“SENSREC”

Safe and Environmentally Sound Ship Recycling in Bangladesh – Phase I

Programme No. TC/1614

Activity no 5a

Report of Results of Phase I

WBS Element No TC/1614-04-2320

Final Report

February 2017

SENSREC Deliverable Reports

Final Report of WP1a	**Contributions of Ship Recycling in Bangladesh: An Economic Assessment**
Final Report of WP1b	**Evaluation of Environmental Impacts of Ship Recycling in Bangladesh**
Final Report of WP2a	**Planning the Management of Hazardous Materials: Hazardous Waste Assessment**
Final Report of WP2b	**Common Hazardous Waste Treatment, Storage & Disposal Facility**
Final Report of WP3	**Refinement of a Government One-Stop Service**
Final Report of WP4 Part I	**Development of Training for Health Safety and Environmental Compliance - Curricula, Training Strategy and Training Needs**
Final Report of WP4 Part II	**Pilot Training of Trainers**
Final Report of WP4 Part II	**Strategy for Sustainable Training for the Ship Recycling Industry**
Final Report of WP5a	**Report of Results of Phase I**
Final Report of WP5b	**Document for the Implementation of Phase II**

The reports listed above can all be found on the website of the Ministry of Industries of the Government of the People's Republic of Bangladesh, as well as on the websites of IMO, BRS and BSBRA.

INTERNATIONAL MARITIME ORGANIZATION

Programme No. TC/1514

"SENSREC"

Safe and environmentally sound ship recycling in Bangladesh – Phase I

Activity No. 5a

Report of Results of Phase I

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Final Report

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Glossary of terms and abbreviations

BMA	**Bangladesh Maritime Academy**
BRS	**Secretariat of the Basel, Rotterdam and Stockholm Conventions**
BSBA	**Bangladesh Ship Breakers Association**
BUET	**Bangladesh University of Engineering and Technology**
DO	**Dissolved Oxygen**
DoE	**Department of Environment, Ministry of Environment and Forests, Bangladesh**
DoF	**Department of Fisheries, Ministry of Fisheries and Livestock, Government of Bangladesh**
ECR	**Environmental Conservation Rules, Bangladesh 1997**
EIA	**Environmental Impact Assessment**
ERD	**Economic Relations Division, Bangladesh**
ETP	**Effluent Treatment Plant**
GOSS	**Government One Stop Service**
HKC	**Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, May 2009**
IEA	**Implementing and Executing Agency**
ILO	**International Labour Organization**
IED	**Implementation, Monitoring and Evaluation Division, Bangladesh**
IMO	**International Maritime Organization**
LDT	**Light Displacement Tons**
MEA	**Multilateral Environmental Agreements**
MEPC	**Marine Environment Protection Committee**
MoA	**Memorandum of Agreement**
MoEF	**Ministry of Environment and Forests Government of Bangladesh**
MoI	**Ministry of Industries, Government of Bangladesh**
NGO	**Non-governmental organization**
Norad	**Norwegian Agency for Development Cooperation**
NFP	**National Focal Point**
PCB	**Poly-Chlorinated Biphenyls**

PMO	**Project Management Office**
PPE	**Personal Protective Equipment**
PSC	**Project Steering Committee**
SAFEREC	**Safe and Environment Friendly Ship Recycling Project**
SBSRB	**Ship Building and Ship Recycling Board (recently renamed as Bangladesh Ship Recycling Board, BSRB)**
SBRI	**Ship Breaking and Recycling Industry**
SENSREC	**Safe and ENvironmentally Sound Ship RECycling**
SME	**Small and Medium-sized Enterprises**
UNEP	**United Nations Environment Programme**
UNIDO	**United Nations Industrial Development Organization**
UoC	**University of Chittagong, Bangladesh**
USD	**United States Dollars**
WMU	**World Maritime University**
YPSA	**Young People in Social Action**

Project Overview

The SENSREC (Safe and ENvironmentally sound Ship RECycling in Bangladesh) project was designed with the objective of improving the standards and therefore the sustainability of the industry and was also intended to assist the industry to eventually meet the requirements of the Hong Kong International Convention on the Safe and Environmentally Sound Recycling of Ships, 2009 (the Hong Kong Convention), so that the Government of Bangladesh may be in a position to accede to the Convention, in due course.

The project was designed to be delivered in two phases. Phase I involved several studies and pilot activities, with detailed infrastructure design and sourcing of financing being reserved for the next phase. A number of actions were undertaken to support the implementation of improved practices and upgrade others, taking into account the interests of key stakeholders, including the Government of Bangladesh and the Bangladesh Ship Breakers Association (BSBA). The relevant ministries involved were coordinated through the Ministry of Industries. Significant international partners who added value to the tasks were the Secretariat of the Basel, Rotterdam and Stockholm Conventions (BRS), and the United Nations Industrial Development Organization (UNIDO). Other intergovernmental stakeholders also contributed e.g. the International Labour Organization (ILO).

Five Work Packages were created, covering: economic and environmental impact studies; quantifying and planning for the management of hazardous materials and wastes with an outline design of a downstream facility; development of a Government One-Stop Service; upgrading of training modules and preparation of new modules on safety, health and environment; and the production of a Project Document for Phase II.

These Work Packages entailed considerable effort on the part of a wide range of international and national consultants, local experts, Ministry and industry representatives who combined their expertise to produce the deliverables specified in the original Project Document on which the whole of Phase I was based. A vast amount of information has been amassed to assist in the development of Phase II of the project. The deliverables are fully described in the individual reports that have been approved by the Project Steering Committee. This Final Project Report summarises the key information contained in the individual Work Package reports, which should be consulted for further detail.

Work Package 1a
Contributions of Ship Recycling in Bangladesh: An Economic Assessment

This study provides an up-to-date assessment of the overall contributions that the ship recycling industry is making to the economy of Bangladesh. It discusses the domestic and international regulatory frameworks within which the industry is operating, together with other major factors and developments that have, and will have, shaped the industry and impacted on its economic performance. The study concludes that the internationally competitive ship recycling industry of Bangladesh is making valuable contributions to the national economy. Industry generated output is worth, on average, about Taka 53.3 billion a year

(approximately US$770 million at 2009-10 constant prices) over the past five years to 2015. In terms of customs duties, income and other taxes, the industry has paid around Taka 5 billion a year (or, approximately US$68 million), providing an important source of government annual revenues. The study calculates that industry pays a substantial amount of fees and charges as required under the current regulatory and compliance frameworks and provides jobs to many thousands of skilled and semi-skilled workers coming from across the country, estimated to be between 25,000 and 40,000 full-time equivalent jobs in 2015. It was estimated that in addition to steel scraps, ship recycling yards recover substantial amounts of non-ferrous metals (as scraps, sheets, nets and bar materials), some 7,500 Metric tonnes in 2015, worth about Taka 1.2 billion (or about US$17 million) at the 'yard gate' in 2009-10 constant prices. Ship recycling also recovers numerous machines, components and hardware such as pipes, chains, boats, anchors and propellers, the 'yard gate' value of which was estimated at Taka 7.6 billion (about US$111 million) for the year 2015.

The study notes that global shipping and ship recycling markets are volatile by nature. As such, not only will the industry have to deal with market uncertainties, it will also be facing changes in domestic and international regulatory frameworks and standards, which are currently being developed or implemented. One of the critical regulatory requirements relates to safe and environmentally sound ship recycling practices under the Hong Kong Convention. Also, the beaching method of recycling that is used in Bangladesh may come under threat by the controversial EU Regulation.

The report emphasises that for evidence-based decision-making by the industry stakeholders, it is critical to develop and maintain a credible information base and analytical capacity for the industry, which the authors found was lacking. Nonetheless, it is important that the industry's contributions be duly incorporated in the national accounts and employment statistics generated by the Bangladesh Bureau of Statistics in the future.

Work Package 1b
Evaluation of Environmental Impacts of Ship Recycling in Bangladesh

This report identifies ship recycling at Sitakunda as being within a complex zone of marine coastal, urban and rural land-based environments. Major rivers discharge into the Bay of Bengal close to the ship recycling zone. Inputs to the Bay come from the river and other water systems: canals, streams and direct discharges of sewage from residential, commercial and industrial sources (such as cement, glass, steel and re-rolling, jute, textile, pharmaceutical, automobiles - these typically generate heavy metals, oil, acids, alkalis, ammonia, dyeing agents, drug disposal chemicals, detergent, antibiotics, organic and inorganic wastes, etc.). Intensified agriculture runoff is also of potential concern. The study notes that these inputs have their own impact on the local environment and should be distinguished from those for which ship recycling itself is likely responsible. Mangrove clearance will have affected the ecology of the area.

Field studies and laboratory analyses were conducted to supplement the available literature and information about the environmental conditions around the yards. These show the marine waters and sediments at Sitakunda are contaminated with a range of substances

(including heavy metals, oil, PCBs, agro-chemicals and sewage). The parameters investigated (metals, BOD, TDS) do not appear to be greatly exceeding reference values, in some but not all studies. The reasons for this may be due to factors relating to: low release, mixing, dispersion, and sampling location and timing (including the effect of seasonal weather fluctuations especially rainfall).

A first attempt at producing an Environmental Impact Assessment (EIA) of the ship recycling area was presented based on the information gathered. The report states that improved understanding of the environmental context of the ship recycling area at Sitakunda is needed, to be able to fully appreciate its potential impact in comparison with other possible inputs from industry, as well as settlements and agriculture. Recommendations to enable a comprehensive EIA to be produced are for:

- additional study of the range and distribution of biota over time, particularly to identify useful indicator species and those of local and commercial importance, including fish, shrimp, crab, mollusc, and coastal plants (mangroves) species;
- an improved understanding of the separate contribution to environmental pollution made by other industry, agriculture etc., to be able to differentiate this from ship recycling per se, especially where the same substances maybe being released (e.g. heavy metals, oils and grease, paints);
- further development of monitoring programmes for environmental pollution with establishment of time series measurements, helping to elucidate the causes and better assess mitigation efforts;
- a “Shipyard zone” demarcated in the coastal environment, limiting the activities within a certain area to assist in considering potential environmental impacts and regulatory mechanism;
- development of laboratory facilities for environmental monitoring to assist in progressing these aims;

Work Package 2a
Planning the Management of Hazardous Materials: Hazardous Waste Assessment Report

This Work Package addresses the development of downstream hazardous waste management capacity in the Chittagong region. An inventory of hazardous waste was conducted in the ship recycling industry and in neighbouring industrial areas of the city to assist with design options and costings for hazardous waste management infrastructure under WP2b. The scope of the project encompassed the ship recycling facilities and the other industrial sectors in Chittagong, both of which strongly differ in their evolution and dynamics as regards to their administration, regulation and economics.

The total range of hazardous wastes likely to be generated in the Chittagong ship recycling industry and the Chittagong industrial areas is shown in Table 3 (this table is depicted as Table 20 in section 8 of the detailed report).

Industries focused on were: Textile, Tannery, Fertilizer, Paper Mill, Chemical, Pharmaceutical and Pesticide, Paint and Varnishes, Petroleum Refinery, Cement Industry,

Rerolling mill (Auto), Cable industry, Glass industry, Healthcare institution and Chittagong Port. The landfillable waste from ship recycling included asbestos and asbestos-containing materials (2'100-2'800 MT/year).

Table 3:
Approximate estimates of hazardous waste quantities generated from the Chittagong ship recycling yards and from the Chittagong industrial areas (MT/year)

Type of hazardous waste	From the ship recycling yards (min-max)	From the industrial area	Medical waste	Total (min-max)
Landfillable waste (both toxic and inert)	7'500-10'300	400	-	**7'900-10'700**
Incinerable waste	5'400-6'400	14'000	800	**20'200-21'200**
Bilge water	5'600-6'300	-	-	**5'600-6'300**
TOTAL	**18'500-23'000**	**14'400**	**800**	**33'700-38'200**

It was noted that this picture could evolve rapidly depending on the flux of major industrial players, as well as changing production processes and input materials. In addition, in the absence of a legally enforced waste reporting system, the extent to which data is collected strongly depends on the willingness of the relevant stakeholders to share data. Data quality also depends on the respondents' understanding of the hazardous nature of their wastes, emphasising the importance of developing local competencies and know-how on hazardous waste.

Work Package 2b
Planning the Management of Hazardous Materials: Common Hazardous Waste Treatment, Storage & Disposal Facility (CHW-TSDF)

The results of this Work Package comprise two reports: Report No 2 on initial infrastructure design and Report No 3 on a business case for the development of hazardous waste management infrastructure.

Report No 2

Report no 2 concluded that the ship recycling sector in Chittagong could grow at a rate of 4% in the near future. An average annual growth rate of 6% was assumed for other industries in the coming decade. Based on that and the results of WP2a on Hazardous Waste Assessment (Report No 1), a tentative design basis for the proposed CHW-TSDF was produced.

The report proposed that the development of the CHW-TSDF can be implemented in two stages if sufficient funds are not readily available to construct a facility to manage both the ship recycling wastes and those of all other industries in the area of Chittagong. "Stage 1" would be a facility with landfill for the total inventory and an incinerator of sufficient capacity

just for the ship recycling industry, with a proportionate wastewater treatment facility. In "Stage 2" an additional incinerator would be provided to take care of the incinerable wastes from industries other than ship recycling. The report estimates that a design life of 10 years requires a plan area of about 20 acres (8 hectare footprint) for the proposed CHW-TSDF. (Further consideration as to the projected lifespan of the facility is given in the section on Work Package 5b).

The report recommends that the Government of Bangladesh should provide free land and infrastructure such as: water-supply, disposal pipeline for treated wastewater, power supply, approach roads and compound wall to prevent unauthorised access. For both stages of the development the CHW-TSDF will cost approximately USD 11.5 million (i.e. USD 6 million for Stage 1 and USD 5.5 million for Stage 2) - excluding the cost for land, utilities and project management. The CHW-TSDF could be built over 18 to 24 months by a dedicated team created by the Government of Bangladesh.

Report No 3

This report describes the drivers for developing a sustainable CHW-TSDF - a strong legislative and compliance framework, sufficient volumes of hazardous wastes and cost recovery opportunities for the operator. Key parameters discussed outline the main cost overheads and revenue sources for setting up and operating a CHW-TSDF. Ownership and financial models are enumerated and case studies from experience in India (that now has some 38 TSDFs developed since 2002) were described. A crucial aspect of the commercial viability is the capacity utilization of the CHW-TSDF. The results of a scenario analysis showed that starting with 20% of the estimated volume of waste input and increasing only up to 50% in 10 years, the business case is still viable by adapting other variables such as lower interest rates, a longer repayment period and lower debt levels and moderate tipping fees. The modeling shows that there is scope for increasing the lifetime of the facility, or reducing its size and investment cost.

Potential donors and funding sources are listed. Recommendations are made for the organizational structure for financing the CHW-TSDF.

Work Package 3
Refinement of a Government One-Stop Service

Under this Work Package all the processes involved for establishing a ship recycling yard and for recycling an imported ship in Bangladesh were described and discussed with relevant Ministry officials and ship recycling representatives. An instructive field visit to Turkey was carried out that highlighted Turkey's approach to the organization of multiple governmental agencies dealing with ship recycling approvals. Meetings and discussions were held with representatives of the Bangladesh Ship Breakers Association, with the Ministry of Industries and with other departments involved in ship recycling activities in Bangladesh.

In the draft Bangladesh Ship Recycling Act 2016, the Bangladesh Ship Recycling Board

(BSRB) will be formed under the Ministry of Industries (MoI) of the Government of Bangladesh. Until the formation of the Board, the report concluded that the following steps can be undertaken to enhance ship recycling activities:

- the MoI can take the initiative to reduce the number of organizations visiting the ship at the outer anchorage, for example, the Chittagong University, Bangladesh Navy and Marine Academy;
- reduction of the number of visits by the personnel of the Department of Explosives to one, at the beaching area;
- A safety agency appointed by the MoI can undertake the task earlier performed by the Chittagong Dry Dock Limited;
- the Bangladesh Navy can visit the ship after beaching (to take away and destroy the communication and signaling equipment);
- cutting permission from the MoI should be sufficient if the Department of Environment does not have its own rules for giving permission for cutting the ship. Safety agencies can work on behalf of the MoI.

