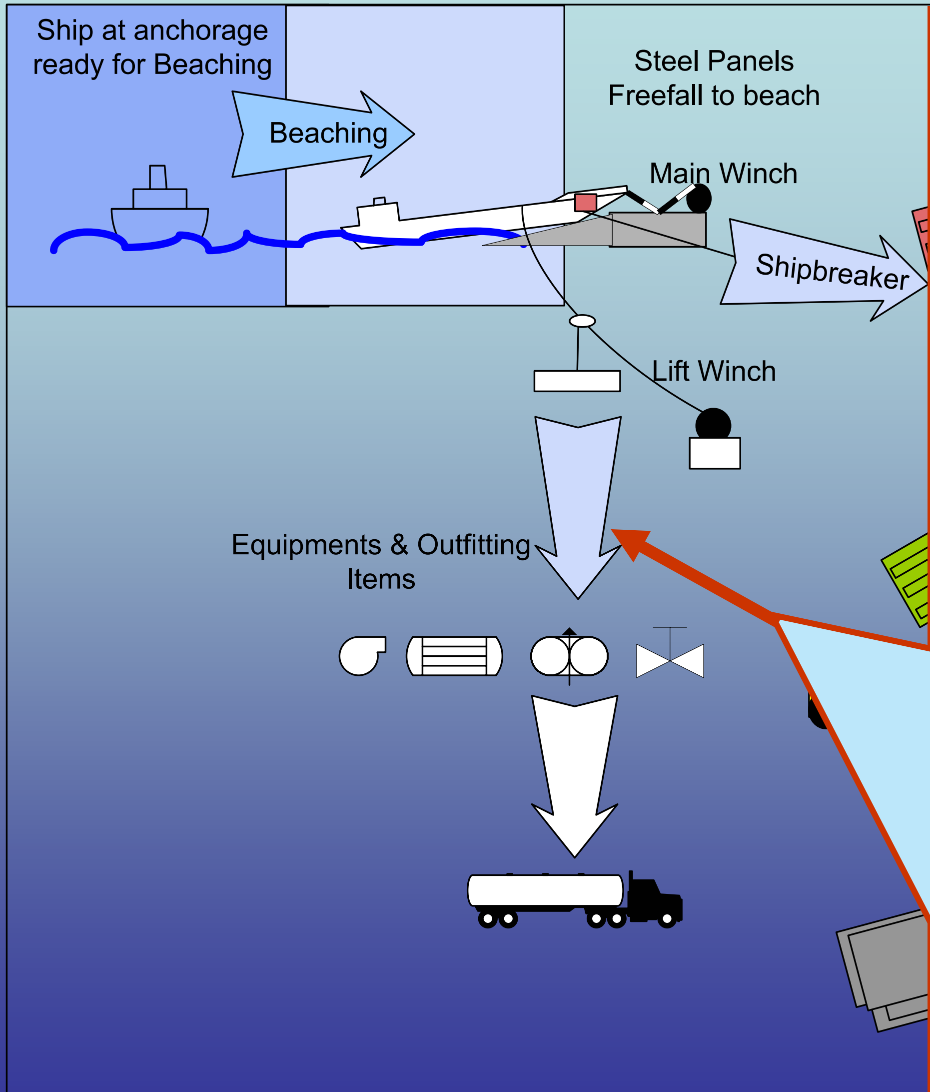


Ship Beached

- Only small portion of ship available out of sea
- Dismantling performed bow to stern and top to bottom allowing ship to float & drift forward on each tidal cycle,
- Ship is held in position by winch ashore

Ship Breaking Process - Safety & Environment

Inter Tidal Processes

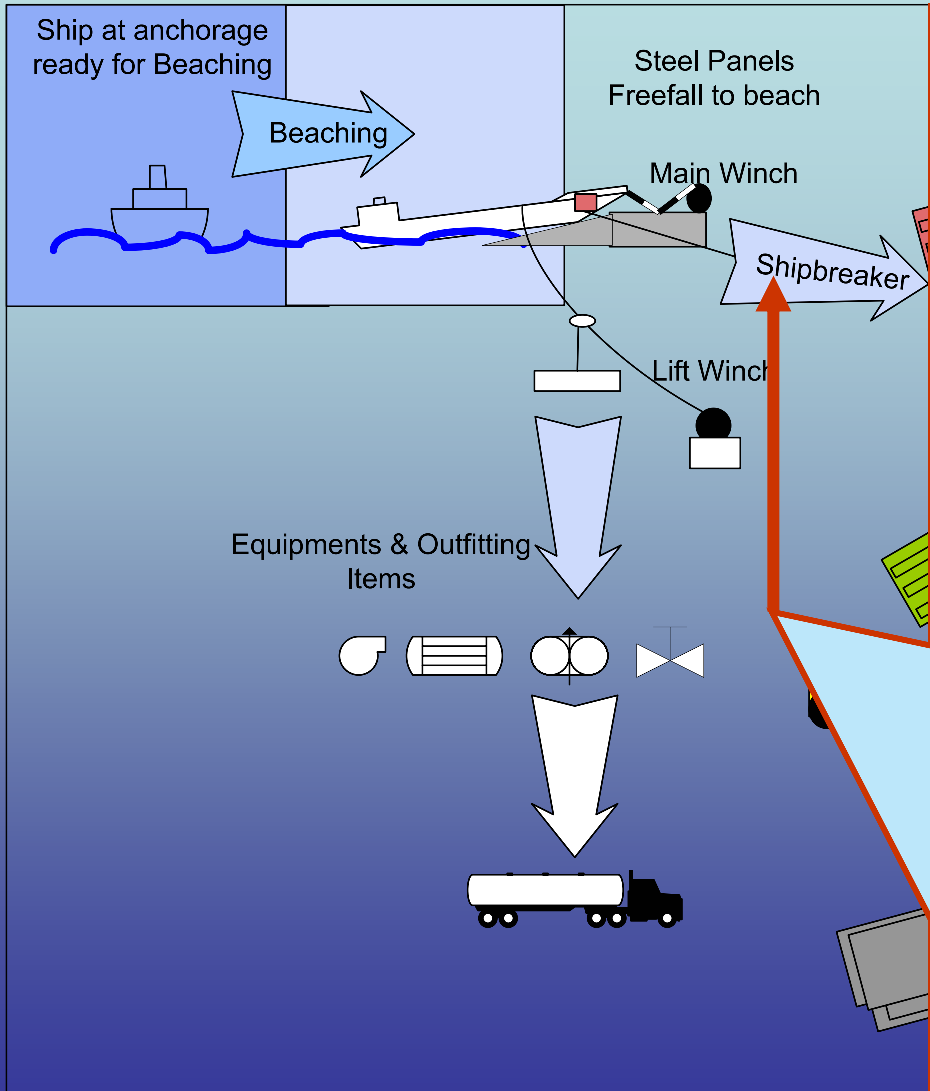


Machinary/Eqpts/Fittings

- Items removed by skilled workers from down stream industries
- No record of skill level of external workers
- No control on work procedures and safety measures for external workers
- Environment friendly final disposal or reuse of hazardous materials

Ship Breaking Process - Safety & Environment

Inter Tidal Processes



Removal of Structure

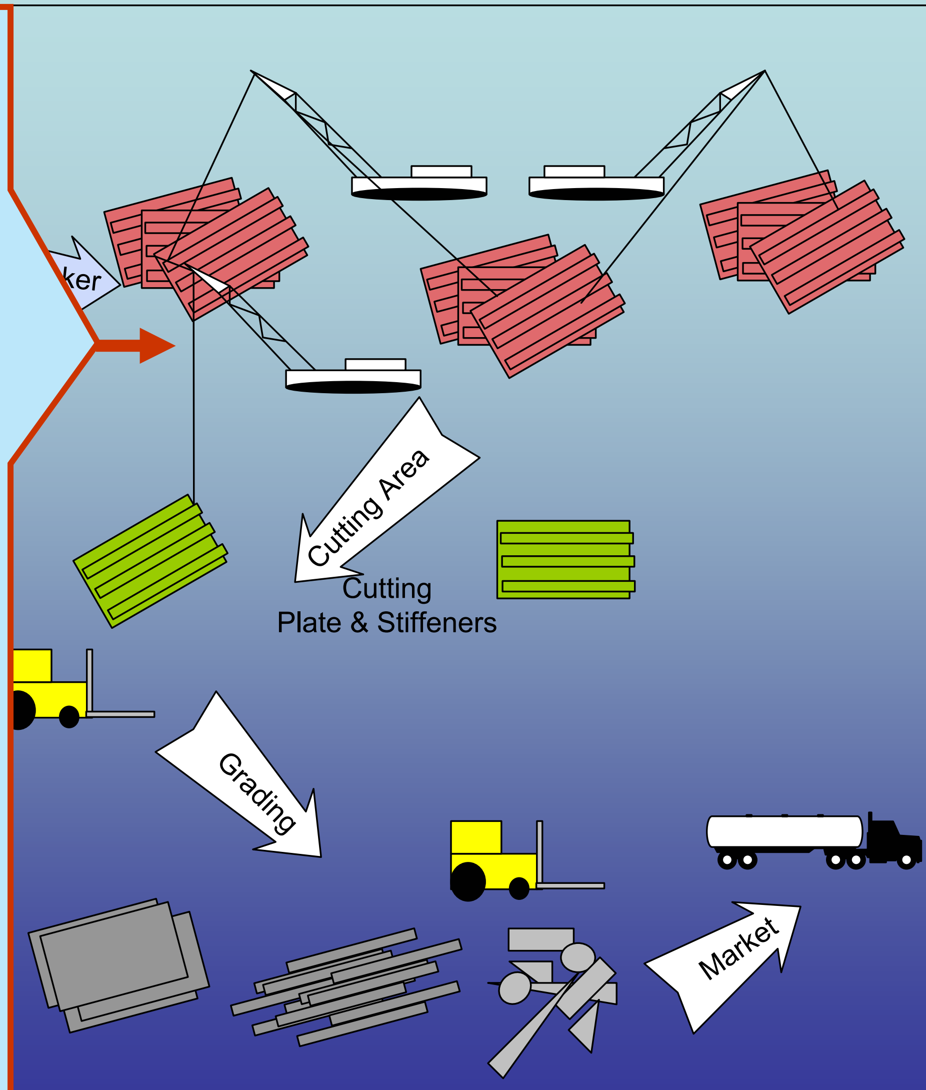
- Preparing for cutting
  - Gas freeing – 2nd stage
  - Bilge cleaning
  - Other liquid & solid waste removal
- LPG & Oxygen flame cutting
- Paint chipped away by hammers prior cutting if needed
- Cut steel panel free fall to beach and winched across tidal area to Panel Yard.

