Guidelines for Safe Dismantling of Obsolete Vessels

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ABSTRACT

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The ship dismantling industry was created due to the growing demand for steel and the increasing number of obsolete ships around the world. It is a labor-intensive industry that grew after the end of the cold war. This industry is huge with immense potential. The Maritime Administration (MARAD) is required to dispose the obsolete National Reserve Defense Fleet (NRDF) in a manner that maximizes the returns to the USA. Every year there are hundreds of ships being scrapped in the market and their scrapped parts are being sold individually.

Majority of the ships from around the world were being sent to the Asian countries for dismantling as these countries have abundant ocean coasts, abundant labor, low labor rates and less stringent environmental laws/ law enforcement. As a result there was a huge market for these in countries like India, Pakistan and Bangladesh. Due to the unsafe environmental practices as well as the unsafe worker safety and health practices in the developing nations such as India, the Under Secretary of Defense for Acquisition and Technology established the Interagency Panel on ship scrapping to investigate ways to ensure that vessels are disposed of in a safe and sound manner. As a result Ship Cutting must now be done in the USA as the Environmental Protection Agency (EPA) prohibits the export of US Government owned ship's containing Polychlorinated Biphenyl (PCB). This caused a loss of business for the developing countries and affected International trade.

Most organizations in developing countries have not followed the international guidelines to ensure the safety of the personnel and the environment in which they work. Most of these shipyards do not have proper equipment to deal with issues such as ventilation, waste oil, first-aid for employees, fire fighting equipment in case of fire, trained personnel, personal protective equipment, training programs, written guidelines and so on.

This report describes the guidelines developed by the Basel Action Network (BAN) and the International Labor Organization (ILO) for safe dismantling and disposal of obsolete vessels. These guidelines should be followed by all ship dismantlers which may be particularly beneficial to those South Asian countries where lack of regulations have had an adverse effect on worker

safety and the environment. The guidelines could also be used to identify hazards present on board ships, to help control environmental pollution, to control workers' exposure to hazardous substances, to build a healthy work environment, and most of all to comply with international standards. Implementation of these guidelines can assist the south Asian ship dismantlers in maintaining a competitive advantage while protecting worker safety and the environment.

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ACRONYMS

ACM – Asbestos Containing Material

BAN - Basel Action Network

DNV – Det Norske Veritas

DWT – Dead Weight Tonnage

EPA – Environmental Protection Agency

ICS – International Chamber of Shipping

ILO - International Labor Organization

IWPSR – Industry Working Party on Ship Recycling

LPG – Liquefied Petroleum Gas

MARAD – MARitime Administration

NDRF – Nation Defense Reserve Fleet

NGO – National Government Organization

NPDES – National Pollutant Discharge Elimination System

OSH – Occupational Safety & Health

OSHA – Occupational Safety and Health Administration

PAH – Polycyclic Aromatic Hydrocarbons

PCB's – Polychlorinated Biphenyls

PVC – Polyvinyl Chloride

TBT – Tributyl-tin

TWG – Technical Working Group

UNEP – United Nations Environmental Program

WVU –West Virginia University

1. INTRODUCTION

1.1 SHIP DISMANTLING AS AN INDUSTRY

Dismantling of obsolete vessels is defined as breaking up its structure in order to scrap its parts that are in good condition and can be reused and also to dispose of any potential hazards or hazardous material present on the ship that if left behind could cause damage to the environment and the society. Every year hundreds of ships are being termed obsolete and as a result over the past decade the demand for ship breaking has grown immensely. Even today the industry has huge potential; if proper measures are undertaken, it can develop into one the biggest industries in developing nations. The ship breaking yards of Alang, India possibly represent the largest concentration of ship-breaking industry in the world. Table 1 shows the number of ships that were sent to Alang for deconstruction since 1982.

YEAR	No. of Ships	LDT
1982-83	5	24716
1983-84	51	259387
1984-85	42	228237
1985-86	84	516602
1986-87	61	395139
1987-88	38	244776
1988-89	48	253991
1989-90	82	451243
1990-91	86	577124
1991-92	104	563568
1992-93	137	942601
1993-94	175	1256077
1994-95	301	2173249
1995-96	183	1252809
1996-97	348	2635830
1997-98	347	2452019
1998-99	361	3037882
1999-00	296	2752414
2000-01	295	1934825
2001-02	333	2727223
2002-03	300	2424522
2003-04	294	1986121
2004-05 (Partial data)	164	785304

Table 1: Ships dismantled in Alang, India since 1982
(Source: Gujarat Maritime Board, India March 2005)

In the early 1970's the ship dismantling industry was not as much in demand as it is today. This industry was well-developed in the European Countries and in the United States. After 1983 the number of ships being dismantled in the USA was reduced due to the reduced price of scrap metal and increased in the cost of upholding environmental and health and safety standards. This lead to the migration of the scrapping industry to the developing nations where the labor cost is low.

1.2 ORIGIN OF INACTIVE FLEET

Normal lifecycle of a ship is around 25 years. At the end of 25 years any ship, whether a merchant vessel or a countries' naval fleet vessel, has to undergo thorough inspection to check

for its strength, its efficiency, and if it can sustain the strong currents of the unpredictable oceans while performing their primary task at the same time. If the ship is found sea worthy it can be set to sail again, but if for any reason the ship does not pass inspection, it is termed “obsolete” and is sent out for scrapping. There also are changes in technology and design over 25 years and hence most naval ships are rendered obsolete so that new ships can be added to the fleet. These ships can either be sold to other developing countries or scrapped. As a result hundreds of ships are being docked after being termed Obsolete and this has lead to the development of a “Ghost Fleet”, particularly in the developed countries such as U.S.A and U.K.

1.3 ENVIRONMENTAL CONSIDERATIONS

Ship dismantling poses a lot of safety and environmental hazards such as air and water pollution, loss of marine life, exposure of workers to dangerous toxins and if proper care is not taken, it can lead to a disaster for the marine life and society in or around which the ship dismantling takes place. As a result adequate measures must be taken to ensure that this process is completely environment friendly. Old ships that are being scrapped contain hazardous material such as waste oil, asbestos, lead, various metals and their compounds, Polychlorinated Biphenyl (PCB), dyes and chemicals, paints, bilge & ballast water and many more. These substances cause marine and air pollution and are extremely harmful to nature.

1.4 WORKER SAFETY

One of the main reasons why the ship scrapping industry does not do as well in the developed countries is because of stringent rules and regulations and worker Compensation laws that protect the worker or the employee from being exposed to a hazardous environment, which could lead to chronic or acute diseases. Because of the presence of extremely hazardous substances and waste on board the vessel it is important that adequate measures be taken to protect the employees. Written procedures and guidelines for the safe dismantling of the vessel along with adequate Personal Protective Equipment (PPE) are methods that can be adopted worldwide.

1.5 PROBLEM STATEMENT

To date, safe procedures have not been established for the dismantling of these obsolete vessels that maximizes the returns and minimizes the environmental health and safety impact.

Selling these vessels to the Asian countries merely means selling of hazardous waste to the developing countries where the compliance laws are not very stringent and unemployment is very high. Developing a procedure with the help of the various organizational guidelines can be of great help to the whole industry. It would create more awareness to those who are not aware of the various dismantling and disposal methods and hazards and would thus create a voluntary standard of its own.

The safe procedures would also reduce the impact on the workforce and the environment. This would create a more conducive environment to work in, and could really help grow this industry, which has a huge potential, into a safe and environment friendly industry.

There exists a need to study and integrate all safety and environmental guidelines as they relate to the ship breaking industry. Such a study will enable users to get all the desired information on the right procedures and their impacts on the economy, environment, workers and international trade.

1.6 NEED FOR SAFETY GUIDELINES IN SHIP BREAKING

Under the National Maritime Heritage Act [2] of 1994, Maritime Administration (MARAD) was required to dispose obsolete National Defense Reserve Fleet Vessels in a manner that was going to maximize financial returns to the United States. MARAD offered the ships for sale through open “Invitations for Bid” which allowed the purchaser to scrap the vessel either in the United States or in a foreign nation in compliance with the terms of the Environmental Protection Agency’s (EPA) Enforcement Letter of November 30, 1995[1]. The US navy alone had 112 vessels in line for scrapping and the number was expected to grow by 10-15% every year thereafter [2].

Almost 75% of the scrapping costs in the US are labor, environment and safety related. In order to maximize returns in this field of work most of the ship cutting was being done in developing countries such as India, China, Bangladesh and Mexico. These countries do not have stringent safety and environmental laws and hence developed countries tend to benefit from ship breaking in these countries.