Work Package 4
Development of Training for Health Safety and Environmental Compliance

A consortium of national and international partners was formed and Work Package 4 (WP4) was divided into two parts – WP4 Part I (Curricula, Training Strategy and Training Needs) and WP4 Part II (Strategy for Sustainable Training for the Ship Recycling Industry). A Training Needs Assessment identified the elements of an appropriate work system and a suitable training system that needed to be improved and/or implemented. From this a three tier curriculum to support Bangladeshi needs was developed covering: initial training for all workers, additional training for skilled and special workers and awareness training for managers. Eight modules for incorporation into the curriculum were created:

1. Ship Recycling Administration and Regulatory Framework
2. Job Hazard Awareness-Hazard and Risk (practical)
3. Awareness and Communication of Information about Hazardous Materials
4. Inventory of Hazardous Materials (IHM)
5. Personal Protective and Safety Equipment
6. Worker Wellbeing & Health
7. Environmental Awareness
8. Vocational Education and Training

Regarding provision of training facilities, it was stated that alternative solutions to comply with training requirements are required. It was proposed that in the interim, until a dedicated training facility is established, proven institutions such as the Bangladesh Marine Academy should be utilized to support ship recycling training.

Based on assumptions described in the report (Sustainable training strategy report of WP4 Part II) calculations were made to assess the total number of workers required to be trained per year with an increased capacity in training facilities and numbers of trainers. Approximate costs (summarised in the Annex to WP4 Part II) to utilise the Bangladesh

Marine Academy, training up to 1008 workers per year, were given as USD 160 per worker, plus the cost of international expertise and living expenses.

Work Package 5a – Summary Report of Phase I

This part produced a summary report (this document) on the basis of the tasks comprising Phase I of the SENSREC project, with a brief analysis of the findings and recommendations.

Work Package 5b – Document for Implementation of Phase II

This Work Package summarises and highlights salient points deliberated in the "Project Document for Phase II" (component 'b' of Work Package 5). The Project Document is divided into two portions, *namely*: Part A and Part B. Part A deals with the essential tasks to be performed during the course of establishing the Common Hazardous Waste Treatment, Storage and Disposal Facility. Part B outlines the necessary strategies for capacity building by implementing the training modules for the workforce in ship dismantling yards in Chittagong, Bangladesh.

For establishing the CHW-TSDF adequate for a 10-year lifespan, USD 16.1 million, plus the land area of 7.8 hectare (*i.e.* 19.3 acre), would be required to conduct all the required studies and investigations and for construction and erection of the facility. If instead the CHW-TSDF life-span is to be extended by another 10 years, an additional USD 37.8 million will have to be invested at that time, and additional land area of 7.2 hectare (*i.e.* 17.8 acre) will have to be allocated, in order to conduct all the required studies and investigations as well as for the construction and erection of the suitable additional landfills and for the replacement of the 10-year old incinerator by a new incinerator of higher capacity. A detailed discussed on the budget summarized above is presented at the end of Chapter 11 of the report.

It is estimated that the numbers of workers who need training is between 25,000 and 40,000. Following on from the interim proposals for training described in WP4, in the longer term, it is recommended that a dedicated “Training Complex” is built. This would require an allocation of approximately USD 7.1 million to cover the capital costs of construction, commissioning, modest furniture, laboratory equipment and fire-fighting systems. In addition to those costs, finance for air conditioners, residential quarters, guest house, cost of land, recurring costs and operation and maintenance costs would be required.

Outcome vs Project Document Objectives

Taken together the outputs of the five Work Packages have provided significant and substantial results that will assist the strengthening of the national capabilities of the Government of Bangladesh and the operators of ship recycling yards and will enhance the standards of health, safety and environmental compliance to make the ship recycling industry more sustainable. There has been excellent cooperation between key stakeholders, including the Government of Bangladesh with relevant ministries coordinated through the Ministry of Industries, the Bangladesh Ship Breakers Association (BSBA), the Secretariat of the Basel, Rotterdam and Stockholm Conventions (BRS) and the United Nations Industrial Development Organization (UNIDO) as well as other international stakeholders e.g. the International Labour Organisation.

A comprehensive up-to-date picture of the industry has been produced on which further progress can be built. Continuation and expansion of the activities undertaken through Phase I of the Project, supporting health, safety and environmental protection by training, environmental monitoring, proposals for streamlining governance and infrastructure development, will provide considerable underpinning to the ship recycling process as a whole and help the ship recycling industry in Bangladesh to maintain its economic position as one of the leading ship recycling nations. Much remains to be done to cement the results of Phase I and meet current and future challenges of national and international ship recycling compliance standards. The SENSREC project has enabled key steps to be taken to fulfil this objective. The continuation of Phase II, with the development of infrastructure for hazardous waste treatment storage and disposal, coupled with wide implementation of training on health safety and environment will certainly provide a major contribution towards meeting national and international standards as new legislation is being introduced in Bangladesh on ship recycling.

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Introduction

Background to the SENSREC Project

This project was designed to enhance the development of safe and environmentally sound ship recycling in Chittagong, Bangladesh, with the aim of improving the standards and therefore the sustainability of the industry. As a by-product, the project was also intended to assist the industry to eventually meet the requirements of the Hong Kong International Convention on the Safe and Environmentally Sound Recycling of Ships, 2009 (the Hong Kong Convention), so that the Government of Bangladesh may be in a position to accede to the Convention, in due course.

The project was designed to be delivered in two phases. Phase I was concerned with the establishment of a number of actions to support the implementation of improved practices and upgrade others, taking into account the interests of key stakeholders including the Government of Bangladesh and the Bangladesh Ship Breakers Association (BSBA). The relevant ministries involved were coordinated through the Ministry of Industries. In addition, the Secretariat of the Basel, Rotterdam and Stockholm Conventions (BRS), and the United Nations Industrial Development Organization (UNIDO) were significant international partners who added value to the tasks by sharing their expertise, know-how, and in the case of BRS funding, to assist in creating opportunities for long-term improvements in safety, health, and environmental protection and ultimately for the development of new infrastructure. Other intergovernmental stakeholders also contributed e.g. the International Labour Organization (ILO). Phase I involved several studies and pilot activities, with detailed infrastructure design and sourcing of financing being reserved for the next phase.

There were five work packages covering: economic and environmental impact studies; quantifying and planning for the management of hazardous materials and wastes with an outline design of a downstream facility; development of a Government One-Stop Service; upgrading of training modules and preparation of new modules on safety, health and environment; and the production of a Project Document for Phase II.

Implementation and Governance

The International Maritime Organization (IMO) has acted as the Implementing and Executing Agency (IEA) for the project with the overall implementation, fiduciary and project administration responsibilities, working very closely with the Ministry of Industries (MoI) who acted as the National Executing Partner for the project. MoI hosted a Project Management Office supporting the day-to-day implementation and coordination of the project activities. An Executive Committee acted as the highest decision-making body for the project. Its members were the IMO and MoI with BRS, BSBA and Norad participating as observers. Also a Project Steering Committee was established as a multi-stakeholder committee to provide guidance and advice on all technical components of the project. It was chaired by the MoI and comprised of representatives from the Government of Bangladesh (inter-ministerial), the ship recycling industry, strategic partners (IMO, BRS, UNIDO, ILO) and Norad.

Structure of this document

Each of the ensuing sections of this report describes a component of the studies (a "work package") undertaken for Phase I of this Project. A brief introduction outlines the purpose of each activity, which is summarised in two boxes at the beginning of the section. The left hand side box is entitled the "Project Document Summary". This box draws upon the descriptions of each work package set out in the original SENSREC Project Document, describing the objectives, the expected outcomes and the resources allocated to achieve the objective. The description draws on and refers to the Project Document's Annexes: Annex 2, the Logical Framework Matrix, and Annex 3, Resources and Budget. Alongside this box is a Project Outcome box. Here the key actions and outputs are summarised for comparison with the expected outcomes described in the left hand side Project Objective box. Following this introductory page the Executive Summary (or a similar summary) of each work package is reproduced from the specific work package report(s), with some minor editorial changes (mainly use of terminology, for example ship recycling is a preferred term used throughout as opposed to ship breaking) for consistency of presentation in this report.

The Executive Summaries are stand-alone passages taken from the Work Package reports that describe the results of the work carried out. Where thought necessary and appropriate, additional extracts from the main body of the Work Package Reports are included in sections entitled "Additional Highlights" to amplify or better illustrate the topic.

During the execution of the project, some of the work packages were split into components, each with their own Executive Summary or Summary report. This approach is replicated in this document, no attempt being made to try and combine the components.

All of the information presented in this report can be found in the Work Package reports and Project Document – no additional information is included from external sources.

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Work Package 1a
Contributions of Ship Recycling in Bangladesh: An Economic Assessment

Introduction

The objective of this study is to provide an up-to-date analysis of the economic impact of the ship recycling industry in Bangladesh. Specifically, the study assessed the industry's:

- direct and indirect economic contributions, measured in terms of steel supply and employment generated;
- economic impacts on other industries; and
- past economic performance as well as the future economic outlook of the industry.

The Project Document for Phase I elaborated in its Annexes the key attributes of this Work Package together with the main outputs, which are summarised in the boxes below.

Project Document Summary WP1a: Economic Assessment

Objective - Logical Framework Matrix:

- identify the key benefits of ship recycling including:
  - o direct and indirect employment,
  - o proportion of national steel demand met, and
  - o economic benefits to the country from savings accrued from the utilization of scrap steel from ships;
- in comparison with:
  - o input of raw materials and
  - o alternative methods of steel generation.

Expected Outcome

Improved understanding and evaluation of specific economic impacts of the ship recycling industry in Bangladesh.

Expected Outputs

- Project reports and evaluation of stakeholder understanding from Phase I project closure meeting,
- Economic analysis of ship recycling in Bangladesh for inclusion in final study report.

Target group

Decision-makers at government level and ship recycling industry.

Resources

Scoping Study with specifications for detailed studies,
National + International consultants.

Project Outcome WP1a: Economic Assessment

Activities

- Site Visit to Chittagong, including ship recycling yards, rolling and re-rolling mills;
- Discussions and information gathering via questionnaires with representatives of:
  - o the Bangladesh Ship Breakers Association,
  - o the Ministry of Industries, and
  - o other Ministries, Ministry of Labour and Employment, Department of the Environment, National Board of Revenue, Bangladesh Bureau of Statistics,
  - o Academia.

Issues covered

- Structure Growth and Performance of the Ship Recycling Industry in Bangladesh,
- The Policy Environment Facing the Bangladesh Recycling Industry,
- Broader Economic Contributions of the Ship Recycling of Bangladesh,
- Outlook for the Ship Recycling Industry of Bangladesh.

Outputs

- Findings presented at Workshop June 2016,
- Project Report produced with economic analysis.

Executive Summary

The report “Contributions of Ship Recycling in Bangladesh: An Economic Assessment” forms part of Work Package 1 of the project ‘Safe and Environmentally Sound Ship Recycling in Bangladesh – Phase I’, jointly implemented by the International Maritime Organization (IMO) and the Government of the People’s Republic of Bangladesh.

This study provides an up-to-date assessment of the overall contributions that the ship recycling industry has made to the economy of Bangladesh. It also discusses the domestic and international regulatory frameworks within which the industry is operating, together with other major factors and developments that have, and will have, shaped the industry and impacted on its economic performance.

It is important to note that there are important social, human health and environmental impacts of ship recycling which do not fall within the scope of this economic study and, on their own right, would warrant dedicated study. However, readers interested in the environmental impacts are referred to the companion study of Work Package 1.

In this study, ship recycling is taken to encompass all *economic* activities involved in dismantling and converting imported end-of-life ocean-going vessels (through using labour, land, infrastructure, machinery, and various utilities and consumables) into steel and other recyclable and reusable commodities that are mostly sold in domestic markets.

Bangladesh is one of the leading ship recycling countries in the world.

- On average, the industry recycled over 175 ships totalling about 1.8 million light displacement tons (LDTs; the most relevant measurement unit in ship recycling) each year over the past decade to 2015;
- Over this period, the Bangladesh ship recycling industry has accounted for over 25 percent of the total ships recycled (in LDTs) by the five leading ship recycling nations; the four others being India, China, Pakistan and Turkey;
- In 2015, Bangladesh became the top ship recycling country in the world, surpassing India once again since 2008;
- Despite the structural and cyclical ups and downs in the global shipping and ship recycling markets, the ship recycling industry in Bangladesh has managed respectable growth, estimated at about 14 percent a year on average since 1980;
- With expanded capacity of recycling yards over the years, Bangladeshi recyclers have imported relatively large and diverse range of ships for recycling.

The internationally competitive ship recycling industry of Bangladesh is making valuable contributions to the national economy.

- The industry has sustained its international competition due to a combination of factors including adequate domestic demand for steel scraps and reusable materials and products; proximity to critical infrastructure and a thriving industrial zone with

many re-rolling mills and other 'linkage' industries; stable climate and geographical advantage; relatively affordable labour; mature entrepreneurship; and enabling and conducive regulatory environments;

- The industry generated output worth, on average, about Taka 53.3 billion a year (approximately US$770 million at 2009-10 constant prices) over the past five years to 2015;
- In terms of customs duties, income and other taxes, the industry has paid around Taka 5 billion a year (or, approximately US$ 68 million), providing an important source of government annual revenues. Additionally, the industry pays a substantial amount of fees and charges as required under the current regulatory and compliance frameworks;
- Importantly, the industry provides jobs to many thousands of skilled and semi-skilled workers coming from across the country, estimated to be between 25,000 and 40,000 full-time equivalent jobs in 2015.

In addition to these *direct* contributions, the industry is making important *indirect* contributions to the national and local economies by supporting and stimulating a host of economic activities along its supply chain−upstream and downstream, including domestic steel manufacturing, ship building and repairing services.

- Between 80 and 90 percent of all materials recovered from recycled ships (measured in Metric tonnes) constituted various forms of steel scraps. Typically, between 50 and 60 percent of these recovered steel scraps are used in re-rolling mills in Bangladesh. As such, steel scraps recovered from ship recycling account for over half of the domestically sourced feedstock into total steel manufacturing in Bangladesh;
- Recycled ships are effectively imported feedstock for domestic steel manufacturing. In view of this, the import dependency for feedstock of domestic steel making is not reduced by domestic ship recycling. But the substantial value-adding and employment opportunities that the ship recycling industry has been generating since 1980 would have been foregone had there been equivalent direct imports of steel scraps for domestic steel making;
- As such, for every Taka 1,000 of value-added generated by the ship recycling industry, there was an additional Taka 2,000 of value-added generated along the supply chain−upstream and downstream, implying a value-added multiplier of 3. Value-added includes wages and salaries, proprietary income, other proprietor income, and indirect business taxes;
- In addition to steel scraps, ship recycling yards recover substantial amounts of non-ferrous metals (in the form scraps, sheets, nets and bar materials), estimated at 7,500 Metric tonnes in 2015, worth about Taka 1.2 billion (or about US$17 million) at the 'yard gate' in 2009-10 constant prices;
- Ship recycling also recovers numerous machines, components and hardware such as pipes, chains, boats, anchors and propellers, the value of which was estimated at Taka 7.6 billion (about US$111 million) at the 'yard gate' for the year 2015.

- By ensuring ongoing supply of key feedstock to domestic steel making as well as recovering other reusable or recyclable materials, ship recycling has contributed to the development and growth of many industries in Bangladesh, and thereby is playing an important role in broadening and deepening the industrial base of the country.

The substantial domestic demand for steel scraps and the expected ongoing global supply of recyclable ships from the pool of ageing global merchant ships suggest a promising outlook for the ship recycling industry in Bangladesh.

Nonetheless, global shipping and ship recycling markets are volatile by nature. As such, not only will the industry have to deal with market uncertainties, it will also be facing domestic and international regulatory frameworks and standards which are currently being developed or implemented. One of the critical regulatory requirements relates to safe and environmentally sound ship recycling practices under the Hong Kong Convention. Also, the beaching method of recycling that is used in Bangladesh may come under some threat by the controversial EU Regulation.

