Gujarat Maritime Board
Republic of India

PREPARATORY SURVEY
ON
THE SHIP RECYCLING YARD IMPROVEMENT PROJECT
IN
INDIA
FINAL REPORT
<Advanced Version>

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JAPAN INTERNATIONAL COOPERATION AGENCY

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Abbreviations and Acronyms

ACMs (ACM)	Asbestos Containing Materials
AERB	Atomic Energy Regulatory Board
AFS	Anti-fouling Systems
ASF	Asian Shipowners' Forum
BAN	Basel Action Network
BANI	Ban Asbestos Network
bbl	Barrel
BDI	Baltic Dry Index
BIMCO	Baltic and International Maritime Council
BIS	Bureau of Indian Standards
BOD	Biochemical oxygen demand
BRICs	Brazil, Russia, India and China
CFC	ChloroFluoroCarbon
Class NK	Class Nippon Kaiji Kyokai
CO	Carbon Monoxide
CO2	Carbon Dioxide
COD	Chemical Oxygen Demand
CP	Cutting Permission
CRZ	Coastal Regulated Zone
CPCB	Central Pollution Control Board
CZMA	Coastal Zone Management Administrative bureau
CRZMA	Coastal Regulated Zone Management Administrative bureau
DASR	Document for Authorization to conduct Ship Recycling
DISH	Director of Industrial Safety and Health
DL	Datum Line
DPR	Detailed Project Report
DO	Dissolved Oxygen
DSA	Danish Shipowners' Assosiation
DWT	Dead Weight Tonnage
EAC	Expert Appraisal Committees
EC	European Community
ECSA	European Community Shipowners' Associations
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPRP	Emergency Preparedness and Response Plan
EU	European Union
EUSRR	EU Ship Recycling Regulation
FPSO	Floating Production, Storage and Offloading system
F/S	Feasibility Study
g	Gravitational Acceleration
G7	Group of Seven
GCRZMA	Gujarat Coastal Regulated Zone Management Administrative bureau
GDP	Gross Domestic Product
GEPIL	Gujarat Enviro Protection and Infrastructure Limited

GMB	Gujarat Maritime Board
GMS	Global Marketing System
GPCB	Gujarat Pollution Control Board
GPS	Global Positioning System
GSHAP	Global Seismic Hazard Assessment Program
GT	Gross Tonnage
Hcl	Hydrochloric Acid
HEPA	High Efficiency Particulate Air Filter
HKC	Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009
HM	Hazardous Materials
HP	Home Page
HSS	heavy grains(=wheat, maize/corn, rye,etc) and/or sorghum(s) and/or soyas(soybeans)
HTL	High Tide Level
HHWL	Highest High Water Level
ICRR	International Certificate of Ready for Recycling
ICS	International Chamber of Shipping
IHM	Inventory of Hazardous Materials
ILO	International Labor Organization
IMD	India Meteorological Department
IMDG	International Maritime Dangerous Goods Code
IMF	International Monetary Fund
IMO	International Maritime Organization
INR	India Rupee
IRRC	International Certificate of Ready for Recycling
ISO	International Organization for Standardization
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
JSA	The Japanese Shipowners' Association
LDT	Light Weight Ton
LEL	Lower Explosion Limit
LFL	Lower Flammable Limit
LPG	Liquefied Petroleum Gas
LT	Long Ton
LTL	Low Tide Level
MHWN	Mean High Water Neap
MHWS	Mean High Water Spring
MLWN	Mean Low Water Neap
MLWS	Mean Low Water Spring
MoEF	Ministry of Environment and Forestry
MOU	Memorandum of Understanding
MSZ	Makran Subduction Zone
NABET	National Accreditation Board for Education and Training
NDMA	National Disaster Management Authority
NGO	Non-Governmental Organizations
NH3	Ammonia

NO3	Nitrate
NOx	Nitrogen Oxide
O3	Ozone
ODA	Official Development Assistance
ODs	Ozone Depleting substances
OECD	Organization for Economic Co-operation and Development
PAH	Polycyclic Aromatic Hydrocarbon
PCBs	Polychlorinated Biphenyl
PCHM	Potentially containing Hazardous Materials
PESO	Petroleum and Explosives Safety Organization
PGA	Peak Ground Acceleration
pH	Potential Hydrogen
PM	Particulate Matter
PPEs	Personal Protective Equipment
PPP	Public-Private Partnership
ppt	Parts Per Thousand
PSC	Port State Control
r	correlation coefficient
R^2	coefficient of determination
REIA	Rapid Environmental Impact Assessment
RO	Registered Organization
RORO	Roll-on/Roll-off ship
RSPM	Respirable Suspended Particulate Matter
SBC	Ship Breaking Code
SEIAA	State Environmental Impact Assessment Authority
SHE	Safety Health and Environment
SO2	Sulphur Oxide
SO4	Sulfate
SOC	Statement of Compliance
SPCB	State Pollution Control Board
SPM	Suspended Particulate Matter
SRF	Ship Recycle Facility
SRFP	Ship Recycle Facility Plan
SRFMP	Ship Recycle Facility Management Plan
SRIA	Ship Recycling Industries Association
SRP	Ship Recycling Plan
SSRP	Ship Specific Recycle Plan
TBT	Tributyltin
TOR	Terms of Reference
TSDF	Treatment Storage Disposal Facility
UNEP	United Nations Environment Programme
US$	United States Dollar
VHS	Video Home System
VLCC	Very Large Crude Oil Carrier
Web	World Wide Web
x	Variable x
y	Variable y

4TC	4 average total cost
σ	Sigma
μ	Mu

SUMMARY

1. BACKGROUND AND HISTORY OF THE PROJECT

1.1. BACKGROUND OF THE PROJECT

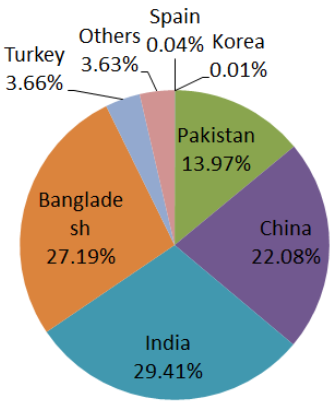
1.1.1. REQUIREMENTS OF THE CONVENTION AND RELATION OF THE PROJECT

In India, Pakistan and Bangladesh, all located in South West Asia, ships were broken up at inter-tidal zones in a so-called "Beaching Method" way that enjoyed heydays in the 90's. In the beginning of the 90's, ships were being demolished without sufficient cleaning works, stripping of residual oils and wastewater, once they were grounded in the inter-tidal zone. Because of this, fatal accidents of explosions/fire by flammable gas, fall from high places, etc., were taking place and health hazard under cruel working conditions was created. Serious environmental pollution by the hazardous materials such as various kinds of oil, scientific substances and heavy metals onboard the ships became a big concern.

With this backdrop, environmental and human rights groups pointed out issues of the industry and criticized the major shipping countries and shipbuilding countries that they were exporting pollutions to these ship breaking countries. Under this situation, ship recycling countries as well as shipping and shipbuilding countries were required to response to these issues and the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009 was adapted and regulated ship recycling facilities for sound operation and management to mitigate environmental pollution and industrial accident is required

Ship Recycle Convention requires Safe and Environmentally Sound Ship Recycling regardless ship recycling method. It is opined that requirements of the Convention can be achieved by "beaching method" with further improvement of the facilities, management method, ship recycling process, education and training for workers, etc., therefore, ship owners' associations in Asia, Japan and Europe have expressed support for securing safe and environmentally appropriate ship recycling capability through improved beaching.

1.2. SHIP RECYCLING INDUSTRY IN INDIA



Source: JICA Survey Team

Figure 1-1 Comparison of ship recycling volume by major ship recycling countries

While 2006 to 2015, India, Bangladesh, China and Pakistan shares 92.7% of total tonnage broken. Among these India ranks top with about 29.4% of total tonnage broken followed by Bangladesh 27.2%, China 22.1%, and Pakistan 14.0% and many of ship owners in the world are heavily rely on India for recycling of their ship.

Ship recycle in India has been conducted mainly in Alang / Sosiya district of Gujarat State. The ship recycling facility has 153 yards covered by the Gujarat Maritime Board (GMB) along the about 9km long coast. 130 ship recycling companies are leasing yards from GMB.

The steel supplied from ship recycling covers about 3% of the domestic consumption. The industry has been greatly contributing the regional industry with employing directly about 20 thousand workers and 500 thousand indirectly.

1.3. BACKGROUND AND HISTORY OF THE RQUEST OF THE PROJECT

Ship recycling industry has already been established as an important industry in the province of Bhavnagar province of Gujarat state, while improving environmental and occupational safety is urgent and then Ship Breaking Code 2013 (SBC) was established and its contents are more severe than those of GMB's ship recycling rules, including 1) preparation and approval for anchorage and beaching, 2) ship recycling Enhancement of the licensing and approval system of the ship owners, and 3) gas-free obligation provisions for safe for hot work to the owner.

However, compared with China and Turkey, which have facilities complied to the Convention facilities that complied the Ship Recycling Convention are not being developed well. Ministry of Shipping, of India which is the regulatory agency, intends to increase and maintain ship recycling orders by recognizing the trend of ratification of the global ship recycling convention and developing the facility comply with the Convention

However, in order to implement ship recycling in safe and environmentally sound manner in the global shipping, it is necessary to further secure improvement, including the necessity to secure a yard with SOC and the importance of maintaining the industry in the Bhavnagar, Gujarat including the maintenance at the remaining yards and waste disposal facilities. With these background, improvement of existing ship recycling yard by "Ship Recycling Yard Improvement Project" (hereinafter referred to as "the Project") is required by the Indian government.

Based on the request from the Government of India concerning Improvement of Ship Recycle Yard, and the opportunities of the Japan-India Summit Meeting in September 2014 and December 2015, this survey is aimed at to survey necessary for appraisal to be implemented as Japanese Yen Loan Project.

2. PRESENT CONDITION AND ISSUES OF THE INDUSTRY

2.1. PRESENT CONDITION AND ISSUES OF SHIP RECYCLING PROCESS

Ship Recycling Facilities in the Alang / Sosiya have already started concrete paving etc., by themselves. Also, the Nippon Kaiji Kyokai (ClassNK) has issued Statement of Compliance (SOC) to the four advanced recycling facilities in Alang / Sosiya. Thereafter, further improvement work is under way to acquire certification from such as ClassNK and RINA (Italian classification society) etc. In this survey, out of 131 yards in total in operation, 6 yards were found as certified yards (as HKC compliant) with the SOC issued by the third party (Classification Society) and 11 yards under the process of making request for the certification.

(1) Issues of Ship Recycling Facilities

Result of comparison of the requirements of the Ship Recycling Convention and the current recycling facilities in Alang / Sosiya area, with the judgment of conformity is explained in the Table 2-1.

Table 2-1 Conformity of Requirements of the IMO Convention and Ship Recycling Facility

Status	Requirements of the Convention	Current Situation	Judgement of Conformity
	Identification of HMs, labeling of their location, etc.	Advanced yards confirmed drastically based on IHM provided by Ship owner	Conformed
	Gas free for safe Entry	Before enter the anchoring area of Alang, inspection is obliged by rule for tanker, etc.	Actually No tanker is accepted
	Prior removal of HMs	Residual oils, Bilge is confirmed the quality and then after beaching pumped out it.	Spillage risk depend on the method.

		Cleaning with saw dust, etc.	Oils are transferred to authorized dealer
	Treatment of Asbestos wests	ACM is safely removed by wetting method of in the negative chamber (trained worker is at work)	Some are conformed
	Removal of AF paint such as TBT	There is a case to remove paints of cutting line at intertidal zone. Paint chips are processed at TSDF in Alang/Sosiya	Some are conformed
	Ozone Depleting Material	Specialized subcontractor will handle	Conformed
	PCBs	Substances with low concentration PCBs are sold as-is to resellers. Not basically processed in TSDF. There is no specific handling of high concentration PCB-containing substances, and approved dealer take them.	Partially conformed Low concentrated PCB can be incinerated
	HMs management, Treatment	Storage in facilities. TSDF outside the yard has final reclamation plot.	Conformed
	Bilge, Oily Water treatment	10 tons /day small ETP（Effluent Treatment Plant） is under operation by GEPIL	Conformed

Source: JICA Survey Team

In the recycling method by beaching, it is difficult to prevent completely falling the hazardous materials to the intertidal zone at the time of cutting of hull. It should be considered how to prevent and recover hazardous substances released to the intertidal zone or soil, and also the process of recovering hazardous substances as much as possible. The points to be improved by Indian ship recycling facilities in order to conform to the Convention from the recognition of the current problems are as follows.

a. It is necessary to manage oil and other hazardous materials in vessels under recycling either in the intertidal zone or in the facility shall not to flow to the sea in the rain and storm or normal condition.
b. Ensure that the vessel can be pulled as close as possible to the shore and cut the hull as far as possible on the shore side, and cutting work at sea and cut off of blocks should be prevented.
c. The recycling zone should be covered with an appropriate impermeable floor structure, and a drain ditch and drain recovery means should be provided at an appropriate position between the coastline and the facility.
d. Secure safe access to the ship should be ensured

2.2. PRESENT SITUATION AND ISSUES OF OCCUPATIONAL SAFETY AND HEALTH

Alang / Sosiya has a Safety Training & Laborer Welfare Institute established by GMB in 2003, providing training courses compulsory for workers engaged in ship recycling. However, as the result of the survey, issues on occupational safety and hygiene are recognized as follows.

2.2.1. PRESENT CONDITION OF OCCUPATIONAL SAFETY AND HEALTH IN SHIP RECYCLING PROCESS

- Facility management and operation (Document confirmation) : Normal yards does not cover all the necessary information required in Ship Recycle Plan (SPR). In specific, ship recycling method and procedures, training plans, various permits and certificates are either not developed or could not be confirmed.

- Safe-for-entry and safe-for-hot-work procedures : Before cutting works is commenced, removal of hazardous materials, oils and gas shall be completed and Decontamination Certificate is issued by GPCB, followed by the Cutting Permit issued by GMB with confirmation of gas and oxygen contents are required. However, normal yard these documents are confirmed.

- Safety measures for the working at height : According to accident statistics, relatively high number of accidents is caused by falling from heights. The application of those safety measures shall be ensured by raising the awareness of skilled workers and site supervisors.

- Safety measures for the operation of heavy equipment : According to accident statistics, accident due to cut of wire rope when ship is pulling up to shore, however, equipment inspection of heavy machinery, winch line, etc. was not satisfactory in some yards which shall be made as a routine task of HSE officers.

- Personal Protective Equipment (PPE) : In normal yards, wearing of PPEs are not drastically observed. Workers must apply appropriate PPEs such as masks and gloves for toxic fumes, ng glass wool removal and washing and changing after the work should be instructed.

- Medical monitoring on workers : In Alang / Sosiya ship recycling yard, medical doctors certified by Directorate of Industrial Safety and Health (DISH) are conducting medical examination both at pre-employment stage and periodically in every six months. Since it is considered insufficient to grasp the health hazard of workers by current examination items, it is recommended that occupational specific items shall be included.

- Zoning of the yard and sorting of materials in the yard : Normal yards do not have clear boundary of different zones in the yards where oily block and cutting plates are stacked together and LPGs are stored in close proximity to gas cutting area. Proper zoning in the yard and segregation of dismantled blocks and parts shall be practiced.

Proper zoning in the yard reduces operational risk (NK certified yard)

Oily parts and steel plates are stacked together (Normal yards)

LPG is stored close to cutting zone (Normal yards)

- Identification and removal of hazardous substances : Some certified yards prepared the Inventory of Hazardous Materials (IHM) and removal work has being done as per IHM. In the case of normal yards, identification of hazardous substances is done without IHM and it may be a possibility of hazardous substance remaining unidentified.

  For the removal of hazardous substances, some certified yards are equipped with their own asbestos removal facilities and trained workers perform the removal. Other normal yards are outsourcing the removal operation to authorized external agency.

  Ozone Depleting Substances (ODS) is collected by custom department. Radioactive devices, remaining oil, PCB contained device and equipment are removed and collected by authorized external agency on the ship. In case of paint removal, there may be difficult to remove the paints prior to cutting.

- Hazardous waste management : Each yard is equipped with temporary storage of hazardous wastes and non-hazardous wastes. Collection and disposal of hazardous waste is following the manifest system base on the hazardous management rule (revised in 2003). Based on the application, authorized agency (GEPIL) collects hazardous and non-hazardous wastes from each yards with designated van and disposed at industrial waste disposal facility (TSDF) .

As the result of the evaluation of the present condition of occupational safety and hygiene and guidelines of the Ship Recycling Convention, the following occupational health and safety issues were revealed.

a. insufficient inspection and safety confirmation before entering the compartment, before fire use
b. Insufficient safety measures such as fall prevention during high altitude work
c. Insufficient workers' sanitation facilities (rest rooms, showers, etc.)
d. insufficient use of PPE properly
e. Periodic health checkup and management of workers is inadequate
f. Inadequate handling and education of harmful substances

2.3. CURRENT STATUS AND ISSUES ON ENVIRONMENTAL CONSIDERATION

2.3.1. CURRENT SITUATION ON ENVIRONMENTAL CONSIDERATION

(1) Wastes generated from Ship

In this survey, investigation of the type and amount of waste generated from the ship during the recycling process for two ships. As a result, one vessel is confirmed the usage of asbestos, but PCB, TBT paint, etc., are not detected. PCB may be contained in insulation of electric wire etc. TBT paints have not been applied for two vessels.

Waste oil, sludge, etc., are cleaned by sawdust, oil sand etc., by subletting. Therefore, there are cases where insufficient washing oil leakage from the cut block to the sea or soil. The treatment of oil sands is also an issue.

Although the amount of waste discharged from the ship is 0.1-0.3% per LDT[1], glass wool occurs in large quantities in waste from the ship. These are packed after bagging and landfilled with TSDF. Volume reduction of glass wool is an issue.

(2) Ship recycling process in inter-tidal zone

In order to avoid oil leakage in intertidal zone and into the sea, the primary cutting block is required not to drop into intertidal zone. In normal yards, cutting process was carried out in the inter-tidal zone and blocks and materials were scattering in the inter-tidal zone. Measures to avoid the fall of oily blocks to the inter-tidal zone are required to propose.

Blocks being dropped in the sea / in the inter-

Cutting is done in the inter-tidal zone (Normal yards)

Oil still remaining inside fuel tank after

Water coming inside the fuel tank while the ship is waiting in inter-

[1] LDT : Light Displacement Ton. Weight tonnage of ship without cargoes, persons, fuels, water, etc.

tidal zone (Normal yards)	cleaning (yard in process of verification)	tidal zone (yard in process of verification)

- Pollution prevention measures on the yard

Some certified yards have laid concrete floor, pit, bilge collection tank. On the other hand, normal yards do not have concrete pavement so cutting operation is done on the ground. Some normal yards, however, also stored oily parts on the steel plates to prevent oil spillage on the soil. Yard improvement to prevent possible pollution need to be planed which is similar to certified yards.

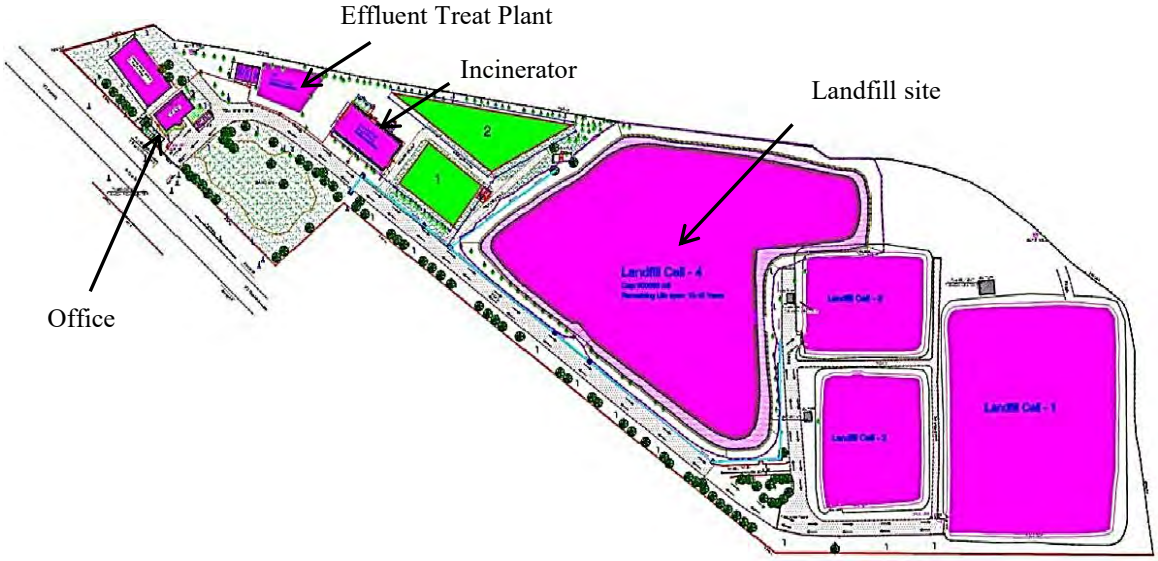
Concrete floor on the yard (NK certified yard)

Drainage pit to prevent pollution on the soil and sea (NK certified yard)

Oily parts storing space (All yards: only some yards have the roof)

2.3.2. OUTLINE OF EXISTING FACILITIES

TSDF is located 2km away from Alang and mainly consist of Incinerator (5 tons/day capacity), Effluent Treatment Plant (30m^3/day capacity), Landfill site for hazardous materials (70,000m^3) and Landfill site for general wastes (30,000m^3). Layout of TSDF is shown on the Figure 2-1 below.



Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang / Sosiya

Figure 2-1 Layout of TSDF

Remarks: Area shown in color green is site for expansion.
color pink shows existing facilities

(1) Issues of TSDF Facility

1) Effluent treatment equipment
Current Effluent Treatment Plant (wastewater treatment equipment) cannot deal with wastewater etc. containing high concentration of oil. It is necessary to have a processing device capable of treating high oil content drainage and sludge.

2) Incinerator
Although the incinerator currently declares the performance of 1100 ° C in the secondary furnace, due to the characteristics of the fixed furnace, it is possibility the temperature of the secondary combustion is lower than the specification. In order to detoxifying PCBs, an incinerator capable of stably exhibiting high-temperature incineration at 1100 ° C or higher is necessary.

3) Management type landfill disposal site
More than 62% of volume brought into managed landfill sites is glass wool and since it cannot be incinerated, it is landfilled. Landfill sites have limitations, reducing the volume of industrial waste is an issue.

3. PRELIMINARY DESIGN OF THE PROJECT

3.1. NATURAL CONDITION SURVEY AND TESTING

Topographic survey was carried out across a range of areas from a road alongside ship recycling yards to a shore line over 9.4km from South to North at Alang/Sosiya. Also, seventy (70) borings were performed to investigate soil properties from surface to 10m depth in the survey area. According to the boring N-value obtained from the SPT is generally more than 30 at almost boring locations. The results of Grain Size Analysis/ Atterberg Limits test/ Density Test of Soil Particle etc., are within ranges of the soil properties of normal soil, hence soil in the area seems to be usable for construction of the structures. The results of the CBR tests indicate that the soil can be used as a subgrade for the pavement.

3.2. SCOPE AND CONTENTS OF THE PROJECT

(1) Required Project Contents

The issues to be addressed are reviewed and facilities and work procedures that need to be considered in order that ship recycling facility to become compliant to the Ship Recycle Convention are as follows. These measures are mainly focused on how to prevent environmental pollution in the ship recycling process in the intertidal zone. The outline of the required measured is explained with basic design including contents, quantity, etc.

Table 3-1 Proposition of recommended facilities and equipment to comply with the Convention

Measures need to be considered	Items of Facility or Process	Recommended Contents of the Project
	Improvement of Yard to prevent pollution of intertidal zone and soil	Improvement of yard with concrete floor and oil correcting drain for the recycling works with Hazardous materials and contaminants.
	Heavy equipment for the work in intertidal zone	Heavy lifting equipment for steel plate and hull block. (currently only winches) Introduction of Large Crawler cranes for the recycling work in intertidal zone. The crane will be time base rent scheme with operator for all yards who may be needed. (Large block will directly transferred

Measures need to be considered	Items of Facility or Process	Recommended Contents of the Project
		from ship to shore or by lightning after part of ship, avoid pollution of the sea)
	Wheel Loader for beach	Bucket m^3 for the purpose of 10km beach cleaning (cleaning of debris) of Alang/Sosiya
	Bunker oil tank cleaning device	Cleaning of double bottom FO tank. Introduction of mobile high pressure cleaning device. Equipment shall be 1 TEU size and make available for all yards.
	Afloat Tanker Cleaning Barge	One cargo oil tank, slop tank cleaning and transportation barge
	Multi-purpose vessel	For the purpose of oil combatting, firefighting and monitoring during tanker cleaning operation at sea. One multi-purpose work boat.
Reinforcement of capability of Hazardous Materials and wastes treatment.	Reinforcement of oil treatment and incineration capacity of TSDF	As the result of the improvement of yards and other project, it is expected to increase the volume of wastes and HMs. Improvement of Incineration performance. Improvement of Oil treatment performance.
Improvement of work environment	Improvement of living condition	Improve living condition of workers and provide safe and hygiene housing thus promote inhabitant workers

Source: JICA Survey Team

As the results of the review and investigation above mentioned, the Project consists of the following components:

1) Improvement of existing 70 ship recycling yards
2) Introduction of Mobile Decontamination Units
3) Introduction of Large Mobile Cranes and Beach Cleaning Wheel Loaders
4) Introduction of Tank Cleaning Barge
5) Introduction of Multi-Purpose Vessel
6) Improvement of environment facilities of TSDF

3.3. IMPROVEMENT OF SHIP RECYCLING YARD FACILITIES

3.3.1. IMPROVEMENT OF YARD FACILITIES

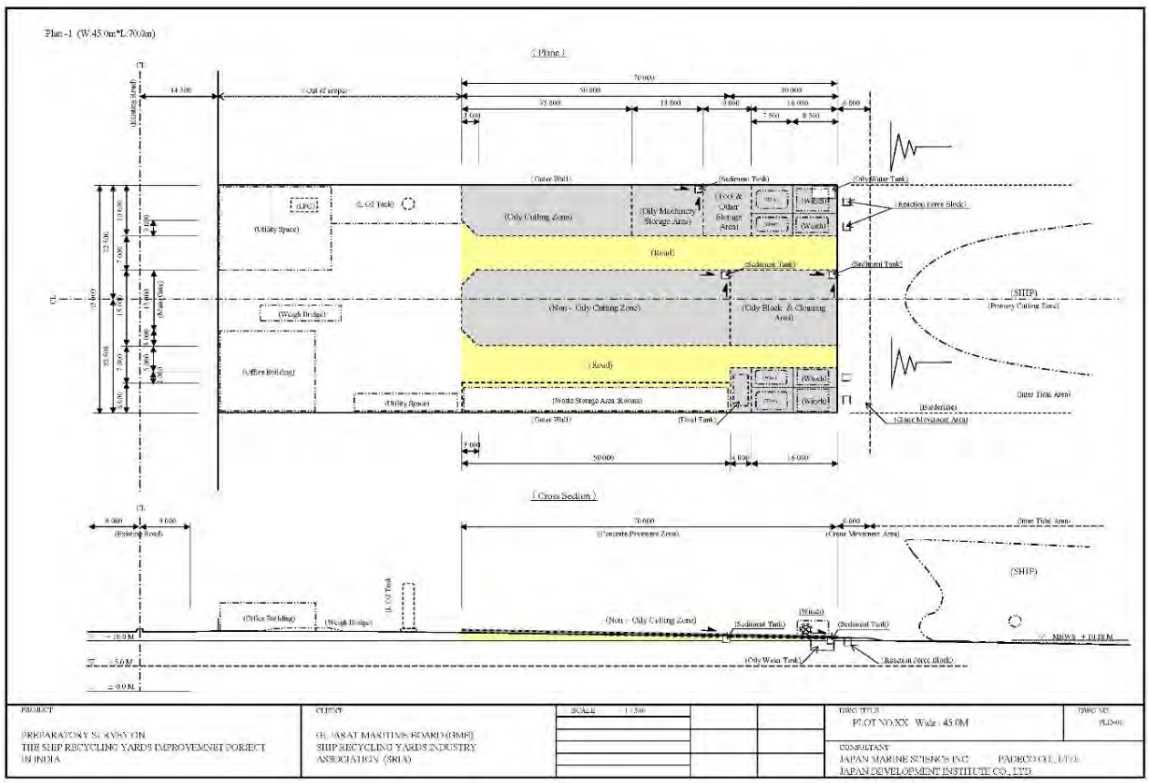
(1) Improvement of Yard

The following improvement of the existing yard facilities will be implemented under the Project in order to comply with the requirements of the Convention.

1) Provision of high rigidity concrete floor for the cutting area and storage area for the pollutant
2) Provision of collecting rain water (including drainage and oil collecting tank foundation)
3) Provision of the foundation of towing winches

Preliminary design is made as standard design by the different width of the yards of 45m, 60m, 90m, & 120m and the improvement of the yards will be done with standards of other yard facilities. However, the facilities such as temporary storage of hazardous materials, storage of LPG cylinders, asbestos handling facility, sanitary, drinking water, shower facility, workers' changing room, first aid facility, firefighting facility, sewage treatment facility, temporary storage of hazardous materials, etc., will not be covered by the Project.

Assuming that the commencement of the Project is 2020, if more than 60 yards have already been improved, the remaining less than 70 yards will be subject to the Project.



Source: JICA Survey Team

Figure 3-1 Image of Improved Yard

(2) Jetty for Mooring Waste Oil Collection Barge

In this Project it is planned to introduce an offshore tank cleaning barge and the barge is moored on the jetty with the extension is 50 m in Alang, and the waste oil is transferred on land. The site o f the Jetty will be South end of Alang.

3.3.2. PROPOSAL FOR INTRODUCTION OF NEW MACHINES

(1) Improvement for facilities of ship recycle yard

The following two kinds of machines would be proposed on this Project from the aspect of improving environmental preservation, safety and working efficiency in the yards.

a. Large Crawler Cranes (120t) five(5) machines
b. Beach Cleaner three(3) machines

1) Large Crawler Cranes（120t）

In order to dragged the ship's hull to the shore easily, weight of heavy stern blocks of the ship needs drastically to reduce, avoid the blocks are dropped down, and to reduce environmental pollution to intertidal zone, silt, and sea by hazardous materials, the large crane with telescopic boom with about 120 ton capacity and more than 40m outreach will be introduced. The crane shall be of crawler crane since it need to run on the beach.

On the assumption that the 25 days per ship are taken for 125 ships per year, the necessary number of the cranes is calculated to five (5) cranes as an initiation.

Operation and maintenance will be rent out by GMB (or SPV) to the private operator who has a capability to operate and maintain the crane.

2) Beach Cleaner

Since debris (piece of wood, concrete, heat insulating material, wire end materials, cut steel etc.) are generated as a result of dismantling the ship and are scattered on the beach, Beach Cleaner with bucket capacity of about 2 m^3 using a commercially available wheel loader (with special bucket) to clean the beach will be introduced.

Conditioned that the width of the yard is 100 m, the depth including the beach is 50 m, the required number of the beach cleaner is calculated as three (3). This beach cleaner will be entrusted its operation and maintenance to the private company as same as crane operator and rents to each yard.

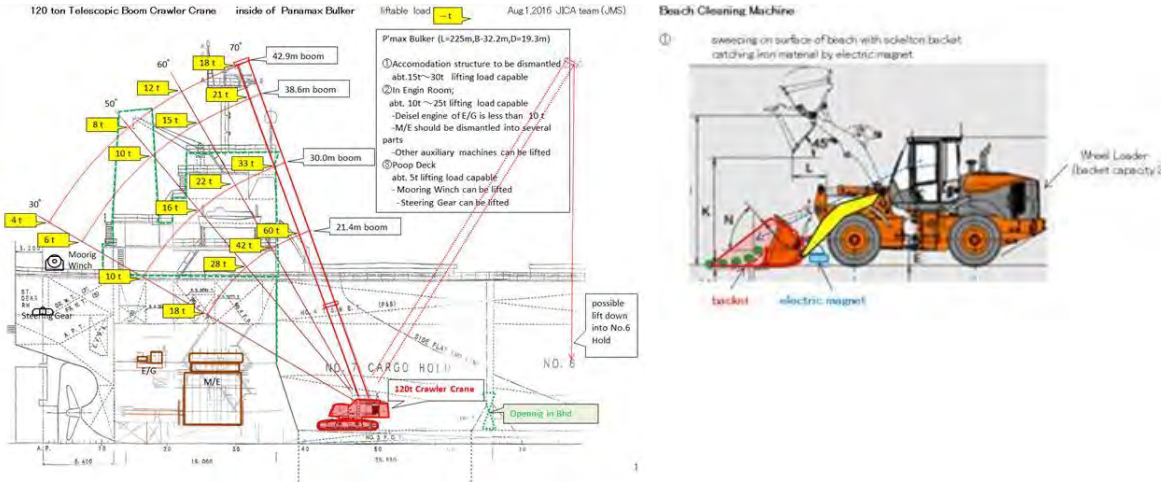


Figure 3-2 Dismantling method of Stern block of ship by Large Crawler Crane (120T) and Beach Cleaner

3.4. IMPROVEMENT OF ENVIRONMENT FACILITY AND TSDF

3.4.1. STUDY OF TREATMENT METHOD OF HAZARDOUS SUBSTANCES

(1) Estimation of the Wastes to be Treated

Based on this statistics of the type and characteristics hazardous wastes and oily wastes generated in the process of ship recycling, and also record of waste received by TSDF, annual volume of wastes is classified by the process as follows.

W/W	Wastewater Treatment	1,602.275	t/year
S/S	Stabilization & Solidification	2,499.650	t/year
SLF	Secured Landfill	50.585	t/year
INC	Incinerable Treatment	843.800	t/year
	Total	4,996.310	t/year

(2) Treatment Plan of Hazardous Wastes

Proposed planned plant consists four (4) parts.

Table 3-2 Planned Wastes Treatment Plant

Process of Hazardous Wastes Treatment	Wastes Treatment Plant
1. Before Beaching, at Anchoring Cargo oil tank cleaning and gas free works of Crude oil tanker at offshore	: Tank cleaning and waste oil collecting plant Transfer oily water after cleaning tanks and sludge at offshore to onshore.
2. After Beaching FO tank cleaning and gas free before cutting work	: Tank cleaning plant by high pressure water. With mobile high pressure cleaning system, work inside the yard.
3. While Recycling Treatment of liquid wastes such as bilge, waste oil, oily water	: Oily Water treatment plant By Oil collecting tank, Oily water separator, and Sludge treatment plant, wastewater will be treated.
Treatment of solid wastes such as PCB contained materials, ODS, etc.	: Incineration Plant Detoxifying of hazardous substances by high temperature incinerator
4. Final Treatment Landfill of solid wastes	: Compressor (Baler) Reduce landfill wastes

Source: JICA Survey Team

3.4.2. OFFSHORE AND BEACH ENVIRONMENT FACILITY PLAN

(1) Offshore tank cleaning barge

Offshore tank cleaning barge will be introduced for the cleaning of residual sludge in the cargo oil tank of crude oil tanker and oily water and sludge in the slop tank. Offshore tank cleaning work by one (1) Offshore tank cleaning barge (with tank cleaning devices) cargo oil tank of crude oil tankers will be carried out and ten (10) crude oil tankers (VLCC) in a year will be accepted conditioned that safe operation shall be secured. After the tank cleaning, required volume of waste oily water to be transferred and treated at shore facility is as follows.

- Tank cleaning water (for Cargo oil tank) : about 1,000 kL
- Slop oil (Oil contents) :100 – 300 kL

The basic concept and outline of the offshore tank cleaning barge is as follows. Basically its function is the transfer of cleaning water and sludge to the offshore tank cleaning barge after washing with high pressure water at the cargo oil tank.

Table 3-3 Basic Concept of the Oil Colleting Barge

Function	Storage of collected waste oily water (collecting oil tank 250 m^3x4) Oily water separator
Loa x Breadth x Depth	Abt. 50 m × 13 m ×4.0 m

Source: JICA Survey Team

(2) Mobile Decontamination System

With the current practice, oil tank cleaning is not enough and, therefore sludge or the residual oils may possibly be distilled by washing sea water when the cut block is sunk at high tide. In order to take measures against this issue, more severe cleaning process with the Mobile Decontamination System (MDS) for cleaning bunker oil (FO) tanks is planned.

MDS cleans inside of the tank with high pressure water and collect washed water and residual oil by the vacuum unit. The recovered washing water and residual oil are separated in oil and water by a centrifugal separator. The separated water is reused as washing water, and the oily water and sludge are finally processed with TSDF. Five (5) sets of MDS will be introduced. Mobile Decontamination System will be introduced and it is planned to outsource its operation to private enterprises selected by GMB.

Table 3-4 Specification s of Mobile Decontamination System : MDS

Planned number to be cleaned	360	ships/ year
Required cleaning day	7	days/ ship
Possible working day / year	52	times /year /MDS
Number to be introduced	5	sets
Possible number of ships to be cleaned	260	ships / year

Source: JICA Survey Team

Figure 3-3 Detailed Image of Mobile Decontamination System

3.4.3. ENVIRONMENT FACILITY PLAN FOR HAZARDOUS MATERIAL TREATMENT ON LAND

(1) Baler

In order to actively and safely utilize the landfill site of TSDF, glass wool which occupied about 62% of wastes to be landfilled, will be compressed by using Baler. Baler can simply compress to 1/10 of the volume thus this can contribute elongation of life of the landfill site. The amount of waste to be landfilled is 2500 tons per year, and two (2) sets of Baler will be introduced.

- Planned volume 2,500 tons /year x specific gravity 0.05 tons /m3
- Volume to be dealt 50,000 m3/ year

Table 3-5 Specifications of Baler

Volume of glass wool	50,000	m^3/ year
Selected capacity	65.0	m^3/h
Number to be introduced	2	Sets (100% backup)

Source: JICA Survey Team

(2) Small High Temperature Incinerator

Based on the type of wastes generated from ship, the incinerator of this Project is planning a fluidized bed with water cooled stoker, and that can handle a wide variety of wastes, from liquids such as waste oil and waste liquid to sludge, sludge such as oil sludge, and even solid waste. The combustion gas is re-incinerated in a second chamber with a temperature of 1,200 ° C. or more for a retention time of about 2 seconds or longer for the re-incinerate unburned in the exhaust gas sufficiently. As a result of the survey, the amount of waste to be incinerated now is 5,700 tons / year. PCB contains substances (including plastics) that require internal high temperature incineration are halved.

In order to stably incinerate PCBs at 1400 ° C or higher and to secure an outlet temperature of 1100 ° C by a small fluidized bed furnace this incinerator is sets the furnace temperature to 1400 ° C.

Table 3-6 Specifications of Small High Temperature Incinerator

Planned Volume	5,700	t/year

Planned Volume High Temp (50%)	2,850	t/year
Planned Volume Low Temp (50%)	2,850	t/year (8.0 t/day)
Temp. of Second chamber	1,400	Deg. C

Source: JICA Survey Team

(3) Improvement of Effluent Treatment Plant (ETP)

3) Planning of Oily water separator

a. Waste oil colleting (Oily Water separation) system

The separated oil-containing wastewater generated during the recovering process of the waste oil is treated in a wastewater treatment facility and then drained as clear treated water. Oil sludge generated during recovery process of waste oil is treated with a sludge treatment plant.

b. Wastewater treatment system

Water treated with waste oil recovery system is discharged to the sea through rivers. Therefore, a higher performance of oil-water separation is required for the wastewater treatment system.

In the planned treatment process, the characteristics of wastewater is high concentration of oil and the concentration fluctuates drastically. Another feature is that the SS[2] is included in addition to the oil content, and the wastewater is mainly the sea water. Due to the characteristics of such wastewater, it is adopted the physical / chemical treatment method also in wastewater treatment of this plan. The planned water quality of the discharged water is with oil content of 5 ppm or less and SS 50 ppm or less.

4) Capacity of Oily Water Treatment (ETP) system

a. Sludge treatment plant

- Planned generation volume: 2,360 t / year (yard generation amount + tanker generation amount)
- Purification treatment volume: 2,360 t / year

b. Wastewater treatment plant

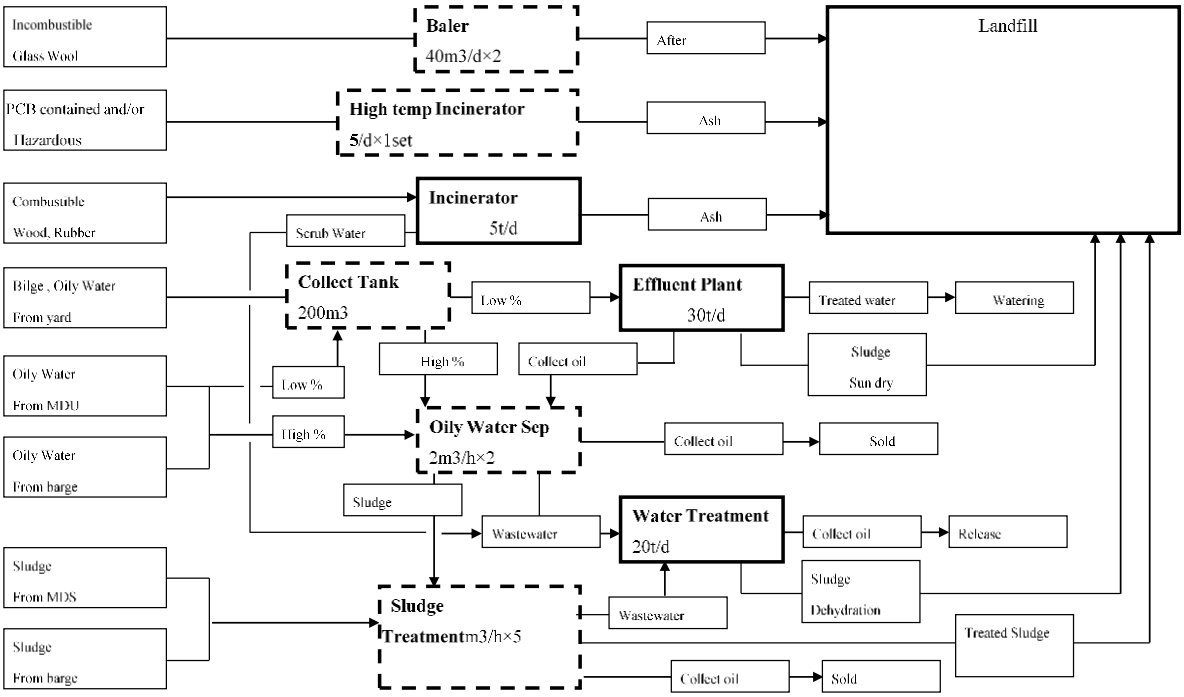
- Planned generation volume: 34,700 t / year (yard + MDS + tanker generation volume)
- Average oil content wastewater: 5% (as the amount of high-oil-containing withdrawn)
- Throughput: 33,000 t / year

c. Oily water separator

- Planned generation volume: 1,750 t / year (wastewater treatment receiving separated oil-containing wastewater)
  1,800 t / year (generated from MDS)
- Average oil content: 40%
- Throughput: 3,550 t / year
- Oil sales volume: 1,420 m 3 / year

[2] SS: Suspended Solids, is a generic term for insoluble substances having a particle diameter of 2 mm or less suspended in water.

Entire wastes treatment flow with material balance is shown on the Figure 3-4.



Source: JICA Survey Team

Figure 3-4 Entire flow of the improved waste treatment system at TSDF

3.4.4. MULTI PURPOSE WORK BOAT

While the tanker cleaning by Offshore tank cleaning barge, it is necessary to prevent accidents such as oil spill and fire from the ship, but in the event that these accidents happen, introduce one (1) Multipurpose Work Boat that can be used for recovery of spilled oil, firefighting, rescue operation etc.

Table 3-7 Particulars of Multi-Purpose Vessel

Hull Shape	Mono hull
Navigation Area	Coastal
Gross Tonnage	Abt. 199 GT
L xB x D	31.50m x 9. Bollard 0m × 4.80m
Main Engine	Mid Speed 4 stroke Diesel x 2sets
Propulsion System	Z Type Propeller x 2 sets or equivalent

Source: JICA Survey Team

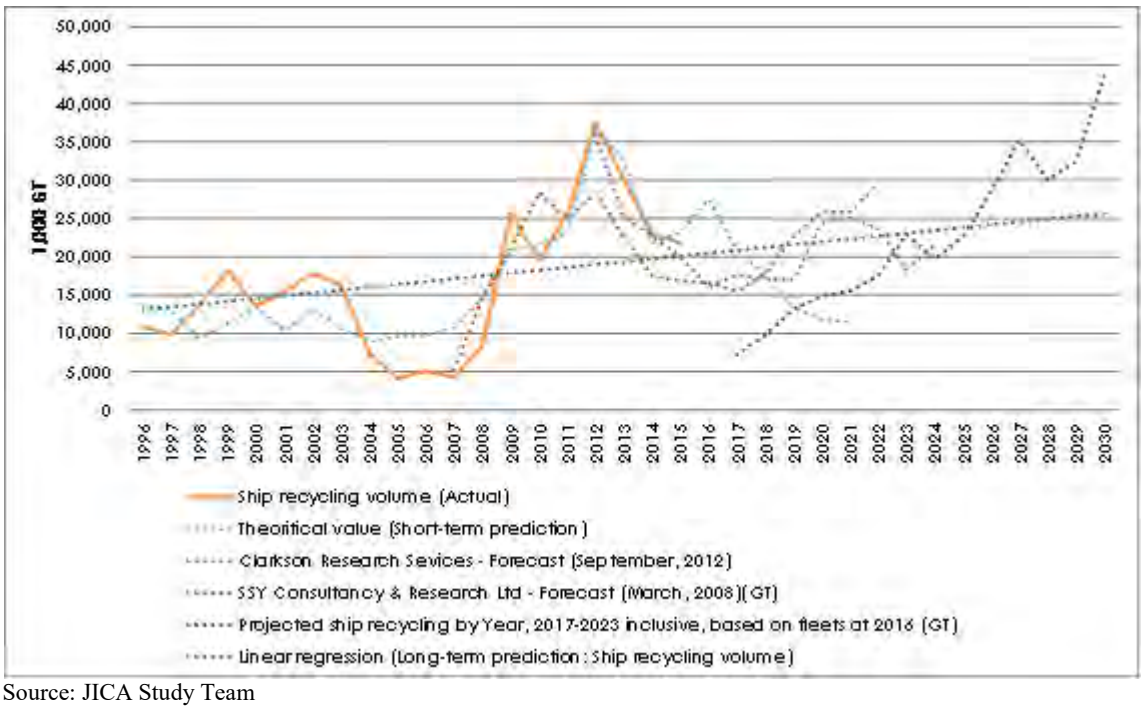
The ship shall be organized to operate by GMB or a shipping operator selected as the private contractor at any time in accordance with Indian domestic law.

3.5. DEMAND FORECAST

In this report, as a demand forecasting survey of the global ship-recycling volume, a multiple regression equation used in the preceding JICA information collection study.

3.5.1. LONG-TERM DEMAND FORECAST

Based on the result, the demand forecast for short-term ship recycling volume until 2021 was analyzed to be in the downward trend, although there would be an increase toward 2016 at peak. Long-term demand forecast is made by using the theoretical values of explanatory factors the multiple regression equation which are obtained from the short-term demand forecast model with a linear regression analysis technique. Based on this analysis result, a trend was obtained in that the demand forecast for ship recycling volume is expected to reach about 20 million gross tons by 2020, and reach about 30 million gross tons by 2040.



Source: JICA Study Team

Figure 3-5 Long-term demand forecast

As a long-term trend of global demand for ship recycling, although it is on an upward trend and it is expected to temporarily decline in the short term, global demand for recycling of vessels f is analyzed as being on an increasing trend.

11. ENVIRONMENT AND SOCIAL CONSIDERATION

11.1. PROJECT COMPONENT

(1) Status of the existing EIA

GMB contracted MECON Ltd for the preparation of the EIA of this Project. Environmental Clearance (EC) was obtained from MoEFCC in November 2nd, 2016. Following is a brief summary of the processes taken until obtaining EC:

(2) Gaps with JICA guideline and supplementary EIA study

The JICA Study Team initially reviewed the EIA (November 2015 version) prepared by GMB, taking into account the requirements of JICA Guideline for Environment and Social Consideration (2010). The following gaps and issues were identified in the process:

- Construction of dry dock is not included in the updated Project scope, large mobile cranes etc., are new additions to the Project and the treatment capacity of the new effluent treatment plant (ETP) in TSDF has changed from 30 t/day to 120 t/day hence not included in the EIA.
- The JICA survey team proposed additional baseline survey on sediment quality, soil quality (around TSDF and yard area), air quality (asbestos) and groundwater quality (around TSDF and yard area).

Considering the above points as well as recommendations from the JICA Environmental Advisory Committee (EAC), the JICA Study Team conducted a supplementary EIA study. In summary, the following study was conducted as part of the supplementary EIA study.

- Implementation of baseline environmental survey for sediment quality, soil quality, air quality (asbestos) and groundwater quality. As per recommendation of JICA EAC, TBT accumulation in benthos was also studied.
- Impact assessment for the construction stage based on the construction plan and preparation of construction EMP and EMoP.
- Impact assessment for the operation stage based on the updated Project scope and preparation of EMP and EMoP.
- Stakeholder consultation in the scoping and draft final reporting stages.

(3) Amendment of the approved EIA

The approved EIA study commissioned by MECON is required to be updated since the scope of the Project has changed from the approved EIA as per JICA's Preparatory survey. This process should be done during the detailed design stage of the Project including of obtaining necessary approvals from MoEFCC.

11.2. REGULATORY FRAMEWORK

11.2.1. ENVIRONMENTAL LAWS AND REGULATIONS

(1) EIA procedure

Under EIA Notification 2006, the Ministry of Environment and Forest and Climate Change (MoEFCC) issues Ship recycling projects are classified as Category A regardless of the project scale.

(2) CRZ Notification

As per CRZ Notification 2011, ship breaking projects are required to obtain CRZ clearance from MoEFCC. CRZ clearance of this Project has been acquired from MoEFCC in November 2nd, 2016, together with the issuance of EC.

(3) GPCB permits

Table 11-5 shows the permits required from GPCB for this Project.

Table 11-1 List of permits required from GPCB

Component	Type of permit	Responsible organization	Timing of acquisition
Improved TSDF	Consolidated Consent and Authorization (CC&A)	GMB/TSDF operator	Before operation
Improved yard	Consolidated Consent and Authorization (CC&A)	Yard operator	Before operation

Temporary concrete plant for construction	Consent to Establish (CTE) and CC&A	Construction contractor	Before construction

Source: JICA Study Team

11.2.2. ENVIRONMENTAL LAWS AND REGULATIONS

Table 11-7 shows the national environmental standards relevant to this Project.

Table 11-2 List of national environmental standards relevant to this Project

Category	Name
Ambient air quality	National Ambient Air Quality Standards 2009
Stack emission gas	Environment (Protection) Rules 1986: Common Hazardous Waste Incinerator CPCB Norms for Stack monitoring.
Noise	Noise Pollution (Regulation and Control) Rules 2000
Seawater quality	Environment (Protection) Rules 1986: Primary Water Quality Criteria
Drinking water quality	Drinking Water Specification IS:10500 (2012)
General discharge standard	Environment (Protection) Rules 1986: General Standards for Discharge of Environmental Pollutants CPCB Norms for Stack monitoring.
Discharge standard from ETP	Environment (Protection) Rules 2015: Treated Effluent Quality of Common Effluent Treatment Plant CPCB Norms for Stack monitoring.

Source: JICA Study Team

11.3. CURRENT ENVIRONMENTAL STATUS

11.3.1. CLIMATE & HYDROLOGY

The climate in Alang/Sosiya is broadly separated hot summer season (March-June), mild winter season (December-February) and south-west monsoon season (June-September). Average maximum temperature in summer and winter are around 40 °C and 30 °C respectively. Annual rainfall is about 700 mm, which falls mainly in the monsoon season. Wind direction is predominantly from north-west to south west. Alang/Sosiya area has a tidal difference of over 6 m during spring tide. Coastal currents are strong due this large tidal difference.

11.3.2. TOPOGRAPHY

A shallow rocky reef of approximately 500-1,500 m width extends along the coastal area of Alang/Sosiya. Mud and sand accumulates on top of these reefs to create mud flats. A sandy beach of approximately 25-200 m width runs along the shore.

11.3.3. POLLUTION

(1) Air quality

1) Ambient air quality

Air quality survey was conducted through the EIA during March-May 2015 at 5 sites around Alang/Sosiya. Surveyed parameters were PM10, PM2.5, SO2, NOx and CO. Following are the main findings of the survey:

- For PM_{10}, C_{98} values of all sites satisfied the 24 hour Indian standard.
- For $PM_{2.5}$, C_{98} values of all sites satisfied the 24 hour Indian standard.
- For SO_2, NOx and CO, C_{98} values of all sites satisfied the 24 hour Indian standard.

2) Air quality inside recycling yard/TSDF

Air quality survey was also conducted through the EIA at two yards and inside TSDF. Surveyed parameters were PM_{10}, $PM_{2.5}$, SO_2, NOx and CO. PM10 exceeded Indian standard at all the sites. PM2.5 exceeded Indian standard at one yard and at TSDF. Fugitive dust emission from yard activities are likely cause of high PM levels.

3) JICA supplementary survey (asbestos)

Asbestos survey was conducted and sampling was implemented inside the ship breaking yard and at TSDF. Sampling and analysis were conducted in accordance to OSHA method ID-160.

Asbestos concentration were all below the OSHA standard (0.1 f/cc), which implies that asbestos removal and handling works are undertaken in an appropriate manner.

Asbestos concentration at TSDF disposal site very slightly exceeded the OSHA standard presumed that there might have been some accidental leaks during the transportation and storage process with tear in the leak-roof bags or there might have been some error during the analysis for example by miscounting with glasswool fibers.

Asbestos concentration at the boundary of the ship recycling yard was below OSHA standard (0.1 f/cc).

(2) Water quality

1) Seawater

The EIA has conducted seawater quality survey in May 2015 at 8 locations around the Project sites. Although BOD levels slightly exceeded Indian standard at one site (SW3), other parameters were all under Indian standard. Hazardous substances such as heavy metals and PCBs were all below detection limit.

2) Groundwater

The EIA has conducted groundwater quality survey in May 2015 (dry season) at 4 locations around the Project sites. Since India has no groundwater quality standards, the results are compared with Indian drinking water standard (IS: 10500, 2012).

The results show no contamination by hazardous substances such as heavy metals as they were all below Indian drinking water standard. However, at some sites, concentration of TDS, magnesium, nitrate and sulphate exceeded Indian drinking water standard, which may be due to influences from farmland and sewage.

a. JICA supplementary survey

Since the EIA lacked baseline groundwater quality data around TSDF(4 sites) and ship recycling yard (2 sites). In addition, leachate water of TSDF landfill site was also collected for analysis. Analyzed parameters are cadmium, hexavalent chromium, lead, mercury, PCBs, PBBs, PBDEs, PCN, PAHs and TBT, which are except PAHs, hazardous substances listed in Appendix 1 and 2 of the HKC.

For groundwater, all parameters except lead were below detection limit. For lead, all sites except one site had lead levels exceeding Indian standard. While the cause of such lead levels are uncertain (i.e. natural or anthropogenic origin) it should not be interpreted as a representative baseline data of the area as the results are based on one-time survey in the wet season. Further regular groundwater monitoring will be necessary to obtain an accurate trend of groundwater

quality. For leachate, lead, mercury, PCBs and PBBs were above detection limit and the others all below detection limit.

For further verification, GMB requested the JICA Study Team to undertake additional survey in the dry season specifically for parameters that were above Indian standards (i.e. lead) or were relatively high (i.e. mercury and PCBs).

b. Additional survey

As per request of GMB, additional groundwater/leachate survey was implemented in February 2017 focusing on lead, mercury and PCBs. Sampling and analysis were conducted by a leading Japanese consultancy firm. Water samples were taken from the same wells as the supplementary survey plus one additional site inside TSDF. Following are the main findings of the groundwater survey:

- The values of pH and salinity were similar to the supplementary survey.
- Lead concentration (max value 0.007 mg/l) was significantly lower than the supplementary survey (around 0.12～0.21 mg/l) at all the sites and were also below Indian standard. Although the sampling sites are different, the results of the additional survey were similar to the values recorded in the EIA study (< 0.005 mg/l).
- Mercury concentration was below detection limit at all the sites and were also below Indian standard.
- PCBs concentration was below detection limit (< 0.5 mg/l) at all the sites and were also below Indian standard. The results were similar to the supplementary survey.

Following are the main findings of the leachate survey:

- The values of pH and salinity were similar to the supplementary survey.
- Lead concentration (0.001 mg/l by ICP/MS) was significantly lower than the supplementary survey (0.99 mg/l)..
- Mercury concentration (0.0002 mg/l by ICP/MS) was significantly lower than the supplementary survey (0.01 mg/l).
- PCBs concentration was below detection limit (< 0.5 μg/l) which was significantly lower than the supplementary survey (22.14 μg/l).

In general, the results of the additional survey were significantly lower than the supplementary survey, especially for groundwater lead concentration and leachate lead, mercury and PCBs concentration. Possible reasons for these differences are erroneous in case the samples were not pretreated sufficiently groundwater quality may differ with the season.

(3) Soil quality

A supplementary soil quality survey was conducted. Survey parameters for the ship recycling yard are cadmium, hexavalent chromium, lead, mercury, PCBs, PBBs, PBDEs, PCN, PAHs and TBT, which are except PAHs, hazardous substances listed in Appendix 1 and 2 of the HKC. For the TSDF sites, dioxin was measured.

The results were compared with Netherland and Canadian soil quality standards, as there are no Indian standards yet. Apart from lead and PAHs, all parameters were below detection limit at all the sites. Although lead and PAHs levels were relatively high, none of the sites exceeded Netherland and Canadian soil quality standards.

(4) Sediment quality

Sediment samples were collected from 10 sites (2 sites outside the ship recycling yard area). Survey parameters are cadmium, hexavalent chromium, lead, mercury, PCBs, PBBs, PBDEs, PCN, PAHs and TBT, which are except PAHs, hazardous substances listed in Appendix 1 and 2 of the HKC.

The table also shows the Australian and Canadian sediment quality guideline values for ad hoc comparison. However, note that these guideline values were used solely for reference purpose and may not be appropriate to apply for Indian environment. The main findings of the survey are as follows:

- For heavy metals, lead and cadmium were detected at relatively high levels but others were all below detection limit.
- For organic pollutants, PCBs levels were relatively high at 7 sites.
- Further regular monitoring will be necessary to obtain an accurate trend of sediment quality.

As per request of GMB, additional sediment survey was implemented in February 2017 focusing on parameters that exceeded the sediment guideline values namely cadmium, lead and PCBs. Sampling and analysis were conducted by a leading Japanese consultancy firm. Following are the main findings of the sediment quality survey:

- Cadmium concentration was less than 0.5 mg/kg at all the sites, which are lower compared to the supplementary survey (approx. range: 2～3 mg/kg). All sites were below the lower threshold of the Australian and Canadian guideline values.
- Lead concentration was in the range of 10～80 mg/kg, which are lower compared to the supplementary survey (approx. range: 100～300 mg/kg).
- While PCBs concentration was more or less similar to the supplementary survey, some sites were slightly higher than the supplementary survey (approx. range: < 0.01～0.1 mg/kg). Some sites exceeded the lower threshold of either the Australian or Canadian guideline value. Although PCBs values were relatively high for both surveys, these values are not at a level that will require immediate remedial action in case for example the values are compared with Japan's "Provincial Sediment Removal Standards (1975)" for PCBs, which is set at 10 mg/kg.