Considering the fact that the US Navy is only a small percentage of the world wide fleet of Naval and Merchant Vessels that are to be scrapped, there is a need in the Maritime Industry to

establish guidelines for safe ship breaking; such guidelines can be applied globally across the industry. Setting world wide standards for ship breaking will not only control the cross border transportation of hazardous goods and will also ensure the safety and health of the personnel in whichever country scrapping takes place. In response to the huge threat that these obsolete vessels pose if not scrapped properly, organizations such as the International Labor organization, the International Maritime Organization and Basel Convention have come up with guidelines that can help reduce or eliminate the risks involved in the dismantling process. These organizations realized the cross boundary transfer of hazardous material from the developed to the developing nations and the extreme health and environment hazards that the society in the developing nations may be exposed to.

2. CURRENT SHIP BREAKING PRACTICES

2.1 REMOVAL OF HAZARDOUS SUBSTANCES ON BOARD SHIPS

Once a ship is termed obsolete, it is decommissioned and docked in the ports where it awaits its final journey to the ship breaking yards. As most of the ship breaking takes place in the Asian countries, the ship is first sold to these nations based on the highest bid and is then sent for scrapping. Every ship is known to be carrying a large amount of hazardous substances and materials that could be harmful to humans and the environment. It is therefore necessary to remove all the hazardous substances from the ships structure prior to dismantling. Thus, a "Certificate of Dismantling" is required for every vessel prior to the commencement of the dismantling process. The Certificate of Dismantling includes:

- An updated list of hazardous substances and wastes on the ship 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).
- Assurance on the part of owners, brokers and breakers that the ship is decontaminated and gas free for hot work.
- Relevant information (drawings, etc.) necessary for the development of a safe ship-breaking plan.

A typical list of hazardous materials and their location on ships is shown in Tables 2, 3 &4 [6]. These tables give a general overview of the types of hazardous material that can be found on ships and clearly identifies their location. Prior to the commencement of dismantling, all these hazardous materials should be removed from the ship; otherwise their location should be clearly marked so as to warn employees at the time of dismantling.

Table 2: List of Hazardous substances and their location on a ship

Wastes	Location on ship
Metal wastes & alloys of:	
Antimony	Alloys with lead in lead acid store batteries, solder
Beryllium	Fuel containers, navigational systems & hardening agent in alloys
Cadmium	Bearings
Lead	Connectors, couplings & bearings
Mercury	Thermometers, pressure sensors
Wastes having contaminants in massive form any of the following:	
Antimony or its compounds	Used as fire retardant in plastics, rubber etc.
Cadmium or its compounds	Batteries, anodes, nuts & bolts
Lead or its compounds	Cable insulation, batteries & paint coatings
Wastes having as contaminants any of the following:	
Arsenic or its compounds	Paints
Mercury or its compounds	Light fittings, level switches
Wastes having as contaminants any of the following:	
Hexavalent chromium compounds	Paints on the ships structure
Waste Zinc residues containing lead and cadmium in high conc.	Anodes (Cu, Cd, Pb, Zn)
Waste lead acid batteries (whole or crushed)	Emergency generator room, radio room, fire alarm, lifeboats
Wastes containing inorganic constituents which may contain metal and organic materials:	
Glass waste from Cathode ray tubes and activated glasses	Computer screens and TV's
Waste asbestos as dust and fibres	Engine & Machinery Rooms: Steam supply & exhaust piping, Relief & safety valves, water pipes & hangers, HP turbine insulation, boiler drums & casings, heaters & tanks, Accommodation: Sanitary & Commissionary spaces, steam & exhaust pipes, refrigeration pipes, air conditioning ducts, cable transits, external & internal bulkheads & deck heads, decks adjoining machinery spaces, Decks: Steam supply piping, exhaust piping, stripping pump, tank cleaning piping, brake linings
NOTE: Asbestos containing material can be found under materials that do not contain asbestos	
Wastes containing organic constituents which may contain metal & inorganic materials	
Waste mineral oils unfit for their originally intended use.	Oil sumps of engine, lubricating Oil, gear boxes, separators, compressors, pipes used to pump
oil, hydraulic fluids, cargo residues in case of oil tankers.	
Waste non halogenated organic solvents	Antifreeze liquids
Substances containing or contaminated with PCB, PCT, PCN or PBB	Capacitors in light fittings, PCB in oil residuals, gaskets, couplings, wiring at a concentration level of 50 mg/kg or more
Wastes containing either organic or inorganic constituents	
Waste pesticides and other wastes from the	Paints & rust stabilizers, anti-fouling coatings on ships' bottom

use of biocides which are off specification and unfit for their originally intended use	
Waste oils & water hydrocarbon mixtures, emulsions	Cargo residues, Tank scale, Fuel Diesel & Gas oil bunkers, Lubricating oil, Grease, Sludge, Oily water, Oily rags & Sludge
Wastes from production and use of inks, dyes, pigments, paints, varnish	Paints & coatings on ships structure
Wastes of an explosive nature & other gases	Acetylene, Propane, Butane, cargo residues, Oxygen, Halon, Carbon dioxide, Refrigerants (R12/R22)

Table 3: Wastes and substances that might be on board the vessel

Wastes	Location on ship
Unsorted waste batteries	Portable radios and torches
Waste non-halogenated organic solvents	Solvents and thinners
Waste halogenated organic solvents	Solvents and thinners
Wastes from use of pharmaceutical products	Miscellaneous medicines

Table 4: Other hazardous substances and waste present on board vessel

Hazardous substances/wastes	Location on ship
Different types of chemicals:	
Anti-seize compounds	
Engine additives	
Kerosene	Present in related ships equipment and machinery
White spirit	Also present in addition in the ships store to replenish consumed stocks
De-ionizer regenerating	
Evaporator dosing and descaling acids	
Battery electrolyte	
Hotel service cleaners	
Chemical refrigerants	
Bulk (non-oily waste)	
Ballast water	Ballast tanks and piping's
Raw sewage	Sewage treatment plant, piping's & sewage tanks
Treated sewage	Sewage tanks, sewage treatment plant and oily water separates
Debris/Garbage	Separate collection rooms to be disposed off on shore
Galley wastes	Gallery areas and cold storage

2.2 SHIP CUTTING IN SHIP YARDS

Once all the hazardous material has been removed and the ship is given the Certificate of Dismantling, it is brought into the ship yard for cutting. There are three methods for ship cutting: the beach method, berth method, and the block breaking method. The beach method is the most commonly used method in developing countries while the berth method is used

primarily in the developed nations. Both methods are similar and only differ in the manner in which the vessels are docked.

2.2.1 Beach Method

In the beach method, ships are beached during high tide. Workers use cutting torches to dismantle the ship from the end facing the beach to the end facing the ocean. As the cutting progresses, the vessel is beached further inland by means of huge chains pulled manually by men [9]. Large sections are cut using liquefied petroleum gas and oxygen torches and the scrap metal is sorted by material type and sold in the second hand market. Some of the reasons the developing countries use the Beach Method are:

- Conveniently located close to major markets for scrap metal, thus offering minimum transport distances
- A long uniform inter-tidal zone, allowing vessels of various sizes to be dry-beached
- Availability of low cost labor willing to do the dirty and dangerous work

All the major scrapping countries have a need for employment and lack the availability of mechanized facilities and investment capital. Since manpower is available in abundance and there is presence of a huge market for second hand equipment and components, the breaking process revolves around the principles of maximum separation thus reflecting a reverse shipbuilding process. This is why beaching has been adopted as the most common practice by the scrapping majors. The current method of scrapping when measured against the International Standards and local legislations fails to comply in almost every aspect.

When the vessel arrives to the breaking site it has to be beached under its own power, which means that it has to be seaworthy, thus preparing the vessel with respect to the removal of harmful substances prior to arrival has limited or no possibilities. The beaching process can be broken down into four major steps: 1) Off-shore operations, 2) Inter-tidal operations, 3) Beach operations, and 4) Shore operations.

The Off-Shore Operations deal with the removal of on board consumables and loose equipment. All the tanks are emptied and the vessel is made as light as possible to enable it to climb as high as possible on the beach. These operations are carried out at or near the breaking

facility. If reception facilities are not available then the oil/ballast water is discharged into the sea thus causing marine pollution.