Ship Breaking Process - Safety & Environment

Panel & Cutting Yard Processes

Cause of Concerns

- ❑ Working & Store Areas
  - Open air
  - Sand bed - turned red
  - Visible oil stains
  - TBT or other hazardous
- ❑ Personal Gears
  - Normally used
    - Goggles
    - Gloves
    - Hard Shoes
  - Normally Ignored
    - Hard hat
    - Breathing Mask
    - Ear protection
- ❑ Lifting Gear Testing



Gaddani Ship Breaking - In Picture

Ship Beached

Gaddani Ship Breaking - In Picture

Ship Beached

Gaddani Ship Breaking - In Picture

Beached Ship and Winch Arrangement

Gaddani Ship Breaking - In Picture

Cranes Shifting Steel Panel to Cutting Yard

Gaddani Ship Breaking - In Picture

Cutting Gases

Gaddani Ship Breaking - In Picture

Cutting

Gaddani Ship Breaking - In Picture

Cutting

Gaddani Ship Breaking - In Picture

Graded Steel

Gaddani Ship Breaking - In Picture

Graded Steel

Gaddani Ship Breaking - In Picture

Loading for Transfer to Market

Gaddani Ship Breaking - In Picture

Liquid Waste Store

Gaddani Ship Breaking - In Picture

Solid Waste Store

Governmental Controls

❑ Baluchestan Development Authority

- "Shipbreaking Industries Rules" – only allowing Oil & Gas Free ships to beach for breaking
- Not in line with international standards

❑ Central Board of Revenue & Pakistan Customs

- Taxation policies and also put ban on items for import control.
- The "Ship-Breaking Industries (Special Procedures) Rules, 1997" do not ban import of materials identified toxic/hazardous on ship for breaking

❑ Environment Protection Agency

- Responsible for environment monitoring & protection
- In process to setup environment monitoring system

❑ Ministry of Labour & Manpower

- Responsible for Human Resources Development and Occupational Safety & Health
- No specific rules/plans for shipbreaking industries

Governmental Controls

Ministry of Environment

Working to bring essential changes to

ensure

Environmentally Sound Management

of

Shipbreaking in Pakistan

Pakistan Ship Breakers' Association

- National Forum of Ship Breakers
- Struggles with Government in making of policy favorable to this industrial sector
- Indicated plans to improve yard facilities and work environment

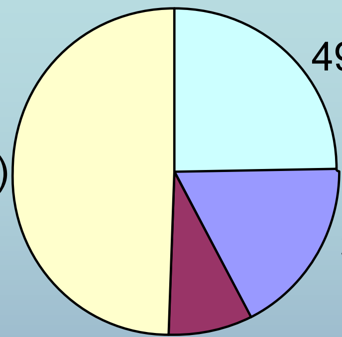
Major Steel Sources

- **Pakistan Steel Mills**
  - based on iron Ore
- **Re-melt Steel Industries**
  - based on shredded/bundled scrape, imported or local
- **Shipbreaking Steel**
  - mainly re-rolled

Economics of Steel in Pakistan

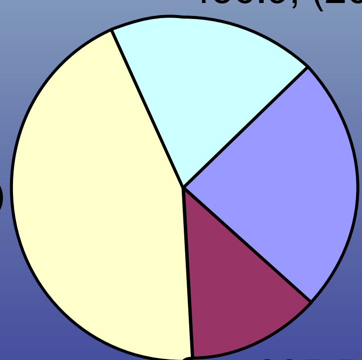
Steel Sources Comparison

2002-2003



Total 2005.3 Thousands Metric Ton

2003-2004



Total 2300.9 Thousands Metric Ton

- 8 – 12% Shipbreaking
- 17 – 24% Re-melt industries
- 20 – 25% unidentified sources
- 14 % growth rate 2002 to 2004

Estimated target for Ship Breaking

0.53 Million Tons/Annum

- Shredded Scrap
- Shipbreaking Scrap
- Steel Mill Products
- Other Source

Rehabilitation of Shipbreaking Industries

Economics Consideration

Steel Supply & Demand

Estimated Global Tonnage of Ships Available for Scrape over Next 10 Years	6 Million LTD/Year
Pakistan's Average Yearly Share of Total Tonnage for Scraped	13%
Estimated Scrape Tonnage Available for Pakistan over Next 10 Years	0.78 Million LTD/Year
Estimated Steel Demand from Shipbreaking Industries	0.53 Million metric tons/Year

Revenue & Finances

	PKR	USD
Lowest Tax Level over Last 3 Years	3028/LTD	50.1/LTD
Estimated Yearly Revenue for 0.53 MLTD	1604.84 Million	26.97 Million
Government Revenue 50%	802.42 Million	13.48 Million
Fund Tax Cut to Revive Activities 25%	401.21 Million	6.74 Million
Fund Rehabilitation Activities 25%	401.21 Million	6.74 Million

Reforms Needed

Taxation

- Needed a taxing system responsive to international and local market dynamics providing level ground to all related steel industries in Pakistan

Resources Development

- Human Resources Development – for safe ship dismantling functions
- Infrastructure Development – ensuring safety of workers and environment friendly processing and disposal of materials

Reforms Implementation

Funding the Principal Cost

- Government ?
- International Funding Agency

Ratification of Ship Recycling Facilities

- International Classification Societies may establish Rules and Procedures to classify Ship Recycling facilities
- Global control of business flow on basis of category of yard classed to

Ship Recycling in Pakistan

Economics & Environment

Conclusions

- ❑ Over 30 years of ship breaking history, survived many recessions
- ❑ Have considerable potential
  - Ship Recycling Capacity:

    Maximum 1.5 Million LTD/Year

    Supportable 0.53 Million LTD/Year
  - Employment: 15000 direct

    150000 indirect
  - Revenue: Over Rs1604 Million / annum

    (USD 27 Million / annum)

Ship Recycling in Pakistan

Economics & Environment

Conclusions

- Reforms needed
  - Taxation System
  - Resources Development

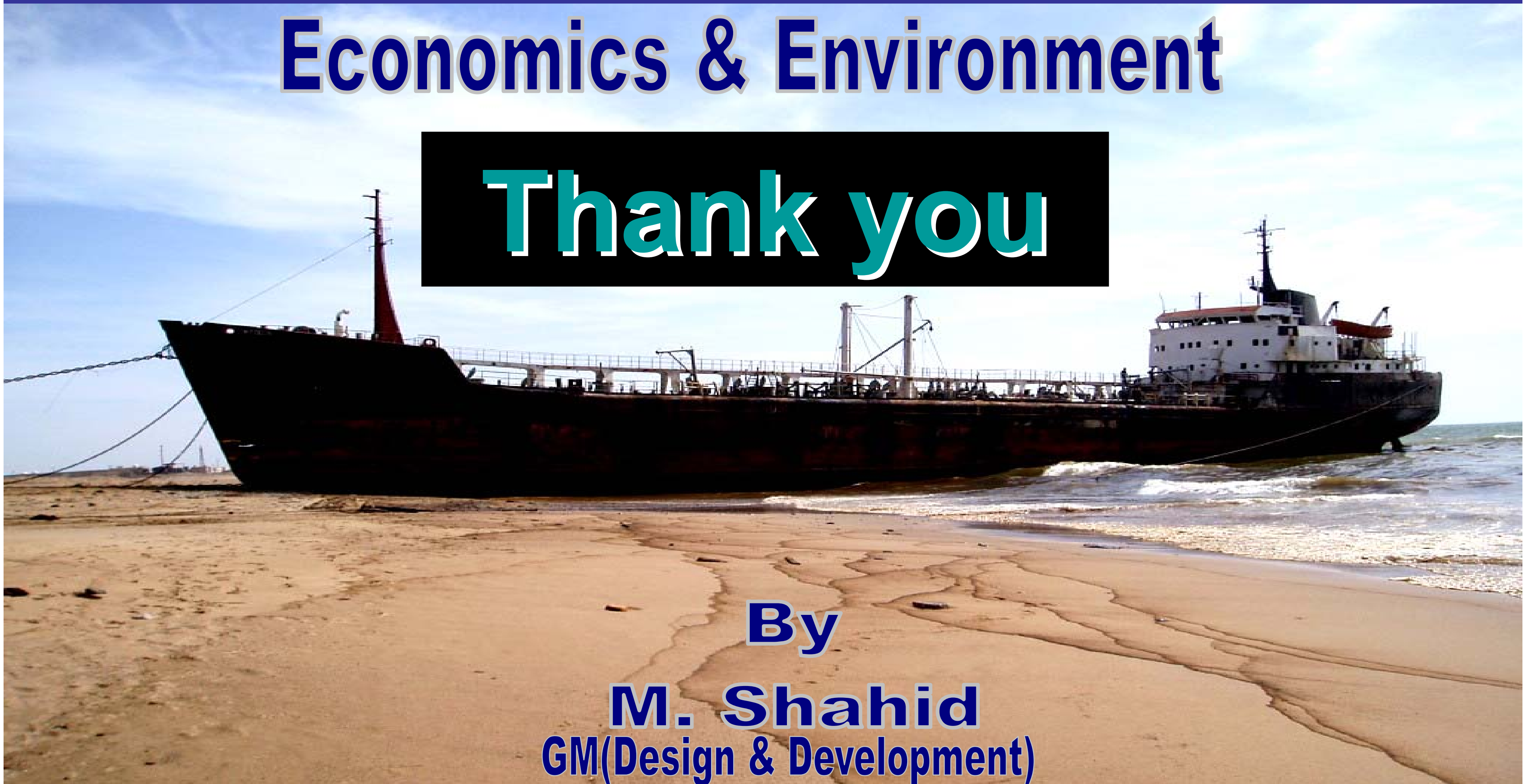
- Lack of initial capital is a major impediment in reforms

- International Funding Agencies are recommended to make investment and establish development programme for this sector.

- Classifications of Ship Recycling facilities coupled with global business flow control is also recommended.

Ship Recycling in Pakistan

Economics & Environment



Thank you

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www.BinarySysEng.com


BIMCO CENTENARY
2005
Ship Recycling
– the Current Status

INDIA

Location:
Alang, Gujarat, WC India

Number of recyclers:
Approx. 85

People involved (directly or indirectly):
250,000

Estimated capacity:
4.5 mill ldt

Some characteristics:
- Leading recycling area – purchases all types of ships
- Top prices paid for specialized ships
- Beaching + tides
- Gas free for hot work requirement

CHINA

Location:
Shanghai and Xinhui areas

Number of recyclers:
Approx. 10

People involved (directly or indirectly):
100,000

Estimated capacity:
1.7 mill ldt

Some characteristics:
- Leading area for tankers
- Efficient
- No beaching
- Gas free for men only
- High port costs

BANGLADESH

Location:
Chittagong, Bay of Bengal

Number of recyclers:
Approx. 25

People involved (directly or indirectly):
100,000

Estimated capacity:
1.5 mill ldt

Some characteristics:

- Leading area for tankers
- Top prices paid for VLCCs and ULCCs
- Beaching + brief tides
- Gas free for men only
- Risk of piracy at achorage

PAKISTAN

Location:
Gadani Beach, near Karachi

Number of recyclers:
Approx. 30

People involved (directly or indirectly):
100,000

Estimated capacity:
1.0 mill ldt

Some characteristics:

- Mainly buy tankers (all sizes) and even under tow and small ships
- Beaching but no tides
- Gas free for men only
- Low port costs