Last but not least, for evidence-based decision making by the industry stakeholders, it is critical to develop and maintain a credible information base and analytical capacity for the industry, which the authors of the report have found lacking. This report is expected to make a contribution to this end. Nonetheless, it is important that the industry's contributions be duly incorporated in the national accounts and employment statistics generated by the Bangladesh Bureau of Statistics in the future.

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Additional Highlights

All ship recycling yards in Bangladesh operate on the 18km long Sitakundu-Bhatiyari coastal strip in the north of Chittagong (Figure 2.3 of the study). In 2015, there were 148 registered ship recycling yards of which 68 yards were in operation. From 2012 to 2014 there was a sharp rise in the number of yards recycling ships of 10,000 LDT and smaller. In 2015, the number of recycled ships of this size fell but with a significant increase in yards recycling larger ships.

Performance and trends

Recycled tonnage in Bangladesh fell sharply in 2010 because of a temporary ban on ship recycling from June until October 2010 in Bangladesh. It recovered since 2011 reaching an all-time high of an estimated 2.9 million LDTs of recycled ships in 2012. In the past three years to 2015, recycled tonnage in Bangladesh averaged around 2.2 million LDTs from just over 210 recycled ships per annum. A sharp increment has been observed in importing larger ships from 2012 onwards. The increased number of re-rolling mills (approximately 500) and large rolling mills (about 10) also fuelled the demand for bigger ships during this period.

Changing ship recycling practices in Bangladesh

The Bangladesh ship recycling industry has undertaken various measures and made significant investments particularly since 2010 in, for example, introducing and expanding mechanisation at the yards, improving yard infrastructure, waste management infrastructure and practices with regard to labour force training and equipment. There are considerable opportunities for the Bangladesh ship recycling industry to maintain its global position but the industry will have to overcome some of the challenges, particularly relating to workplace safety and environmental management.

National ship recycling policy, rules and regulations

The current approval processes and procedures for purchasing, importing, beaching and recycling a ship are formidable. With a purchase price of US$300 per LDT for ships, taxes and duties could represent about 10 percent of the total price paid for a ship.

Conditions have improved significantly in response to demands from civil society groups, and government's initiatives following the release of the Ship Breaking Guidelines and Ship Breaking and Recycling Rules in 2011. Likely costs associated with improving workplace health and safety in a ship recycling yard have been assessed. For a typical yard, costs may range between Taka 4,000,000 and Taka 9,000,000 (approximately between US$50,000 and US$112,000 at the current exchange rate).

Implications of international regulations for ship recycling in Bangladesh

If and when the Hong Kong Convention comes into force, Bangladeshi ship recyclers are likely to face formidable regulatory challenges in bringing ships from outside. The Convention is expected to enter into force within the next five to ten years. In Bangladesh, gradually, the concept of 'responsible recycling' is gaining currency within the ship recycling industry.

Details for a potential ban of the beaching method are being considered for the EU Regulation. Although controversial, an outright ban on the beaching method, if implemented, can inflict significant damage to the Bangladesh ship recycling industry that uses the beaching method exclusively for ship recycling.

Broader Economic Contributions of the Ship Recycling Industry of Bangladesh

The Bangladesh Bureau of Statistics does not have credible data on the industry's levels of employment.

Contribution to domestic steel manufacturing

The import dependency of steel used in Bangladesh has been declining over the years, with about a third of final steel products in recent years depended on direct imports in one form or other. Of the remaining two thirds of steel used in Bangladesh steel scraps recovered from ship recycling accounted for 50 percent and more.

Contribution to other activities

Through the recycling and reusing processes, additional economic value is generated representing the *indirect* value-added from ship recycling.

In 2015:

- about 7,500 Metric tonnes of non-ferrous metals (worth about Taka 1.2 billion (equivalent to about US$17 million; in 2009-10 constant prices);
- about 60,000 Metric tonnes of machines and components were recovered worth about Taka 4.1 billion (equivalent to about US$60 million; in 2009-10 constant prices);
- about 108,000 Metric tonnes of hardware worth about Taka 3.5 billion (equivalent to about US$51 million; all in 2009-10 constant prices);
- about 20,500 Metric tonnes of furniture, fittings worth about Taka 1.2 billion (equivalent to about US$17 million; all in 2009-10 constant prices);
- about 62,800 Metric tonnes of various consumables. Of these, about 59,800 Metric tonnes were oils, worth about Taka 760 million (equivalent to about US$11 million). The remaining 3,000 Metric tonnes were other consumables worth about Taka 760 million (equivalent to about US$11 million; in 2009-10 constant prices).

Broader impacts of ship recycling

There are many upstream activities that service the industry and generate output and employment through that process - electricity and other utilities; oxygen plants; machinery and equipment maintenance and repair services; and banking, insurance and regulatory services. There are about 500 re-rolling mills across Bangladesh, with about 400 workers per operational mill on average. The majority of the operational mills source their key feedstock (steel scraps) from the Bangladesh ship recycling industry.

In order to provide a comprehensive set of estimates and a fuller understanding of all the indirect employment induced by the domestic ship recycling industry, it is necessary to undertake a detailed labour force survey along the supply chain of the industry.

Outlook for the Ship Recycling Industry of Bangladesh

Future domestic demand for steel scraps is intimately tied to the demand for feedstock of domestic re-rolling and rolling industries. Domestic demand for steel products of these industries is largely driven by infrastructure and construction growth, which in turn is influenced by broader economic growth, population growth and growth in urbanisation.

Sujauddin et al. estimated that the per capita steel consumption in Bangladesh was 25kg in 2008. By comparison, in 2008, the per capita steel consumption in the Philippines, Indonesia and India were 39 kg, 38 kg and 45 Kg, respectively. Vietnam, Malaysia and Thailand consumed much more, estimated at about 200 kg per person.

It is expected that the steel consumption in Bangladesh will grow to 50kg per person in 2022. The projected and targeted economic growth for the next several years is expected to further boost growth trends in construction activities within Bangladesh, which will generate sustained domestic demand for steel.

Global steel markets and ship recycling

Due to slowing economic growth in most developed economies, the demand for steel is predicted to slow down substantially from its recent peaks. At the moment, steel makers across the world seem to be dealing with an excess supply of between 400 and 700 million tons of lower-grade steel as it continues to drive steel prices down and reduces profit for the steel producers globally. China's global market dominance and potential supply gluts weigh into the domestic steel markets and, by extension, into ship recycling markets.

On the supply of recyclable ships

Importantly, about half of the current global fleet (around 110 thousand ships in the global merchant fleet, of which about 55 percent are of size 500 Gross Tons (GTs) and above) are aged 20 years or older. This would mean that there are many ships in the current global merchant fleet which can potentially end up in a ship recycling yard in the coming decade, subject to favourable economic returns from such a decision by ship owners.

On realising ship recycling opportunities

To what extent the Bangladesh ship recycling industry's growth prospects can gainfully be realised is not easy to predict. To translate future opportunities for the industry into a reality and for evidence-based decision making by the industry stakeholders, it is critically important to develop and maintain a credible information base and analytical capacity for the industry, which the authors of this report have found lacking.

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Work Package 1b
Evaluation of Environmental Impacts of Ship Recycling in Bangladesh

Introduction

The goal of this study is to prepare an environmental impact analysis with up-to-date environmental information of the ship recycling industry in Bangladesh. The specific objectives are:

a) to review available literature, taking into account an associated Scoping Study Report to provide an up-to-date picture of the environmental impact of the ship recycling industry;
b) to identify local environmental pressures from other sources as well as their environmental impact;
c) to carry out field work (environmental sample collection and analysis) and stakeholder consultation in order to obtain additional data to fulfil identified information gaps;
d) to prepare a comprehensive environmental impact study report of the ship recycling industry.

Project Document Summary WP1b: Environmental Impact Assessment

Objective - Logical Framework Matrix:

Identify the environmental factors of the ship recycling industry. This may include impacts on:

- fisheries,
- air,
- land, and
- water pollution

Expected Outcome

Improved understanding and evaluation of specific environmental impacts of the ship recycling industry in Bangladesh.

Expected Outputs

- Project reports and evaluation of stakeholder understanding from Phase I project closure meeting.
- Environmental analysis of the ship recycling in Bangladesh for inclusion in the final study report.

Target group

Decision-makers at government level and the ship recycling industry.

Resources

- Scoping Study with specifications for detailed studies
- National + international consultants

Project Outcome WP1b: Environmental Impact Assessment

Activities

- Inception Workshop
- Site Visit to Chittagong including
  - ship recycling yards,
  - surrounding local environment,
- Field sampling of recycling yards and control areas, laboratory analysis.
- Discussions and information gathering with stakeholders via Inception Workshop and with representatives of:
  - the Bangladesh Ship Breakers Association
  - Ministry of Industries, Department of the Environment, Department of Explosives.
  - Academia

Issues covered

- Background Information
  - Environmental Context of ship recycling at Chittagong
  - Field Work to fill data gaps
  - Environmental impact study
- Environmental Impact Analysis
  - Policy and Legal Framework
  - Baseline environment
  - Evaluation of impacts

Outputs

- Initial findings presented at Workshop June 2016
- Project Report produced.

Executive Summary

The report “Evaluation of Environmental Impacts of Ship Recycling in Bangladesh” comprises two Parts: Part 1 describes the purpose and approach taken to assessing the environmental conditions which prevail at and around the ship recycling area at Sitakunda, Chittagong, Bangladesh in order to provide a baseline understanding of the environmental factors affecting this area. Part 2 describes in some more detail an assessment of the environmental impact of ship recycling in the form of an Environmental Impact Analysis. This is not complete, as it is not expected that this assessment would constitute a full formal Strategic Environmental Assessment, or an Environmental Impact Assessment, which would require a more detailed study. Some aspects are covered in greater depth in other elements of the SENSREC project as a whole and are outside of the scope of this report, and some data are lacking. Information gaps that need to be filled are discussed in the report. Information has nevertheless been obtained through literature survey, investigation and field work undertaken in connection with this report to establish the main features of the environmental system under examination.

Ship recycling at Sitakunda, Bangladesh, sits within a complex zone of marine coastal, urban and rural land-based environments. There are major river discharges (from the Karnaphuli, the Feni and the Sangu) into the Bay of Bengal close to the ship recycling zone and tidal influences on the shoreline. The river and other water systems, canals, streams and direct discharges of sewage from residential, commercial and industrial sources all make inputs to the Bay. Ship recycling is not therefore an isolated activity. These other inputs will have their own impact on the local environment and should be distinguished from those for which ship recycling itself is likely responsible. Reports providing a comprehensive overview of the state of the environment in this area have not been found. Topics that require further elaboration on the environmental status of the ship recycling area include: the geographical context, hydrography, sediment, marine ecology pollution impacts, designated environmental zones and environmental monitoring.

The ship recycling yards are located in the Sitakund coast, along the northern part of Chittagong district. The Dhaka-Chittagong highway (known as the Asian highway) and the railway pass through this area. The total area supports hilly streams, Sandwip channel, accreted mud flats, wet meadows, mangrove ecosystem, plain land, hills and hillocks. The upland area is used for cultivation and human settlement. The hill bottom alluvial land system extends up to the tidal alluvial land and the Sandwip Channel.

The streams from the nearby hilly region run through heavy industrial areas (such as cement, glass, steel and re-rolling, jute, textile, pharmaceutical, automobiles, that typically generate heavy metals, oil, acids, alkalis, ammonia, dyeing agents, drug disposal chemicals, detergent, antibiotics, organic and inorganic wastes, etc.) and ultimately empty into the Bay of Bengal, where the ship recycling yards are also located. Intensified agriculture runoff and domestic sewage are also of potential concern. Mangrove clearance

has been carried out (as reported from Landsat[1] imagery studies) and will have affected the ecology, including the distribution of flora and fauna in the area.

Considering all these issues, drawing a clear picture of the pollutants from ship recycling activities alone would be difficult without conducting a thorough pollutant profiling investigation, which was beyond the scope of this study. Nevertheless:

- studies have shown that while marine waters and sediments at Sitakunda are contaminated with a range of substances (pollutants including heavy metals, oil, PCBs, agro-chemicals and sewage) the parameters investigated (metals, BOD, TDS) do not appear to be greatly exceeding reference values, in some but not all studies. The reasons for this are unclear and could be due to any or all of factors relating to: low release, mixing, dispersion and sampling location and timing (to take account of the effect of seasonal weather fluctuations especially rainfall);

- the composition and quantity of pollutants from point and non-point sources (other than ship recycling), their distribution in natural systems and impacts also need to be fully studied;

- further knowledge of the effects on biota is required to be able to verify/substantiate such observations.

It has been alleged that 10 different coastal fish species have disappeared, and 21 species are under threat and occurring rarely in the Sitakunda area due to environmental damage caused by ship recycling activity[2]. This claim needs to be validated through scientific study to take account of other potential causes, such as fish take. For example, during the field visits carried out as part of this study, stake fish nets and fry catching nets were observed in the vicinity of the ships, indicating that fishing activities are an ongoing practice at subsistence level.

Some water parameters (pH, EC, TDS, Chloride, dissolved oxygen, COD, oil and grease, and NH_3) and ambient air (SPM, SO_x, NO_x and sound level) quality data are now routinely monitored by the DoE. But heavy metals, PCBs, PAH and biological samples (e.g. aquatic biodiversity) also need to be routinely monitored in a regular and consistent manner.

Studies such as modelling, comparative analysis of pollutant profiles from the range of inputs from all industries into the Bay and their transport, together with contour maps of plumes and dispersal calculations would lead to more definitive understanding of the sources of the contaminants.

From this study it has been evident that many variables for a robust understanding of the impacts of the ship recycling industry on the environment are unknown. These variables

[1]Abdullah HM, Mahboob MG, Banu MR, Seker DZ., 2013. Monitoring the drastic growth of ship breaking yards in Sitakunda: a threat to the coastal environment of Bangladesh. Environmental Monitoring and Assessment 185(5): 3839–3851.

[2]The Daily Star (2010b) Ship breaking yard pollution threatens extinction of hilsa. http://www.thedailystar.net/news-detail-132782, retrieved 23/05/2016.

include, for example, concentrations and species variations of pollutants in different sub-systems, land-use change, segregation of pollution load from other (non-ship recycling) activities, biodiversity of the area, local oceanography, water current and circulation, discharge through streams and canals etc. Further studies are therefore needed by means of a carefully designed, broader, systematic investigation of these aspects of the environment in this area.

Bangladesh has a well-developed set of environmental policies, Acts and Rules that deal with industrial pollution of water, soil and air. In recent years, a number of the ship recycling yards have invested in upgrades to their facilities. Waste treatment facilities including oil-water separator, incinerator, and sewage tanks are in the process of being established. It is hoped that an environment monitoring laboratory and a landfill site will also be established in the near future.

Recommendations are made for:

- An improved understanding of the environmental context of the ship recycling area at Sitakunda, in terms of the coastal marine and land environment, to be able to fully appreciate its potential impacts in comparison with other possible inputs from industry, recycling and distribution as well as settlements and agriculture;
- Additional study of the range and distribution of biota over time, particularly to identify useful indicator species and those of local and commercial importance, including fish, shrimp, crab, mollusc, and coastal plants (mangroves) species;
- An improved understanding of the separate contribution to environmental pollution made by other industry, agriculture etc., to be able to differentiate this from ship recycling per se, especially where the same substances maybe being released (e.g. heavy metals, oils and grease, paints);
- Further development of monitoring programmes for environmental pollution with establishment of time series measurements, helping to elucidate the causes and better assess mitigation efforts;
- A “Shipyard zone” demarcated in the coastal environment, limiting the activities within a certain area to assist in considering potential environmental impacts and regulatory mechanism;
- Development of laboratory facilities for environmental monitoring to assist in progressing these aims.