The Inter-Tidal Operations deal with the vessel being beached under its own power to gain access for structural demolition. The ships bow and sides are opened to gain access to the components. The larger sections including the hull plating are then removed, extracted and towed or floated ashore. The antifouling agents, hydrocarbons in pipes and debris and remains in tanks are deposited in the water sediments causing high levels of water pollution. Air pollution due to emissions from cutting, burns, falls from heights, overloading by carrying, squeeze, falling objects, suffocation, explosions and exposure to toxins are some of the other dangerous conditions induced by these operations.

The Beach Operations involve size reduction of the recovered scrap steel using torch cutting and the sorting and transport of recovered materials and substance. During this operation there exists the possibility of liquid collected from the vessel leaking into the soil due to the lack of proper containment. Air pollution due to emissions from cutting, burns, falls from heights, overloading by carrying, squeeze, falling objects, suffocation, explosions, exposure to toxins are some of the other dangerous conditions induced due to ongoing cutting/sorting/transport operations.

Figure 1: Ship beached (Source: http://news.bbc.co.uk/2/hi/in_pictures/3558527.stm)

In the Shore Operations the sorted materials are transported to nearby markets or reprocessing facilities. The hazardous materials exported from the breaking site, overloading by carrying, burns and other incidents related to the nature of the reprocessing facility.

Figure 2: Workers pulling on a beached ship (Source: http://www.greenpeace.org/norway/photosvideos/photos/ship-being-scrapped-at-alang-s)

2.2.2 Berth Method

This is the most common method used in the USA for ship breaking. During the first stage of this process the vessel is prepared for cutting. It is transported to the shipyard and berthed in a dry dock or kept afloat in shallow water. Crane services, fire protection and a sorting area are made available near the area. Electrical components and materials containing asbestos and PCB are removed from the vessel. Refrigerants and fuels are pumped out off the ship and the propeller is also dismantled. Once these materials are removed the surface is prepared for cutting. Paints, residues and anti-fouling compounds are removed at this point manually. The solvents used to remove paints and the dust from grit blasting are extremely hazardous [9] [2].

Figure 3: Sections of a ship being cut and transported in a dry dock (Source: http://www.osha.gov/SLTC/etools/shipyard/ship_breaking/working_conditions/index_wc.html)

The second stage in this process involves cutting the large structures out of the ship from top down. Torch cutting and mechanical cutting are used in this manual process. Cranes are used to lift structures to land where they are disassembled and sorted by metal type. As the vessel's weight decreases the hull is exposed above water [9] [2]. Eventually the ship is light enough for a crane to tow the structure ashore where disassembly is completed.

In the final stage of this process, large sections are cut into smaller pieces, which are then sorted and then loaded for transport. The cutting methods used here also include torch and

mechanical cutting [9]. The ship cutting process produces many hazardous wastes that must be handled carefully and disposed off according to EPA regulations and local environmental laws [2].

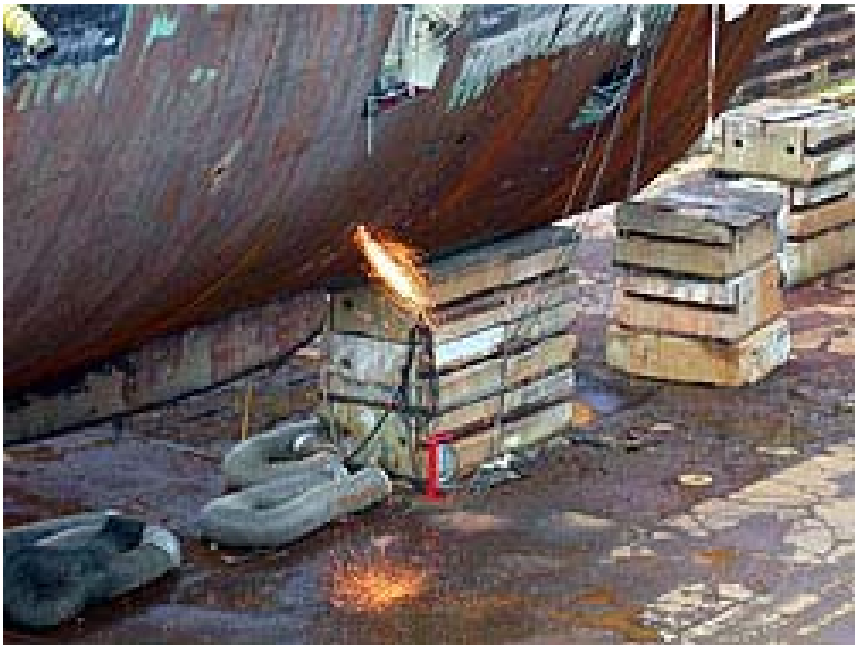

Figure 4: Ships hull being cut using an oxy-acetylene flame (Source: http://www.osha.gov/SLTC/etools/shipyard/ship_breaking/hotwork/index_hw.html)

2.2.3 Block Breaking Method

This proposed method is modeled after modern zone outfitting methods. Traditional shipbuilding involves construction and outfitting of a ship from the keel up in the dock. Based on this method the ship is dry-docked similar to the berth method, but instead of completing removals prior to sectioning, the ship is sectioned into blocks prior to removal. Horizontal sections from the front and the rear are cut out and removed. The modules are towed to a disassembly area. Equipment and reusable materials are removed after completion of the removals the blocks are cut up and the materials are sorted as in the berth method. By completing removals on blocks rather than on the ship this method provides greater accessibility for removals, thus reducing ventilation requirements and crane lifts and the whole ship could be disassembled simultaneously, space permitting.

Figure 5: Blocks of ship being removed (Source: http://www.usshorne.net/horne/breaking.htm)

2.3 DISPOSAL AND RECYCLING OF SHIPS COMPONENTS & WASTES

Following the disassembly of the vessel a waste stream is generated which includes a variety of different substances commonly found in most categories of vessels. The safe extraction of the waste/material stream is complex and its requirements begin from the preparation phase of the vessel. Table 5 shows an example of a generic waste/material stream that follows after demolition.

Table 5: Waste stream generated after demolition

Material Stream	**Source On Board**
Ferrous scrap Material	Hatch covers, pipes & fittings, anchors and chains, shaft, rudders, sheet metal & non-integrated tanks
Non Ferrous Scrap Material	Aluminum found in the wheelhouse, zinc found in anodes, copper found in cables, pipes motors and fittings
Machinery	Main engine, auxiliary engines, pumps, boilers, separators deck machinery and cranes
Minerals	Ceramics, concrete, tiles, glass and windows as well as asbestos and mineral wool for insulation
Plastics	Fittings, furniture, light fittings, lifeboats and rafts
Liquids Chemicals & Gases	Fuel oils, lubrication oil, hydraulic fluids, refrigerants, cargo residues, chemicals and sludge
Electrical & Electronic Equipment	Control panels and navigation aids, switch boards, domestic instruments and sensors
Miscellaneous Waste	Marine growth, batteries, mercury and domestic waste

This waste stream is further transported to local enterprises for resale or recycling. The following is a list of items offered for resale:

1. Pumps and motors
2. Navigational equipment
3. Paints an chemicals

4. Life saving equipment
5. Steel Components
6. Sanitary equipment
7. Furniture
8. Batteries and electrical cabling
9. Oil Products

Table 6 below is a list of the components from various manufacturers available in the second hand market.

Table 6: Secondhand Marine Equipment	
Main engine spares:	Man, Sulzer, Mak, Stork Wartsila, Alco, B&W. Russian, Skl, Alpha, Henshin, Mitsubishi, Deutz and Pielstick
Auxiliary engine spares:	Man, Yanmar, Skl, Sulzer, Daihatsu, Nigatta, Caterpillar, Cummins, Mitsubishi, Wartsila, Mak, Mut, Swd, Cripelle, Allen and Fiat
Air compressors:	Hatlapa, Speree, Tanabe, Hamworthy, Yanmar, Atlas Copco, J.P, Saur, Ingersol Rand, Sulzer, Suction Gas, Veb Make & Screw and Compressors
Oil purfiers:	Alfa Laval, Mitusbishi, W.S.K Kracko and De-Laval
Fresh water generator:	Alfa Laval- Nirex and Atlas Sasakura
Hydraulic motors / pumps:	Hagglunds, Rexroth, Hydromatic, Uchida, Ihi, nachi, Kawasaki, Mitsubishi and others

Figure 6: Second hand marine equipment being sold in the market (Source: http://www.ship-technology.com/contractors/propulsion/gumatech/gumatech2.html)

A fairly large portion of the waste stream is reprocessed rather than being recycled. Examples of waste stream remanufacturing are listed below

1. Oil remanufacturing: Dirty oils are reprocessed and offered for sale
2. Steel remanufacturing: Undamaged steel is remanufactured by cutting grinding and hot work
3. Copper reclaim: Damaged cables are stripped for insulation either by burning or by mechanical stripping
4. Mineral reprocessing: Asbestos is reprocessed by manual crushing in some sites and sold to manufacturing industries.