TURKEY

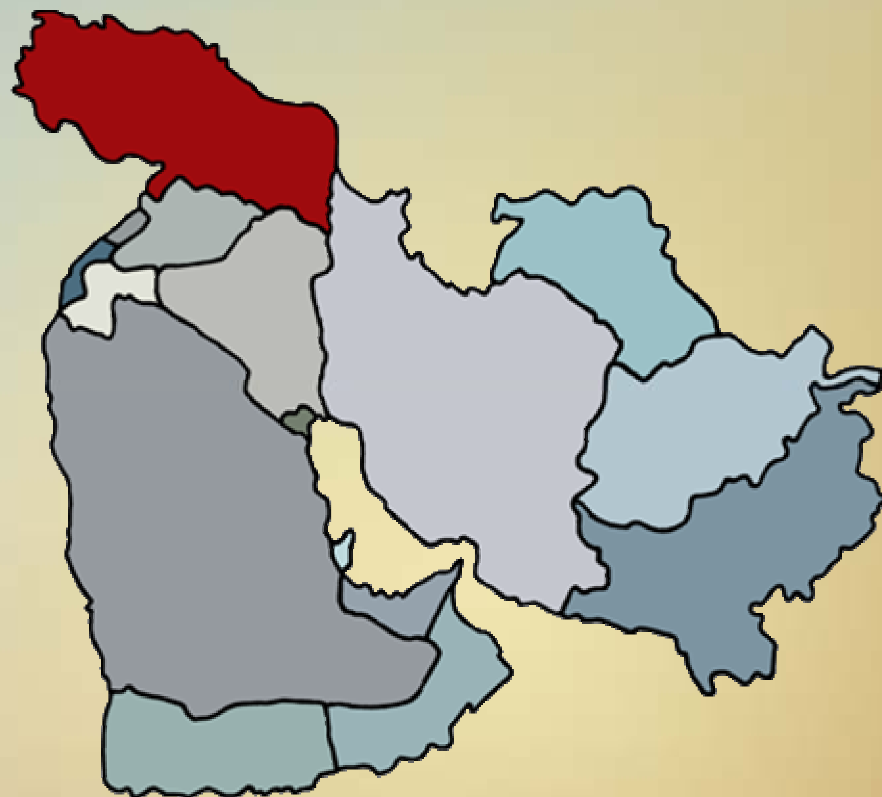
Location:
Aliaga, north of Izmir

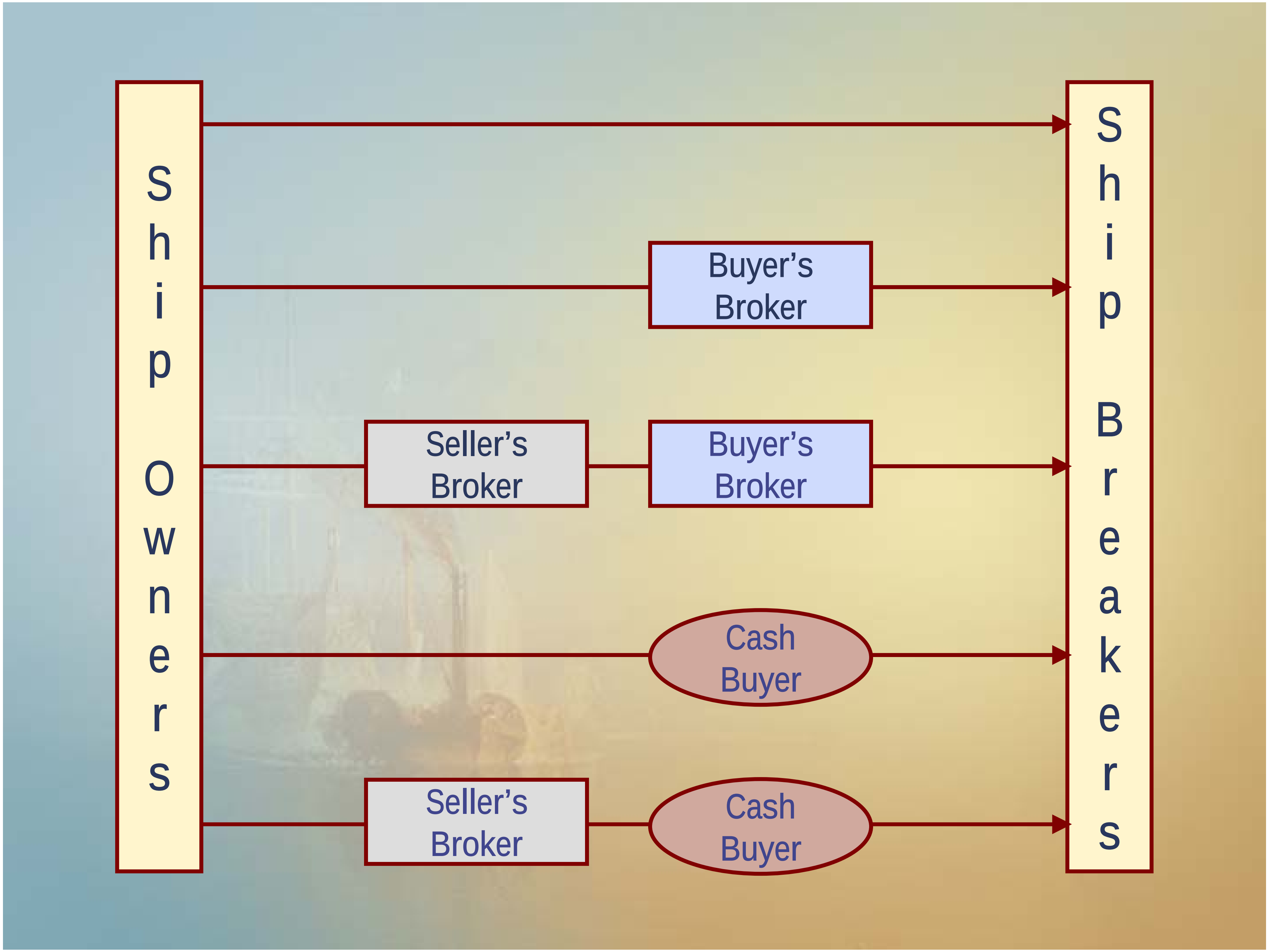
Number of recyclers:
20

People involved (directly or indirectly):
8,000

Estimated capacity:
1.0 mill ldt

Some characteristics:
- Buy all types and sizes
- Beaching on slipway
- Efficient
- Low prices




Ship Owners
Ship Breakers
Buyer's Broker
Seller's Broker
Buyer's Broker
Cash Buyer
Seller's Broker
Cash Buyer

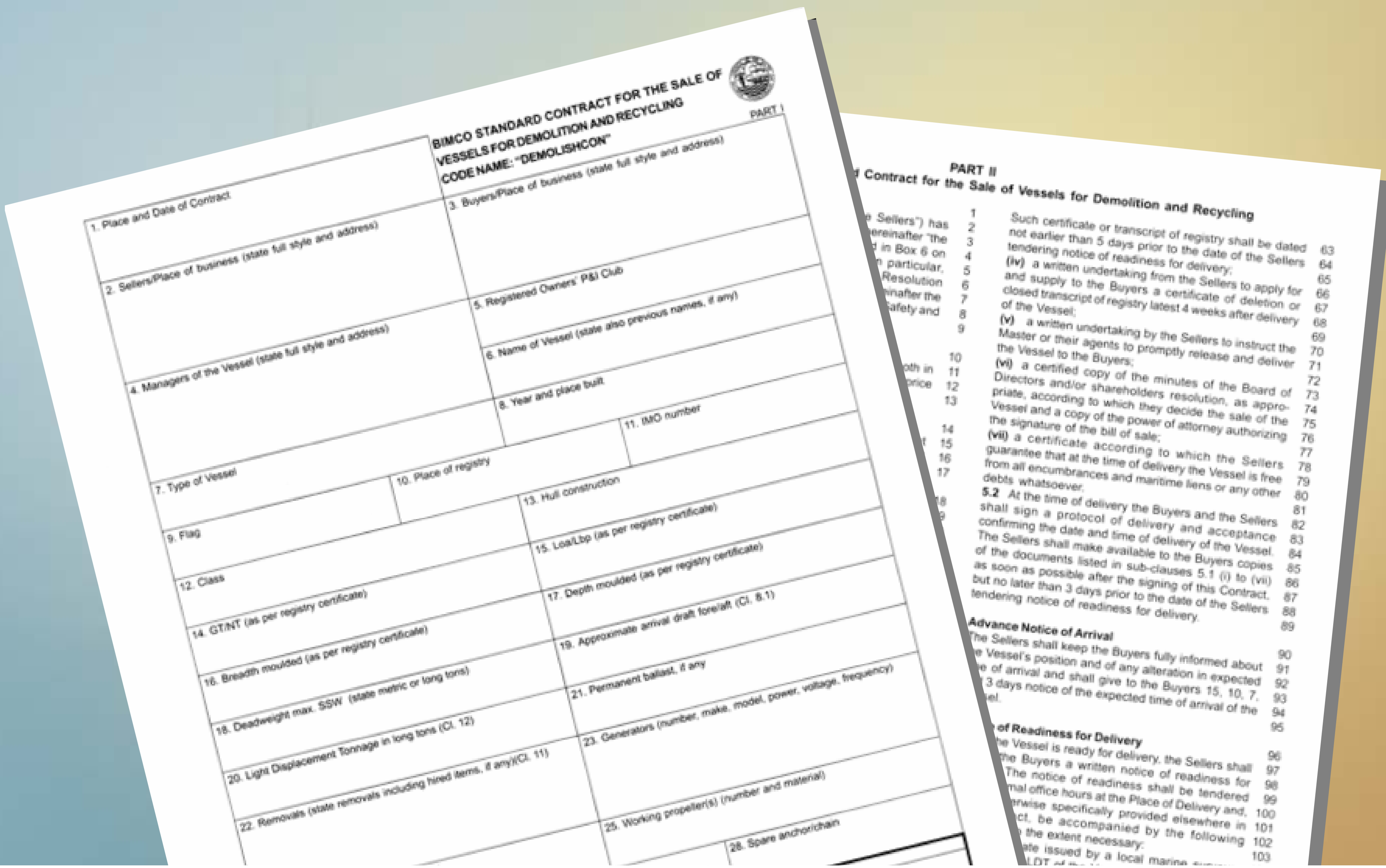
Management

- Who are the managers?
- What are their backgrounds?
- Are they reputable?

Track Record

- How many vessels have they bought and from whom?
- How did they perform?
- Have any deals been subject to re-negotiation on arrival to delivery port?
- Can they provide a list of ship owners and brokers as reference?

DEMOLISHCON


BIMCO STANDARD CONTRACT FOR THE SALE OF VESSELS FOR DEMOLITION AND RECYCLING
CODE NAME: "DEMOLISHCON"

PART I

1. Place and Date of Contract
2. Sellers/Place of business (state full style and address)
3. Buyers/Place of business (state full style and address)
4. Managers of the Vessel (state full style and address)
5. Registered Owners' P&I Club
6. Name of Vessel (state also previous names, if any)
7. Type of Vessel
8. Year and place built
9. Flag
10. Place of registry
11. IMO number
12. Class
13. Hull construction
14. GT/NT (as per registry certificate)
15. Loa/Lbp (as per registry certificate)
16. Breadth moulded (as per registry certificate)
17. Depth moulded (as per registry certificate)
18. Deadweight max. SSW (state metric or long tons)
19. Approximate arrival draft fore/aft (Cl. 6.1)
20. Light Displacement Tonnage in long tons (Cl. 12)
21. Permanent ballast, if any
22. Removals (state removals including hired items, if any)(Cl. 11)
23. Generators (number, make, model, power, voltage, frequency)
25. Working propeller(s) (number and material)
28. Spare anchor/chain

PART II

Contract for the Sale of Vessels for Demolition and Recycling

Such certificate or transcript of registry shall be dated not earlier than 5 days prior to the date of the Sellers tendering notice of readiness for delivery;
(iv) a written undertaking from the Sellers to apply for and supply to the Buyers a certificate of deletion or closed transcript of registry latest 4 weeks after delivery of the Vessel;
(v) a written undertaking by the Sellers to instruct the Master or their agents to promptly release and deliver the Vessel to the Buyers;
(vi) a certified copy of the minutes of the Board of Directors and/or shareholders resolution, as appropriate, according to which they decide the sale of the Vessel and a copy of the power of attorney authorizing the signature of the bill of sale;
(vii) a certificate according to which the Sellers guarantee that at the time of delivery the Vessel is free from all encumbrances and maritime liens or any other debts whatsoever.
5.2 At the time of delivery the Buyers and the Sellers shall sign a protocol of delivery and acceptance confirming the date and time of delivery of the Vessel. The Sellers shall make available to the Buyers copies of the documents listed in sub-clauses 5.1 (i) to (vii) as soon as possible after the signing of this Contract, but no later than 3 days prior to the date of the Sellers tendering notice of readiness for delivery.