In the additional survey, cadmium and lead concentration were more or less an order of magnitude lower than the supplementary survey. Possible reasons for these differences are discussed below:

- There are some seasonal variation in intertidal mud accumulation and distribution.
- Although sediment samples were taken by referring to GPS data of the supplementary survey, there may have been some slight differences in the actual sampling locations.
- Although heavy metal analysis in the supplementary survey were conducted in accordance to EPA methodologies, erroneous results may be obtained in case the samples were not pretreated sufficiently.

11.3.4. NATURAL ENVIRONMENT

(1) Marine fauna

The EIA conducted marine plankton and benthos surveys along the coastal area of the Project site (100 m-2 km area from shore). As the results of the phytoplankton survey. Identified species were *Navicula*s spp., *Coscinodiscus* spp., *Nitzschia* spp., and *Surirella* spp. As to the zooplankton survey, identified species were foraminifera, copepods, decapods, polychaeta and gastropods. In addition to the above surveys, the EIA conducted benthos survey in the more nearshore area of each transect. Main species identified were polychaetas, gastropods, bivalves and crabs. The EIA also analyzed the heavy metal content inside a crab species (*Matuta lunaris*) caught near the Project site.

Under the he aim of the survey was to analyze the TBT concentration inside benthic species inhabiting the intertidal area of the ship recycling yards. However, the field survey team could only collect one live specimen namely a small crab. The crab was analyzed at the laboratory but no TBT was detected (DL: 0.01 mg/kg).

11.3.5. SOCIAL ENVIRONMENT

The JICA Study Team conducted social survey to understand the current social and economic status of Alang, Manar and Sosiya village, the neighboring villages of Alang Sosiya Ship Recycling Yard.

(1) Population

According to the Census 2011, the total population of Alang, Manar and Sosiya villages is approximately 13,000. Percent working population is around 40%, which is similar to Bhavnagar district.

(2) Livelihood

When the three villages are combined, 40% of the villagers were engaged in agriculture and animal husbandry, 30% in ship recycling related work and 16% in small shops. The results shows relatively high dependence on ship recycling at these villages. Income level of owner farmers is the same level as experienced ship recycling workers which is in the range of INR 10,000 to 15,000 per month. Income of employed agriculture workers and inexperienced ship recycling workers are more or less at the same level which is around INR 5,000 to 8,000 per month.

(3) Fishery

Since the nearshore area around Alang/Sosiya Ship Recycling Yard is designated as a port area, fishing activities are prohibited inside the designated port areas. None of the interviewed villagers in the JICA Social Survey were engaged in fishery.

(4) Social infrastructure

1) Water and sanitation

Water supply to Alang Yard is supplied through pipeline from Gujarat Water Supply Board.

2) Educational institution

Educational institutions in the villages are primary school to upper primary school and the highest class is 8 standards. There are 5 schools in Alang village, 3 schools in Manar village and 2 schools in Sosiya village.

3) Medical facility

Main hospitals in Alang Sosiya Ship Recycling Yard are Alang Hospital and Red Cross Hospital. Both hospitals cater for ship recycling workers and surrounding villagers. There are also small private clinics in the villages but are only capable of first-aid treatment.

(5) Level of education

According to Census 2011, male literacy rate in Alang-Manar village and Sosiya village are above 80% whereas female literacy rate is 55 to 60% which is lower than male.

(6) Religion

According to Census 2011, majority of the population in Alang-Manar village are Hindu (97.28%) and the rests consist of Muslim (2.47%), Jain (0.18%) and others.

11.3.6. WORKING ENVIRONMENT OF SHIP RECYCLING INDUSTRY

Total of 60 workers were interviewed as a part of JICA Social Survey. Based on the JICA Social Survey and existing information, following section outlines the current working environment in Alang Sosiya Ship Recycling Yard.

(1) Legal framework on working condition

1) Occupational safety

Occupational safety is regulated by India Factories Act 1948 and Gujarat Factories Rule 1963. Safety measures such as preventive measures such as fire and explosion, wearing protective equipment / safety belts, placement of safety personnel, etc. are prescribed in the Gujarat State Factory Regulations. In addition, Ship breaking code 2013 also specifies occupational safety measures of ship recycling business in detail according to the above regulations.

2) Labour insurance

In accordance to Employees' State Insurance Act 1948, it is mandatory for workers to join labour insurance (Employees State Insurance: ESI). Under ESI, workers are entitled to receive financial support for their medical services[3]. Also, in case of an accident, compensation will be made towards worker's families from the employers based on Public Liability Insurance Act 1991.

(2) Current condition of workers

1) Number of workers

The number of workers employed in ship recycling yards fluctuates depending on the ship recycling demand. Based on the information provided from GMB and Alang Sosiya Ship Recycling General Workers Association (ASSRGWA), the number of workers is usually around 20,000 of which most are male.

2) Home state of workers

Most of the workers employed in ship recycling yards are migrant workers from outside Gujarat state, majority of which are from impoverished states in northern India. Home states of the workers interviewed in JICA Social Survey were Orissa (47%), Bihar (27%), Jharkhand (13%) and Uttar Pradesh (12%). These four states constituted 99% of the total interviewed workers.

3) Religion of workers · caste

All workers interviewed in the JICA social survey were Hinduism. Approximately 30% of the workers belonged to one of Scheduled Caste, Scheduled Tribe and Other Backward Caste (OBC).

4) Age and year of experience of workers

Around 70% of the workers interviewed in the JICA Social Survey were aged between 25-40 years old. Around 70% of the workers had less than 10 years' experience in ship recycling work, and around 40% less than 1 year of experience. Workers with more than 10 years' experience were around 12%.

(3) Occupation type and wage

1) Occupation type

Around 100 to 150 workers are required to dismantle one ship. Each yard employs workers in different positions including managers in charge of worker's safety and recycling processes,

[3] According to Alang Hospital, government is responsible for 60% of insurance whereas employers and employees cover 20% respectively. Some recyclers (employers) also covers the portion of employees.

crane and winch operators, gas cutters, and unskilled workers handling non-ferrous metal, ropes and steel plates.

The working hours are basically from 8 to 17 o'clock, a break time of 1 hour in the day and 30 minutes in the afternoon is established. It does not run at night, the holiday is only Sunday.

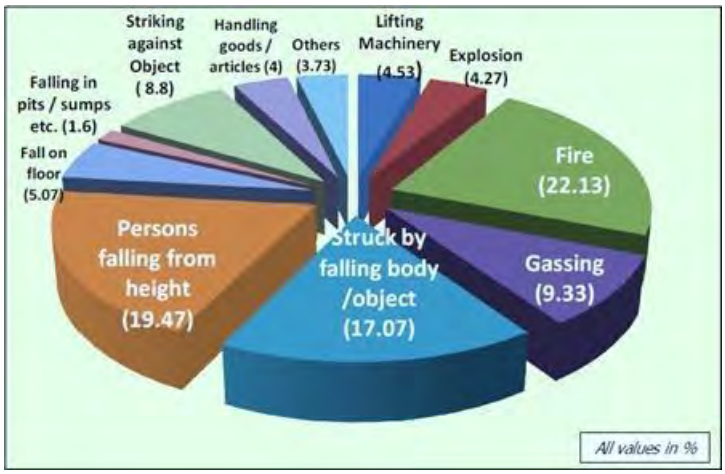
2) Workers' wage

Depending on the position of workers, required skill differs and so does their wage level. Monthly wage for supervisor level is INR 15,000, heavy equipment operator is INR 17,000, gas cutter is INR 10,000 and unskilled worker is between INR 8,000 to 10,000. Table 11-41 shows position-wise wage level of workers.

(4) Occupational accidents

3) Status of accidents

Figure 11-26 shows the probable causes of fatal accidents in Alang Sosiya Ship Recycling Yard. Major causes of fatal accidents are fire and explosion (26.40%), falling from height (19.47%) and struck by falling objects (17.07%).



Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

Figure 11-1 Causes of fatal accidents in Alang Sosiya Ship Recycling Yard

Table 11-42 shows the statistics of accidents during 2011-2015 in Alang/Sosiya based on the report by European Community Ship owners' Associations (ECSA). There were 41 cases of fatal accidents and 19 cases of injury accidents during this 5 years period. The statistics shows that over 70% of the fatal accidents occurred onboard. Accidents caused by fire/explosion and falling from heights commonly lead to death.

Table 11-3 Statistics of accidents during 2011-2015

Causes of accidents	Location	Injury	Death
Fire and explosion (in pump, engine room and during gas cutting)	On board	2	11
Falling from heights	On board	—	10
Struck from falling object including cutting block (Gas cutting)	On board	5	9
Crane operation (Struck from falling object)	Yard	4	6
Winch operation (wire breakage, entrainment)	Yard	8	5
Total	-	19	41

Source: Prepared by JICA Survey Team based on ECSA Technical Report "ECSA Fact Finding Visit to Indian Ship Recycling Yards Alang-Sosiya, April 2016"

(5) Health status of ship recycling workers

Workers were interviewed regarding their health issues. However, no health issues or complains were raised by the interviewed workers. Therefore, in order to further investigate workers' health issues, results from past workers' medical checkup at the yards and information provided by the hospitals in Alang Sosiya Ship Recycling Yard were studied. In addition, past studies of Indian research institution were also reviewed.

1) Result of worker's medical checkup

According to one of the DISH certified medical doctor who has been examining workers in Alang Sosiya Ship Recycling Yard for the past 10 years, common symptoms among the workers are skin diseases and hypertension.

In addition to the above medical checkup, some certified yard voluntarily had conducted further medical checkup of its workers for the past 12 years. According to the yard owner, some workers have cough and skin issues but no asbestos related symptoms have been identified so far. The owner informed that cough was noticed mainly among cigarette smokers and the main causes of skin issues was likely to be attributed to unhygienic living conditions.

2) HIV/AIDS

It is reported that the adult HIV prevalence rate in the area was 0.23% in 2015 which is the same level as the national average. As for the ship recycling workers in Alang/Sosiya, survey was carried out the targeting 2,155 workers in 2004. Based on the survey, HIV prevalence rate was 0.70% which is higher rate than Gujarat state and the Indian national average.

(6) Living condition of workers

Majority of the workers are living in dormitories provided by ship recycling yards, self-made wooden house and rented shanty dwellings, etc. GMB is in catering sanitary facilities across the 10 km stretch of ASSRY. At present, there are total of seven such complexes in operation.

11.4. ANALYSIS OF ALTERNATIVES

11.4.1. WITHOUT PROJECT OPTION

While there will be no construction related impacts, the following issues are likely to arise without this Project:

- The global ship breaking capacity will become limited if the number of HKC certified ship recycling yards in Alang/Soisya do not increase. This may result in a global increase in old and unsafe ships.
- The ASSRY may lose its competitiveness against other countries, which may result in the decline of the ship recycling industry in the region. This will subsequently lead to the decline in employment opportunities and regional economy.
- Environmental risks from ship recycling activities will remain as present.

11.4.2. ANALYSIS OF ALTERNATIVES OF SHIP BREAKING METHODS

The following four types of ship breaking methods are compared to analyze the most suitable option for the ASSRY, taking into account environmental impacts, costs, labor safety and so on.

Option 1: Ship breaking by beaching method as done presently
Option 2: Pre-removal of hazardous material at a new dry dock and then ship breaking by beaching method
Option 3: Pre-removal of hazardous material at a new berthing facility and then ship breaking by beaching method

Option 4: Ships will be broken on land by constructing a new slipway at each yard

As per the alternative analysis, beaching method is considered most appropriate for ASSRY for the following reasons:

- Technical aspect: High level of maintenance work is required for non-beaching methods.
- Cost: Beaching method requires the least investment for construction and maintenance and favorable in ASSRY in terms of geographical features.
- Social: High operational cost of non-beaching methods may result in loss of competitiveness of ASSRY, which may result in the decline of the ship recycling industry in the region.
- Environment: Dry-dock method will eliminate the risk of pollution by ship paints. The merit of dry-dock however is likely to become less in the future as ships using hazardous paints are likely to gradually decrease through recent enforcements. Non-beaching methods will have additional potential environmental impacts such as loss of habitats, coastal erosion and dredging associated water pollution.
- Labor: No major difference between the four methods.

11.5. SCOPING AND TOR OF THE EIA STUDY

Scoping was conducted by referring to the current environmental status, opinions of stakeholders and JICA's "Guidelines for environmental and social considerations (2010)", which provides a list of items to be considered in the scoping process. The potential impacts of each scoping item were rated in accordance to the following criteria:

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown.
D: No impact is expected

As a result of scoping, we examined the TOR of the environmental and social consideration survey in order to evaluate the influence in detail for the items that may have a negative influence. Table 11-50 of this volume shows the results of scoping and survey TOR.

11.6. IMPACT ASSESSMENT AND MITIGATION MEASURES

11.6.1. IMPACT ASSESSMENT

This Section assesses the impacts for items that were rated with potential negative impacts in the scoping exercise. Note that mitigation measures are not considered in the assessment. Table 11-47 summarizes the results of the impact assessment.

Table 11-4 Results of impact assessment

	Item	Rating of scoping		Rating after impact assessment	
		Construction	Operation	Construction	Operation
1	Air pollution	B-	A-	B-	B-
2	Water pollution	A-	A-	B-	B-
3	Soil pollution	A-	A-	B-	B-
4	Waste	A-	A-	B-	B-
5	Noise	B-	B-	B-	B-

	Item	Rating of scoping		Rating after impact assessment	
		Construction	Operation	Construction	Operation
6	Odor	D	B-	D	D
7	Sediment	D	A-	D	B-
8	Ecosystem, flora/fauna	D	A-	D	B-
9	Topography	D	B-	D	D
10	Livelihood, living environment	B-	B+	D	B+
11	Water use	D	B-	D	C-
12	Infectious diseases (HIV/AIDS etc.)	B-	B-	B-	B-
13	Occupational safety	B-	A-	B-	B-
14	Accidents	B-	B-	B-	D

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown.
D: No impact is expected

11.6.2. MITIGATION MEASURES (CONSTRUCTION STAGE)

This Section describes the planned mitigation measures for items that are assessed to have potential negative impacts in the construction stage.

(1) Air pollution

1) Fugitive dust and exhaust gas emissions from construction vehicles

In order to minimize fugitive dust and exhaust gas emissions from the construction vehicles which may deteriorate the surrounding air quality, covering of truck loading bed, check vehicles, etc., shall be carried out.

2) Dispersion of fugitive dust from yard improvement works

In order to minimize to deteriorate the surrounding air quality through dispersion of fugitive dust by yard improvement works (excavation and ground-levelling works), water spraying of exposed surfaces, covering of unused stockpiles shall be carried out.

3) Dispersion of fugitive dust from concrete batching plant

In order to minimize to deteriorate the surrounding air quality by various fugitive dust sources by a temporary concrete batching plant, utilization of concrete batching plant equipped with standard dust suppression measures, water spraying of exposed surfaces, covering of unused stockpiles shall be carried out.

(2) Water pollution

1) Pollution by uncontrolled disposal of excavated soil

Construction works at the ship recycling yards will generate excavated soil. The excavated soil will be reused inside the yard as material for raising the yard ground level (e.g. road section) in order to minimize risk of groundwater and seawater contamination. Figure 11-2 shows the how the excavated soil will be reused and covered.

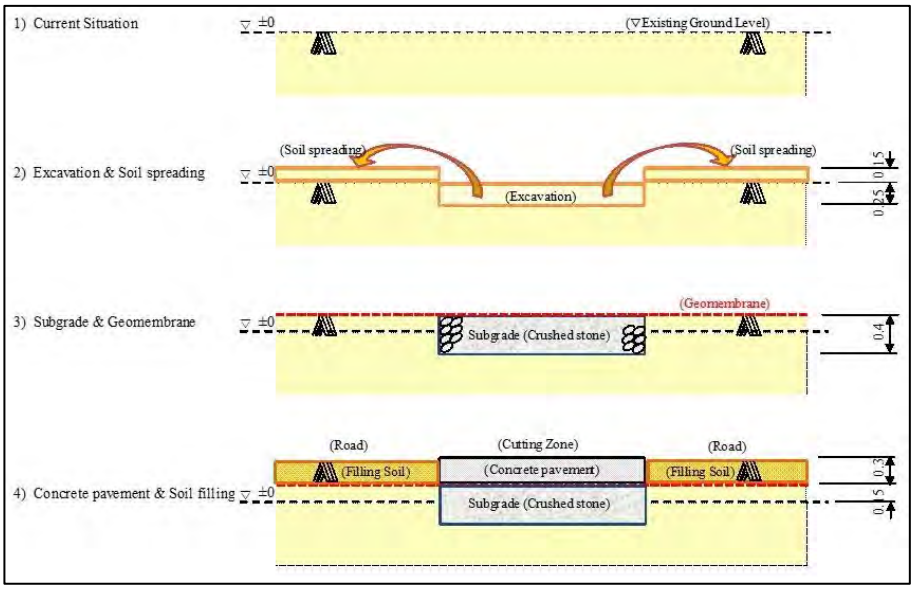


Figure 11-2 Process of excavated soil reuse

Source: JICA Study Team

2) Pollution by uncontrolled discharge of concrete washwater

Concrete washwater generated from the construction sites and concrete batching plant (e.g. agitator washout areas) will be collected and treated through an impermeable settling pond installed inside the premises of the concrete batching plant.

(3) Soil pollution

Soil pollution by excavated soil will be avoided by reusing inside the yard as material for raising the yard ground level.

(4) Waste

Major construction wastes will be handled as per Construction and Demolition Waste Management Rules 2016 and will be reused/recycled as much as possible to reduce waste volume. Hazardous wastes if any, will be handled as per Hazardous Waste Rules 2008 and treated/disposed at GPCB authorized facilities after obtaining authorization from GPCB.

(5) Occupational safety

The Construction Contractor will be required to prepare an Occupational Health and Safety Plan in accordance to Indian laws and regulations and JICA's "The Guidance for the Management of Safety for Construction Works in Japanese ODA Projects" and obtain approval from GMB and other relevant organizations if necessary.

11.6.3. MITIGATION MEASURES (OPERATION STAGE)

This Section describes the planned mitigation measures for items that are assessed to have potential negative impacts in the operation stage.

(1) Air pollution

1) Impacts of stack emissions from TSDF incinerators

The EIA prediction shows that the new incinerator will have negligible impacts on the local air quality. The predicted sum concentrations are also below the 24-hour national ambient air quality standard (PM_{10}: 100 µg/m^3, SO_2: 80 µg/m^3, NOx: 80 µg/m^3) at all the stations.

Impacts of incinerating PCB containing materials are considered negligible as the new incinerator is designed to destruct PCBs into constituent elements through the high-temperature incineration process (minimum of > 1,100 °C with over 2 seconds retention time). The incinerator will be designed so that formation of hazardous incineration byproducts such as dioxins are minimized by rapid cooling of flue gas.

2) Impacts of yard operation

a. Impacts of asbestos handling

Currently asbestos are removed and handled by qualified yard workers or by GPCB authorized operators thereby measures to prevent to disperse asbestos in the air are taken. If these measures employed appropriately risk of pollution by asbestos dispersion is considered as minimim:

- Asbestos handling in the yard area are undertaken only in dedicated facility equipped with negative pressure chamber and HEPA filter exhaust outlet.
- Wetting of asbestos parts during removal and handling works.
- Removed asbestos are contained in specialized leak proof bags and stored in dedicated storage facility until transport to TSDF.
- At TSDF, asbestos wastes are solidified with cement at a dedicated disposal site.

b. Impacts of refrigerants handling

Refrigerants may contain ozone depleting substances (ODS) and green-house gases (e.g. HFC, HCFC) are currently removed from ships by authorized persons and then sent to customs. This procedure may change as customs are expected to no longer accept refrigerants in the future, yard operators will be required to treat as per the conditions written in the EIA as follows.

- When recovering ozone-depleting substances (ODS) or refrigerants (CFC-12, HCFC-22, HFC, etc.) from the ship, store them in a dedicated place to prevent leakage to the atmosphere.
- Recycle and recover the recovered refrigerant through an authorized dealer.

c. Impacts of gas-cutting works

Gas cutting of ship parts may release heavy metals with toxic fumes into the atmosphere. To prevent such release of toxic fumes it is recommended to remove paints prior to gas cutting. However, such practice is too time consuming and impractical thereby it is considered that risk of pollution will be remain. For the time being, regular air quality monitoring will be conducted in the yard and surrounding areas to check the pollution status.

3) Impacts of waste transportation

Waste transportation (solid waste) between the recycling yard and the TSDF is currently undertaken on vehicles equivalent to 2 ton trucks. Because the traffic volume of waste transport vehicles per day from the recycling yards after the project completed is expected relatively small and the range of travel is limited, the influence on air quality is considered to be minimal

(2) Water pollution

1) Impacts of ship breaking activity in the intertidal zone

In order to prevent oil spills/leakage into intertidal zone during ship recycling activity is expected to decrease the negative impact significantly through the employment of MDS and large mobile crane.

2) Impacts of yard operation

The risk of water pollution by the rainwater runoff from yard operation is expected to decrease significantly through the concrete pavement of the cutting area and storage area of dismantled parts.

3) Impacts of tank cleaning vessel

There is a risk of accidental oil spill during the operation of offshore tank cleaning barge as it will be conducted in offshore. By installation of oil boom and stand-by of oil spill response vessel (Multi-purpose response vessel) during tank cleaning works are planned so that water pollution can be minimized in case of such oil spill incidents.

To reduce the volume of oily water treatment at TSDF, low-oil content oily water generated through the tank cleaning process is planned to be discharged with the lower to sea after treatment by onboard ETP

Although, there is no effluent discharge regulation in India, Environment (Protection) Amendment Rules 2015: effluent standards for common effluent treatment plants (into sea) will be applied. Treated effluent will be monitored continuously and the water quality of the receiving sea area will also be monitored throughout the operation. In case of any detection of water pollution or exceedance of discharge standards, operation will be ceased immediately.

4) Impacts of TSDF effluent treatment plant

In this project, new ETP (120 m^3/day) will be installed in TSDF. Under full operational condition, the total effluent generated from the existing and new ETPs will add up to 150 m^3/day. To minimize such pollution risks, the following measures will be implemented:

- Wastewater will be treated to levels below the effluent standard set under Environment (Protection) Rules, 1986 (Schedule VI) and treated effluent will be reused as far possible within the TSDF facility so to minimize discharge outside TSDF.
- Continuous monitoring of treated effluent concentration through automatic/online monitoring system as per requirement of EC.
- Pre- and post-effluent concentration will be monitored regularly to check the effectiveness of the ETP.

Appropriateness of treated water to discharge into the rainwater drainage outside should be studied in the D/D stage together with an impact assessment on downstream water use.

(3) Soil pollution

1) Impacts of TSDF incinerators

Emission gas from the TSDF incinerators will have negligible impact on ambient air quality, which also can be implied that potential for soil pollution from the incinerator emissions will be minimal including PCBs.

2) Impacts of yard operation

The risk of soil pollution from yard operation is expected to reduce significantly through the yard improvement works as pollutants will be contained within the concrete flooring areas. Toxic fumes from the gas-cutting works may pollute the soil. Therefore, for the time being, regular soil quality monitoring will be conducted in the yard area to check the pollution status.

(4) Wastes

The Project will have the following positive impacts regarding waste:

- The lifespan of the TSDF landfill will be extended significantly as waste volume can be reduced by the baler and high-temp incinerator.
- Oily sludge can be disposed at the TSDF landfill in a more stable state as most of the oily content will be removed through the new oil sludge treatment plant.
- Hazardous wastes with persistent organic pollutants (e.g. PCB containing wastes) can be

disposed at the TSDF landfill in a safer state through thermal treatment by the high-temp incinerator.

(5) Noise

Noise levels from recycling activities are expected to be of similar level as present, as there will be no significant additional noise sources generated through this Project.

(6) Odor

Therefore, odor impacts are unlikely to occur as there will be no additional odor sources generated through this Project.

(7) Sediment

The risk of sediment pollution is expected to reduce significantly as less pollutants will enter the sea through the implementation of the project. However risk of pollution by paint chips can not be avoided perfectly regular sediment quality monitoring will be conducted in the sea area to check the pollution status.

(8) Ecosystem

Risk of marine pollution is expected to reduce significantly through this Project. The abundance and diversity of marine life will be monitored regularly to see how marine life will change over time.

On the other hand, as there will still be risk of pollution by falling paint chips, benthos TBT concentration will be regularly monitored to check the impacts of paint chips on benthos.

(9) Topography

The new jetty for the Offshore tank cleaning barge may not cause coastal erosion or accretion by interrupting the longshore littoral drift due to its limited length (around 50 m) and sufficient spacing between the piers (5 m spacing).

(10) Infectious disease

According to existing information, HIV infection is not uncommon among the yard workers. To minimize spreading of HIV, HIV/AIDS awareness program will be implemented as part of the GMB training program.

(11) Occupational safety

1) Occupational accidents

The fatal accidents occurring in the ship recycling yards previously are preventable providing that standard safety practices are implemented as in certified yards. Training of yard workers and managers on occupational safety are also important and necessary approach to prevent accidents. In this respect, the Project will strengthen and improve the current GMB safety training programs.

2) Health impacts

a. Impacts of asbestos handling

The results of the JICA asbestos survey imply that asbestos removal works are undertaken in a safe manner as asbestos concentration in work environment was below OSHA standard. Therefore, the health risk of asbestos handling will likely be low providing that current asbestos handling protocol is appropriately implemented. Regular health checks are being done and also will be implemented for workers involved in asbestos handling for more than 30 days/year, which is a requirement under the EC (Specific conditions xiv) of this Project.

b. Impacts of gas-cutting works

Paints coated on ship plates may contain hazardous substances such as heavy metals. Yard workers and operators will be trained though GMB's training program so to raise their awareness on the health risks and importance of employing appropriate safety measures.

11.7. ENVIRONMENTAL MANAGEMENT PLAN

Based on the environmental impact assessment, an Environmental Management Plan (EMP) was prepared including mitigation measures against the anticipated environmental impacts, the responsibility for its implementation and supervision, and estimated cost. If necessary, the EMP should be revised in the detailed design phase in line with the progress of the Project plan and design. Table 11-50 in the Final Report shows the detail.

11.8. ENVIRONMENTAL MONITORING PLAN

Table 11-51 and Table 11-52 in the Final Report show the EMoP for the construction and operation stages respectively. EMoP for construction stage shall be revised in the process of the detailed design, construction plan as needed. The operation EMoP was developed based on approved EIA, conditions of EC, CPCB guidelines, draft monitoring plan of GMB and JICA Study Team's technical judgement. Monitoring form to be used for reporting to JICA is attached as Appendix - 11.

11.9. IMPLEMENTATION STRUCTURE

Various organizations will be responsible for implementation and supervision of the EMP/EMoP. The GMB's Environmental Cell will be responsible for the overall management and supervision of the recycling yards and TSDF and implementation of ambient environmental monitoring.

Environmental monitoring and lab analysis are planned to be assigned to a research institution. The GMB Alang office will be responsible for inspection of recycling yards and implementation of GMB's training programs for the yard workers.

Yard operators will be responsible for implementing HSE measures and environmental monitoring inside the yard area. SRIA will implement regular health checks under the supervision of DISH. GPCB will also conduct regular inspection at each yard.

TSDF operator will be responsible for implementing HSE measures and monitoring of TSDF facilities and surrounding environment. GPCB will also conduct regular inspection at TSDF.

11.10. STAKEHOLDER MEETING

As part of the EIA procedure, GMB holds a public hearing on Alan's GMB training facility on 20th October 2015 under the auspices of GPCB. Major environment-related questions / opinions and answers obtained at public hearings are shown in Table 11-54 of the Final Report.

In accordance with the JICA Guideline, two stakeholder meetings were held during the course of the study to explain about the study results. The meetings were attended by representatives from SRIA, GPCB, ship recyclers, ASSRGWA, cash buyers and so on. Table 11-54 and Table 11-55 in the Final Report show the main questions and opinions raised by the participants and responses from GMB/JICA Study Team

11.11. CONCLUSION AND RECOMMENDATIONS

- As the EMoP covers a wide range of monitoring parameters in various fields and furthermore, some target parameters are not included in any of the India's environmental standards, hence there are no nationally approved analysis methodology. In this respect, it is strongly recommended GMB to establish a standard sampling and analysis protocol for the EMoP and at the same time strengthen the capacity of the organizations/personal. A baseline survey should

also be implemented prior to operation in accordance to the established standard sampling and analysis protocol, especially for monitoring parameters that will be compared with baseline data for the assessment.

- Currently to avoid groundwater contamination, non-reusable effluent from the TSDF ETP is planned to be discharged into the rainwater drainage outside TSDF. However, the appropriateness of such discharge route should be studied in the D/D stage together with an impact assessment on downstream water use.
- Low-oil content effluent from the offshore tank cleaning barge is planned to be discharged into sea area after onboard treatment. Effluent standards of Environment (Protection) Amendment Rules 2015 are planned to be applied A detailed impact assessment should be undertaken in the D/D stage taking into account and the EMP and EMoP should be updated accordingly.
- Considering the long latency period of asbestos symptoms, retired workers should also be eligible for regular free health checks. Since there is no such scheme now, GMB should initiate to establish such scheme.
- Due to certain changes in the Project plan and design, new potential impacts are generated which are not assessed in the approved EIA. Table 11-57 shows the new potential impacts. GMB should therefore submit to MoEFCC an amended EIA with an impact assessment and obtain approval together with CRZ clearance.

Table 11-5 Main changes of the Project from the approved EIA and additional potential impacts

Item	Approved EIA	Changes and additional potential impacts
New ETP of TSDF	Treatment capacity is 30t/day and treated effluent planned to be reused inside TSDF.	Treatment capacity increased to 120t/day and non-reusable treated effluent planned to be discharged outside TSDF.
New incinerator of TSDF	Treatment capacity is 25t/day with similar design as existing incinerator	Although treatment capacity is reduced to 5t/day, the new incinerator is planned to treat PCB containing material and the design has changed accordingly. Ozone Depleting Substances (ODS) in the new incinerator during the detailed design stage may be substance to be incinerate.
Offshore Tank cleaning barge and associated jetty/access road	Not mentioned	Low-oil content effluent from the offshore tank cleaning barge is planned to be discharged after onboard treatment into offshore sea area

Source: JICA Study Team

1. BACKGROUND AND HISTORY OF THE PROJECT

1.1. BACKGROUND OF THE PROJECT

1.1.1. REQUIREMENTS OF THE CONVENTION AND RELATION OF THE PROJECT

In India, Pakistan and Bangladesh, all located in South West Asia, ships were broken up at inter-tidal zones in a so-called "Beaching Method" way that enjoyed heydays in the 90's.

In the beginning of the 90's, ships were being demolished without sufficient cleaning works, stripping of residual oils and wastewater, once they were grounded in the inter-tidal zone. Because of this, fatal accidents of explosions/fire by flammable gas, fall from high places, etc., were taking place. Serious environmental pollution by the hazardous materials such as various kinds of oil, scientific substances and heavy metals onboard the ships became a big concern. Moreover, health hazard was created because workers did not use enough protective equipment/gear and worked under cruel working conditions.

With this backdrop, environmental and human rights groups pointed out issues of the industry and criticized the major shipping countries and shipbuilding countries that they were exporting pollutions to these ship breaking countries.

Under this situation, ship recycling countries as well as shipping and shipbuilding countries were required to response to these issues and the guidelines were made as under.

a. IMO Guidelines on Ship Recycling (IMO Resolution A962(23) December 2003)

b. Safety and Health in Ship-breaking: Guidelines for Asian Countries and Turkey (ILO May 2003)

c. Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships (UNEP Basel Convention May 2002)

Although there will be environmental issues and labor safety issues in the process of ship recycling, ILO guideline is focused on labor safety and Basel guideline on preservation of the environment. Both of the guidelines have specified that facilities need to be provided in the ship recycling yard and the recycling process of the ship, but no requirements on the ships to be recycled.

Besides the above, Guideline of International Maritime Organization (IMO) points to the requirements to be taken by the stakeholders (shipbuilders, operators, ship recycling yards, etc.) from cradle (building) to grave (recycling) of ships comprehensively in various phases. The draft final guideline was adopted at 49th MEPC in July 2002 and resolved at 23rd plenary meeting in December 2003 as Resolution A.862(23).

Thereafter, drafting of the international framework on ship recycling discussed whether the Basel Convention (the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal) can be applied to internationally navigating ship or not. Thereafter, IMO took the initiative to draft the convention for ship recycling and The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009 was adapted.

1.1.2. SHIP RECYCLING CONVENTION

The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009 (hereinafter referred to as "the Convention") was adopted 15th May 2009 and regulated following requirements.

Applied to : Ships (commercial ship more than 500GT)

: Ship Recycling facilities (place of ships to be recycled)

(1) Requirements to Ships

- Restrict to use Asbestos, Polychlorinated Biphenyl: (PCBs）, Ozone Depleting Substances, Hazardous paints for the new building ship
- Provision of Inventory of Hazardous Materials (IHM) which indicate name and type, location and volume of hazardous materials.
- Periodical inspection by competent agency of the flag nation or recognized organization

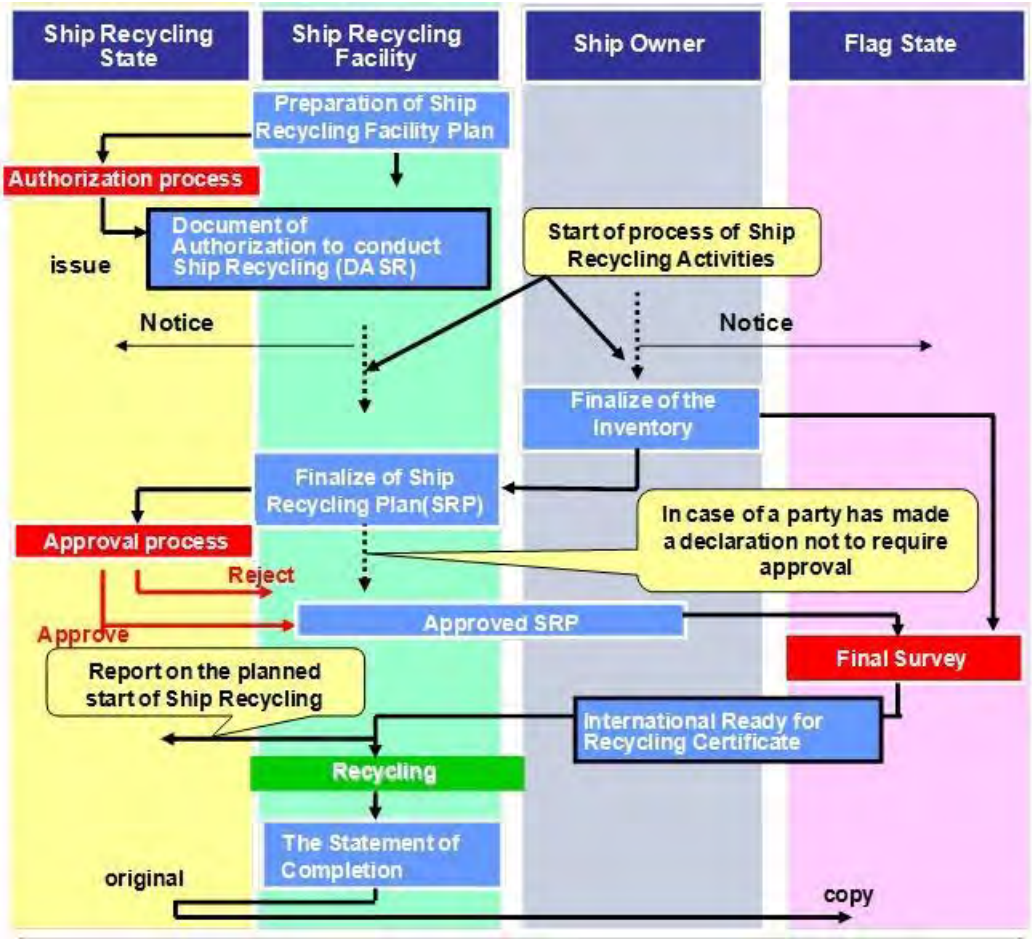
(2) Requirements to Ship Recycling Facilities

- Sound operation and management to mitigate environmental pollution and industrial accident is required
- Provision of Document for Authorization of Ship Recycling Facility (DASR) by the competent authority or recognized organization of recycling nation and periodical inspection

(3) Requirements to Ship Recycling Process

- Ship owner shall finalize the Inventory of Hazardous List and based on the information from ship owner, ship recycler shall provide Ship Recycling Plan (SRP)
- Approval of SRP by Ship Recycling nation
- Final Inspection by flag nation (Conformity of IHM and actual ship's condition and confirmation of approved SRP)
- Issue of International Certificate of Ready for Recycling (ICRR)
- Recycling
- Notation of completion of recycling to the flag nation and recycling nation.

Ship recycling process in accordance with the requirements of the Convention is shown below.



Source: Japan Ship Center

Figure 1-1Ship Recycling Process in accordance with the Convention

(4) Entry into force the Convention

This Convention shall enter into force 24 months after the date on which 1) not less than 15 States have either ratified, acceptance or approval, 2) the combined merchant fleets of the States constitute not less than 40 per cent of the gross tonnage of the world's merchant shipping, and 3) the combined maximum annual ship recycling volume of the States during the preceding 10 years constitutes not less than 3 per cent of the gross tonnage of the combined merchant shipping of the same States.

Looking at the requirements of entry into force at the present time, the total volume of world merchant fleet at the end of 2014 is 1,167 million gross tons, required total tonnage of the contracting and ratifying countries is 466.8 million tons.

In addition, the ship recycling record is the peak in 2012, then 14 million tons in the year become basic figure, but India alone has a record of 12.21 million gross tons. If either "China", "Bangladesh" or "Pakistan" ratifies and India ratifies it, it can satisfy the entry into force requirement for the ship recycling country

1.1.3. INTERNATIONAL SHIP RECYCLING SITUATION AND ITS ISSUES

After adoption of the Convention in May 2009, only France, Norway, Congo Rep., have ratified the convention as of February 2016. Thus, it will require some years to satisfy the entry into force conditions to become effective. On the other hand, EU published their Ship Recycling Regulation in 2013 (hereinafter referred to as “EUSRR”) tacitly to exclude ship recycling facilities by “beaching method” to become effective at the end of 2018. The EUSRR also recommend the member states to ratify the Convention which may accelerate other countries to ratify the Convention and expected to satisfy the entry into conditions within a few years from now..

However, EUSRR is explicitly aimed to eliminate ship recycling by the beaching method. The EU regional regulation is a comprehensive amendment that shifts to the Ship Recycling Convention-compliant procedure from the Basel Convention-compliant procedure, which has been the basis of the comprehension to ship recycle so far. Although the provisions of the Recycling Convention are incorporated to the EU regional regulation as they are, some requirements to be satisfied by Ship Recycling Facilities as a requirement is added to the Ship Recycling Convention. In case of facilities outside the EU, in addition to the approval by the recycling country, the EU regional regulation are subject to approval by the EU after application by the facility, review by the application by EU and review by field survey, whereby the facility unless it is posted in the EU List, vessels of EU flags cannot be recycled at the facility.

This additional requirement was expanded in the process of coordination with the EU Council, which has strongly influenced by the Basel Convention, and the EU Parliament Environment Committee passed a draft amendment prohibiting beaching on March 2013. Subsequently, the EC and the EU board of directors concerned with such amendment, has coordinated with the EU Executive Committee, working with Japan, etc., impermeable floor and appropriate drainage facilities were stated instead of banning of beaching.

If the EU SRR is applied before the Ship Recycling Convention, EU-registered ships may not be recycled in the three countries of India, Bangladesh and Pakistan, which hold more than 70% of the world's ship recycling capacity. Ship recycling is not simply an industry for recycling, but also has roles such as adjustment of supply and demand of ships in international shipping, promotion of elimination of sub-standard ships, and the situation where the ship recycling capacity of the world is drastically reduced must be avoided internationally.

Ship Recycle Convention requires Safe and Environmentally Sound Ship Recycling regardless ship recycling method. Japan has the stance that requirements of the Convention can be achieved by “beaching method” with further improvement of the facilities, management method, ship recycling process, education and training for workers, etc., then considering the assistance to India world largest ship recycling nation.

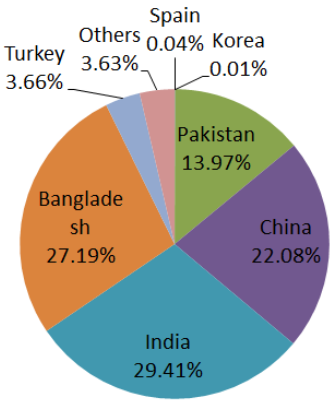
India also made "Ship Breaking Code" in 2013, and some private ship recyclers have aggressive efforts such as starting environmental measures. In addition, ship owners' associations in Asia, Japan and Europe have expressed opposition to the exclusion of beaching and expressed support for securing safe and environmentally appropriate ship recycling capability through improved beaching.

1.2. SHIP RECYCLING INDUSTRY IN INDIA

While 2006 to 2015, India, Bangladesh, China and Pakistan shares 92.7% of total tonnage broken. Among these India ranks top with about 29.4% of total tonnage broken followed by Bangladesh 27.2%, China 22.1%, and Pakistan 14.0% and many of ship owners in the world are heavily rely on India for recycling of their ship.

Ship Recycling Volume (Uniti: 10,000 GT)

Country	2015	2006-2015
Spain	8	8
Korea	6	3
Pakistan	4,598	2,797
China	4,036	4,422
India	4,558	5,889
Bangladesh	7,517	5,445
Turkey	752	733
Others	330	727.7



Average share by country 2006-2015

Source: JICA Survey Team

Figure 1-2 Comparison of ship recycling volume by major ship recycling countries

Ship recycle in India began in the 1960s for the recovering/reusing mainly for steel scraps. Kolkata and Mumbai were the centers, but in the 1980's, they moved to the Alang / Sosiya district of Gujarat State, and maintaining the world's largest recycling capacity. The ship recycling facility has 167 yards covered by the Gujarat Maritime Board (GMB) along the about 9km long coast. 130 ship recycling companies are leasing yards from GMB. The width of the plot is 30 meters minimum to 120 m, but there are also some operators who own and operate adjacent plots.

Along the yards extending north to south, four lanes of access roads are provided, which is convenient for transportation of product goods and equipment. Also along the road to the Alang / Sosiya district specialized warehouses ranging from dishes removed from the ship to diesel main engines are lined up. These are also operated with GMB approval. Public utilities and facilities are provided with water service, Red Cross Hospital, firefighting facility, police station, post office, bank, customs office, and also training facilities for workers. The steel supplied from ship recycling covers about 3% of the domestic consumption. The industry has been greatly contributing the regional industry with employing directly about 20 thousand workers and 500 thousand indirectly.

In response to the labor and environmental issues mainly pointed out by foreign organizations and NGOs, etc., the Gujarat Maritime Board Ship Recycling Regulations (2003) established regulations on ship recycling. For strengthening regulations, prior to the acceptance of ships, removal of hazardous materials in advance, gas free of tanks before recycling work, issuance of inspection and certificate of explosives management department of Gujarat State Pollution Control Board are included. Regarding the implementation of safety measures against asbestos removal during recycling work, implementation of safety and health training for worker, and as to the management of waste, improvements have been made taking measures such as newly constructing and managing waste treatment storage facilities called “Treatment, Storage Disposal Facility (TSDF)”.

In India, the Supreme Court Order concerning ship recycling was issued on September 6, 2007. Based on this Supreme Court Order, Ship Breaking Regulation 2013 was formulated in March 2013.

1.3. NATIONAL DEVELOPMENT PLAN RELATED TO THE PROJECT

Government of India (GOI) set forth the promotion of Ship related industry including shipbuilding and others in their 12th Five Years Development Plan (April 2012 to March 2017) targeted to promote the creation of 2.5 million work opportunities with ship related industries by promoting further development of the infrastructures. Also, GOI claimed to provide regulatory framework corresponding to the international conventions adopted by the International Maritime Organization (IMO).

1.4. BACKGROUND AND HISTORY OF THE RQUEST OF THE PROJECT

Ship recycling industry has already been established as an important industry in the province of Bhavnagar province of Gujarat state and is expected to develop in the future as a basis of important industries in the district, while improving environmental and occupational safety is urgent and then Ship Breaking Code 2013 (SBC) was established and its contents are more severe than those of GMB's ship recycling rules, including 1) preparation and approval for anchorage and beaching, 2) ship recycling Enhancement of the licensing and approval system of the ship owners, 3) gas-free obligation provisions for safe for hot work to the owner, and 4) strengthening removal of hazardous materials substances in advance.

However, compared with China and Turkey, which have facilities complied to the Convention facilities that complied the Ship Recycling Convention are not being developed well. Ministry of Shipping, of India which is the regulatory agency, intends to increase and maintain ship recycling orders by recognizing the trend of ratification of the global ship recycling convention and developing the facility comply with the Convention

On the environmental aspect, hazardous materials generated by ship recycling may deteriorate the coastal environment and put the workers in danger. Therefore, it is expected that it will contribute to solving problems such as environmental conservation and labor safety, by improving facilities complying with the convention and appropriately managing and processing.

The world total dismantling tonnage in 2014 is 22.77 million gross tons, and India is the No. 1 (6.8 million tons) in the world, with about 30% of the world share, 97% of which are processed in Alang / Sosiya in Gujarat

However, there are problems in the operational process of ship recycling and the method of removing, storing and treating various hazardous materials, etc. generated in the ship recycling process, and for example, 1) explosion / fire accident caused by flammable gas etc. and high-occurrence of a serious accident such as a worker's fall from high place, 2) serious environmental pollution due to residual oils, chemical substances, heavy metals etc. onboard the ship, 3) concern of workers' health damage due to the poor work environment of workers, etc. is enlisted.

To address these issues, not only the countries where the ship recycling facility is located, but also the shipping countries using it and international maritime agency, as the international framework to be tackled together, "The Ship Recycling Convention" which Japanese government is the major proponent was adopted. This Convention is a treaty for obliging vessels to be sent to facilities where ship recycling is being carried out in an appropriate process that does not pollute the environment and secure the safety of workers.

Although the Indian government has not ratified the Convention, has been working to modernize ship recycling facilities based on the expected increase in demand for environmental recycling facilities comply with the Convention adopted by the Convention and the importance of shipping and recycling industry in India.

On the other hand, for ship recycling facilities, as of the end of February 2016 out of 167 yards, 4 yards was received the Statement of Compliance (SOC) from a classification society as a facility complied with the Convention. However, in order to implement ship recycling in safe and environmentally sound manner in the global shipping, it is necessary to further secure improvement, including the necessity to secure a yard with SOC and the importance of maintaining the industry in the Bhavnagar, Gujarat including the maintenance at the remaining yards and waste disposal facilities. With these background, improvement of existing ship recycling yard by "Ship Recycling Yard Improvement Project" (hereinafter referred to as "the Project") is required by the Indian government.

Based on the request from the Government of India concerning Improvement of Ship Recycle Yard, and the opportunities of the Japan-India Summit Meeting in September 2014 and December

2015, this survey is aimed at to survey the objective of the Project, outline, project cost, project implementing organization, operation / maintenance system, environmental and social consideration necessary for examination to be implemented as Japanese Yen Loan Project.

1.5. COOPERATION BY OTHER DONERS AND/OR INTERNATIONAL AGENCIES

As to the improvement of the ship recycling industry in India, no other donners and/or international agencies are recognized in so far. It is however, Japan Federation of Basic Industry Worker's Unions (JBU) of Japan that has decided to assist Indian workers in Ship recycling industry by the resolution that IndustiALL will support earliest ratification and entry into force the Convention at IndustriALL Global World Conference was held in November 2014 in Nagasaki, Japan.

After that, JBU concluded the support agreement with the Steel, Metal & Engineering Workers' Federation of India (SMEFI, Mumbai) and Alang Sosiya Ship Recycling and General Workers' Association (ASSRGWA). Contents of the cooperation are as follows.

(1) Contents of the Cooperation

Duration : 3 years , Total cost 5 Million Japanese Yen

1st Year, to assist to build training center in Alang
2nd Year, to train workers
3rd Year, to supply training equipment

JBU's cooperation is the continuation of the overseas activity of FNV Bondgenoten, Netherlands, for exclusive cooperation in Alang related to ship recycling. Training center is under construction at the site FNV owned, with a cost component of 3 Million Japanese Yen.

(2) Target of Training and its Implementation

Target group of the training are the workers belonging to SMEFI and ASSRGWA and the first training given to the trainers and then the workers. Training material such as video, will be provided by the Indian labor union.

2. PRESENT CONDITION AND ISSUES OF THE INDUSTRY

2.1. PRESENT CONDITION AND ISSUES OF SHIP RECYCLING PROCESS

In Alang / Sosiya, ship recyclers initiated their business from the early 1980's by the beaching method which recycling works has been done by the process of ship is grounded at the intertidal zone and primary dismantling at the same area, then large block is pulled up to the recycling yard. Early in 1990's GMB adopted the 1993 Ship-breaking Regulations and started to put emphasis on labor safety and the environment. Furthermore, as the Ship-Breaking Code of India 2013 is established, further improvement of the ship recycling facilities and method to establish safer recycling process by the beaching method is initiated, and workers' safety education and training is carried out for the labors and more environmentally friendly.

2.1.1. PRESENT CONDITIONS OF THE SHIP-RECYCLING PROCESS IN ALANG /SOSIYA

(1) Current Ship Recycling Process

Ship-recycling operations conducted in the Alang/Sosiya district are shown in Table 2-1. The recycling consists of 11 stages; the beaching process starts from ship-anchoring at an offshore point 12km away from the beach, followed by inspections carried out by several authorities and government offices then ship will be beached. The ship grounded in the intertidal zone is started the recycling work of the hull in this intertidal zone. As recycling work progresses, the hull with increased buoyancy is gradually drawn to the landside by the winch, and proceeds to recycling work on the coast. This flow is shown in the following Table 2-1 Process of Ship Recycling Project

Table 2-1 Present Ship Recycling Process before the Hong Kong Convention

1	Inspection Preparation of Certificates	1) Ships for recycling anchor 12km off the Bhavnagar Port 2) GMB, SPCB、Port Authority ,GPCB, Customs office carry out inspection
⇩		
2	Beaching (Depends on the High Tide and Ship Type)	1)Procedure to obtain beaching permit 2) Detailed inspection by the Customs Office , GMB, GPCB。 3) Issuance of beaching permit upon passing inspections 4) Beaching
⇩		
3	1) Recovery of heavy Oil & Remaining Oil 2)Cleaning of oil tank & fuel tank 3)Disconnecting fuel & lubricant oil pipes 4) Inspection for gas-free checking	1) All the tanks shall be subject to preliminary checking. 2) Upon completing inspection by the customs office, radar, GPS, VHS satellite communication system, antenna shall be destroyed and removed from the ship 3) Cleaning and disposal of all oil and oily waste
⇩		
4	Recovery of un-used materials or remainder.	1) Marking on the cylinder by the Safety officer. The remaining gas in the cylinder shall be discharged to the air unless they are toxic. 2) The empty cylinders shall be taken out of the ship and stored in the designated stock yard.
⇩		

5	Collection of bilge water and other related waste materials	1) Inspection of the bilge tanks. 2) Collection of bilge water by means of tank lorry to carry them to the treatment plant at Alang. 3) Thorough cleaning of the bilge tank required
6	Obtaining "Free from Contamination Certificate" from GPCB.	1) As the result of GPCB's Inspection Free From Contamination Certification issued. 2) Fire Safety Inspection and Obtaining Cutting permission from GMB.
7	Recovery of reusable and recyclable materials	1) Draft an inventory list of the reusable materials prepared by the Safety Officer and the owner of the ship recycle Yard. Then the owner of the recycling yard places the salable materials and equipment to an auction. 2) All the materials shall be taken out of the ship.
8	Disposal of asbestos and other insulation material.	1) Checking the inventory list and actual situation of asbestos within the ship by the safety officer. 2) Cleaning of all spaces where asbestos may be stocked or transported to avoid any chemical reaction of asbestos or glass-wool. 3) The work shall be carried out by well-trained experts wearing specialty protective gear and equipment such as masks, glasses, and helmets. 4) Discharge of asbestos and or glass wool out of ship and transportation of them to TSDF.
9	1) Cutting big size blocks on the ship and transporting them to the yard or dropping them to the inter-tidal zone. 2) Transporting the dropped blocks on the land or on the beach by means of winches. At the recycle yard these blocks are cut and sliced to smaller size to enable transportation to the Ship Recycling Facilities	1) Cutting hull of the ship to big size blocks, then dropping the block to the inter-tidal zone using winch or cranes. 2) When the tide is low to be a workable zone, the workers cut the blocks to smaller sizes to transport by winches or crane. 3) Paint chips or oil stains on the blocks are wiped and cleaned before the blocks are transported to the recycle yard.
10	1) Ship breaking at the Beach. 2) Ship breaking at the beach enables usage of additional equipment	1) As the ship loses total weight by being cut into blocks at the inter-tidal zone, it is gradually pulled to the beach which allows cranes to transfer material on board to the recycling yard directly. 2) The heavy equipment of the ship, such as the main engine and generator is unloaded using crawler cranes.
11	Blocks transported to the recycle yard using crane or winches are cut, sliced, and sold.	1) Big size blocks are cut to smaller size blocks. 2) The blocks are cut, sliced to the suitable size for delivery 3) Delivery

Source; JICA Survey Team

(2) Fundamental Requirements of the Ship Recycling Convention

Ship recycling process under the Convention requested to the ship recycling facilities to provide Ship Recycling Facility Plan in advance, to demonstrate the establishment of the worker's safety system and management system for the Hazardous Materials, then ship recycling facilities are also required to prepare a ship recycling Plan (SRP) for each ship they recycle. Furthermore, the recycling facilities are requested to ensure safe for entry and safe for hot work. Recyclers are also requested to prevent adverse effects to human health and the environment, making the most use of the inventory list of asbestos and other hazardous materials.

Table 2-2 Main Requirements of the Ship Recycling Convention

1	Application of the Convention	Commercial ships engaged in international voyage not less than 500 GT and ship recycling facility
2	Requirement on Ships	a) Prohibited to install Asbestos, PCBs, Ozone depleting substances, anti-fouling compound and system to new ship b) Provision of Inventory of Hazardous Materials (IHM) which includes definition, location, and quantity of Hazardous Materials (HMs) onboard. c) Periodic inspection of ships by competent authority of the flag state or an organization recognized by them
3	Requirement on Ship Recycling Facilities	a) Sound operation and facilities to minimize environmental pollution and workers injury b) Approval of ship recycling facilities by competent authority or a recognized organization of the recycling state. Document for Authorization of Ship Recycling Facility and periodical inspection of them.
4	Ship Recycling Procedure	a) Finalization of IHM by ship owner and provision of Ship Recycling Plan (SRP) by Ship Recycling Facility with the cooperation of the ship owner. b) Approval of SRP by the recycling state. c) Final inspection by the Flag state (inspection of IHM with actual ship and confirmation of approved SRP) d) Issue of the International Certificate of Ready for Recycling (ICRR) by the Flag state. e) Ship recycling f) Information of completion on ship recycling by the ship recycling facility to the flag state and recycling state.

Source; Summarized by the Survey Team based on HKC

(3) Evaluation and tasks for requirements of Ship Recycling Convention

In response to the requirements of the Ship Recycling Convention, items necessary for dealing with the Convention are summarized by studying the current state of the Indian laws and regulations concerning ship recycling and the current state of recycling process as follows. In the Ship Recycling Convention, technical guidelines for facilities were not described, and tasks and necessary improvements were evaluated from the recycling method and facility aspects according to the requirements of the Ship Recycling Facility Plan (SRFP).

3) Issues of the recycling process

In the ship recycling process, work procedures, environmental measures, safety measures, facilities, etc. are managed and remarkably improved by SBC etc., in recent years. In particular, the process at the recycling preparation stage required by the Ship Recycling Convention and the current

applicable laws of India can be compared as follows and it can be seen that the requirements are satisfied

Table 2-3 IMO Convention Requirements on Ship Recycling Process and its Conformity in India

Ship Recycle Convention	Status of India	Conformity
Ship owner shall provide and maintain Inventory of Hazardous materials		
Recycle facility shall have approval and periodical inspection by the authority		
Ship owner shall finalize the Inventory		
Recycle facility shall provide Ship Recycle Facility Plan (SRFP)	Recycle facility shall provide Recycle Facility Management Plan (RFMP)	Conformed
Recycle country shall approve SRFP	State Pollution Control Board (SPCB) will approve RFMP	Conformed
Ship owner and recycle facility shall cooperate to provide Ship Recycle Plan (SRP)	Recycle facility shall provide Ship Recycle Plan (SRP)	Conformed
Recycle country shall approve SRP	State Maritime Board (SMB) will approve SRP	Conformed
Flag state shall carry out final inspection(Inventory and ship condition with confirmation of approved SRP)		
Recycle country shall provide International Certificate of Ready for Recycling (ICRR)		

Source: JICA Survey Team

However, contrary to establishment of documentation and inspection and approval systems related to the preparation stage, actual beaching methods still have many points to be improved in terms of environmental and occupational safety considerations. Particularly in the beaching method, it can be pointed out that it is difficult to completely remove various hazardous materials as work before recycling. In response to the requirements of the Convention, it should be addressed the following points as a particular issue.

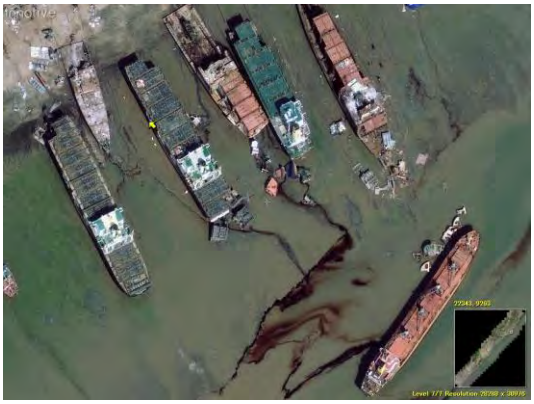
a. Safety and adequate removal of residual oil, explosive / flammable gas in the tank after beaching, before recycling;
b. Safe removal of harmful paint after beaching and prevention of intertidal zone and soil contamination;
c. Prevention of falling of contaminated hull block into intertidal zone in dismantling process in intertidal zone:
d. Prevention of soil, groundwater and air pollution in recycling processes on land; and
e. Further improvement of safety and health of workers in recycling process

Currently, in India, with respect to residual oil, explosion / flammable gas, it is requested to carry out gas-free at the shipowner's responsibility, but securing fuel necessary for moving the ship to beach and grounding from the point of view, it is difficult for the ship owners to pre-clean the tank completely. Regarding the hazardous toxic paint of the bottom, measures to prevent these paints from contaminating the ocean or soil during the process of recycling are necessary in order to direct the beaching directly to the coast.

The Ship Recycling Convention prohibits the use of antifouling system (AFS) including tributyltin (TBT), etc. However, for paints containing TBT, "International Convention on the Control of Harmful Anti - fouling system on Ships, 2001"(hereinafter referred to as the" AFS Convention) came into force in 2008, but many vessels have ceased using it before 2000. For these hazardous and flammable

paints, it is recommended in the Ship Recycling Convention Guidelines that hazardous paints and paints with high flammable should be removed prior to cutting if available.

In the current ship recycling process, it is impossible to completely prevent the paint piece from falling off when the hull block is cut off, but measures to prevent the block from falling into the intertidal zone and thoroughly refurbish the paint piece with the yards shall be considered in this project.



Source: JICA Survey Team , Google Earth (2011)

Figure 2-1 Waste oil spill in the ship recycling process (2011)

2.1.2. CURRENT STATUS AND ISSUES OF SHIP RECYCLING FACILITIES IN ALANG / SOSIYA

At Ship Recycling Facilities in the Alang / Sosiya by considering needs of the shipping industry for internationally safe and environmentally sound facilities such as HKC and SBC etc., some recyclers have already started concrete paving etc., by themselves.