The above are needed to enable a comprehensive Environmental Impact Assessment to be produced and, as indicated in summary in the EIA produced as part of this report, assist in identifying the range of measures (beyond any already in place) that could be employed to manage any potentially polluting emissions, such as how releases to the environment from ship recycling can be reduced with the installation of further treatment plant for ship recycling (such as oil-water separators, incinerator, hazardous waste treatment plant (TSDF), including engineered landfill sites for treated materials).

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Additional Highlights

Context

There are major river discharges (from the Meghna, Muhuri, Karnaphuli and the Sangu) into the Bay of Bengal close to the ship recycling zone and tidal influences on the shoreline. Seven streams flow from the nearby upland areas, associated with rural settlement, intensified agriculture and heavy industrial zones of the Sitakunda, which empty into the coastal water within and around the ship recycling yards. The river and streams carrying untreated sewage, industrial effluents, and agro-chemical residues all make inputs to the coastal water. However, information on the transport, mixing, dispersal and redistribution of pollutants in the area are unknown.

Changes in biota

Compared to 1989, a substantial increase of cleared (open) beach is noted due to increase of the footprint of ship recycling yards that ultimately resulted in the decline of coastal agricultural and mangrove forest areas. There has been a reduction from some 76 species of fish in the Karnaphuli River in 1976 to 54 in 2010, attributed to pollution, according to recent reports of research undertaken by Chittagong University. This apparent negative effect on fish diversity might also result from a number of factors including pollution caused by ship recycling, other potential sources of pollution at Sitakunda, or possibly over fishing such as excessive landing of juveniles.

Field work to fill data gaps

Field studies and laboratory analyses have been conducted to the extent possible to supplement the available information concerning the conditions in marine wasters and sediments around the yards. Some water parameters (pH, EC, TDS, Chloride, dissolved oxygen, COD, oil and grease, and NH_3) and ambient air (SPM, SO_x, NO_x and sound level) quality data of the active ship recycling yards are routinely monitored by the DoE.

Table 3.1: Yearly average seawater quality of ship recycling yards at Sitakunda, Chittagong (source: DoE)

Year	Yearly average							
	pH	EC (µS/cm)	TDS (mg/l)	Chloride (mg/l)	DO (mg/l)	COD (mg/l)	Oil & grease (mg/l)	NH_3 (mg/l)
2016	7.78	24830	12431	9064	5.7	366	5.5	0.19
2015	7.76	21792	10893	8608	5.6	341	5.7	0.19
2014	7.66	20597	10295	7782	5.4	318	5.6	0.20
2013	7.70	15912	7966	5755	5.4	258	5.2	0.18
2012	7.88	20715	10691	8145	5.3	341	6.1	0.27

Environmental Impact Analysis

Scope and limitations

Some of the yards have remained inactive for several years and at the same time critical coastal habitat (i.e. mangrove ecosystem) is being encroached on to establish new yards. Differentiation of pollutants from different sources i.e. industries, agriculture, domestic is also difficult. Ship recycling could be a minor component of environmental pollution in the area and the other sources indicated could be more significant, requiring attention to them to protect the environment.

Baseline environment

As described ship recycling is not an isolated activity in the area. The use of land for industrial purposes includes cement factory, container depots, re-rolling mills, and jute and textile mills.

Water quality

Studies have investigated metals in the seawater of the ship recycling area, extending from Bhatiary to Kumira. The results suggested that levels of heavy metals (mg/L) such as Cd (0.024–0.037) and Pb (0.01–0.35) in the water are within standard limits (with reference to USEPA water quality guidelines), but Hg level (0.82–2.44) is elevated compared to the standard (<0.01).

Sediment quality

Data on sediments at ship recycling yards shows, while there is some variation, mercury (Hg) is within the standard limit but the levels of Cd and Pb are higher. Their levels in sediment are not so significant in the ship recycling area as to be considered polluted in comparison with USEPA sediment quality guidelines.

In general, the data indicate that the coastal environment of Sitakunda, Chittagong receives a number of different pollutants, potentially from differing sources, one of which, ship recycling, is likely to be making a contribution. In particular, pollutants such as heavy metals are found in sediment to levels higher than in ambient water.

Surface and ground water quality

There are no data that correlate groundwater pollution with ship recycling activity, or that demonstrate that ship recycling is a source of groundwater pollution. The presence of heavy metals in the groundwater of ship recycling area of Sitakunda is largely unexplored. A recent study suggests that groundwater is highly polluted by Fe, Pb and Hg, moderately by Mn and Al, and slightly by As when compared with WHO and Bangladesh domestic standards for water quality. Further investigation is suggested.

Air Quality and noise levels

There is limited information on air quality indicators such as suspended particulate matter (SPM), sulphur oxide (SOx), nitrogen oxide (NOx), including metals and sound level in the

area within and around Sitakunda. However, it is likely that the ambient air of ship recycling yards may be affected by heavy metals due to torch cutting of scrap metal.

Potential Impacts

Potential impacts have been described: - of asbestos and asbestos-containing material; of Poly-Chlorinated Biphenyls; of E-Waste; and of paint chips on air quality, the water environment and on the biological environment, as well as of noise. Proposed mitigation measures have been outlined for some issues, other measures are covered in other work packages (e.g. health and safety).

Monitoring requirements

Monitoring of environmental performance during ship recycling is vital to ensure continued compliance with environmental management and mitigation plans, as well as to demonstrate compliance with pollution control standards. Therefore, ship recycling yards must maintain the necessary skilled and trained manpower, tools and equipment in order to undertake monitoring programs capable of satisfying the appropriate monitoring standards. The monitoring of 'Environmental Quality Key Indicators' will have to be carried out by the yards on a regular basis and be recorded for inspection and evaluation.

Conclusions and Recommendations

To improve understanding of the environmental context of the ship recycling area at Sitakunda, in terms of the coastal, marine and land environment needs a carefully designed, broader systematic study with development of monitoring programmes and time series measurements to help to elucidate the causes and better assess mitigation efforts.

From this study it has been evident that many variables for a robust understanding of the impacts of the ship recycling industry on the environment are unknown. These variables include, for example, concentrations and species variations of pollutants in different sub-systems, land-use change, segregation of pollution load from other (non-ship recycling) activities, biodiversity of the area, local oceanography, water current and circulation, discharge through streams and canals etc.

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Work Package 2a
Planning the Management of Hazardous Materials:
Hazardous Waste Assessment Report

Introduction

The objective of this Work Package is to do the preparatory work for the establishment of the means for the management of hazardous materials from ships and other local industries in line with the requirements of the Hong Kong and Basel Conventions. This was carried out as two distinct units of work. The first (WP2a) comprised studies on the types and estimates of the quantities of hazardous materials generated and the second (WP2b) provided an initial infrastructure design. The work package addresses the development of downstream hazardous waste management capacity in the Chittagong region as a whole. WP2a consists of the Baseline, Methodology and Inventory studies, as outlined in this Section.

Project Document Summary WP2a: "Plan the management of hazardous materials"

Objective - Logical Framework Matrix

- Practical ways of meeting the requirements for the different identified waste streams were to be evaluated.
- Information to be used by the ship recycling industry and the Administration to decide how to proceed, understanding the facts and the costs associated with different management options.

Expected Outcome

- Assessment of the prevailing conditions and needs for environmentally sound hazardous waste management.

Expected Output

- A comprehensive hazardous waste assessment report consistent with requirements of the Basel Convention and the Hong Kong Convention.

Target group

Decision-makers at government level and ship recycling industry.

Resources

- National and International consultants.
- Delivered through a Basel, Rotterdam and Stockholm Conventions' resourced complementary programme,
- Cooperation with Norad, UNIDO and IMO.

Project Outcome WP2a: "Plan the management of hazardous materials"

Activities

- Appoint consultancy company
- Prepare baseline methodology
- Hold stakeholder sensitization meetings
- Inventory data collection
- Hazwaste Assessment report
- Hazwaste Assessment Workshop

Issues Covered

- Baseline analyses
- Inventory scope, waste definitions
- Inventory methodology, exclusions
- Results-estimated hazardous waste from:
  - Chittagong ship recycling
  - Chittagong industry

Output

- Report 1: Hazardous Waste Assessment Report: Baseline, Methodology and Inventory.

Executive Summary

The SENSREC project is designed to enhance the development of safe and environmentally sound ship recycling in Bangladesh, with the aim of improving the standards and therefore the sustainability of the industry. Work Package 2 addresses the development of downstream hazardous waste management capacity in the Chittagong region. With this aim in mind, an inventory of hazardous waste has been conducted in the ship recycling industry and in neighbouring industrial areas of the city.

The report of WP2a is entitled “Hazardous Waste Assessment Report – Baseline Methodology and Inventory” and presents the results of this inventory, following which, design options and costings for hazardous waste management infrastructure are developed in WP2b, along with business cases to assist government and industry to establish the requisite infrastructure.

Methodology

The scope of this project encompasses two industrial perimeters: the ship recycling facilities and the other industrial sectors in Chittagong, both of which strongly differ in their evolution and dynamics as regards to their administration, regulation and economics. Therefore, two different approaches were adopted for inventorization and estimation of the hazardous wastes from both the ship recycling facilities and for the industrial areas, respectively.

Data on ship recycling activity in Chittagong was provided by BSBA. The inventory of hazardous wastes from the ship recycling industry was derived on the basis of benchmarks from other ship recycling countries, but mainly from India. Indian waste generation factors from ships were used in combination with the average ship recycling activity that took place in Bangladesh between 2009 and 2015. The Indian waste generation factors were slightly modified to account for the certain waste types that are being reused and not disposed of in Chittagong.

In addition, the inventory of hazardous waste was compiled for the respective industrial sectors in Chittagong - which was based on the methodology presented in the Secretariat of the Basel Convention’s Guidelines. This inventory corresponds to a *first generation inventory* as defined by the Guideline, *i.e.* an inventory being undertaken in a setting where policies pertaining to management and regulation of hazardous wastes are in early stage of development.

The sectors were selected based on their pollution category assigned by the Department of Environment, as well as inputs collected during Stakeholder Consultation Workshops in August 2015. Data on hazardous wastes were collected from representative industries selected from the significant industrial sectors.

To ensure representativeness of the samples, the number of industries of a given sector surveyed represented at least 10% of the total number of industries of the sector in Chittagong’s industrial areas.

Data on hazardous waste were collected through a questionnaire from the surveyed industries. In cases of missing or unreliable data, benchmarks available in the literature were used for the waste calculations. Finally, the data were extrapolated to the whole of the industrial area based on the total capacity installed by the respective sector in the study area (City of Chittagong and the surrounding industrial clusters in the adjoining peri-urban areas).

The following industrial sectors were focused on:

• Textile • Tannery • Fertilizer • Paper Mill • Chemical, Pharmaceutical and Pesticide • Paint and Varnishes	• Petroleum Refinery • Cement Industry • Rerolling mill (Auto) • Cable industry • Glass industry • Healthcare institution • Chittagong Port

Medical waste generation was computed based on the total number of beds available in various healthcare institutions of the city. In addition, available information was collected from the Chittagong Port Authority on the amount of medical waste generated from ships. After completion of the inventorization process, some verification activities were conducted. These included: on-site visits to key industries to understand the nature of their wastes and the corresponding hazardous waste compositions, chemical analyses of selected waste samples, evaluation of the reported use of the certain waste streams and determining whether those were to be disposed of, or whether they have any gainful use (*e.g.* in another industry) based on the current practices of management and general criteria of such wastes.

To ensure that the inventory results could be used for the planning of hazardous waste management infrastructure, the resulting hazardous waste categories were then classified between landfillable wastes and incinerable wastes.

Inventory of Wastes Generated by Ship Recycling Yards

The table below presents the results of the inventorization of wastes generated by the ship recycling yards in Chittagong:

Table 1: Estimates of hazardous waste quantities generated from the Chittagong ship recycling yards (MT/year)

Type of hazardous waste	**Total (min-max)**
Landfillable waste (both toxic and inert)	7’500-10’300
Incinerable waste	5’400-6’400
Bilge water	5’600-6’300
TOTAL	**18’500-23’000**

Landfillable hazardous wastes consist of asbestos and asbestos containing materials (2’100-2’800 MT/year), glass wool (1’300-1'700 MT/year) and other landfillable wastes including

rusted iron scales, ceramic, incinerator ash, *etc.* (4'100-5'800 MT/year). These results show the range of hazardous wastes likely to be generated in current conditions in the Chittagong ship recycling industry.

It should be noted that the hazardous wastes generation from the ship recycling yards depends on two factors: the number of ships recycled in the country and the quantity of hazardous waste contained in a ship. Both factors fluctuate considerably. The average of the recycling activity was computed for the years 2009-2015 to reflect the fluctuation in number of recycled ships. The fluctuation of the quantity of hazardous waste contained in the recycled ships was reflected by using low and high estimate waste factors.

In addition, both of the factors mentioned above may evolve differently in the future. The implications of the Hong Kong Convention and the EU Regulation on the ship recycling sector in Chittagong in general, and more particularly on the number of ships arriving for recycling in future in Bangladesh, is unclear.

Inventory of Wastes Generated by Industries

In the industrial areas, landfillable wastes primarily consist of sludges from effluent treatment plants that are not suitable for incineration. Incinerable wastes include contaminated packaging materials, contaminated plastics and contaminated solid wastes, as well as toxic sludges generated by effluent treatment plants in individual industries or clusters. These wastes contain significant amounts of chemicals, solvents, cleaning agents and heavy metals.

The major hazardous waste generating sectors are:

- the iron and steel industry (re-rolling mills): tundish lining, APC dust
- the textile industry: contaminated packaging and contaminated ETP sludge
- the fertilizer industry: contaminated solid waste
- refineries: oily crude tank sediments
- the chemical industry: contaminated solid waste, contaminated ETP sludge
- tanneries: contaminated solid waste, contaminated ETP sludge
- healthcare institutions - medical waste.

The verification process conducted after completion of the inventory led to a more exact interpretation of the hazardous nature of the waste reported and allocation to the most suitable treatment option. In some cases, it turned out that some waste streams were in fact not hazardous, or that they were currently used in another industry. Such waste streams were excluded from the hazardous waste management options.

Table 2, as shown below, details the results of inventorization of wastes generated by the industries in Chittagong (this table is depicted as Table 17 in section 7.2 of the detailed report).

Table 2: Estimates of hazardous wastes generated by industries in the Chittagong area, excluding ship recycling – estimates by waste type and treatment technology

Waste type	Total generation (MT/year)	Incineration (MT/year)	Toxic waste landfill (MT/year)	Inert landfill (MT/year)	Alternate gainful use / MSW landfill (MT/year)
Tundish lining	25'192				25'192
ETP sludge	19'165	3'443	324		15'397
APC Dust	11'131				11'131
Contaminated solid waste	3'965	3'965			
Contaminated packaging	3'626	3'626			
Oily crude tank sediments	1'459	1'459			
Contaminated plastic waste	1'282	707			575
Bleaching earth	910				910
Spent Lubricants	251	251			
Flesh	222				222
Maintenance scrap	124	124			
Oil and grease	89	89			
Chemical residues	88	88			
Trimming dust	72				72
Raw hides cutting	66				66
Shaving dust	54				54
Asbestos	40			40	
Other contaminated materials	25	24		1	
Glass wool and insulation material	8			8	
Total	**67'768**	**13'777**	**324**	**49**	**53'619**
Episodic and aperiodic waste	678	138	3	0	536
Grand total (Rounded–off)	**68'500**	**14'000**	**400**		**54'100**

In addition to the results shown, biomedical waste generation from the hospital and health sector is estimated at 800 MT/year.

Conclusion

This assessment provides a useful picture of the hazardous waste situation of the ship recycling industry and surrounding industrial areas of Chittagong, which can serve as a basis for the next steps of the project, namely the planning of hazardous waste treatment and disposal infrastructure. Table 3 below shows the results of the inventorization of wastes generated by the ship recycling yards and the considered industrial areas in Chittagong (this table is depicted as Table 20 in section 8 of the detailed report).

It is important to note that this picture can evolve very fast depending on the arrival/growth/departure of big industrial players as well as changing production processes and input materials. In addition, in the absence of a legally enforced waste reporting system, the extent to which data is collected strongly depends on the willingness of the relevant stakeholders to share data.