Advance Notice of Arrival

Preamble

The party stated in Box 2 (hereinafter “the Sellers”) has agreed to sell and the party stated in Box 3 (hereinafter “the Buyers”) has agreed to buy the Vessel stated in Box 6 on the following terms and conditions which, in particular, include an undertaking to comply with IMO Resolution A.962(23) IMO Guidelines on Ship Recycling (hereinafter the “IMO Guidelines”) in accordance with Clause 17 (Safety and Environment).

17. Safety and Environment

Both the Sellers and the Buyers are familiar with the IMO Guidelines and the Sellers shall use their best endeavours to give information to the Buyers in respect of the recommendations of the IMO Guidelines and the Buyers likewise shall use their best endeavours to comply with such recommendations.

The Buyers shall ensure that after delivery the Sellers' representatives are allowed to visit the ship recyclinig facility to ascertain that safe and environmentally sound practices are being conducted in respect of the recycling of the Vessel.

Ship Recycling
– the Current Status

Marine Services

The Green Passport; Its Implementation and Important Safety Issues

Gill Reynolds, Robin Townsend
Lloyds Register
Research and Development

Lloyd's Register

Introduction

- Brief History
- Green Passport
- Licensed Facilities
- Safety Issues
- Conclusion

Brief History

- Traditional scrapping
- 1980’s the beaches take over
- 1995 Brent Spar
- 1999 First Global Ship Scrapping Conference
- Industry Guidelines
- MEPC and the IMO Guidelines. (Res A.962(23))
- Tripartite meeting

Green Passport

- A document that complies with IMO Res A962(23) para 5.

- Consists of; Basic details pertaining to the ship, and an Inventory of Hazardous Materials.

- But;

- What materials should be on the Green Passport?
- How much detail is required?
- How is it produced?
- Who will approve it?

Green Passport

- Newbuilding

  Only opportunity to get a proper accurate inventory

  Control hazardous materials

  Plan for recycling

- Maintenance

  Essential for continuing validity

  Inventory control systems

  Liability planning

  Cost effective

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Existing ships.

- An existing ship Green Passport will always be less certain and have more inaccuracies.
- This does not have to be a problem, we have to closely examine the actual users requirements;
- Through life – Owner
  - Crew safety,
  - Environmental management
  - liability planning
- Scrapping; preparation for scrapping
  - The contract between the parties
  - What does the recycling facility (legislation) actually need?

End User

- The end user, eventually, is the recycling facility.
- However during the operational phase, it is the shipowner.
- The shipowner thus decides the relevant level of accuracy, to ensure safety and environmental performance.
- Any unknowns should be treated as the maximum reasonably expected hazard

Through Life Benefits

- Long term liability planning / reduction
- Safety / environmental planning
- ISO 14000; measurable - achievable

A Green Passport in action, in Life

- Our sample Green Passport highlights three major problems that can be addressed at this drydocking;
- Halon Firefighting

A Green Passport in action, in Life

- Our sample Green Passport highlights three major problems that can be addressed at this drydocking;
- TBT Paint

A Green Passport in action, in Life

- Our sample Green Passport highlights three major problems that can be addressed at this drydocking;
- Refrigerants

Photo courtesy of STASCo.

The Green Passport

Page 1 of 1

INTERIM CERTIFICATE
PROVISIONAL ISSUE

Ship's Name: **GRANATINA**
LR/IMO Number: **9253105**
Port of Survey: **Sines**

Date of Build: **12/2003**
Port of Registry: **Singapore**
Gross Tons: **94934**
Certificate Number: **HQR 400109**
First Visit: **22/10/04**
Last Visit: **22/10/04**

I have carried out the surveys listed below. All recommendations made by me have been dealt with to my satisfaction. I am recommending that class be maintained with new records as follows.

	SURVEYS HELD	STATUS	NEW RECORD
	HULL		
HULL	Green Passport	COMPLETE	22/10/04

*** END ***

The Green Passport

Lloyd's Register

Green Passport

Certificate no:
HQR 04097659
provisional
Page 1 of 14

Document of Compliance
IMO Guidelines on Ship Recycling

Issued in the pursuance of IMO Resolution A.962(23), adopted 5 December 2003.
by Lloyd's Register

Particulars of ship

Name of ship	Joanna	Ship Type:	Liquefied gas Tanker
IMO number	9253105	Classification Society:	Lloyds Register
Flag State and Port of registry	Sunland, Safeville	Date of registration:	05/04/2004
Shipbuilder.	Daewoo Ship/Marine	New building Yard NO:	358
Length (overall)	265	Breadth (Moulded)	41
Depth (moulded)	25	Lightweight (tonnes)	17500
Ship Owner	Clean Ship Co	Address:	35, Sunland

This is to certify:

1. That this document complies with the provisions in IMO Resolution A.962(23) for the requirements of a "Green Passport" as laid out in paragraph 5 of that Resolution.

This Document is valid until 5 November 2009

Date of completion of the survey on which this Document of Compliance is based 05/11/2004

Issued at Seaview Harbour on 05/11/2004

This document is to be accompanied by the 'Inventory of Hazardous Materials', Certificate number HQR 04097659, which forms a part of it.

R. Townsend
Surveyor to Lloyd's Register EMEA

A member of the Lloyd's Register Group

Lloyd's Register

Marine Services

The Green Passport

HQR 0400109

INVENTORY OF HAZARDOUS MATERIALS ON BOARD

PART 1 POTENTIALLY DANGEROUS MATERIALS IN THE SHIP'S STRUCTURE AND EQUIPMENT

1A. Asbestos (Note: All asbestos containing materials (ACMs) or presumed asbestos containing materials (PACMs) should be prominently labelled as such).

Type of Asbestos Materials (Board, Pipe lagging, Contained)	Location	Approximate Quantity
Nil on board – See attached certificate of Newbuild No KOR 3452634 No asbestos purchased since delivery.		

1B. Paint (on vessel's structure) - Additives

Additive (Lead, Tin, Cadmium, Organotins (TBTs), Arsenic, Zinc, Chromium, Strontium, Other)	Location
Nil	Paint applied to hull at new building was TBT Free Self Polishing Coplymer Name;

1C. Plastic Materials

Type	Location	Approximate Quantity
	Engine Room/Machinery Rooms	
Nitril Butadeine Rubber	Valve seats , packing, seals and O'rings , throughout E/R and Machinery spaces	15,000KG
Phenolic Plate	Name plates on electrical items throughout vessel	100KG
PTFE	Gaskets throughout vessel, pipeline sliding pads	20,000KG
Silicate Board	E/R control and Switchboard room decks	10,000KG
Thermoplastic Elastomere	Covering of wiring throughout E/R and Machinery spaces.	150,000KG

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Inventory issues

- Asbestos
- PCB
- Refrigerants

Asbestos Flow Process

- Does your ship contain asbestos?
- If unknown, declare all materials as PACM – see IMO guidance.
- If NO – prove it!!
- If yes – list it, append register.
- What about new purchases / procurement?
- Sample / test if required – but when to stop?

PCB Flow Process

- Does your ship contains PCBs?
- When was it built?
- Cut off dates; 1976 / 7 ?
- Uncertainty = + five years = 1982
- Before 1982 – declare / check PCBs
- After 1982 – simple checks for extra security

Refrigerants flow process

- Your ship circulates refrigerant gases around;
- HVAC
- Cold stores
- Fridges
- Freezers
- Any other cooling system
- List systems and gases as per plaques
- Check maintenance

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Sampling

- Pros

    Accuracy

    Security

- Cons

    Cost

    Inaccuracy

    Liability

    (marking)

- End User Responsibility

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Completing the Green Passport

- Having covered some of the issues, I will in the next few slides give actual examples of how a real Green Passport has been completed during survey onboard ship.

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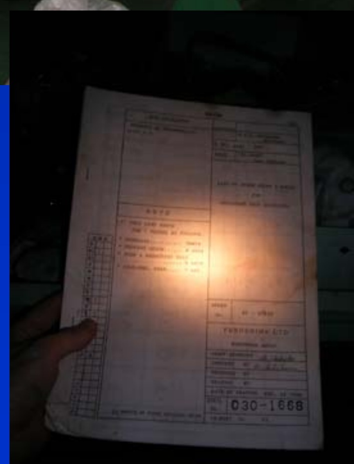
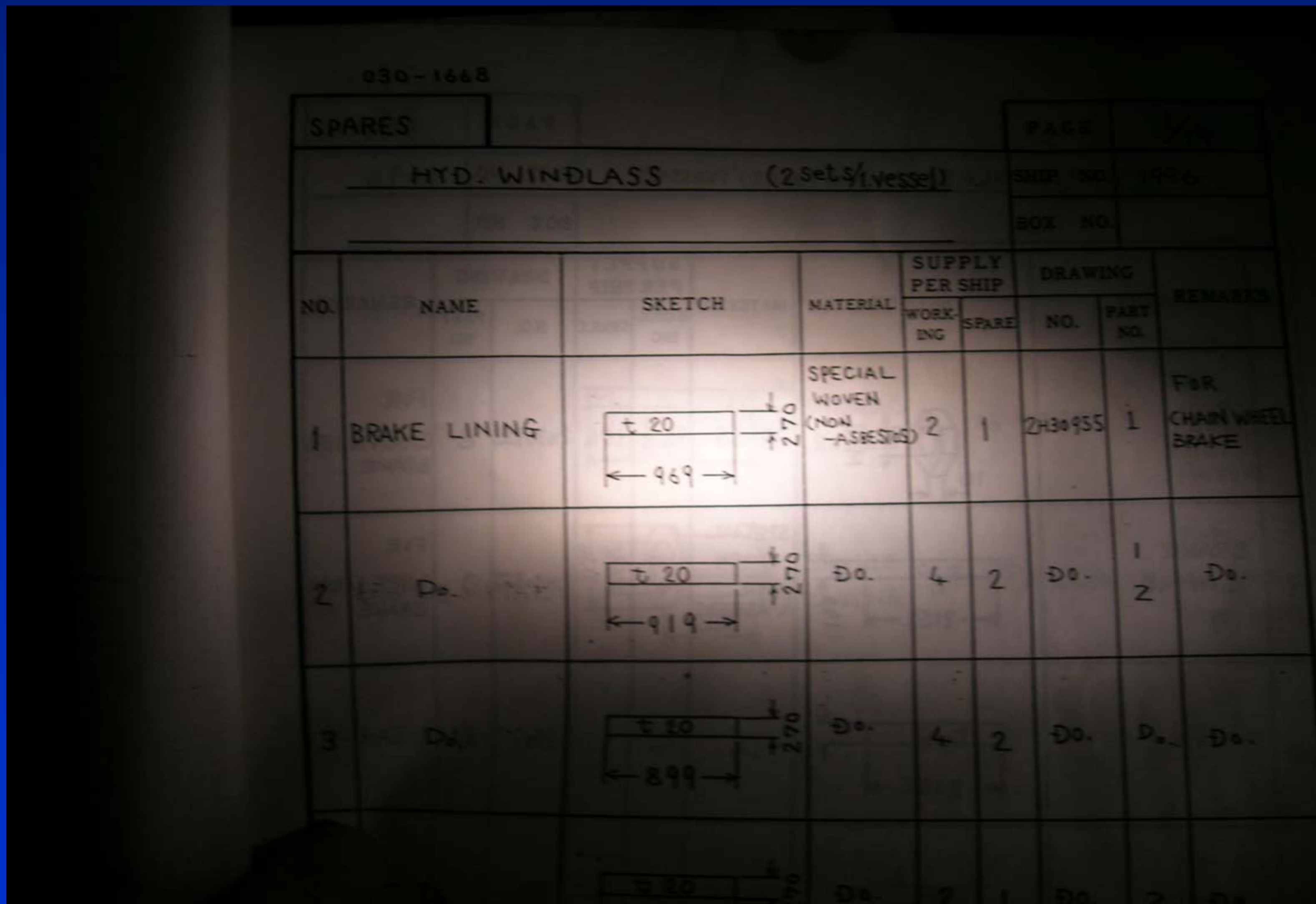
Real Life Examples; Asbestos



Real Life Examples; Asbestos



030-1668

SPARES

HYD. WINDLASS (2 sets/1 vessel)

PAGE

SHIP NO.