Also, the Nippon Kaiji Kyokai (ClassNK) has issued Statement of Compliance (SOC) to the ship recycling facility in China in 2012 and furthermore, in September 2015 SOC is given to the four advanced recycling facilities in Alang / Sosya. Thereafter, further improvement work is under way to acquire certification from such as ClassNK and RINA (Italian classification society) etc.

These yards are clearly segregated the demolition area of the hull, concrete pavement (t = 25 cm to 35 cm), drainage (pipes) for taking in rainwater containing oil etc., and oil recovery tanks are installed then taken out oils or waters periodically. However, construction of improvement work is carried out independently by recyclers, and records of design books (stress calculation documents, etc.) are not maintained.

(1) Condition of Improvement of Ship Recycling Yards

In this survey, 36 yards in Alang/Sosiya were visited and investigation on facilities and equipment made. As a result, out of 131 yards in total in operation, 6 yards were found as certified yards (as HKC compliant) with the Statement of Compliance (SOC) issued by the third party (Classification Society) and 11 yards under the process of making request for the certification.

Table 2-4 Result of the 36 Yards

HKC Compliant Yards information	Total Plot 131

Yard that has SOC issued by Class NK as HKC Compliant	4 plots
Yard that has SOC issued by other than Class NK (i.e. RINA) as HKC Compliant	2 plots
Yards that are under the process to have SOC or about to start the process for Class NK certification	5 plots
Yards under the process that have SOC or about to start the process for other Classes such as RINA etc.	2 plots
Already provided	11 plots
Under preparation or about to start	5 plots

Source: JICA Survey Team

As to the floor structure, there are 11 yards already provided with concrete impermeable floor and 16 yards, including yards under construction (concrete floor). All these yards have been constructed with investments by the recyclers themselves.

Table 2-5 Outlook of the Results of the Surveyed Yards

No.	Plot No.	Recycler	Remarks		Other Observation
			HKC	Concrete Floor	
1	2	Leela Ship Recycler Ltd.	NK	completed	
2	5	Shubh Arya Steel Pvt. Ltd.	RINA+H6:K6	completed	Concrete Pavement 22.5cm thickness Construction Cost: US$ 160k Plot W=90m 15m deep well for oily water Geo-membrane required for the yard
3	19	R.I. Kalthia Ship Breaking Pvt. Ltd.	NK	completed	First plot awarded SOC by Class NK LABO was suggested as a necessary facility
4	30	J.R.D. Industries	under NK Consulting	completed	Number of workers 150
5	36	Shib.Ship Breaking Co.		completed	Concrete Floor Completed
6	55	HATIMI STEELS			
7	59	Y.S. Investments(Plot 24-E)		under construction	Concrete Floor under construction Yard: 54.5m x 120m
8	68	Saumil Impex Pte. Ltd.			
9	78-M	Shree Ram Vessels Scrap Pvt. Ltd.	NK	completed	Plot 60mw Beach side used as Temporary Stock yrd M= Merged Plots(78+79 Concrete Floor Ready (Ready mixed con)
10	V-1	Priya Blue Industries Pvt. Ltd. (Best Oasis)	NK	completed	Concrete Floor : 120m w x 50m D Workers : 500 ns workers 8 winches / 9 crawler Cranes Cleaning Oil: wipe

No.	Plot No.	Recycler	Remarks		Other Observation
			HKC	Concrete Floor	
11	V-5	Mahavir Inductoment Pvt. Ltd.			
12	V-6	Shree Ram Group Company	Under NK Consulting	Completed	Concrete Floor 120m w Concrete thickness 30 cm 6 months for Concrete work
13	V-7	Shree Ram Group Company R.K.Industries Unit II	Under NK Consulting	Completed	Concrete Floor 120m w Concrete thickness 30 cm Took 6 months for Concrete work
14	V-8	Shree Ram Group Conpany R.K.Industries Unit II	Under NK Consulting	Completed	Concrete Floor 120m wx 45m Concrete thickness 30 cm 6 months for Concrete work Oily water well 10Fx1Fx 10 inch
15	V-9	Rajendra Ship Breakers			
16	4	Panchvati Ship Breakers			
17	20	Panchvati Ship Breakers			
18	84-F	Mahavir Metal Corporation			The owner does not know about HKC Yard 45m x 50m+G2:L4
19	84-D	Salwag Shipping Services Pvt.Ltd.	RINA in process	Concrete Floor under construction	Concrete Floor under construction The thickness of the concrete floor : 74 cm
20	84-C	Under GMB's administration			The Plot is vacant No trace of operation
21	84-B	Capital Steel Corporation	Preparation Stage	Under Constructio n	
22	84-A	Lucky Steel Industries			
23	72	Bohra Exports Pvt.,Ltd.		Under construction	Boring not conducted. The site was under construction
24	83	Mercury Industries	Under RINA Consulting		The site closed for 2 years Plot W=30m
25	54	Rushil Industries Co.	No HKC		
26	74	PVR Ship			
27	81-M	Shree Ram	Under preparation	Completed	
28	73	Pure Enterprises Pvt. Ltd.			Not in Operation The Plot has been closed for more than 1 year
29	77	Shree ram	NK	Concrete work started	Concreting Started
30	82	Kiran Ship Breaking Co.			30m w plot The Owner is at the same time the owner of V-6
31	153	GMB			The Plot has not been developed as Recycle Yard. For the Recycle yard earth work is necessary (Sandy and deserted land at present)
32	143	GMB			
33	155	GMB			
34	156	GMB			

No.	Plot No.	Recycler	Remarks		Other Observation
			HKC	Concrete Floor	
35	V-6	GMB			The Plot is located at the mouth of river. Need land filling to obtain certain level above the water level
36	V-10	GMB			The Plot is located at the end of Sosiya At present Abandoned beach Need earth moving work to arrange as a recycle yard.

Source: JICA Survey Team

(2) Current Condition of the Ship Recycling Yards

Main equipment and facilities installed commonly in the yards, which the survey team visited, are as follows:

1) Equipment for handling ships' blocks

Heavy equipment commonly used in each yard are as follows:

i. Equipment for handling cut block

① Winches (for dragging ship's hull or blocks)

- Every yard has installed 75ton load winches fixed in the yard（middle class yards of 60m width has four winches and large class yards of 120m width has eight winches）.
- All winches are reused from the windlasses of broken ships.
- Each winch is surrounded with fence of steel bars at its back and both sides in order to protect the workers when the wire accidentally snaps and rebounds.
- Storage space is set up behind the fence at the rear of a winch. The space is fitted with a roof to prevent the greased wires that may be washed by rain, and its base is sunken or surrounded with coaming to prevent oily rain water to flow out.
- A ship's hull body is dragged by the winches (the dragging operation is carried out at high tide to utilize its buoyancy) periodically during the ship breaking procedure.
- Even large ships can be dragged, provided that the stern blokes are cut down on the inter-tidal zone to reduce its hull weight. 【P.○○ in each photo indicates plot No 】

P.78 75 t Winch with fence

P.19 75 t Winch with fence

P.5 wire storage space with roof behind a winch

P.5 wire storage space is sunken in ground

P.V-7 rear half of hull body to be dragged

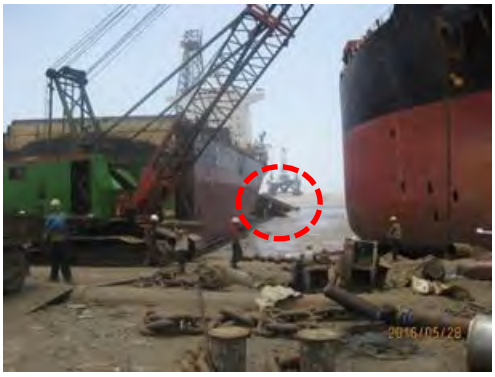
P.V-7 4 folds sheave

② Crawler Crane（for carrying large blocks or equipment）

- There are various load capacity cranes: namely 12tons of small crane, 25 t, 35 t, 50t and 75 t of the biggest crane.
- 3～4 cranes are provided in medium class yard of width 60m、6～8 cranes in large class yard of width 120m.
- These Cranes are from TATA, H&M, P&H, and ESCORT make.

The big crane is operated in the front beach of the yard to carry large blocks into the yard, and the medium size crane is operated to shift the smaller blocks to final cutting area.

P.68 75 tons Crane



P.V.-7 Block fallen into the sea

P.V-5 loading plates on truck, and carrying a plate on worker's shoulder

P.78 many cranes are working along the shore line

③ Wheel Crane

- A wheel crane is operated to carry steel plates or angles / pipes cut out from blocks for distributing them by each grade (classified by thickness of plate) in the storage area, that is located near the entrance gate.（each yard has one or two wheel cranes）
- It is fitted with 4 tires, which make it easy for turning and suitable for distributing work. Each yard has the same type one (12t load)

P.68 wheel crane distributing plates

P.30 wheel crane

④ Tractor

A tractor, towing with a flat floor trailer, to carry short pipes, valves, mooring fittings, electric equipment, etc. (each yard has 1 or 2 units)

P.19 tractor

P.78 tractor

ii. Equipment for cutting works

① Liquid oxygen tank

- Most yards have installed liquid oxygen tanks of cooling type, and supply oxygen gas for cutting works through the pipes fixed in the yard.
- The tank capacity is 20 ㎥、and each yard has the same capacity tank.
- LPG gas is supplied with cylinder bottles.

P.30 liquid oxygen tank

P.5 fixed supply pipe of oxygen gas and LPG gas bottles

② Air plasma cutting machine (mobile type)

This machine is used for cutting stainless steel plates, which are fitted in chemical tankers

P.V-1 Air plasma cutting machine

P.78 Air plasma cutting machine

③ Others

Hand burners are only used for steel cutting works. No Automatic cutting machines or no large cutter, fitted on heavy construction machines, are used.

④ Equipment for cleaning oily dirty blocks

- Compressor：to supply fresh water to washing nozzles with high pressure
- High pressure nozzle：to wash oily dirty blocks by hand in washing area
- Fresh water tank：for storage fresh water for washing

P.78 Oily block washing area

P.78 various tanks

P.V-7 washing blocks
(phot provided by yard)

P.V-7 washing blocks
(phot provided by yard)

iii. Equipment for handling of hazardous material

① For Asbestos

- Mobile exhaust ventilating device (with HEPA filter）;
  For preventing asbestos to scatter outside in the working site. Not confirmed real equipment,
- Mobile vacuum cleaner (with HEPA filter）;
  For gathering asbestos scattered in the working site. Not confirmed real equipment.
  ***Remark:** Some yards do not have above devices, and outsource the treatment works of asbestos to outside company.
- Negative pressure chamber
  This chamber, fitted with exhaust ventilator, is prepared for preventing asbestos to scatter into open air while workers change their clothes

P.V-5 entrance of negative pressure chamber

P.V-5 inside of negative pressure chamber

② Ozone Depleting Substances (Freon, etc.)

- Mobile Freon collecting device:

  Used for collecting Freon gas contained in an air conditioning machine or a refrigerating machine without emitting it into open air.

P.V-7 collecting freon gas
(phot provided by yard)

P.V-7 collecting freon gas
(phot provided by yard)

③ Floating barge

- In order to carry light equipment, furniture, fitting, utensils, etc., collected from engine room and accommodation to the yard, a floating barge (rectangle shape in length 5-6m, width 3m, height 50-60cm) is provided.
- The barge is made by shell plate of broken ship, and is pilled on the inter-tidal zone (for coming and going) by a winch with a wire rope that connects the barge to the winch through a pulley fitted at aft shell of the broken ship.
- Both ends of the barge are curved like a sled to be dragged smoothly on the beach even at low tide
- A certain yard (plot No.V-7) has a large barge (60t load capacity).

P.V-7 barge with sled shape

P. V-7 large barge

④ Fire Fighting Equipment

- Emergency Fire pump in yard
  A diesel engine driven emergency fire pump is fitted at the fire station in the yard.
- Mobile fire pump on board
  An engine driven mobile emergency fire pump is provided on board.
- Portable fire extinguisher
  Suitable number of portable fire extinguisher are allocated in the yard and on board

P.36 Fire Station

P.V-7 Fire Station

P.V-7 Mobile fire pump onboard

P.V-5 Mobile fire pump

⑤ Storage tanks for treatment of wastewater

- Oily water stowage tank; to stowage Oily water gathered from oily block area
- Bilge water stowage tank; to stowage Bilge water except oily water gathered from the yard.
- Rain water tank; to stowage Rain water running over the yard in storm.

P.V-7 Dirty oily water tank(5,000 liter)

P.V-7 Rain Water tank (15,000 liter)

P.V-7 Bilge water tank (45,000 liter)

P.19 Tank truck for Oily Bilge

iv. Other Facilities

P.78 Light Post (target for beaching)

P.68 Weigh Bridge for truck

P.78 stores for waste materials P.78 good workers wears

(3) Oil Removal and Cleaning

Actual situation of the stripping and cleaning of residual oils in tanks after beaching is confirmed at fuel oil tanks inside the ship. Observation is show on the Appendix -1.

1) Current situation of FO Tank cleaning

The process of the FO Tank cleaning is after beaching, residual oils are stripped with pumps to tankers (vehicle) and saleable oil will be sold to the refinery and the remaining sludge inside the tank is absorbed and cleaned with saw dust or sand and collected.

This collected oil sand or saw dust is treated as industrial wastes and transferred to TSDF.

2) Refinement of the collected oil

Refinement of the collected oil is also processed with the recycler or its affiliates

The refined heavy fuel oils and waste oils collected from ship recycling yards or auto garages with the distillation method and are sold as Medium Heavy FO.

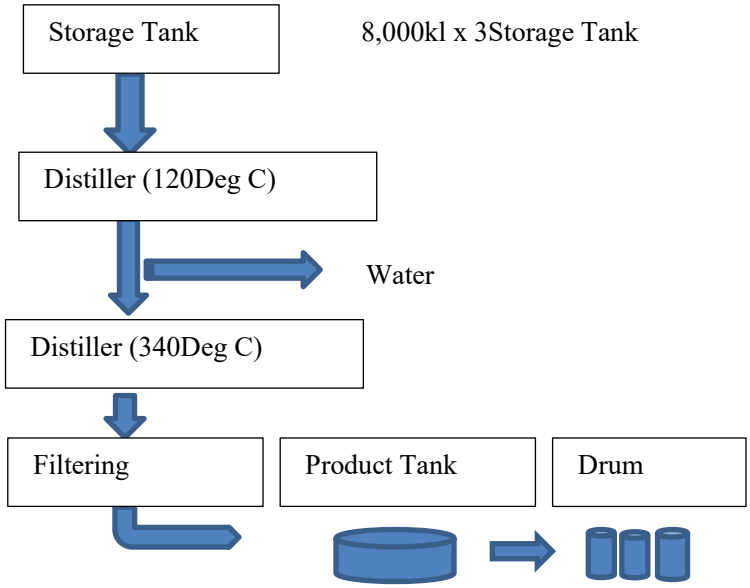
Refinery of Used Fuel oil (Main Building)

The process of the refinement of FO is as follows.

The oil refinery is located about 15 minutes from city of Bhavnagar and there are 7 companies to buy used oil in Alang / Sosiya.

① Buying residual FO from beached ships and directly collected FO is from ships. (No sludge is bought)

② Transport to factory



Capacity 7,000 KL / year
Product Tank after 1st distillation

Drum for sale

i. Pricing

Buying : 22 Indian Rupees/Lit.
Selling : 35 Indian Rupees/Lit.
There are 7 companies who buy residual FOs in Bhavnagar.

(4) Issues of Ship Recycling Facilities

As a result of comparison of the requirements of the Ship Recycling Convention and the recycling facility in the current Allan / Sosiya area, except for the yard where SOC has already been acquired, in terms of prevention of environmental pollution etc., oil leakage, plastic waste, etc., there was concern about the possibility of groundwater contamination due to outflow of hazardous materials to the sea and soil contamination at the recycling site of the contaminated block and it was judged that there is a need for facility improvement for environmental measures.

Table 2-6 Conformity of Requirements of the IMO Convention and Ship Recycling Facility

Status	Requirements of the Convention	Current Situation	Judgement of Conformity
	Identification of HMs, labeling of their location, etc.	Advanced yards confirmed drastically based on IHM provided by Ship owner	Conformed
	Gas free for safe Entry	Before enter the anchoring area of Alang, inspection is obliged by rule for tanker, etc.	Actually No tanker is accepted
	Prior removal of HMs	Residual oils, Bilge is confirmed the quality and then after beaching pumped out it. Cleaning with saw dust, etc.	Spillage risk depend on the method. Oils are transferred to authorized dealer
	Treatment of Asbestos wests	ACM is safely removed by wetting method of in the negative chamber (trained worker is at work)	Some are conformed
	Removal of AF paint such as TBT	There is a case to remove paints of cutting line at intertidal zone. Paint chips are processed at TSDF in Alang/Sosiya	Some are conformed
	Ozone Depleting Material	Specialized subcontractor will handle	Conformed
	PCBs	Substances with low concentration PCBs are sold as-is to resellers. Not basically processed in TSDF. There is no specific handling of high concentration PCB-containing substances, and approved dealer take them.	Partially conformed Low concentrated PCB can be incinerated
	HMs management, Treatment	Storage in facilities. TSDF outside the yard has final reclamation plot.	Conformed
	Bilge, Oily Water treatment	10 tons /day small ETP（Effluent Treatment Plant） is under operation by GEPIL	Conformed

Source: JICA Survey Team

Yards other than the yard that has the SOC has been still recycling the contaminated block, oil containing equipment, etc. on the soil. In addition, blocks are fall into the intertidal zone. Therefore, there is a risk of marine pollution, soil contamination, groundwater pollution, and air pollution. The following points should be dealt with especially as issues among other requirements of the Convention.

The facility guideline of the Ship Recycling Convention provides guidance on how to safely remove each harmful substance. However, in the recycling method by beaching in India, it is difficult to prevent completely falling the antifouling paint such as TBT to the intertidal zone at the time of cutting the bottom and to prevent falling to the soil, and it is important to focus on cutting off the block to the intertidal zone and improving the process of recovering paint pieces as much as possible on land. Also, with regard to PCB-containing substances, since there is no PCB treatment facility near Alang / Sosiya, high-concentration PCB-containing substances should be delivered to authorized

dealers and low concentration PCB-containing substances should be thoroughly handled for incineration and other measures.

In either case, it should be considered how to recover hazardous substances to the intertidal zone or soil, and also to consider the process of recovering hazardous substances as much as possible. In order to prevent discharge of harmful paint, PCB, oil, etc. to the environment, among other requirements of the Convention, the issues to be addressed are the followings.

① Prevent leakage of waste generated in the process of oil leakage, plastic waste and other dismantling into the sea

② To prevent marine pollution, prevention of hull block cutting before contaminants and harmful substances are removed to the intertidal zone

③ Safely remove the residual oil in the tank and cleaning after recycling work is started

④ Prevention of soil, groundwater and air pollution in recycling process of contaminated hull blocks and equipment on land

⑤ Prevention of outflow of pollutants and other oil from the demolition site when rain, storms, etc. occurred

The points to be improved by Indian ship recycling facilities in order to conform to the Convention from the recognition of the current problems and problems are as follows. Plan for improvement of facilities is proposed from this issue and measures.

① It is necessary to manage oil and other hazardous materials in vessels under recycling either in the intertidal zone or in the facility shall not to flow to the sea in the rain and storm or normal condition.

② Ensure that the vessel can be pulled as close as possible to the shore and cut the hull as far as possible on the shore side, and cutting work at sea and cut off of blocks should be prevented.

③ The recycling zone should be covered with an appropriate impermeable floor structure, and a drain ditch and drain recovery means should be provided at an appropriate position between the coastline and the facility.

④ Secure safe access to the ship should be ensured

2.2. PRESENT SITUATION AND ISSUES OF OCCUPATIONAL SAFETY AND HEALTH

2.2.1. EXISTING OCCUPATIONAL SAFETY TRAINING & EDUCATION PROGRAM

Alang / Sosiya has a Safety Training & Laborer Welfare Institute established by GMB in 2003, providing training courses for workers engaged in ship recycling. Training Courses offered are shown below.

Table 2-7 Training Courses provided in Safety Training & Laborer Welfare Institute

Name of Training	Trainee	Duration
Basic Course(7days training course)		
Basic safety for all	All workers	3 days
Cutter men Training	Cutter men	2 days

Basic Firemen Training	All literate and young workers	2 days
Special Course		
Training for cutter men	Cutter men	3 days
Safe Rating I II	Supervisors, Safety Officers	1 day
Disaster Management Training	Supervisors, Safety Officers	Half day
Crane Drivers Training	Crane Operators	2 days
Personal Protective Equipment Training	Supervisors, Safety Officers	1 day
Hazardous Waste Management	Supervisors, Safety Officers	2 days
1 day Safety Training	All workers	1 day
Safe Removal and Handling of Asbestos Materials	All workers	2 days

Source: Study for Establishment of an Environmentally Sound Ship Recycling Project in Gujarat, India, 2010

Contents of the present Training Courses at GMB's Safety Training & Laborer Welfare Institute are mainly guidance of knowledge, technique and safety measures related to the basic ship recycling and handling hazardous material. The initial training for the newly engaged workers is important and in addition to such initial training, periodical Operators' training courses such as cutters', welder's and crane operators' courses should be held.

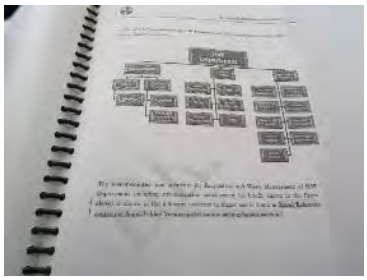
2.2.2. PRESENT CONDITION OF OCCUPATIONAL SAFETY AND HEALTH IN SHIP RECYCLING PROCESS

(1) Facility management and operation (Document confirmation)

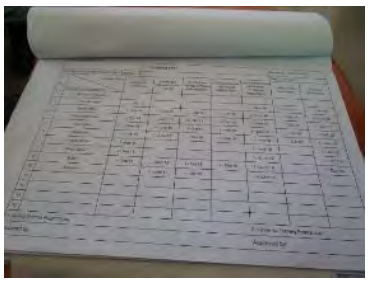
According to Ship Breaking Code 2013, the yards are required to prepare Ship Recycling Facility Management Plan (SRFMP) which contains facility layout, equipment, licenses and permits required to conduct ship recycling, etc. The yards are also required to prepared ship specific Ship Recycling Plan (SRP) which contains recycling method, permits and certificates required in the recycling processes and hazardous material removal plan, etc. The requirement of Ship Recycling Convention includes the preparation of SRP.

NK certified yards are equipped with documents compatible to SRP including facility layout, ship recycling method and procedures, organization structure, training plan. Also, workers' records and necessary permits and certificates (decontamination certificate, cutting permit, etc.) were confirmed. On the other hand, normal yards were only equipped with SRFMP which does not cover all the necessary information required in SPR. In specific, ship recycling method and procedures, training plans and various permits and certificates are either not developed or could not be confirmed by the documents.

For normal yards, training shall be provided to yard owner and HSE officer for the preparation of SRP in compliance with Ship Recycling Convention. At the same time, periodical monitoring shall be carried out by regulatory agency and/or inspection agency to confirm the actual operation.



Organization Structure
(NK certified yard)



Training plan in yard
(NK certified yard)

Worker's training certificate
(Normal yard)

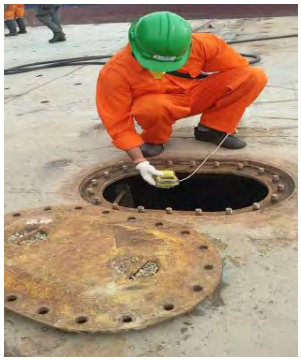
(2) Safe-for-entry and safe-for-hot-work procedures

Followed by beaching, safe-for-entry procedures is being conducted by removing hazardous materials in loose form and oils and gas in engine room and pipelines and Decontamination Certificate is issued by GPCB after the confirmation from competent authorities. Also, safe-for-hot-work procedure is conducted by HSE officer confirming gas and oxygen content inside the ship with gas detector and Cutting Permit is issued by GMB prior to dismantling. Some NK certified yard performs double-checking of confined atmosphere with gas detector before the cutting operation to avoid any possibilities of fire and explosion accidents.

In NK certified yard, those procedures were confirmed by certifications and permits as well as from the photos, whereas in normal yards, the same was confirmed by interview but not by documents nor onboard inspection.

Since dismantling operations in engine rooms and pipelines are the major causes of explosion, safety confirmation procedures shall be strictly followed.

Gas cutting permit issued by GMB (NK certified yard)



Confirmation on gas content in closed spaces (yard in process of verification)

Entry after safe for entry procedure confirming the label (yard in process of verification)

(3) Safety measures for the working at height

Basic safety measures including wearing safety belts and application of warning tapes at the deck edges shall be performed while working at height. The implementation of those safety measures were confirmed in NK certified yard through interview with the manager and HSE officer as well as from the photos. It was also mentioned from HSE officer that majority of the accidents occur on board (in inter-tidal zone), therefore the work on board is assigned to experienced workers having worked over 10 years. Employment of those safety measures in the normal yards are considered to be limited based on the yard observation and from the interview with yard supervisors.

According to accident statistics, relatively high number of accidents is caused by falling from heights. The application of those safety measures shall be ensured by raising the awareness of skilled workers and site supervisors.

Wearing safety belt during working at height (NK certified yard)

Warning tape to indicate the risk of working at height (NK certified yard)

(4) Safety measures for the operation of heavy equipment

Main heavy equipment used in current ship recycling operation are winches and cranes. Especially, braking of winch line during the salvage of ships is one of the causes of serious accidents. As a safety measure, all the observed yards have installed fences around the winch to minimize the accidents and the risk of injury. However, equipment inspection of heavy machinery, wince line, etc. was not satisfactory in some yards which shall be made as a routine task of HSE officers.

According to Ship Recycling Industries Association (SRIA), lack of safety consideration of crane operators towards the helpers supporting their operation is one of the issues for the related accidents. Therefore, safety education including accident prevention measures shall be provided to heavy machinery operator together with their skill development training.


Fence around the winch for safety (All yards)


Lack of routine check of fixtures including winch line (Normal yards)


Lifting large blocks by crane (NK certified yard)

(5) Personal Protective Equipment (PPE)

In NK certified yards, basic PPEs including helmet, shoes, clothes and gloves were worn in all the recycling process. For gas cutting operation, masks and safety goggles were additionally worn. However, in normal yards, there were some workers wearing cloths instead of mask during gas cutting operation and some without gloves during glass wool removal operation.

Especially during cutting the paint coated steel, workers must apply masks as there is a potential exposure to toxic fumes including heavy metals. During glass wool removal, potential temporary skin irritation may be caused from glass wool fiber which potentially be the causes of skin dermatitis with repeated or prolonged contact. Therefore application of masks and gloves shall be a must and washing and changing after the work should be instructed.


Proper PPE during gas cutting (NK certified yard)


No gloves duirng glasswool removal (Normal yards)


Wearing cloths instead of mask during gas cutting (Normal yards)

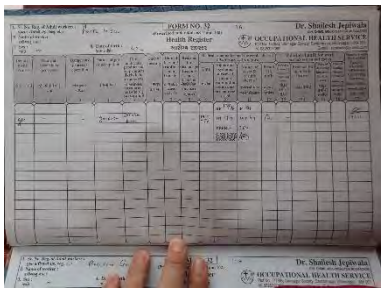
(6) Medical monitoring on workers

According to India Factory Act 1948 and Gujarat Factories Rules 1963, it is made mandatory for the employers to conduct medical examination of their workers. In Alang / Sosiya ship recycling yard,

medical doctors certified by Directorate of Industrial Safety and Health (DISH) who are employed by SRIA are conducting medical examination both at pre-employment stage and periodically in every six months. A periodical examination only covers simple physical and medical examination items. Some NK certified yards are conducting occupational specific examination which is additional to periodical ones, such as pulmonary test for gas cutters and pulmonary, sputum and chest X-ray test for asbestos handlers.

Since it is considered insufficient to grasp the health hazard of workers by current examination items, it is recommended that occupational specific items shall be included.

Periodical medical examination (All yards)



Medical examination form (All yards)

(7) Zoning of the yard and sorting of materials in the yard

NK certified yards have clear zoning in the yard dividing oil contaminated block storage zone, gas cutting zone, non-ferrous disassembly zone and etc. Also, recycled materials are segregated and well organized. On the other hand, normal yards do not have clear boundary of different zones in the yards where oily block and cutting plates are stacked together and LPGs are stored in close proximity to gas cutting area.

Proper zoning in the yard and segregation of dismantled blocks and parts are basic but important method to reduce the risk of any accidents during the operation. Thus, zoning and sorting shall be practiced with the initiative of yard owner and under the supervision of HSE manager and site supervisors.

Proper zoning in the yard reduces operational risk (NK certified yard)

Oily parts and steel plates are stacked together (Normal yards)

LPG is stored close to cutting zone (Normal yards)

(8) Fire accident measures

Firefighting facilities are equipped in all the observed yards. It was also confirmed that fire extinguishers were carried on board for the gas cutting operation. Mock drills for firefighting and emergency evacuation were carried out in in-house training program under the supervision of HSE officer.

Fire fighting facility (Normal yards)

A fire drill (NK certified yards)

(9) Identification and removal of hazardous substances

For the identification of hazardous substances on the ships, NK certified yards are outsourcing preparation of Inventory of Hazardous Materials (IHM) to external expert agencies. In the case of normal yards, identification of hazardous substances is done without IHM. Considering the difficulty of thorough investigation of hazardous substance without IHM, there may be a possibility of hazardous substance remaining unidentified.

In order to minimize the exposure risk to hazardous substances, knowledge of hazardous identification and removal procedures shall be improved among competent authorities who will confirm SRP and issue the decontamination certificate and hazardous material handling workers from each yards.

Identification of hazardous substance including asbestos on board (NK certified yard)

Asbestos removal on board (NK certified yard)

For the removal of hazardous substances, especially for asbestos, some NK certified yards are equipped with their own asbestos removal facilities with negative pressure chamber and shower room and trained workers perform the removal within those facilities with proper PPE. Other normal yards are outsourcing the removal operation to authorized external agency using mobile decontamination unit. With this method, untrained workers will not be in direct contact with hazardous substances.

Mobile decontamination unit (All yards)

Asbestos removal by mobile contamination unit (All yards)

Other hazardous substances such as Ozone Depleting Substances (ODS), radioactive devices, remaining oil, PCB contained device and equipment are removed and collected by authorized external agency on the ship. In case of paint removal, if it is difficult to remove the paints prior to cutting, cutting process shall be done in a control manner with the application of PPE and stored in the designated storage facility.

Some HSE officers pointed out the lack of expertise on PCB handling which shall be incorporated in the training programme.

(10) Hazardous waste management

Each yard is equipped with temporary storage of hazardous wastes and non-hazardous wastes. The storages have separate rooms for different types of wastes such as asbestos, paint chips, batteries, glass wools etc. Collection and disposal of hazardous waste is following the manifest system base on the hazardous management rule (revised in 2003). At first, the ship recyclers shall fill out written applications indicating types and quantity of wastes including potentially containing hazardous substances. Based on the application, authorized agency (GEPIL) collects hazardous and non-hazardous wastes from each yards with designated van and disposed at industrial waste disposal facility (TSDF) by fee based services.

Temporary storage of wastes (All yards)

Asbestos contained parts are sealed and stored (NK yard)

Waste management follows Manifest system (movement document) (All yards)

2.2.3. EVALUATION OF CURRENT MEASURES EMPLOYED TOWARDS LABOR SAFETY AND HEALTH AND ENVIRONMENTAL PROTECTION

The result of site survey is summarized in the following table. The evaluation was separately done for; yards already certified by NK, yards in the process of verification and normal yards. The target yards of the Project will be the similar status of normal yards.

Table 2-8 Results of site investigation and status of conformity with the requirement of the Convention

(C: Complied, NC: Not Complied)

Survey Item	Result of Survey (Certified Yard)	Result of Survey (Yard under application)	Result of Survey (Normal Yard)
Facility management			
Document management	C	C	NC (documents not confirmed)
Training plan	C	C	NC

Survey Item	Result of Survey (Certified Yard)	Result of Survey (Yard under application)	Result of Survey (Normal Yard)
	(room for improvement on training content)	(room for improvement on training content)	(training courses are not prepared / conducted)
Facility operation			
SRP development	C	C	NC
Ship recycling methodology	C	C	NC (block dropping and cutting done in inter-tidal zone)
Worker safety and health compliance approach			
Key safety and health personnel	C	C	C (no adequate training obtained in some cases)
Safe-for-entry / Safe-for-hot-work procedures	C	C	NC (prior confirmation by HSE officer has not been thoroughly done)
Prevention of working at height	C	C (confirmed with documents)	NC (not confirmed)
Housekeeping	C	C	NC (zoning is not properly done, yard not organized)
Health and sanitation	C	NC (under construction incl. resting room)	NC (no adequate facilities equipped incl. resting room, shower rooms etc.)
PPE	C	C	NC (lack of proper PPE identified in some yards)
Medical monitoring	C	C (additional occupational wise checkup advised)	C (additional occupational wise checkup advised)
Emergency preparedness	C	C	C
Fire and explosion prevention	C	C	C (inspection of equipment and fixtures incl. fire-fighting equipment required)
Environmental compliance approach			
Environmental monitoring	C (additional monitoring item recommended)	NC (periodical monitoring will start)	NC (not performed)
Management of Hazardous Materials	C	C	NC (untrained workers are engaged in the removal activity not by specialized agencies)
Prevention of adverse effects to the environment	C	NC (concrete and pit are under construction)	NC (not improved)

Source: Survey Team

In some yards which have SOC by ClassNK etc, the implementation of training of workers, use of appropriate PPE etc. are reviewed and monitored and improved based on the SRFP. However, in other yards, the following occupational health and safety issues were revealed except for the facility operation and management method.

① insufficient inspection and safety confirmation before entering the compartment, before fire use
② Insufficient safety measures such as fall prevention during high altitude work
③ Insufficient workers' sanitation facilities (rest rooms, showers, etc.)
④ insufficient use of PPE properly
⑤ Periodic health checkup and management of workers is inadequate
⑥ Inadequate handling and education of harmful substances

2.3. CURRENT STATUS AND ISSUES ON ENVIRONMENTAL CONSIDERATION

2.3.1. CURRENT SITUATION ON ENVIRONMENTAL CONSIDERATION

(1) Wastes generated from Ship

In this survey, investigation of the type and amount of waste generated from the ship during the recycling process for two ships of bulk carriers and container ships is made. The results are shown in the following table.

As a result, one vessel is confirmed the usage of asbestos, but PCB, TBT paint, etc., are not detected. Asbestos is prevented from being discharged to the atmosphere by trained specialized workers, removed, managed by the manifest, transferred to the TSDF and landfilled. PCB was not detected even in inventory and sample analysis, but it may be contained in insulation of electric wire etc., and PCB waste cannot be stored or processed in case there is as waste. Similarly, TBT paints have not been applied for two vessels, but harmful paints other than TBT (such as lead) have not been removed in advance. The paint pieces are cleaned at the disassembling place on land and sent to the TSDF.

On the other hand, although, waste oil, sludge, etc., should be disposed by incineration under the Indian national regulation, these are collected by the contractor and resold after being processed, ship recycler asked the contractor for washing. Cleaning of the tank is carried out by sawdust, oil sand etc. Therefore, there are cases where insufficient washing oil leakage from the cut block to the sea or soil. The treatment of oil sands is also an issue.

Although the amount of waste discharged from the ship is 0.1-0.3% per LDT[4], glass wool occurs in large quantities in waste from the ship. These are packed after bagging and landfilled with TSDF. Volume reduction of glass wool is an issue.

Table 2-9 Type and Volume of wastes generated from Ship

no.	Type	Type of waste	Approx. Quantity		Disposal Mode
			B.C. Panmax	Container	
1	Asbestos	HW	538 kg	- kg	Solidification/Incineration
2	Glass wool/Mineral wool	HW	8,280 kg	10,650 kg	Secured Landfill Site
3	PUF/Poly styrene		220 kg	- kg	Incineration

[4] LDT : Light Displacement Ton. Weight tonnage of ship without cargoes, persons, fuels, water, etc.

no.	Type	Type of waste	Approx. Quantity		Disposal Mode
			B.C. Panmax	Container	
4	Waste oil		21,000 L	400 L	Incineration
	Used oil			30,000 L	Sale for recycle
5	Oily Sludge		650 kg	32,000 L	Incineration
6	Plastics	HW	70 kg	200 kg	Incineration
7	Paint Chips		2,972 kg	4,480 kg	Incineration
8	Iron scale	NHW	-	-	Sale for recycle
9	Fiber glass/Rexene	NHW	-	-	Sale for recycle
10	Food Waste	NHW	75 kg	250 kg	Secured Landfill Site
11	Card boards & Packages	NHW	-	-	Sale for recycle
12	Glass	NHW	-	-	Sale for recycle
13	Bilge Water	HW	5,500 L	50 MT	Bilge Water Treatment Plant
14	Rubber	NHW	200 kg	- kg	Sale for recycle
15	Lubricating Oil	HW	1,008 L	92,000 L	Authorized Recycler
16	Grease	HW	345 L	300 kg	Authorized Recycler
17	Paints	HW	200 L	160 L	Authorized Recycler
18	H.F.O.	HW	2,000 L	407 MT	Authorized Recycler
19	Engine Oil	HW	110 L	5,000 L	Authorized Recycler
20	Slop Oil	HW	4 L	200 L	Authorized Recycler
21	Hydraulic Oil	HW	400 L	11,300 L	Authorized Recycler
22	Cylinder Oil	HW	1,600 L	60 L	Authorized Recycler
23	Oily-Chemical contaminated rags	HW	50 kg	150 kg	Incineration

Source: Survey Team

(2) Ship recycling process in inter-tidal zone

In NK certified yard, in order to avoid oil leakage in intertidal zone and into the sea, the primary cutting process will be performed on the ship by leaving the bottom of the ship to receive dismantled blocks. In principle, non-oily blocks are permitted to be dropped in intertidal zone according to the ClassNK's certification standard. In normal yards, cutting process was carried out in the inter-tidal zone and blocks and materials were scattering in the inter-tidal zone.

In this Project, Large crane will be introduced for carrying large blocks or equipment to avoid the fall of oily blocks to the inter-tidal zone.

Blocks being dropped inside the ship not to the inter-tidal zone (NK certified yard)

Blocks being dropped in the sea / in the inter-tidal zone (Normal yards)

Cutting is done in the inter-tidal zone (Normal yards)

(3) Potential impact in inter-tidal zone (fuel tank)

During site investigation, oil sludge were identified in the fuel tank after the cleaning process. Therefore, while the ship was waiting for the cutting operation in inter-tidal zone, sea water goes into the fuel tank during high tide which may cause a risk of oil spillage into the sea.

In order to prevent potential impact in inter-tidal zone, the Project will propose introduction of fuel tank cleaning units and its cleaning method.

Oil still remaining inside fuel tank after cleaning (yard in process of verification)

Water coming inside the fuel tank while the ship is waiting in inter-tidal zone (yard in process of verification)

(4) Pollution prevention measures on the yard

NK certified yards have laid concrete floor for second cutting area to avoid spillage of oil and other hazardous substances. Moreover, the pit was installed at the edge of the concrete yard in order to collect rainwater containing leaked oil and other hazardous materials which may run down from the concrete yard. The concrete yard and pit was connected to the bilge collection tank which was also equipped on the yard. Also oil contaminated parts were stored on the concrete floor designated area to avoid direct contact with soil. On the other hand, normal yards do not have concrete pavement so cutting operation is done on the ground. Some normal yards, however, also stored oily parts on the steel plates to prevent oil spillage on the soil.

In this project, yard improvement to prevent possible pollution will be planed which is similar to NK certified yards.

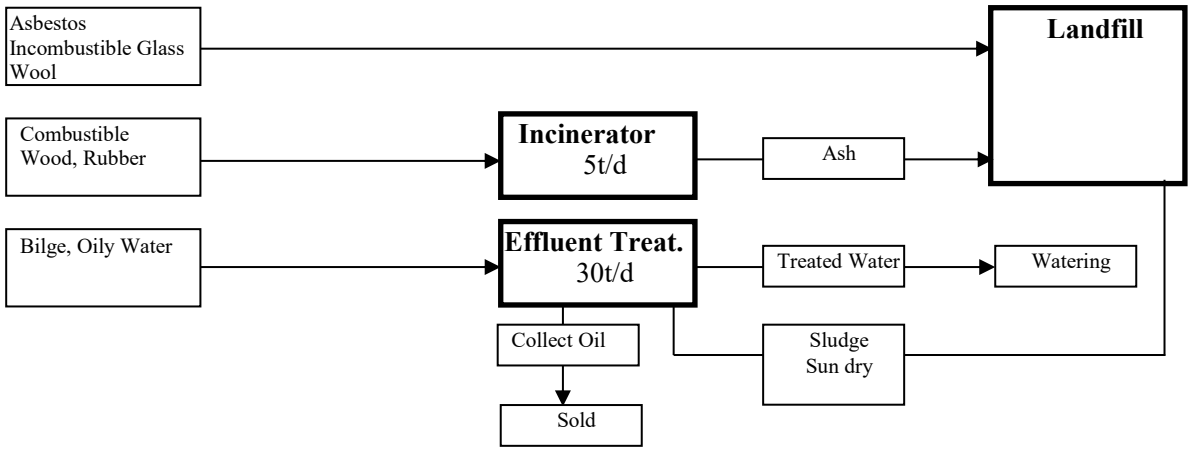
Concrete floor on the yard (NK certified yard)

Drainage pit to prevent pollution on the soil and sea (NK certified yard)

Oily parts storing space (All yards: only some yards have the roof)

2.3.2. OUTLINE OF EXISTING FACILITIES

TSDF is located 2km away from Alang and mainly consist of Incinerator (5 tons/day capacity), Effluent Treatment Plant (30m^3/day capacity), Landfill site for hazardous materials (70,000m^3) and Landfill site for general wastes (30,000m^3). It was constructed by GMB in 2005 and a private operator (GEPL) as the consignee started its operation from 2006. Layout of TSDF is shown on the Figure 2-3 Layout of TSDF below.



Source: Survey Team

Figure 2-2TSDF Existing Facility

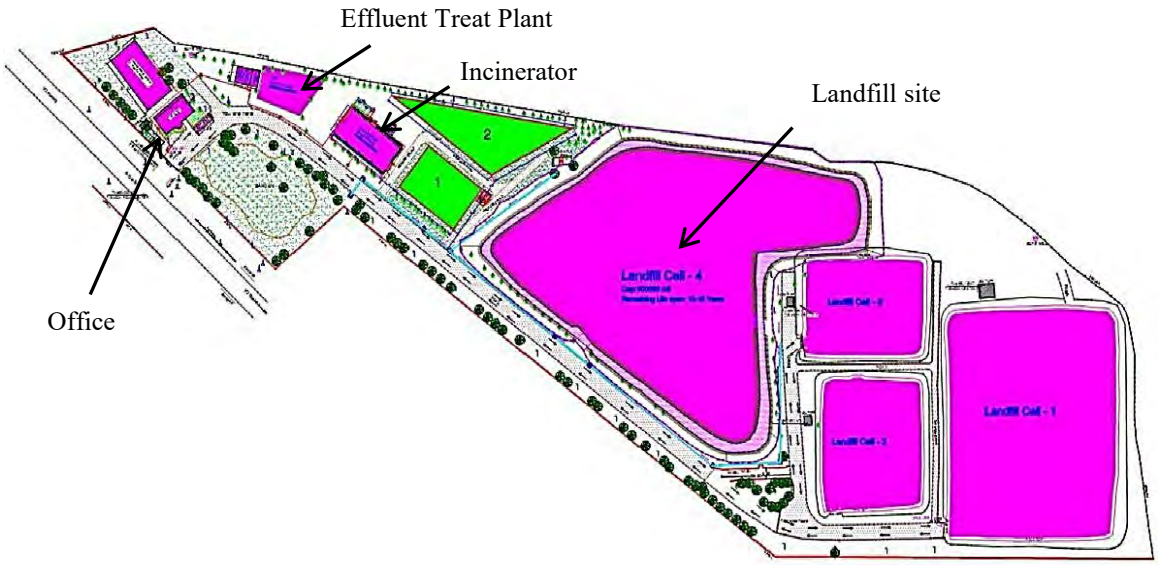


Figure 2-3 Layout of TSDF

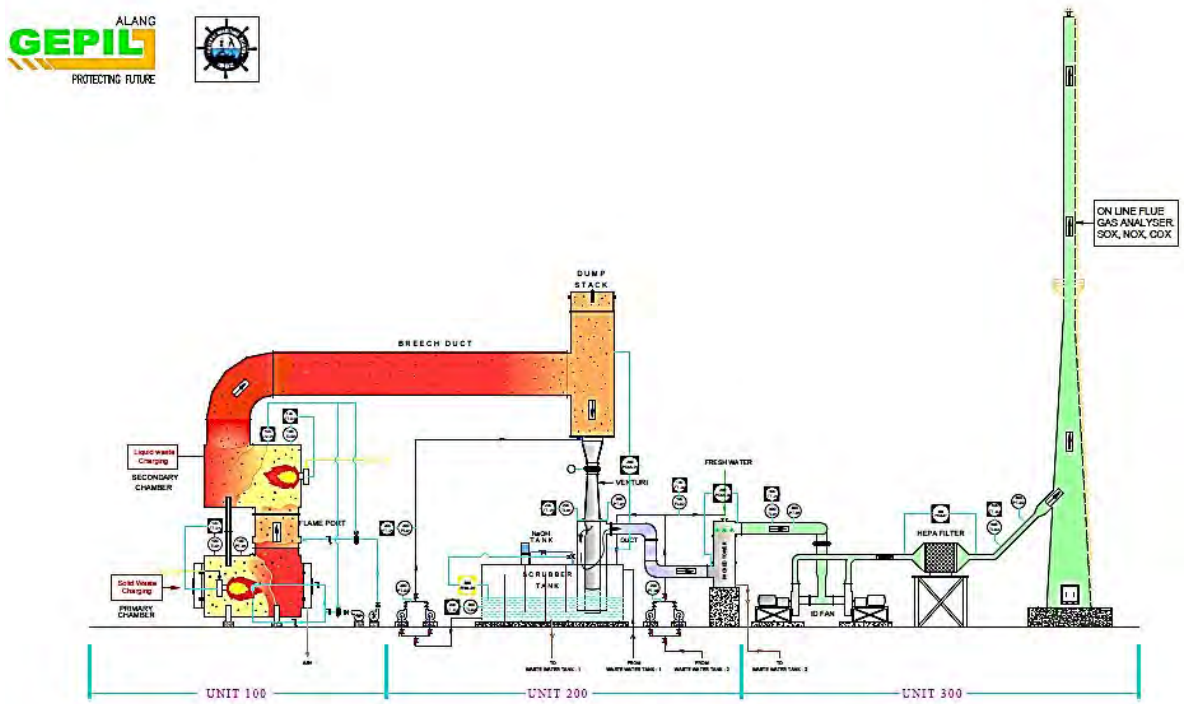
Remarks: Area shown in color green is site for expansion.
color pink shows existing facilities
Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang / Sosiya

(1) Incinerator

The incineration facility can handle solid, semi-solid, and liquid harmless / hazardous waste with a caloric value of 2500 Kcal / kg or more and has incineration capacity of 5 tons / day. The main hazardous waste currently incinerated is oil sludge, cloth / sand containing oil, paint / coating material, rubber gasket, polyurethane foam, polystyrene foam, waste plastic, etc.

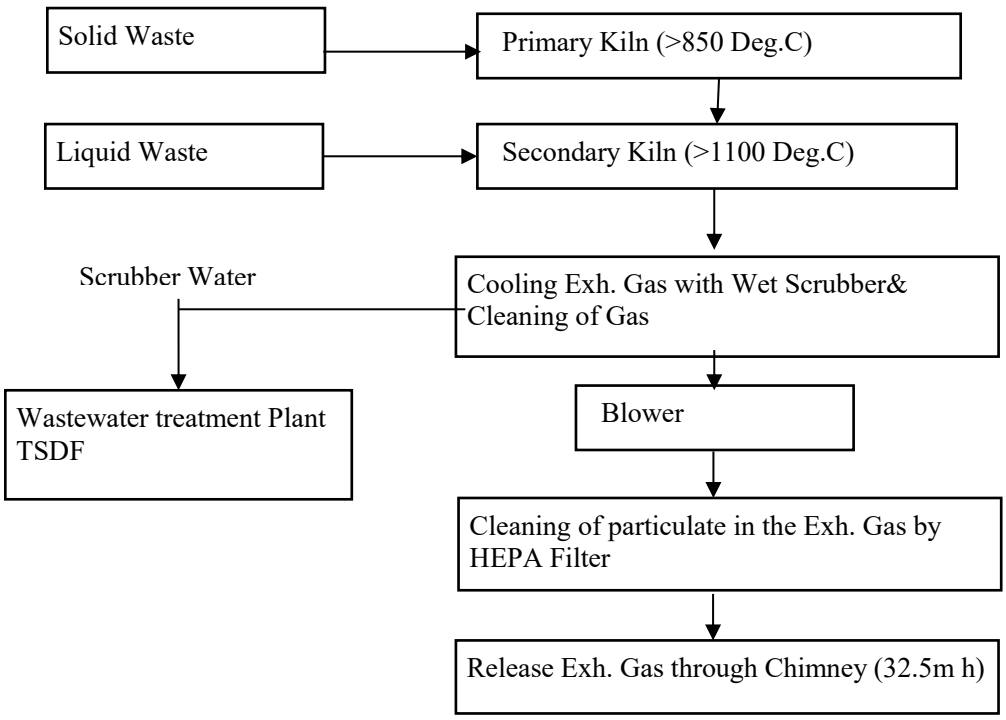
Incinerator consists of primary kiln and secondary kiln and is designed to incinerate wastes more than 850 deg. C and 1100 deg. C respectively in accordance with the guidance of Central Pollution Control Board (CPCB). Exhaust gas is released to the air after treated with wet scrubber. Scrubber

water is treated in the wastewater treatment facility in TSDF and ash is reclaimed in the Landfill site of TSDF. Incineration process is shown on the figure.



Source: GEPIL Presentations

Figure 2-4 Existing Incinerator of TSDL



Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

Figure 2-5 Incineration Process

(2) Management type landfill disposal facility

There are four landfills of TSDF. In 2005, 1) landfill sites for asbestos and glass wool (43,000 m 3), 2) for industrial waste (10,200 m 3), for general waste (8 700 m 3) was constructed. Two of them are already full and covered. Cell No. 4, which was newly prepared as a managed landfill disposal facility, has a capacity of 100,000 m 3, of which 70,000 m 3 is industrial waste and 30 000 m 3 is general waste. The outline of each repository is shown in the following table

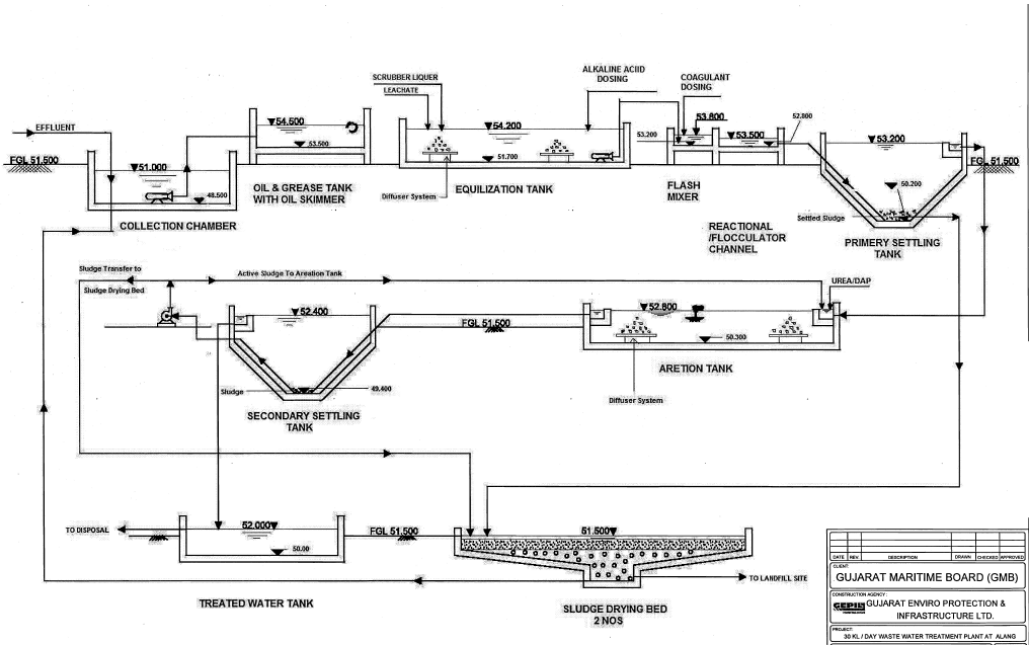
Table 2-10 Outline of Landfill Site

Cell No.	Name	Total Capacity	Total waste volume (MT)	Start operation	Stop operation	Current Status
Cell-1	Asbestos & Glasswool Cell	43,038 m^3	28317.770*	Oct. 2005	May 2013	
Cell-2	Ind.Solid & Chemical Waste Cell	10,212 m^3	4844.575*	Oct. 2005	Dec. 2011	
Cell-4.1	Hazardous Waste Cell	70,000 m^3	12574.673*	May 2013	Under operation	operation
Cell-3	MSW	8,723 m^3	6704.165*	Oct.2005	Under operation	operation
Cell-4.2	MSW	30,000 m^3	Not yet	Not yet		Not yet

Source: GMB Presentaiton

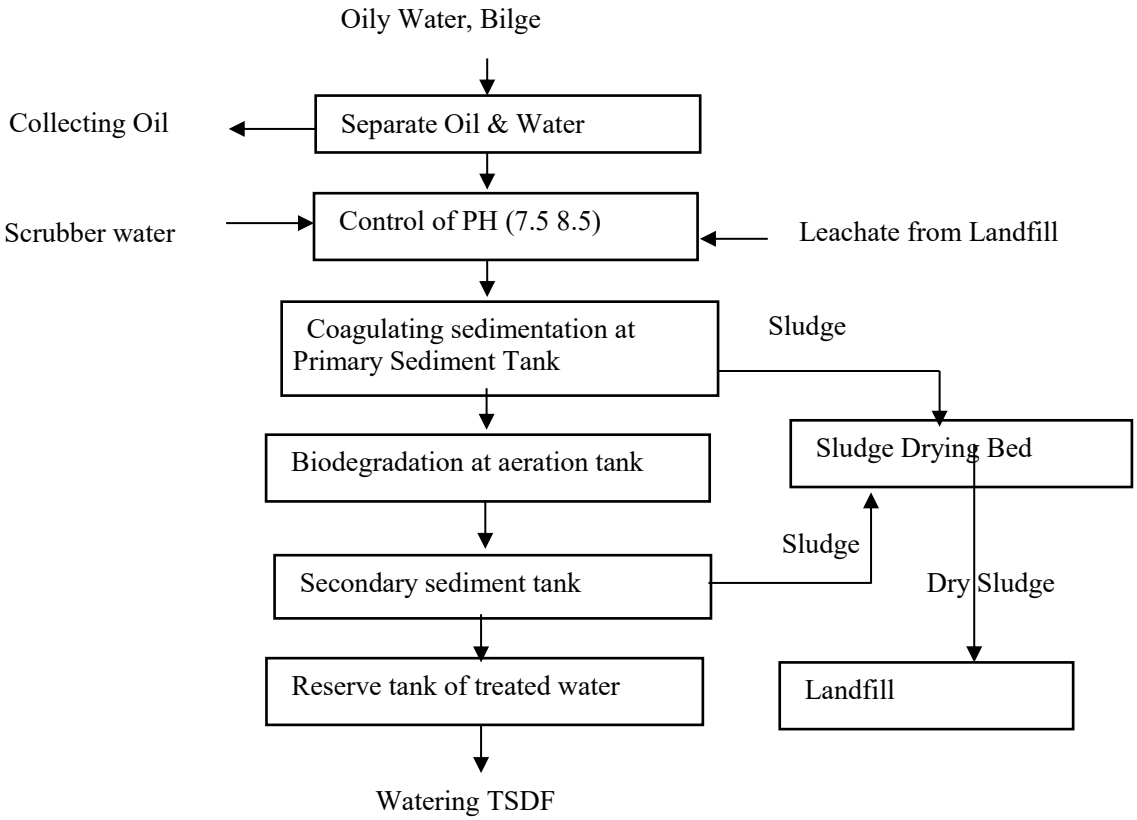
(3) Effluent Treatment Plant

Effluent treatment plant has a capacity of 30m^3/day and treated bilge water, scrubber water from incinerator, leachate from landfill site. Wastewater is treated coagulating sedimentation and biodegradation method and is not released to outside but utilizing water for greenery in TSDF. Sludge is reclaimed at landfill site after it is dried up at a drying bed. Effluent treatment flow is shown on the next.



Source: GMB Presentation

Figure 2-6 FET Flow of TSDF



Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

Figure 2-7 Effluent Treatment Process

(4) Issues of TSDF Facility

1) Effluent treatment equipment

Current Effluent Treatment Plant (wastewater treatment equipment) processes wastewater containing low concentration oil by static separation and chemical dosage. Therefore, it cannot deal with wastewater etc. containing high concentration of oil. Also, it cannot cope with the treatment of sludge generated by fuel oil tank cleaning work after beaching and offshore tanker washing operation. For this reason, it is necessary to have a processing device capable of treating high oil content drainage and sludge.

2) Incinerator

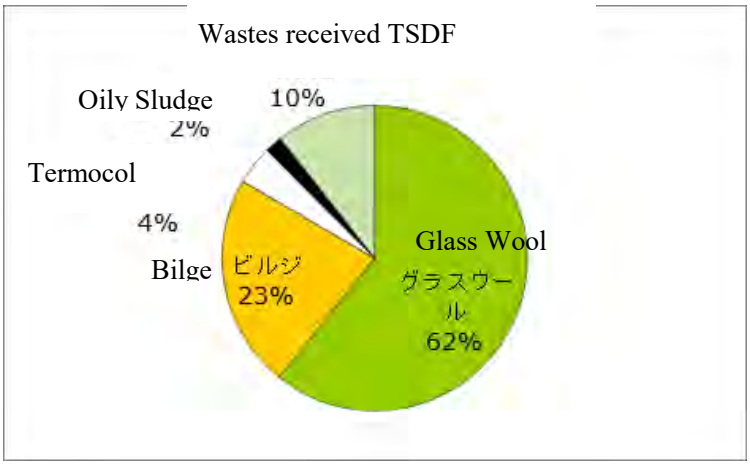
Regarding the detoxification of PCB-containing substances, according to the "Waste Disposal and Public Cleaning Law" of Japan, technical standards and maintenance standards for PCB waste incineration facilities shall be followed this regulation and it is said that 1,100 ° C is the standard regardless of the concentration of PCB waste according to the regulations.

On the other hand, it is said that "it is appropriate to set the permissible requirement of industrial waste disposal facility to 850 ° C or more for 2 seconds or more only in case of trace PCB contaminated insulating oil".

Although the incinerator currently declares the performance of 1100 ° C in the secondary furnace, due to the calorie of the waste actually burned is low and the characteristics of the fixed furnace, it is possibility the temperature of the secondary combustion is lower than the specification. For this reason, an incinerator capable of stably exhibiting high-temperature incineration at 1100 ° C or higher is necessary.

3) Management type landfill disposal site

More than 62% of volume brought into managed landfill sites is glass wool and since it cannot be incinerated, it is landfilled. Landfill sites have limitations, and there are no plans for expansion at present. For this reason, reducing the volume of industrial waste is an issue.