Table 3:
Approximate estimates of hazardous waste quantities generated from the Chittagong ship recycling yards and from the Chittagong industrial areas (MT/year)

Type of hazardous waste	From the ship recycling yards (min-max)	From the industrial area	Medical waste	Total (min-max)
Landfillable waste (both toxic and inert)	7'500-10'300	400[#]	-	**7'900-10'700**
Incinerable waste	5'400-6'400	14'000[#]	800	**20'200-21'200**
Bilge water	5'600-6'300	-	-	**5'600-6'300**
TOTAL	**18'500-23'000**	**14'400[#]**	**800**	**33'700-38'200**

#Refer to Table 2 for further break-down of these wastes

The quality of the data also depends on the respondents' understanding of the hazardous nature of their wastes. Thus, the importance of developing local competencies and know-how on hazardous waste identification and treatment will continue to grow in the future years. The final responsibility is for the future facility operator to capture the waste streams adapted to each landfill cell or incineration system.

An understanding of waste composition and its hazardous substance content requires specific knowledge of each industrial process and/or laboratory analysis. For this reason, it is important that an appropriate Treatment, Storage and Disposal Facility is developed to afford the opportunity for generators to follow best practices and develop specific skills.

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Additional Highlights

Analysis was carried out by questionnaire for Chittagong industrial waste generation and calculating hazardous waste arisings by benchmarking against similar activities in India and comparison with data and experience in Turkish ship recycling yards. Key Findings are found in (the brief) section 8 of the report:

Legacy waste sites are not included in this analysis. However when the time comes, these sites should also be remediated, which will increase the quantity of materials to be disposed of at a TSDF.

The lack of suitable hazardous waste management facilities (at Chittagong) is confirmed and most existing practices are causing environmental hazards.

Through a first generation inventory, estimates of the overall hazardous waste streams in Chittagong have now been made available. Based on this estimate, the suitable waste infrastructure needed to fill the existing gaps can be planned and designed, together with an adapted business model and operating scheme.

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Work Package 2b

Planning the Management of Hazardous Materials:

Common Hazardous Waste Treatment, Storage & Disposal Facility

Introduction

The first part of WP2, on Hazardous Waste Assessment, has been described in the previous section. The objective of the second part of WP2 is to establish means for the management of hazardous materials from ships that meet the requirements of the Hong Kong and Basel Conventions. This part of the work, on initial infrastructure design, addresses the development of downstream hazardous waste management capacity in the Chittagong region. WP2b is therefore the design element that will form the basis for more detailed work to be undertaken in Phase II. This is accompanied by a Business Case.

Project Document Summary WP2b: "Plan the management of hazardous materials"

Objective - Logical Framework Matrix

- Initiate infrastructure design including design option, preliminary design and site selection.
  Practical ways of meeting the requirements for the different identified waste streams will be evaluated.

Expected Outcome

- An initial infrastructure design - with option selection, preliminary design and site selection for detailed planning and design to be carried out in Phase II of the project, identifying funding partners for design and build.

Expected Outputs

- Comprehensive report consistent with requirements of Basel Convention and Hong Kong Convention;
- preliminary design, costing and site selection achieved.

Target group

Decision-makers at government level and ship recycling industry.

Resources

- National and International consultants.
- Delivered through a Basel, Rotterdam and Stockholm Conventions' resourced complementary programme,
- Cooperation with Norad, UNIDO and IMO.

Project Outcome WP2b: "Plan the management of hazardous materials"

Activities

Report production

- Research
- Develop technical data and assumptions
- Compile report
- Obtain critical review comments

Issues Covered

- Recap inventory hazardous waste from WP2a
- Methodology for waste projection
- Tentative design for TSDF
- Site Layout process scheme,
- Capital costing
- Uncertainties
- Critical questions to be addressed
- Technical assumptions and details

Outputs

Report 2: *Common Hazardous Waste Treatment, Storage & Disposal Facility: Design Options for the Environmentally Sound Management of Hazardous Waste in Chittagong, Bangladesh*

Report 3: *Business case for the development of hazardous waste management infrastructure*

Summary

The work conducted under WP2b is described in two reports: Report No 2 on initial infrastructure design and Report No 3 on a business case for the development of hazardous waste management infrastructure.

Summary Report No 2
The results of the work under WP2b, on initial infrastructure design, are described in the report entitled “Common Hazardous Waste Treatment, Storage & Disposal Facility: Design Options for Environmentally Sound Management of Hazardous Waste in Chittagong, Bangladesh”.

The inventory of hazardous wastes generated from the ship recycling industry in Chittagong and from the surrounding industrial areas was developed through a survey under Work Package 2a of the SENSREC Project. Tables 1 and 2 from the “Hazardous Waste Assessment Report” (see Report No 1, described in Work Package 2a above) provide estimates of hazardous wastes generated by the ship recycling industry and by other industries in the Chittagong region, respectively.

It is evident from the inventory assessment that the ship recycling sector has been producing sizable quantities of landfillable and incinerable wastes. However, the industrial sectors cumulatively generate nearly negligible landfillable wastes, but generate comparatively large quantities of incinerable wastes.

The data concerning ships recycled in Chittagong over the past seven years was studied and the opinions of experts helped formulate the underlying assumptions for the growth rate of the ship recycling industry. In that light it was concluded that the ship recycling sector in Chittagong could grow at a rate of 4% in the near future. Also, in the light of expert opinion, an average annual growth rate of 6% was assumed for industry in the coming decade.

Availability of a reliable "Common Hazardous Waste Treatment, Storage & Disposal Facility (CHW-TSDF)" is an important requirement for the effective management of hazardous wastes. As with common effluent treatment plants (CETPs), where government and industry associations/companies participate in operation and maintenance, the operator of the CHW-TSDF facility can be a government agency, quasi-governmental agency, an industry association, a joint venture or a private sector company. Hazardous waste treatment is an expensive process that demands specialized supervision and instrumentation.

The design basis for the proposed TSDF is reproduced here below as Table 1 (taken from Table 5 of Report 2).

Table 1: Tentative "Design Basis" for the proposed TSDF in Chittagong

Sr No.	Disposal Method	Estimated Inventory		Tentative Design Basis		
		From the ship breaking yards (MT/year)	From the industrial areas (MT/year)	From ship breaking yards 10-yr lifetime capacity @ 4% growth rate (MT)	From industries 10-yr lifetime capacity @ 6% growth rate (MT)	Total Waste 10-yr lifetime capacity (MT)
1	**Incinerable** Wastes	5,900	14,000	71,000	184,500	**255,500**
2	**Toxic & Inert** Landfillable Wastes	8,900	400	107,000	5,300	**112,300**
3	Bilge water + Scrubber Effluents + Landfill Leachates + Sewage?	100 m^3/day	75 m^3/day	0.45 million m^3	0.35 million m^3	**0.80 million m^3**

If sufficient funds are not readily available to construct a facility to manage the ship recycling wastes and also those of all other industries in the area of Chittagong, it is proposed that the development of the CHW-TSDF can be implemented by adopting actions and expenditure in two stages. In “Stage 1”, a facility could be constructed with landfill for the total inventory and with an incinerator of sufficient capacity only for the ship recycling industry, with a proportionate wastewater treatment facility. Thereafter, in “Stage 2” when funds are available, an additional incinerator would be added that would take care of the incinerable wastes from industries other than ship recycling. Thus, the TSDF shall serve as the common centralized facility for providing environmental utility services, initially to the ship recycling yards in Chittagong and thereafter to other industries around Chittagong, for disposing of the hazardous wastes in a safe and environmentally sound manner.

Of the land required for creating a TSDF for management and disposal of hazardous wastes, a substantial footprint will be required to provide for several essential services at the TSDF site. It is estimated that, for a design life of 10 years, a plan area of about 20 acres (8 hectare footprint) would be needed for the proposed CHW-TSDF in Chittagong. (Further consideration as to the projected lifespan of the facility is given in the section on Work Package 5b).

It is recommended that the Government of Bangladesh should provide free land and infrastructure such as: water-supply, disposal pipeline for treated wastewater, power supply, approach roads and compound wall to prevent unauthorised access.

The TSDF, for both stages of the development, will cost approximately USD 11.5 million (i.e. USD 6 million for Stage 1 and USD 5.5 million for Stage 2) - excluding the cost for land, utilities and project management (Table 6 of Report 2 is reproduced below as Table 2). The CHW-TSDF could be built over 18 to 24 months by a dedicated team created by the Government of Bangladesh.

Table 2: Breakdown of land and capex requirements for the proposed TSDF in Chittagong for the two stages of development

Stage 1

Sr No	Waste to be treated and disposed of	Land Needed for landfill cells plus approach road and working space adjoining it (plan area) hectare i.e. ha	Land Needed for landfill cells plus approach road and working space adjoining it (plan area) acre	Funds Needed in 2016 million USD
1	Landfillable Wastes	1.40	3.46	2.50
2	Incinerable Wastes (Stage 1)	1.50	3.71	1.90
3	Bilge water + Scrubber Effluents + Landfill Leachates + Sewage?	1.00	2.47	0.22
4	Civil Work, storage and blending sheds, site development, infrastructure, chemical laboratory (modest), firefighting facility, green belt, etc.	3.90	9.64	1.18
	TOTAL =	**7.80**	**19.28**	**5.80**
		Hectare	**Acre**	**million USD**

Stage 2

5	Incinerable Wastes (Stage 2)	Nil	Nil	4.92
6	Remodel and augment the existing ETP to treat scrubber effluents from the new incinerator	Nil	Nil	0.28
7	Additional Civil Work, storage and blending sheds for the new incinerator	Nil	Nil	0.37
	TOTAL =	**Nil**	**Nil**	**5.57**
		Hectare	**Acre**	**million USD**

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Summary Report No 3

The results of the work under WP2b, concerning a business case, are contained in the report “Business case for the development of hazardous waste management infrastructure”.

The report describes the drivers for a TSDF- a strong legislative and compliance framework, sufficient volumes of hazardous wastes and cost recovery opportunities for the operator. Key parameters discussed outline the main cost overheads and revenue sources for setting up and operating a TSDF. Ownership and financial models are enumerated.

Case studies from experience in India (that now has some 38 TSDFs since 2002) for comparison with a potential TSDF at Chittagong were based on:

1. Taloja (Near Mumbai)
2. Alang
3. Haldia (West Bengal)
4. Dabbasapete (Bangalore)

The business case for Bangladesh utilizing the design parameters from Report No2 (summarised above) examines the legislative framework in Bangladesh for hazardous waste control, sustainable development, the 3Rs (reduce, reuse, recycle) and financing models. To encourage private sector participation, Technical Assistance Fund, Viability Gap Funding and Infrastructure Financing mechanisms are discussed and the appropriate Bangladeshi implementing specialized financial institutions are described. Potential access to Bangladesh Government incentives and subsidies such as tax-holidays for socially/ environmentally relevant infrastructure projects is indicated.

A scenario analysis using a simplified business model calculator enabled a number of permutations to be run based on variables including: estimated capital costs, estimated operational costs, inflation and foreign exchange rates, demand for the facility’s services, financing cost, interest rate/cost of capital, repayment period, debt-equity ratio, tipping fees’ debt-service-coverage-ratio, and Internal Rate of Return.

The results showed that starting only with 20% of the estimated volume of waste input and going only up to 50% in 10 years, the business case is still viable by adapting other variables such as lower interest rates, a longer repayment period and lower debt levels and moderate tipping fees. With a crucial aspect of the commercial viability being the capacity utilization of the TSDF, the modeling estimates show that there is scope for increasing the lifetime of the facility, or reducing its size and investment cost.

Potential donors and funding sources are listed. Recommendations are made for the organizational structure for financing the TSDF.

Conclusion

The analysis shows that the demand for hazardous waste disposal services exists, not only from ship recycling but also from other industrial activities. However, to make it a

commercially viable and bankable business, several important framework conditions are necessary:

- the first, and potentially most important one is to strengthen legislative frameworks that give regulators better tools to monitor and enforce compliance, such as reporting requirements for wastes generated and disposal pathways – which requires the corresponding field control resources, permitting and licensing requirements, etc. linked to membership of a TSDF, and a legal basis for TSDF operators to charge for tipping fees. While a strong legislative framework backed by robust institutions is a necessary condition for any investor, it is not sufficient on its own, unless backed by a strong judicial mechanism to provide a fallback for law and judicial oversight of contractual breaches and imposition of fines and penalties.
- a second aspect of the commercial viability is the capacity utilization of the TSDF. The current model has been based on the values from the design document (described in Report No 2 summarized above) including the capacity of the landfill and estimated lifetime of the TSDF. Given that the commercial viability is very sensitive to demand, the sizing of the facility needs to be appropriate so that it can meet the demand without incurring unnecessary costs of an idle facility.
- the third important ingredient is the close collaboration of a wide-range of stakeholders from government agencies, private sector, international development agencies and multilateral financial institutions, for example through the implementation of PPP, that allows a leveraging of both private and public sources of financing.

The report is accompanied by a spreadsheet-based model that includes all of the calculation parameters mentioned in the report.

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Work Package 3
Refinement of a Government One-Stop Service

Introduction

The objective of this work package is to support the development of the Government One-Stop Service (GOSS), as already articulated by the Government of Bangladesh, not to develop a new concept. The purpose of the GOSS is to provide the Government with a focused and knowledgeable service, able to implement improved safety and environmental standards in the yards in a cost-effective and a socio-economically appropriate way, with relevant ministries represented, consistent with the Single Contact Point referred to in the Hong Kong Convention. The Annexes of the Project Document for Phase I elaborated key attributes of this Work Package.

Project Document Summary WP3: Government One-Stop Service

Objective - Logical Framework Matrix

Focused and knowledgeable service that will be able to implement improved safety and environmental standards in the yards in a cost effective and in a socio-economically appropriate way.

Expected Outcome

Fit for purpose Bangladesh Ship Recycling Board (BSRB).

Expected Output

Report with summary conclusions and recommendations for refinement of fit for purpose BSRB.

Target group

Decision-makers at government level.

Resources

- Consultancy team
- Field visit to Turkey organised-representatives from: GoB Ministries, BSBA, IMO, consultants.

Project Outcome WP3: Government One-Stop Service

Activities

- Visit to Turkey to learn from their experience and success – e.g. streamlining processes for government approvals.
- Discussions with representatives of:
  - the Bangladesh Ship Breaking Association;
  - the Ministry of Industries; and
  - other departments involved in ship recycling.

Issues covered

- Land Lease period:
- Obtaining permission to establish a ship recycling yard;
- Obtaining permission to recycle a ship;
- Permission for cutting;
- Composition of Bangladesh Ship Recycling Board under Ship Recycling Act 2015.

Output

- Report issued with recommendations agreed and implemented or under consideration.

Summary

Description of Legislation and Policy Development

Under Work Package 3, the SENSREC project aims to assist the development of a Government One-Stop Service for a more effective enforcement of national regulatory requirements. As elaborated in the report entitled “Refinement of a Government One-Stop Service”, the concept envisages cooperation between the Ministry of Industries and other competent government departments of Bangladesh, such as the National Board of Revenue, the Department of Environment, Department of Fire and Explosives, Department of Inspection for Factories and Establishments, Department of Shipping, etc.

At present, “The Ship Breaking and Recycling Rules 2011” are the rules in effect in Bangladesh for ship recycling activities. In addition to The Ship Breaking and Recycling Rules 2011, the Environmental Law, 1995 (amended in 2010), various Explosives Acts and Rules and the Labour Law are also applicable to the ship recycling industry.

The Ship Breaking and Recycling Rules 2011 established a Ship Building and Ship Recycling Board (SBSRB), which will provide a One-Stop Service for ship recyclers. Additionally, the SBSRB will also carry out certain activities and responsibilities under the Ministry of Industries, Government of Bangladesh. The SBSRB is yet to be formed, as of October 2016, but, as discussed below, note that the SBSRB was recently renamed as: Bangladesh Ship Recycling Board (BSRB).