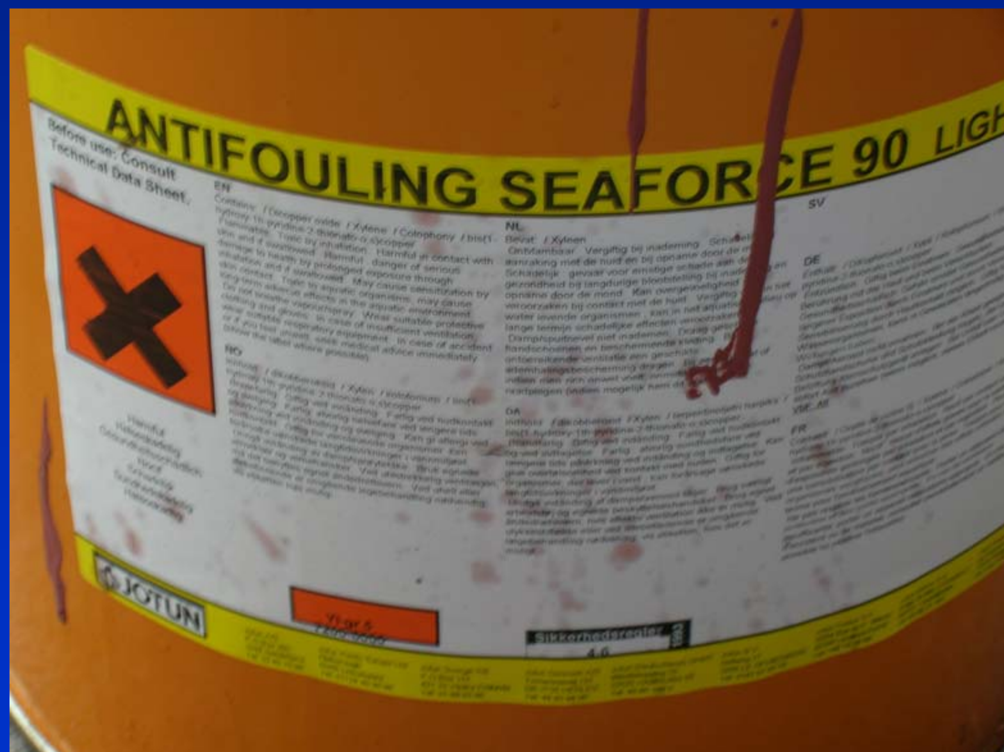
BOX NO.

NO.	NAME	SKETCH	MATERIAL	SUPPLY PER SHIP		DRAWING		REMARKS
				WORKING	SPARE	NO.	PART NO.	
1	BRAKE LINING	t 20, 270, 969	SPECIAL WOVEN (NON-ASBESTOS)	2	1	2H30955	1	FOR CHAIN WHEEL BRAKE
2	Do.	t 20, 270, 919	Do.	4	2	Do.	1 2	Do.
3	Do.	t 20, 270, 899	Do.	4	2	Do.	Do.	Do.
		t 20	Do.	2	1	Do.	2	Do.

Real Life Examples; Asbestos

Real life examples; Paint

TBT replacement



Real life examples; Paint

TBT replacement

Inventory Issues

- PCB

  Outlawed mid 1970s.

  Liquid cooled transformers, lighting ballasts, starter motors, electrical insulation and paint

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Lloyd's Register


COMPASS BRIDGE DK
PORT FWD
2L01B04

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Lloyd's Register

Marine Services

Lloyd's Register

Real Life Examples; Refrigerants

ID Plaque

Real Life Examples; Refrigerants

ID Plaque

Real Life Examples; Wiring

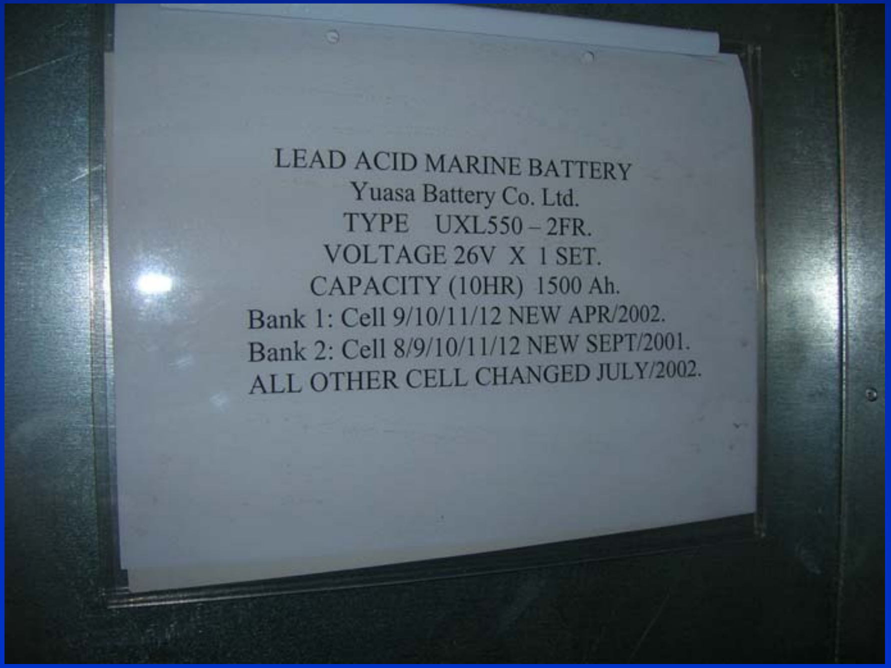
- Electrical and Electronic Equipment

Lloyd's Register

Marine Services

Real Life Examples

- Batteries



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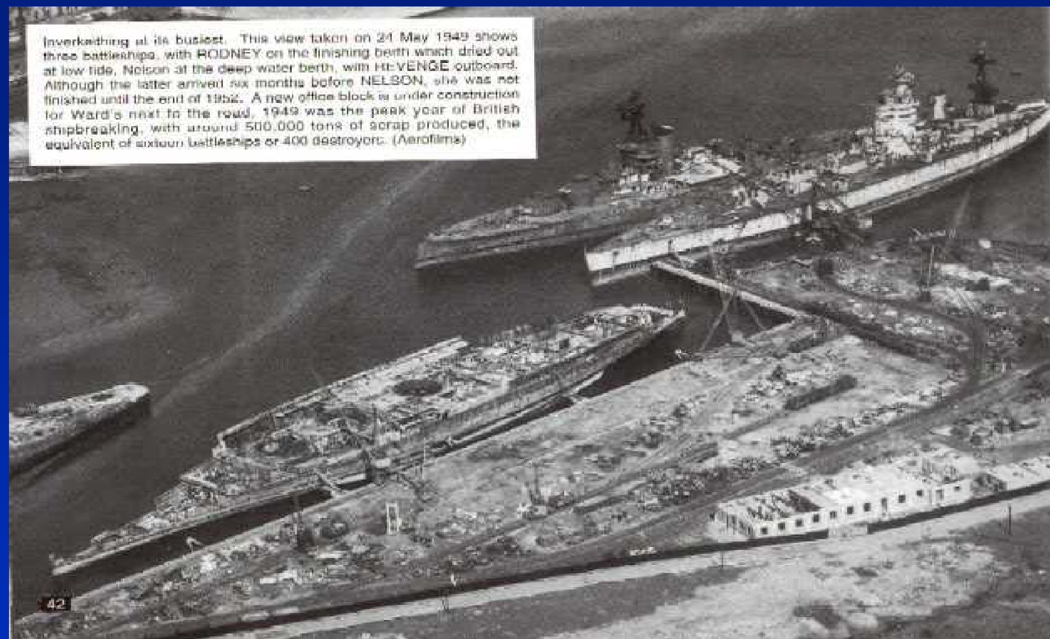
Real Life Examples

- Radioactive Items

Licensed Recycling Facilities



- LR have records of over 2000 scrapping facilities
- How many are licensed?

Present 'Green' Ship Recycling Facilities

- The EC commission report gives a 'green' capacity of less than one million LDT tonnes per annum.
- BUT it admits that it only identifies a yard as 'green' from its own literature or advertising.

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Recycling Facility Standards

- ILO; ‘Safety and Health in Ship Breaking, Guidelines for Asian Countries and Turkey’
- Basel Convention; ‘Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships’.
- Any other Internationally Recognised standards
- Familiarity to Shipowner = IMO / ILO
- List of materials in Green Passport = List of materials Recycling Facility Licensed to handle

Safety Issues

- Switch from End Of Life to Through Life
- Formal summary of all potential hazards
- Crew training, visitor confidence
- Visitor / Surveyor safety
- Liability

Safety Issues

- Recycling facility
- Education
- Licensing

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Conclusion

- MEPC 53 – what to do?
- Mandatory Timetable
- Green Passport
- Licensed Scrapping Facilities
- Legislation
- Inevitable price structure shift – will location shift too?

Lloyd's Register


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Robin Townsend; Robin.townsend@lr.org
+44 (0)20 7423 1487 / 1415

THE IMO's WORK ON SHIP RECYCLING

Sokratis Dimakopoulos

Implementation Officer

Marine Environment Division (MED)

International Maritime Organization (IMO)

THE IMO's WORK ON SHIP RECYCLING

- BRIEF HISTORY OF THE ISSUE OF SHIP RECYCLING IN IMO
- IMO GUIDELINES ON SHIP RECYCLING
- MEPC'S WORK PROGRAMME ON SHIP RECYCLING
- INTERAGENCY CO-OPERATION

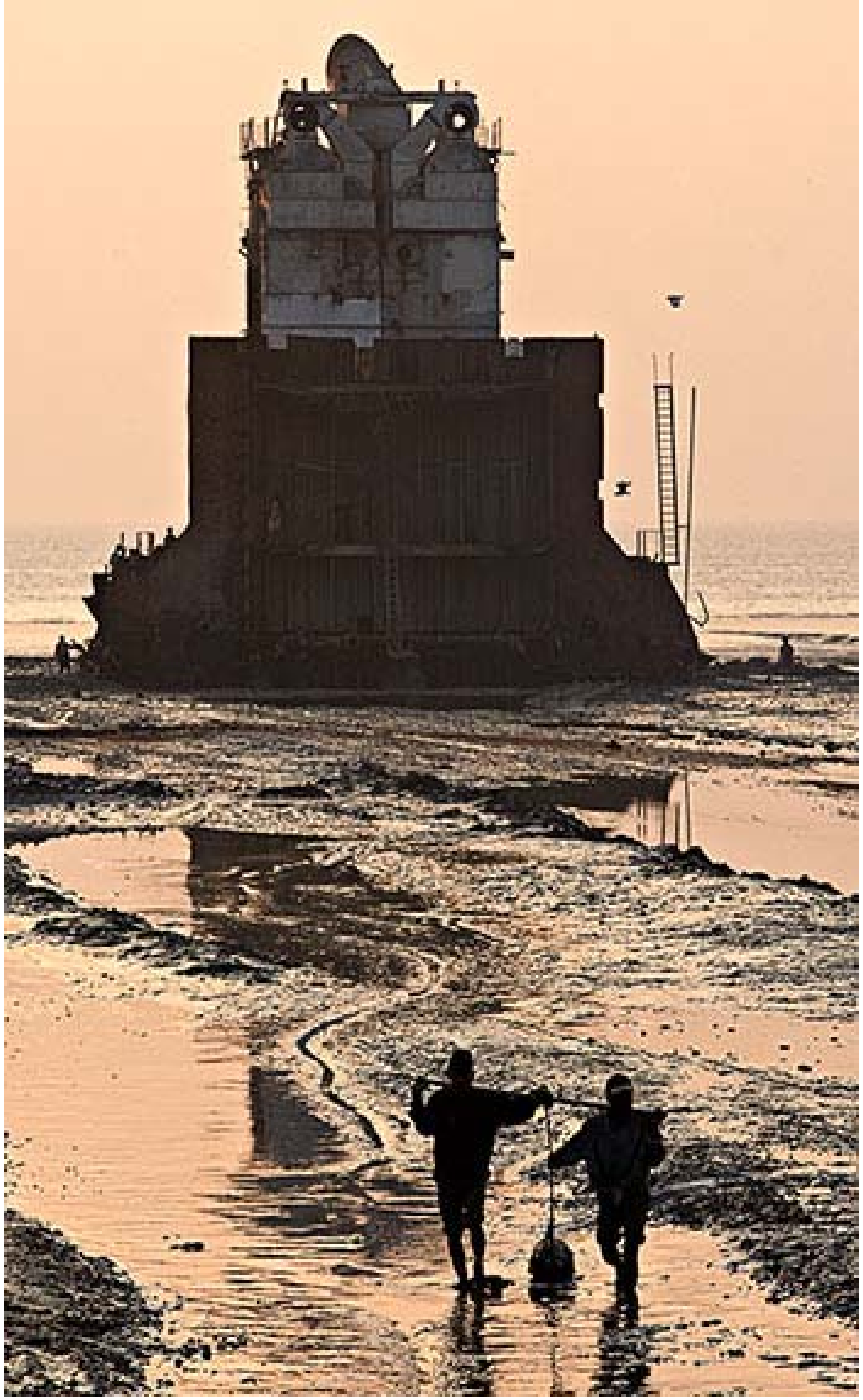
BRIEF HISTORY OF THE ISSUE OF SHIP RECYCLING IN IMO