Source: GEPIL Presentation, JICA Survey Team

Figure 2-8 Wastes coming to TSDF

3. PRELIMINARY DESIGN OF THE PROJECT

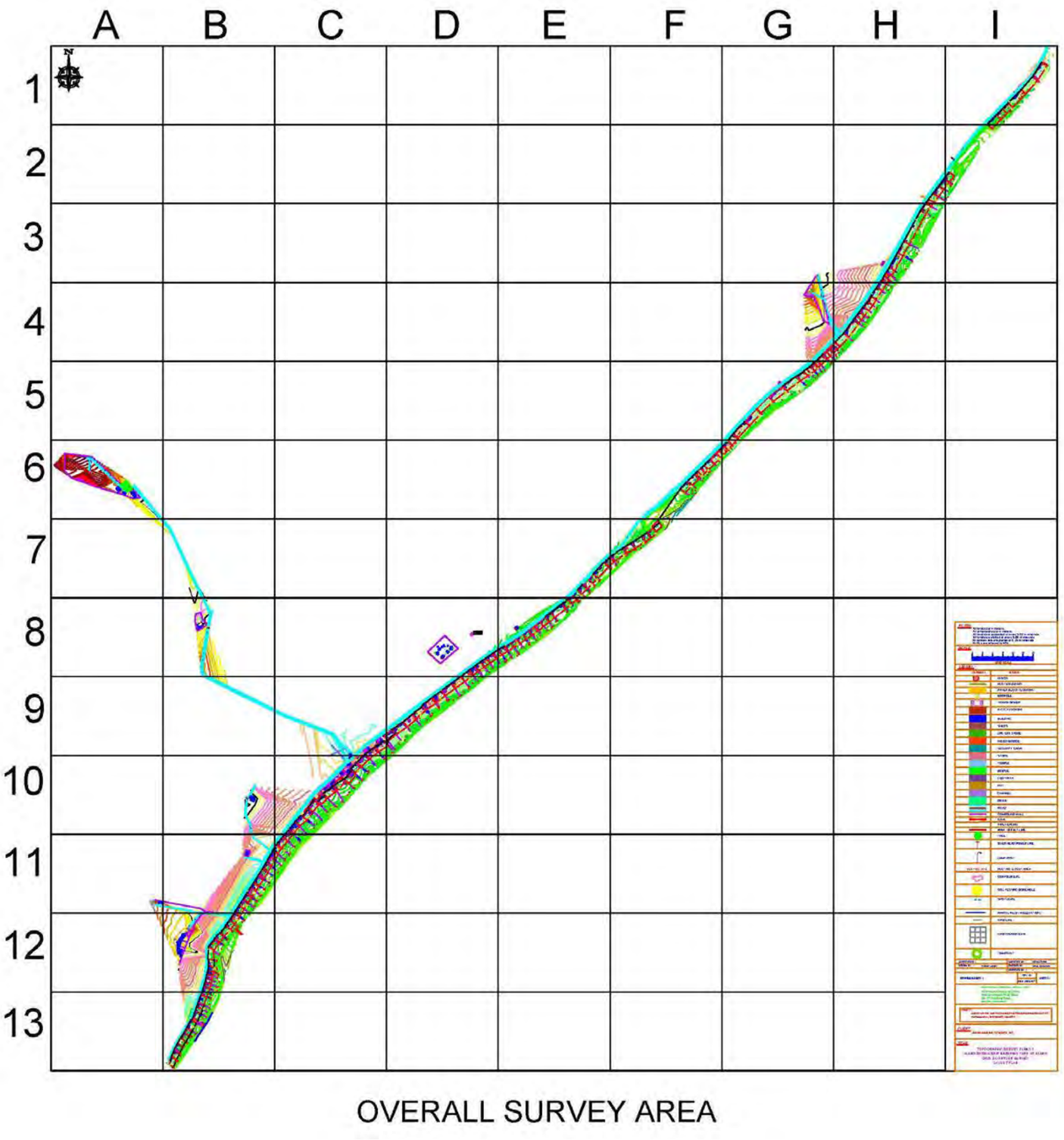
3.1. NATURAL CONDITION SURVEY AND TESTING

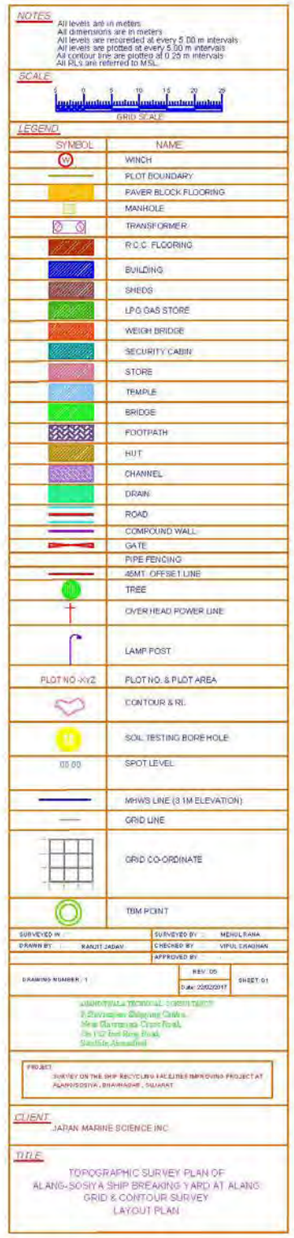
(1) Topographic Survey

In order to obtain design data which is necessary for construction of structures such as concrete floors to improve ship recycling yards, topographic survey was carried out across a range of areas from a road alongside ship recycling yards to a shore line in a width of 130m to 200m and stretched over 9.4km from South to North at Alang/Sosiya. Control point survey and detail survey were carried out by total stations. Contour lines were developed by measuring spot heights every 7m grid. Topographic map is drawn on a scale of 1 to 1,000 with a contour interval of 25cm. On the map, boundaries between each plot and major structures such as buildings and storages are indicated. An elevation of each spot is referred to Chart Datum Level (CDL). The concrete floors are planned to be constructed above high water level. According to GMB tidal levels are shown as below:

Mean High Water Spring (MHWS)	CDL +7.80m
Mean High Water Neap (MHWN)	CDL+6.30m
Mean Low Water Neap (MLWN)	CDL+3.00m
Mean Low Water Spring (MLWS)	CDL+1.60m

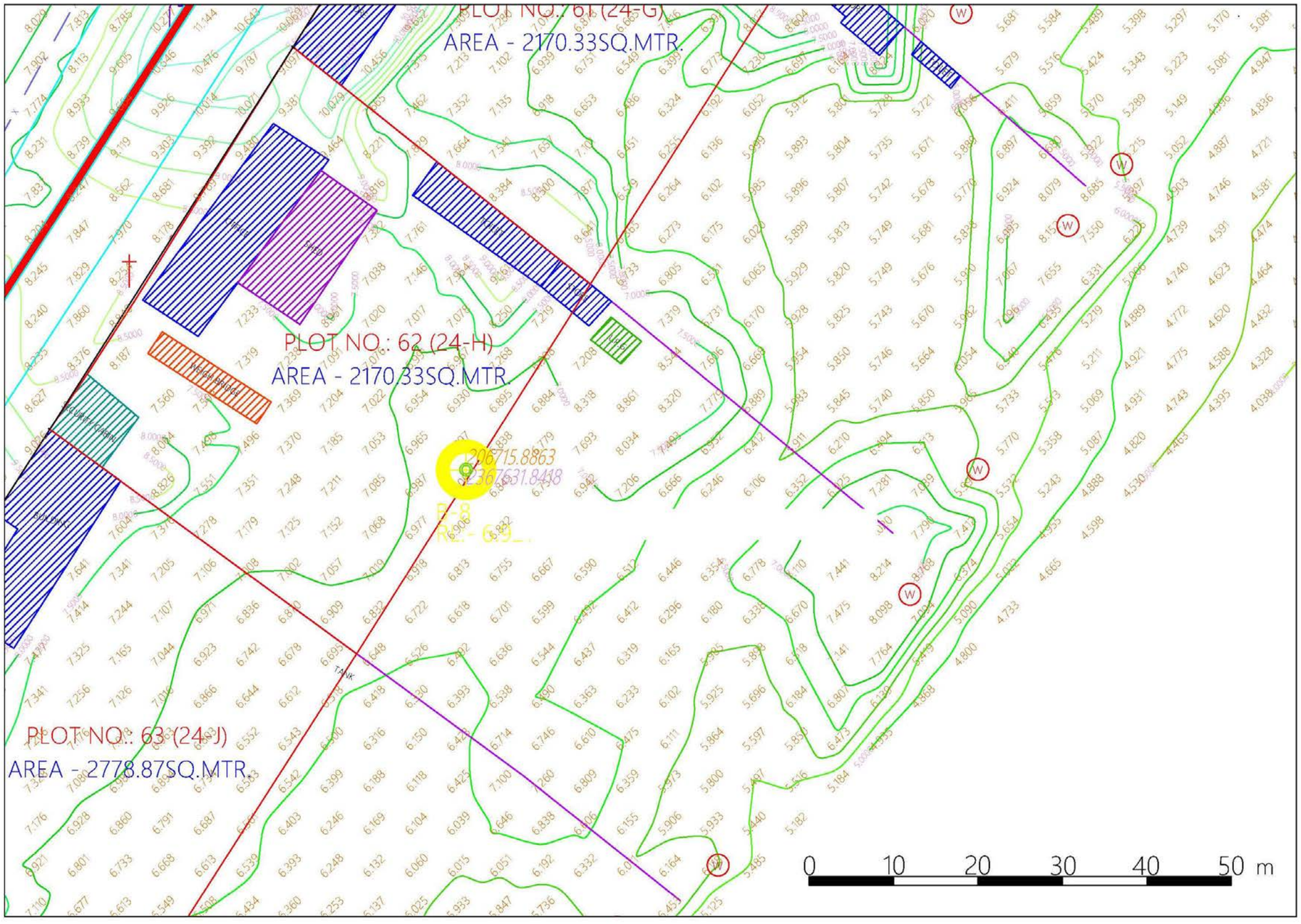
A coastal road outside the yards is indicated on the map, which can be used for rain drainage plan too. Figure 3-1 indicates outline of Topographic Survey Area.





Source: JICA Survey Team

Figure 3-1 Topographic Survey Area

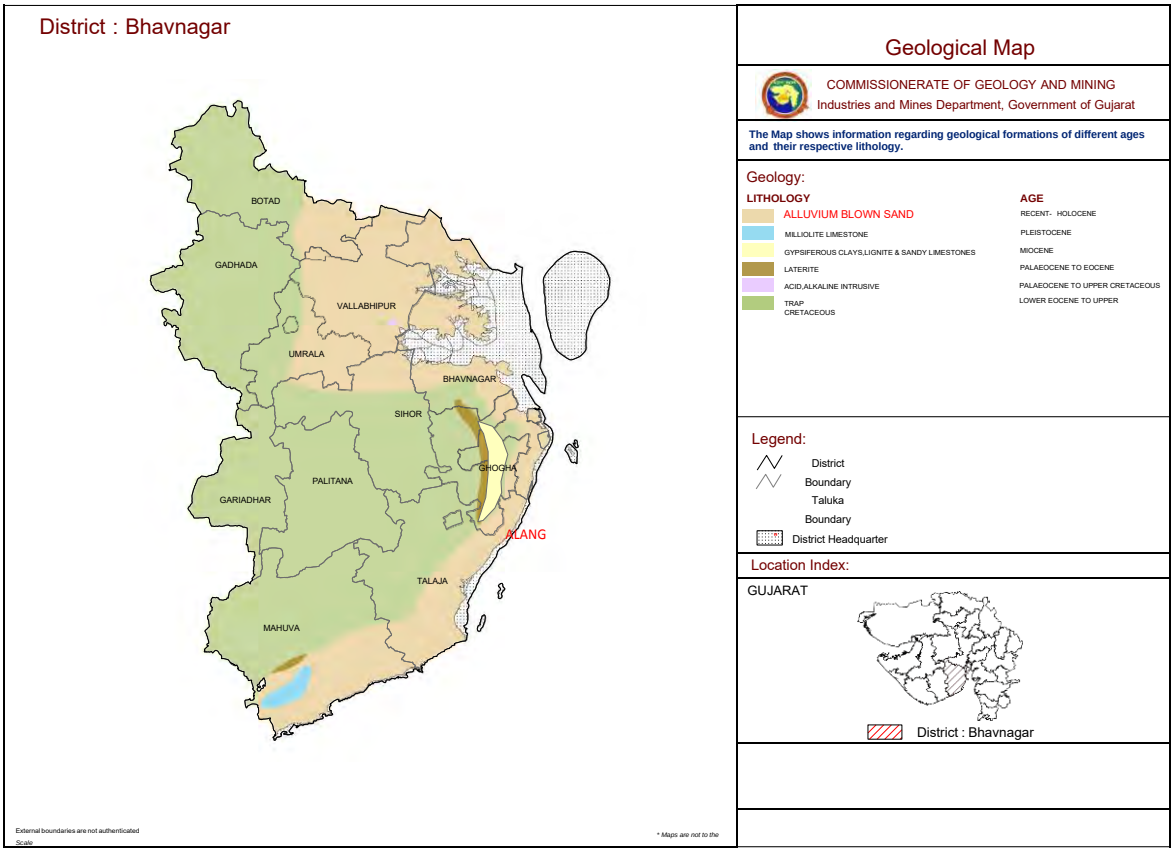


Source: JICA Survey Team

Figure 3-2 Topography of Ship Recycle Yard (Example)

(2) Soil Investigation

Purpose of the soil investigation is to obtain soil data which are necessary for designing concrete floors and its pertinent facilities at the ship recycling yards. Soil properties in the area consist of deposited sand due to tidal current or wave. Figure 3-3 indicates Geological Map in Bhavnagar District



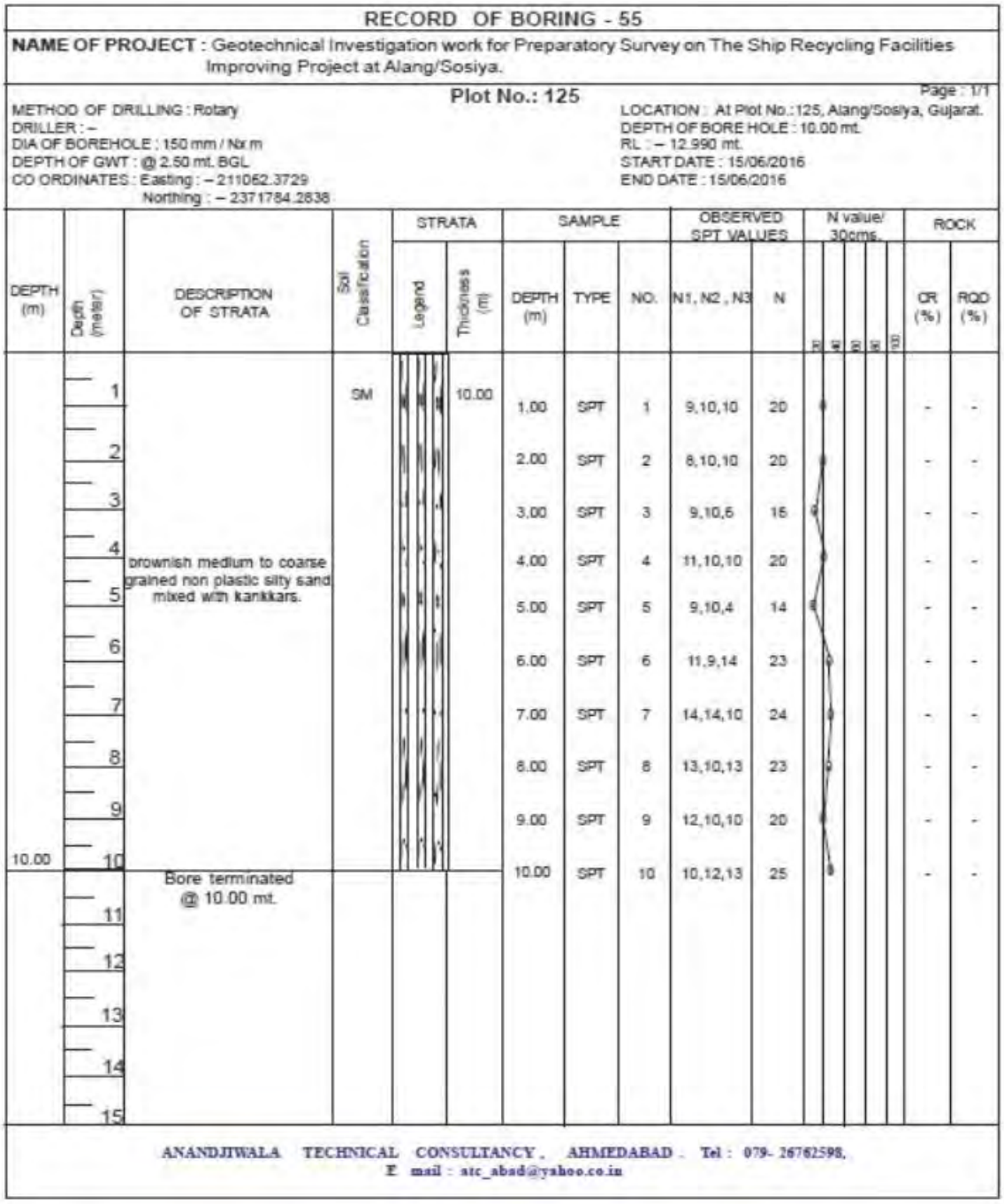
Source：Commissionerate of Geology and Mining Industries and Mines Department, Government of Gujarat

Figure 3-3 Geological Map in Bhavnagar District

Seventy (70) borings were performed to investigate soil properties from surface to 10m depth in the survey area. Location of the borings is indicated in the topographic map. In the process of boring Standard Penetration Tests (SPT) and taking undisturbed samples were performed. According to the boring some silty clay was found beneath the deposited sand. N-value obtained from the SPT is generally more than 30 at almost boring locations. However at several locations loose sand is deposited to 10m depth. There are two types of N-value tendency, one is constant N-value throughout whole 10m depth and another is increasing N-value proportional to depth. Figure 28 and Figure 29 indicate example of Constant N-value regardless of depth and increasing N-value proportional to depth respectively. Laboratory soil testing were performed as follows:

Grain Size Analysis/ Atterberg Limits test/ Density Test of Soil Particle (2.51-2.69g/cm^3)/ In-place Moist Unit Weight Test (1.73-1.86g/cm^3 for 10 pcs. of undisturbed samples)/ In-place Dry Unit Weight Test (1.58-1.70g/cm^3 for 10 pcs. of undisturbed samples). The results of those tests are within ranges of the soil properties of normal soil, hence soil in the area seems to be usable for construction of the structures.

Taking possible pavement on the soil into consideration, CBR tests were performed. Ten (10) samples were taken from each plot and laboratory CBR tests were carried out. The results of the tests indicate that the soil can be used as a subgrade for the pavement. Topographic map and the soil boring data is shown on the Appendix - 2.



RECORD OF BORING - 55

NAME OF PROJECT : Geotechnical Investigation work for Preparatory Survey on The Ship Recycling Facilities Improving Project at Alang/Sosiya.

Plot No.: 125

Page : 1/1

METHOD OF DRILLING : Rotary
DRILLER : –
DIA OF BOREHOLE : 150 mm / Nx m
DEPTH OF GWT : @ 2.50 mt. BGL
CO ORDINATES : Easting : – 211062.3729
Northing : – 2371784.2838

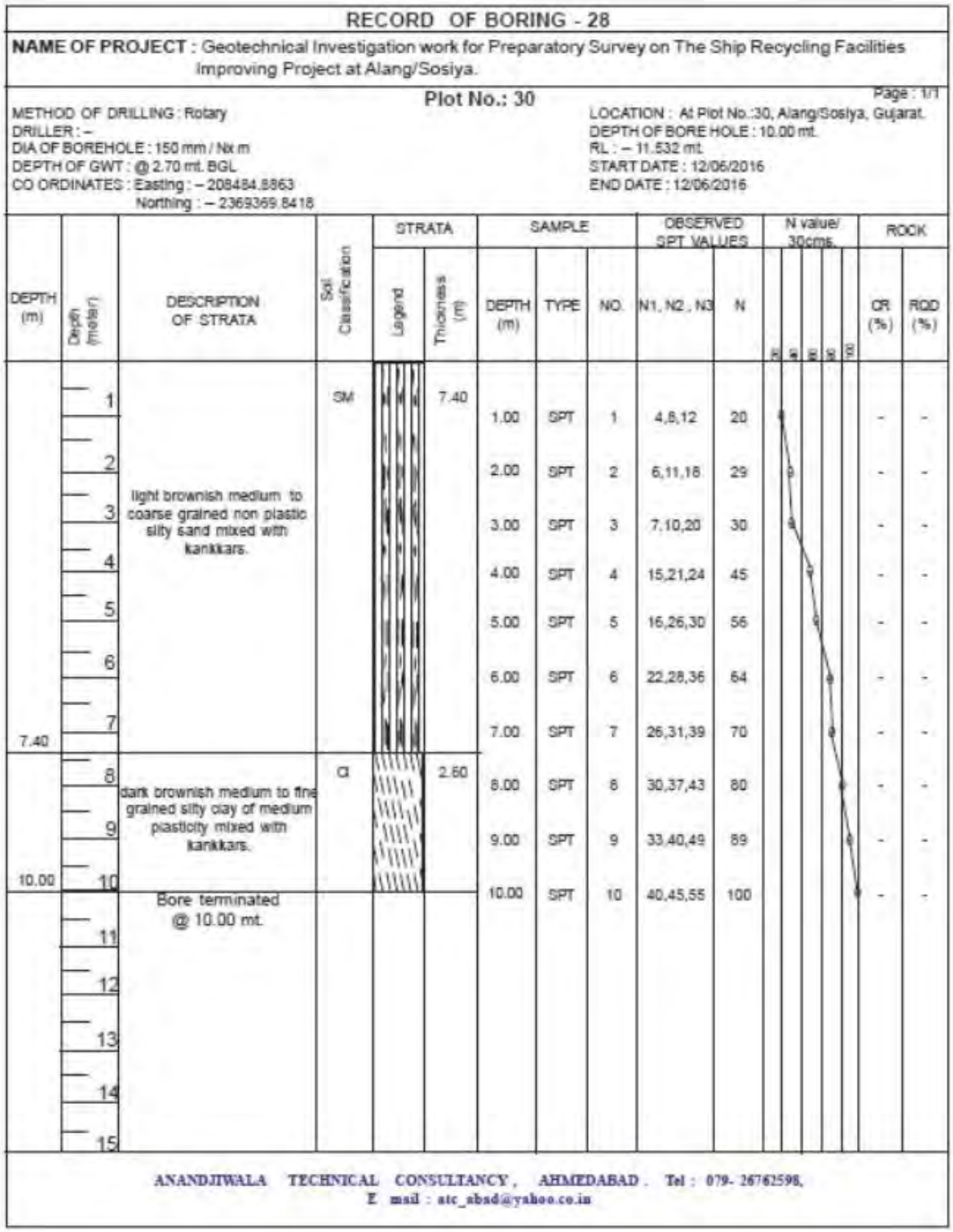
LOCATION : At Plot No.:125, Alang/Sosiya, Gujarat.
DEPTH OF BORE HOLE : 10.00 mt.
RL : – 12.990 mt.
START DATE : 15/06/2016
END DATE : 15/06/2016

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA Legend	STRATA Thickness (m)	SAMPLE DEPTH (m)	SAMPLE TYPE	SAMPLE NO.	OBSERVED SPT VALUES N1, N2, N3	OBSERVED SPT VALUES N	N value/ 30cms.	ROCK CR (%)	ROCK RQD (%)
	1	brownish medium to coarse grained non plastic silty sand mixed with kankkars.	SM		10.00	1.00	SPT	1	9,10,10	20		-	-
	2					2.00	SPT	2	8,10,10	20		-	-
	3					3.00	SPT	3	9,10,6	16		-	-
	4					4.00	SPT	4	11,10,10	20		-	-
	5					5.00	SPT	5	9,10,4	14		-	-
	6					6.00	SPT	6	11,9,14	23		-	-
	7					7.00	SPT	7	14,14,10	24		-	-
	8					8.00	SPT	8	13,10,13	23		-	-
	9					9.00	SPT	9	12,10,10	20		-	-
10.00	10	Bore terminated @ 10.00 mt.				10.00	SPT	10	10,12,13	25		-	-
	11												
	12												
	13												
	14												
	15												

ANANDJIWALA TECHNICAL CONSULTANCY, AHMEDABAD. Tel : 079- 26762598,
E mail : atc_abad@yahoo.co.in

Source: JICA Survey Team

Figure 3-4 Borelog Example with N-value Constant Regardless of Depth



RECORD OF BORING - 28

NAME OF PROJECT : Geotechnical Investigation work for Preparatory Survey on The Ship Recycling Facilities Improving Project at Alang/Sosiya.

Plot No.: 30

Page : 1/1

METHOD OF DRILLING : Rotary
DRILLER : –
DIA OF BOREHOLE : 150 mm / Nx m
DEPTH OF GWT : @ 2.70 mt. BGL
CO ORDINATES : Easting : – 208484.8863
Northing : – 2369369.8418

LOCATION : At Plot No.:30, Alang/Sosiya, Gujarat.
DEPTH OF BORE HOLE : 10.00 mt.
RL : – 11.532 mt.
START DATE : 12/06/2016
END DATE : 12/06/2016

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA Legend	STRATA Thickness (m)	SAMPLE DEPTH (m)	SAMPLE TYPE	SAMPLE NO.	OBSERVED SPT VALUES N1, N2, N3	OBSERVED SPT VALUES N	N value/ 30cms	ROCK CR (%)	ROCK RQD (%)
7.40	1–7	light brownish medium to coarse grained non plastic silty sand mixed with kankkars.	SM		7.40	1.00	SPT	1	4,8,12	20		-	-
						2.00	SPT	2	6,11,18	29		-	-
						3.00	SPT	3	7,10,20	30		-	-
						4.00	SPT	4	15,21,24	45		-	-
						5.00	SPT	5	16,26,30	56		-	-
						6.00	SPT	6	22,28,36	64		-	-
						7.00	SPT	7	26,31,39	70		-	-
10.00	8–10	dark brownish medium to fine grained silty clay of medium plasticity mixed with kankkars.	CI		2.60	8.00	SPT	8	30,37,43	80		-	-
						9.00	SPT	9	33,40,49	89		-	-
						10.00	SPT	10	40,45,55	100		-	-
	11–15	Bore terminated @ 10.00 mt.											

ANANDJIWALA TECHNICAL CONSULTANCY, AHMEDABAD. Tel : 079- 26762598,
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Source: JICA Survey Team

Figure 3-5 Borelog Example with N-value Increasing propositional to Depth

Figure 3-6 Boring at Seashore

3.2. SCOPE AND CONTENTS OF THE PROJECT

As the result of the comparison between the Requirements of the Ship Recycling Convention and Indian Regulation and Ship recycling process facility, labor and environment etc. of beaching method in Alang / Soya area, prevention of environmental contamination of intertidal zones and soils by oil and other hazardous materials generated during ship recycling operation and the recycling process emphasizing the safety of workers and the necessity of facility improvement to implement this are again recognized.

(1) Required Project Contents

The issues to be addressed in the previous chapter are reviewed and facilities and work procedures that need to be considered in order that ship recycling facility to become compliant to the Convention are as follows. These measures are mainly focused on how to prevent environmental pollution in the ship recycling process in the intertidal zone. The outline of the required measured is explained with basic design including contents, quantity, etc.

Table 3-1 Proposition of recommended facilities and equipment to comply with the Convention

Measures need to be considered	Items of Facility or Process	Recommended Contents of the Project
	Improvement of Yard to prevent pollution of intertidal zone and soil	Improvement of yard with concrete floor and oil correcting drain for the recycling works with Hazardous materials and contaminants.
	Heavy equipment for the work in intertidal zone	Heavy lifting equipment for steel plate and hull block. (currently only winches) Introduction of Large Crawler cranes for the recycling work in intertidal zone. The crane will be time base rent scheme with operator for all yards who may be needed. (Large block will directly transferred from ship to shore or by lightning after part of ship, avoid pollution of the sea)

Measures need to be considered	Items of Facility or Process	Recommended Contents of the Project
	Wheel Loader for beach	Bucket ㎥ for the purpose of 10km beach cleaning (cleaning of debris) of Alang/Sosiya
	Bunker oil tank cleaning device	Cleaning of double bottom FO tank. Introduction of mobile high pressure cleaning device. Equipment shall be 1 TEU size and make available for all yards.
	Afloat Tanker Cleaning Barge	One cargo oil tank, slop tank cleaning and transportation barge
	Multi-purpose vessel	For the purpose of oil combatting, firefighting and monitoring during tanker cleaning operation at sea. One multi-purpose work boat.
Reinforcement of capability of Hazardous Materials and wastes treatment.	Reinforcement of oil treatment and incineration capacity of TSDF	As the result of the improvement of yards and other project, it is expected to increase the volume of wastes and HMs. Improvement of Incineration performance. Improvement of Oil treatment performance.
Improvement of work environment	Improvement of living condition	Improve living condition of workers and provide safe and hygiene housing thus promote inhabitant workers

Source: JICA Survey team

Proposed scope of the Project and corresponding requirements of the Ship Recycle Convention is shown on the table next.

Table 3-2 Proposed scope of the Project and corresponding requirements of the Ship Recycle Convention

Requirements of Ship Recycling Convention	Contents to Correspond	Item to Cope in Facility and Procedure	Project Scope
Regulation 17 – General requirements • Authorized SRF shall establish management systems, procedures and techniques not pose health risks to the workers and prevent, reduce, minimize adverse effects on the environment caused by Ship Recycling, taking into account guidelines developed by the Organization. • Authorized SRF shall, only accept ship comply with this Convention; or meet the requirements of this Convention and accept ships which they are authorized to recycle. **Regulation 18 – Ship Recycling Facility Plan (SRFP)** 1. Authorized SRF shall prepare a SRFP including a policy ensuring workers' safety and the protection of human health and the environment including; 2. a system for ensuring implementation of the requirements set out in this Convention 3. identification of roles and responsibilities for employers and workers 4. a programme for providing appropriate information and training of workers 5. an emergency preparedness and response plan; 6. a system for monitoring the performance of Ship Recycling; 7. a record-keeping system showing how Ship Recycling is carried out; 8. a system for reporting discharges, emissions, incidents and accidents causing damage, to workers' safety, human health and the environment; and 9. a system for reporting occupational diseases, accidents, injuries and other adverse effects on workers' safety and human health,	• Provision of SRFP & monitoring • Approval of SR Facility by GMB	• Provision of SRFP by SRF • Identify risks to safety and environment and establish required management system, techniques, improve facilities and have approval from CA or RO. (CA: Competent Agency (RO: Recognized Organization)	• Technical Cooperation (Capacity Development) Expedite understanding to HKC and provision of SRFP by conducting Management Level Staff Training Course To Build Awareness of Hazardous and Risks, Recycler Top Management Course • Expedite acquisition of SOC by improving yards. Training Course Ⅰ Initial Training Course For All Workers Training Course Ⅱ Initial Training Course For Skilled And Special Workers Training Course Ⅲ Managers And Management Level Staff Training Course To Build Awareness Of Hazardous And Risks Recycler Top Management Course (Hkc) Recycler Top Management Course (Training Course In Japan) Training Course (Trainees) Trainer Course (Crane Operators) Other Trainings •

Requirements of Ship Recycling Convention	Contents to Correspond	Item to Cope in Facility and Procedure	Project Scope
Regulation 21 – Emergency preparedness and response Authorized SRF shall establish and maintain an emergency preparedness and response plan, including information of necessary equipment, the necessary information & communication Competent Authority(ies), the neighborhood and emergency response services.			
Regulation 19 – Prevention of adverse effects to human health and the environment • Prevent explosions, fires by ensuring that Safe-for-hot work conditions and procedures are established, throughout Ship Recycling • prevent harm from dangerous atmospheres by ensuring that Safe-for-entry conditions and procedures are established in ship spaces, including confined spaces and enclosed spaces, throughout Ship Recycling • prevent other accidents, occupational diseases and injuries or other adverse effects on human health and the environment; and • prevent spills or emissions throughout Ship Recycling which may cause harm to human health and/or the environment, **Regulation 20 – Safe and environmentally sound management of Hazardous Materials** • Authorized SRF shall ensure safe and environmentally sound removal of any Hazardous Material contained in a ship, actively use the IHM and the Ship Recycling Plan, prior to and during the removal of Hazardous Materials. • ensure that all Hazardous Materials detailed in the IHM are identified, labelled, packaged and removed prior to cutting by properly trained and equipped workers. **Regulation 22 – Worker safety and training** • Authorized SRF shall provide for worker safety by measures including training programmes prior to	• Oil et., removal before fire works	• Caution for use of fire in the cutting work	• Technical Cooperation (Capacity Development) To deepen safety hot work, risks in the work place, occupational injuries and environment risks by implementing Training Course Ⅰ Initial Training Course for All Workers, Training Course Ⅱ Initial Training Course for Skilled And Special Workers, Training Course Ⅲ Managers.

Requirements of Ship Recycling Convention	Contents to Correspond	Item to Cope in Facility and Procedure	Project Scope
any ship recycling operation. • Authorized SRF shall provide and ensure the use of personal protective equipment for operations requiring such use.			
		1) Improvement of yard for protection of pollution to soil and intertidal zone	At the shore plot where hazardous, polluted wastes may be released, improvement by providing impermeable floor and oil correcting ditch etc.
		2) Mitigation of negative impact to environment by fallen cut block at intertidal zone	Invest 5 (Five) Larger large crawler cranes for the recycling work at intertidal zone. By transferring large block from ship directly to shore yard and/or lightening weight at aft, avoid pollution to the sea.
		3) Protection of pollution in intertidal zone by cleaning debris & wastes	Invest 3 'Three) Beach cleaning wheel loader with bucket capacity of $2m^3$ for cleaning 10km length of Alang /Sosiya coast
		4) Protection of oil leakage to sea by bunker oil tank cleaning	Invest 5 (five) High pressure mobile decontamination system for bottom FO tank cleaning. Make sure residual oil cleaning to protect spill to environment and fire, explosion.
		1) Cleaning and gas freeing for cargo oil tank of offshore tankers.	Invest 1 (one) Offshore tank cleaning barge which can clean cargo oil tank and slop tank of VLCC at offshore, and transfer oily water to shore.

Requirements of Ship Recycling Convention	Contents to Correspond	Item to Cope in Facility and Procedure	Project Scope
• Prevent explosions, fires by ensuring that Safe-for-hot work conditions and procedures are established, throughout Ship Recycling • prevent harm from dangerous atmospheres by ensuring that Safe-for-entry conditions and procedures are established in ship spaces, including confined spaces and enclosed spaces, throughout Ship Recycling • prevent other accidents, occupational diseases and injuries or other adverse effects on human health and the environment			Protection of oil spill from cargo tank of tanker and establish safe for entry and safe for hot work
		2) Cleaning work above and protection of marine environment	Invest 1 (one) Multipurpose vessel to monitor and act against offshore tank cleaning works, oils spill while recycling , fire , etc.
Regulation 20 – Safe and environmentally sound management of Hazardous Materials • Authorized SRF shall ensure safe and environmentally sound removal of any Hazardous Material contained in a ship, actively use the IHM and the Ship Recycling Plan, prior to and during the removal of Hazardous Materials. • ensure that all Hazardous Materials detailed in the IHM are identified, labelled, packaged and removed prior to cutting by properly trained and equipped workers. • All wastes generated from the recycling activity shall be only transferred to a waste management facility authorized to deal with their treatment and disposal.	Reinforcement of treatment capacity of Hazardous and wastes	1) Reinforcement of oily water treatment and incineration capacity at TSDF	By the improvement of yard, introduction of Mobile decontamination system, improvement of recycling process, wastes volume may be increased. To cope with the increased wastes and hazardous, reinforce the treatment capacity of existing TSDF facility 1. Increase incineration capacity 2. Increase bilge and oily water treatment capacity

Source: JICA Survey Team

As the results of the review and investigation above mentioned, the Project consists of the following components:

1) Improvement of existing 70 ship recycling yards
2) Introduction of Mobile Decontamination Units
3) Introduction of Large Mobile Cranes and Beach Cleaning Wheel Loaders
4) Introduction of Tank Cleaning Barge
5) Introduction of Multi-Purpose Vessel
6) Improvement of environment facilities of TSDF

Detail of the above project component is explained hereafter.

3.2.2. IMPROVEMENT PLAN

(1) Improvement of existing ship recycling yards

Under the Project, in order to protect any releases of hazardous materials to the inter-tidal zone while the ship recycling process is going on, provide impermeable floor (concrete paved floor) with drainage at shore yards where demolishing hull block and equipment including hazardous materials, aimed at complying the requirements of the Convention.

(2) Improvement of environment facilities of TSDF

Under the Project, the following new facilities will be introduced aimed at extending the life of the landfill site and to improve the negative impact by the process of oil cleaning and collection.

1) Baler

Compress the volume of solid wastes not suitable for incineration such as Glass wool.

2) Sludge Treatment Plant

Recover residual oils contained in oily sludge as much as possible and sell it. Oily sludge, after treatment, will be land filled in stabilized condition.

3) Oil Separation Tank

Separate low density oily water (such as bilge water) to oil and water with heating device.

4) Oily Water Separator

Oily water, of comparatively low density, will be separated into oil and water. Recovered oil will be sold.

5) High Temp Incinerator

About 1400 deg. C with for the Low-concentration PCB waste (unintentionally mixed very small amount of PCB contaminated electric parts and wastes with PCB concentration: 5,000ppm or less)

3.3. IMPROVEMENT OF SHIP RECYCLING YARD FACILITIES

3.3.1. IMPROVEMENT OF YARD FACILITIES

In the ship recycling yard, cutting area for cutting hull block, storage area for steel plates and removed parts, towing winches, temporary storage of hazardous materials, office, warehouse, workers' rest space are arranged depending on the size of the yard. However, as the cutting area and storage area is an exposed area, there will be risk of contaminating ground water or soil in the yard by pollutant and also the chance to pollute marine environment by washing rain water with the pollutant. Therefore, the following improvement of the existing yard facilities will be implemented under the Project in order to comply with the requirements of the Convention.

1) Provision of high rigidity concrete floor for the cutting area and storage area for the pollutant
2) Provision of collecting rain water (including drainage and oil collecting tank foundation)
3) Provision of the foundation of towing winches

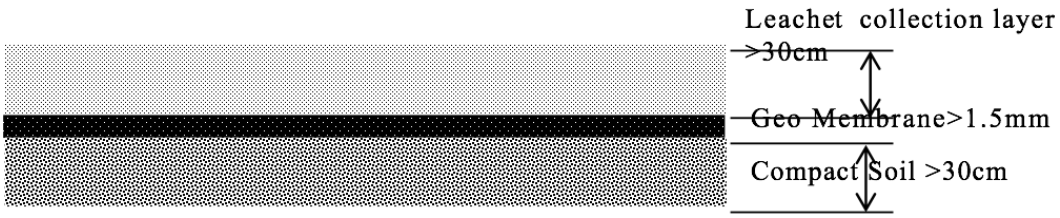
The following works are not under the scope of the Project yet but to be provided by the recycler as appropriate.

1) Temporary storage of Hazardous materials
2) Storage of LPG cylinders
3) Asbestos handling facility (not required in case it will be outsourced)
4) Sanitary, Drinking water, shower facility
5) Workers' changing room
6) First aid facility
7) Firefighting facility
8) Sewage treatment facility (Septic tank)

Improvement of the yard facilities with the concrete pavement has been started by recyclers themselves, and audit process for the acquisition of SOC by the Class NK or RINA is under progress. Although detailed design of the improved facilities was not available from the ship recyclers, concreted impermeable flooring will be provided considering improvement of safety and protection of environmental pollution and preliminary design is developed based on the investigation and analysis of the current issues.

Preliminary design is made as standard design by the different width of the yards of 45m, 60m, 90m, & 120m and this design could be utilized further for individual detailed design at the time of the construction. The above fore mentioned facilities such as temporary storage of hazardous materials, etc., will not be covered by the Project, however, required facility will be further confirmed with ship recyclers and appropriate recommendations made to the recyclers.

As to the technical guideline, Class NK's comprehension to the Convention and the guideline of the State Pollution Control Board for the impermeable structure will be considered and protection of soil and ground water pollution and also to protect any spill of the hazardous materials to the inter-tidal zone to be considered in compliance to the requirements of the Convention.



Source: JICA Survey Team

Figure 3-7 Impermeable Floor Structure by CPCB Guideline

The dismantling method is equivalent to the current method and renovation for environmental improvement (prevention of diffusion of hazardous substances and securing of occupational health and safety) shall be carried out. In the current method, the target ship is beached on the surface of the recycling yard using a difference in tide (high tide at spring tide), and it is pulling up into the recycling yard by a large winch then cut, removed, and transferred the materials (product or material).

(1) Number and Basic plan of the Yards to be improved

Ship recyclers are operating at yards (working place) on lease basis from GMB. Therefore the yards (the size, winch and office building, etc.) are different respectively, and there are no standard facilities available. The scope of the improvement work of the facility is defined as the concrete pavement areas in the yard and areas where installation of oil water treatment tank is placed and winch foundation with reaction force block. Therefore the Office building and the Parking lots, Weigh Bridge facilities and an equipment ridge for toxic substance depository are excluded from the scope of work.

As shown in Table 3-3 there are 131 yards in total including 24 yards certified by the classification at the end of 2016. According to SRIA, it is assumed that the number of the yard to be approved by the classification and that is going to invest in the near future for the improvement of their facilities by themselves will be 60 yards by 2017, and 60 yards or more in 2018. Assuming that the commencement of the project is 2020, if more than 60 yards have already been improved and classification certification is received, the remaining less than 70 yards will be subject to the project. Meanwhile, the willingness of investment by the private sector depends on recycling demand, scrap price, etc. There is a possibility that it is less than 60 yards are improved before the commencement of this project. In that case more than 70 yards are subject to renovation. On the other hand, if the number of non-operating yard possessed by GMB is included, it will be about 150 yards in total then there will be a necessity to improve more than 70 yards.

Although it is basic policy of India that the whole yard shall be improved without discrimination for each yard, ship recycler shall lease land by contract from GMB and prepares for operation by themselves then only their business can be started. For this reason, it is unlikely that new businesses will enter the empty yard before this project is commenced and also it is not expected to strengthen the recycling capacity due to the sharp rising demand for ship recycling, it is decided to cover 130-60=70 yards under the project.

For the Ship recycling yards, as width for each plot is different, hence a set of the width of the yard, as standard, is shown in Table 3-4, with the total of 70 yards.

Table 3-3 Current situation of Ship breaking yard（plot）

Width of the yards	Number

30m ～ 50m	72
51m ～ 70m	54
71m ～ 90m	16
> 91m	11
Total	153

source：JICA Survey Team

Table 3-4 Renovation of number of Ship breaking yard（plots)

Width of the yards	Number
45m	25
60m	30
90m	10
120m	5
Total	70

source：JICA Survey Team

It is found that the yard which GMB owned and is not currently used is 7 yards and that required earth work such as replacement of sand and earth when using it as a recycling yard. Therefore further examination is require to the temporary improvement of each yard at the time of project implementation to use it as a substitute place. Also, if the yard will be used as a joint storage of hazardous waste, a maintenance shop for donated equipment, etc., as well as earth work, internal paving, other facilities etc. should be considered.

3.3.2. PRELIMINARY DESIGN

(1) Technical Interpretation of Class NK

Based on the apprehension that prevention of the spillages of hazardous materials into the intertidal zone is of vital importance for compliance with the requirements of the Convention for the ship recycling with beaching method, compared to the other Dry dock method, Afloat method and Landing method against Regulation 19.4 of the Convention, “The ship recycling facilities shall prevent spills or emissions throughout Ship Recycling which may cause harm to human health and/or the environment”, the following points to improve beaching method has been studied:

1) Technical Requirements

- Preparation before cutting ship
- Cutting work at the intertidal zone
- Infrastructures
- Emergency preparedness and response
- Environmental monitoring and reporting

i. Preparation before cutting ship

Ship recycling facility shall minimize a risk of spill before start cutting work of ship at intertidal zone by providing the following measures.

a) Preparation of IHM Part 1 to Part 3(not only by ship owner but ship recycling facility)
b) Minimize residual oils to a maximum extent before beaching
c) Identify the location of hazardous materials on board by actively utilizing IHM
d) For the tanker, Safe for Hot Work certificate shall be obtained
e) Hazardous materials such as residual oils and cargo residues shall be removed from ship.

f) Ballast water treatment as per national norm
g) Permanent provision of oil spill preventing equipment during ship recycling work

ii. Ship cutting process at Intertidal zone
a) As much as possible, cutting shall be done in a controlled manner to ensure that paint chips and other wastes shall not to fall into the intertidal zone. (Ship breaking code has prohibited direct throw of these wastes to sea)
b) Assess whether hazardous materials are removed from the cut block and if the block is judged unclean then it shall not fall into the intertidal zone and/or surface without an impermeable floor. Dirty blocks should fall in to the hull.
c) Prevent any leakages from cut section of hull
d) These processes shall be managed by the competent person.

iii. Emergency Preparedness and Response
The Ship Recycling facility shall establish and maintain the Emergency Preparedness and Response Plan (EPRP) including oil spill solution measures for the intertidal zone.

iv. Environmental Monitoring and Reporting
a) The ship recycling facility shall provide and maintain an Environmental monitoring program including monitoring of intertidal zone.
b) The ship recycling facility shall establish a reporting process for incidents of oil spills to the intertidal zone.

At present, apprehension of the requirements of the Convention by Class NK is sole and publicized with same understanding by the Ministry of Land Infrastructure Transport and Tourism of Japan. Therefore, this apprehension can be the basic requirement to improve ship recycling facilities in India and can be deployed / introduced as the Project.

(2) Preliminary Design

1) Basic Design Policy

In India, design criteria and design procedure of the port structure on ship recycling yard has not yet been established. In addition, the design process of a unified scrapping yard does not exist. Therefore, "Technical Standards and Commentary for Port and Harbor Facilities in Japan" as a design criteria is applied for the design.

a. Performance Criteria of Ship Recycling Yards

The performance criteria of aprons shall be as specified in the subsequent items:

① Width
Yard widths shall be properly set to allow safe and smooth ship breaking operation. The pavement is made of about 60 % of size to a margin in the yard and other areas shall not be paved (as the road).

② Gradient
Gradient of Yard shall be properly set to drain water and other surface waters taking into consideration of the ship recycling operation at the yard with backyards, and hence cross slopes need to be properly determined. Yards normally have a down slope of 1 - 2% toward the sea. In some cases, reverse slopes are used depending on the conditions of yards and environmental consideration. Since the settlement of backfilling may cause slopes to be reversed, construction should be carefully performed.

③ Pavement Materials

Yards shall be paved with proper materials taking account of the surcharges and the conditions of use of mooring facilities. The form of the pavement considers the soil quality situation of the roadbed, building, workability, the cost performance and a maintenance, etc., and a concrete pavement is selected.

ii. Load Condition

In the design of the pavement structure, design load is determined taking the conditions of material to be used, load of heavy equipment, cranes which handles hull blocks so as determine the thickness of the pavement.

The performance verification of yard pavements shall be confirmed such that pavement structures are stable under the load of vehicles and related equipment. Figure 3-8 shows an example of the performance verification procedures of yard pavements.

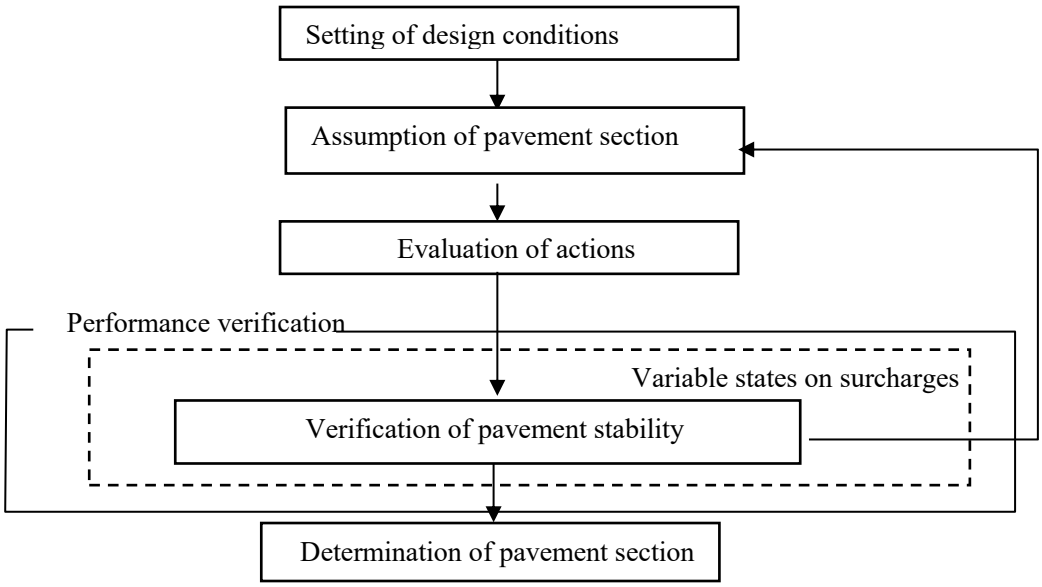


Figure 3-8 Example of Procedures for the Performance Verification of Yard Pavements

Actions to be considered in the performance verification of yard pavements are generally the load of trucks, truck cranes, rough terrain cranes, all terrain cranes, forklift trucks, straddle carriers, etc., depending on the types of steel blocks and ship breaking methods.

Here, truck cranes, rough terrain cranes, and all terrain cranes are denoted as the movable cranes. The performance verification of yard pavements normally takes account of the ground contact areas on which loads are applied, setting the maximum load and the ground contact pressures to determine the pavement thickness.

iii. Design of Concrete Pavement

a. Procedure of Performance verification

Figure 3-9 shows an example of the procedures of the performance verification for concrete pavements. It is preferable to perform the verification of concrete pavements both on base course thickness, and concrete slab thickness considering, cyclic numbers of actions, conditions of the

bearing capacities of roadbeds. The yard considers the steel block weight and gas cutting works, and does a rigid pavement.

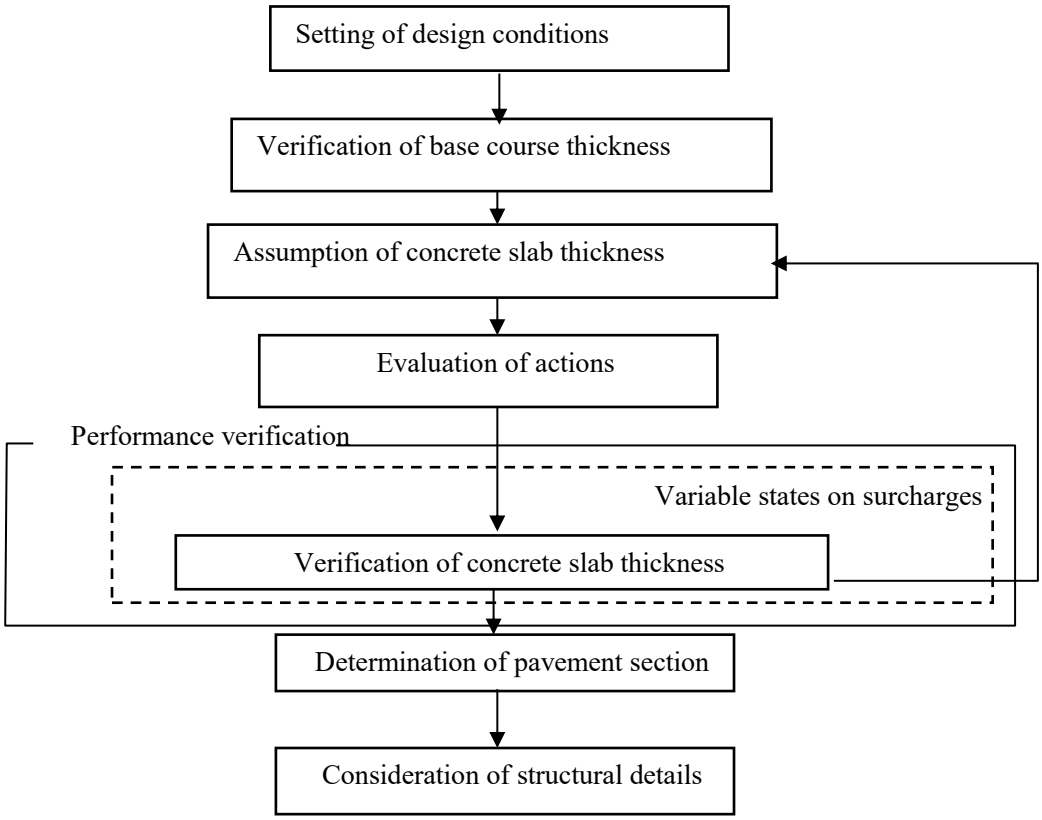


Figure 3-9 Example of the Procedures of Performance Verification for Concrete Pavements

b.Design Conditions

① Procedure of performance verification

The design conditions considering the performance verification are generally as follows:

i. Design working life

The design working life of concrete pavements shall be properly set considering the conditions of use and other related conditions of mooring facilities. The design working life of concrete pavements used for the yards of winch foundation and other facilities may be generally set at 20 years.

ii. Conditions of Action

iii. Cyclic numbers of actions

iv. Sub grade bearing capacity

v. Materials used

The design action conditions are those requiring the maximum concrete slab thickness among the types of actions to be considered. The characteristic values of actions may be set referring to Table 3-5**.**

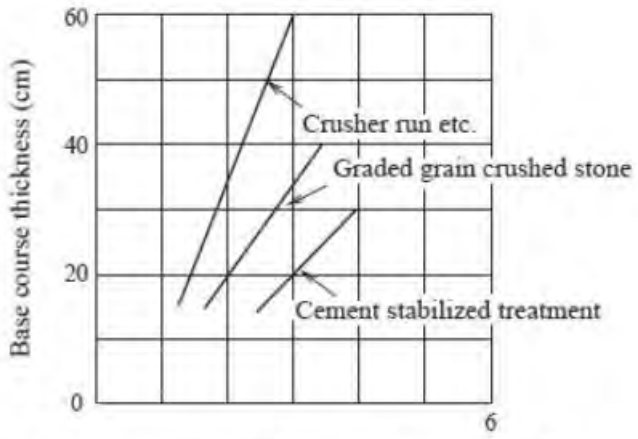
Table 3-5 Reference Values for the Action Conditions of Concrete Pavements used for the Yards

Action classification	Type of action			Action (kN)	Ground contact radius (cm)
	Fork lift truck	2t		25	10.6
	Tractor trailer	for 20ft, 40ft		50	17.8
	Fork lift truck	3.5t		45	13.8
CP2	Fork lift truck	6t		75	17.8
	Truck	25 ton class		100	17.8
	Fork lift truck	10t		125	22.2
	Straddle carrier			125	22.2
	Fork lift truck	15t		185	26.8
	Mobile crane (truck crane, rough terrain crane, all terrain crane)		Type 20	220	19.9
	Fork lift truck	20t		245	30.7
	Mobile crane (truck crane, rough terrain crane, all terrain crane)		Type 25	260	20.3

Source : Technical guideline of Port Facilities (The Ports and Harbours Association of Japan)

② Pavement Structure

It is preferable to prepare a test base course and set base course thickness at value which makes the bearing capacity coefficient equal to 200N/cm3. In the cases where the preparation of a test base course is difficult, the base course thickness may be directly set using the design curves shown in Figure 3-10. The minimum base course thickness is generally set at 15cm.



$$\frac{\text{Bearing capacity coefficient of base course}}{\text{Bearing capacity coefficient of subgrade}} = \frac{K_1}{K}$$

K_1 is the bearing capacity coefficient of base course K_{30} (200N/cm³).
K_2 is the bearing capacity coefficient of subgrade K_{30}

Figure 3-10 Design Curves of Base Course Thickness

The base course thickness of concrete pavements may be set referring to Table 3-6 prepared based on the past records.

Table 3-6 Reference Values for Base Course Thickness of Concrete Pavements

Design condition	Base course thickness (cm)				
	Upper sub-base course		Lower sub-base course		
	Cement stabilized base	Graded grain material	Graded grain material	Crusher run etc.	
50 or more and less than 70	–	40	–	20	60
	20	–	20	–	40
	25	–	–	30	55
70 or more and less than 100	–	20	15	–	35
	–	20	–	20	40
	15	–	15	–	30
	15	–	–	15	30
100 or more	–	20	–	–	20
	15	–	–	–	15

Source : Technical guideline of Port Facilities (The Ports and Harbours Association of Japan)

(a) Verification of concrete slab thickness

The bending strengths of concrete slabs may be set at 450N/cm2 for 28 days test piece.

Figure 3-11 shows the relation between concrete slab thickness and bending stress. The bending stresses are calculated using an equation called Arlington formula. The symbols CP1 - CP4 in Figure 3-11 are the classification names needed for using (d) Empirical method of setting concrete slab thickness.

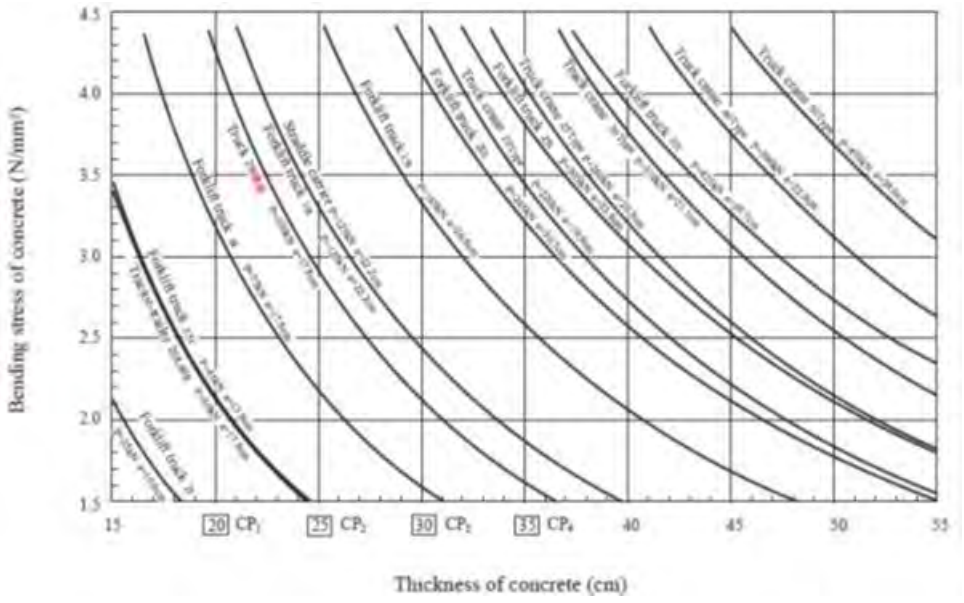


Figure 3-11 Relation between Concrete Slab Thickness and Bending Stress

(b) Setting of concrete slab thickness

The method of setting the thickness of concrete slabs in compliance with the concept of Pavement Design and Construction Guide has been proposed. In this method, the fatigue characteristics of concrete slabs are calculated based on the wheel load stresses imposed on concrete slabs and their cyclic numbers during design working life. And the relation between the above mentioned characteristics and the degree of fatigue as a failure criterion is proposed to set the thickness of concrete slabs.

(c) Empirical method of setting concrete slab thickness

a. The concrete slab thickness set referring to the empirical values given in Table 35 may be considered to have the same performance as the one set using the method of Setting Concrete Slab Thickness.