Scrap steel is the only waste generated from the demolition that is recycled. This scrap serves as the raw material for cold rolling facilities. The quality of the end product directly depends upon the quality of the scrap steel and the recycling process.

2.4 WORKERS AND ENVIRONMENTAL SAFETY

The current ship breaking procedures adopted in the developing countries expose the workers and the environment to hazardous substances. The effects of such exposure are normally well-known and documented in industries comparable to the ship breaking industry which makes it better to control and contain the exposure and develop means to protect workers from the same [8]. The dismantling of the ships is undertaken by unskilled, low paid, manual labor without the provision of personal protective equipment. With practically no training on the procedures, injuries and death are common in the ship breaking yards. Accidents / Incidents causing injuries or death are primarily due to the absence of the following

- Proper planning and work procedures
- Appropriate training and provision of personal protective equipment
- Safe working platforms and tools
- Skilled labor

As a result of no systematic monitoring of health among workers in the ship breaking areas there is practically no available data on workers health. Working conditions that have a negative impact on the health of workers are [8]:

- Torch cutting without protection
- Lifting of heavy objects
- Noise
- Exposure to chemicals/oils/gas
- Exposure to asbestos and heavy metals and
- Exposure to dust

The ship breaking process also causes the release of materials such as [8]:

- Polychlorinated biphenyl - PCB’s are found in glues, ceiling materials and cable insulation. They are extremely toxic and bios-accumulate and persist in the environment. Exposure to PCB’s causes a number of adverse health problems such

as cancer, liver damage, and immune system damage. PCB's have recently being classified as a carcinogen. As per accepted standards sediments containing more than 300micro grams per kilogram are considered strongly polluted.

- Polyvinyl chloride - PVC is commonly found in cables, floor coverings and plastic devices. They contain more than 50% chlorine. Combustion of PVC produces hydrochloride gas. If inhaled, it can react with water vapor and humidity and form hydrochloric acid in the lungs. The combustion of PVC also produces carbon monoxide and dioxins, which are among the most toxic substances known. These highly toxic substances enter the food chain by being inhaled directly or being deposited in the soil, water and crops.

- Polycyclic aromatic hydrocarbons - PAH are formed by the combustion of oil and are the largest single class of carcinogens known today. They are more resistant to biological degradation with increasing molecular weight. Exposure to PAH have serious long-term effects to the environment and workers.

- Tributyl Tin – TBT is used as an anti-fouling agent and also is a very toxic component, and has effects at very low concentrations. They are toxic to various aquatic organisms, especially larva of oysters and fish. Extremely high levels of TBT can be found near the ship breaking facilities that have resulted in the reduction of aquatic life around the area.

- Asbestos – When ACM (Asbestos Containing material) is disturbed it breaks into very fine fibers, which stay suspended in the air and are inhaled by workers. These fibers are then accumulated in the lungs. Accumulation of high concentration of asbestos in the lungs can lead to lung cancer and asbestosis, which is the permanent scaring of the lungs. Asbestos on a ship is not categorized as hazardous material in some countries and manual crushing of asbestos is used as a recovery method.

- Wastewater: Wastewater discharges from the facility should be regulated under an individual National Pollutant Discharge Elimination System (NPDES) permit. The NPDES permit would include effluent limits, and would require sampling or monitoring, and reporting. Wastewaters are required to be tested for pollutant

concentrations prior to discharge and would need to meet water quality standards at their discharge.

- Oil and Fuel Removal and Disposal: Ships may contain diesel fuel, fuel oil, natural and synthetic lubricating oils and hydraulic oils. Fuels and oils may be found in various tanks throughout the ship, in machinery and pipes. Best management practices should be in place for removing, storing and disposing of these materials. In most cases hazardous waste or used oil management regulations must be enforced.

- Heavy metals – Heavy metals such as Lead, Mercury and Cadmium can be associated with the ship-breaking industry that can cause harm to the human health and the ecological system.

  Mercury is a heavy metal that affects the nervous system. It can be found in small quantities in instruments such as thermometers, electrical switches etc. Consumption of contaminated fish is one of the most common ways to mercury exposure.

  Lead has various health effects on humans. In ships lead can be found in batteries, paints and components in motors generators and cables. Long-term exposure can lead to mental retardation, damage to the peripheral nervous system and impairment of hearing and vision. They can also damage the blood vessels, kidneys heart and nervous system. There are high levels of lead in the air at the ship breaking sites and the exposure is higher in workers performing steel cutting. Improper disposal of batteries containing lead causes a threat to health and environment.

These substances can be harmful to the environment if handled incorrectly and may cause pollution and contamination of drinking water leading to long-term effects. The biggest environmental concern is the absence of a process to contain these toxins and prevent them from entering into the environment or the food chain.

3. INTERNATIONAL INITIATIVES

In the past decade there has been increased media focus on the ship scrapping sites in the developing countries and the conditions that prevail which have lead to the loss of lives as well as deteriorating environmental conditions. As a result, a number of organizations with related interests have volunteered to present facts and findings as well as to develop solutions to make things better for the struggling ship scrapping industry.

3.1 BASEL ACTION NETWORK (BAN)

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted in Basel, Switzerland on 22 March 1989. The Convention was initiated in response to numerous international scandals regarding hazardous waste trafficking that began to occur in the late 1980s. The Convention entered into force on 5 May 1992 and today has its Secretariat in Geneva, Switzerland. BAN is the world's only organization focused on confronting the excesses of unbridled free trade in the form of “Toxic Trade” (trade in toxic wastes, toxic products and toxic technologies) and its devastating impact on global environmental justice. BAN works to prevent the globalization of the toxic chemical crisis. They work in opposition to toxic trade in toxic wastes, toxic products and toxic technologies, that are exported from rich to poorer countries. Their mission is to ensure national self-sufficiency in waste management through clean production and toxics use reductions and in support of the principle of global environmental justice i.e. where no peoples or environments are disproportionately poisoned and polluted due to the dictates of unbridled market forces and trade. This network has worked extensively in India in particular and has touched base on not only environmental matters but also the existing working conditions. Currently BAN is involved in a joint action committee of cooperation where the Indian trade unions and Green Peace are partners.

3.2 UNITED NATIONS ENVIRONMENTAL PROGRAM- THE BASEL CONVENTION

The spirit of this convention lies in a requirement to ensure that developing countries are not exploited by developed nations thus making them a trashcan for hazardous wastes generated. The ban on the export of waste, which comes under the 1989 convention of Transboundary

movements of hazardous wastes and their disposal if applied to this industry, will have a considerable effect on current practices. The Technical Working Group (TWG) of the Basel Convention was instructed to develop technical guidelines for the sound management of dismantling of ships. These guidelines include a list of hazardous wastes and substances and make provisions of their removal in an environmentally sound manner. The TWG also set up a working group that would report, in particular, items concerning workers conditions.

3.3 DET NORSKE VERITAS (DNV)

DNV was established to develop a factual base for Norway in 1988. Ship scrapping locations, onboard substance composition, safety health and environmental hazards to ship scrapping were some of the issues addressed by the DNV.

The DNV initiated a project "Decommissioning of ships-Environmental standards". The work included in this project encompassed the following:

- Development of a methodology on the establishment of guidelines for scrapping facilities
- Implications of legal interpretations of the Basel Convention
- Preparations prior to demolition including, precautionary actions associated with ship scrapping

DNV was also commissioned by the European Commission to assess technological and economic feasibility of ship scrapping in Europe and by United Nations Environmental Program (UNEP) to develop guidelines for environmentally sound management of ship dismantling.

3.4 GREENPEACE INTERNATIONAL

Greenpeace was established to focus on the implications of environmental issues arising due to ship scrapping as well as those related to occupational safety and health. The organization has carried out studies in India and China and their reports are available for reference today.

3.5 INTERNATIONAL CHAMBER OF SHIPPING (ICS)

The ICS established the industry working party on ship recycling in February 1999. This was a result of growing concerns by Non- Governmental Organizations (NGO) and the industry on the legal position of vessels sold for recycling, lack of environmental concerns and the

conditions and safety provisions for workers in ship breaking industries. The primary task of the Industry Working Party on Ship Recycling (IWPSR) was to establish a code of practice on ship recycling which includes and inventory template on onboard hazardous materials.