According to the Ship Breaking and Recycling Rules 2011, once the ship is anchored, the ship recycler has to submit applications to the SBSRB so that members of the SBSRB can board the anchored ship. These members are officials delegated from the following agencies:

i. National Board of Revenue (NBR);
ii. Department of Explosives;
iii. Department of Environment;
iv. The SBSRB (technical personnel)

In July 2015, the Cabinet of Bangladesh cleared the draft of the “Bangladesh Ship Re-cycling Act 2015”. The draft Act proposed the following:

- The establishment of special ship recycling zones to enhance monitoring and to minimize environmental hazards;
- The formation of a Ship Recycling Board (BSRB) for better regulation of the industry;
- The making of a provision of punishment for violating the Ship Recycling Act 2015.

In the draft Bangladesh Ship Recycling Act (now renamed the Bangladesh Ship Recycling Act 2016) the Bangladesh Ship Recycling Board (BSRB) will be a legal entity under the Ministry of Industries (MoI) of the Government of Bangladesh. The Government will select the location of the Head Office of the BSRB. The BSRB may establish branch office/offices

at any location in Bangladesh with the permission of the Government. The BSRB will consist of 7 (seven) members from relevant ministries or organizations appointed by the Government. The BSRB will also consist of 3 (three) more members or representatives from the approved Trade Body related to the ship breaking and recycling activities of Bangladesh.

The functions of the BSRB will be:

- overall supervision of ship recycling;
- to obtain necessary permissions from concerned authorities for the establishment of new ship recycling yard on behalf of the ship recycler;
- overall supervision, issuing of No Objection Certificates (NOC), anchoring and recycling activities;
- to approve Ship Recycling Facility Plans;
- to manage hazardous materials and ensure their proper storage;
- wherever necessary, to cooperate with the relevant ministry/organization for health and safety of the workers as per the existing rules and regulations;
- to cooperate with the relevant ministry/organization for environment-friendly ship recycling as per the existing rules and regulations;
- to ensure international standards for ship recycling;
- to communicate with national and international organizations, research organizations and universities for the improvement of ship recycling.

Programme Activities to support the refinement of the GOSS

The following activities were carried out under this Work Package: a delegation visited Turkey to learn from Turkey's experience and successes (e.g. in solving the problem of competing jurisdictions); meetings and discussions were held with representatives of the Bangladesh Ship Breakers Association, with the Ministry of Industries and with other departments involved in ship recycling activities in Bangladesh. Topics covered by these meetings included:

A) Land Lease period:

Obtaining land by the ship recycler to be used as ship recycling yard- to consider extending land leases from one to five years,

Outcome: this was agreed to be reviewed by the MoI who would have no objection if the leasing provisions allow it.

B) Obtaining permission to establish a ship recycling yard:

Currently, the following requirements must be met. The ship recycler has to:

a. build the entire infrastructure for ship recycling on the yard;

b. obtain an IRC (import license), issued by the Board of Investment (BoI);

c. obtain, for each ship to be imported for recycling, a Value Added Tax (VAT) registration certificate from the Department of Customs, Excise and VAT;

d. obtain an Environmental Clearance licence from DoE;

e. obtain, under the "The Ship Breaking and Recycling Rules -2011", a licence from MoI. However, at present, MoI does not issue this licence;

f. obtain membership from the approved Trade Body related to ship breaking and recycling activities of Bangladesh.

Outcome: Common understanding of the prevailing requirements

C) Obtaining permission to recycle a ship:

I - **To obtain an NOC (No Objection Certificate):**

- Memorandum of Agreement has to be signed between the ship recycler and the owner of the ship by which the ship will be sold to the recycler;
- NOC fees to be paid;
- the yard Environment Clearance Certificate to be approved by the Department of Environment (DoE);
- Letter of agreement to pay various government fees;
- Declaration regarding hazardous materials.

II - Outer anchorage inspection:

a) inspection fees paid;
b) copy Letter of Credit provided.

III - Official visits at anchorage by:

a) Customs;
b) Bangladesh Navy ;
c) Department of Explosives (anchorage and beach);
d) DoE plus representatives from Chittagong University, Chittagong Dry Dock Limited and Marine Academy;
e) DoE visit at anchorage and beach.

Outcome: Under III, the Department of Explosives rules are under review, MoI is considering limiting some visits at anchorage.

III - Beaching Permission

Documents to be submitted to MoI:

a) Report of the ship inspection by the DOE and Chittagong Dry Dock Limited at the outer anchorage area;
b) Beaching fee paid;
c) Report of the ship inspection by the Department of Explosives at the outer anchorage area, regarding safe for hot work and safe for man entry;
d) Rummage Clearance Certificate;
e) Membership certificate from Trade Body related to ship breaking and recycling activities of Bangladesh.

Recommendation: The consultant discussed this issue with MoI and it is understood that the processes will be simplified after the Bangladesh Ship Recycling Act 2016 is enacted and the BSRB is established.

IV To obtain permission for cutting, the following documents have to be submitted to the MoI:

a) Ship Recycling Plan (SRP);
b) Yard Environment Clearance certificate (DoE);
c) Ship cutting fee;
d) Department of Explosives Gas Free Test Certificate for safe for hot work and safe for man entry after beaching;
e) Workers registration (information such as age, experience and training certificates);
f) Copy of Vendor Chalan.

Recommendation: The consultant proposed that permission from MoI should be sufficient, as the DoE does not have its own rules for giving permission for cutting the ship. He also proposed that the Safety Agencies, who are currently appointed by the MoI, can do the necessary work for the issuing of the permits on behalf of MoI. He proposed that this issue should be resolved after the formation of the BSRB under the Ship Recycling Act 2016. Furthermore, the Consultant proposed that Workers registration should be enforced as a mandatory requirement, in order to comply with the various international standards for ship recycling.

D) Experience gained from Turkish Ship Recyclers Association applied to Bangladesh

In Turkey, the owner of a yard seeking the issuance of a permit to operate a ship recycling facility has to be granted a ship recycling facility authorization by the Ministry of Transport Maritime Affairs and Communications, Government of Turkey (MoTMAC) and a ship recycling permit by Ministry of Environment and Urbanization, Government of Turkey (MoEU), both of which are valid for one year unless in the meantime the owner or the legal entity changes.

There are three permits, all of which are issued by the Harbour Master of Aliaga, who does this on behalf of the MoTMAC. The first is a permit for the landing (i.e. beaching) operation of the ship; the second is the ship recycling permit that is required for the start of the recycling process; and the third is a permit issued at a later stage for the cutting of the ship's double bottom. The first and second permits may be granted at the same time or separately depending on the conditions. Often, inspections take place after the ship has been landed.

The Bangladeshi system and the Turkish system are based on different models and therefore the process for issuing a beaching permit in Bangladesh takes around 20 days, and sometimes a whole month. On the other hand in Turkey the same process takes around 10 days.

In Turkey, the Ministry of Environment and Urbanization has issued a licence to a privately run integrated waste management facility, named Sureko, located about 130 km east of Izmir, for the disposal of various waste streams (not PCBs). The Ship Recyclers Association of Turkey (SRAT) has a commercial relationship with this waste management company. The SRTA sends all the hazardous waste to Sureko and to other similarly approved facilities

E) Composition of Bangladesh Ship Recycling Board (BSRB) under the new Ship Recycling Act 2016

The consultant considered that, in order to save time and effort, the representatives of the government ministries and agencies within the BSRB should be fully empowered to issue the necessary licenses and permits rather than being the middle tier between the applicant and the issuing authority.

Conclusion

All the processes involved for establishing a ship recycling yard and for recycling an imported ship in Bangladesh have been described and discussed with relevant Ministry officials and ship recycling representatives.

An instructive field visit to Turkey was carried out that highlighted Turkey's approach to the organization of multiple agencies dealing with ship recycling approvals.

At present, ship recycling activities are regulated by the Ship Breaking and Recycling Rules, 2011. In July 2015, the Cabinet of Bangladesh cleared the draft of the "Bangladesh Ship Recycling Act 2015". In the draft, the Bangladesh Ship Recycling Board (BSRB) will be formed under the Ministry of Industries (MoI) of the Government of Bangladesh. Until the formation of the Board, the following steps can be undertaken to enhance ship recycling activities:

- the MoI can take the initiative to reduce the number of organizations visiting the ship at the outer anchorage, for example, the Chittagong University, Bangladesh Navy and Marine Academy;
- reduction of the number of visits by the personnel of the Department of Explosives to one, at the beaching area;
- A safety agency appointed by MoI can undertake the task earlier performed by the Chittagong Dry Dock Limited;
- the Bangladesh Navy can visit the ship after beaching (to take away and destroy the communication and signaling equipment);
- cutting permission from the MoI should be sufficient if the Department of Environment does not have its own rules for giving permission for cutting the ship. Safety agencies can work on behalf of the MoI.

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Work Package 4
Development of Training for
Health Safety and Environmental Compliance

Introduction

The objective of this work package is based on the recognition that during Phase I of the project, training on occupational health, safety and the environment will become necessary to assist the implementation of requirements that have been imposed on the ship recycling industry by decisions of the honourable High Court. The ship recycling industry, through the BSBA, has been implementing training materials developed by ILO (through the SAFEREC project). Also some generic courses have been developed by s training provider, which needed to be reviewed and extended as necessary to fully address the requirements of the High Court and of the industry. The Annexes of the Project Document for Phase I elaborated key attributes of this Work Package.

Project Document Summary WP4: "Training for Health Safety and Environmental Compliance"

Objective - Logical Framework Matrix:

A review of the current curriculum and modules required, proposals for further development described.

Expected Outcome

- Improved training modules on occupational health, safety and the environment to assist the implementation of requirements on the ship recycling industry by decisions of the Honourable High Court.
- Initial (pilot/ training of trainers) training to be delivered.

Expected Output

Updated and improved training packages and delivery of training activities to be finalized during Phase II of the project to fully address the requirements of the Hong Kong Convention.

Target group:

Ship recycling industry and workers in ship recycling yards.
Decision-makers at government level.

Resources:

Consortium teams to upgrade, extend or develop additional training modules and pilot the suite through train-the-trainer sessions to assist in refining the content, materials and delivery methods.

Project Outcome WP4: "Training for Health Safety and Environmental Compliance"

Activities

- Training method review
- Training needs assessment
- Training Priorities assessment
- Curricula development
- Training materials improvements
- Piloting Train the Trainer
- Capacity building of the trainers
- Training Strategy
- Training Videos and animations
- Assistance for development of undergraduate teaching materials

Issues covered

- All the activities listed above
- Conclusions and Recommendations

Outputs

Practical materials including :

- development of module content,
- teaching materials support including audio visual training materials,
- PowerPoint slides
- posters
- animations, etc.
- piloting a "Train The Trainers (TTT)" course in Bangladesh to create a pool of trainers for the sustainable training programme.

Summary

Organisation
A consortium of national and international partners, with relevant skills and expertise, was formed from academic institutes and industry (including ACS, BMA, BUET, UoC, WMU, Strathclyde University). Work Package 4 (WP4) was divided into two parts - WP4 Part I (Curricula, Training Strategy and Training Needs) and WP4 Part II (Strategy for Sustainable Training for the Ship Recycling Industry). WP4 Part I was led by WMU of Malmo, Sweden supported by three other international partners and three national partners. ACS Marine UK led the consortium for WP4 Part II.

Outline of the activities
The consortium members identified the following activities to fulfil the objective of WP4:

- literature review;
- worker surveys;
- interviews, meetings and group work with stakeholders (workers, ministry officials, international organization representative, employers association, etc.);
- on-site observation during the field mission in Bangladesh; visits to ship breaking yards, training institutes, and a shipbuilding yard;
- extensive data collection through national & international partners;
- secondary data collection through stakeholder interviews;
- secondary data collection to understand & evaluate the target audience;
- examining the existing training contents & training facilities;
- visiting relevant institutes to understand availability of local resources;
- compilation & examination of the past training materials/contents;
- analysis of the collected data including gap analysis;
- establish the current training needs;
- identifying the most suitable curricula for Bangladesh ship recycling training from a Bangladesh perspective;
- development of the curricula & identification of modules that may be suitable in each set of curricula;
- development of training manuals, videos, animations, safety posters and translation of key material into Bangla:
- piloting a Train The Trainers (TTT) course to develop a pool of trainers/expertise.
- preparation of a strategy for the full implementation in Phase II of the project of the training programmes and materials that were developed under WP4 in Phase I;
- development of teaching materials for BUET.

All the above tasks were undertaken in two phases over the period from September 2015 to March 2016 and from April 2016 to November 2016.

Training needs assessment:
A key task was the training needs assessment. The results of this fell into two parts: firstly an elaboration of a work system and secondly identification of the necessary elements of a suitable training system.

The work system
The following factors to be taken into account for an effective work system to operate were observed to comprise:

- *workplace and layout* - as established by the ILO, decent working conditions in any workplace is paramount for enhancing Occupational Health and Safety;
- *categories of workers* - appreciation of the various employment categories of workers must be addressed. Often, workers are employed through contractors, sub-contractors and are not connected to one particular breaking yard or occupation, therefore they might be missed out when training programmes are set up;
- *education, knowledge and literacy* - most of the workers are often poorly educated persons with limited (or no) knowledge of the risks related to the sector (finding from field survey 2015);
- *migrant workers* – the majority of the workforce is composed of migrant workers (some 60-80% as determined by the 2015 Field survey), most of whom have low literacy levels and/or language difficulties;
- *stability of the workforce* - the sector employs a large proportion of daily workers, as a means of managing fluctuations in workload. However, each yard directly employs a small number of permanent workers (often for control and team management/supervisory functions);
- *awareness of managers* - the Field mission revealed a need to enhance awareness at the management level in order to meet HSE standards;
- *risk assessment and reporting* - systematic risk assessment and accident/incident reporting are not performed; there is a need to enhance hazard identification to achieve complete risk assessment. Systematic reporting of incidents and accidents occurring during operations must be organized to understand weak areas needing additional focus; and
- *hinterland support* - environment and health protection for workers and surrounding communities requires adequate resources e.g. waste management support.

<u>The training system</u>

The elements of a suitable training system that needed to be improved and/or implemented were identified as:

- *Existing training system - gaps with international practices*. Despite the existence of a SAFEREC manual and BSBA train-the-trainer manual, formalized training is lacking in numerous areas. These gaps need to be addressed in order to reach international training standards and practices;
- *Training content* - the current training content proposed by BSBA has been self-developed. Despite the commitment of trainers, the lack of formalized training material and content details render the overall training system dependent on individual trainers' availability, resources and expertise. Consequently, harmonized and written training material need to be produced;
- *Training method* – Due to the diverse ability of the target audiences several training methods have been selected to facilitate transfer of knowledge. Visual materials such as training and demonstration videos or pictures developed for SAFEREC need to be

integrated into the training content development. Furthermore, practical demonstration and on-site exercises can improve trainees' understanding and inspire the development of better ship recycling procedures. Technical manuals and presentations in Bangla (e.g. in Microsoft PowerPoint), animations, videos and safety posters have been developed as part of piloting a TTT course.

Outcome of Training Needs Assessment (TNA)

Following the completion of the Training Needs Assessment, the consortium proposed that skilled workers and managers/regulators need to be trained, as well as unskilled workers. This led to the development of a three tier curriculum concept to support Bangladeshi needs as follows:

- Tier/Curricula 1: initial training for all workers;
- Tier/Curricula 2: additional training for skilled and special workers;
- Tier/Curricula 3: awareness training for managers/regulators.

Development of Training modules:

In order to develop the three curricula the consortium investigated pertinent national & international rules, regulations and guidelines. These included: the Hong Kong Convention, the Basel Convention, the various conventions of the International Labour Organization, and the International Maritime Organization's guidelines on ship recycling. International best practices in ship recycling industry elsewhere were also considered, especially those in Turkey.