Table 3-7 Reference Values for Concrete Slab Thickness

Action classification	Concrete slab thickness (cm)
CP1	20
CP2	25
CP3	30
CP4	35
Applied to piled pier slab	10

iv) Structural details

➢ Iron mesh

(a) It is effective to bury iron mesh in a concrete slab structure to prevent cracking.

(b) It is preferable to overlap the junctions of reinforcing bars. The overlap length and the depth of the reinforcing bars from the surface need to be properly set considering the thickness of the concrete slab.

➢ Joints

It is preferable to place joints on concrete pavements to allow the concrete slabs to expand, shrink, and warp freely to some extent, reducing stresses.

(a) Joints of the concrete pavement of apron shall be arranged appropriately, considering the size of yard, structure of mooring facilities, the type of joint and load condition. In addition, joints shall have a structure that is appropriate for the type of joint.

(b) Longitudinal joint

① Longitudinal construction joints shall generally be press-type structured and made of tie bars.

② Tie-bars are provided to prevent adjoining slabs from separating, and sinking / rising of either slab at joints. Tie-bars also serve as a reinforcement to transfer the sectional force. Because the yard pavement has a relatively small width and is physically constrained by the main structure of the sheds, separation of yard concrete slabs at joints rarely occurs. However, it is necessary to provide tie-bars at longitudinal construction joints to prevent sinking / rising of either slab at joints due to differential settlement of layers below the base course, and to accommodate a wide variety in the directions of traffic load that is not observed on ordinary roads.

(c) Transverse joints

① Transverse shrinkage joints

Transverse shrinkage joints shall generally be dummy-type structured and made of dowel bars.

② Transverse construction joints

Transverse construction joints shall generally be press-type and made of dowel bars. Transverse construction joints are placed at the end of daily work or inevitably placed due to rain during construction or the failures of construction machines or other equipment. It is preferable for transverse construction joints to fit position with transverse shrinkage joints.

③ Transverse expansion joints

It is preferable for transverse expansion joints to generally have a structure using both joint sealing compounds and joint filers in upper and lower parts and use dowel bars. On piled pier slabs, however, dowel bars are not used. It is preferable to set transverse expansion joints at proper intervals depending on construction conditions. Expansion joints are the weakest points of pavements; hence, consideration is needed for reducing the number of their placement points as much as possible.

④ Dowel bars

Dowel bars have a function to transfer loads and prevent the unevenness of adjoining slabs. In either case of transverse shrinkage joints, transfer construction joints, or transfer expansion joints, dowels bars are placed to fully transfer loads.

(d) Joint structures

Figure 3-12- 3-15 show standard joint structures.

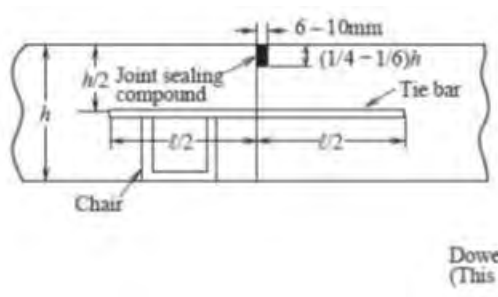


Figure 3-12 Longitudinal Construction Joint

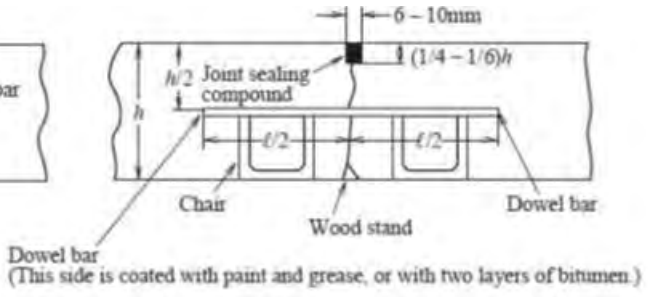


Figure 3-13 Transverse Shrinkage Joint

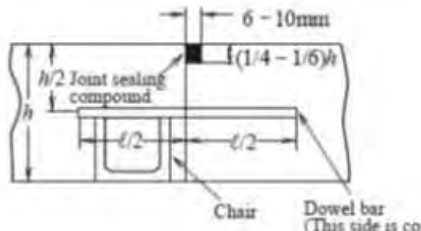


Figure 3-14 Transverse Construction Joint

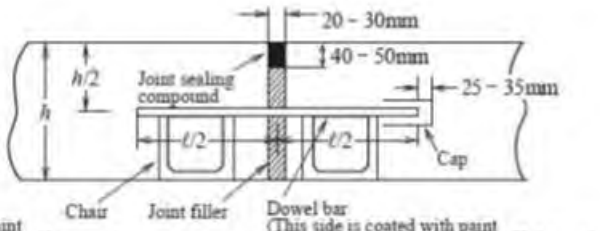


Figure 3-15 Transverse Expansion Joint

➢ Tie bars and dowel bars

(a) Tie bars and dowel bars shall be properly selected considering the traveling loads imposed on apron pavements in all directions.

(b) The specifications and placement intervals of tie bars and dowel bars may refer to the values shown in Table 3-8.

Table 3-8 Reference Values for the Specifications and Placement Intervals of Tie Bars and Dowel Bars

Action Classification	Slab thickness (cm)	Tie bar			Dowel bar		
		Diameter (cm)	Length (cm)	Interval (cm)	Diameter (cm)	Length (cm)	Interval (cm)
CP1	20	25	80	45	25	50	45
CP2	25	25	100	45	25	50	45
CP3	30	32	100	40	32	60	40
CP4	35	32	100	40	32	60	40

Note: The values of tie bars and dowel bars are those of SD295A (deformed steel bar) specified in JIS G 3112 and of SS400 (round steel bar) specified in JIS G 3101, respectively.

➢ End protection

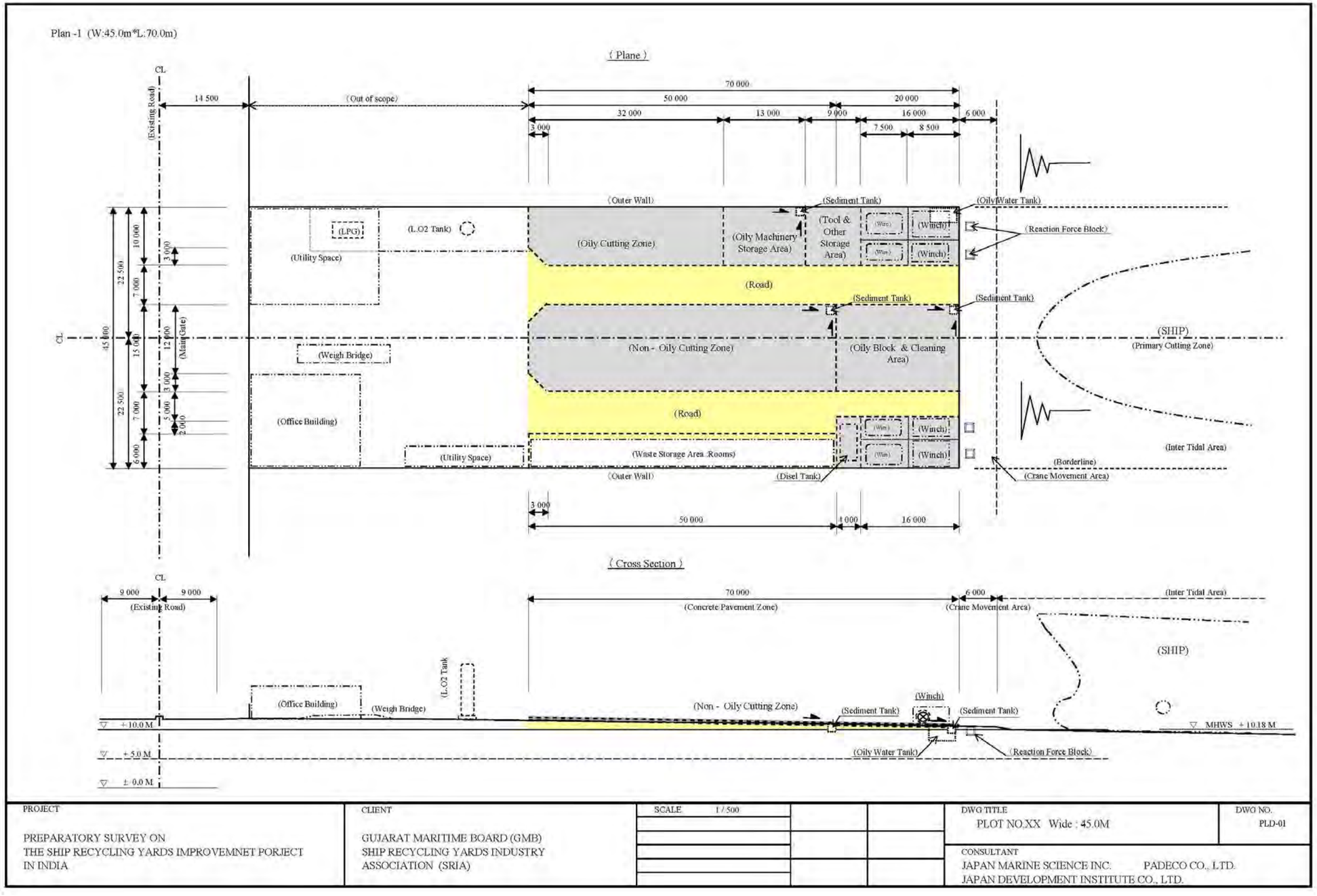
An end protection work along the landward side of pavement shall be provided at a location where there is a risk of destruction of the base course due to infiltration of rain water or destruction of the concrete slab and base course due to heavy loading.

iv. Facility Drawings

See Appendix -3 . Yard width of W = 45m, and for W = 60m shown in the figure. In addition, since the position and status of the renovation plot is unknown, for W = 90m and W = 120 m carry out the quantity calculated as W = 45m * 2, 60m * 2.

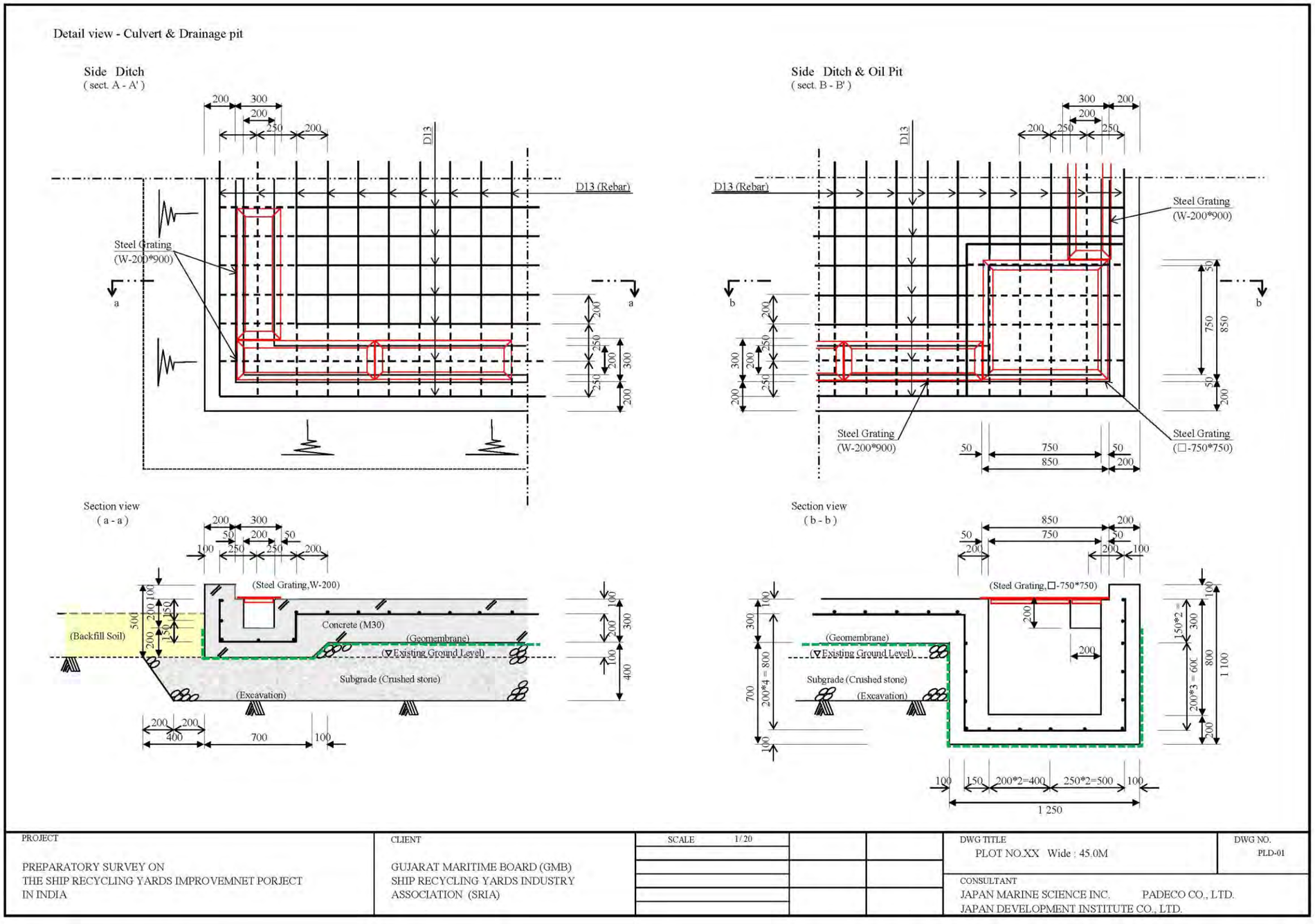
As for the dismantling place, as it is on the concrete floor slab as shown in Fig. 3-15, collecting water flowing from the side groove into the water collecting pit is sent to the oil / water separation tank for collection. The recovered water containing oil is transferred to the treatment plant and processed in a predetermined procedure.

For wastewater other than the dismantling place (concrete floor slab), wastewater due to rainfall is discharged using natural infiltration, spontaneous falling, or nearby rainwater drainage facilities.



Source: JICA Survey Team

Figure 3-16 Image of the Improved Yard



Source: JICA Survey Team

Figure 3-17 Oil Collecting Ditch

(3) Jetty for Mooring Waste Oil Collection Barge

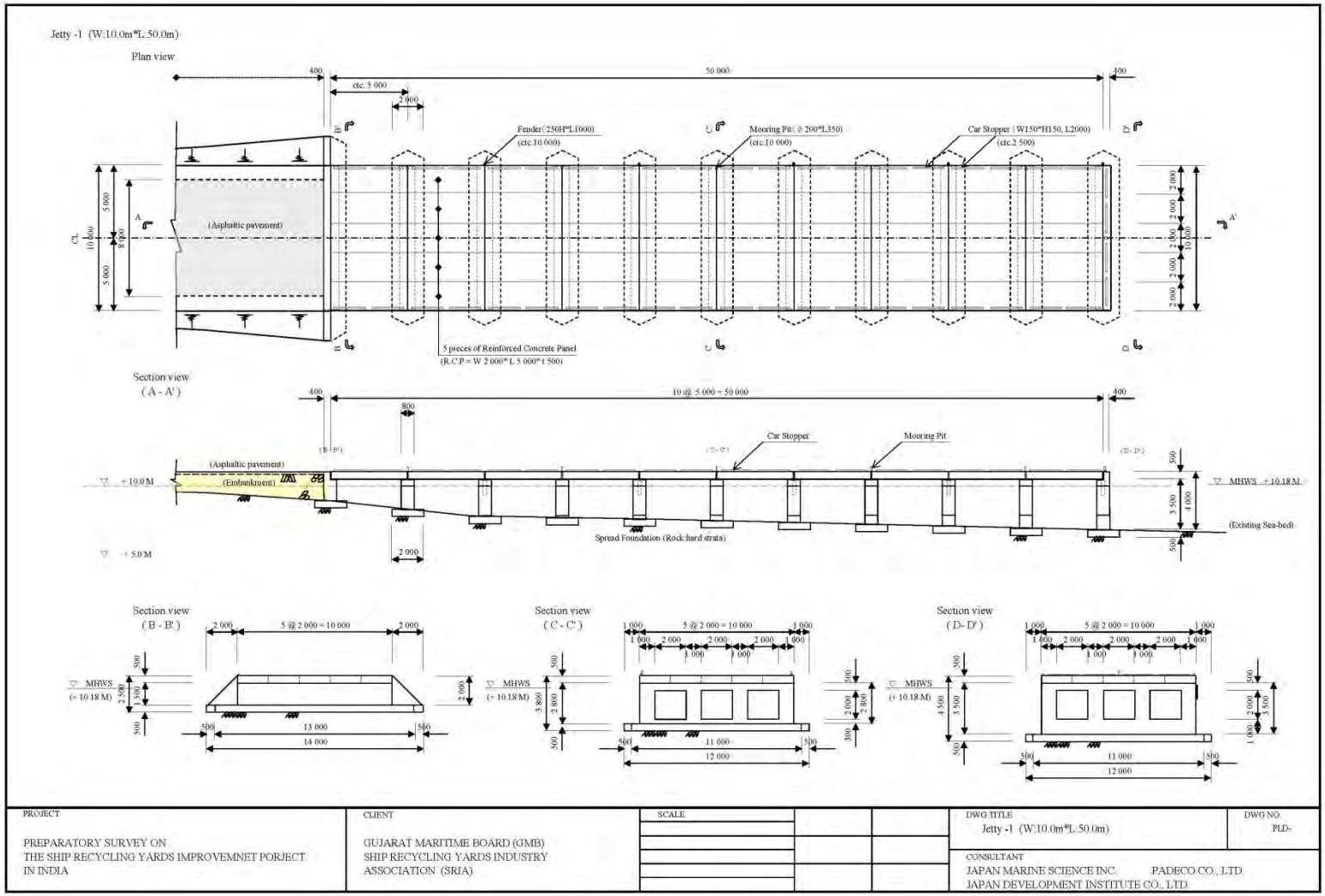
In this Project it is planned to introduce an offshore tank cleaning barge to wash the cargo oil tanks and to collect oily water after clean up the tanker at sea in the environmental plan for offshore and shore as described in Section 3.4.2. This offshore tank cleaning barge is moored on the jetty in Alang, and the waste oil is transferred on land. Source: JICA Survey Team

Figure 3-18 shows a jetty design drawing for mooring of offshore tank cleaning barge.

The construction site is the southernmost part of the Alang, and the structure is as shown in the Source: JICA Survey Team

Figure 3-18. Jetty is an RC construction, the foundation is a direct foundation with rock cuts, launched a peer at 5 m pitch, and a concrete slab of 1 span 5 m × 10 span is placed, the extension is 50 m.

As a mooring facility, install pits, fenders, and car stops. From the road part to the abutment position, embankment structure with stone and earth and sand is used, and asphalt pavement is applied.



Source: JICA Survey Team

Figure 3-18 Jetty for the mooring of Waste Oil Collection Barge

(4) Work Procedure

When considering the current state of yard ownership (user) of recyclers, it is judged that it is difficult to change the plot (move), so it is considered to improve (renovate) at the current position.

It is also confirmed that the material supply area (quarry) such as sand, stone etc., is available near the site (within 15 km), and local purchase of rebar (D 10 ~ 16), cement (ordinary Portland tare 40 kg)is possible (price).

3.3.3. PROPOSAL FOR INTRODUCTION OF NEW MACHINES

(1) Improvement for facilities of ship recycle yard

In considering for current situation of facilities and concerned issues in recycling yards, the following two kinds of machines would be proposed on this project from the aspect of improving environmental preservation, safety and working efficiency in the yards.

① Large Crawler Cranes (120t)	five(5) machines
② Beach Cleaner	three(3) machines

1) Large Crawler Cranes（120t）

In the procedures of breaking a ship after beaching, the ship is broken from bow part toward aft part. When the hull breaking work proceeds to some proportion, usually to No.1 or No.2 hold, the remaining hull body should be dragged to the shore side by the winches fixed in the yard. In case of a large ship, however, the dragging works by the winches (75t x4 sets) is very tough because the ship's weight is very heavy (for example, P'max bulker's weight is about 12,000t), even if the ship is dragged with assistance by own buoyancy in high tide. Therefore, to reduce the weight, some blocks of the stern part or accommodation structure are cut down into the inter-tidal zone.

Especially, since aft part of ship arranged with engine room and accommodation is very heavy and is slim in the lower hull shape, the bottom of aft part sinks in the sand of beach. Therefore, the friction between the bottom of ship and the surface of beach is very large. In order to reduce the friction, some stern blocks of the aft portion of the ship should be cut down. There is some risk of polluting the inter tidal zone where the blocks are dropped down and dragged to the shore by winch. This risk should be eliminated for keeping environmental preservation.

If the accommodation structure and machinery in engine room, which are main heavy portions of aft part, can be broken and dismantled in early stage by use of a big crane, the stern blocks and some parts of accommodation structure need not to be cut down in order to reduce the hull weight for the dragging. In the case of P'max Bulker of which gross ship's weight is about 12,000 ton (=12,000LDT), its total weight of the accommodation structure (approximately 500t) and the machinery in engine room (approximately 700t) is 1,200t, which accounts for a 10% of the gross ship's weight. Furthermore, since the equipment, machinery and furniture in engine room and in accommodation, which are valuable and resalable goods, can be removed carefully and smoothly by use of the crane without damages, the working efficiency may be increased.

For above purposes, the big crane gets onboard into the hold just before engine room in the early stage, and works to break the accommodation structure and dismantle the machines in engine room. In Turkish recycle yard, there is a similar example that a big crane gets on the double bottom to break the accommodation and engine room in the late stage of breaking procedure.

Figure 3-19 Example of cranes operating on board in Turkey

2) Beach Cleaning Machine for inter-tidal zone

As cutting works of breaking ship's hull are done in the inter-tidal zone, trash and debris (wooden chips, concrete blocks, heat insulation materials, plastic materials, electric cable, and steel cutting chips, etc.) in the breaking works are scattered over the beach.

Currently the trash and debris are gathered up by hand of workers in respective yards at their discretion. The cleaning works, however, would be made more efficiently and widely with the machines.

(2) Specification, Number and Operation for New Machines

Required specifications of new machines with its operational method are as follows.

1) Large Crawler Crane

a. Specifications

- The crane should retain adequate lifting capacity at the top of boom which is angled and extended just above the zone of accommodation and engine room, in order to break efficiently accommodation structure and quickly dismantle machines in engine room.

Because the crane lifting ability is decreased steeply in reverse proportion to the outreach radius (which is depended on the boom length and its angle), the nominal crane capacity is required to be about 120 ton in order to exercise the necessary lifting ability (10-25 ton) just above the accommodation zone and engine room zone. (See Source: JICA Survey Team

- Figure 3-21 crane operation chart regarding to the relation between outreach and lifting ability)

- On the other hand, the gross weight with loads lifted should be less than the limitation in the strength of the double bottom structure.

- The crane must have a telescopic boom because it gets onboard and is operated in the narrow hold.

The telescopic boom should be capable to extend up to 47m in length for breaking large ships, such as a cape size bulk carriers (200,000DW) and a panamax size container ships. (See Source: JICA Survey Team

- Figure 3-21 Crane operation chart in detail).

- The crane should have the traveling mechanism which is fit for running on sand beach in front of the yard and does not damage the double bottom in the holds when it gets on board.
- The traveling mechanism of mobile cranes is divided roughly into a wheel type with tires and a crawler type with caterpillar.
- The tires of wheel type might lose traction on sand beach, and damages the inner bottom plate of double bottom structure because each of tires touches the plate with heavy weight concentrated into one point.
- On the other hand, the crawler touches ground with plane surface, which does not lose traction on sand beach and does not damage the inner bottom plate.
- Therefore, the crawler type should be chosen for the crane.
- Furthermore, the crawler crane can easily adjust its own position while being maneuvered in narrow space, and exercise better performance in other operating activities. See Table 3-9 for the detail.
- Accordingly, the crawler crane should be satisfied with the specifications as follows;
    - ➢ maximum load capacity 120 ton or over
    - ➢ own weight less than 125 ton
    - ➢ a telescopic boom (maximum length 47m or over)
    - ➢ crawler type for traveling

Table 3-9 Comparison of performance between Crawler crane and Wheel crane

Concerned items	Crawler		Wheel	
Mobility for transportation from plot to plot	×	Damages the pavement of public roads by crawlers. Required to be transported on a long trailer		Can drive on public road by itself, but restricted by the regulation (in case the axis load exceeds 10.2t, prior permission is required)
Mobility on sand area in plot	○	Stable drive even on sand area	×	Once wheel loses traction on sand area, it cannot move at all
Double bottom is bearable ?	○	Bearable against touch by flat surface of crawlers,	×	Heavy load concentrated at one point may dent /damage the top plate of double bottom
Heavy load at the point of Out-rigger legs on double bottom	○	No Out- riggers Crane weight to be supported by crawlers surface	×	Leg fixing points on double bottom should be reinforced with thick plates against concentrated load at one point
Adjustment of setting at the best position in last hold	○	As revolving motion is possible with crawlers driving in reverse each other (left crawler forward and right one backward), adjusting movement is quick and easy.	△	As only turning motion is possible, adjusting movement is difficult in narrow space of the last hold.
Pick &Carry	○	Capable to move while lifting heavy load	△	Move while lifting only small load

Source: JICA Survey Team

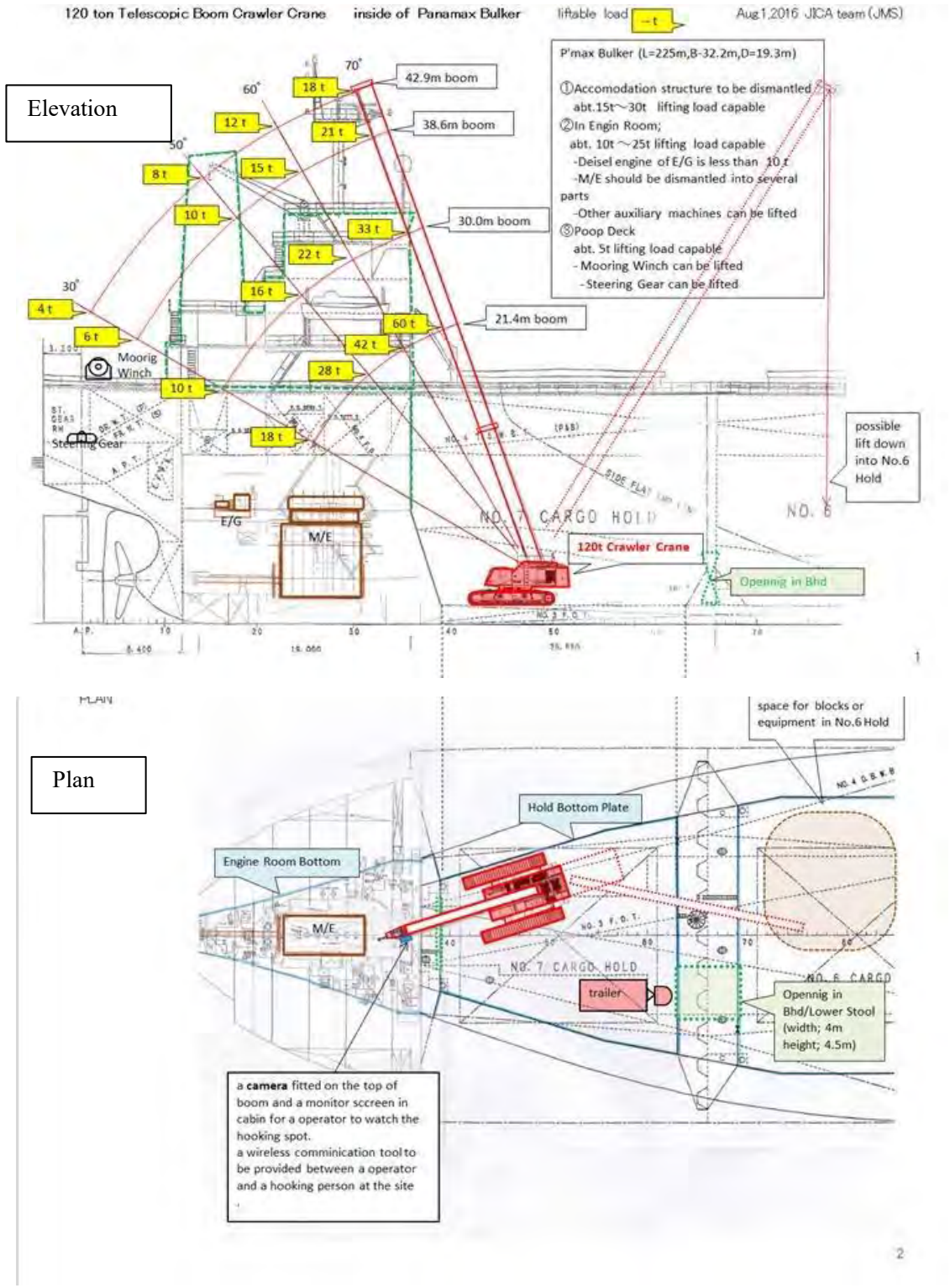
Source: Manufacturer's Catalog

Figure 3-20 Crane (TADANO GTC-1200) in detail

b. Operational Procedures

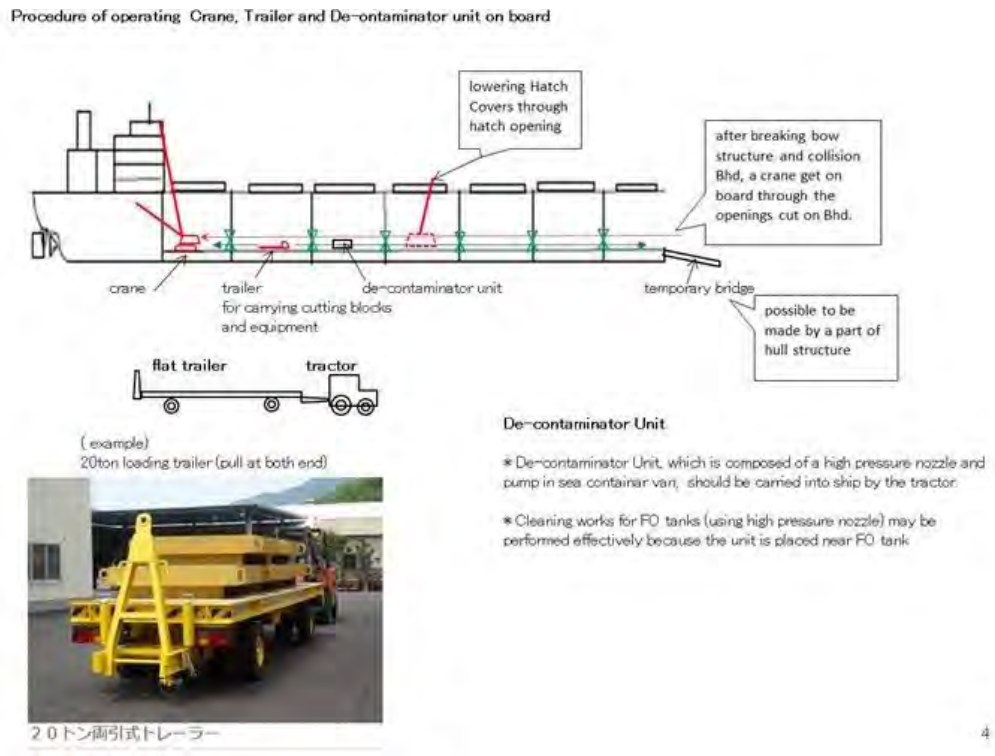
- Starting breaking works from the bow part after beaching, and after collision bulkhead (fore bulkhead of No.1 hold) is removed, an opening square hole (width abt.4m, height abt.5m) is made by cutting the lowest part of each of bulkheads to create a passage for the crane on the double bottom leading to the hold just adjacent to the engine room.
- Setting a temporary bridge at the front cutting edge of double bottom, the crane gets on the double bottom and travel to reach the last hold.
- In the last hold, the crane extends its telescopic boom through the hatch opening and starts lifting works. Firstly the accommodation structure is broken and removed, secondly the machines and other equipment contained in engine room are dismantled.

- Besides the crane in the hold, a trailer (20t load with a towing tractor) is prepared. Cut blocks and dismantled equipment / machines are put on the trailer by the crane. The trailer carries them outside along the passage and returns back to the last hold.



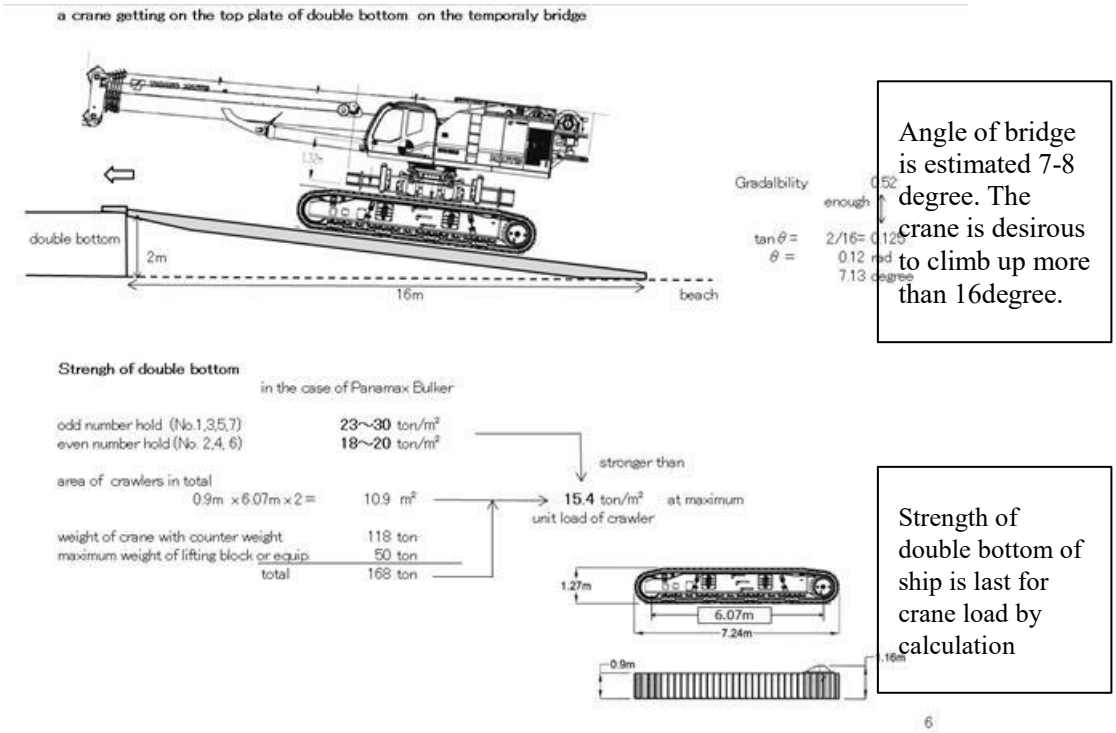
Source: JICA Survey Team

Figure 3-21 Crane Operation in Panamax Bulker



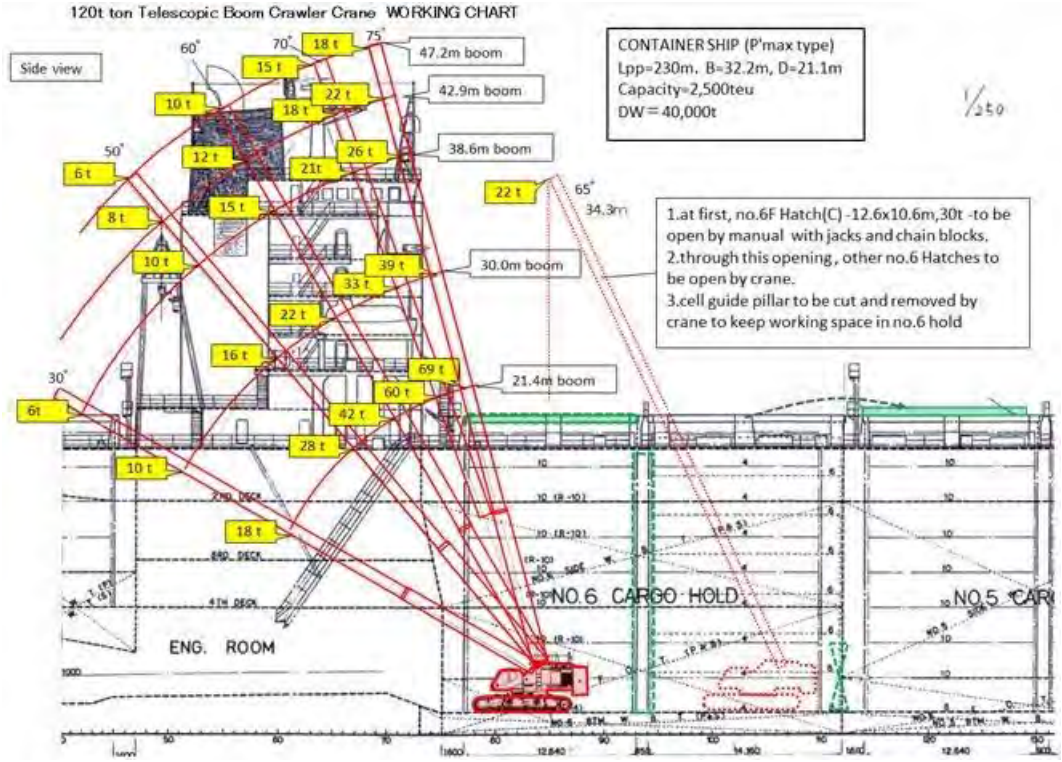
Source: JICA Survey Team

Figure 3-22 Crane traveling on board and Trailer



Source: JICA Survey Team

Figure 3-23 Temporary Bridge for boarding



Source: JICA Survey Team

Figure 3-24 Crane operation for Cape size Bulk Carrier

c. Ships to be adopted

It is a bulk carrier and a container ship that the crane can works effectively. Regrettably, an oil tanker, gas carrier, pure car carrier, ferry, and passenger ship are not suitable for the crane due to their hull structures. General cargo ship (handy size) is also not suitable because its hold space is small and the strength of its double bottom is not enough for the crane's weight. Handy size ships, however, are relatively light and need not to reduce their ship's weight by cutting the stern blocks for the dragging. Therefore, the effectiveness of the crane cannot be performed for the handy size ships. According to the record for past eight years regarding the number of each kinds of ship broken in Alang-Sosiya district (see Table 3-10), total number of bulk carriers and container ships accounts for 40% (annual average 125 ships / 313ships in all).

Focusing the latest three years, the number accounts for 58% (annual average 191ships / 331ships in all) and total LDT is supposed to account for approximately 80%. Even if only two kinds of ship are suitable for the crane, the crane can contribute to improve total working efficiency in the yards

Table 3-10 Past record of broken ships number in Alang-Sosiya

	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	total	ann.ave.
BULK CARRIER	6	61	26	34	110	137	70	39	483	63
CONTAINER	9	33	97	27	45	114	95	56	476	62
GEN. CARGO	23	59	82	74	109	46	54	41	488	64
OIL TANKER	3	0	6	21	32	20	7	5	94	12
CHEMICAL TANKER	12	14	28	41	24	10	5	8	142	19
LPG/LNG	8	13	11	22	6	1	4	10	75	10
RO/RO	14	13	30	54	32	11	23	14	191	25
PASSENGER	7	5	5	2	6	2	2	2	31	4
REFEER	5	23	14	36	24	19	1	12	134	17
OTHERS	49	43	49	46	27	34	38	3	289	38
TOTAL	136	264	348	357	415	394	299	190	2403	313
SRIA Home Page	136	264	348	357	425	394				

2.666

2012-13	2013-14	2014-15	total	ann.ave.
137	70	39	246	92
114	95	56	265	99
46	54	41	141	53
20	7	5	32	12
10	5	8	23	9
1	4	10	15	6
11	23	14	48	18
2	2	2	6	2
19	1	12	32	12
34	38	3	75	28
394	299	190	883	331

Source: JICA Survey Team

d. Owning・Operating scheme

Since the procurement cost of crane is expensive, it should be used only during limited days in concentrated works for breaking accommodation and dismantling machines in engine room in early stage in order to attain the good efficiency for its cost.

Therefore it should be shared among many yards as a common use. The cranes are owned by GMB (or SPV), who rent it to respective yards during a certain days on the rental scheme. GMB (or SPV) appoints an appropriate private company and outsource the management job of the rental scheme (including reception, making contract, collection of rental fee, etc.), maintenance and transportation of the cranes.

The temporary bridge and the trailer (20 t load with tractor), which are used for supporting crane operation, are also handled on the rental scheme. The same company should be appointed to manage the rental scheme and maintenance for them. As the cranes are shared among many yards, they need to be transported from plot to plot. A long trailer with truck for transporting the crane should be provided. The maintenance of it and the transportation service of the cranes are outsourced to the same company.

The appointed private company should prepare the warehouse to store the spare parts for the cranes, the 20t trailers, the long trailer and temporary bridges, and arrange the parking space for the cranes and others, if necessary.

Although operators of the cranes are not required any special skill higher than usual operating skill, the exclusive operators are designated to avoid accidental damages caused by miss operations in the case that any unaccustomed operator handles the crane. The private company employs the exclusive operators and it rent the cranes with the exclusive operators to respective yards.The

exclusive operators should take training course prepared by the crane maker and improve their operating skill to achieve high working efficiency without any accidental damages.

e. Required number of cranes

In case of common use among many yards, the required number is calculated from how many ships are broken with the carne per year and how many working days with the crane are taken for a ship. Average number of ships in past eight years is 125 as mentioned above, and necessary working days are supposed to be 25days for a ship.

According to the hearing from several yards, working terms for breaking accommodation is 10 to15 days and dismantling engine room is 15 to 20 days provided that the preparation works, such as cutting main parts of accommodation structure, unfixing equipment in accommodation area, and loosening bolts/nuts of machines, removing pipes in engine room, are executed in advance, the lifting works by the crane may be completed in approximately 25 days.

On the assumption that the 25 days per ship are taken for 125 ships per year, the necessary number of the cranes is calculated to ten (10) cranes according to Table 3-11. However, actual introduced number would be reduced to five (5) cranes by half of ten, because all yards may not always use the crane with additional expense of the rental fee and some yards might hesitate to apply the new procedure by using the crane. Since this type of large crane is also the first trial and the procurement cost is relatively high, we decided to avoid excessive investment and introduce five (5) sets.

Table 3-11 Calculation for required number of Large Crawler Crane

Annual ships No.	a	125
Crane working days per ship	b	25
Total crane working days per year	c=axb	3,125
Actual working days of yard per year except Sunday/Holiday	d	300
Required number of cranes	c/d	10.4

Source: JICA Survey Team

The 20t trailer (with a towing tractor) is also required five (5), which is used together with the crane, provided that the crane is transported every 25 days from plot to plot (the transportation can be done in just one day), total transportation frequency for 5 cranes is 60 times per year, which means 60days per year, <(300/25) x5=60 >.

So, one (1) Long Trailer (with a head truck) is enough for transportation service.

f. Contribution to streamline the working procedures

The cranes may contribute to reduce the working hours in following procedures;

- Collecting equipment and furniture in accommodation
- Dismantling machines (particularly, heavy machines like diesel generator) in engine room.
- Dragging ship's hull body by winches due to reducing weight in aft part of ship
- Omitting cleaning work for the blocks which are dropped into the inter tidal zone (if the blocks are dirty)

In total, 3-4 days may be streamlined due to above items, furthermore, due to weight reduction at the stern part, it is expected that safety of work will be improved and work time for of dragging to a beach by a winch will be shortened,

Also, the following merits are expected to be enjoyed by the ship recyclers.

- No risk of polluting the inter tidal zone due to no block to be dropped down,
- Improving safety when heavy machines/equipment are removed,
- Receiving cash earlier due to collecting saleable/valuable machines and equipment in early stage,
- The crane may be highly appreciated by the recyclers.

As European side especially is much concerned that the beaching method in India has a risk to pollute the inter-tidal zone when blocks drop down, the recyclers who aim to receive more ships from European ship owners want to avoid the risk. The crane will contribute to make a merit in business.

g. Turning a corner of the long trailer at the entrance of a yard

There are entrance gates of the yards along the service road of which width is 14m (one way 7mx2). The gate is positioned about 4.5m back from of the road, and the width of gate is about 6m (in the case of plot No.30). The central reservation of the road is not set in front of the gates. (The gate size and gate position to the road are almost same for all yards. And particularly there is no central reservation along the north and south end portion of the road)

On these conditions, there is no problem for the long trailer to turn the corner at the gate and enter into the yard.

v. Beach Cleaner

a. Specification of the beach cleaner

- A usual wheel loader on the market should be utilized and an attached bucket is specially ordered. While the wheel loader runs in the inter-tidal zone, the bucket sweeps on the surface of the beach.
- The wheel loader of which bucket capacity is about 2 m^3 and engine power is 120-130 HP should be chosen. The bucket is specially ordered with modification from the original shape (length extended to abt.2.5m, but width 2.5m and height 1.3m as same as original one).
- The bucket has a guide plate on the bottom which smoothly scoops the trash and debris, and storage pocket for them in the rear. The bottom is grid structure through which sand drop down and only trash and debris are retained. The bottom of the storage pocket can be open with hinge (by hand) to discharge the trash and debris gathered in full.
- Additionally an electric magnet in the shape of rectangular box (length abt.2.5m as same as width of the bucket, width abt.40cm, height abt.15cm) is fitted on the back of the bucket. The magnet can catch trash of iron material (small cutting pieces, melting chips, steel wire, etc.)
- The electric magnet can be switched to ON /OFF position by a remote switch in the operator cabin.
- If necessary, an electric generator should be installed additionally in the wheel loader to supply the electric power to the magnet.
- The material of the bucket should be anti-wearing and anti-corrosion against sand beach.

b. Operational procedures

- During low tide, the beach cleaner sweeps all over the inter-tidal zone continuously while the wheel loader moves ahead and the bucket scoops trash and debris with sand.

- After a certain amount of trash and debris with sand is scooped, once the wheel loader stops, the bucket is raised up and inclined backward to shift the trash and debris into the storage pocket and simultaneously to drop the sand.
- The electric magnet catches iron trash, traveling horizontally on the surface of beach with a small clearance.
- When the storage pocket is full with the trash and debris, the bottom plate is opened just above a trash box and all trash drops down into the box. At the same time, the iron material trash drops down by switching the magnet off.
- The beach cleaner is basically operated by one operator, however, another worker may be arranged, if necessary, to help the smooth flow of trash into the bucket.

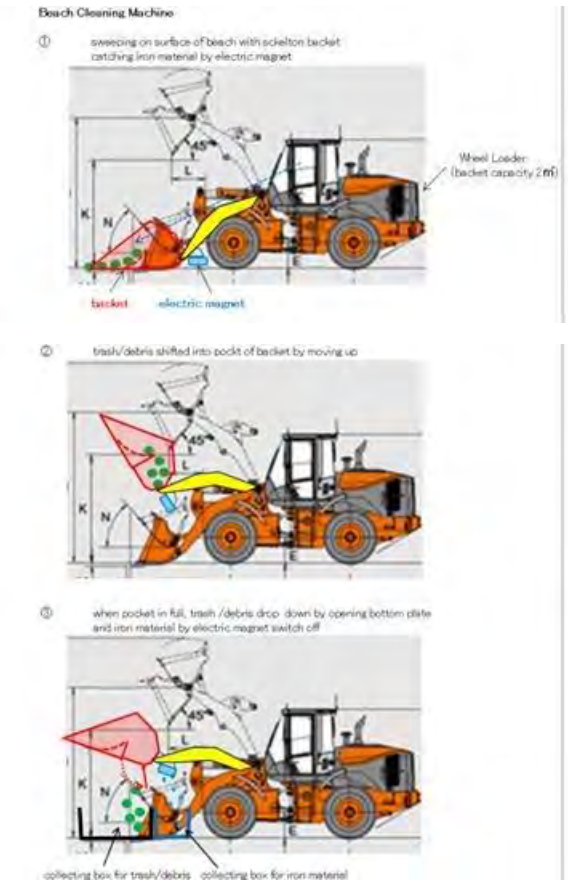
c. Common share scheme

The beach cleaners should be treated by the same scheme as the big crane for the rental and maintenance scheme. It is preferable to outsource them to the same private company. However, the operator (and the helper) is arranged by respective yards.

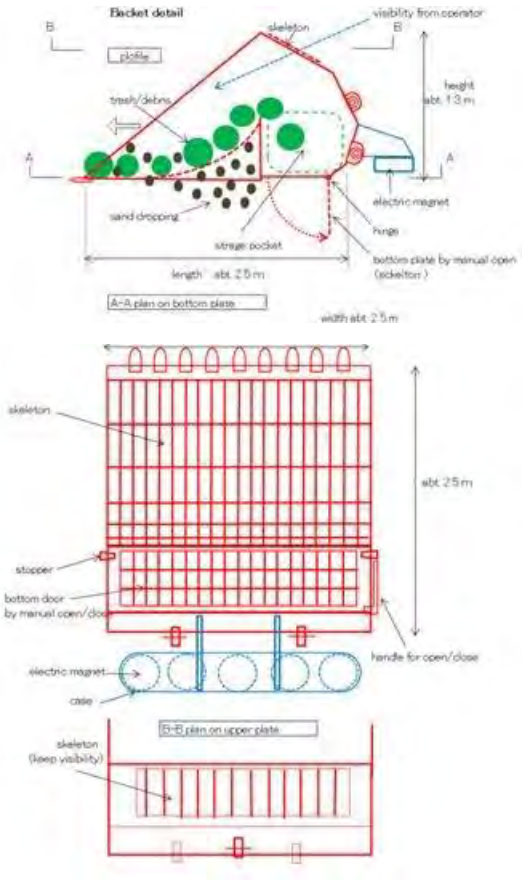
d. Required Number

Presently the respective yards carry out cleaning their inter-tidal zone in way of picking up the trash and debris by the hands of several workers who are employed by them. It is recommended to use the cleaning beach cleaner to clean thoroughly the beach in front of their yards with only one or two workers in shorter time. The thorough cleaning works with the beach cleaner should be carried out for the interval from finishing breaking a ship to beaching a next ship

< Machine outline>



< Bucket in detail>



Source: JICA Survey Team

Figure 3-25 Beach Cleaning Machine

a. The bottom plate of the bucket that scoops the surface of the beach with a cleaning bucket shall be of lattice structure
b. stop once, tilt the bucket backwards,
   · Drop the sand and collect garbage in your pocket
   · When the pocket is full, open the bottom plate and drain the dust

On the assumption that the inter-tidal zone area in width 100m and up to 50m from the shore is affected under works of breaking a ship, required number is calculated to be 2.1 beach cleaners according to Table 3-12, however, the required number would be three (3) beach cleaners since, beach cleaning is required by the GMB after ship recycling is completed thus it is expected to be used frequently and also taking into consideration when the breaking ships increase in future.

Table 3-12 Calculation for required number of Beach Cleaning Machine

Cleaning area for one ship =50mwidth x 500m offshore	a	25,000 ㎡
Cleaning capacity＝2km/hr x 2.5m Average traveling speed × bucket width	b	5,000 ㎡／/hr
Required times	c=a/b	5hrs（remark 1）
Annual required working days for 313 ships (remark 2)	d	313 days
Annual available working days (remark 3)	e	150days
Required number	d/e	2.1 →3 beach cleaners

(remark 1) the thorough cleaning operation including preparation works can be performed **in one day**

(remark 2) average annual ship number is 313 broken in past 8 years（maximum 415 ships in 2011）

(remark 3) although annual working days of a yard is 300 days (except Sunday/ Holiday), actual possible working days are reduced to 150days by half, because the beach cleaner can be used **only during low tide** in working hour (9:00～17:00)

Source: JICA Survey Team

3.4. IMPROVEMENT OF ENVIRONMENT FACILITY AND TSDF

3.4.1. STUDY OF TREATMENT METHOD OF HAZARDOUS SUBSTANCES

(1) Estimation of the Wastes to be Treated

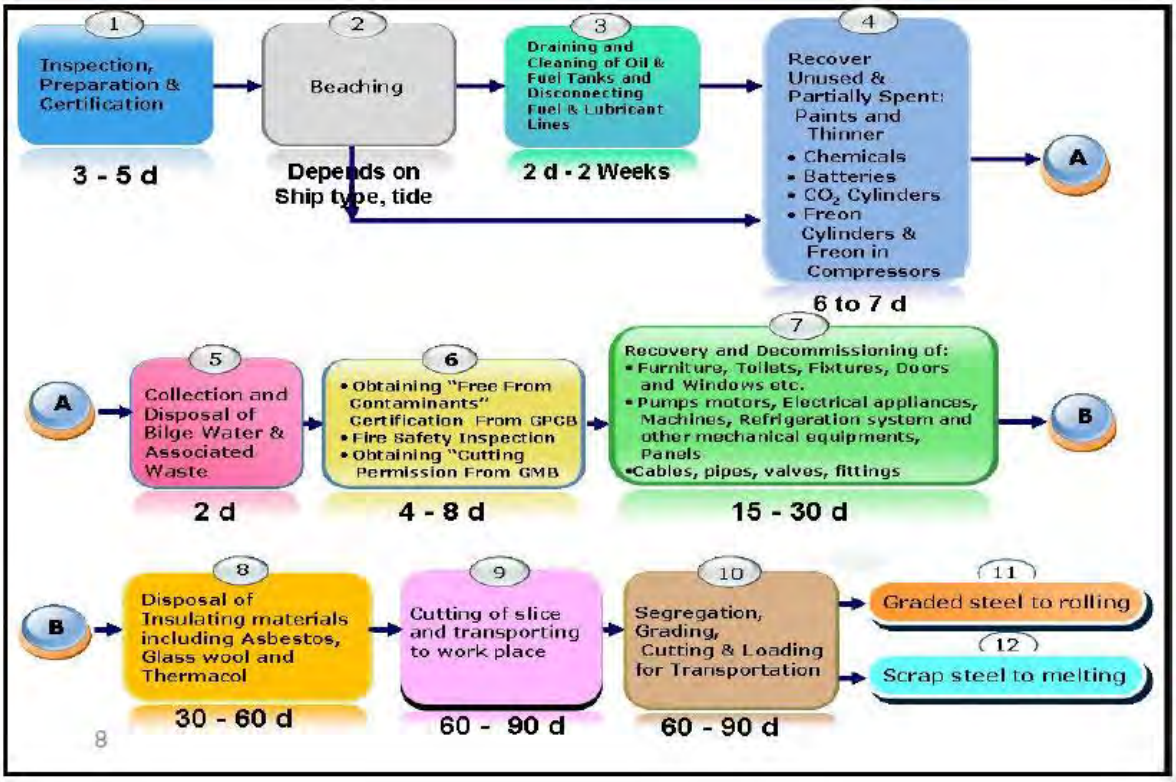
In Alang / Sosiya, in accordance with the Ship Breaking Code (2013), ship to be recycled is started beaching process after the documents review by GMB, GPCB, Custom Department and anchoring permission is given, inspection by GMB, GPCB, Custom Department & AERB, followed by paying import duties then title of the ship will be transferred to recycler. These standard processes are shown in
Source: GMB, Ship Breaking Industry at Alang Sosiya」 May 27, 2015
Figure 3-26.

The process of removal and handling of hazardous substances in this process is mainly following 3 process.

Table 3-13 Removal and Handling Process Hazardous Substances

Process	Substances	Process in the Figure
1: Removal of Hazardous before beaching	Stores not in the ship structure such as gas bottle, paints, chemicals, etc.	1
2: Identification and removal of Hazardous after beaching		2,7,8
3: Temporally storage and transportation of Hazardous to TSDF		10

Source: JICA Survey Team



Source: GMB, Ship Breaking Industry at Alang Sosiya」 May 27, 2015

Figure 3-26 Process of recycle

As hazardous waste discharged in the process of recycling of the ships, there are fuel oil remaining in the ship itself, oil water such as bilge, asbestos, glass wool etc., as solid wastes. The types, characteristics of these are shown in the following table.

Table 3-14 Wastes to be treated

Type of waste		Characteristics		Treat/Process
	Waste Oil	Residual oil in FO tank	Good waste oil is corrected and sold.	×
	Slop Oil	Slop oils reside in the Slop oil tank of tanker	Supernatant(quality oil) of slop oil tank after tank cleaning will be collected and sold. Waste oil in lower part (high density oily water) is remained.	○
	Oily Sludge	Silted oily sludge on the tank bottom contains rust, other impurities.	Oily sludge contains crude oil may cause of fire and explosion	○
	Bilge Water (Bilge wastes oil)	Wastewater contains L.O. and F.O. in the bottom of engine room	It maybe emulsified with detergent. It is generated while voyage and at port.	○
	Ballast Water	Sea Water (Mud and it may contain marine growth)	Ballast water is obliged to exchange at high sea.	×
	Tank Cleaning Water	Cleaning water of cargo oil tank of tanker and Bunker oil (FO	Cargo oil tank will be cleaned at offshore and bunker oil tank will be cleaned after beaching by High pressure MDS and collected	○
	Cleaning water for bottom and machine room	Wastewater with red rust accumulated on the bottom	Cleaned and collected	○
	Rain Water	Rain water on the recycle yard may contaminated by oil etc.	Rain water will be collected by drain and separated at EFT and water will be discharged to sea. Separated oil will be collected and incinerated.	○
	Oily wastes	Oily wastes in the engine room and used for recycling work.	To be incinerated	○
	Other oily wastes Chemicals	Waste painting, grease, LO, and other residuals on board ship	Recyclable wastes will be collected. Others will be wasted to TSDF	○
	Asbestos	Used for heat insulation, etc.	To be landfilled	○
	Garbage, Sewage	Wastes generated until last voyage	To be collected and solid wastes will be incinerated. Sewage will be treated.	○

Source: JICA Survey Team

(2) Estimation of Wastes Volume Generated

In general, volume of oily wastes generated from ship is estimated as follows.

Table 3-15 Volume of oily wastes generated from ship

Oily Waste	Generated ratio of wastes	
		Bulge water Oil content abt. 1~2%
		Collect Oil Oil content abt. 50%
Tank Cleaning Water	With 100,000 DWT tanker, about 12.5% of DWT will be generated. In case of ship recycling less volume is expected.	Oil content abt. 2.4%
Slop Oil	With 100,000 DWT tanker, about 2% of DWT will be generated.	Oil content abt. 15%
Oil Sludge	0.1 % of DWT depend on type of tanker and cargo	Calorie 4,000～5,000kcal/kg

Source: JICA Survey Team

In this study, type and volume of wastes generated though the recycling process is investigated with two (2) types of ships one of bulk carrier and the other a container ship and the results of the study is shown on the table below. Due to the fact that the number of subjects to be surveyed was limited, the number of days after the beaching and the state of cleaning work were different, the total amount of each waste is different but it shows the residual amount of hazardous waste in the ship for processing.

In the table, the asbestos of the bulk carrier is the total amount of gaskets, packing, etc., that may contain asbestos. Residual fuel oil, lubricating oil are sold as they are and cannot be processed.