- MEPC 42 (November 1998) - The issue of ship recycling was first brought to the attention of the IMO Marine Environment Protection Committee
- MEPC 47 (March 2002) – It was agreed that IMO should develop recommendatory guidelines to be adopted by an Assembly resolution
- MEPC 49 (July 2003) – The IMO Guidelines on Ship Recycling were finalized
- Assembly 23 - adopted on 5 December 2003 the IMO Guidelines on Ship Recycling by resolution A.962(23)
- MEPC 50 (December 2003) -adopted resolution MEPC.113(50) “Ship recycling for the smooth implementation of the amendments to MARPOL Annex I”
- Ship recycling is a high priority item on the MEPC’s work programme

IMO Guidelines on Ship Recycling
Resolution A.962(23)

- Provide guidance to involved stakeholders as to "best practice", which takes into account the ship recycling process throughout the life cycle of the ship

- Focus on the preparation of ships for recycling and the minimization of the use of potentially hazardous materials and waste generation during a ship's operating life



IMO *Guidelines on Ship Recycling,* adopted by resolution A.962(23)

Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships, adopted by the Sixth Meeting of the Conference of Parties to the Basel Convention

Safety and Health in Shipbreaking: Guidelines for Asian countries and Turkey, developed by ILO

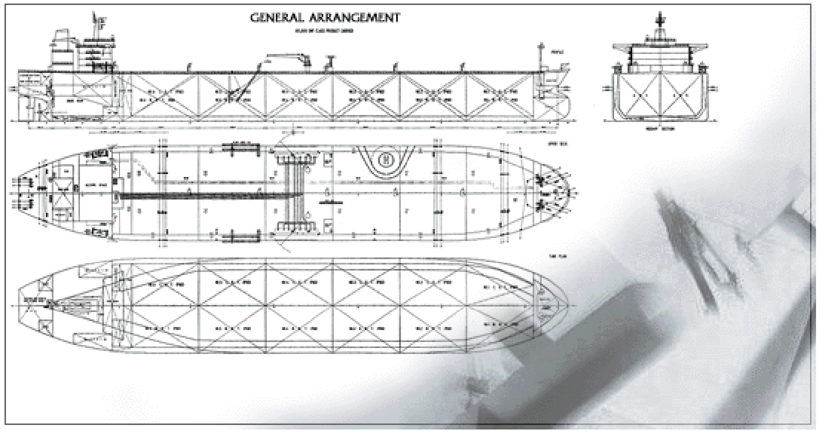
GREEN PASSPORT

- inventory of potentially hazardous materials on board
- accompanies the ship throughout its operating life
- successive owners of the ship should maintain the accuracy of the Green Passport and incorporate into it all relevant design and equipment changes
- the final owner should deliver the document, with the ship, to the recycling facility

IMO GUIDELINES ON SHIP RECYCLING

Ship Design/Construction

- use of materials which can be recycled in a safe and environmentally sound manner
- minimization of the use of materials known to be potentially hazardous to health and the environment
- consideration of structural designs that could facilitate ship recycling
- use of techniques and designs which, without compromising safety or operational efficiency, contribute towards the facilitation of the recycling operation
- design of marine equipment that contain hazardous substances facilitating the safe removal of those substances
- advice from marine equipment manufacturers as to how such hazardous substances can be safely removed, at the end of the working life of the equipment



IMO GUIDELINES ON SHIP RECYCLING

Operation/maintenance

- minimization of the potentially hazardous materials on board the ship, including those carried as stores, during routine or major maintenance operations or major conversions
- minimization of hazardous waste generation and retention during the operating life of a ship
- Green Passport

IMO GUIDELINES ON SHIP RECYCLING

Preparation of ship for recycling

- selection by the shipowner of a recycling facility
- use of a standard ship recycling sale and purchase contract
- development of a recycling plan by the recycling facility in consultation with the shipowner (MEPC/Circ.419)
- preparations to protect occupational health and safety
- preparations to prevent pollution

MEPC- Ship Recycling

MEPC'S WORK PROGRAMME ON SHIP RECYCLING

Possible mandatory application of certain elements of the Guidelines

Possible mandatory requirements

- Requirements applicable to ships :
  - **ship design and construction (**e.g. shipbuilders to provide new ships with a "Green Passport", States to prohibit/restrict/minimize the use of potentially hazardous materials in new ships)
  - **ship operation (**e.g. shipowners to maintain and update the "Green Passport", minimization of the amount of potentially hazardous materials on board the ship during routine or major maintenance or major conversions)
  - **preparation for recycling (**e.g. shipowners to use "approved/licensed" recycling facilities, shipowners to prepare Parts 2 and 3 of the Green Passport prior to the final voyage to the recycling facility, shipowners to deliver the "Green Passport" to recycling facility
- Requirements applicable to recycling facilities

  (e.g. ship recycling plan, waste reception facilities at recycling facilities, recycling facilities to be "licensed")

MEPC'S WORK PROGRAMME
ON SHIP RECYCLING

Reporting system for ships destined for recycling

Reporting system for ships destined for recycling.

Such a system should be:

- transparent, effective and it should ensure uniform application and respect commercially sensitive information

- developed in such a way as to facilitate the control and enforcement of any mandatory provisions on ship recycling that may be developed by IMO

- implemented by the **shipowner**, the **recycling facility**, the **flag State** and the **recycling State** with the latter two stakeholders having the primary role for ensuring its proper application

- a stand-alone reporting mechanism

- workable and effective, with the minimum required administrative burden and catering for the particular characteristics of world maritime transport

MEPC'S WORK PROGRAMME ON SHIP RECYCLING

"Single list" of the on board potentially hazardous materials

A/A	Material	Equipment/System	Location*	Hazard	Quantity/Volume*	Remarks*
1	Hydraulic Oil	Crane	Upper Deck		1 m^3	
2	Halon	Fire Fighting	Engine Room		2000 kgs	
3		TV Screen	Recreation Room		1	

* This information is ship specific

Note: The above entries are examples only

MEPC'S WORK PROGRAMME ON SHIP RECYCLING

- Mechanisms to promote the implementation of the Guidelines
- Criteria for ships to be declared "Ready for Recycling"
- Proposed amendments to the Guidelines

IMO

MEPC'S WORK PROGRAMME ON SHIP RECYCLING

Ship recycling fund

IMO

MEPC'S WORK PROGRAMME ON SHIP RECYCLING

Future working arrangements

INTERAGENCY CO-OPERATION

IMO

UNEP

ILO

1st session of the Joint ILO/IMO/BC Working Group on Ship Scrapping (15-17 February 2005)

- Consideration of the ILO, IMO and BC work programmes on the issue of ship scrapping
- Examination of the relevant ILO, IMO and BC Guidelines on ship scrapping
- Promotion of the implementation of the Guidelines on ship scrapping
- Joint technical co-operation activities

CONCLUSIONS

IMO encourages and promotes ship recycling in compliance with the international standards on safety, health and environment.

IMO's work on ship recycling aims at the development of a **realistic, pragmatic, well-balanced, workable and effective solution** to the problem of ship recycling, which should take into account the **particular characteristics** of world maritime transport and the **need for securing the smooth withdrawal of ships** from trade at the end of their operating lives.

CONCLUSIONS

Areas where IMO has focused its attention include, but are not limited to:

.1 the minimization of the use of hazardous materials in the design, construction and maintenance of ships, without compromising their safety and operational efficiency;

.2 the identification of potentially hazardous materials on board ships and the preparation of the relevant inventories (e.g. Green Passport); and

.3 the preparation of ships for recycling in such a manner as to reduce environmental and safety risks and health and welfare concerns as far as practicable.

CONCLUSIONS

The issue of ship recycling has been given high priority at the MEPC in order that the promotion of the implementation of the IMO Guidelines on Ship Recycling and the consideration of a **possible new legally binding IMO instrument** on ship recycling are progressed as efficiently and expeditiously as possible.

IMO maintains close co-operation with ILO and the appropriate bodies of the Basel Convention, with the aim of avoiding duplication of work and overlapping of responsibilities and competencies between the three Organizations.

Thank you for your attention

Using Artificial Neural Networks to Predict the Ship Demolition Market

FARSHID KHALILI
GEORGE BRUCE

UNIVERSITY OF
NEWCASTLE UPON TYNE

Overview of the presentation

1. Demolition Market for Tankers and Bulk Carriers
2. Artificial Neural Networks (ANN)
3. Using Artificial Intelligent to predict the market
4. Conclusions

Demolition Market

Image source: http://www.thenewgallery.co.uk/images/Tyler/Ship%20and%20Spanner.jpg

Locations for demolition

Nation/Year		1991	1992	1993	1994	1995	1996	1997	1998*
Bangladesh		940	2284	2594	3947	4915	4231	2978	3163
		20%	13%	14 %	19 %	33 %	26 %	22 %	21 %
China		374	8921	9318	3397	676	1331	164	979
		8%	52%	52%	16 %	5 %	8 %	1 %	7 %
India		1079	3140	2949	5917	4868	7851	7577	7427
		23%	18 %	16%	29 %	33 %	48 %	55 %	49 %
Pakistan		1280	1609	1921	5301	3623	2043	1630	1962
		27%	9%	11 %	26 %	25 %	13 %	12 %	13 %
Others		22 %	8 %	7 %	10 %	4 %	5 %	10 %	10 %
Total		4685	17228	17982	20714	14677	16313	13744	15021