3.6 INVOLVEMENT OF THE US GOVERNMENT

The US Maritime Administration has initiated the MARAD ship-scrapping program. The aim was to establish a long-term ship-scrapping program to dispose off the NDRF vessels, which were obsolete. The US Environmental Protection Agency has also published a document "A Guide for Ship Scrappers – Tips for Regulatory Compliance" which is a detailed reference comprising environmental issues and also touches base with procedures and regulations that embrace aspects of workers' health and safety. The US Government has also developed standards based on the guidelines from OSHA that are mentioned in Table7 below:

Table 7: OSHA standards for ship breaking							
Standard	**Part Number**	**Part Title**	**Subpart Title**	**Subpart**	**Standard Number**	**Title**	**Description**
29 CFR	1910	Occupational safety and health standards	Adoption and extension of established federal standards	B	1910.5	Shipyard Employment	As per this standard each employer shall protect the employment and places of employment of each of his employees engaged in ship breaking by complying with standards prescribed by part 1915 in effect on April 28, 1971
29 CFR	1910	Occupational safety and health standards	Commercial diving operations	T	1910.401	Scope and Application	Applies to places of employment within the waters of the US where diving related operations are performed. It applies to diving and related support operations conducted in connection with all types of work and employment including ship breaking. It is governed by 45CFR Part 46 (Protection of Human subjects, US Dept. of health & human services), which regulates research development or related purposes involving human subjects.
29 CFR	1915	Occupational safety and health standards for shipyard employment	Welding, cutting & heating	D	1915.54	Welding, cutting & heating of hollow metal containers and structures	Structures that have contained flammable substances before welding should be either filled with water or thoroughly cleaned & ventilated. A vent should be provided to release any pressure built-up during the appl of heat. The place should be tested and made safe before any operation is begun. Jacketed vessels shall be vented before and during any heated operation.
29 CFR	1915	Occupational safety and	Welding, cutting &	D	1915.55	Gas welding & cutting	This standard deals with transporting, moving and storing compressed gas cylinders,

		health standards for shipyard employment	heating				securing valve protection caps, procedures of hoisting cylinders, handling of cylinders, placing the cylinders, treatment of cylinders, use of damaged cylinders, fuel gas and oxygen manifolds, hoses and their stowage, use of fuel gases and torches used for ship breaking.
29 CFR	1915	Occupational safety and health standards for shipyard employment	Welding, Cutting & Heating	D	1915.51	Ventilation & Protection in welding cutting & heating	This standard deals with Mechanical ventilation requirements, welding cutting and heating in confined spaces, welding cutting or heating of metals of toxic significance and general welding and heating.
29 CFR	1915	Occupational safety and health standards for shipyard employment	Welding, Cutting & Heating	D	1915.53	Welding cutting & heating in way of preservative coating	This standard deals with testing of preservative coatings to determine flammability, precautions, to prevent ignition of coatings & protection against toxic preservative coatings.
29 CFR	1915	Occupational safety and health standards for shipyard employment	Scaffolds, Ladders & other working surfaces	E	1915.75	Access to and guarding of dry rocks and marine railways	This standard deals with regulating the sizes of gangways & ramps & their safety between the floating dry dock and the piper, sizes and height of railings, material used for railings, location of portable stanchions, mid-rails, ramps & permanent stairways and size regulations for catwalks.
29 CFR	1915	Occupational safety and health standards for shipyard employment	Scaffolds, Ladders & other working surfaces	E	1915.76	Access to cargo spaces and confined spaces	This standard deals with access to cargo spaces with ladders which are safe and means of access into confined spaces as well as the number of access points.
29 CFR	1915	Occupational safety and health standards	Scaffolds, Ladders & other	E	1915.71	Scaffolds & staging	This standard deals with the general requirements for scaffolds, their load capacities, their safety factor, the strength and

		for shipyard employment	working surfaces				type of lumbar, condition of the scaffolds, requirements for horse scaffolds, other types of scaffolds, scaffold planking, back rails and toe boards and access to staging.
29 CFR	1915	Occupational safety and health standards for shipyard employment	General working conditions	F	1915.93	Utilities	This standard deals with the general requirements and procedures to supply steam from an outside source and their hoses. It also talks about the provisions and precautions for electric supply from an outside source.
29 CFR	1915	Occupational safety and health standards for shipyard employment	General working conditions	F	1915.91	Housekeeping	This standard deals with good housekeeping procedures and things to remember at all times for safe working conditions around and in the vessel.
29 CFR	1915	Occupational safety and health standards for shipyard employment	General working conditions	F	1915.92	Illumination	This standard deals with adequate lighting in the work areas, requirements for temporary lighting, proper grounding of exposed non-current carrying parts, portable emergency lighting and precautions against overloading of branch circuits.
29 CFR	1915	Occupational safety and health standards for shipyard employment	General working conditions	F	1915.94	Work is confined or isolated spaces	This standard deals with the work in confined spaces and procedures to be followed while doing so.
29 CFR	1915	Occupational safety and health standards for shipyard employment	General working conditions	F	1915.96	Work in or on lifeboats	This standard addresses issues with working on lifeboats and requirements to be fulfilled prior to beginning work them.
29 CFR	1915	Occupational safety and	General working	F	1915.97	Health & sanitation	This standard deals with issues related to proper protection against hazards, adequate

		health standards for shipyard employment	conditions				PPE, adequate washing facilities, prevention of food and drinks in work areas, smoke free work zones, exposure to uncovered garbage and drainage waste and employment or adults and no minors.
29 CFR	1915	Occupational safety and health standards for shipyard employment	General working conditions	F	1915.98	First Aid	This standard deals with providing adequate first aid on board the vessel by means of a first aid room with a qualified attendant or a first aid kit, contents of a first aid kit, and intervals of inspection of the kit.
29 CFR	1915	Occupational safety and health standards for shipyard employment	Gear & Equipment for rigging & materials handling	G	1915.111	Inspection	This standard deals with the inspection of all gear and equipment provided by employer for rigging & materials handling and the intervals between inspections to ensure safety.
29 CFR	1915	Occupational safety and health standards for shipyard employment	Gear & Equipment for rigging & materials handling	G	1915.112	Ropes, chains & slings	This standard deals with various kinds of ropes & rope slings, their load capacities, the number & spacing of clips on these ropes and procedures for safe use. It also covers chain and chain slings, their inspection intervals, their safe working loads, treatments and safe working procedures.
29 CFR	1915	Occupational safety and health standards for shipyard employment	Gear & Equipment for rigging & materials handling	G	1915.113	Shackles & hooks	This standard deals with shackles, hooks and their safe working loads, inspection intervals, places of application of load, etc.
29 CFR	1915	Occupational safety and health standards for shipyard employment	Gear & Equipment for rigging & materials handling	G	1915.114	Chain falls & pull lifts	This standard deals with chain falls, their capacity indication, inspection intervals, method of securing the pull lift and strength of structure to which pull lift is secured.
29 CFR	1915	Occupational	Gear &	G	1915.115	Hoisting &	This standard deals with testing and

		safety and health standards for shipyard employment	Equipment for rigging & materials handling			hauling equipment	certification of derricks & cranes by accredited personnel, guarding of all hauling equipment, truck cranes used on a vessel, and safety measures on marine railways.
29 CFR	1915	Occupational safety and health standards for shipyard employment	Gear & Equipment for rigging & materials handling	G	1915.116	Use of gear	This standard deals with methods of securing slings regulations against their use for employees, use of appropriate sign language with a well trained signalman, construction regulations for material and strength of pallets, hatch rules, warning issued when loads being lifted or lowered, etc.
29 CFR	1915	Occupational safety and health standards for shipyard employment	Gear & Equipment for rigging & materials handling	G	1915.117	Qualifications of operators	This standard deals with employment of people who are well versed with signs, notices and operating instructions, employees having proper eyesight, having a strong heart, or any such disease that could incapacitate him suddenly.
29 CFR	1915	Occupational safety and health standards for shipyard employment	Tools & related equipment	H	1915.131	General precautions	This standard deals with tools with proper slings of adequate strength or bags to be used to free employee hands, precautions while using air tools, guards for power driven saws and machinery, proper securing of the pneumatic tools to the extension hose and proper warnings on high pressure hoses.
29 CFR	1915	Occupational safety and health standards for shipyard employment	Tools & related equipment	H	1915.132	Portable electric tools	This standard deals with safety of portable electric tools, their proper grounding and safety on using the non-frayed or worn out cables.
29 CFR	1915	Occupational safety and health standards for shipyard	Tools & related equipment	H	1915.133	Hand tools	This standard deals with safety in the use of hand tools, their maintenance, their inspection and their design.

		employment					
29 CFR	1915	Occupational safety and health standards for shipyard employment	Tools & related equipment	H	1915.134	Abrasive wheels	This standard deals with the use of abrasive wheels, the regulations to be followed on different types of wheels such as angular exposure, safety guards, etc, their inspection and employee protection while working on abrasive wheels.
29 CFR	1915	Occupational safety and health standards for shipyard employment	Tools & related equipment	H	1915.136	IC Engines other than ship's equipments	This standard deals with location of IC engines the outlet to their exhaust; exhaust line inspections, testing of carbon monoxide levels and use of blowers where necessary.