Table 3-16 Type and volume of wastes generated though the recycling process

no.	Type	Type of waste	Approx. Quantity		Disposal Mode
			B.C. Panamax	Container	
1	Asbestos	HW	538 kg	- kg	Solidification/Incineration
2	Glass wool/Mineral wool	HW	8,280 kg	10,650 kg	Secured Landfill Site
3	PUF/Poly styrene		220 kg	- kg	Incineration
4	Waste oil		21,000 L	400 L	Incineration
	Used oil			30,000 L	Sale for recycle
5	Oily Sludge		650 kg	32,000 L	Incineration
6	Plastics	HW	70 kg	200 kg	Incineration
7	Paint Chips		2,972 kg	4,480 kg	Incineration
8	Iron scale	NHW	-	-	Sale for recycle
9	Fiber glass/Rexene	NHW	-	-	Sale for recycle
10	Food Waste	NHW	75 kg	250 kg	Secured Landfill Site
11	Card boards & Packages	NHW	-	-	Sale for recycle
12	Glass	NHW	-	-	Sale for recycle
13	Bilge Water	HW	5,500 L	50 kL	Bilge Water Treatment Plant
14	Rubber	NHW	200 kg	- kg	Sale for recycle
15	Lubricating Oil	HW	1,008 L	92,000 L	Authorized Recycler
16	Grease	HW	345 L	300 kg	Authorized Recycler
17	Paints	HW	200 L	160 L	Authorized Recycler

18	H.F.O.	HW	2,000	L	407	k L	Authorized Recycler
19	Engine Oil	HW	110	L	5,000	L	Authorized Recycler
20	Slop Oil	HW	4	L	200	L	Authorized Recycler
21	Hydraulic Oil	HW	400	L	11,300	L	Authorized Recycler
22	Cylinder Oil	HW	1,600	L	60	L	Authorized Recycler
23	Oily-Chemical contaminated rags	HW	50	kg	150	kg	Incineration

Source: JICA Survey Team

Ship recycling volume in Alang / Sosiya is 2,872 vessels and 25 million LDT in the past 10 years as shown in the table below. An average of 287 ships and 2.5 million LDT a year, the average LDT per vessel was 8,631 tons. The maximum recycling amount in the past is 415 ships and 3.85 million LDT in 2012.

Also, in the current situation, it takes about 3 months to 4 months to recycle a single ship, so it will become same number as 390 ships in 2012 if recycle 3 ships / yard in a year with full number of yards of about 130. In 2012, a large number of ships after the Lehman shock were recycled.

Table 3-17 Ship Recycle Volume

year	No. of Ship recycled	LDT recycled
2006-07	136	760,800
2007-08	136	643,437
2008-09	264	1,944,162
2009-10	348	2,937,802
2010-11	357	2,816,236
2011-12	415	3,847,000
2012-13	394	3,847,566
2013-14	298	3,059,891
2014-15	275	2,490,152
2015-16	249	2,431,752
Total	2,872	24,778,798

Source: JICA Survey Team

Based on this statistics, it is assumed that about 300 vessels are recycled annually in this project and estimated the hazardous waste volume of the ship using the average ship LDT of about 8000 LDT. Table 3-18 shows the types and amounts of waste received in 2015 by TSDF for reference.

Table 3-18 Wastes received at TSDF in 2015-2016 (unit: tons)

No.	Type of Wastes	Volume	Classification of Treatment
1	Asbestos	22.715	S/S
2	Bilge Water	1,600.395	W/W
3	Documents	34.270	INC
4	Ceramics	10.030	SLF
5	Polluted Sand	106.000	INC
6	Cooling Powder	106.320	S/S

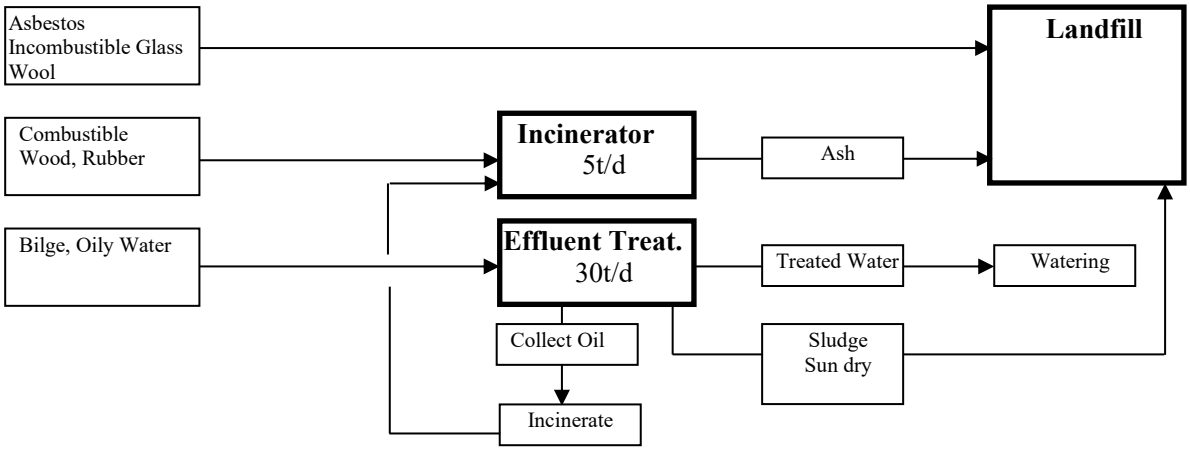
7	Garbage	34.050	SLF
8	Glass	6.505	SLF
9	Glass Wool	2362.790	S/S
10	Incinerated Ash	7.825	S/S
11	Oily Sludge	1.220	INC
12	Oily Waste	42.885	INC
13	Oily Water	1.970	W/W
14	Paint and Coating	24.520	INC
15	Puff	41.955	INC
16	PVC and Plastic waste	1.230	INC
17	Residuals	516.890	INC
18	Treated Residuals	7.950	INC
19	Rubber Packing, Insulation	27.100	INC
20	Clay	4.420	INC
21	Thermocol	35.350	INC

Source: GEPIL TSDF Statistic, JICA Survey Team

From above record, annual volume of wastes is classified by the process as follows.

W/W	Wastewater Treatment	1,602.275	t/year
S/S	Stabilization & Solidification	2,499.650	t/year
SLF	Secured Landfill	50.585	t/year
INC	Incinerable Treatment	843.800	t/year
	Total	4,996.310	t/year

These wastes are currently treated in TSDF as shown on the Source: JICA Survey Team
Figure 3-27. Present capacity of the environment facility of TSDF is shown on the Table 3-19.



Source: JICA Survey Team

Figure 3-27 Treatment Flow of Environment Facility in TSDF

Table 3-19 Capacity of Environment Facility of TSDF

No.	Facility	Capacity		Specifications
1	Incinerator	5t/d	1t/h	Fixed bed Type

2	Effluent Treatment Plant	30m^3/d	4m^3/h	DAF＋Bio treatment
3	Landfill	100,000m^3		Sanitary Landfills

Source: GEPIL, TSDF Statistic, JICA Survey Team

(3) Treatment Plan of Hazardous Wastes

Safe extraction and disposal of a large amount of waste oil, oil sludge, waste liquid etc. are required at ship recycling by the beaching method in Alang / Sosiya. The plan is an improvement and construction for environmentally compatible facilities that properly treat the wastes generated in the process of ship recycling.

In the past, the waste generated during the tanker repair work has been treated in Japan. This plan is applied to the treatment of the waste generated in the process of ship recycling. Also, this plan aims at to treat ship recycling waste, but it is also planned to respond adequately to the proper treatment of other industrial waste.

In addition, as shown in Source: GMB, Ship Breaking Industry at Alang Sosiya」 May 27, 2015
Figure 3-26, the waste disposal process begins at the time when the ship is anchored offshore, so not only the onshore waste facility, but also the cargo oil washing process of the crude oil tanker and the collecting oil sludge, waste oil etc., from ships will be planned.

1) Structure of Wastes Treatment Plant

Proposed planned plant consists four (4) parts.

Table 3-20 Planned Wastes Treatment Plant

Process of Hazardous Wastes Treatment	Wastes Treatment Plant
1. Before Beaching, at Anchoring Cargo oil tank cleaning and gas free works of Crude oil tanker at offshore	: Tank cleaning and waste oil collecting plant Transfer oily water after cleaning tanks and sludge at offshore to onshore.
2. After Beaching FO tank cleaning and gas free before cutting work	: Tank cleaning plant by high pressure water. With mobile high pressure cleaning system, work inside the yard.
3. While Recycling Treatment of liquid wastes such as bilge, waste oil, oily water	: Oily Water treatment plant By Oil collecting tank, Oily water separator, and Sludge treatment plant, wastewater will be treated.
Treatment of solid wastes such as PCB contained materials, ODS, etc.	: Incineration Plant Detoxifying of hazardous substances by high temperature incinerator
4. Final Treatment Landfill of solid wastes	: Compressor (Baler) Reduce landfill wastes

Source: JICA Survey Team

Since ships to be recycled is required to remove hazardous material before anchoring and beaching permission is issued by the Ship Breaking Code 2013, ships generally collect and sell residual oils to mitigate their volume and then beached. Ships are normally beached by their own power, FO & LO required for propulsion and other waste oils remain after the beaching.

On the other hand, Crude Oil Tanker as "Special Concerned Ship" under the Ship Breaking Code, is required to have Safety for Hot Work certificate before anchoring and beaching. Therefore, Crude oil tanker (except product tanker) was not recycled in the last couple of years in Alang.

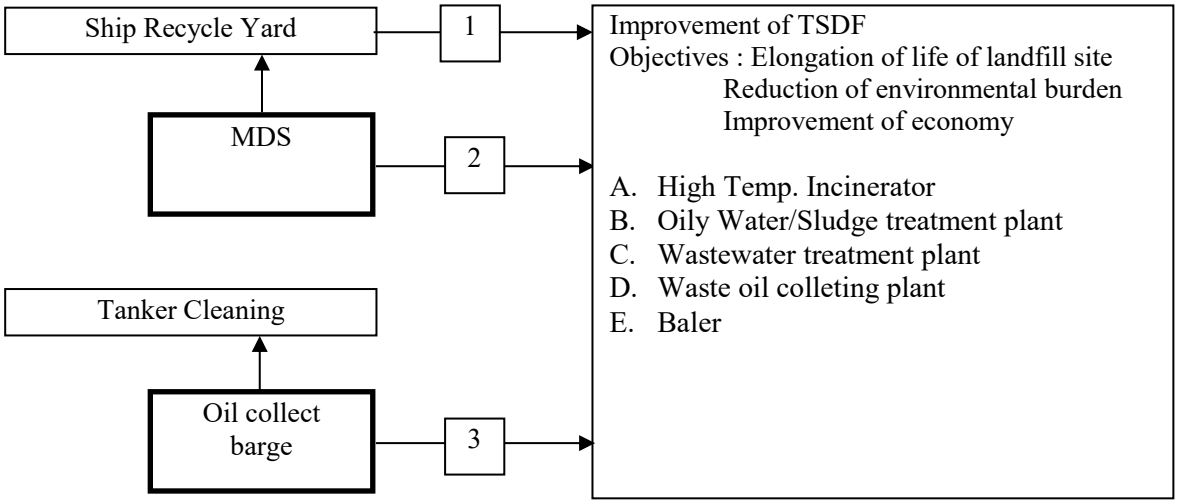
With this backdrop, after the beaching, FO tanks of ships are cut after gas freeing is confirmed and residual oil is pumped out and then cleaned with saw dust or sand manually. Although the FO tanks are cleaned, sludge on the tank wall cannot be wiped out perfectly, thus oil contained in sludge may possibly be distilled by washing sea water when the cut block is sunk at high tide.

Under the circumstances, more severe cleaning process is introduced before cutting is started and the following measure is investigated.

2) Flow of the wastes and target of the improvement of TSDF

Source: JICA Survey Team

Figure 3-28 shows the flow of waste treatment and the waste disposal facility to be rehabilitated in TSDF.



Source: JICA Survey Team

Figure 3-28 Comprehensive plan of wastes treatment process

(4) Volume of Wastes Generated (Planned Volume)

The volume of generated oily water is calculated as 10 vessels / year for offshore cleaning of crude oil tankers, and 360 vessels / year for washing by mobile high-pressure cleaning equipment for all vessels as follows. Also, due to the improvement of the yard with concrete flooring then drain recovery will be carried out, and illegal dumping of bilge etc. will be monitored more severely when the project is carried out, presumed that the amount of oily water generated from the recycle yard will be increased in the recycling process the volume of waste generated is planned as follows.

1) Generated from Tanker cleaning

① Oily water

- Number of cleaning tanker 10 ship/year
- Oily wastewater (Low concentration) 0 kL/ship

(Processing on the ocean using a built-in cleaning vessel (Barge) equipment)

- Oily wastewater (High concentration) 1,000 kL/tanker
- Annual generated volume 10,000 kL/year (estimate)
- Oil contents of oily water 10 %

② Oil Sludge

- Number of cleaning tanker 10 ship/year
- Oil sludge volume 200 m3/tanker (estimate)
- Annual generated volume 2,000 m3/year (estimate)
- Oil contents of oil sludge 5 %

2) Generated from MDS

① Base Conditions

- Number of breaking ship 360 ship/year
- Cleaning water volume 50 kL /time/ship
- Oil contents of cleaning water 10 %
- Oil sludge contents of cleaning water 2 %

Wastes volume form oil separator installed on MDS (Consider recycling use of cleaning water)

- Annual generated volume oily water 15,000 kL/year (estimate)
- High concentration oily water 4,500 kL/year (estimate)
- Oil Sludge 1,000 m3/year (estimate)

3) Wastes volume generated from ship recycle yard

① Oily wastewater

- Average LDT of breaking ship 8,000 T/ship
- Generated volume 0.34 % of LDT per Ship
- Number of breaking ship 360 ship/year
- Volume of Oily wastewater 9,400 kL/year
- Oil content of wastewater 3 %

② Incinerable waste

- Average LDT of breaking ship 8,000 T/ship
- Generated volume 0.20 % of LDT per Ship
- Number of breaking ship 360 ship/year
- Volume of Incinerable waste 5,700 T/year
- Amount of waste requiring for high temperature incineration 2,850 T/year

③ Direct landfill waste (glass wool etc.)

- Volume of direct landfill waste 2,500 T/year

Based on the above estimation of wastes volume capacity of Incinerator, wastewater (oily water) treatment plant is set as follows.

3.4.2. **OFFSHORE AND BEACH ENVIRONMENT FACILITY PLAN**

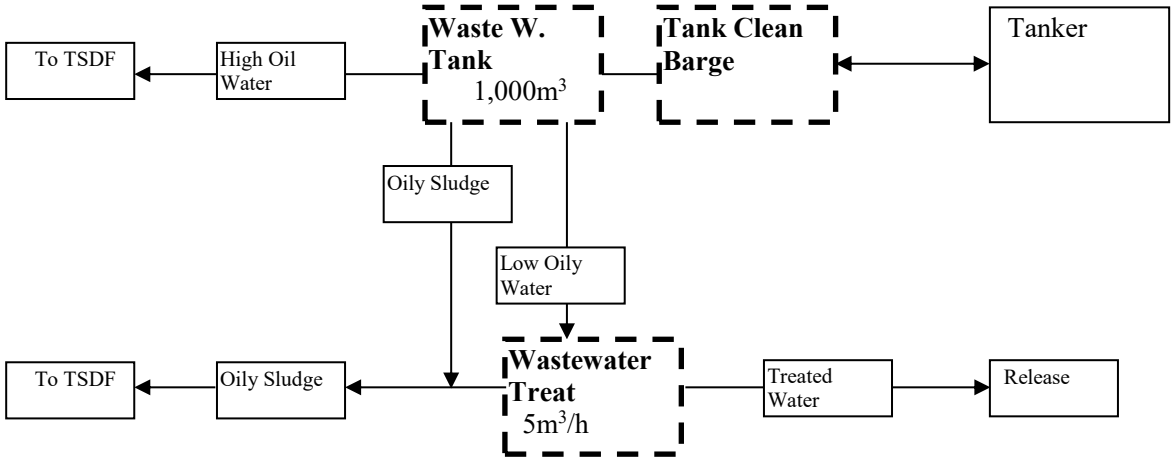
(1) Hazardous wastes treatment in offshore or at anchorage area

At anchorage area, ship owner is required to establish gas free condition for cargo oil tanks for tankers to have an anchoring permission and other practical inspection will be carried out onboard. Ship owner can clean the cargo oil tanks before entering sea of India. However, in this project, cargo oil tank cleaning and discharge of slop and sludge to offshore tank cleaning barge exclusively for tanker prior to anchoring.

With this offshore tank cleaning barge, cargo oil tank of Crude oil tanker will be cleaned at offshore and accept about 10 VLCCs per year by securing the safety.

VLCC is currently recycled mainly in Bangladesh, Pakistan. With recycling results in 2013, there were 64 vessels including 39 crude oil tankers and 25 crude oil and product tankers. On the other hand, there were 33 vessels in 2016. In November 2016, a catastrophic accident occurred due to a tanker fire in Pakistan and due to this it is supposed that regulations such as tank washing and gas-free will be applied in the future, Although it is expected that most of VLCCs can be recycled in India and Bangladesh, we plan to accept VLCC recycling demand of about 10 vessels in 3 countries for the time being, and this project also planned to accept ten (10) vessels a year.

The flow of wastewater treatment by offshore tank cleaning barge is as follows.

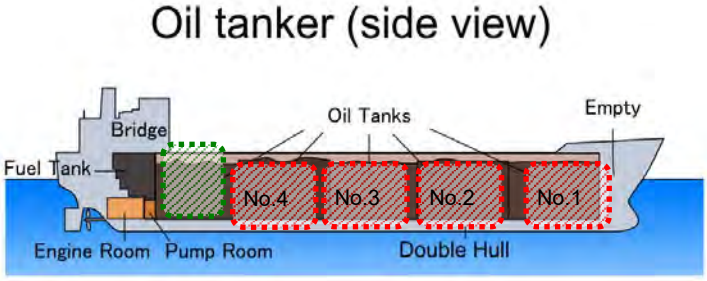


Source: JICA Survey Team

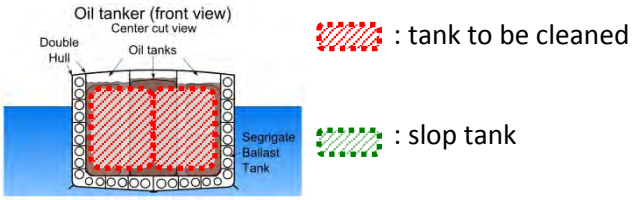
Figure 3-29 Process Flow of the Tank Cleaning Barge

1) Process of Cargo oil tank cleaning of Crude oil tanker

Process of the cargo oil tank cleaning of crude oil tanker is as follows.



Sludge before cleaning



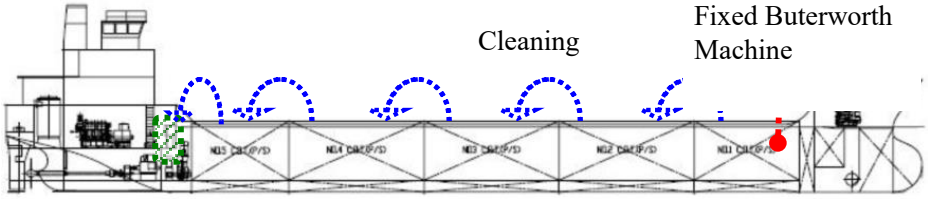
Source: JICA Survey Team

Figure 3-30 Cleaning process of Crude oil tanker

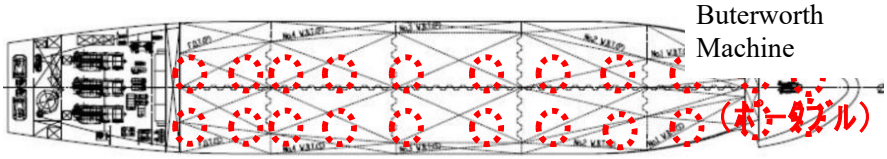
2) Preparation before cleaning

① Sea water is filled up to slop tank (one side a) with about 1,000kL
② Heat up the sea water up to 60 deg. C utilizing ship's boiler
③ Clean the tank with Butterworth machine (installed onboard) and portable machines as necessary

Start the cleaning from foreside tank and lastly slop tank.



Ship's Butterworth machine
Capacity : 70~80tons/hr
Range : 10m
Pressure : 7～8 kg/ cm2



Portable machine
Capacity : 30ton/hr
Range : 10m
Pressure :8kg/cm2

3) Cargo tank cleaning works (in case of Handy size tanker)

Cleaning order	Fixed Machine	Capacity (No.)	Cleaning time	Cleaning water
No.1(P&S)	6 (3/one side)	60～70 kL／H	2～3hrs	Abt. 1,260 kL
No.2(P&S)	6 (3/one side)	60～70 kL／H	2～3hrs	Abt. 1,260 kL
No.3(P&S)	6 (3/one side)	60～70 kL／H	2～3hrs	Abt. 1,260 kL
No.4(P&S)	6 (3/one side)	60～70 kL／H	2～3hrs	Abt. 1,260 kL
No.5(P&S)	6 (3/one side)	60～70 kL／H	2～3hrs	Abt. 1,260 kL
Total			15hrs	Abt.6,300 kL

Tank cleaning water will be accumulated to slop tank (side B) temporally. Water other than the supernatant (oil) will be circulated to other side of slop tank (side A) and reused for the tank cleaning water.

Therefore, waste oily water volume needed to transfer and treat at the shore wastewater treatment plant is as follows.

- Tank cleaning water (for Cargo oil tank) : abt. 1,000kL
- Slop oil tank (oils) : 100=300kL

4) Slop Tank cleaning

Cleaning of Slop tank(side B) accumulated tank cleaning water.

Slop tank (one side)	No. of Machine	Capacity, No.	Cleaning time	Clean water
	2/ one side	60～70 kL／H	2 hrs.	Abt. 280L0 kL

- Tank cleaning water (for slop tank) :280kL

5) Sludge removal works

Inert gas and fresh air purging
Tanks which can be safely enter will be cleaned by order.

- Worker : 27 workers (9 workers x 3days) (specialized entity)
- Sludge volume : 10~30 tons

Offshore tank cleaning barge will be berthed along the tanker and transfer wastewater, sludge. Waste oils transferred to the offshore tank cleaning barge at offshore will be transferred to the shore waste oil treatment facility and tanks in the TSDF.

(2) Specifications of Offshore Tank Cleaning Barge

1) Offshore tank cleaning barge

Offshore tank cleaning barge will be introduced to collect oily water and sludge which is generated as waste oily water for the cleaning of residual sludge in the cargo oil tank of crude oil tanker and oily water and sludge in the slop tank. The jetty to moor the barge will be used. In order to have Gas Free for Hot Work which is the condition of crude oil tanker for anchoring, offshore cargo oil cleaning and sludge removal work by the specific company. Also, the barge will be provided oily water separator is able to discharge water below the regulatory level of oil contents.

The basic concept and outline of the offshore tank cleaning barge is as follows. Basically its function is the transfer of cleaning water and sludge to the offshore tank cleaning barge after washing with high pressure water at the cargo oil tank.

Table 3-21 Basic Concept of the Oil Colleting Barge

Function	Storage of collected waste oily water (collecting oil tank 250 m^3x4) Oily water separator

Regulation	Ship safety laws and relative regulations Regulations of transport and storage of dangerous goods
Ship Certificate	Non self propelled, bulk oil (dangerous goods) carrier
Gross ton	Abt. GT
Voyage area	Coastal
Hull structure	Small steel ship structure regulation (classNK) Structural regulation for small oil tanker (A type) NK （(steel barge) Equipment Type 4 classified
Max. complement	Crew 0 p. Passenger 0 p, others 0 p.
Others	Anchoring

Source: JICA Survey Team

2) Maneuvering

Basically, the offshore tank cleaning barge is to be towed by the multipurpose work boat or a working boat as non-self-propulsion.

If long distance operation is required, weather must be taken into consideration. In Japan's petroleum base which owns the same type of barge, as the operational criteria of holding the barge to ship side, the effective wave height is set to 0.7 m and the wind speed is set to 8 m / s or less. The wind waves have not a big influence, but in the case of swells, the offshore tank cleaning barge and the multipurpose work boat collide with each other. Also, it may roll each other and make intense contact with each other when stopping rather than they are voyaging. Therefore, it is required to provide operation criteria and always remind to operate the barge safely.

3) Operation and Maintenance

This Offshore tank cleaning barge is able to moor the Jetty newly constructed at the south end of Alang, however, normally this will be moored to the quay at Goga managed by GMB, 30 km north of Alang /· Sosiya district. Goga is the place of where boat of government agency such as Customs, GMB, etc. for inspection of ships to be recycled is go and back.

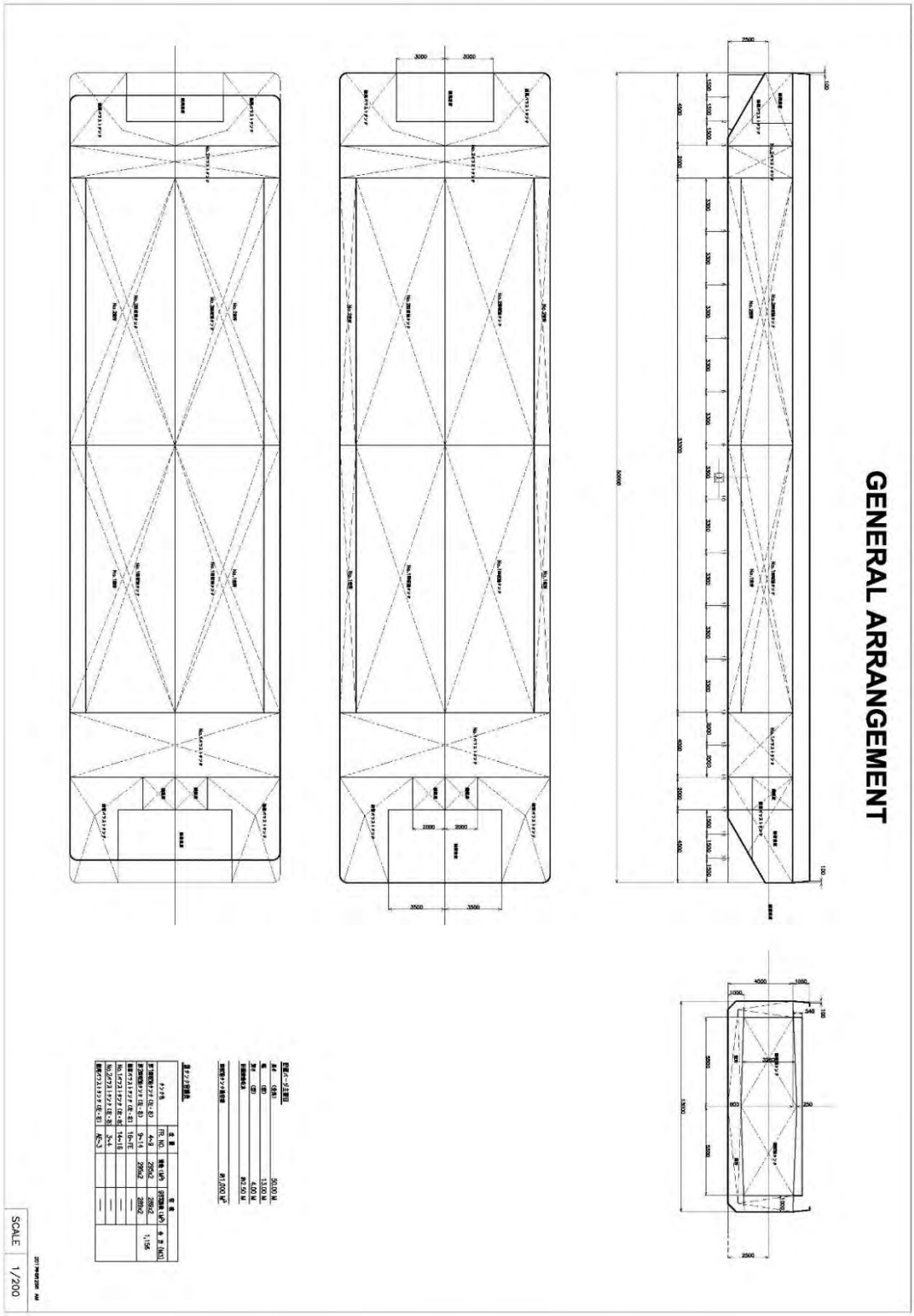
Operation and maintenance of the barge will be managed by the operator selected by GMB.

Table 3-22 Specifications of Offshore Tank Cleaning Barge

Hull Shape	Tank Barge
Hull Structure	As per Steel ship hull structure, Small tank hull structure (Type A)regulation
Gross Ton	Abt. 160 t
Loa x Breadth x Depth	Abt. 50 m × 13 m ×4.0 m
Draft	Abt. 2.5 m
Propulsion	Self propulsion (onboard engine with propeller)
Anchor winch	Installed
Store	Provided
Complement	n.a.
Rooms	n.a.
Firefighting Equipment	n.a.
Crane	n.a.
Diving Equipment	n.a.

Oil dispersant	n.a.
Oil Boom	Can be installed
Oil colleting equipment	n.a.
Oil collecting tank	Abt. 250 $m^3 \times 4$
Oil transfer pump	Yes
Ballast tank	Fore tank abt. 32.8 $m^3 \times 2$ Aft Tank. Abt 31.6 $m^3 \times 2$
Bollard	12 tons bollard, 198tons cross bid

Source: JICA Survey Team



Source: JICA Survey Team

Figure 3-31 Oil Collection Barge

(3) Hazardous waste treatment after the beaching

After the beaching, ship recycler shall obtain gas free for hot work certificate and remove wastes and hazardous materials as per regulated and then "Free from Contaminants Certificate" from GPCB. After this "Cutting Permission" is issued by GMB, then, removed wastes and hazardous materials shall be transferred to TSDF and treated as appropriate.

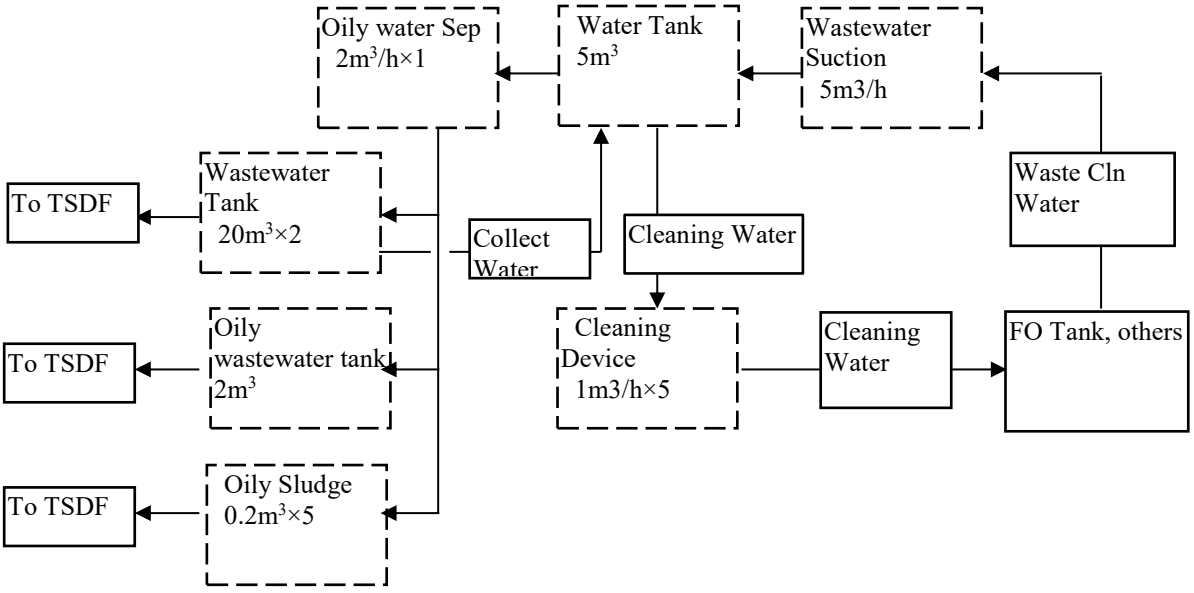
For the removal process of hazardous material at beaching stage, in order to attain the issue to protect offshore and beach pollution, it is important to protect oil spill from tanks while cutting works at beach and intertidal zone.

In order to have a Cutting Permission, bunker oil (FO) tanks of ships have been cleaned with saw dust or sand manually. Although the FO tanks are cleaned, sludge on the tank wall cannot be wiped out perfectly, thus oil contained in sludge may possibly be distilled by washing sea water when the cut block is sunk at high tide.

Under the circumstances, more severe cleaning process is introduced before cutting is started and introduction of Mobile High Pressure Cleaning Unit for cleaning bunker oil (FO) tanks is planned.

1) Mobile Decontamination System

Mobile decontamination system is the system to mechanically and effectively collect and clean these tanks. It cleans inside of the tank with high pressure water and collect washed water and residual oil by the vacuum unit. The recovered washing water and residual oil are separated in oil and water by a centrifugal separator. The separated water is reused as washing water, and the oily water and sludge are finally processed with TSDF. Process is explained as follows.



Source: JICA Survey Team

Figure 3-32 Flow of the Mobile Decontamination System

By the introduction of the Mobile Decontamination System, the following advantages can be expected compared with the conventional cleaning method.

Table 3-23 Comparison of MDS and Conventional Method

Item	High Pressure water clean (MDS)	Saw dust, / Oil sand clean
Required time	4~7days	6 – 14days
Oil collection	Fuel oil and other oils can be collected and sold.	Oily sand and saw dust contained oils and sludge cannot be reused . To be treated at TSDF which required cost.
Safety	No fire will be used since water pressure cleaning system	In case cleaning is not enough, it may possibly ignited

Source: JICA Survey Team

2) Specification s of Mobile Decontamination System : MDS

a.	Planned number to be cleaned	:	360	ships/ year
b.	Required cleaning day	:*1	7	days/ ship
c.	Possible working day / year	:	52	times /year /MDS
d.	Number to be introduced	:	5	sets
e.	Possible number of ships to be cleaned	:	260	ships / year

*1 including preparation

3) Detail of the Mobile Decontamination System

	For the working tools followings are supplied. • Personal Protective Equipment for workers (PPE) • Gas detecor • Berathing apparatus • Others
	High Pressure Cleaning Device • Water / Air mixed jet cleaning device • Air pressure 0.6~0.7Mpa • Discharge water vol. & pressure 16L/min 8Mpa • Pump 20L/min

	Centrifugal Separator • Oily water after cleaned is separated to water and oil by centrifugal separator installed to MDS. • For the emalsion oil, heating device will be included.
	Pressurized water supply device. • By air compressor, high presuure water tank is provided.
	

Source: JICA Survey Team

Figure 3-33 Detailed Image of Mobile Decontamination System

4) Operation and Maintenance of Dynamic Oil Cleaning System

Five (5) units of Mobile Decontamination System will be introduced and it is planned to outsource its operation to private enterprises selected by GMB.

This cleaning operation will be carried out in a land side and it is distinguished from a sea cleaning operation. Expected private operators are among the ship recyclers, but also some companies that conduct the waste oil recovery business as described in Chapter 2. These business operators have oil recovery pumps, explosion-proof equipment, protective clothing for workers, etc., and have experience in washing tasks inside the ships, so there is no issues in carrying out the cleaning work.

In maintaining of the equipment, it is important to manage a centrifugal separator that performs wastewater treatment with a mixture of oil and water, especially after washing. In the case of

using an emulsifier in washing, it may be difficult to properly separate oil and water in the centrifugal separator, so it is necessary to pay attention to handling the centrifugal separator and bowl inside. Therefore, guidance from suppliers with regard to necessary attention to separable oil and maintenance of centrifugal separator is required. For other high pressure pumps also need to explain such as exchange of consumable parts, replacement to spare parts etc.

3.4.3. ENVIRONMENT FACILITY PLAN FOR HAZARDOUS MATERIAL TREATMENT ON LAND

(1) Improvement of TSDF

In order to sustain its operate of ship recycling industry in Alang / Sosiya, it is important to use landfill site of TSDF where the hazardous and wastes are process in a safe manner and in a long term. For this purpose, following measures are studied.

Against the capacity of 70,000m3 of Cell-4 for hazardous material landfill, it is estimated that from the start of its operation in May 2013 up to the end of 2016, 22,000MT are landfilled and the remaining capacity is 48,000MT. Assumed that 7,000 MT of wastes which is correspond to about 0.2% of LDT will be processed, the cell will become full before 7 years from now. Considered that about 62% of wastes are Glass Wool, compression of this volume can be expected for elongation of the usage of landfill site.

Table 3-24 Record of Wastes received TSDF

Year	No. of Ship recycled	LDT recycled	Wastes		
			MT	Kg /LDT	%/LDT
2006-07	136	760,800	1,032.861	1.357	0.13%
2007-08	136	643,437	2,017.025	3.134	0.31%
2008-09	264	1,944,162	5,027.841	2.586	0.25 %
2009-10	348	2,937,802	5,418.040	1.844	0.18 %
2010-11	357	2,816,236	8,215.310	2.917	0.29 %
2011-12	415	3,847,000	8,318.979	2.162	0.22 %
2012-13	394	3,847,566	10,555.355	2.743	0.27 %
2013-14	298	3,059,891	7,505.890	2.45	0.24%
2014-15	275	2,490,152	7,279.395	2.920	0.29%
2015-16	249	2,431,752	4,996.310	2.05	0.20%
2016-17 (Ap-16)	30	298,838	564.595	1.88	0.18%

Source: GEPIL, TSDF record, JICA Survey Team

1) Reduce Volume of wastes not for Incineration such as Glass Wool

As mentioned above, by compressing wastes with low specific gravity with volume, elongation of its life of landfill site is planned. By using Baler, it can be simply compress to 1/10 of volume thus 10 times of capacity at landfill site may be expected. Exclusively for glass wool, landfill site may be expected to use another years as follows.

Assumed that about 62% =4,340MT out of 7,000 MT / year is glass wool. Rest of 38% = 2,600 MT, by the compression of glass wool annual volume of wastes can be reduced to 3,094 MT thus another 15.5 years of operation of landfill site is expected.

2) Treatment of wastes not suitable for landfill

a. Since Oily sludge is not stabilized condition, it is not suitable for landfill. It may incinerate, however oily sludge is not high calorie and required pre –treatment for filtering particulars, it is recommended to recover waste oil as much as possible and then stabilized (remove water, oil and make it minimum volume of sludge) by introduction of oil sludge treatment and then land filled.

b. Incombassibles representing such as asbestos cannot be incinerated with incinerator with normal temperature and it shall be landfilled.

(2) Baler

In order to reduce the volume of waste to be landfilled above, a compressed packing machine (Baler) will be introduced. The amount of waste to be landfilled is 2500 tons per year as follows, but since glass wool is the main material and its specific gravity is light, the capacity is increased.

- Planned volume 2,500 tons /year
- Average specific gravity 0.05 tons /m3
- Volume to be dealt 50,000 m3/ year

1) Specifications of Baler

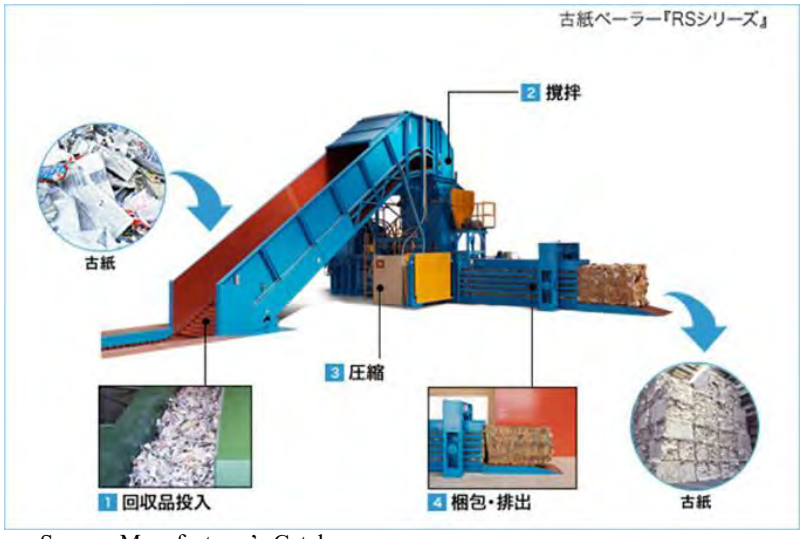
a.	Volume of glass wool	:	*1	50,000	m^3/ year
b.	Running hour	:	*2	8	h/day
c.	Running day	:		240	d/y
d.	Required capacity	:		26.0	m^3/h
e.	Safe margin	:		20	%
f.	Say	:		31.3	m^3/h
g.	Selected capacity	:	*3	65.0	m^3/h
h.	Number to be introduced	:		2	Sets (100% backup)

Remarks

*1 As a glass wool itself, the specific gravity is 0.02 t / m 3, but it is supposed to be 0.05 t / m 3 considering that it is bagged at the time of shipping from the yard. (From reference values of similar cases in Japan)

*2 Considering that the input work becomes manual work.

*3 Selected model capacity is selected from the standard capacity table of hydraulic jumbo press machine (standard capacity 65 m 3 / h).



Source: Manufacturer's Catalog

Figure 3-34 Baler for general wastes

(3) Small High Temperature Incinerator

1) Planning of Small high Temperature Incinerator

For incineration of waste, incineration treatment is indispensable to reliably prevent environmental contamination by oil based waste while preventing easy disposal of landfill waste. At the final disposal site, there is a possibility of generating methane gas CH4 due to anaerobic fermentation of landfilled organic waste, and by appropriately incinerating organic wastes such as oil sludge, it can be suppressed generation of methane gas which is 21 times higher greenhouse effect coefficient than carbon dioxide.

In studying the incineration process, the use of waste heat as a measure to control emission of global warming gas is actively considered. The process is planned ad it is able to recover heat effectively and to use hot water as technically possible.

The incineration of waste should adopt a combustion method that matches the waste properties, but as a model that can incinerate a wide variety of waste as far as is possible based on the type of waste from the ship, small fluidized bed + water cooled stoker system is adopted.

In this small incinerator, waste including ship oil sludge is also planned as a suitable incineration system, and the average calorific value of the incineration target including ship oil sludge is set to about 4,000 kcal / kg. Although the waste is not limited to marine-based waste but its composition fluctuate greatly, it can be said that it is sufficiently safe to set about 4,000 kcal / kg as the average calorific value of oil based waste.

The incinerator of this project is planning a fluidized bed, and that can handle a wide variety of wastes, from liquids such as waste oil and waste liquid to sludge, sludge such as oil sludge, and even solid waste.

Waste incineration involves emission of flue gas, insufficient exhaust gas treatment will become a cause of air pollution. The combustion gas is re-incinerated in a second chamber with a temperature of 1,100 ° C. or more for a retention time of about 2 seconds or longer for the re-incinerate unburned in the exhaust gas sufficiently. With this re-incineration, dioxins can be reduced and environmental impact can be reduced. High-temperature exhaust gas is rapidly cooled by spraying cooling water to prevent re-synthesis of dioxins. The proposed exhaust gas treatment employs a wet type exhaust gas scrubber system.

Through this exhaust gas treatment, the value of the dioxin concentration in the exhaust gas discharged from the stack becomes 0.1 ng · TEQ / m^3 N or less. The advantage of the wet exhaust gas treatment is high removal efficiency of harmful substances in exhaust gas such as sulfur oxide, hydrogen chloride etc.

Wet type exhaust gas treatment is effective in case crude oil containing heavy sulfur and waste oil of heavy fuel oil are many as an oil based waste. The exhaust gas is treated with a wet electrostatic precipitator as a final stage and then discharged to the atmosphere from the chimney. It is planned to reuse treated water for washing water of exhaust gas scrubber and electrode of wet type electric dust collector.

2) Incineration Capability

As a result of the survey, the amount of waste to be incinerated now is 5,700 tons / year. PCB contains substances (including plastics) that require internal high temperature incineration are halved.

- Planned generation volume 5,700 t / year
- High temperature incineration processing amount (50%) 2,850 t / year
- Low temperature incineration processing amount (50%) 2,850 t / year (8.0 t / d)

The low temperature incineration amount shall be corresponding with the extension of the operation time of the existing incinerator.

3) Specifications of Small High Temperature Incinerator

In order to stably incinerate PCBs at 1400 ° C or higher and to secure an outlet temperature of 1100 ° C by a small fluidized bed furnace this incinerator is sets the furnace temperature to 1400 ° C.

In order to render the PCBs harmless, it is necessary to secure at least 2 seconds at 1200 ° C in the relative regulations however with the design of 1200 ° C it may be lower than the calorific value of the burned matter, therefore it is set at 1400 ° C.

The nominal capacity of this incinerator is 0.6 ton / hour as follows and the capacity at the time of 8 hours operation is 4.8 ton / day ≒ 5 ton / day. Since the amount of incinerated wastes fluctuates, if the amount of incinerated material increases, extend the operation time to respond.

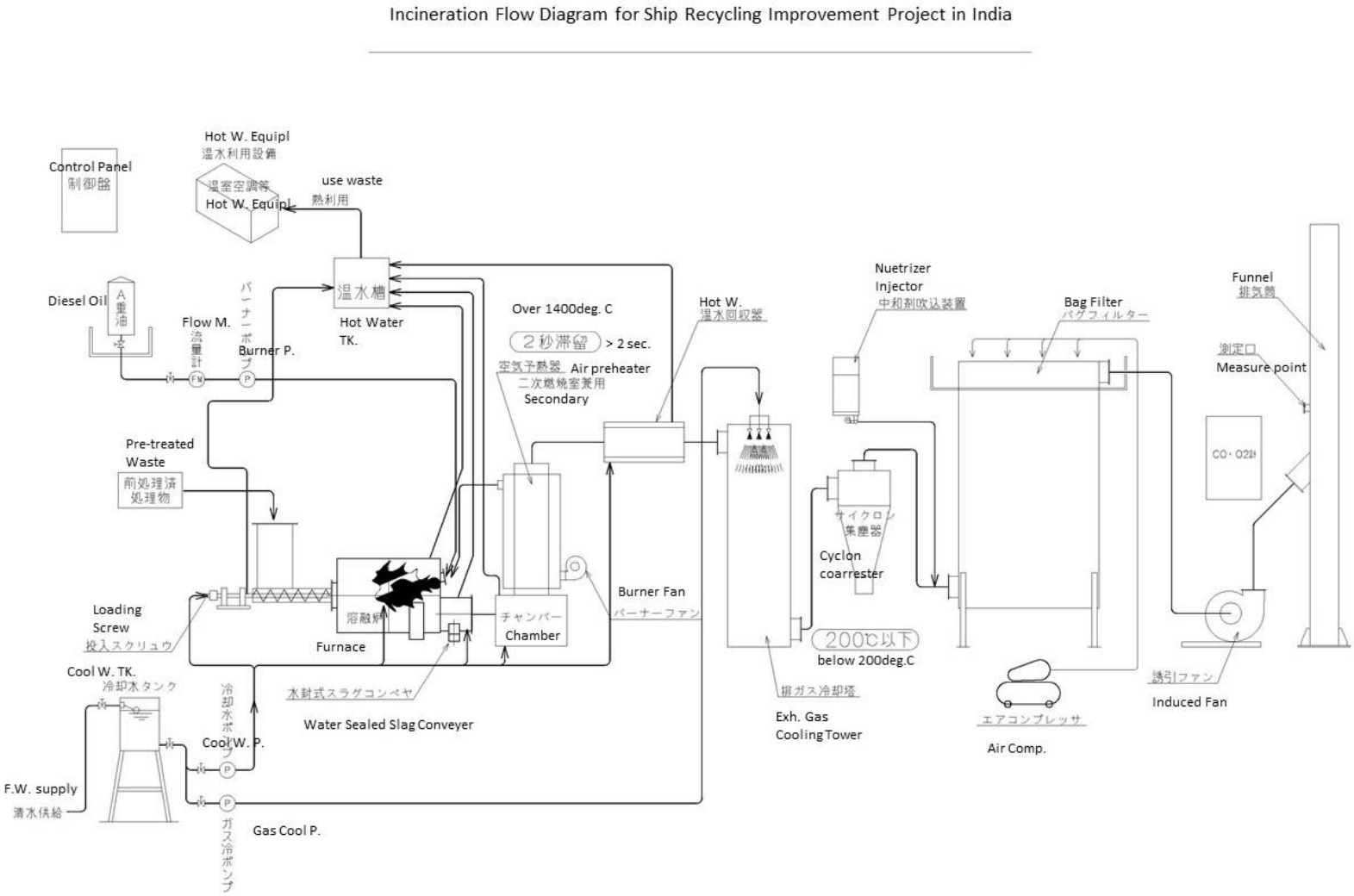
However, based on the operation of 240 days a year, it is decided that maintenance in the furnace can be taken.

a.	Planned Volume	:		2,850	t/year
b.	Running hour	:	*1	24	hr/day
c.	Running day	:	*1	240	Day/year
d.	Required capacity	:		0.5	t/hr
e.	margine	:		20	%
f.	Say	:		0.6	t/hr
g.	Capacity of selected incinerator	:		1.0	t/hr
h.	Number to be introduced	:		1	Set (back up parts to be supplied)

Remarks

*1 Although, automatic operation is possible, it is planned operating hours taking into consideration of periodical maintenance time and days.

Although only one (1) incinerator is planned, it is possible to carry out sufficient maintenance by providing the spare parts etc., and to continue demonstrate the initial performance continuously. The furnace needs to periodically repair refractories, and it is required to implement necessary maintenance on the entire incineration facility systematically, and to have the necessary maintenance know-how to this planning facility.



Source: JICA Survey Team

Figure 3-35 Flow of the Small High Temperature Incinerator

(4) Improvement of Effluent Treatment Plant (ETP)

1) Planning of Oily water separator

a. Waste oil colleting (Oily Water separation) system

Waste oil generated at the time of recycling a ship contains moisture (seawater) and sludge, and cannot be used as it is as a fuel oil. In the waste oil recovery (oily water separation) equipment, after waste oil is heated, water and sludge components are separated by natural sedimentation, then the remaining moisture and sludge in the centrifugal separator are removed and finished as recovered fuel oil. Recovered fuel oil can be sold as necessary.

The separated oil-containing wastewater generated during the recovering process of the waste oil is treated in a wastewater treatment facility and then drained as clear treated water. Oil sludge generated during recovery process of waste oil is treated with a sludge treatment plant.

Although the proposed plan utilizes centrifugal separation as a treatment system for waste oil, treatment, with strong emulsion waste is not suitable for centrifugation. Waste oil may be in an emulsified state in the engine room or in case detergent is used for the tank cleaning. In such a case, it is difficult to recover the waste oil by the centrifugal separation method. As a method of treating waste oil, there are distillation method and filtration method other than centrifugation method, but the centrifugal separation method is technically stable and have an advantages in economic efficiency. In the case of waste oil with strong emulsion not suited for centrifugation, choose incineration and recovery heat from waste oil. Also, for mineral type highly viscous oil and heavy oil heavier than water, it is not suitable for treatment of waste oil recovery process by centrifugal separation method but incineration.

Moisture contained in ship-based waste oil is often seawater, and corrosion of the centrifuge by the seawater may occur. In order to effectively treat the waste oil, it is necessary to raise the temperature of the waste oil to 90 ° C or higher, and corrosion resistance against high temperature seawater is required for the centrifugal separator. The centrifuge is a high-speed rotating machine with thousands rpm, and if corrosion occurs in the rotating body, accidents of scattering of the rotating body may happen. Therefore, it is necessary to adopt a high-grade seawater resistant stainless steel for the material of the wetted part of the centrifugal separator.

b. Wastewater treatment system

Water treated with waste oil recovery system is discharged to the sea through rivers. Therefore, a higher performance of oil-water separation is required for the wastewater treatment system.

The planned treatment process is divided into "physical / chemical treatment" and "biological treatment". The characteristics of wastewater to be treated are that the concentration of oil in the wastewater is high and the concentration fluctuates drastically. Another feature is that the SS[5] is included in addition to the oil content, and the wastewater is mainly the sea water. Due to the characteristics of such wastewater, it is adopted the physical / chemical treatment method also in wastewater treatment of this plan.

Physical / chemical treatment is a combined treatment method of gravity separation by specific gravity, agglomeration pressurized float separation, filtration treatment and adsorption treatment. Ship oil-containing wastewater (slop oil, tank wash water, ballast water,

[5] SS: Suspended Solids, is a generic term for insoluble substances having a particle diameter of 2 mm or less suspended in water.

bilge, etc.) is accepted in a storage tank (separation tank). Separate the oil-containing wastewater by the tank and separate the oil content in the wastewater naturally floating and separated on the tank top. The oil separated at the top of the tank is transferred to the waste oil recovery system and recovered as fuel oil.

Since the wastewater at the bottom of the tank contains oil, it is necessary to treat it to remove oil, and the oil containing wastewater is first treated with TPI[6] Oil Separator. The TPI Oil Separator is an apparatus for effectively floating and separating oil using the difference in specific gravity by the inclined plate, required smaller installation spaces compared with the API[7] Oil Separator, and has high oil separation performance.

Characteristics of marine oil-containing wastewater are that is often formed in oil emanation by high-pressure washing of a tanker cargo room or chemical cleaning. Therefore, an emulsion of oil and water is formed in the wastewater of the lower aqueous layer of the slop tank where the tank washing effluent containing the high concentration oil is stored. In addition, an oil emulsion is formed in the bilge at the bottom of the engine room due to heavy use of detergent for engine maintenance.

This project incorporates agglomerated pressurized floatation device into the treatment process, since marine oil - containing wastewater forms an emulsion of oil and water. The agglomeration pressurizing floatation device is a system in which fine oil droplets in wastewater are coagulated as a large floc by a coagulant and the floes are floated and separated together with fine air bubbles. By treating with agglomerated pressurized floatation device, oil content in wastewater can be reduced to about 10 to 20 ppm.

In order further to clarify the wastewater, the wastewater is treated with a sand filtration device. By treating with sand filtration, it is also possible to reduce the oil concentration in the wastewater to 5 ppm or less. Regarding the discharged water after processing, measure and record the water quality continuously. The item to be continuously measured is the oil concentration value.

The planned water quality of the discharged water is with oil content of 5 ppm or less and SS 50 ppm or less. The SS content of discharged water is not measured continuously, but it can be judged visually. In actual operation, because it is required to manage by the oil concentration, if the oil content is 5 ppm or less, it is considered that the SS content satisfies 50 ppm or less。

2) Capacity of Oily Water Treatment (ETP) system

d. Sludge treatment plant

• Planned generation volume	2,360 t / year (yard generation amount + tanker generation amount)
• Purification treatment volume	2,360 t / year

e. Wastewater treatment plant

• Planned generation volume	34,700 t / year (yard + MDS + tanker generation volume)
• Average oil content wastewater	5% (as the amount of high-oil-containing withdrawn)

[6] TPI: Tiltable Plate Interseptor
[7] API: American Petroleum Institute

- Throughput 33,000 t / year

f. Oily water separator

- Planned generation volume 1,750 t / year (wastewater treatment receiving separated oil-containing wastewater)
  1,800 t / year (generated from MDS)
- Average oil content 40%
- Throughput 3,550 t / year
- Oil sales volume 1,420 m 3 / year

3) Specification of oil-water treatment equipment

The specifications of each device corresponding to the above processing volume are as follows.

a. Sludge treatment plant

i. Planned volume	:		2,360	t/y
ii. Running hour	:	*1	8	h/d
iii. Operation days	:	*1	240	d/y
iv. Required capacity	:		1.23	t/h
v. Margin	:		20	%
vi. Say	:		1.48	t/h
vii. Selected capacity	:		1.0	t/h
viii. Number to be introduced	:		2	Sets (100% backup)

Remarks
*1 inputs will be made manually.

b. Wastewater treatment plant

i. Planned volume	:		33,000	m^3/y
ii. Running hour	:	*1	24	h/d
iii. Operation days	:	*1	330	d/y
iv. Required capacity	:		4.2	m^3/h
v. Margin	:		20	%
vi. Say	:		5.0	m^3/h
vii. Selected capacity	:		5.0	m^3/h
viii. Number to be introduced	:		1	Set (spare parts to be supplied)

Remarks
*1 Because of automatic run can be made, running hour, days are set.

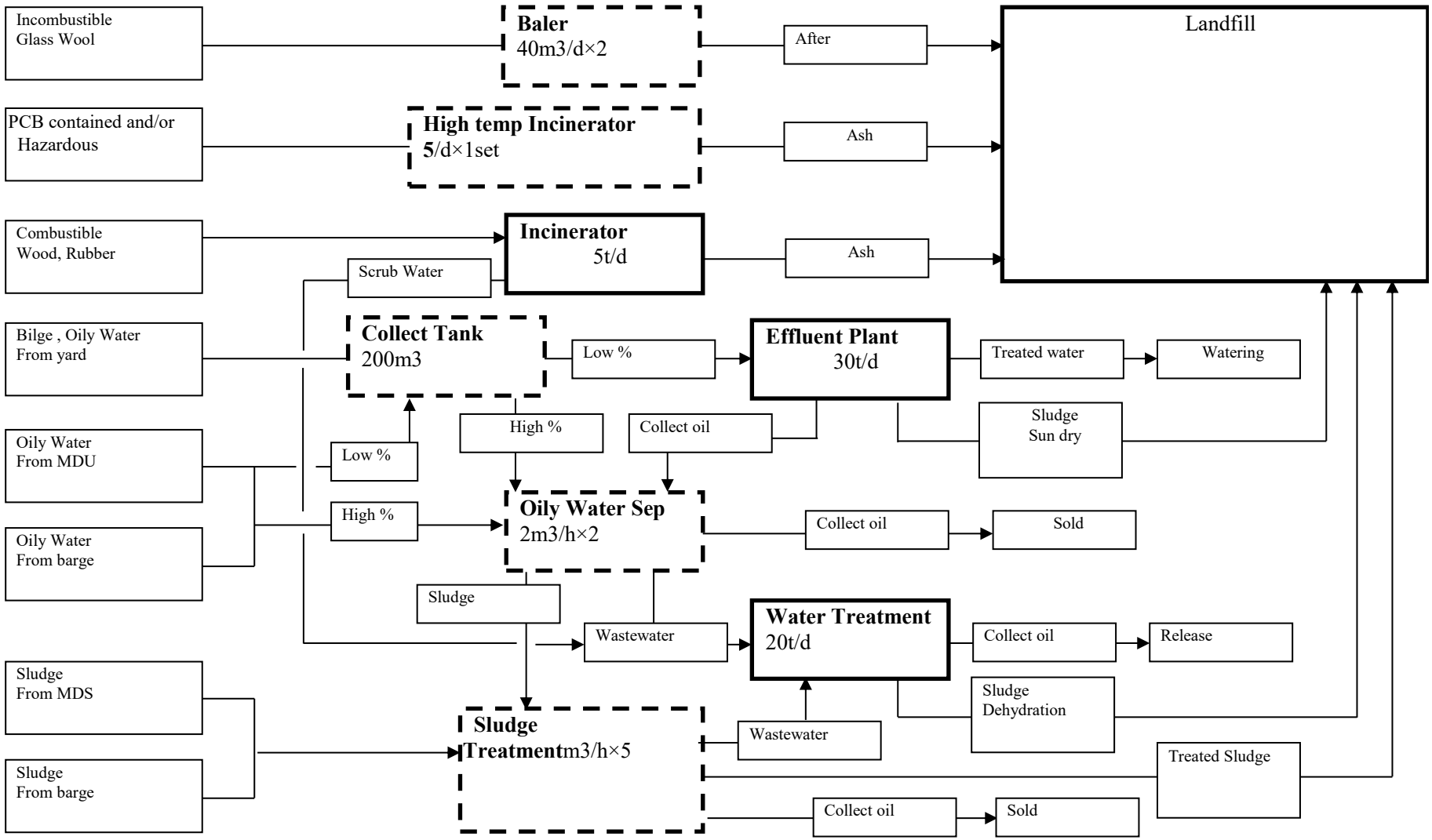
c. Oily water separator (oil recovery)

i. Planned volume	:		3,550	m^3/y
ii. Running hour	:	*1	20	h/d
iii. Operation days	:	*1	300	d/y
iv. Required capacity	:		0.6	m^3/h
v. Margin	:		20	%

vi.	Say	:	0.8	m^3/h
vii.	Selected capacity	:	1.0	m^3/h
viii.	Number to be introduced	:	2	Sets (100% backup)

Remarks
*1 Because of automatic run can be made, running hour, days are set.

Entire flow of the waste treatment system at TSDF and its material balance is shown on the figure next.