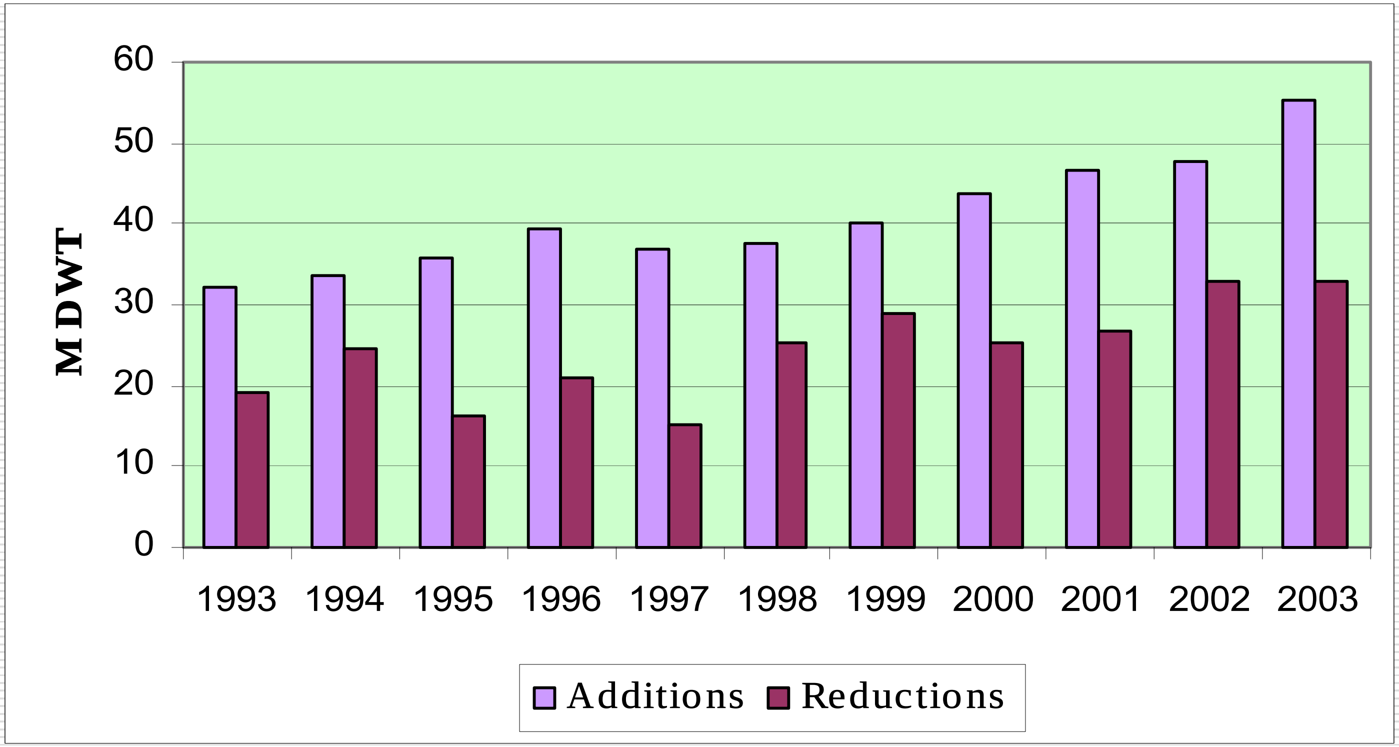
Source: Drewry Shipping Consultant, 1998.

Materials Recovered from Ship Demolition

Materials	Standard Tanker %	Standard Bulk Carrier %
Steel	74.4	63.15
Copper	0.01	0.04
Zinc	0.03	0.04
Special Bronze	0.03	0.04
Machinery	14	19
Electrical/Electronic Equipment	2.5	5
Joinery - related products	5	6
Minerals	0.5	2.5
Plastics	0.5	1.2
Liquids	2	1
Chemicals and gases	0.03	0.03
Other miscellaneous	1	2
Total	100	100

Source: DNV, 2001

World tonnage additions and reductions



Source: ISL, 2004

Vessels sold for scrapping (> 10,000 DWT)

Average 1992-1999	Tankers	Bulk Carriers	Combos	Gas vessels	Other dry	All Vessels
Number	83	117	12	6	146	363
DWT ‘000	9920	6120	1550	40	1940	19570
Age	24.4	24.8	22.4	26.9	26.3	25.3

Source: DNV, 2001

ANN Overview

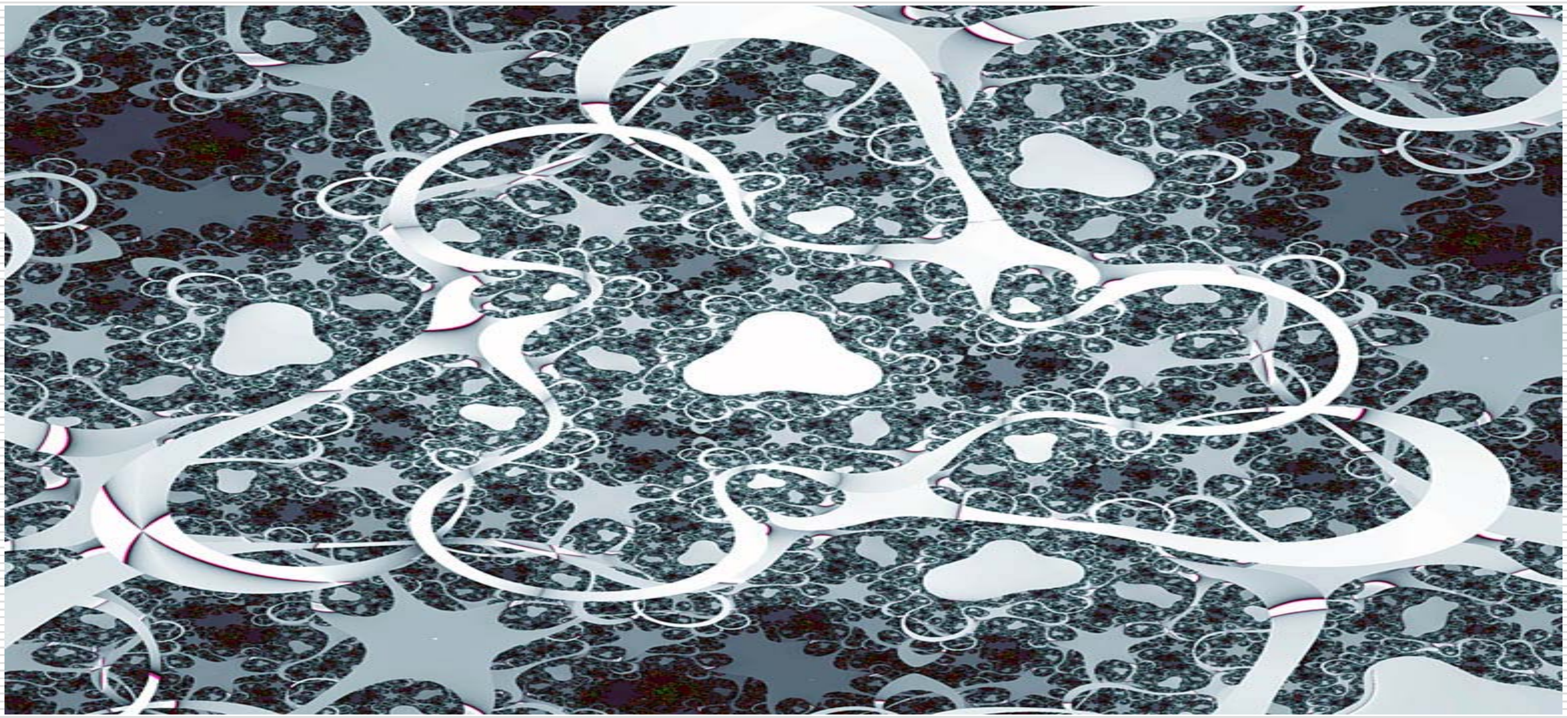
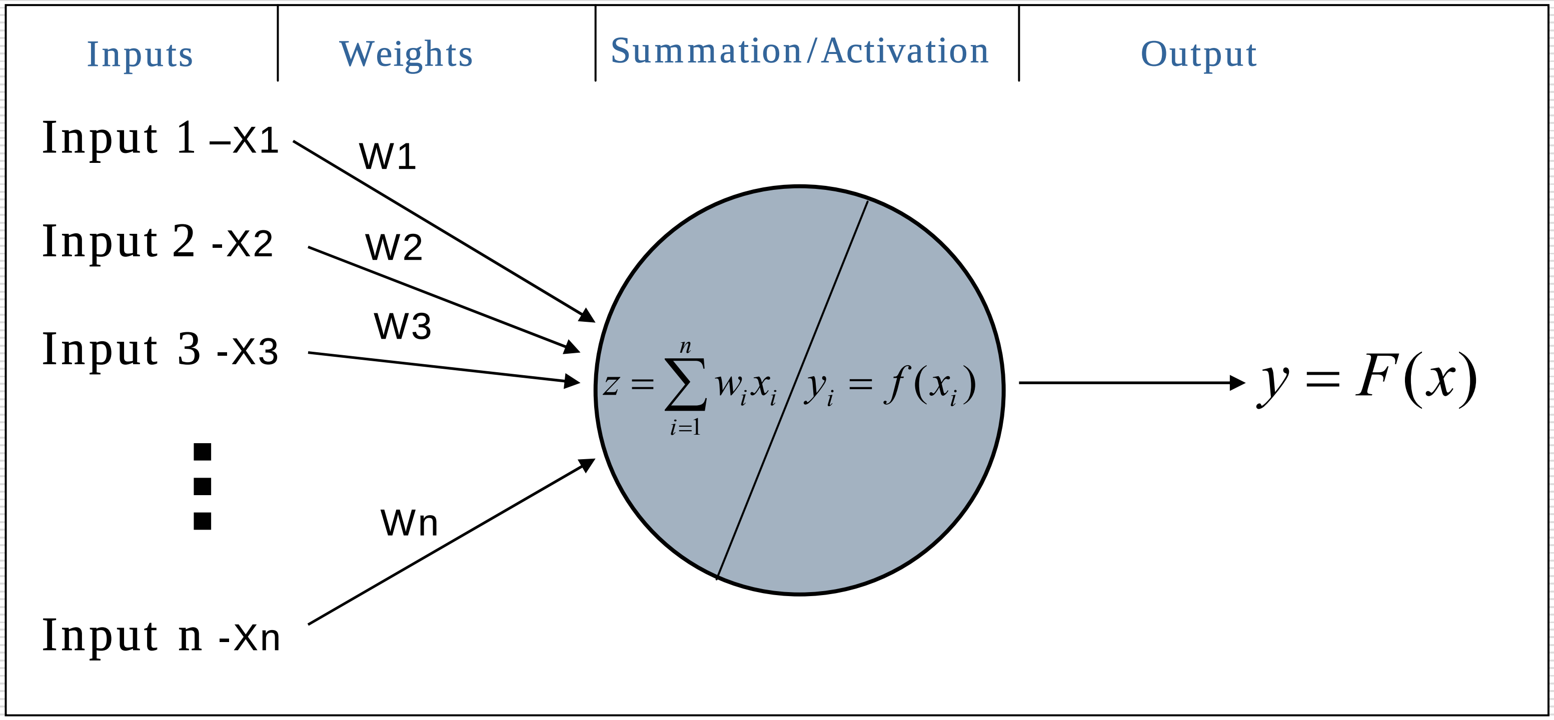


Image source: http://www.nmazca.com/fractalism/25mar02_2.jpg

Fundamentals

- Artificial Neural Networks exploit an analogy to the human brain.
- The brain consists of large numbers of neurons connected to each other by synapses.
- The output from the neuron is a function of its inputs from many other neurons, which are ‘weighted’ at the receiving synapses.