The following topics were identified for inclusion in the modules:

- *Health and Safety training*
  The topic of 'occupational safety and health' is covered to some extent by the current training setup but the content should be improved (e.g. managing health and safety, safety culture, medical health surveillance and welfare support, long term occupational illnesses);

- *Awareness and communication of information on Hazardous Materials*
  Both workers and managers should be trained to instil the necessary awareness - on the IHM, the information it contains and how it assists in preparing a proper Ship-Recycling Plan; and on improvements in how to properly record and report handling and processing of Hazmat involved in ship recycling practices;

- *Job hazard awareness, including handling and management of Hazardous Materials*
  Both job hazard awareness and effective uses of preventive measures are partly covered in existing training; however there are further important issues that need to be addressed. Common and specific occupational hazards should be covered in the training;

- *Assessments, reviews and exposure measurements, and workers wellbeing*
  Training on these issues should be considered - to collect data and measure the risks in order to take necessary actions and informed decisions. Other issues for which more detailed training should be provided are: hygiene practices, working in

confined spaces, development of standard operating procedures and conducting investigation after accidents to identify their root causes to prevent further recurrences.

- *Personal Protective Equipment (PPE)*
  During yard visits, it was observed that most of the workers were not always wearing adequate PPE for their job tasks indicating a lack of awareness of the importance of wearing proper PPE. Specific attention should be given to selection of PPE for each task (i.e. fit for purpose);

- *Fire protection and prevention*
  This issue can be improved by providing more ship recycling-related examples and potential causes of fire and explosion in ship recycling processes. Awareness can be raised on the areas of a ship, as well as ship recycling tasks, which have a higher probability for fire and explosion;

- *Emergency response and evacuation*
  Detailed emergency response and evacuation training should be given to the workers and other staff. It is partially covered by current training, but a more comprehensive approach should be adopted, supported by case studies, to ensure effective behaviour during an emergency;

- *First-aid awareness*
  During yard visits, it was observed that some yards covered first-aid awareness but more practical demonstrations can be provided for the scenarios related to ship recycling;

- *Environmental awareness*
  There is no evidence that this issue is covered within the current training;

- *Vocational Education*
  Vocational education and training (on the job training) prior to the initial assignment of workers to ship recycling tasks, should be provided to workers and training records should be kept. It is believed this will help professionalization of the industry.

Proposed Training Modules:
The elements outlined above were grouped into eight different modules for incorporation into the curriculum as follows:

1. Ship Recycling Administration and Regulatory Framework
2. Job Hazard Awareness-Hazard and Risk (practical)
3. Awareness and Communication of Information about Hazardous Materials
4. Inventory of Hazardous Materials (IHM)
5. Personal Protective and Safety Equipment
6. Worker Wellbeing & Health
7. Environmental Awareness

8. Vocational Education and Training

Each module possesses a core which is available in the “initial training for all workers” (except core module 4 on IHM which is available in additional training for skilled and special workers). This core comprises the basic knowledge to be acquired. Around this core, additions must be made in order to meet the needs of each target group (support/operation/management levels) as well as to meet the needs of workers engaged in different activities (e.g. loaders, cutters, etc.). An example of the content of such a module is shown in Table 1 below.

Table 1: Example of a module content structure (incomplete extract):

MODULE 1
Ship Recycling Administration and Regulatory Framework

1. Module Aims and Objectives .....
   1.1 National framework and national regulations (Ministry of Industries, Department of Environment and Ministry of Labour) .....
   1.1.1 National legal framework on OSH in Ship Recycling .....
   1.1.2 Main National Laws .....
   1.1.3 Enforcement machinery for ensuring OSH in Shipbreaking in Bangladesh .....
   1.1.4 International and regional instruments addressing OSH in Shipbreaking .....
   1.1.5 Responsibilities of employer to provide training on OSH standards and PPE General Responsibilities .....
   1.1.6 OSH Relationship between employees and employers .....
   1.1.7 Consultation with and Participation of Workers for OSH management .....

Development of Curricula

The curricula were prepared on the basis of existing national and international frameworks taking into account the target audience’s knowledge, experience & education level. As indicated, three curricula were provided to meet the present needs. A typical example (extract) is shown in Table 2, with the training methodology in Table 3.

Table 2: Example of Curriculum Table (extract)

Topic	**Goals**	**Duration**	**Expected approach**	**Expected delivery method**	**Expected learning outcomes**	**Assessment methods**
1.1 1.1.1 Training requirement under national legislation 1.1.2 Local legislation	Understanding basic knowledge about national legislative framework	30 minutes	Student centred instruction (Adult learning/ Adult education)	Interactive presentation with visual aids	Recognise basic legislative national framework related to SRF and training requirements	Peer evaluation

Table 3: Example of training methodology approach:

Training Method	Advantages	Limitations	Outcomes	Comments/ Suggestions
Lecture: Formal presentation by expert/ trainer	• Time efficient way to impart new information or build on existing knowledge base • Ideal for presenting factual topics • Group size is not an issue • Easy to organize and control • Possible to use with low literacy learners • Good lecturer can arouse interest in topic	• Does not typically engage learners in active participation • Input can be too abstract if not related to learners' real life experience • Retention of information is low • Difficult to assess degree of comprehension/learning • Can alienate non-majority language speakers • Learners with less formal education experience may lose focus or become discouraged	Knowledge	• Limit lecture time to 20 minutes • Supplement lecture with visual aids as much as possible to support non-majority language speakers and visual learners • Relay stories and real life experiences and examples to relate to learners and enliven the lecture • Interrupt the lecture periodically to create opportunities for learner involvement – pose questions, ask learners to provide examples or apply the information presented • Follow the lecture with an activity to re-inforce knowledge

Course length and structure

The actual duration of the course needed to be established. The decision of the Honourable High Court determined the total length of the training for ship recycling workers:

> "*A system of comprehensive training must be introduced to impart training to those who shall be employed for ship breaking activities. An Institute will be set up for the training purposes by BSBA at their cost for training such persons. The training period shall be at least 3 months duration. First 20 days shall be allocated for theoretical training, while the rest of the period shall be involved in practical vocational courses. No workers shall be allowed to be employed in the ship breaking yards without certificate showing completion of the course (Hon'ble High Court Verdict on 6/4/11, regarding workers training)*"

This was interpreted as follows:

(1) the period of 3 months includes rest days;

(2) the training is to be divided in two parts: 20 days for theory and the remaining period for vocational training (2 months and 10 days).

(3) the training should comprise:

- theoretical training of 20 days (or 3 weeks), lasting 15 full days, not counting weekends;
- practical vocational training of 2 months and 10 days, totalling 47 days actual onsite training;

The training would then cover a 3-month period as required by the High Court Decision. Issue of a certificate of training will signify the completion of both courses.

Development of Training Materials

In order to satisfy the training curricula and for in-depth knowledge for the trainers eight different module contents were developed, with training manuals, mainly in English. Some sections of the modules, especially the case studies, were translated into Bangla. Similarly visual presentations (PowerPoint slides) to support the main modules were prepared both in English and Bangla, together with four different videos and animations.

Piloting Train The Trainer

In order to create a pool of expertise locally a train the trainer course was held at the Bangladesh Marine Academy. Nineteen participants attended from different organizations including the BSBA and personnel nominated from government organizations. The participants received 15 days theoretical and practical training. All the modules were taught by international consortium members. The ongoing training activities were observed by Her Excellency the Ambassador of Norway to Bangladesh and representatives from BRS, IMO, BSBA and other stakeholders.

Training Facility requirements and capacity estimate

In the Bangladeshi ship recycling industry, one of the issues of the most pressing concern is the physical location of a training facility and associated administration. From the findings of WP4, Part I, it is evident that the present facilities are insufficient and inadequate in quantity and quality to accommodate a large number of trainees. Hosted inside the BSBA hospital, the BSBA institute remains of restricted capacity due to its size and lacks specialist training areas and equipment.

For a training facility to appropriately deliver practical and effective training demanded by the approved curriculum, it is important that it provides the necessary capacity to allow for skills development in a safe and controlled manner.

In the range of 25,000 – 40,000+ workers are required by Bangladeshi law to undergo theoretical training lasting 3 weeks/15 days, in a training facility. Based on assumptions described in the report (WP4 Part II Strategy for Sustainable Training for the Ship Recycling Industry) calculations were made to assess the total number of workers to be trained per year if the training facilities and numbers of trainers are increased. The number of years is also estimated for training the required number of workers. This issue is further considered and developed in the report of WP5b “Project Document for Implementation of Phase II of SENSREC Project”. Approximate costs (summarised in the Annex to WP4 Part II) to utilise the Bangladesh Marine Academy, training up to 1008 workers per year were given as USD 160 per worker, plus the cost of an international expert and living expenses.

Strategy for full implementation of the training programme

In order to enhance the occupational health & safety standards a systematic training strategy needs to be adopted for sustainable ship recycling in Bangladesh. The following recommendations were made for the development of the sustainable training:

R1: A Ship Recycling Subcommittee on Training and a permanent Ship Recycling Office for Training and Records should be established. BSRB with BSBA support should regulate and control the activities of these bodies;

R2: BSRB to establish an ID-Card based worker registration and records database system for ship recycling workers;

R3: The Ship Recycling Subcommittee on Training and the permanent Ship Recycling Office on Training and Records of the BSRB to be empowered to manage worker registration and upkeep of training records;

R4: The Ship Recycling Subcommittee on Training periodically to review training materials and implement a process for improvements to the training programme;

R5: The Ship Recycling Subcommittee on Training to initiate the creation of refresher and skills upgrade courses based on the SENSREC training programme;

R6: A collective approach is needed in the form of adequate bespoke ship recycling training facilities for the entire ship recycling zone. The Bangladesh Ship Recycling Board (BSRB) could coordinate and facilitate the development of such facilities in collaboration with BSBA;

R7: An investigation into the optimal ship recycling training facilities size, location, design and funding/investor options should be initiated as soon as possible for the Bangladeshi ship recycling zone;

R8: In the interim period, until a dedicated training facility is established, proven institutions such as the Bangladesh Marine Academy should be utilised and supported for ship recycling training;

R9: An investigation should be conducted by the appropriate authorities to facilitate the establishment and funding of a dedicated pool of full-time ship recycling trainers;

R10: The Ship Recycling Subcommittee on Training should evaluate the training needs for safety officers to be able and qualified to conduct on-site/hands-on training in yards;

R11: The Ship Recycling Subcommittee on Training should provide ongoing support and training for ship recycling trainers.

Preparation of undergraduate teaching materials for BUET

The Bangladesh University of Engineering Technology (BUET) has participated in WP4 through the preparation of a programme on ship recycling for undergraduate students in its Department of Naval Architecture and Marine Engineering. The aim of this teaching material is to familiarise the future leading engineers of the maritime sector of Bangladesh with the strengths and weaknesses of the country's ship recycling industry and with the international expectations for improved safety and environmental protection.

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Work Package 5b
Project Document
for Implementation of Phase II of SENSREC Project

Introduction

The objective of this work package is to provide the necessary information for transition of the project as a whole from the background studies and training module development to implementation of Phase II. Phase II is to be based on this report which describes the substantive physical and institutional infrastructure to be developed. Essential features are:- a) the proposal for the procurement of a common hazardous waste treatment storage and disposal facility for industries in the Chittagong area and for ship recycling; and (b) the planning for the implementation of comprehensive training on occupational health, safety and the environment for the workforce of the ship recycling industry.

Project Document Summary WP5b: "Document for Implementation of Phase II"

Objective - Logical Framework Matrix:
Preparation of a project document for implementation of Phase II, included as part of Phase I.

UNIDO experience expected to be used to build the necessary infrastructure capacity in Bangladesh

Expected Outcome
Scoping document for Phase II.

Expected Output
Scoping document produced;

Target group:
Decision makers at government level

Resources:
Consultancy team of national and international experts.

Project Outcome WP5b: "Document for Implementation of Phase II"

Activities

- Report production

Issues covered

- Overview of proposed TSDF project
- Feasibility Study
- Site Selection Protocol
- Steps for obtaining Environmental Clearance Certificate
- Project Development documentation
- Tender Document and Process
- Construction and Commissioning
- Recommendations for the Project
- Planning for Implementation of the Training Modules

Output(s)

- Project document :
  - Establishing the Common Hazardous Waste Treatment, Storage & Disposal Facility and
  - Planning for Implementation of the Training Modules

Executive Summary

This executive summary summarises and highlights salient points deliberated in the "Project Document for Phase II" (component 'b' of Work Package 5). The Project Document is divided into two portions, Part A and Part B. Part A encompasses the description and significance of all the essential tasks to be performed during the course of establishing the Common Hazardous Waste Treatment, Storage and Disposal Facility (CHW-TSDF or "the facility"). In Part B, effort has been made to outline the necessary strategies for capacity building by implementing the training modules for the workforce in ship dismantling yards in Chittagong, Bangladesh.

Part A: The Proposed CHW-TSDF

The proposed Common Hazardous Waste Treatment, Storage and Disposal Facility (CHW-TSDF) is the important requirement for effective management of hazardous wastes generated by the ship recycling sector as well as other industries in the region of Chittagong. It should be recognized that the process of establishing the facility is a complex task and would call for managing five kinds of broad tasks as outlined below:

1. Feasibility Study including site selection and Environmental Impact Assessment
2. Preparation of the Development Project Proforma (DPP) and approval
3. Preparation of Detailed Project Report (DPR) and Tender Document (TD)
4. Tendering process and awarding of contracts
5. Construction, erection and commissioning

The above five groups of activities will have to be carefully planned and orchestrated so that the proposed CHW-TSDF project in Chittagong can be executed in a timely manner. **Figure 1** depicts the inputs and outputs of the above-mentioned five groups of activities in a manner that the project can be managed with the least duplicate actions and unnecessary delays.

One of the most crucial and important steps happens to be the site selection for establishing the proposed facility. This task is based on various screening criteria investigated under the feasibility study *e.g*. various buffering distances are applied to different attributes, which is the function of perception of risk by community, degree of treatment given to hazardous waste, safety measures considered for landfill construction, experts' opinion based on their experience, transportation risk and hazard.

Various attributes such as lake or pond, river, water supply well, water resources, ground water table level, wetlands, flood plain, urban development, regulatory zone, airports, populated areas, fault zones, land slope, road network availability, land cost *etc*. can be considered for screening criteria based on their importance to the site. Finally, the site is approved and notified by the competent Ministry in Government of Bangladesh.

The facility is likely to fall within the "red category industry", as per the legal protocol for conducting EIA as stipulated by the Environment Clearance rules of Government of Bangladesh. An Initial Environmental Examination (IEE) is followed by a detailed

Environmental Impact Assessment (EIA). Following the due diligence procedure for EIA, a draft EIA Report should be prepared and approval of it given by the competent authority.