4. GUIDELINES FOR SAFE SHIP DISMANTLING

The guidelines discussed below contribute to protecting the ship-breaking workers from workplace hazards and assisting the improvement in managing occupational safety and health issues at the workplace. These guidelines apply to individuals at all levels in the ship breaking facilities and all ship breaking operations irrespective of the nature of the facility i.e. beach, pier or dry dock. Although these guidelines represent good practices for all, they are more particularly aimed at the step-by-step improvement of the more hazardous situation of dismantling of ships on beaches. The guidelines are broken down into two major categories; 1) Developing a national framework, and 2) Developing safe ship breaking operations

4.1 DEVELOPING A NATIONAL FRAMEWORK

4.1.1 Delegating Responsibilities and Duties and Forming the Legal Framework

The government of every country should nominate an authority which should, along with the other organizations, develop and review a policy for the safe ship breaking of ships. This policy should not only recognize ship breaking as an official occupation of the national economy but also aim at preventing illness and injury to health arising from ship breaking activities through the identification of hazards and the elimination of or exercising control over risks from all existing situations in the working environment. The policy should be supported by the laws and regulations and also have an effective mechanism of inspection for enforcement. Controlling the import and preparation of ships, employment and working conditions, workers rights and welfare as well as protection of the workers and the environment in and around the shipyard should be included in the policy.

The competent authority in turn should establish the respective duties and responsibilities for all others involved, specify their respective responsibilities and provide arrangements and practice for coordination between authorities and bodies called upon. The competent authority should also establish control mechanisms for waste management and protection of the environment. The competent authority should have the power to restrict hazardous processes, require advance notification prior to the use of hazardous processes and place restrictions on workers for reasons of safety and health currently using these processes.

The national laws and regulations should ensure the safety and health of workers and support the competent authority in every way so that they can fulfill their duties. These laws should also support the requirements put up by the ILO, Basel Convention and the IMO on the Trans-boundary movement and disposal of hazardous waste [5]. They should be able to account for new technologies and standards and should also specify that it is the employer of the facility that is solely responsible for the protection and safety of the workers and the environment.

Labor inspectors should periodically inspect the facility in the presence of the employers and the employees to check for compliance and enforce all applicable laws and regulations, advice all on safe performance and activities and work with organizations of workers and employees in developing and updating safety rules and measures. Labor inspectors should be competent to deal with unusual issues and be capable of providing support and advice when needed. They should also notify the findings to the respective authorities so that the required remedial action is taken.

Personal safety and safety of other co-workers should be the duty of every worker. All workers should be properly trained to comply with safety and health measures, be responsible at work, and notify to the immediate supervisor, any situation that presents imminent danger or hazard at the workplace. The employees should also report any accident or injury that occurs in the workplace and assist the employer in compliance with laws and regulations. Professional training programs should be adopted for these purposes.

Every worker should have the right to bring hazards or risks to health and safety at the workplace to the management. They should also have the right to remove themselves from dangerous situations and refrain from using tools equipment processes or machines if they have enough justification to believe that it is a threat to personal safety and health.

Their rights should also include medical examinations, medical treatment free of cost and compensation for occupational diseases and injuries. In addition workers should receive formal training in a language best understood by them and finally all workers should have the right to elect their own representative in order to achieve worker participation.

It is the overall responsibility of the **employer** to protect the employees and the environment of the ship breaking facility. Employers should make arrangements for the identification and assessment of risks and hazards at each workplace generated by the use of tools and machines.

They should also implement appropriate preventive measures to prevent the risks and hazards in conformity with the national laws and regulations. In addition, employers should also provide clean workplaces, appropriate for the job, controlled ambient factors to reduce hazards by organization at work.

Suppliers should be responsible for providing information concerning the correct installation and use of machinery and equipment and instructions on how to avoid known hazards. The designers of the facility should ensure that the levels of hazardous ambient factors from ship breaking facilities and processes be minimized and they conform to nationally recognized standards and their design promotes a safe and healthy working environment.

Contractors' responsibilities include establishing an effective means of communication with the facility, arrangements for reporting work-related injuries and diseases, training to their workers prior to commencing work and ensure that the onsite Occupational Safety & Health (OSH) activities are followed.

The commissioning party hiring the contractors should ensure that they have the same training as that of the workers in the facilities, are registered and hold licenses, and contractors that have violated contractual obligations are excluded from future bidding. The commissioning party should also ensure that the contracts include the compliance with safety and health requirements and sanctions in case of non-compliance.

Employers should cooperate with workers as much as possible in discharging their responsibilities. Workers in turn should work closely with their fellow workers in following the prescribed procedures and practices. Suppliers should cooperate with employers in providing them 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.

4.1.2 Occupational Safety & Health (OSH) Management

With a view to achieving acceptable environmentally sound conditions of occupational safety and health, it is necessary to invest in permanent structures for their continuous review, planning, implementation, evaluation and action. This should be done through the implementation of OSH management systems. The main elements of an OSH system should include an OSH policy,

hazard and risk assessment, evaluation of performance and actions for improvement. The OSH policy should include basic principles:

1. Management commitment to safety and health programs
2. Recognition of OSH as an integral part of the management structure
3. Prevention of work-related injuries and diseases
4. Complying with OSH national laws and regulations
5. Encouraging workers to participate actively in OSH management systems

An initial review prior to beginning work should be conducted to identify the necessary work procedures and hazards, assess the risks and hazards arising from current practices, and identify the applicable laws and regulations and other specific guidelines for the tasks to be carried out in order to determine if the existing plans or controls are adequate to eliminate hazards and risks. The initial review should be used in the systematic development of safety arrangements in ship breaking and as the basis for planning and practical implementation of the OSH policy.

Considering the nature of the ship breaking industry, arrangements should be made to identify hazards and risks and conduct periodic risk assessments in temporary or permanent facilities and on every ship being scrapped. The data collected from this assessment should be used as part of the safe ship-breaking plan. Also, employers should plan and implement protective and preventive measures to eliminate the assessed risks and hazards.

An OSH planning and implementation should include the preparation of a plan for achieving each goal with defined responsibility and criteria indicating the job to be done by whom and when. The planning phase should also include the selection and implementation of preventive and protective measures and the provision of adequate resources as appropriate.

Emergency preparedness arrangements should be established prior to commencement of work based on the location and environment of the facility and the nature of activities being performed onsite. The arrangements should include first-aid, fire fighting and evacuation of all personnel to safety, establishment of internal communication and communication with the emergency services in the area and the competent authorities, provision of training to all employees and regular exercises in emergency preparedness and prevention.

4.1.3 Reporting and Recording of Work Related Injuries and Diseases

Reporting and recording of work related injuries and diseases is essential and should be undertaken to identify major safety and health problems arising from ship breaking activities, provide reliable information on occupational injuries and diseases on a national level and develop and monitor the effectiveness of methods undertaken to ensure safety and health at work.

Reporting and recording of injuries and diseases should be mandatory to provide reliable information on occupational diseases, to identify major health and safety problems, to evolve safety measures, and to monitor their effectiveness. The competent authority should establish uniform procedures for reporting, recording, and notification of occupational diseases and injuries and also to specify the categories of work related injuries that are subject to reporting and recording. They should also assist employers in implementing these procedures and practices at work. The employer should then impart all the information to the workers and their representatives on the process of reporting and recording of the information in case of occupational injury or disease.

It is the responsibility of the employer to ensure that all records are readily available and retrievable at reasonable times. For each worker injured, a separate record should be made. Employer should also prepare records within a period of time as determined by the competent authority for inspection and information purposes. Workers should cooperate with the employer in carrying out the arrangements for recording and notification of work related injuries and diseases. The employer should inform the workers of these arrangements and the competent authority receiving and recording the information on work related injuries and diseases. They should also discuss all the work related injuries and diseases in the facility with the workers to help reduce the risk of exposure to such events in the future.