A Neural Unit

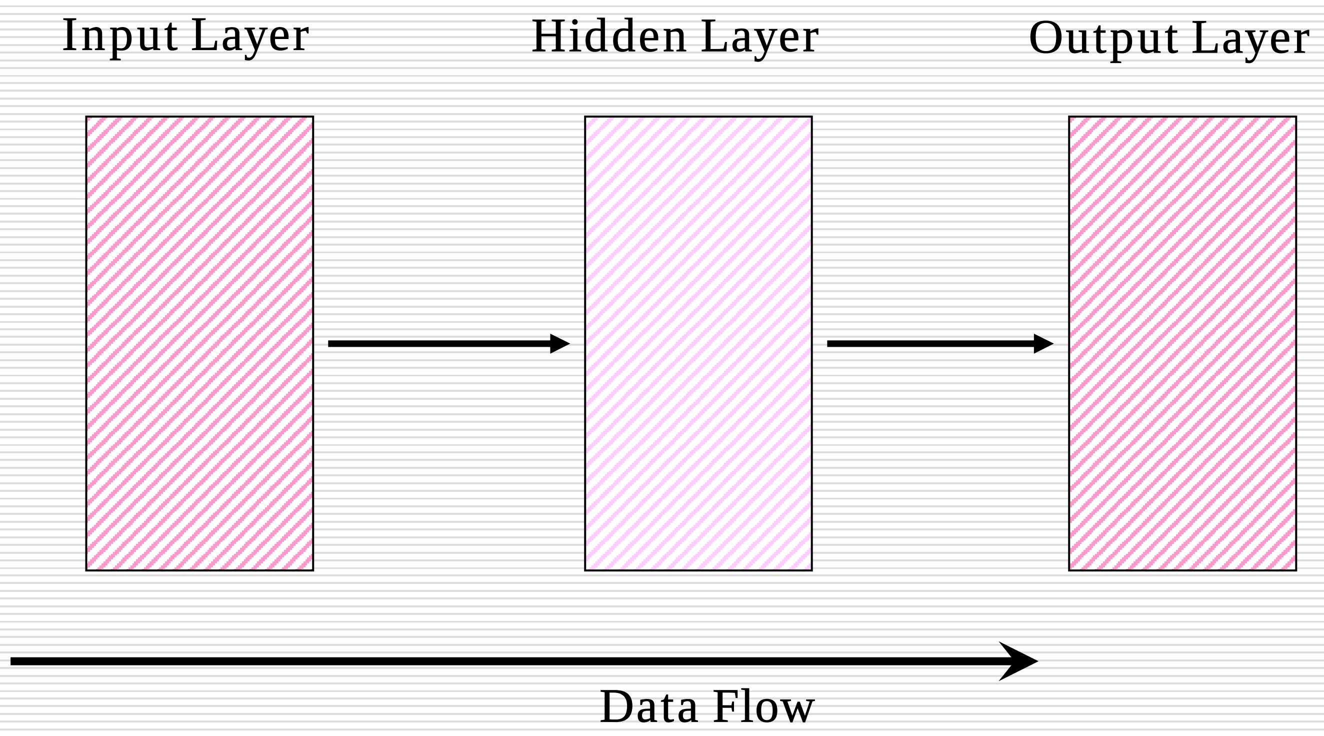


Source: Haykin, 1994

Activation Functions

- Linear or identity; x
- Hyperbolic tangent; $\tanh(x)$
- Logistic (Sigmoid); $(1+e^{-x})^{-1}$
- Threshold; $0 \text{ if } x<0 \text{ , } 1 \text{ } otherwise$
- Gaussian; $e^{-x^2/2}$

Feed Forward NN (A connection topology)



Neural Network Applications

- Classification

  Including: Target Recognition, Pattern Recognition, Character Recognition.

- Function Approximation

  Including: Process Modelling, Process Control, Data Modelling, Machine Diagnostics.

- Time Series Prediction

  Including: Dynamic Modelling System, Financial Forecasting.

- Data Mining

  Including: Clustering, Data visualisation, Data extraction.

Using ANN to Predict the Bulk Carrier Demolition Market

Image source: http://www.rolfeandnolan.com/getimage.aspx.ID-14051.gif

Influencing factors on demolition

- Steel Price
- Bunker Price
- Demolition Price
- Building Price
- Freight Rate

Possible inputs and output

Network Inputs

- Steel Price ($/Tonne)
- Demolition Prices in Pakistan & India ($/LDW)
- Demolition Prices in Far East ($/LDW)
- Capesize Building Price (Mill. $)
- Bunker Price ($/Ton)
- Capesize Freight Rate ($/Day)

Network Output

- Bulk carriers sold for demolition (M DWT)

The best Network has been implemented

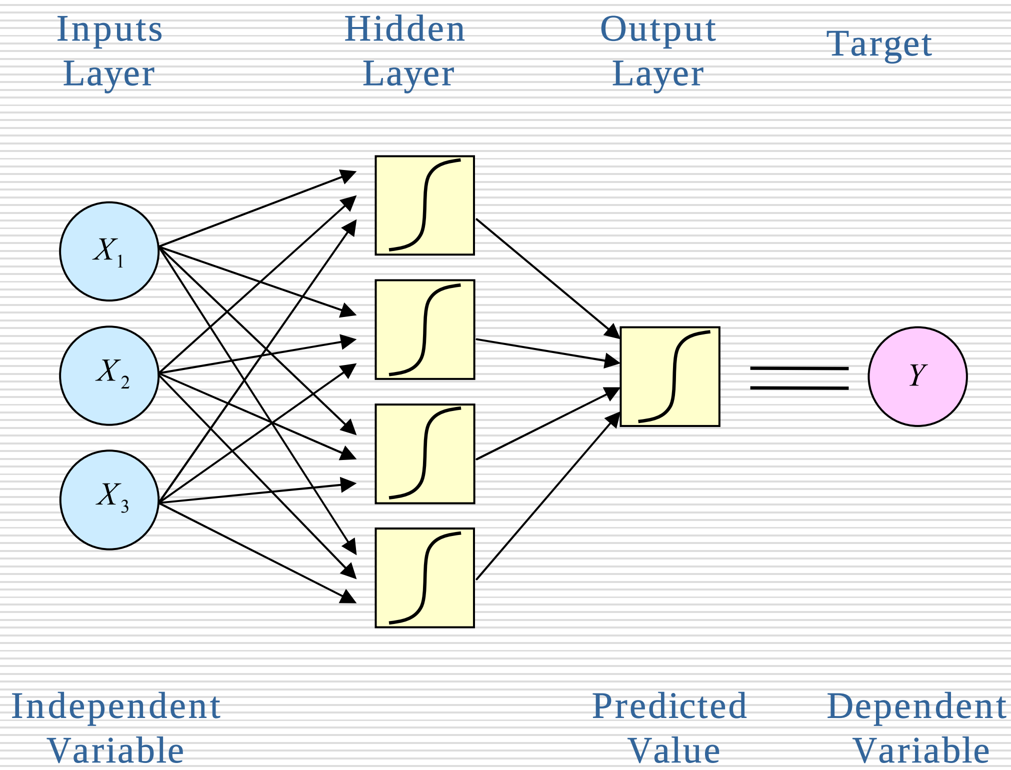
Network Inputs

- Steel Price ($/Tonne)
- Bunker Price ($/Tonne)
- Capesize Freight Rate ($/Day)

Network Output

- Bulk carriers sold for demolition (M DWT)

ANN Architecture



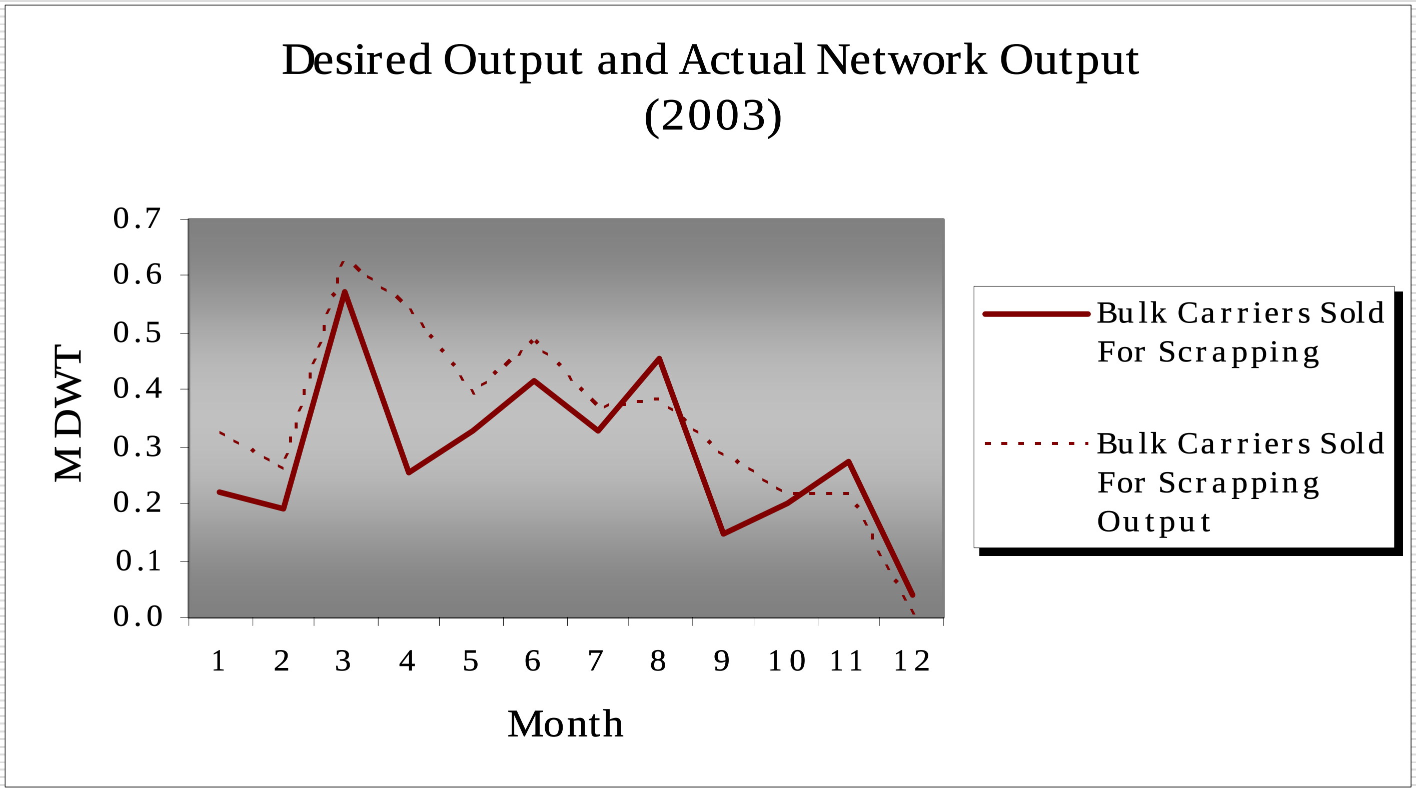
Creating a suitable ANN

- Static network
- Function approximation
- Sigmoid activation function
- Feed forward
- One hidden layer
- Four neurons in the hidden layer
- Momentum learning rule

Nature of the Data and Training

- Monthly data between January 1995 and December 2003
- First 8 years data used to train the network
- Final 12 months for model testing, and comparison between actual and output data

Predicted versus Actual output



Source of Actual Data: Platou, R.S. ,2004

Desired versus Actual output

Year 2003	Bulk Carriers Sold For Scrapping	Bulk Carriers Sold For Scrapping Output
January	0.22	0.32
February	0.19	0.26
March	0.57	0.62
April	0.25	0.55
May	0.33	0.39
June	0.42	0.48
July	0.33	0.37
August	0.46	0.38
September	0.15	0.28
October	0.20	0.22
November	0.27	0.21
December	0.04	0.0

Further Research

- Review and use the data for different ship types.
- Look for further factors influencing demolition.
- Look for leading or lagging indicators

Conclusions

- Some determining factors may affect or neutralise each other.
- Important factors so far are:
  - Bunker price as an indicator for operating cost of a ship,
  - Freight rate
  - Steel (and scrap) price.

References

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Questions