Source: JICA Survey Team

Figure 3-36 Entire flow of the improved waste treatment system at TSDF

3.4.4. MULTI PURPOSE WORK BOAT

In Alang / Sosiya, ships are necessary to anchor offshore and get necessary inspection, such as customs inspection, before obtaining the permission of beaching. In particular, tankers are required to be gas-free of cargoes before anchoring as vessels requiring special attention. For this reason, cleaning with a offshore off shore tank cleaning barge explained in the previous section is performed. In this work, it is necessary to prevent accidents such as oil spill and fire from the ship, but in the event that these accidents happen, introduce a multipurpose work boat that can be used for recovery of spilled oil, firefighting, rescue operation etc..

The roles and required functions of this multipurpose work boat can be roughly classified into the following three, but in the anchorage off the coast of Alang/ Sosiya, the outline specification was examined in consideration of the natural conditions of the monsoon season.

- Role-1: Role as disaster prevention vessel at the time of disaster
  Required functions: firefighting, oil boom deployment, oil recovery, offshore tank cleaning barge towing

- Role-2: Tanker cargo oil cleaning work and role as a work ship performing safety management during anchorage
  Required functions: Tanker's hull posture securing (tug boat function), warning ship / communication function

- Role-3: role as a work vessel performing rescue activities
  Required functions: rescue to the deck of a falling person, transportation of injured persons to land

For multipurpose work boat, ship type and equipment that aim for safe, efficient operation and operation, high economy, environmentally friendly vessel is studied.

(1) General Plan

Hull shape : single deck with long forecastle deck
Application : Multipurpose working vessel, oil fence extension ship, oil recovery offshore tank cleaning barge towing etc.
Navigational area : coastal area
Qualification : Indian Classification Association (IRS), etc. (equivalent to JG 4th type ship)

a. The vessel shall have necessary equipment for as a work vessel, and sufficient stability, good propulsion, sea worthiness and maneuverability.

b. As described above, make structures and facilities that can work safely, smoothly and efficiently for different applications and functions.

(2) Principal Particulars

1) Deck part

a. Hull shape without stepped deck at stern deck and lowered ship side height, hull outfitting shall be of that the visual angle of the bridge can take a viewing angle of 360 degrees as much as possible, to improve the visibility of the whole work area and rear deck work. Other main specifications are as follows.

b. Equipped with a rotating propulsion device and a controllable pitch propeller (CPP) to improve maneuverability during ship maneuvering and berthing.

c. For the stern deck, without steps on the deck, lower the ship side to improve the workability on the deck and the stern side

2) Water spraying capacity

The firefighting capacity required for multipurpose work boat is defined in the "Petroleum Complex Disaster Prevention Law" and "Fire Law" against the oil storage base in Japan, and the foam spraying capability is regulated as the sum of on-site firefighting capacity and maritime firefighting capacity. On the other hand, the ship is a solitary firefighting activity on the sea, and because there is no regulation, it is planned that sprayed water to reach the height of a tanker anchored by empty load, and the same level of firefighting capacity as ships of the same size firefighting function in Japan Respectively.

a. Foam extinguishing agent

It is advisable to avoid installing "synthetic surfactant foam" on an alternative disaster prevention ship according to the new technical standards, and to load a required amount of water-based foam extinction agent or AGF foam extinguishing agent. The capacity shall be 6,000 liters / minute.

a. Extinguishing nozzle height

By the new technical standard of Japan it is required to have effective height (about 33 m above the sea level) even in the case of light condition of the maximum tanker that can be berthed to the relevant country base.

(3) Engine part

a. By installing multiple generators, it is possible to select the number of generators to be operated according to the load. It is also enable to select the number of operating units suitable for low load.

b. If shore power supply during anchorage is not available, by installing one sound-proof radiator cooling generator as a port use generator, is can be ensured operation while low load power during anchorage, with low vibration and low noise environment.

c. By providing one spare port generator with the same specifications it can be replaced at the time of trouble occurrence and regular maintenance.

d. Machinery cooling system shall be a fresh water central cooling system and reducing the seawater cooling heat exchanger and seawater piping. Also, by using central cooling, the number of pumps can be reduced.

Table 3-25 Particulars of Multi-Purpose Vessel

Hull Shape	Mono hull
Navigation Area	Coastal
Gross Tonnage	Abt. 199 GT
L xB x D	31.50m x 9. Bollard 0m × 4.80m
Main Engine	Mid Speed 4 stroke Diesel x 2sets

Maine Generator Engine	2 sets		
Propulsion System	Z Type Propeller x 2 sets or equivalent		
draft	3.50m		
Ship Speed	Abt. 11.0Knots		
Compliment	17 Crews		
Officers	3 officers + 6 Crews		
Rooms	5 rooms		
Public Space	Salon for 12		
Kitchen	yes		
Firefighting Equipment	Pump output(abt.1200 ps)	Height	Range
Foam/Water nozzle	Abt.4,000 L/min x1	Abt.17～33m	Abt.70m
Foam/Water nozzle	Abt.18,000L/min x 1	Abt.15m	Abt.120m (max)
Foam/Water nozzle	Abt. 1,800L/min x1	abt.11m	abt.60m
Foam Tank	22,000L (11,000Lkn		
Crane			
Fresh Water Generator	n.a.		
Oil dispersant equipment	Yes		
Oil dispersant nozzle	Yes		
Oil dispersant tank	to be onboard whenever necessary		
Oil Boom	To be onboard whenever necessary (Type B)		
Oil Collecting Equip	To be onboard whenever necessary		
Outrigger	Yes		
FO Tank	abt.40m^3		
F.W. Tank	n.a.		
Portable W. Tank	Abt.20m^3		
Towing bollard	50tons		

Source : JICA Survey Team

(4) Operation plan of the Multi-purpose work boat

The ship shall be organized to operate by GMB or a shipping operator selected as the private contractor at any time in accordance with Indian domestic law. If workers are required to onboard in addition to crews, stakeholders shall decide how many workers to be onboard.

1) Standards for navigation (operation) of multipurpose work boat

In general, "wind speed 15 m / sec, wave height 1.5 m or less", however the final decision shall be judgment of the harbor master. Basically, it does not work at night.

2) Tanker Fire

This vessel equipped with firefighting equipment will engage the initial firefighting activity. Also, if other tug boat or warning ship is in the sea area, receive assistance according to circumstances.

3) Oil spilled from tanker (oil boom)

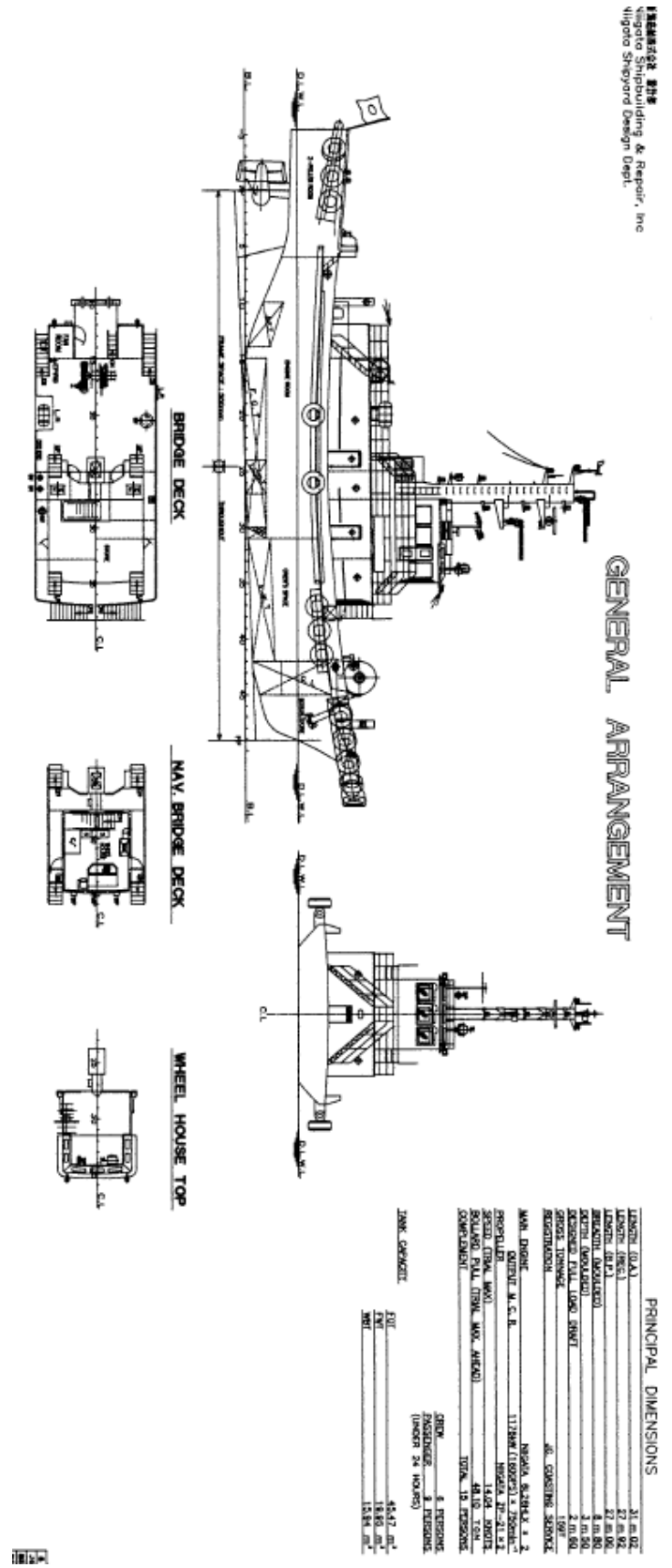
Oil boom does not expand when tanker anchoring.

When cleaning the cargo oil tank, expand 200 m as a pre-deployment on the tanker side.

In case of spilled oil, the protective oil boom 400 m - 800 m of land kept (GMB arrangement) will extend, and if necessary, enter the expansion work of the oil boom stored on land.

4) When a tanker is not anchored at the time of non-accident work

During daytime, the main duties are support for anchorage of various ships waiting for beaching, monitoring, monitoring of marine pollution, and so on. This multipurpose work boat is scheduled to moor to the quay at Goga managed by GMB, 30 km north of Alang /· Sosiya district as same as the Offshore tank cleaning barge.



Source : JICA Survey Team

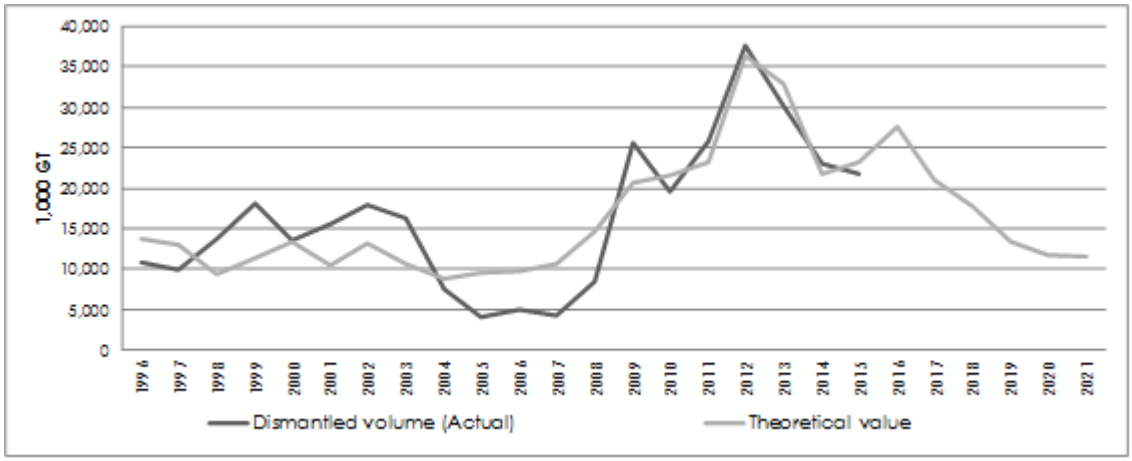
Figure 3-37 An Example of Multi-purpose vessel

3.5. DEMAND FORECAST

In this report, as a demand forecasting survey of the global ship-recycling volume, a multiple regression equation used in the preceding JICA information collection study, where the explanatory variables of GDP (emerging markets), charter rate, and shipping tonnage (year-on-year base)) were used, was reviewed. This attempt was made to create a more accurate multiple regression equation with updated data to be published in October, 2016, so that better regression coefficient describing the global ship recycling volume in the future shall be obtained.

3.5.1. SHORT-TERM DEMAND FORECAST

The following table is expected to show a short-term demand forecast of ship recycling volume as a theoretical value, by conducting multiple regression analysis to obtain a multiple regression equation consisting of the updated data of GDP, charter rate and shipping tonnage.



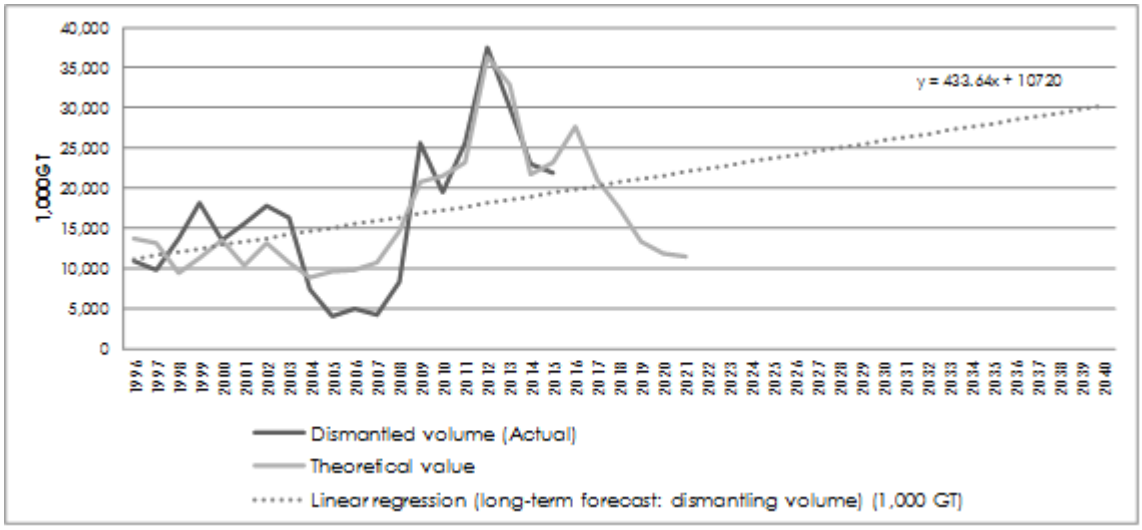
Source : JICA Survey Team

Figure 3-38 Short term demand forecast of ship recycling volume

Based on the result, the demand forecast for short-term ship recycling volume until 2021 was analyzed to be in the downward trend, although there would be an increase toward 2016 at peak. The R value for the multiple correlation of the multiple regression equation was obtained as 0.88, and the coefficient of determination (R^2 value) was 0.77. Thus it was judged to be a sort of reliable regression model.

3.5.2. LONG-TERM DEMAND FORECAST

By using the theoretical values of explanatory factors (GDP (emerging markets), charter rate, and shipping tonnage (year-on-year base)) with a linear regression analysis technique. the long-term demand trend forecast analysis up to 2040, was also carried out by using the multiple regression equation which are obtained from the above demand forecast model.



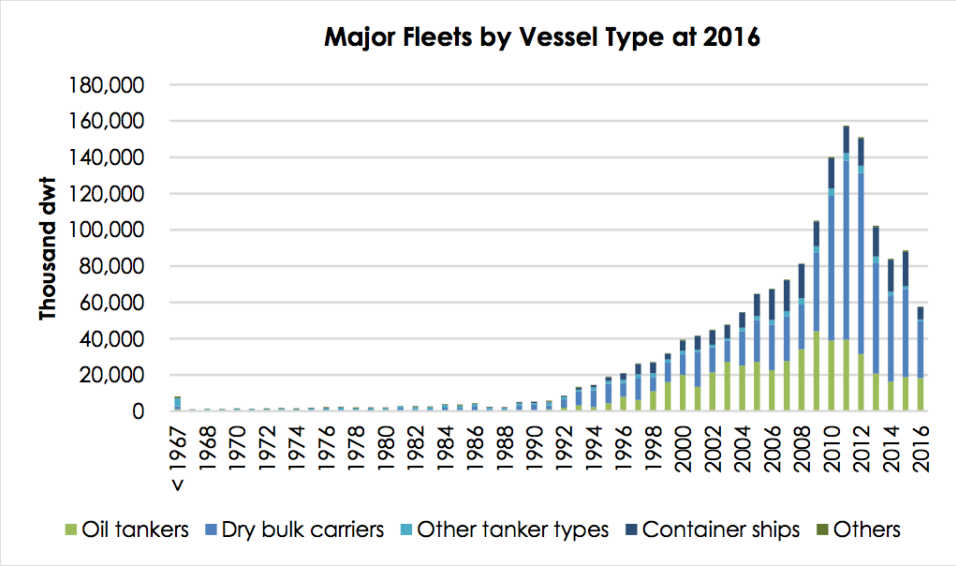
Source : JICA Survey Team

Figure 3-39 Long term demand forecast of ship recycling volume

Based on this analysis result, a trend was obtained in that the demand forecast for ship recycling volume is expected to reach about 20 million gross tons by 2020, and reach about 30 million gross tons by 2040. On the other hand, it is necessary to keep in mind that these figures show only the trend as a likeliness, and it is very difficult to make long-term demand forecasts.

(1) Ship recycling volume by the types of ship

It was considered that it is possible to analysis the ship recycling volume by the types of ship by utilizing the shipping tonnage data with the year of construction by the types of ship at the time of 2016, together with the average recycling age of ships by types. Tonnage data of construction by year for types of ship was referred from the dataset provided by the HIS Fairplay, and for the average age of ship recycling by types of ship, the past performance data as shown in the table below was used.



Source : HIS Fairplay, JICA Survey Team

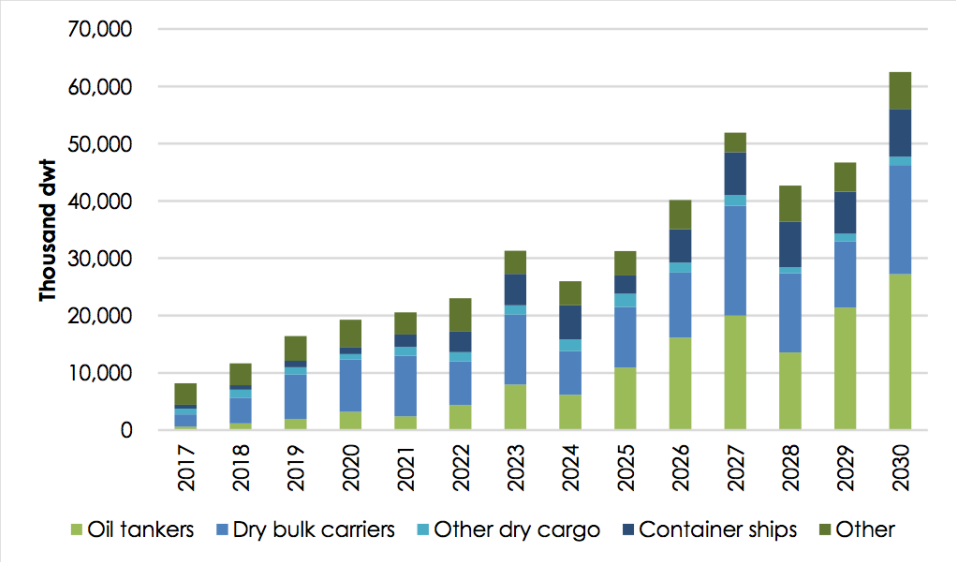
Figure 3-40 Major Fleets by Vessel Type in 2016

Table 3-26 Average scrap age (by types of ship)

Types of ship	Average scrap age
Dry bulk carriers	26 year
Combined carriers	23 year
Oil tanker	27 year
Chemical carriers	26 year
LPG carriers	29 year
LNG carriers	40 year
Other tanker types	27 year
Other dry cargo	27 year
Container ships	26 year
Reefers	26 year
RO-ROs	24 year
Passenger/ferries	33 year
Offshore vessels	29 year
Others	31 year

Source : JICA Survey Team

Based on these data, a ship recycling demand forecast by types of ship was analyzed from 2017 to 2030, and the result is shown in the figure below.



Source : JICA Survey Team

Figure 3-41 Projected Ship Recycling volume by types of ship, 2017-2030

From this result, scrapping demand for oil tanker and container ships, which were built a lot in the second half of 1990, shall begin to be apparent around 2020, and the scale of ship recycling volume for oil tanker in 2020 is expected to reach 3,187 thousand DWT (about 1,958 thousand gross tons). When we look at the whole ship recycling demand in 2020, it is expected to reach to the scale of

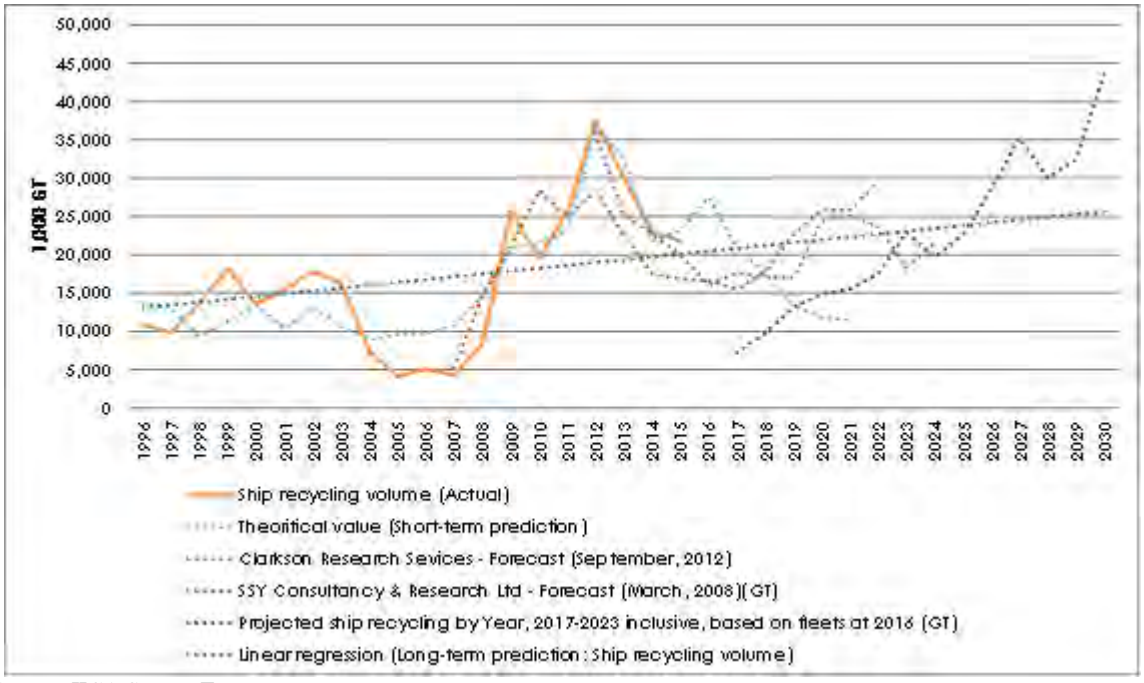
19,283 thousand DWT (about 14,864 thousand gross tons[8]), which also suggests that is in the expanding trend.

The number of ships recycled in the Alang /·Sosiya district recorded highest 415 ships, or 3.86 million LDT has recycled in 2012 after the Lehman shock. The annual average number of ship recycled was about 2.8 ships / yard and about 9,300 LDT per ship at the time. Likewise, from the recycling results of the Alang / Sosiya district to the past, 3-4 months time per vessel was required, that is, 4 to 3 ships / 1 yard per year were recycled. When maximum of 130 yards are operated, 390 ships in a year will be recycled and this can be regarded as the maximum number of vessels processed in the area.

Therefore the number of ships to be recycled in India (Alang/Sosiya), as a base of financial analysis, 3 vessels per yard in a year was used. Hence 130 yards × 3 vessels = 360 vessels are assumed to enter into the ship recycling yards (In the project, 70 yards × 3 vessels = 210 vessels) in a year. Since the average LDT per vessel is calculated as 8,826.17 LDT from the weighted average of past data. From this fact, in this survey, the demand is forecasted with the assumption that 130 yards × 3 vessels = 390 vessels (70 yards × 3 vessels = 210 vessels in this project) on the premise that three (3) vessels per year are to be recycled annually, and the average LDT per ship was calculated as 8,826.17 LDT from the weighted average of past data.

As a result of the demand forecast, it is expected that 26,478 thousand LDT per year by 70 yard, or 3,442,204 LDT per year by all of 130 yards which share of 51.3% of total global demand 6,709,757 LDT in 2020 can be achievable, assuming 1 GT is calculated to be 0.45 LDT.

The following illustration shows the actual value of the ship recycling volume in the past, as well as the dataset of the short-term and long-term demand forecasting of several analysis results, with which models made by the report is also shown in comparison.



Source: JICA Survey Team

Figure 3-42 Long-term demand forecast

[8] The Conversion factor between DWT and GT is subject to the types of ship, and for the oil tanker, for instance, the factor of 1 DWT = 0.61 GT was used. Consequently for calculation of total GT of the whole ship to be dismantled, the coefficients for each ship types were calculated then the total value was calculated using each respective conversion factors depending on the types of ships.

Regarding the number of ships to be recycled in India (Alang/Sosiya), as a base of financial analysis, 3 vessels per yard in a year was used. Hence 130 yards × 3 vessels = 360 vessels are assumed to enter into the ship recycling yards (In the project, 70 yards × 3 vessels = 210 vessels) in a year. Since the average LDT per vessel is calculated as 8,826.17 LDT from the weighted average of past data, We estimated the ship recycling demand volume for 130 yards and 70 yards to be about 3.44 million LDT and about 1.85 million LDT respectively. Therefore, in view of the demands for ship recycling volume of the world as a whole, it is assumed that Alang/Sosiya would be able to capture 51.3% of the world market as of 2020, assuming 1 GT is calculated to be 0.45 LDT.

3.5.3. CONSIDERATION ON THE SUTAINABILITY OF THE PROJECT

In consideration of the viewpoint as to whether ship recycling business will be continued in India in the future, it is important not only to analyze the demand side of ship recycling volume but also to consider the supply side where the dismantling business takes place at the ship recycling yards. In other words, as stated above, although demand for ship recycling as a whole in the world tends to increase in consideration of the existing volumes of fleets, which will be dismantled sooner or later in any case in the future, if the profits arising from ship recycling activities (by manufacturing and selling scrap iron) is not appreciated as a business, it cannot be considered sustainable. Even though it is a positive effect that, as a policy-driven force, the number of supply of certified ship recycling yards is going to be restricted worldwide by the international ship recycling conventions, for ship recyclers in India, they may enjoy more bargaining power against shipowners / cash buyers in terms of ship-purchasing price, but it is considered that evaluation of continuity of the business can be depending on the comparative advantages of producing scrap steel from the industries in comparison to products in electric furnaces.

The production cost of scrap steel in the ship recycling business in 2016 was US $ 288.7 / LDT on the assumption that ship purchase could be made at US $ 250/LDT, and compared with the manufacturing cost in the electric furnace, it is about 44% lower cost compared to crude steel made in Japan[9] and 13% lower cost compared to thick plates made in China[10]. Even if the ship purchase cost increases by US $ 50/LDT, it is considered to be still competitive in comparison to the Japanese crude steel about 35%, and almost equivalent to the manufacturing cost of the plates in China.

It is still difficult to evaluate the continuity of ship recycling business only with a focus on manufacturing cost alone, and yet crude steel production in India gets strong, by referring to the economic stability and infrastructure related development, together with well-performing automotive sector. The steel demand has been steady increased by 6.1% from the last year, 2016 and this year's steel demand amount will be 88.6 million tons, which is the world's second largest and it overwhelms Japan, and it is still expected to increase in the future. Therefore, it seems that scrap steel demand from local steelmakers is likely to increase with the expansion of facilities, and demand for scrap steel from ship recycling yards is also expected to remain steady in the future.

[9] Average production cost per ton of crude steel produced by Asahi Kogyo, Tokyo Iron and Steel, Joint Steel, Osaka Steel, Co-British Steel, Hokuetsu Metal, Tokyo Steel Iron, Chubu Kohan Kohm

[10] RMB 2,255.76/tone (China Iron & Steel Production Cost Index, www.custeel.net)

11. ENVIRONMENT AND SOCIAL CONSIDERATION

11.1. PROJECT DESCRIPTION

11.1.1. BACKGROUND

Alang / Sosiya ship recycling yard (hereinafter "ASSRY") stretches over a 10 km stretch of coastline along the western shore of Gulf of Khambat in the state of Gujarat. The ASSRY started its operation in 1983, mainly to serve the rising demand for steel melting scrap in the north/west region of India. The Alang / Sosiya area was selected as an ideal location for ship recycling due to the unique geographical features of the area including a high tidal range and wide intertidal area, which makes any size ships to be beached easily during high tide. With the increasing growth of ASSRY, the Alang / Sosiya area was designated as Industrial Notified Area in year 2000 covering an area of around 1,252 ha. Presently, most of the ship recycling activity in India is undertaken in ASSRY.

The ASSRY is divided into 153 plots. These plots are owned by Gujarat Maritime Board (GMB) and are leased to private ship recycling operators for them to carry out ship recycling activities (around 130 plots are currently in operation). Out of these plots, only around 35 plots are presently certified with Statement of Compliance (SOC) under the Hong Kong Convention (HKC), hence improvements and certification of other plots are in urgent need before HKC enters into force. GMB is in process of issuing compulsory provision to make all the yards improved in one-year time till July 2018, and beyond GMB will carry out yard improvement through JICA's loan. In addition, other related facilities such as the existing waste treatment, storage, disposal facility (TSDF) and occupational safety measures will need further improvement so to make ship recycling activities in Alang / Sosiya more environmentally sustainable and safer. Figure 11-1 shows the location of ASSRY and TSDF.

Figure 11-1 Location of ASSRY and TSDF

Source: JICA Survey Team (prepared with Google Earth)

11.1.2. SHIP RECYCLING PROCEDURE

Ship recycling in ASSRY is conducted by "beaching method" where the ships are dismantled in the inter-tidal zone after grounding the ship during high tide. The main recycling procedures are as follows:

- Ship bound for ship recycling initially anchor at a designated offshore anchoring point (Ghoga) after obtaining Anchoring Permission.
- The anchored ship is then inspected onboard and if cleared, ship will be issued Beaching Permission which allows the ship to be beached at the recycling yard.
- Once the ship is beached, ship breaking can proceed once all onboard hazardous substances (e.g. residual oil, bilge, asbestos) are removed and necessary permits are obtained (e.g. Decontamination Certificate, Breaking Permission).
- The dismantled ship parts are moved to the recycling yard cutting area with winch and crane, which will be cut further into smaller pieces by gas cutting.
- Steel plates and other sellable materials will be delivered to recyclers and the remaining wastes (around 0.01% of LDT) will be transported to TSDF for treatment/disposal.

11.1.3. PROJECT SCOPE

(1) Improvement of existing ship recycling yards

Seventy existing ship recycling plots will be improved to the standard as per requirement of the Hong Kong Convention (HKC). The target plots will be determined in the ensuing stages through discussions between GMB, SRIA, recyclers and other stakeholders. Improvement works will mainly consist of the following:

- Construction of impermeable concrete floor at ship-parts cutting areas, oily-machinery storage areas and winch operation areas. The concrete floor will be a three-layered structure, consisting of crushed stone foundation, geomembrane and concrete layers.
- Construction of rainwater collection ditch and tank to collect rainwater runoff from the concrete floor areas.
- Construction of winch foundation.

In addition, the following facilities will be installed at each recycling plots by the yard operators.

- Temporary storage house for hazardous wastes
- Storage house for LPG cylinders
- Asbestos handling facility (not required if asbestos handling is outsourced)
- Sanitary, drinking water and shower facilities
- Workers changing room
- First aid facility
- Firefighting facility
- Sewage treatment facility (e.g. septic tank)

Figure 11-2 shows an example layout of an improved recycling yard. Figure 11-3 shows cross-section design of the concrete flooring. Figure 11-4 shows image of an improved yard

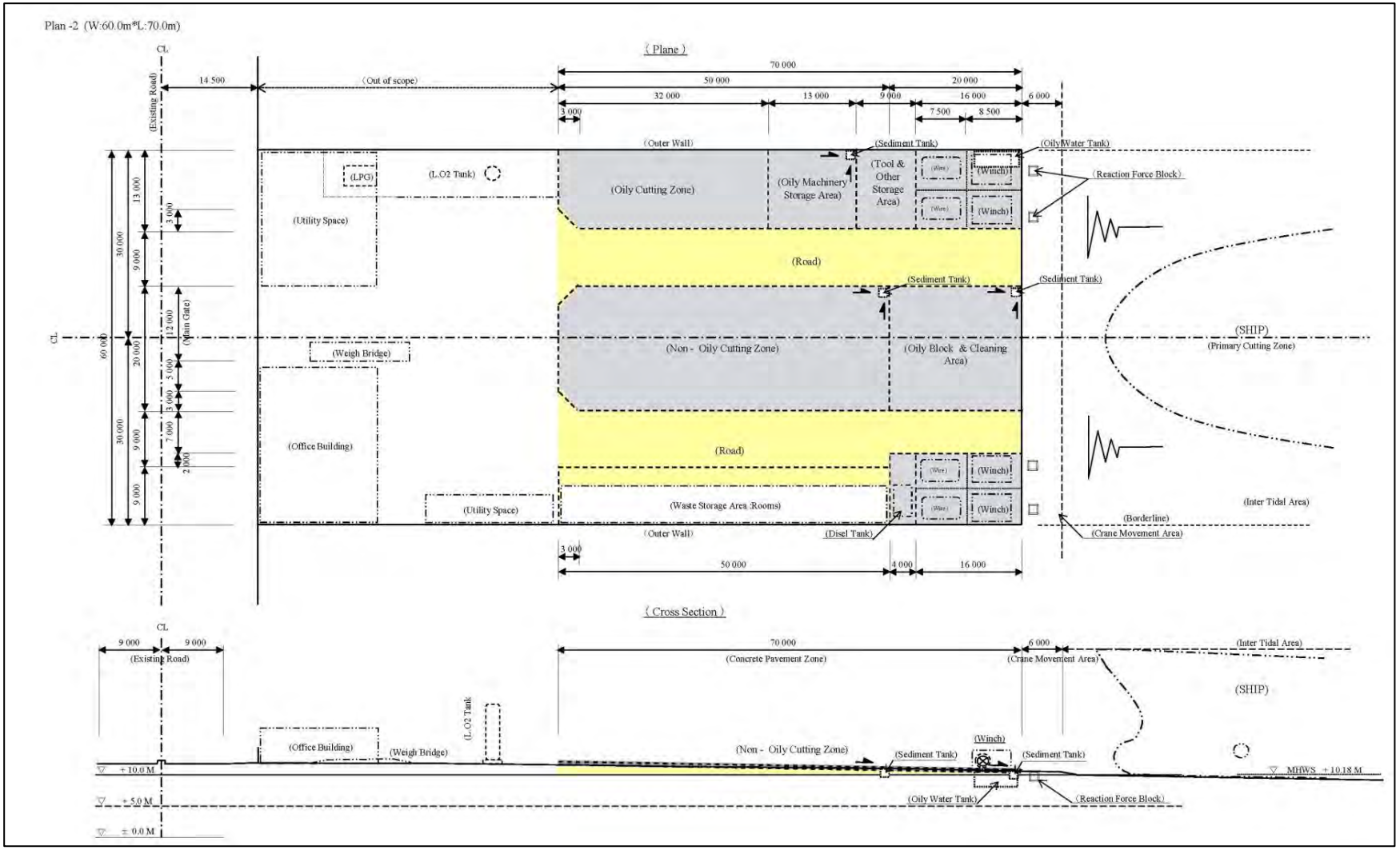


Figure 11-2 Example layout of an improved recycling yard

Source: JICA Survey Team

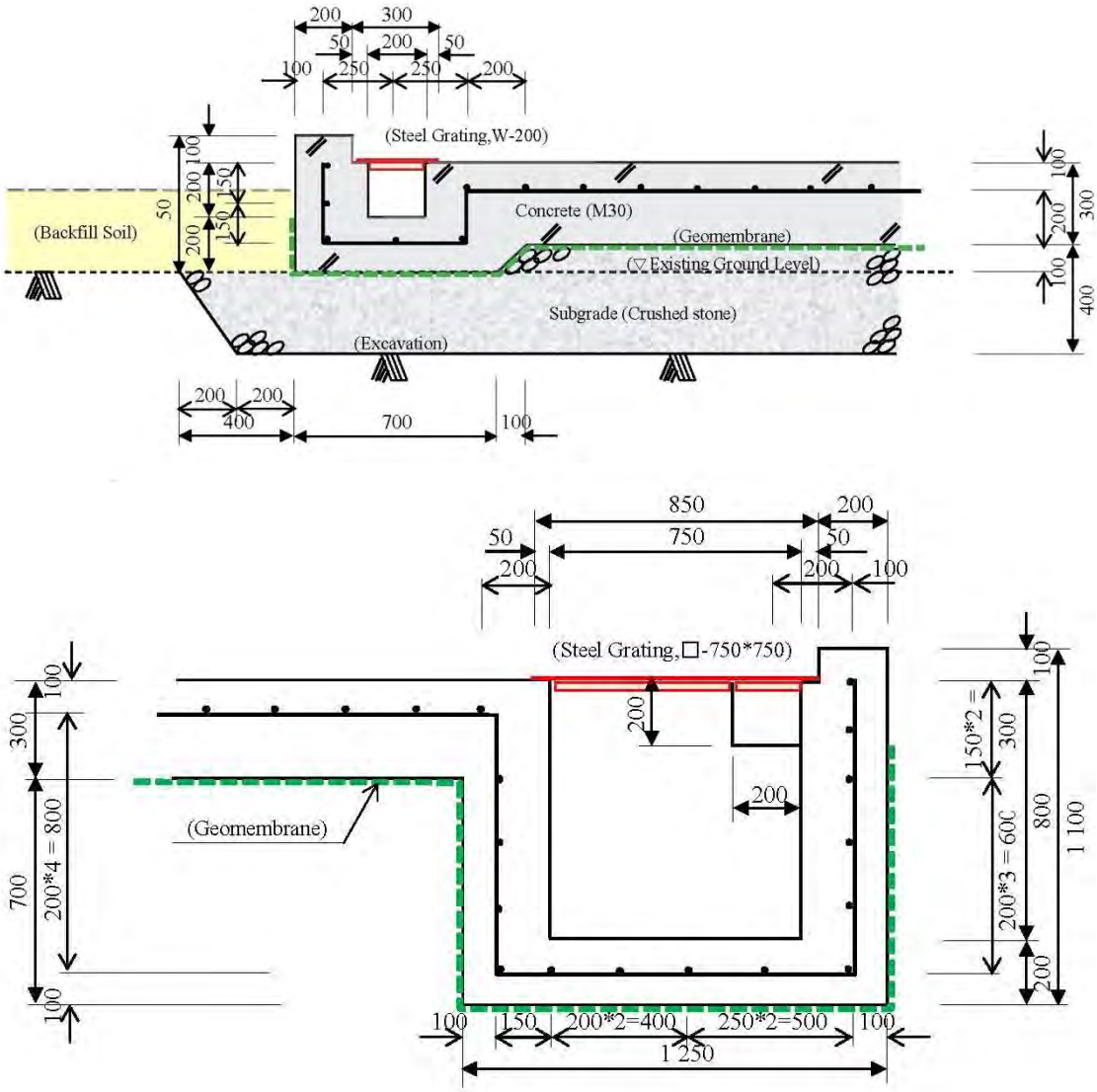


Figure 11-3 Cross-section design of concrete flooring

Note: Upper diagram is cross-section of concrete flooring and rainwater collection ditch. Lower diagram is cross-section of rainwater collection tank.

Source: JICA Survey Team


Concrete-floored cutting zone


Concrete-floored storage zone


Rainwater collection ditch


Rainwater collection tank

Figure 11-4 Image of improved recycling yard

Source: JICA Survey Team

(2) Improvement of TSDF

1) Overview of existing TSDF facilities

TSDF is located around 2 km inland from the ASSRY. The facilities include incinerator (capacity: 5 t/day), effluent treatment plant (ETP) (capacity: 30 m^3/day), landfill for hazardous wastes (capacity: 70,000 m^3), landfill for non-hazardous wastes (capacity: 30,000 m^3) and temporary waste storage area. There is also fire-fighting system having one underground reservoir of 200 m^3 and two over ground reservoir of 5 m^3. TSDF was constructed in 2005 and upgraded in 2011 by GMB. In 2005, initially, GMB constructed three cells i.e. disposal for asbestos & glass wool wastes (43,000 m^3), disposal for industrial hazardous wastes (10,200 m^3) and disposal for municipal solid wastes (8,700 m^3) and started operation from 2006. Than after, the TSDF facility was upgraded by developing two more landfill cells for hazardous wastes (capacity: 70,000 m^3), landfill for non-hazardous wastes (capacity: 30,000 m^3) and incinerator (capacity: 5 t/day), effluent treatment plant (ETP) (capacity: 30 m^3/day) and firefighting system. TSDF was constructed in 2005 by GMB and started operation from 2006. The facility is currently operated by a private operator (GEPIL). Figure 11-5 shows the existing layout of TSDF.

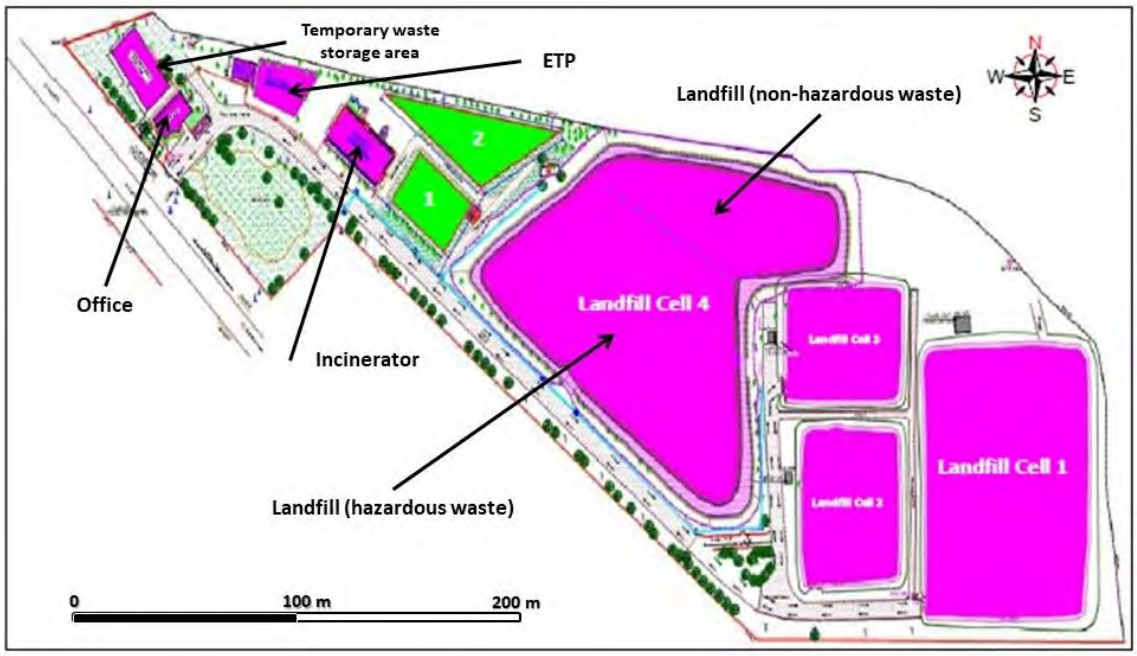


Figure 11-5 Existing layout of TSDF

Note: The green colored area is currently not used and is the candidate sites for expansion.
Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

2) Overview of TSDF improvement plan

The TSDF will be improved by installing baler, sludge treatment plant, oily water collection tank, oily water separation system, effluent treatment plant (ETP) and high-temp incinerator. These facilities will contribute in extending the life-span of the TSDF landfill, stabilization of hazardous wastes and enhance oil recovery. Brief descriptions of each facility are provided below.

a. Baler

Two balers (capacity: 40 m^3/day) will be installed to reduce the volume of wastes unsuitable of incineration such as glass wool.

Figure 11-6 Image of baler
Source: JICA Survey Team

b. Sludge treatment plant

Sludge treatment plant (capacity: 8 tons/day) will be installed to recover oil from oily sludge generated from recycling activities. The recovered oil can be sold and the remaining sludge will be disposed in the TSDF controlled landfill after drying.

c. Oily water collection tank

Oily water collection tank (capacity: 200 m^3) will be installed to collect and separate low-oil content oily water (e.g. bilge water) generated from recycling activities. The tank applies heat to enhance oil/water separation. The separated water, which will still contain some amount of oil, will be sent to existing ETP for final treatment. The separated and more concentrated oily water will be sent to oil/water separation system for further treatment.

d. Oil/water separation system

Oil/water separation system (capacity: 16 tons/day) will be installed to separate high-oil content oily water generated from recycling activities. The recovered oil can be sold and the remaining sludge will be sent to the new oil sludge treatment plant for further treatment. The separated water, which will still contain some oil, will be sent to ETP for final treatment.

e. Effluent treatment plant (ETP)

A new ETP (capacity: 120 m^3/day) will be installed to treat the additional wastewater that will be generated through this Project. The treated effluent will be reused inside TSDF or if necessary discharged outside TSDF as per Indian effluent discharge standard. The remaining sludge will be sent to the landfill for hazardous wastes after drying. Figure 11-7 shows the wastewater treatment process of the improved TSDF.

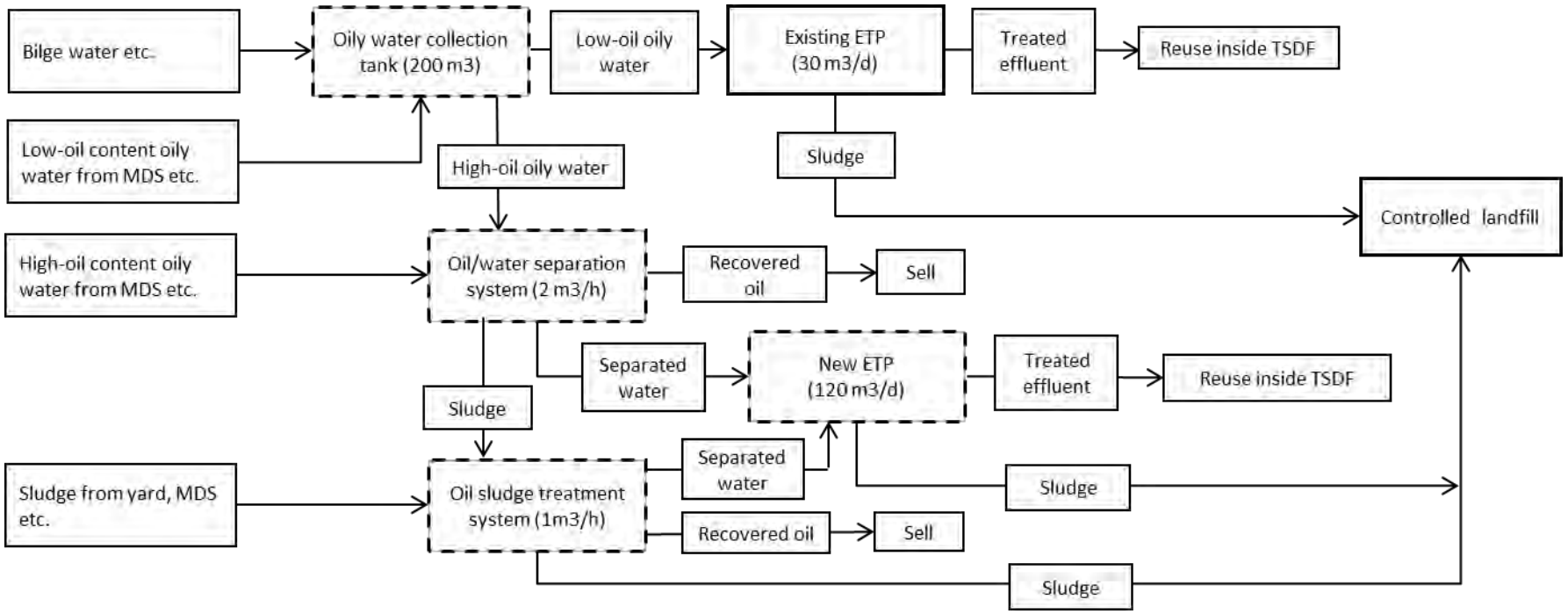


Figure 11-7 Wastewater treatment process of improved TSDF

Note: Dotted boxes indicate new facilities that will be installed through the Project.
Source: JICA Survey Team

f. High-temp incinerator

A high-temp incinerator (treatment capacity: 5 tons/day, incineration temp.: 1,400 °C) will be installed to thermally treat persistent hazardous wastes including PCB containing materials. The incinerator will also contribute to waste reduction and stabilization of hazardous wastes disposed at the TSDF landfill. Flue gas will be treated through gas cooler and dust collector system prior to discharge. Bottom ash can be used as recycling material and fly ash will be disposed at the landfill.

3) Introduction of Mobile Decontamination System (MDS)

Mobile Decontamination System (MDS) will be introduced to mechanically and efficiently remove residual oil and sludge remaining inside beached ships, which currently are removed by hand using wood chips/sand. Five MDS units will be introduced and their operation will be consigned to a private operator.

4) Introduction of large crawler crane and beach cleaner

Large mobile crane (120 t telescopic boom crawler crane) will be introduced to employ an alternative way for dismantling ships, specifically for large bulk carriers and container ships. Currently, to reduce the weight of large ships and enable easier winching, the heavy stern section of the ship is initially cut off from the ship body and dropped on to the intertidal zone. However, such practice may lead to oil spills/leakages which can be avoided by using large mobile crane. This is because heavy blocks and engines parts in the stern section can be removed from inside the ship by employing large mobile cranes, hence preventing the need of cutting-off of stern section. Five large mobile cranes will be procured and their operation will be consigned to a private operator.

Beach cleaning wheel loader will be introduced to remove debris left over in the beach area through ship dismantling works. Three units will be procured.

5) Introduction of offshore tank cleaning barge

Offshore tank cleaning barge will be introduced to remove oily water and sludge from oil tankers. The collected oily water and sludge will be transported to TSDF for treatment and disposal. However, to reduce the volume of oily water treatment at TSDF, low-oil content oily water will be discharged to sea from the barge after treatment through onboard ETP. Operation of the offshore tank cleaning barge will be consigned to a private operator.

The collected oily water and sludge will be unloaded via a new jetty (50 m length x 10 m width) that will be constructed at the southern end of the recycling yard next to plot 84. An access road of approximately 50 m length will also be constructed by expansion and pavement of existing dirt road. Figure 11-8 shows the approximate location and layout of the new unloading jetty and access road. Figure 11-9 shows the basic design of the new unloading jetty.

Figure 11-8 Approximate location and layout of the new unloading jetty and access road

Source: JICA Survey Team (prepared with Google Earth)

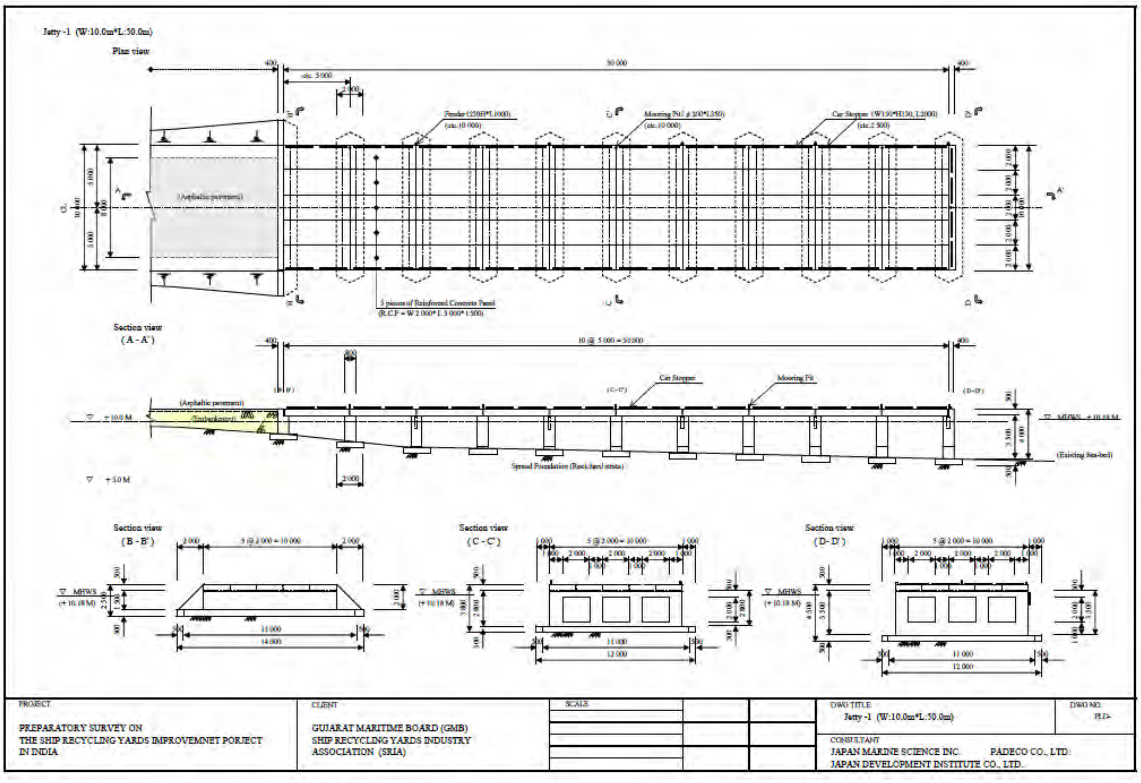


Figure 11-9 Basic design of the new unloading jetty

Source: JICA Survey Team

6) Introduction of multi-purpose work boat

A multi-purpose work boat will be procured to use for oil spill recovery, firefighting, rescue and so on.

11.1.4. RISKS OF CLIMATE CHANGE

A possible risk on this Project due to climate change is the inundation of the ASSRY by rise in sea level. According to the IPCC's Fifth Assessment Report, global average sea level is predicted to rise by around 10-20 cm by 2040. However, since the lowest point of the ASSRY is approximately 1.5 m higher than the mean spring tide high tide level (CDL+7.05), the risk of inundation can be considered negligible at least until 2040.

11.1.5. CONSTRUCITON PLAN

(1) Construction method

1) Ship recycling yard

Following is a brief description of the construction process of ship recycling yard improvement works:

- Excavation and compaction of concrete flooring area
- Laying of crushed stone as foundation of concrete flooring area
- Laying of geomembrane on top of stone foundation layer
- Placement of concrete floor on top of geomembrane layer

(2) Temporary facilities

A temporary concrete batching plant (approx. area: 2,500 m^2) and pre-casting yard will be established near the Project site. The location will be determined by the construction contractor. A temporary material storage yard (approx. area: 2,800 m^2) will also be established to store construction materials such as stones and metal bars. It is planned to use one of the empty plots for this purpose.

(3) Construction materials

Main construction materials required will be soil, sand/aggregates stone, metal bars, cement, geomembrane, wood, steel and so on. All these materials will be procured from local suppliers. Development of a new quarry will not be required.

(4) Construction machines

Table 11-1 shows the main construction machines and equipment required.

Table 11-1 Main construction machines and equipment

Backhoe (0.6 m^3)	Macadam roller (10～12 t)
Dump truck (10 t)	Wheel loader (2.1 m^3)
Bulldozer (21)	Excavator (0.7 m^3)
Truck crane (25-50t)	Hydraulic breaker (1 t)
Breaker (600-800kg)	Concrete mixer (7.0 m^3)
Concrete cutter	Welder (300 A)
Compressor (3.5～3.7 m^3/h)	Road roller (0.8～1.1 t)
Motor grader (3.1 m)	Generator (45 KVA)

Source: JICA Survey Team

(5) Construction workers

Table 11-2 shows the type and number of construction workers required, which assumes simultaneous construction of 4 plots.

Table 11-2 Type and number of construction workers

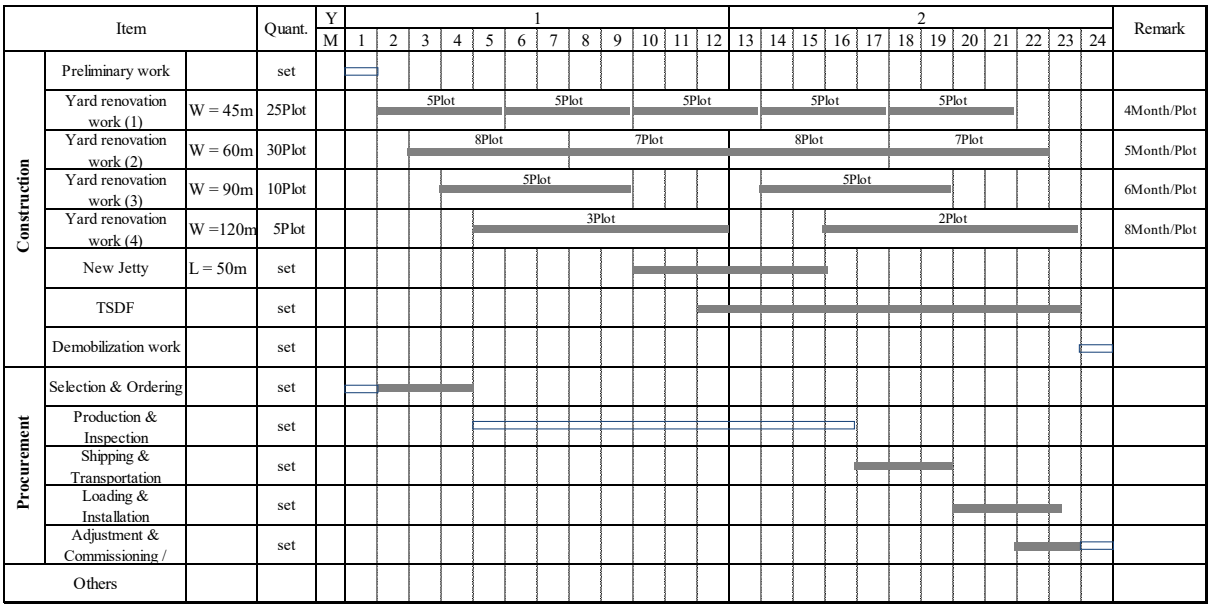
Type	No.
Site Engineer	4
Surveyor	4
Foremen	4
Carpenter	8
Re-bar Vendor	8
Plaster	12
Skilled Worker	8
Unskilled Worker	60
Total	108

Source: JICA Survey Team

(6) Construction schedule

Table 11-3 shows the construction schedule. Construction will take around 2 years from start to completion.