Work related injuries and occupational diseases notification should be sent as soon as possible to the victim’s family, the competent authority, insurance company, and labor inspectorates. This notification should be made as specified in forms and formats such as, an accident report for the labor inspectorate, a compensation report for the insurance company or a report for the statistics producing institute. The notification should include, the facility and the employer, the details of the injured person, the nature and location of the injury and the accident

and its occurrence in details. The notification of the occupational diseases should include the facility and the employer, the details of the person affected by the disease and the description of the disease at a minimum.

4.1.4 Occupational Health Services

Occupational health services is recognized as a service for a single facility or a service common to a number of facilities by the facilities concerned, public authorities, and any bodies authorized by the competent authority. The basic function of this service should be preventive and supportive to the employer especially in identification and assessment of risks from health hazards in the work place, surveillance of the factors affecting workers health, advice on planning and design of work places, adaptation of the work to the worker, organizing first aid and emergency treatment, analyzing work related accidents and diseases and collaboration in providing information, training and education in OSH hygiene and ergonomics.

The competent authority should be the one making provisions for the establishment of occupational health services by laws and regulations, by collective agreements and in any other manner approved by the authority after consulting with the employers and workers. It is then the responsibility of the employer for setting up or providing access to occupational health services.

4.2 DEVELOPING SAFE SHIP-BREAKING OPERATIONS

Ship breaking can be divided into three core phases:

1) Preparation,
2) Deconstruction, and
3) Material stream management.

By doing so, it is easy to identify individual tasks and those hazardous to safety and health thereby helping to eliminate or minimize risks. Each core phase must be safely executed. The safe execution is dependent on the adoption of safe working practices and processes and providing advance information on ship characteristics, hazardous material remaining on board or inherent in the ship when presented for breaking. Figure 9 below shows an example of a model ship-breaking plan.

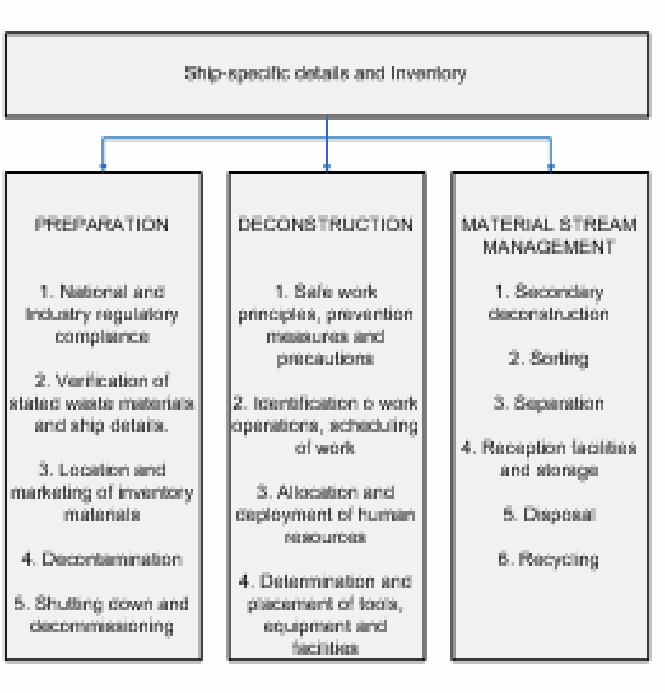

Figure 7: Model safe ship breaking plan

Ship-breakers must prepare plans in advance for the de-construction of the ships. Advance information and planning is essential to safeguard the safety and health of those involved in the ship breaking process. For a complex process such as ship breaking, it is important to document all the work systems. Planning should also be used as a means to improve working conditions at the sites, reduction in work related accidents, and increased productivity. Basic training in safe working procedures, and PPE should be provided to all workers. It is important to develop plans and actions for fire prevention and have fire-fighting teams present on site when work is in progress. Escape routes and rescue plans should be developed and rehearsed at regular intervals of time. Monitoring and roaming safety inspection teams should be established and must be an integral part of the safe ship-breaking plan.

4.2.1 Preparation

This phase should be carried out prior to the arrival of the vessel at the yard and prior to commencement of deconstruction. This phase involves:

- Adherence to international and national regulation and guidelines.
- Verification and survey, which includes inventory of materials, analysis of available data, surveillance of working environment, risk assessment, and monitoring.
- Locating and marking of inventory materials.
- Decontamination, which includes, plans for residual gas freeing, tank cleaning and removal of cargo residues.
- Shutting down and decommissioning, which includes, shutting down of hydraulic systems, boilers, electrical systems, fire protection systems, fuel oil systems and fresh water systems along with feed tanks.

The local compliance documents should be verified to ensure there are no deficiencies in the information provided. The inventory of the hazardous materials mentioned should be located. This should include physically marking their location on the ship immediately on arrival. Spaces and equipment that require decontamination should be identified and the details for completing each process should be provided. The general arrangement plan should identify these areas requiring screening before commencing work. Confined space access should not be granted before the identification and marking of hazardous material and decontamination has taken place.

4.2.2 Deconstruction

The main deconstruction processes and sub processes should be identified in this phase. The first process of this phase includes management, supervisor and worker responsibility ensuring safe access and egress from the work place, setup and stabilization of places where work is performed, following hot work procedures to prevent fire and explosion, establishing safe atmospheres and setting up fire fighting and first aid facilities.

The deconstruction phase should follow the convention of working from the top to the bottom of the structure to avoid assigning workers to work below one another thus providing them with protection and reducing probability of an accident or incident. Setting up the

schedules in the order in which the processes should be carried out will make it possible to quantify the time and man power required to complete the operation. Using a General Arrangement (GA) plan for cutting helps the supervisor get an overall picture of the sequence of operations. The GA plan has various other advantages that can be appended to it such as, the destination of the removed items, location of safety measures, and advance work preparations to be put in place.

The schedules and safety and health measures should be reviewed daily. The progress should be viewed in the context of productivity and effectiveness and execution of the safety and health provisions. All workers should be trained in the use of tools and equipment and a log should be established that records the competencies of the individuals. Workers should ensure that they are provided with the right tools and equipment to perform the job.

4.2.3 Material Stream Management

This final phase deals with the management of materials arising from the ship deconstruction phase. The activities carried out in this phase are:

1. Secondary deconstruction
2. Sorting
3. Separation
4. Reception facilities
5. Disposal
6. Recycling

The breaking area should be zoned to ensure each type of waste material is handled thus reducing the risk of a hazard from occurring. Figure 2 shows how a site can be subdivided to reduce the risk of accidents from materials.

Zone A: Some of the hazards encountered in this zone are, risk of fire, slips, trips and falls, asbestos removal, risks posed by falling objects, and danger to breathing.

Zone B: Hazards encountered in this zone include, risk of fire, hazardous vapors, handling of asbestos, exposure to handling hazardous liquids and slips, trips and falls.

Zone C: Hazards encountered in this zone include slips and trips, manual lifting of heavy objects, vapors, handling of asbestos and other physical hazards.

Zone D: Hazards encountered in this zone include, slips and trips, manual lifting of heavy objects, handling of hazardous materials, risk of fires.

Zone E: Hazards encountered in this zone are minimal.

Zone F: Hazards encountered in this zone include hazardous materials, vapors, and risk of explosion and handling of hazardous substances.