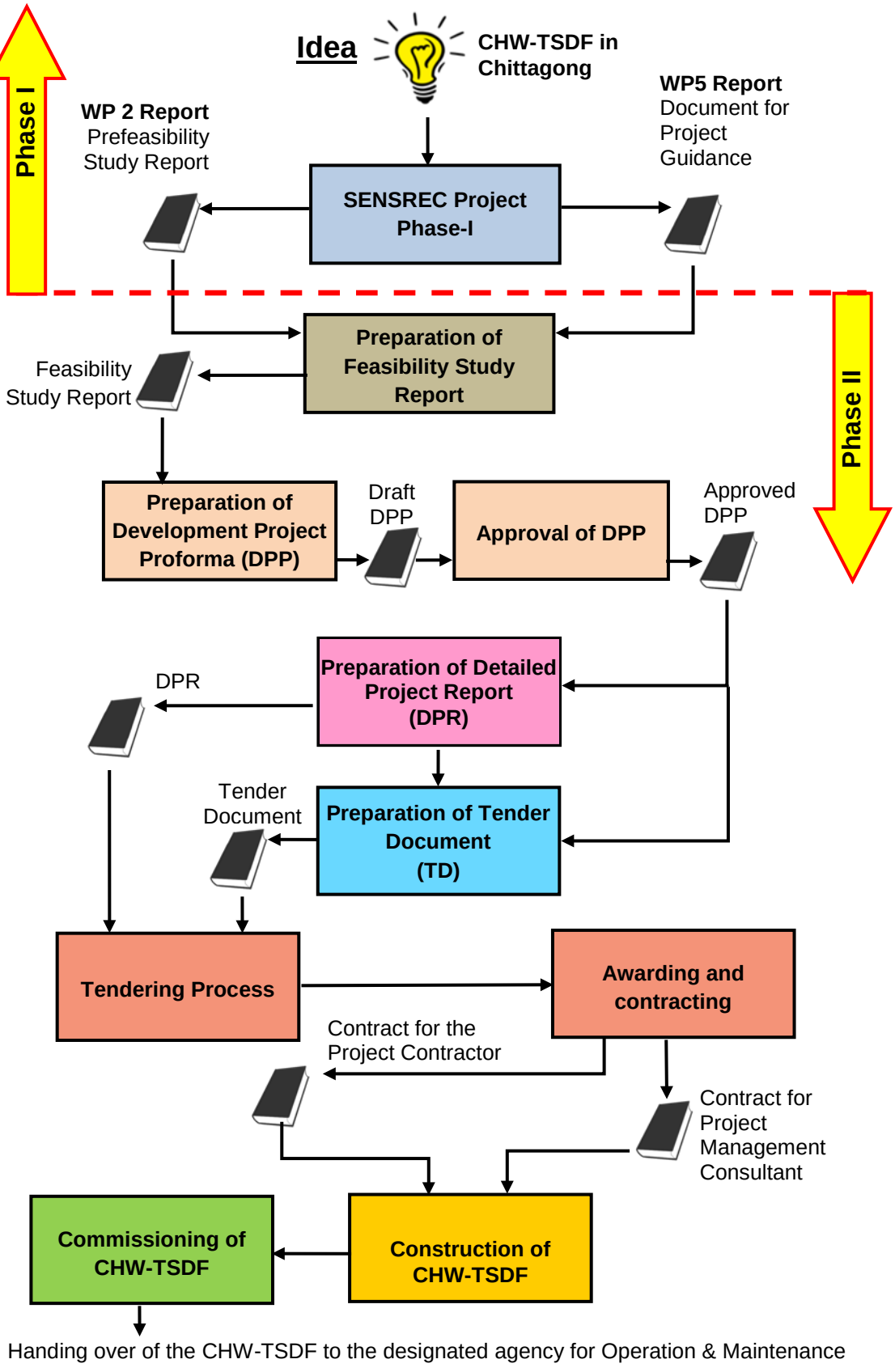

Figure 1: Process flow diagram for implementation of *CHW-TSDF Project*

At this stage, the Project Proponent needs to complete the so-called Development Project Proforma (DPP). On preparing the DPP, the protocol for approval of DPP needs to be implemented by approaching the concerned Ministries and Authorities of Government of Bangladesh for the clearance of the CHW-TSDF project.

The Detailed Project Report (DPR) will be developed on the basis of the EIA and feasibility study reports and the approved DPP by the concerned Ministry of Government of Bangladesh. Further, a consultant is appointed for the development of the Tender Document (TD), which typically describes requirements for three essential elements, namely: financial prequalification, technical prequalification and the commercial offer.

Based on the tender document, the tendering process is initiated for inviting the bidders. The selected bids among the bidders after scrutiny are shortlisted based on the prescribed criteria. The successful eligible contractor is selected and the contracts for the project contractor and the Project Management Consultant (PMC) are awarded.

Once the contract is signed between the Project Proponent and the contractors, construction shall be carried out based on the approved drawings and best engineering practices. The construction and erection will be carried out under the guidance and supervision of the Project Management Consultant.

During the commissioning phase, the contractor has the responsibility to start, operate and demonstrate the activities of the CHW-TSDF, as specified in the contract document. At the end of commissioning, on demonstrating satisfactory performance fulfilling all contractual obligations, the contractor will hand over the CHW-TSDF to the Project Proponent for operation and maintenance.

Part B: The Capacity Building Activity

Phase II of the SENSREC Project will also include the implementation of the training modules developed in Work Package 4 i.e. WP4 of Phase I. Here, a key requirement is for the BSRB to take over the responsibility for implementing the training programmes. They will need to articulate and implement the strategy at the outset so that all the workers in the ship recycling industry would have the opportunity to receive the desired training as per the directions of the High Court.

One of the critical questions to be answered is related to desirable duration in which the BSRB would wish to train and certify adequate number of workers in the ship recycling industry so that the industry will not suffer. This should help in defining what facilities are needed and the necessary budget for enabling the training activities. As suggested here the responsible body for imparting the training could be the so-called “special purpose vehicle” i.e. SPV. The BSRB itself may serve as the SPV or a committee under the supervision of BSRB could serve the function.

Further, the SPV and/or BSRB will also need to agree on implementing some important administrative actions, such as creating and maintaining a database of workers and also organize the certification of trained workers, the accreditation of training materials, the selection and certification of trainers, *etc.* All these issues are discussed in Chapter 13 of the report and corresponding suitable recommendations are proposed.

Essential Institutional Mechanism and Empowerment

In order to make the proposed CHW-TSDF project in Chittagong successful, some of the critical functions will have to be assigned to empowered agencies and certain enabling mechanism will have to be put in place by the concerned Ministry of the Government of Bangladesh. It appears that there are four most important interventions required for engaging all the stakeholders of the project and making critical and significant decisions in a timely manner. Therefore, the concerned Ministry will have to address the following five tasks:

a) Creation of Special Purpose Vehicle: Creation of the "Special Purpose Vehicle (SPV)" is the essential step that should be undertaken before initiating any activity in the proposed CHW-TSDF project in Chittagong. It is envisaged that the SPV would serve as the "one window" facilitating agency appointed by the concerned Ministries in the Government of Bangladesh for initiating and navigating all the necessary steps during the course of implementation of Phase II of the SENSREC project. The SPV could be a standalone agency empowered by the concerned Ministries in the Government of Bangladesh. For example, the planned establishment of the BSRB may prove to be most effective in carrying out of the functions of the "one window" facilitating agency (*i.e.* SPV).

b) Identification of Competent Project Proponent: It is envisaged that the "Project Proponent" will have to be identified for setting up of the CHW-TSDF as well as for operation and maintenance of the facility. This can be achieved in several ways. For example, the Project Proponent could be appointed by the concerned Ministry in the Government of Bangladesh and the individual (or group) should be empowered for the creation and operation of the facility. In such event, the concerned Ministry will carefully choose and empower the team members having critical, complementary and significant competencies related to construction, erection, commissioning and operation and maintenance of the proposed TSDF project in Chittagong.

Alternately, the Project Proponent could also be a private enterprise having relevant experience and enthusiasm for establishing and operating the CHW-TSDF project. A formal process will have to be followed, through which the most suitable bid shall be accepted and legally contracted for the construction, erection, commissioning and operation and maintenance of the proposed CHW-TSDF project.

c) Articulation of Business Model: The concerned Ministries and Departments in the Government of Bangladesh, with inputs from UN Specialized Agencies (UNIDO, UNEP, BRS), have the paramount responsibility for setting-up the "rules of game" by first making a resolution about SPV and secondly by articulating the "Business Model". If the project is started with a collectively developed and agreed "business

model" for establishing the CHW-TSDF in Chittagong, there will be a win-win situation for all the stakeholders. It is strongly recommended that a private enterprise aspiring to own and operate (Project Proponent) a commercial CHW-TSDF should be mandated to contribute 25% as their collateral at the outset to ensure the commitment to the TSDF.

During the operation and maintenance phase of the CHW-TSDF, it would be desirable that the tariff for pre-treatment, incineration or landfilling of hazardous wastes should be mutually agreed by SPV, Project Proponent and the generators of the wastes (including Bangladesh Ship Breakers Association and other industries).

d) Formulation of the Targeted Regulatory Instrument: The Project Proponent should ensure that the setting up and operating the said TSDF does not violate any laws and regulations of the land. It will also be necessary for the Government of Bangladesh to ensure that the hazardous waste generators (ship recyclers and other industries) will be held responsible for sending their wastes to the CHW-TSDF. In order to facilitate the regulatory process some dedicated and directed legal instrument (for example Government Resolution, Gazette Notification, Ordinance, Legal regulation or amendment to the existing law) should be formulated. It will not only ensure the prevention of environmental damage due to hazardous wastes but will also ensure the success of the proposed business model.

e) Implementation of the Training Modules for the Ship Recycling Industry: There are requirements for the capacity building part of Phase II. A key requirement is for the BSRB to take over the responsibility for implementing the training programmes. Also, a new “Training Facility” will have to be built if one aims at training at least 25,000 workers in a reasonable time frame (say within 5 years). Such a facility should have provision for multiple class-rooms and several laboratory facilities of rather larger sizes and in some cases certain labs will have to be built in multiple numbers. The ultimate objective should be to build a new facility – which is suitable for training at least 5,000 workers every year.

The Budgetary Estimates for Phase-II

Indicative Budget for the Proposed TSDF Project (Objective A): It would be useful to recall that the *WP2b Report* published earlier as a part of the deliverables from Phase-I of the SENSREC project was a kind of "Pre-feasibility study" - in which some of the approximate infrastructure and budgetary requirement were published. It was estimated that the plan area of nearly 8 hectares (i.e. 20 acres) would be required for establishing the proposed CHW-TSDF project in Chittagong for the assumed life period of 10 years of the facility. The budgetary cost estimate for construction, erection and commissioning of the proposed project worked out to be USD 11.5 million. It was also reported that the construction, erection and commissioning could possibly be managed in 18-24 months period by creating a dedicated team by the Government of Bangladesh to facilitate and monitor the project.

It is well understood that, in addition to the construction and erection costs reported in WP2b Report, a variety of short term study and investigation projects will have to be undertaken in the process of feasibility study including site selection and EIA. Those investigations could

cost a total USD 1.2 million. Further USD 1.0 to 1.2 million (typically 8-10% of the construction cost) should be budgeted for covering the unforeseen and difficult to plan expenses including duties, local taxes *etc*. The budget for appointing the Project Management Consultant (PMC) could be in the vicinity of 8-10% of the construction cost (USD1.0-1.2 million). Finally, a budget of USD 1.2 million is estimated for covering contingencies and unforeseen expenses (typically 5-12% of the construction cost).

Thus, for establishing the CHW-TSDF adequate for 10-year life, USD 16.1 million and the land area of 7.8 hectare (*i.e.* 19.3 acre) would be required to conduct all the required studies and investigations and for construction and erection of the facility. However, if the CHW-TSDF life-span is to be extended by another 10 years; an additional USD 37.8 million will have to be invested at that time, and additional land area of 7.2 hectare (*i.e.* 17.8 acre) will have to be allocated, in order to conduct all the required studies and investigations as well as for the construction and erection of the suitable additional landfills and for the replacement of the 10-year old incinerator by a new incinerator of higher capacity. A detailed discussed on the budget summarized above is presented at the end of Chapter 11 of the report.

Indicative Budget for the Capacity Building Activity (Objective B): In the second part of this Report, in Part B, effort has been made to outline the strategies for capacity building by implementing the training modules for the workforce in ship dismantling yards in Chittagong as well as an indicative budget for setting up of a "Training Facility" has been estimated.

Regarding a budget for the capacity building part of Phase II; it has to be noted that it will be possible to estimate this after the authorities reach a decision on the length of time required to train all workers in the ship recycling industry and the size of infrastructure required to achieve the scheduled task. Clearly, if one desires to complete the task of training all the workforce in rather short period of time, then multiple classrooms and multiple sets of laboratory facilities would be required to be built in the training facility.

In the present exercise, costs have been estimated for constructing an adequate facility for completing training of 25,000 workers in 5 years (*i.e.* a facility containing all necessary infrastructure for training 5,000 to 6,000 workers every year). The detailed basis-related and infrastructure-related assumptions made for the said budgeting exercise have been discussed in Chapter 13 of the report.

It is envisaged that the "Academic and Administrative Building" has a built-up area of 5,400 m^2 and the "Indoor Laboratories" has a built-up area of 11,250 m^2. These buildings will have to be placed in the vicinity of each other. Yet, they should be built sufficiently apart so that adequate masterplan of the land can be made to provide for access area surrounding buildings, approach and access for firefighting, "rendezvous spot" for escape and shelter in case of disaster or accident, parking, roads, gardens, *etc.* Thus, a plan area of about 4 hectare (*i.e.* 10 acres) will have to be provided for construction of the proposed "Training Complex" designed to train 5,000 to 6,000 workers every year.

In addition, the “Outdoor Training Areas” will be needed. For this purpose it is envisaged that the outdoor training will be given in the wet-intertidal areas, intertidal zones and secondary cutting zones of the yards where the workers are employed. The *Production Supervisors* and *Health Safety and Environment Officers* in the respective yard will supervise the workers under training and report the progress to the *Training Institute*.

The proposed “Training Complex”, approximately, would require allocation of USD 7.1 million to cover the capital costs of construction, commissioning, modest furniture, laboratory equipment and fire-fighting systems. These budgeted costs, however, do not cover air conditioners, residential quarters, guest house, cost of land, or any recurring costs, or the operation and maintenance costs.

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Synthesis

Introduction

This project was designed to enhance the development of safe and environmentally sound ship recycling in Chittagong, Bangladesh, with the aim of improving the standards and therefore the sustainability of the industry. As a by-product, the project was also intended to assist the industry to eventually meet the requirements of the Hong Kong International Convention on the Safe and Environmentally Sound Recycling of Ships, 2009 (the Hong Kong Convention), so that the Government of Bangladesh may be in a position to accede to the Convention, in due course.

The project is to be delivered in two phases. Phase I was concerned with the establishment of a number of actions to support the implementation of improved practices and upgrade others, taking into account the interests of key stakeholders including the Government of Bangladesh and the Bangladesh Ship Breakers Association (BSBA). The relevant ministries involved were to be coordinated through the Ministry of Industries. In addition, the Secretariat of the Basel, Rotterdam and Stockholm Conventions (BRS), and the United Nations Industrial Development Organization (UNIDO) were significant international partners who added value to the tasks by sharing their expertise, know-how, and in the case of BRS funding, to assist in creating opportunities for long-term improvements in safety, health, and environmental protection and ultimately for the development of new infrastructure. Other intergovernmental stakeholders also contributed e.g. the International Labour Organization (ILO). Phase I involved several studies and pilot activities, with detailed infrastructure design and sourcing of financing being reserved for the next phase.

Overall purpose of SENSREC and intended outcome

The overall purpose of the SENSREC project as set out in the document: “Project Document for Safe and Environmentally Sound Ship Recycling in Bangladesh - Phase I”, is to undertake a comprehensive, targeted evaluation of the requirement to deliver safe and environmentally sound ship recycling, taking into account the health, safety and environmental compliance aspects of ship recycling in the context of the prevailing social and economic circumstances, and to improve ship recycling standards in the direction of the provisions of the Hong Kong Convention.

The SENSREC project’s main intended outcome is the strengthening of the national capabilities of the Government of Bangladesh and the operators of ship recycling yards, to put in place sound and effective measures that enhance the standards of health, safety and environmental compliance at ship recycling yards as well as the capacity for environmentally sound downstream waste management of the hazardous and other materials that are generated from the process of ship recycling.

Project Results

The five main Work Packages covering: economic and environmental impact studies; quantifying and planning for the management of hazardous materials and wastes with an outline design of a downstream facility; development of a Government One-Stop Service;

upgrading of training modules and preparation of new modules on safety, health and environment; and the production of a Project Document for Phase II have all been successfully completed.

Taken together the outputs of the Work Packages have provided significant and substantial results that will assist the strengthening of the national capabilities of the Government of Bangladesh and the operators of ship recycling yards and enhance the standards of health, safety and environmental compliance to make the ship recycling industry more sustainable.

A comprehensive up-to-date picture of the industry has been produced on which further progress can be built. Continuation and expansion of the activities undertaken through Phase I of the Project, supporting health, safety and environmental protection through training, environmental monitoring, proposals for streamlining governance and infrastructure development will provide considerable underpinning to the ship recycling process as a whole and help the ship recycling industry to maintain its economic position as one of the leading ship recycling nations. Much remains to be done to cement the results of Phase I and meet current and future challenges of international ship recycling compliance standards but the SENSREC project has enabled key steps to be taken to fulfil this objective

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