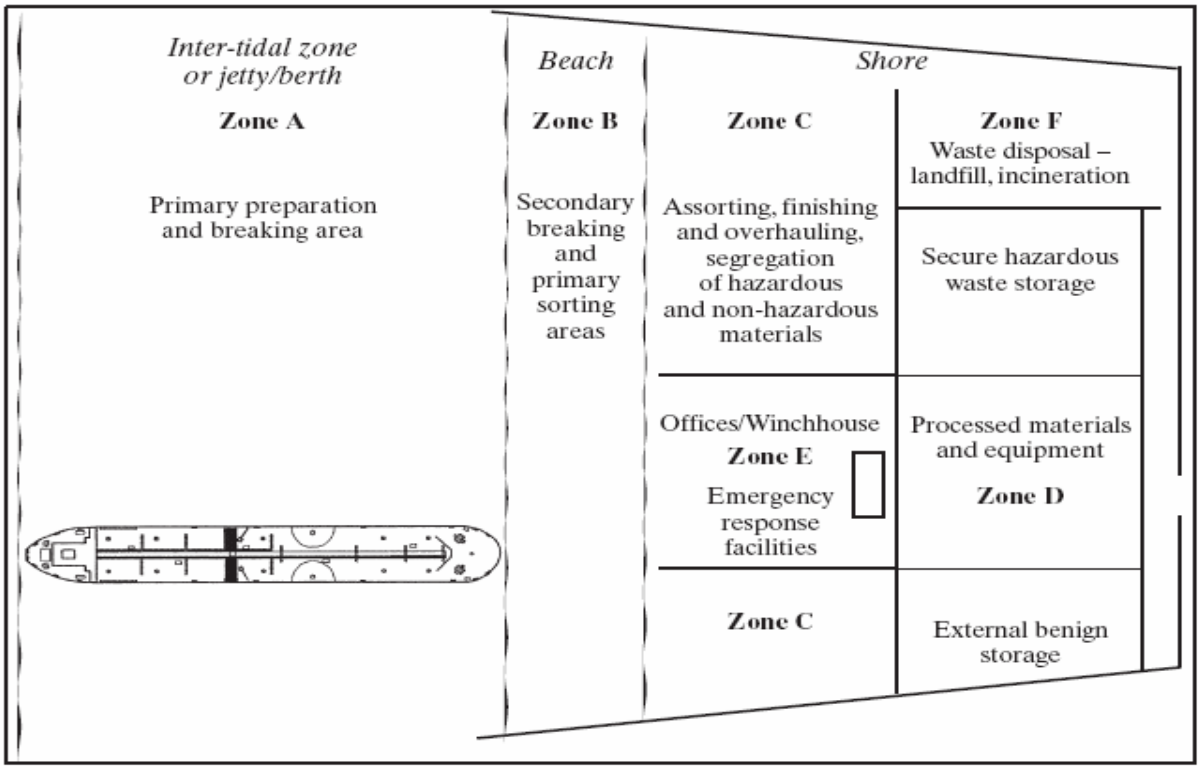

Figure 8: Work Zones

4.2.4 General Preventive and Protective Measures

Provisions should be made to ensure that the workers safety is of primary concern at the job site. Safe means of access and egress should be provided. These should be well-maintained and provided with barriers, free of obstructions and should be conveniently located. Proper escape routes should be provided in case of fires and explosions. These routes should be well-marked, free of obstruction and should show the direction of escape in case of a fire.

An appropriate housekeeping program should be developed to ensure proper storage of materials, secure stacking of loose materials, cleaning up of oily or slippery walkways reducing

the risk of slipping hazards and removing dirt and rubbish in an environmentally sustainable manner. The employer should ensure that all possible actions are taken to avoid the risk of fire, extinguish the fire if it starts, and evacuate all the persons from the facility safely. This process should include storage of Liquefied Petroleum Gases (LPG) and flammable cylinders in a secure and isolated location, enforcing “No Smoking” in the work zone, proper housekeeping helping remove oily rags and flammable waste, periodic inspections of workplaces and proper training of personnel.

In order to control and extinguish the fire quickly, adequate fire fighting equipment should be readily available in house. Proper training given to the employees should include when and where to raise an alarm, correct use of the fire-fighting equipment and also when not to attempt fighting the fire and evacuate the premises to call professional fire-fighters.

Entry into confined spaces should be permitted only after the space has been thoroughly inspected, is gas free and a permit is issued to work in it. While work is going on in the confined space an attendant should be stationed near the space at all times and all rescue equipment should be readily available.

4.2.5 Hazardous Material Management

All hazardous substances on board the ship should be removed prior to the deconstruction of the vessel. The employer should ensure that an inventory of hazardous substances is available and that they have all been removed and all tanks have been gas freed. The employer should also ensure that the employees are not exposed to atmospheres greater than the exposure limits. If hazardous substances cannot be removed, their location should be clearly marked and chemical safety data sheets available for ready reference. In addition the employer should work on assessing the various jobs and the kinds of hazards present in each job so as to control the employee from excessive exposure.

The employer should also ensure the active monitoring of the chemical hazards at the workplace by estimating exposure based on work patterns and dust lamp tests for illuminating dust emissions. The reason for monitoring is to ensure that workers’ health is protected and to promote the implementation of effective preventive methods. The monitoring data should be recorded and these records should be kept for future reference.

4.2.6 Measures against Physical, Biological, Ergonomic and Psychosocial Hazards

Adequate measures should be taken by employers to protect the employees from physical hazards such as noise, vibration, optical radiation, heat stress, lighting and electricity. Measures such as developing a monitoring program for noise exposure attempting to control noise at source, accommodating acoustical factors before designing enclosures, face and eye protection for employees working under Ultra Violet radiation, provision of adequate lighting wherever necessary and proper laying and maintenance of electric cables should be undertaken. These are some of the steps that can help improve the environment at work. Besides this, employees should be sent for periodic medical examinations that include audiometric testing at no cost to them.

Proper sanitation should be provided for workers and the workplace should be clean of rodents such as rats and insects. Extermination should be done at regular intervals if required within the facility. The facility should also be free of poisonous animals and first aid kits and antidotes should be readily available.

Selection of tools should be appropriate based on the climate and ergonomic implications. Manual handling of loads should be completely discouraged and processes should be designed to reduce manual handling.

4.2.7 Training and Competence

Proper training should be imparted to all employees in the deconstruction facility. Training programs should be developed and training documented. Training programs should be conducted by competent people and be reviewed at regular intervals to be modified as required.

Training should include different aspects of the OSH legislation, operating procedures for all equipment, emergency measures, the rights and duties of the workers, safe handling of equipment and hazardous substances and access to information. Training should be imparted to all employees at no cost and should also be done during normal business hours.

Before assigning the job to an employee the manager or supervisor must ensure that the employee possesses the skill, knowledge, and training to perform the job correctly. For specific tasks special training should be imparted to the assigned employee. This training should have all

relevant safety and hazard information and include the use and maintenance of tools along with the methods and procedures in performing the tasks.

4.2.8 Personal Protective Equipment

It should be the responsibility of the employer to provide and maintain suitable protective equipment and clothing to the employees. PPE should be used as the last source of protection in case all other means to eliminate hazards have been exhausted.

A competent person who has an understanding of the environment and the hazards posed must select Personal Protective Equipment (PPE). The employer should also ensure that the PPE is provided free of cost to the workers and is effective in the nature of the job being performed. Adequate training on the use of the PPE should be given to all workers. PPE should be provided for head protection, protection of the face, eyes, hand, feet, respiration, hearing, falls and radioactive materials.

4.2.9 Emergency Preparedness

In an industry as hazardous as the ship deconstruction industry, it is extremely important to plan in advance for an emergency and develop a contingency plan for the same. The plan should be made considering the nature of activity being performed at the facility and national laws. Every worker should be trained to respond in a particular fashion in case of an emergency to avoid confusion. All workers should know their roles and responsibilities and the employer should periodically hold refresher training to keep the information fresh in the employee's minds.

Emergency response teams should be setup and should be well versed with fire fighting, first aid, evacuation procedures, etc. First aid facilities should be provided within the workplace and should have trained personnel during every shift. Transportation vehicles should be available to move injured workers to receive medical help and proper provision should be made to evacuate people in case of an injury requiring medical assistance.

4.2.10 Welfare

Apart from protection at the workplace, the employers should also look into the well being of the workers including job security and benefits. Reasonable working hours should be schemed

to avoid overworking the employees. Working hours should also have adequate breaks and reasonable daily and weekly rest periods. Night work should be discouraged, but if the need be then adequate measure should be taken to compensate the employees accordingly. Professional help should be provided to employees to help them keep away from alcohol problems and all steps should be taken to eliminate child labor in the industry. Changing and sanitary facilities should be provided and well maintained along with lunchrooms for recuperating during breaks. Clean and unlimited supply of water should be maintained at all times.

5. CONCLUSIONS

The focus of this research was to identify the current working conditions in the ship breaking industry, particularly in South Asia, and its impact on the people and the environment. Ship dismantling is a profitable business in South Asia due to low labor costs and the ability to reprocess and recycle steel, and a demand for second hand marine equipment. However, the industry needs to ensure safety of workers and protect the environment.

This report describes the rise of the ship dismantling industry and its gradual movement from the developed to the developing nations due to rising costs for upholding safety and health standards. It further discusses the various methods used for ship dismantling around the world. The report also describes the various health and environmental hazards that result from ship dismantling. The standards and guidelines provided by the organizations such as the ILO, the Basel Convention, and OSHA to control transboundary movement of hazardous substances and safe working practices in ship dismantling yards were also discussed. This research identified the key safety and environmental concerns and proposed a solution to the ship breakers and the government agencies.

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