Table 11-3 Construction schedule



Source: JICA Survey Team

(7) Construction waste

Construction waste will include among others the following:

- Used formwork (wood): approx. 5 t
- Concrete debris: 160 m^3
- Metal scrap: 4 t
- Domestic waste: 35 t

11.1.6. STATUS OF EIA AND GAPS WITH JICA GUIDELINE

(1) Status of the existing EIA

GMB contracted MECON Ltd for the preparation of the EIA of this Project. Environmental Clearance (EC) was obtained from MoEFCC in November 2nd, 2016. Following is a brief summary of the processes taken until obtaining EC:

- GMB submitted project application to MoEFCC in September 2014.
- TOR of EIA was reviewed at the EAC meeting on December 2014 and final version issued to GMB on December 2014.
- GMB submitted EIA report to MoEFCC in June 2016.
- EIA report was reviewed at the EAC meeting in July 2016. Submission of additional information was requested to GMB.
- After submission of additional information, the EIA report was again reviewed at the EAC meeting in September 2016. EAC recommended issuance of EC to MoEFCC under 19 conditions.
- MoEFCC issued EC dated November 2nd, 2016 under 33 specific conditions and 8 general conditions (EC is attached as Appendix - 7)

(2) Gaps with JICA guideline and supplementary EIA study

The JICA Survey Team initially reviewed the EIA (November 2015 version) prepared by GMB, taking into account the requirements of JICA Guideline for Environment and Social Consideration (2010). The following gaps and issues were identified in the process:

- The scope of the Project has changed from the approved EIA. Main changes are as follows:
  - Construction of dry dock and associated capital dredging are not included in the updated Project scope.
  - Construction of 15 new ship recycling yards are not included in the updated Project scope.
  - Mobile decontamination system, tank cleaning barge and associated jetty/access road, large mobile crane and multi-purpose vessel are new additions to the Project and hence not included in the EIA.
  - The treatment capacity of the new effluent treatment plant (ETP) in TSDF has changed from 30 t/day to 120 t/day.
  - The treatment capacity of the new incinerator in TSDF has changed from 25 t/day to 5 t/day.
- Although the approved EIA covered wide range of baseline data to be sufficient for being appraised by MOEF&CC, the JICA survey team proposed additional baseline survey on sediment quality, soil quality (around TSDF and yard area), air quality (asbestos) and groundwater quality (around TSDF and yard area).
- Under the JICA Guideline, it is necessary to illustrate impacts during the construction as well.
- A public hearing was conducted at the draft EIA stage in accordance with Indian regulation. However the JICA Guideline stated holding consultations is highly desirable, especially when the items to be considered in the EIA are being selected (scoping stage), and when the draft report is being prepared.

Considering the above points as well as recommendations from the JICA Environmental Advisory Committee (EAC), the JICA Survey Team conducted a supplementary EIA study as per the updated

scope of the Project. In summary, the following study was conducted as part of the supplementary EIA study.

- Implementation of baseline environmental survey for sediment quality, soil quality, air quality (asbestos) and groundwater quality. As per recommendation of JICA EAC, TBT accumulation in benthos was also studied. All the surveys were subcontracted to Chola MS Risk Services. Laboratory analysis was conducted by Chennai Testing Laboratory Private Limited (CTL), a National Accreditation Board for Testing and Calibration Laboratories (NABL) and ISO/IEC 17025:2005 certified laboratory.
- Impact assessment for the construction stage based on the construction plan and preparation of construction EMP and EMoP.
- Impact assessment for the operation stage based on the updated Project scope and preparation of EMP and EMoP.
- Stakeholder consultation in the scoping and draft final reporting stages.

(3) Amendment of the approved EIA

The approved EIA study commissioned by MECON is required to be updated since the scope of the Project has changed from the approved EIA as per JICA's Preparatory survey. This process should be done during the detailed design stage of the Project including of obtaining necessary approvals from MoEFCC.

11.2. REGULATORY FRAMEWORK

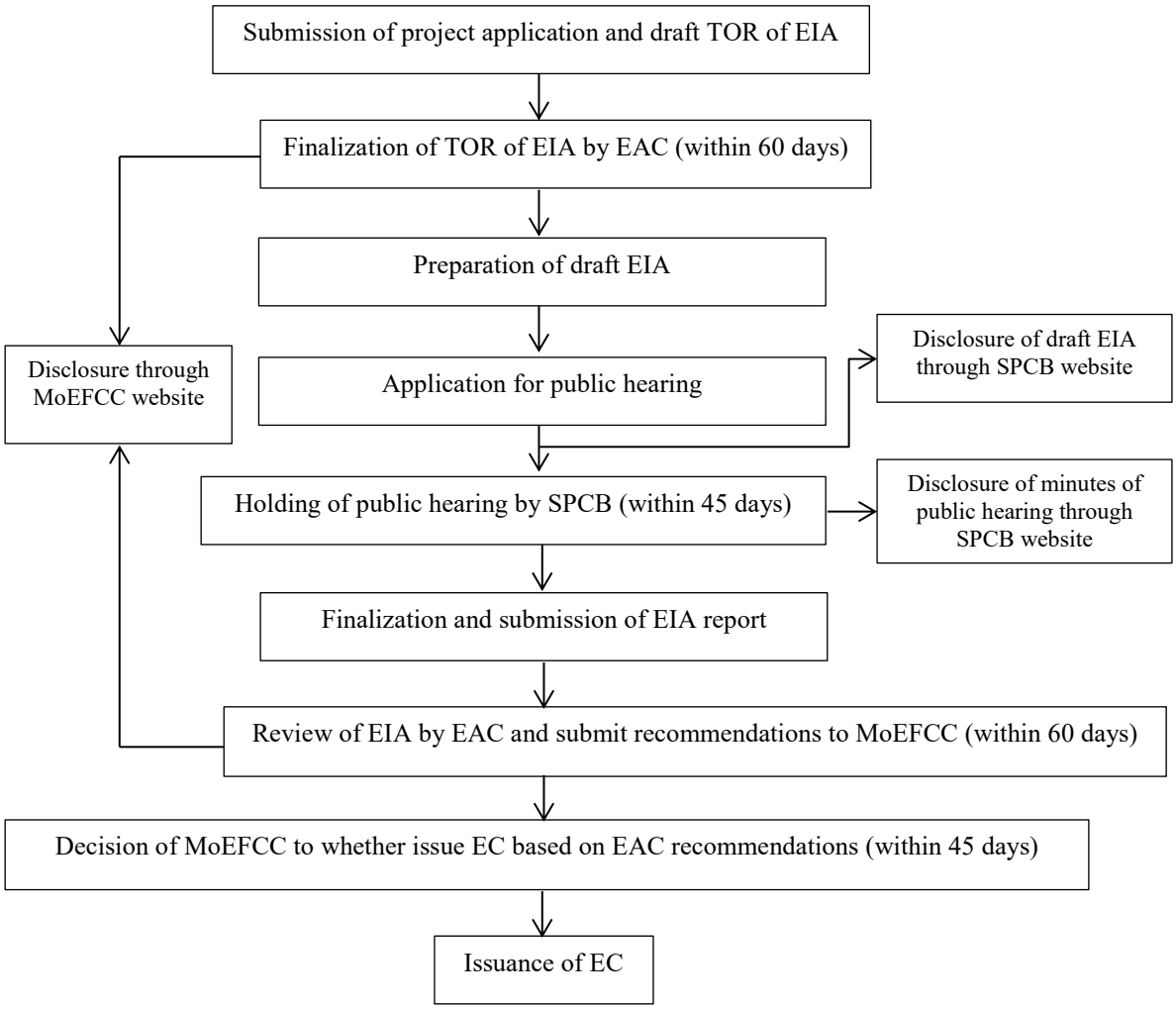
11.2.1. ENVIRONMENTAL LAWS AND REGULATIONS

(1) EIA system

1) EIA procedure

India's EIA system is prescribed in detail under EIA Notification 2006. Projects prescribed under EIA Notification must obtain Environmental Clearance (EC). The Ministry of Environment and Forest and Climate Change (MoEFCC) issues EC for Category A projects, and the State Environment Impact Assessment Authority (SEIAA) for Category B projects. Ship recycling projects are classified as Category A regardless of the project scale.

In India's EIA system, Expert Appraisal Committee (EAC) play's an important role in the EIA procedure. They determine the TOR of the EIA and also review and make recommendations to MoEFCC on the submitted EIA. Public hearing is required in the draft EIA stage which is held by SPCB. Information on the EIA is disclosed to the public at key stages. Figure 11-10 shows the main procedures involved for acquiring EC.



Source: EIA Notification 2006

Figure 11-10 Main procedures required for acquiring EC

2) Contents of EIA

The EIA report is required to include the following contents as per EIA Notification 2006:

- Project description
- Description of the environment
- Anticipated environmental impacts and mitigation measures
- Analysis of alternatives
- Environmental monitoring program
- Description of the environment
- Additional studies (public consultation, risk assessment, social impact assessment)
- Project benefits
- Environmental management plan

3) Gaps between JICA environmental guideline

There are no major gaps between India's EIA system and JICA environmental guideline. However, there is no requirement to conduct stakeholder consultation in the scoping stage, which is required under JICA environmental guideline. Table 11-4 shows gaps between India's EIA law and JICA environmental guideline and the Project's policy to fill the gaps.

Table 11-4 Gaps between India's EIA law and JICA environmental guideline and the Project's policy to fill the gaps

No.	JICA Environmental Guideline (2010)	India EIA law (EIA Notification 2006)	Gap	Project policy
1	When assessment procedures already exist in host countries, and projects are subject to such procedures, project proponents etc. must officially finish those procedures and obtain the approval of the government of the host country.	It is required to obtain Environmental Clearance (EC) for projects prescribed in the EIA Notification. Ship recycling projects are subject to EC.	None	□
2	EIA reports must be written in the official language or in a language widely used in the country in which the project is to be implemented. When explaining projects to local residents, written materials must be provided in a language and form understandable to them.	Summary of draft EIA is required to be prepared in English and local language and disclosed prior to public hearing.	None	□
3	EIA reports are required to be made available to the local residents of the country in which the project is to be implemented. The EIA reports are required to be available at all times for perusal by project stakeholders such as local residents and copying must be permitted.	TOR of EIA, summary of draft EIA, minutes of EAC are required to be disclosed through website. Draft EIA must also be available for viewing if requested.	None	□
4	In preparing EIA reports, consultations with stakeholders, such as local residents, must take place after sufficient information has been disclosed. Records of such consultations must be prepared.	Public hearing is required at the draft EIA stage. Minutes of the meeting is disclosed at SPCB website.	None	□
5	Consultations with relevant stakeholders, such as local residents, should take place if necessary throughout the preparation and implementation stages of a project. Holding consultations is highly desirable, especially when the items to be considered in the EIA are being selected, and when the draft report is being prepared	Stakeholder consultation is required only in the draft EIA stage.	No requirement at scoping stage.	Stakeholder meetings will be held at the scoping and draft EIA though the JICA Preparatory Survey.

No.	JICA Environmental Guideline (2010)	India EIA law (EIA Notification 2006)	Gap	Project policy
6	It is desirable that EIA reports cover the items enumerated in the following: ・ Executive summary ・ Project description ・ Baseline data ・ Environmental impacts ・ Analysis of alternatives ・ Environmental Management Plan ・ Consultation	EIA is required to include the following: ・ Project description ・ Baseline data ・ Impact assessment and mitigation measures ・ Analysis of alternatives ・ Environmental monitoring plan ・ Other studies (public consultation, risk assessment, social impact assessment) ・ Project benefit ・ Environmental Management Plan	None	□

Source: JICA Survey Team

(2) CRZ Notification

As per CRZ Notification 2011, ship breaking projects are required to obtain CRZ clearance from MoEFCC. The main procedures for obtaining CRZ clearance are as follows:

- Submission of Project documents (e.g. EIA report, CRZ map) to state Coastal Zone Management Authority (CZMA).
- Review of documents by CZMA and submit recommendations to MoEFCC within 60 days.
- Decision of MoEFCC to issue CRZ clearance based on recommendations of CZMA within 60 days.

CRZ clearance of this Project has been acquired from MoEFCC in November 2nd, 2016, together with the issuance of EC. Recommendation letter issued by CZMA to MoEFCC is attached as Appendix -8.

(3) GPCB permits

Table 11-5 shows the permits required from GPCB for this Project.

Table 11-5 List of permits required from GPCB

Component	Type of permit	Responsible organization	Timing of acquisition

Improved TSDF	Consolidated Consent and Authorization (CC&A)	GMB/TSDF operator	Before operation
Improved yard	Consolidated Consent and Authorization (CC&A)	Yard operator	Before operation
Temporary concrete plant for construction	Consent to Establish (CTE) and CC&A	Construction contractor	Before construction

Source: JICA Survey Team

11.2.2. ENVIRONMENTAL LAWS AND REGULATIONS

Table 11-6 shows the national environmental laws/regulations relevant to this Project.

Table 11-6 List of national environmental laws/regulations relevant to this Project

Category	Name
	Environment (Protection) Act 1986
	Environment (Protection) Rules 1986
	Forest Conservation Act 1980
	Wildlife (Protection) Act, 1972
CRZ	CRZ Notification 2011
EIA	EIA Notification 2006
	Air (Prevention and Control of Pollution) Act 1981
	Water (Prevention and Control of Pollution) Act 1974
	Noise Pollution (Regulation and Control) Rules 2000
	Central Motor Vehicles Rules, 1989
	Hazardous Waste (Management Handling and Transboundary Movement) Rules 2008
	Municipal Solid Wastes (Management and Handling) Rules 2000
	Construction and Demolition Waste Management Rules 2016
	Plastic Waste Management Rules 2016
	Batteries (Management and Handling) Rules 2001
	E-Waste (Management and Handling) Rules 2016
	Factories Act 1948
	Gujarat Factories Rules 1963

Source: JICA Survey Team

11.2.3. ENVIRONMENTAL STANDARDS

Table 11-7 shows the national environmental standards relevant to this Project.

Table 11-7 List of national environmental standards relevant to this Project

Category	Name
Ambient air quality	National Ambient Air Quality Standards 2009
Stack emission gas	Environment (Protection) Rules 1986: Common Hazardous Waste Incinerator CPCB Norms for Stack monitoring.
Noise	Noise Pollution (Regulation and Control) Rules 2000
Seawater quality	Environment (Protection) Rules 1986: Primary Water Quality Criteria
Drinking water quality	Drinking Water Specification IS:10500 (2012)
General discharge standard	Environment (Protection) Rules 1986: General Standards for Discharge of Environmental Pollutants CPCB Norms for Stack monitoring.
Discharge standard from ETP	Environment (Protection) Rules 2015: Treated Effluent Quality of Common Effluent Treatment Plant CPCB Norms for Stack monitoring.

Source: JICA Survey Team

11.2.4. ENVIRONMENTAL GUIDELINES

Table 11-8 shows the national environmental guidelines relevant to this Project.

Table 11-8 List of national environmental guidelines relevant to this Project

Category	Name	Organization
EIA	Technical EIA Guidance Manual for Ship Breaking Yards 2009	MOEF
	Guidelines for Common Hazardous Waste Incineration 2012	CPCB
	Guidelines for Storage of Incinerable Hazardous Wastes by the Operators of Common Hazardous Waste Treatment, Storage and Disposal Facilities and Captive HW Incinerators 2008	CPCB
	Protocol for Performance Evaluation and Monitoring of the Common Hazardous Waste Treatment Storage and Disposal Facilities including Common Hazardous Waste Incinerators 2010	CPCB

Source: JICA Survey Team

11.2.5. INTERNATIONAL CONVENTIONS

Following is a list of relevant international conventions ratified by India.

- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
- Stockholm Convention on Persistent Organic Pollutants
- International Convention on the Control of Harmful Anti-fouling Systems on Ships
- International Convention for the Prevention of Pollution from Ships

11.3. CURRENT ENVIRONMENTAL STATUS

11.3.1. CLIMATE

The climate in Alang/Sosiya is broadly separated into three seasons: hot summer season (March-June), mild winter season (December-February) and south-west monsoon season (June-September). Average maximum temperature in summer and winter are around 40 °C and 30 °C respectively. Annual rainfall is about 700 mm, which falls mainly in the monsoon season. Wind direction is predominantly from north-west to south west.

11.3.2. HYDROLOGY

(1) Marine area

Alang/Sosiya area has a tidal difference of over 6 m during spring tide. Coastal currents are strong due this large tidal difference. Coastal wave action is limited partly due to the attenuation effects of the offshore reefs.

(2) Surface water

There are two rivers in the Alang/Sosiya area namely Manar and Pasvivali rivers. The river mouths of these rivers are blocked by a fixed weir. There is also a river (Kathodi river) adjacent to TSDF but is mostly dry except the monsoon season.

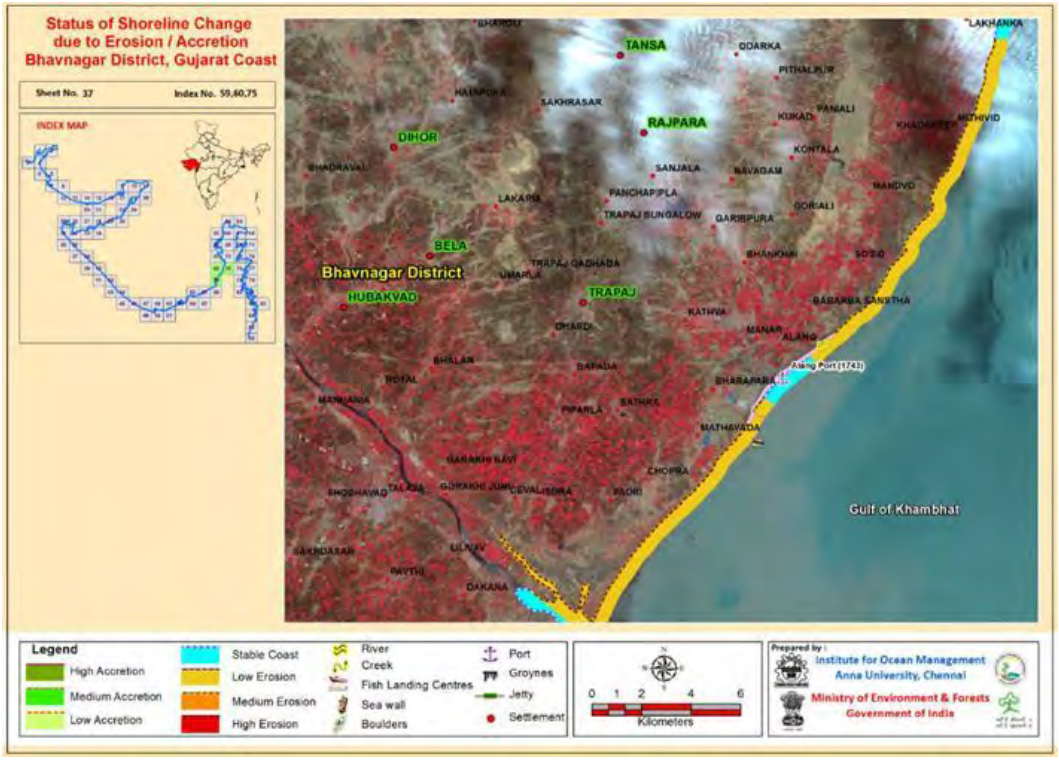
11.3.3. TOPOGRAPHY

A shallow rocky reef of approximately 500-1,500 m width extends along the coastal area of Alang/Sosiya. Mud and sand accumulates on top of these reefs to create mud flats. A sandy beach of approximately 25-200 m width runs along the shore. Figure 11-11 is a nautical chart around the Alang/Sosiya area.

Source: JICA (2015), The Data Collection Survey on Ship Recycling in India

Figure 11-11 Nautical chart around the Alang/Sosiya area

MoEFCC assesses the coastal erosion/accretion status along the Indian coastline through the National Assessment of Shoreline Change program. Figure 11-12 shows the coastal assessment made for the Alang/Sosiya area.



Source: National Assessment of Shoreline Change

Figure 11-12 Coastal assessment of the Alang/Sosiya area

The EIA compares the coastline along the Alang area by using satellite image of years 2000 and 2008 (see Figure 11-13). No significant erosion or accretion are identified, which is consistent with the assessment of National Assessment of Shoreline Change.

Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

Figure 11-13 Comparison of Alang coastline between years 2000 and 2008

11.3.4. **POLLUTION**

(1) Air quality

1) Ambient air quality

Air quality survey was conducted through the EIA during March-May 2015 at 5 sites around Alang/Sosiya. Surveyed parameters were PM10, PM2.5, SO2, NOx and CO. Figure 11-14 shows the sampling sites. Table 11-9 shows the survey results. Table 11-10 shows the Indian and WHO air quality standards.

Source: JICA Survey Team (prepared with Google Earth)

Figure 11-14 Location of EIA air quality sampling sites

Table 11-9 Results of EIA air quality survey

	PM_{10} (μg/m³)			**$PM_{2.5}$ (μg/m³)**			**SO_2 (μg/m³)**			**NOx (μg/m³)**			**CO (μg/m³)**		
	Max	Min	C_{98}	Max	Min	C_{98}	Max	Min	C_{98}	Max	Min	C_{98}	Max	Min	C_{98}
A1	114	56	98	63	26	58	11.2	4.5	9.6	45.5	20.2	44.0	1.32	0.08	1.06
A2	111	48	98	66	22	58	10.5	4.5	10.2	32.2	12.2	32.2	0.99	0.08	0.80
A3	98	45	97	56	23	55	9.6	4.2	9.6	34.5	12.2	31.2	0.88	0.07	0.82
A4	94	31	87	45	14	44	9.2	4.2	8.5	34.8	13.1	31.2	0.99	0.06	0.75
A5	97	48	96	52	22	50	8.5	4.5	7.9	30.2	14.2	27.5	0.92	0.06	0.75

Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

Table 11-10 Ambient air quality standard of India and WHO

	Unit	**National ambient air quality standard 2009**[*1] (Industrial, residential, rural and other area)	**WHO ambient air quality guideline** (Interim target 2[*2])
PM_{10}	μg/m³	100 (24 hour)	100 (24 hour)
$PM_{2.5}$	μg/m³	60 (24 hour)	50 (24 hour)
SO_2	μg/m³	80 (24 hour)	50 (24 hour)
NO_2	μg/m³	80 (24 hour)	200 (1 hour)
CO	mg/m³	2 (8 hour)	-

Source: JICA Survey Team

Following are the main findings of the survey:

- For PM_{10}, C_{98} values of all sites satisfied the 24 hour Indian standard.
- For $PM_{2.5}$, C_{98} values of all sites satisfied the 24 hour Indian standard.
- For SO_2, NOx and CO, C_{98} values of all sites satisfied the 24 hour Indian standard.

2) Air quality inside recycling yard/TSDF

Air quality survey was also conducted through the EIA at two yards and inside TSDF. Surveyed parameters were PM_{10}, $PM_{2.5}$, SO_2, NOx and CO. Table 11-11 shows the survey results.

PM10 exceeded Indian standard at all the sites. PM2.5 exceeded Indian standard at one yard and at TSDF. Fugitive dust emission from yard activities are likely cause of high PM levels. CO levels were under Indian standard at all the sites. SO_2 and NOx were under Indian standard at all the sites.

Table 11-11 Results of EIA air quality survey at recycling yard and TSDF

Location	PM_{10}	$PM_{2.5}$	SO_2	NO_X	CO
Plot in southern part of SRY	127	58	6.6	38.5	810
Plot in northern part of SRY	195	86	9.2	41.1	1260
TSDF Area	120	71	8.9	32,5	750
					All values in $\mu g/m^3$

Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

3) JICA supplementary survey (asbestos)

Since the EIA lacked baseline asbestos data (as no asbestos removal works were done during the course of EIA), asbestos survey was conducted in October 2016. Asbestos sampling was implemented at plot 66 (non-certified yard) when asbestos removal works were ongoing on the ship (ship name: MV Suchada Naree, ship type: bulk carrier) and inside the ship breaking yard with mobile asbestos decontamination system. Asbestos was also sampled at TSDF's asbestos disposal site. Sampling was conducted for 30 minutes at each site, during which air was drawn at a rate of 2 liters/minute. Table 11-12 shows the location of the asbestos sampling sites. Figure 11-15 shows the location of the asbestos sampling sites at the ship breaking yard. Sampling and analysis were conducted in accordance to OSHA method ID-160.

Table 11-12 Location of asbestos sampling sites

Location		Latitude	Longitude
A	Outlet of Mobile Asbestos Decontamination Unit	21º23'08.05"N	72º10'12.13"E
B	Outlet of Mobile Asbestos Decontamination Unit	21º23'08.05"N	72º10'12.13"E
C	Inside ship breaking yard	21º23'08.43"N	72º10'12.44"E
D	Inside ship breaking yard	21º23'07.20"N	72º10'11.63"E
E	Outside ship breaking yard	21º23'08.68"N	72º10'11.58"E
F	Outside ship breaking yard	21º23'08.24"N	72º10'11.17"E
G	Near TSDF asbestos disposal area	21º24'51.84"N	72º09'39.23"E
H	Near TSDF asbestos disposal area	21º24'51.84"N	72º09'39.23"E
I	Inside ship adjacent to asbestos removal activity	21º23'03.22"N	72º10'12.55"E
J	Inside ship adjacent to asbestos removal activity	21º23'03.22"N	72º10'12.55"E

Source: JICA Survey Team

Figure 11-15 Location of asbestos sampling sites at the ship breaking yard

Note: Mobile Asbestos Decontamination Unit was parked near sites A&B.

Source: JICA Survey Team (prepared with Google Earth)

Table 11-13 shows the results of the asbestos survey. Apart from sites E and F, the results were compared with OSHA asbestos work environment standard for shipyard employment (1915.1001). Results of sites E and F were compared with Japanese standard for boundary of asbestos handling factories set under Japan's Air Pollution Control Act.

Table 11-13 Results of asbestos survey

	Location	**Results (f/cc)**	**OSHA*1 (f/cc)**	**Japan*2 (f/cc)**
A	Outlet of Mobile Asbestos Decontamination Unit	0.034	0.1	—
B	Outlet of Mobile Asbestos Decontamination Unit	0.050	0.1	—
C	Inside ship breaking yard	0.084	0.1	—
D	Inside ship breaking yard	0.000	0.1	—
E	Outside ship recycling yard	0.034	—	0.01
F	Outside ship recycling yard	0.050	—	0.01
G	Near TSDF asbestos disposal area	0.101	0.1	—
H	Near TSDF asbestos disposal area	0.017	0.1	—
I	Inside ship adjacent to asbestos removal activity	0.034	0.1	—
J	Inside ship adjacent to asbestos removal activity	0.050	0.1	—

f/cc: fiber per cubic centimeter of air

*1: OSHA asbestos work environment standard for shipyard employment (1915.1001)

*2: Japanese standard set under Air Pollution Control Act: applied to boundary of asbestos handling factories

Source: JICA Survey Team

Asbestos concentration at sites I and J (inside ship) and sites A-D (inside yard) were all below the OSHA standard (0.1 f/cc), which implies that asbestos removal and handling works are undertaken in an appropriate manner. Asbestos concentration at TSDF disposal site (site G) very slightly exceeded the OSHA standard despite the fact that asbestos wastes are contained within leak-proof bags throughout the transportation and solidification treatment processes. Following are possible reasons why asbestos were detected at TSDF disposal site:

- Although asbestos are transported and disposed at TSDF in leak-roof bags, there might have been some accidental leaks during the transportation and storage process for example through tear in the leak-roof bags.
- There might have been some error during the analysis for example by miscounting with glasswool fibers which were abundant in the vicinity of the sampling site.

Asbestos concentration at the boundary of the ship recycling yard (site E, F) exceeded the Japanese standard (0.01 f/cc) although their concentration was below OSHA standard (0.1 f/cc). This may be due to the proximity between the yard boundary and Mobile Asbestos Decontamination Unit (the laboratory report is attached as Appendix -9).

(2) Water quality

1) Seawater

The EIA has conducted seawater quality survey in May 2015 at 8 locations around the Project sites. Figure 11-16shows the sampling sites. Table 11-14 shows the Indian seawater quality standard. Table 11-15 shows the survey results.

Source: JICA Survey Team (prepared with Google Earth)

Figure 11-16 Location of EIA seawater quality sampling sites

Table 11-14 Seawater quality standard of India

Parameter	**Indian standard:** Primary Water Quality Criteria for Designated Best Uses for Coastal Waters (harbor waters)
pH	6-9
DO	>3.0 mg/l or 40% saturation
Color and odour	No noticeable colour or offensive odour
Oil and grease	10 mg/l
Fecal Coliform	500/100 ml (MPN)
BOD	5 mg/l

Source: Environment (Protection) Rules 1986

Table 11-15 Results of EIA seawater quality survey

Sl. No.	Parameter	Results			
		SW2	SW3	SW4	SW5
1	pH Value	7.29	7.18	7.25	7.35
2	Colour & Odour	18 & Slight fishy smell	20 & Slight fishy smell	19 & Slight fishy smell	21 & Slight fishy smell
3	Dissolved Oxygen (as O_2), mg/l	6.8	6.5	6.4	6.9
4	Suspended Solids, mg/l	1572	1663	1728	1705
5	Turbidity, NTU	190	185	198	205
6	BOD (3 days at 27 °C), mg/l.	2.9	5.6	3.6	2.3
7	Total Dissolved Solids, mg/l	39920	40550	41490	39420
8	Free Ammonia (as NH_3), mg/l	<0.1	<0.1	<0.1	<0.1
9	Oil & Grease, mg/l	<0.1	<0.1	0.2	<0.1
10	Lead (as Pb), mg/l	<0.005	<0.005	<0.005	<0.005
11	Mercury (as Hg) mg/l	<0.0005	<0.0005	<0.0005	<0.0005
12	Cadmium (as Cd), mg/l	<0.002	<0.002	<0.002	<0.002
13	Electrical Conductivity, µs/cm at 25°C	50900	53156	59588	51976
14	Dissolved Iron (as Fe) mg/l	0.51	0.71	0.63	0.69
15	Dissolved Manganese (as Mn) mg/l	0.089	0.079	0.083	0.092
16	Sodium Absorption Ratio	61.6	60. 7	69.6	64.2
17	Boron (as B), mg/l	3.5	3.3	3.2	3.4
18	Coliforms, MPN/100 ml	<1.8	<1.8	<1.8	<1.8
19	Poly Chlorinated Bi Phenyls, mg/l	-	-	<0.0005	<0.0005

Sl. No.	Parameter	Results			
		SW6	SW7	SW8	SW9
1	pH Value	7.45	7.43	7.48	7.20
2	Colour & Odour	4 & Odourless	4 & Odourless	5 & Odourless	6 & Odourless
3	Dissolved Oxygen (as O_2), mg/l	6.5	6.8	6.4	6.6
4	Suspended Solids, mg/l	823	658	708	661
5	Turbidity, NTU	60	80	84	56
6	BOD (3 days at 27°C), mg/l.	2.7	2.9	2	3.4
7	Total Dissolved Solids, mg/l	40140	42500	39960	38200
8	Free Ammonia (as NH_3), mg/l	<0.1	<0.1	<0.1	<0.1
9	Oil & Grease, mg/l	<0.1	<0.1	<0.1	<0.1
10	Lead (as Pb), mg/l	<0.005	<0.005	<0.005	<0.005
11	Mercury (as Hg) mg/l	<0.0005	<0.0005	<0.0005	<0.0005
12	Cadmium (as Cd), mg/l	<0.002	<0.002	<0.002	<0.002
13	Electrical Conductivity, s/cm at 25°C	50700	53820	49902	51872
14	Dissolved Iron (as Fe) mg/l	0.57	0.67	0.43	0.59
15	Dissolved Manganese (as Mn) mg/l	0.087	0.092	0.078	0.083
16	Sodium Absorption Ratio	65.9	68.7	63.7	64.2
17	Boron (as B), mg/l	3.4	3.1	3.8	5.7
18	Coliforms, MPN/100 ml	<1.8	<1.8	<1.8	<1.8
19	Poly Chlorinated Bi Phenyls, mg/l	-	-	<0.0005	<0.0005

Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

Although BOD levels slightly exceeded Indian standard at one site (SW3), other parameters were all under Indian standard. Hazardous substances such as heavy metals and PCBs were all below detection limit.

2) Groundwater

The EIA has conducted groundwater quality survey in May 2015 (dry season) at 4 locations around the Project sites. Figure 11-17shows the sampling sites. Table 11-16 shows the survey results. Since India has no groundwater quality standards, the results are compared with Indian drinking water standard (IS: 10500, 2012).

Figure 11-17 Location of EIA groundwater sampling sites

Source: JICA Survey Team (prepared with Google Earth)

Table 11-16 Results of EIA groundwater quality survey

Sl. No.	Parameters	Acceptable Limit *	Permissible Limits in absence of Alternate Source *	GW1	GW2	GW3	GW4
1	Taste	Agreeable	-	Agreeable	Agreeable	Agreeable	Agreeable
2	Turbidity, NTU	Max. 1	Max. 5	<1.0	3.5	<1.0	<1.0
3	TDS,mg/l	500	Max. 2000	580	1300	1295	2380
4	Total Hardness (as $CaCO_3$), mg/l	Max.200	Max. 600	198	138.6	772.2	366.3
5	Calcium (as Ca),mg/l	Max. 75	Max. 200	39.6	27.72	122.76	51.48
6	Magnesium (as Mg),mg/l	Max. 30	Max. 100	23.76	16.63	111.67	57.02
7	Total alkalinity (as $CaCO_3$), mg/l	Max. 200	Max. 600	226.6	484.1	339.9	525.3
8	Fluoride (as F),mg/l	Max. 1	Max. 1.5	0.11	<0.1	0.2	0.28
9	Colour, Hazen	Max.5	Max. 25	<1	<1	<1	<1
10	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
11	pH at 25°C	6.5-8.5	No relaxation	7.32	7.56	7.56	7.52
12	Chloride (as Cl),mg/l	Max. 250	Max. 1000	130.91	256.97	392.73	635.15
13	Sulphate (as SO_4),mg/l	Max. 200	Max. 400	68.31	230.95	140.26	535.93
14	Iron (as Fe),mg/l	Max. 0.3	No relaxation	<0.05	0.14	<0.05	0.07
15	Aluminium (as Al),mg/l	Max. 0.03	Max. 0.2	<0.01	<0.01	<0.01	<0.01
16	Residual Free Chlorine ,mg/l	Max. 0.2	_	<0.1	<0.1	<0.1	<0.1
17	Mercury (as Hg),mg/l	Max. 0.001	No relaxation	<0.0005	<0.0005	<0.0005	<0.0005
18	Cadmium (as Cd),mg/l	Max. 0.003	No relaxation	<0.002	<0.002	<0.002	<0.002
19	Total Arsenic (as As),mg/l	Max. 0.01	Max. 0.05	<0.01	<0.01	<0.01	<0.01
20	Anionic detergent (as MBAS), mg/l	Max. 0.2	Max. 1	<0.02	<0.02	<0.02	<0.02
21	Boron (as B),mg/l	Max. 0.5	Max. 1	<0.5	<0.5	<0.5	<0.5
22	Chromium (as Cr^{+6}),mg/l	Max. 0.05	No relaxation	<0.01	<0.01	<0.01	<0.01
23	Copper (as Cu),mg/l	Max. 0.05	Max. 1.5	<0.02	<0.02	<0.02	<0.02
24	Cyanide (as CN),mg/l	Max. 0.05	No relaxation	<0.01	<0.01	<0.01	<0.01
25	Lead (as Pb),mg/l	Max. 0.01	No relaxation	<0.005	<0.005	<0.005	<0.005
26	Manganese (as Mn) ,mg/l	Max. 0.1	Max. 0.3	<0.02	<0.02	<0.02	<0.02
27	Nitrate (as NO_3),mg/l	Max. 45	No relaxation	7.92	12.79	51.42	97.5
28	Selenium (as Se),mg/l	Max. 0.01	No relaxation	<0.005	<0.005	<0.005	<0.005
29	Zn (as Zn),mg/l	Max. 5	Max. 15	<0.02	<0.02	<0.02	<0.02
30	Phenolic Compounds (as C_6H_5OH), mg/l	Max. 0.001	Max.0.002	<0.001	<0.001	<0.001	<0.001
31	Total Coliform organisms, MPN/100 ml	Absent/100 ml	-	Nil	Nil	Nil	Nil
	* Drinking Water Specification, IS : 10500 (2012)						

Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

The results show no contamination by hazardous substances such as heavy metals as they were all below Indian drinking water standard. However, at some sites, concentration of TDS, magnesium, nitrate and sulphate exceeded Indian drinking water standard, which may be due to influences from farmland and sewage.

c. JICA supplementary survey

Since the EIA lacked baseline groundwater quality data around TSDF and ship recycling yard, a supplementary survey was conducted. Groundwater samples were collected in August 2016 from wells around TSDF (4 sites) and from inside 2 ship recycling yards (see Figure 11-18 and Figure 11-19 for the sampling locations). In addition, leachate water of TSDF landfill site (Cell 4.1) was also collected for analysis (GW5). Analyzed parameters are cadmium, hexavalent chromium, lead, mercury, PCBs, PBBs, PBDEs, PCN, PAHs and TBT, which are except PAHs, hazardous substances listed in Appendix 1 and 2 of the HKC.

Station	Latitude	Longitude
GW1: groundwater	21°24'41.61"N	72° 09'42.93"E
GW2: groundwater	21°24'43.89"N	72° 09'50.16"E
GW3: groundwater	21°24'55.24"N	72° 09'30.41"E
GW4: groundwater	21°24'49.38"N	72° 09'50.76"E
GW5: Leachate	21°24'51.87"N	72° 09'38.08"E

Figure 11-18 Location of groundwater/leachate sampling sites around TSDF

Source: JICA Survey Team (prepared with Google Earth)

Station	Latitude	Longitude
GW6: groundwater	21°24'04.51"N	72°11'05.99"E
GW7: groundwater	21°25'40.53"N	72°12'51.21"E

Figure 11-19 Location of groundwater sampling sites at ship recycling yards
Source: JICA Survey Team (prepared with Google Earth)

Table 11-17 and Table 11-18 show the results of the survey for groundwater (GW1-4 and GW6-7) and leachate (GW5) sites respectively (lab report is attached as Appendix - 9). For groundwater, all parameters except lead were below detection limit. For lead, all sites except GW2 had lead levels exceeding Indian standard. While the cause of such lead levels are uncertain (i.e. natural or anthropogenic origin) it should not be interpreted as a representative baseline data of the area as the results are based on one-time survey in the wet season. Further regular groundwater monitoring will be necessary to obtain an accurate trend of groundwater quality. For leachate, lead, mercury, PCBs and PBBs were above detection limit and the others all below detection limit.

For further verification, GMB requested the JICA Survey Team to undertake additional survey in the dry season specifically for parameters that were above Indian standards (i.e. lead) or were relatively high (i.e. mercury and PCBs).

Table 11-17 Results of groundwater quality analysis

	Unit	DL	GW1 (TSDF)	GW2 (TSDF)	GW3 (TSDF)	GW4 (TSDF)	GW6 (Yard)	GW7 (Yard)	Indian standard*1	Japan standard*2	Analysis method
pH		-	8.0	7.6	7.6	7.6	8.0	7.8	6.5-8.5	-	IS 3025 (Part 11)-1983 (R.2006)
Salinity	‰	-	1.9	1.01	0.78	0.86	2.72	1.77	-	-	2520-B APHA 22nd Ed. 2012
Cd	mg/l	0.002	BDL	BDL	BDL	BDL	BDL	BDL	0.003	0.003	IS 3025 (Part 41)-1992 (R.2009)
Cr^{+6}	mg/l	0.01	BDL	BDL	BDL	BDL	BDL	BDL	-	0.05	3500-Cr-B APHA 22nd Ed. 2012
Pb	mg/l	0.005	0.17	BDL	0.15	0.12	0.21	0.19	0.01	0.01	IS 3025 (Part 47)-1994 (R.2009)
Hg	mg/l	0.001	BDL	BDL	BDL	BDL	BDL	BDL	0.001	0.0005	IS 3025 (Part 48)-1994 (R.2009)
PCBs	µg/l	0.01	BDL	BDL	BDL	BDL	BDL	BDL	0.5	ND	Annex M of IS 13428-19988TEST
PBBs	µg/l	0.01	BDL	BDL	BDL	BDL	BDL	BDL	-	-	CTL/SOP/WATER/192-2016
PBDEs	µg/l	0.01	BDL	BDL	BDL	BDL	BDL	BDL	-	-	CTL/SOP/WATER/193-2016
PCN	µg/l	0.01	BDL	BDL	BDL	BDL	BDL	BDL	-	-	CTL/SOP/WATER/194-2016
PAHs	µg/l	0.03	BDL	BDL	BDL	BDL	BDL	BDL	0.1	-	APHA 22 nd Edition 6440 C
TBT	µg/l	0.01	BDL	BDL	BDL	BDL	BDL	BDL	-	-	CTL/SOP/WATER/195-2016

*1 : IS 10500: 2012 (Drinking water)

*2 : Japanese Environmental Quality Standards for Groundwater Pollution

DL: Detection limit, BDL: Below Detection Limit, ND: Not to be detected

Source: JICA Survey Team

Table 11-18 Results of leachate quality analysis

	Unit	DL	GW5			Analysis method
pH		-	7.5			IS3025 (Part 11)-1983 (R.2006)
Salinity	‰	-	8.56			2520-B APHA 22nd Ed. 2012
Cd	mg/l	0.002	BDL			IS 3025 (Part 41)-1992 (R.2009)
Cr^{+6}	mg/l	0.01	BDL			3500-Cr-B APHA 22nd Ed. 2012
Pb	mg/l	0.005	0.99			IS 3025 (Part 47)-1994 (R.2009)
Hg	mg/l	0.001	0.01			IS 3025 (Part 48)-1994 (R.2009)
PCBs	µg/l	0.01	22.14			Annex M of IS 13428-1998
PBBs	µg/l	0.01	3.425			CTL/SOP/WATER/192-2016
PBDEs	µg/l	0.01	BDL			CTL/SOP/WATER/193-2016
PCN	µg/l	0.01	BDL			CTL/SOP/WATER/194-2016
PAHs	µg/l	0.05	BDL			APHA 22nd Edition 6440 C CTL/SOP/WATER/102-2012
TBT	µg/l	0.01	BDL			CTL/SOP/WATER/195-2016

DL: Detection limit, BDL: Below Detection Limit, ND: Not to be detected
Source: JICA Survey Team

d. JICA additional survey

As per request of GMB, additional groundwater/leachate survey was implemented in February 2017 focusing on lead, mercury and PCBs. Sampling and analysis were conducted by a leading Japanese consultancy firm (IDEA Consultants Inc.). Water samples were taken from the same wells as the supplementary survey plus one additional site inside TSDF (GW8). Sampling was conducted with the same protocol employed in the supplementary survey. Figure 11-20 shows the location of the TSDF sampling sites.

Figure 11-20 Location of groundwater/leachate sampling sites around TSDF

Note: GW8 is the new sampling site (latitude: 21°24'46.63" N, longitude: 72°09'47.80 E)
Source: JICA Survey Team (prepared with Google Earth)

Laboratory analysis was conducted by employing as far as possible a similar method to the ones employed in the supplementary survey. For heavy metals (lead and mercury), samples were analyzed through two types of instruments namely: Atomic Absorption Spectrometry (AAS) and Inductively coupled plasma - mass spectrometry (ICP/MS). Table 11-19 and Table 11-20 show the results of the survey for groundwater (GW1-4 and GW6-8) and leachate (GW5) sites respectively. The results of the supplementary survey are included in the tables for comparison.

Table 11-19 Results of groundwater quality analysis (additional survey)

	Unit	DL	GW1 (TSDF)	GW2 (TSDF)	GW3 (TSDF)	GW4 (TSDF)	GW8 (TSDF)	GW6 (Yard)	GW7 (Yard)	Indian standard*1	Japan standard*2	Analysis method
			8.0	7.6	7.6	7.6	-	8.0	7.8			IS3025 (Part 11)-1983 (R.2006)
			7.4	7.5	7.3	7.5	7.4	7.6	7.6			EPA 1600/4-79/020 150.1
			1.9	1.01	0.78	0.86	-	2.72	1.77			2520-B APHA 22nd Ed. 2012
			<2	<2	<2	<2	<2	3.2	<2			EPA ESTUARI
		0.005	0.17	BDL	0.15	0.12	-	0.21	0.19			IS 3025 (Part 47)-1994 (R.2009)
		AAS: 0.005	BDL	BDL	BDL	BDL	BDL	BDL	0.007			ISO 8288: 1986
		ICP/MS: 0.001	0.001	BDL	0.001	BDL	BDL	0.004	0.007			EPA 6020A
		0.001	BDL	BDL	BDL	BDL	-	BDL	BDL			IS 3025 (Part 48)-1994 (R.2009)
		AAS: 0.0005	BDL	BDL	BDL	BDL	BDL	BDL	BDL			ISO 12846: 2012
		ICP/MS: 0.0001	BDL	BDL	BDL	BDL	BDL	BDL	BDL			EPA 6020A
		0.01	BDL	BDL	BDL	BDL	-	BDL	BDL			Annex M of IS 13428-1998
		0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL			EPA 8082A

Grey column: Results of supplementary survey

*1 : IS 10500: 2012 (Drinking water)

*2 : Japanese Environmental Quality Standards for Groundwater Pollution

AAS: Atomic Absorption Spectrometry, ICP/MS: Inductively Coupled Plasma Mass Spectrometry

DL: Detection limit, BDL: Below Detection Limit, ND: Not to be detected

Source: JICA Survey Team

Table 11-20 Results of leachate quality analysis (additional survey)

	Unit	DL	GW5			Analysis method
			7.5			IS3025 (Part 11)-1983 (R.2006)
			7.7			EPA 1600/4-79/020 150.1
			8.56			2520-B APHA 22nd Ed. 2012
			6.5			EPA ESTUARI
		0.005	0.99			IS 3025 (Part 47)-1994 (R.2009)
		AAS: 0.005	BDL			ISO 8288: 1986
		ICP/MS: 0.001	0.001			EPA 6020A
		0.001	0.01			IS 3025 (Part 48)-1994 (R.2009)
		AAS: 0.0005	0.0005			ISO 12846: 2012
		ICP/MS: 0.0001	0.0002			EPA 6020A
		0.01	22.14			Annex M of IS 13428-1998
		0.5	BDL			EPA 8082A

Grey column: Results of supplementary survey
AAS: Atomic Absorption Spectrometry, ICP/MS: Inductively Coupled Plasma Mass Spectrometry
DL: Detection limit, BDL: Below Detection Limit, ND: Not to be detected
Source: JICA Survey Team

Following are the main findings of the groundwater survey:

- The values of pH and salinity were similar to the supplementary survey.
- Lead concentration (max value 0.007 mg/l at GW7) was significantly lower than the supplementary survey (around 0.12～0.21 mg/l) at all the sites and were also below Indian standard. Although the sampling sites are different, the results of the additional survey were similar to the values recorded in the EIA study (< 0.005 mg/l).
- Mercury concentration was below detection limit at all the sites and were also below Indian standard. The results were similar to the supplementary survey.
- PCBs concentration was below detection limit (< 0.5 mg/l) at all the sites and were also below Indian standard. The results were similar to the supplementary survey.

Following are the main findings of the leachate survey:

- The values of pH and salinity were similar to the supplementary survey.
- Lead concentration (0.001 mg/l by ICP/MS) was significantly lower than the supplementary survey (0.99 mg/l)..
- Mercury concentration (0.0002 mg/l by ICP/MS) was significantly lower than the supplementary survey (0.01 mg/l).
- PCBs concentration was below detection limit (< 0.5 µg/l) which was significantly lower than the supplementary survey (22.14 µg/l).

In general, the results of the additional survey were significantly lower than the supplementary survey, especially for groundwater lead concentration and leachate lead, mercury and PCBs concentration. Possible reasons for these differences are discussed below:

- Although heavy metals and PCBs were analyzed in the supplementary survey as per Indian approved methodologies, erroneous results may be obtained in case the samples were not pretreated sufficiently (e.g. removal of impurities contained in the sample prior to measurement).
- Groundwater quality may differ with the season. Groundwater in wet season may be prone to receive more pollutants such as through soil infiltration and rise in groundwater level. However, regular monitoring will be required to further verify if there are such seasonal fluctuations in the area.

(3) Noise

Noise survey was conducted through the EIA during April-May 2015 at 7 sites around Alang/Sosiya. Table 11-21 shows the survey results.

Table 11-21 Results of EIA noise survey

Stn. No.	Location	Results					
		Day (0600-2200 hr.)			Night (2200-0600 hr.)		
		Max.	Min.	Avg.*	Max.	Min.	Avg.*
AN1	In front of Alang Fire Station	78.0	44.0	72.2	50.4	41.5	45.5
AN2	Alang Village	56.6	45.9	53.0	47.5	40.5	43.7
AN3	Sosiya Village	61.3	42.9	54.9	43.0	40.6	42.0
AN4	Mathavda Village	52.7	41.4	49.6	46.4	40.5	42.4
AN5	Kathava Village	60.4	47.0	55.0	49.5	41.1	44.7
N6	Chopada Village	56.2	43.5	52.1	44.6	40.3	42.2
N7	Bharpara Village	57.1	45.3	52.2	44.6	40.4	42.8
* Logarithmic Averages.						All Values in dB (A).	

Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

Noise levels at the recycling yard area (St. AN1) satisfies both day time (75 dB) and night time (70 dB) Indian standards for industrial area. Village sites (St. AN2-7) also satisfies both day time (55 dB) and night time (45 dB) Indian standards for residential areas.

(4) Soil quality

Although the EIA conducts soil quality survey around TSDF and in some farmland, however JICA survey team decided further exercise on soil quality in accordance with Japanese practice as a baseline for this Project.

1) JICA supplementary survey

A supplementary soil quality survey was conducted in August 2016. Soil samples were collected from HKC uncertified ship recycling yards and from around TSDF. Survey parameters for the ship recycling yard are cadmium, hexavalent chromium, lead, mercury, PCBs, PBBs, PBDEs, PCN, PAHs and TBT, which are except PAHs, hazardous substances listed in Appendix 1 and 2 of the HKC. For the TSDF sites, dioxin was measured.

For the ship recycling yard, soil samples were collected from 10 plots as shown in Figure 11-21. For each plot, samples were collected from 6-10 spots depending on the width of the plot. Surface (around 0-10 cm) and subsurface (around 10-30 cm) samples were collected separately

then later mixed together at equal quantities to make one composite sample per plot. As for the TSDF sites, soil samples (surface only) were collected from the same four locations as the groundwater survey sites (see Figure 11-21).

Station	Latitude	Longitude	Station	Latitude	Longitude
So1: Plot V-6	21°26'17.40"N	72°13'19.56"E	So6: Plot 51	21°24'34.01"N	72°11'46.84"E
So2: Plot 136	21°25'38.92"N	72°12'52.73"E	So7: Plot 42	21°24'21.94"N	72°11'35.29"E
So3: Plot 120M	21°25'25.04"N	72°12'42.81"E	So8: Plot 36	21°24'15.75"N	72°11'27.14"E
So4: Plot V2	21°25'05.69"N	72°12'19.42"E	So9: Plot 62	21°23'12.90"N	72°10'17.91"E
So5: Plot 89/90	21°24'50.92"N	72°12'05.26"E	So10: Plot 84F	21°22'37.58"N	72°10'00.21"E

Figure 11-21 Location of soil sampling sites (ship recycling yard)
Source: JICA Survey Team (prepared with Google Earth)

Table 11-22 shows the results of the soil quality analysis for the ship recycling yard sites (lab report is attached as Appendix - 9). For reference, the results were compared with Netherland and Canadian soil quality standards, as there are no Indian standards yet. Apart from lead and PAHs, all parameters were below detection limit at all the sites. Although lead and PAHs levels were relatively high, none of the sites exceeded Netherland and Canadian soil quality standards.

Table 11-22 Results of soil quality analysis (ship recycling yard)

	Unit	DL	So1	So2	So3	So4	So5	So6	So7	So8	So9	So10	Netherlands*1	Canada*2	Analysis method
Moisture	%	-	7.60	10.33	7.13	4.68	3.75	5.11	7.42	6.93	5.58	7.09	-		IS 2720 (Part 2):1973 (R.2010)
TOC	%	-	0.21	0.22	0.35	0.31	0.44	0.30	0.29	0.26	0.21	0.37	-		FAO Method (Pg. No.61) 2007
Particle size (>0.5 mm)	%	-	60.6	69.22	69.25	55.2	72.98	67.69	65.79	61.61	61.41	60.81	-	-	
Particle size (<0.5 mm)	%	-	39.4	30.78	30.75	44.8	27.02	32.31	34.21	38.39	38.59	39.19	-	-	
Cd	mg/kg	2.0	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	13	22	EPA 3050B–1996 (Rev-2)/EPA 7130-1986
Cr^{+6}	mg/kg	0.1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	78	-	EPA Method - 7196A:1992 (Rev-1)
Pb	mg/kg	5.0	58.59	34.00	10.26	39.86	108.31	16.74	51.42	159.97	35.82	17.21	530	600	EPA 3050B–1996 (Rev-2)/EPA 7420-1986
Hg	mg/kg	0.2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	36	50	EPA 7471A-2007 (Rev-2)
PCBs	mg/kg	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1	33	CTP/SOP/SOIL/132-2014
PBBs	mg/kg	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-	CTP/SOP/SOIL/139-2014
PBDEs	mg/kg	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-	CTP/SOP/SOIL/132-2014
PCN	mg/kg	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-	CTP/SOP/SOIL/151-2014
PAHs	mg/kg	0.05	0.334	0.306	BDL	0.328	0.652	2.03	0.536	0.337	0.904	0.705	40	-	CTP/SOP/SOIL/147-2014
TBT	mg/kg	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-	CTP/SOP/SOIL/158-2014

*1：Soil Remediation Circular 2013

*2：Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (Industrial use)

DL: Detection limit, BDL: Below Detection Limit

Laboratory: Chennai Testing Laboratory Private Limited (NABL certified lab)

Source: JICA Survey Team

Table 11-23 shows the results of soil quality analysis for TSDF sites (lab report is attached as Appendix - 9). Dioxins levels were below detection limit at all the sites.

Table 11-23 Results of soil quality analysis (TSDF)

	Unit	DL	So1 (GW1)	So2 (GW2)	So3 (GW3)	So4 (GW3)	Analysis method
Moisture	%	-	20.41	5.87	9.79	13.81	IS 2720 (Part 2):1973 (R.2010)
TOC	%	-	0.35	0.47	0.44	0.21	FAO Method (Pg. No.61) 2007
Dioxins/furans	ng-TEC/kg	0.06	BDL	BDL	BDL	BDL	USEPA 1613

DL: Detection Limit, BDL: Below Detection Limit
Laboratory: Vimta Lab Limited (NABL certified lab)
Source: JICA Survey Team

(5) Sediment quality

1) JICA supplementary survey

As per requirement of JICA's Environmental guideline, supplementary sediment quality survey was conducted. Sediment samples were collected from 10 sites: 8 sites in front of the ship recycling yard and 2 sites outside the ship recycling yard area (see Figure 11-22). Survey parameters are cadmium, hexavalent chromium, lead, mercury, PCBs, PBBs, PBDEs, PCN, PAHs and TBT, which are except PAHs, hazardous substances listed in Appendix 1 and 2 of the HKC.

Station	Latitude	Longitude	Station	Latitude	Longitude
S1	21°26'43.41"N	72°13'33.86"E	S6	21°24'10.53"N	72°11'33.32"E

S2	21°26'14.41"N	72°13'20.91"E	S7	21°23'27.39"N	72°10'35.08"E
S3	21°25'36.38"N	72°12'56.45"E	S8	21°22'53.53"N	72°10'11.94"E
S4	21°25'03.17"N	72°12'22.09"E	S9	21°22'32.98"N	72°10'05.01"E
S5	21°24'31.34"N	72°11'48.63"E	S10	21°22'26.16"N	72°09'55.74"E

Figure 11-22 Location of sediment sampling sites

Source: JICA Survey Team (prepared with Google Earth)

Table 11-24 shows the results of the sediment quality analysis (lab report is attached as Appendix – 9).The table also shows the Australian and Canadian sediment quality guideline values for ad hoc comparison, as there is no sediment quality standard in India yet. However, note that these guideline values were used solely for reference purpose and may not be appropriate to apply for Indian environment. The main findings of the survey are as follows:

- For heavy metals, lead and cadmium were detected at relatively high levels but others were all below detection limit.
- For organic pollutants, PCBs levels were relatively high at 7 sites.
- While it is not possible to accurately identify the source of lead, cadmium and PCBs, it should not be interpreted as a representative baseline data of the area as the results are based on one-time survey in the wet season. Further regular monitoring will be necessary to obtain an accurate trend of sediment quality.

For further verification, GMB requested the JICA Survey Team to undertake additional survey in the dry season specifically for parameters that were above the Australian and Canadian sediment quality guideline values (cadmium, lead and PCBs).

Table 11-24 Results of sediment quality analysis (supplementary survey)

	Unit	DL	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Australia*1	Canada*2	Analysis method
Moisture	%	-	17.23	16.40	17.14	16.70	20.45	31.45	21.14	17.83	20.66	33.54	-	-	IS 2720 (Part 2):1973 (R.2010)
TOC	%	-	0.84	0.85	0.92	0.88	1.01	0.40	1.01	0.45	0.84	0.95	-	-	FAO Method (Pg. No.61) 2007
Particle size (>0.18 mm)	%	-	31.00	27.33	27.28	30.67	32.91	31.08	33.57	29.91	34.06	30.99	-	-	
Particle size (<0.18 mm)	%	-	69.00	72.67	72.72	69.33	67.09	68.92	66.43	70.09	65.94	69.01	-	-	
Cd	mg/kg	2.0	2.84	2.68	BDL	3.21	2.86	2.61	2.42	2.92	2.78	2.85	$ISQG_L$: 1.5 $ISQG_H$: 10	ISQG: 0.7 PEL: 4.2	EPA 3050B–1996 (Rev-2)/EPA 7130-1986
Cr^{+6}	mg/kg	0.1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-	EPA Method - 7196A:1992 (Rev-1)
Pb	mg/kg	5.0	328.19	248.83	170.75	273.81	180.32	211.93	293.14	410.11	248.14	115.82	$ISQG_L$: 50 $ISQG_H$: 220	ISQG: 30.2 PEL: 112.0	EPA 3050B–1996 (Rev-2)/EPA 7420-1986
Hg	mg/kg	0.2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	$ISQG_L$: 0.15 $ISQG_H$: 1	ISQG: 0.13 PEL: 0.70	EPA 7471A-2007 (Rev-2)
PCBs	mg/kg	0.01	0.042	0.024	BDL	0.045	BDL	BDL	0.041	0.096	0.032	0.040	$ISQG_L$: 0.023 $ISQG_H$: NA	ISQG: 0.0215 PEL: 0.189	CTP/SOP/SOIL/132-2014
PBBs	mg/kg	0.01	BDL	BDL	BDL	0.012	BDL	BDL	0.010	0.016	BDL	BDL	-	-	CTP/SOP/SOIL/139-2014
PBDEs	mg/kg	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-	CTP/SOP/SOIL/132-2014
PCN	mg/kg	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-	CTP/SOP/SOIL/151-2014
PAHs	mg/kg	0.05	0.601	0.515	0.429	0.282	0.524	0.512	0.673	2.04	0.799	0.438	$ISQG_L$: 4 $ISQG_H$: 45	-	CTP/SOP/SOIL/147-2014
TBT	mg/kg	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	$ISQG_L$: 0.005 $ISQG_H$: 0.070	-	CTP/SOP/SOIL/158-2014
Methyl mercury	mg/kg	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-	CTP/SOP/SOIL/023

Note may be taken that there is no reference value for Indian conditions. However, for the purpose of adhoc comparison, Australian/New Zealand and Canadian guidelines were used as reference standards.

*1: Australian and New Zealand Guidelines for Fresh and Marine Water Quality, $ISQG_L$: Interim Sediment Quality Guideline-Low, $ISQG_H$: Interim Sediment Quality Guideline-High

*2: Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, ISGG: Interim sediment quality guidelines, PEL: Probable effect level

DL: Detection limit, BDL: Below Detection Limit, NA: Not available

Source: JICA Survey Team

2) JICA additional survey

As per request of GMB, additional sediment survey was implemented in February 2017 (dry season) focusing on parameters that exceeded the sediment guideline values namely cadmium, lead and PCBs in monsoon season. Sampling and analysis were conducted by a leading Japanese consultancy firm (IDEA Consultants Inc.). Sediment samples were taken from the same 10 sites as the supplementary survey. Sampling was done with the same protocol employed in the supplementary survey.

Laboratory analysis was conducted by employing as far as possible a similar method to the ones employed in the supplementary survey. For heavy metals (cadmium and lead), samples were analyzed through two types of instrument namely: AAS and ICP/MS. Table 11-25 shows the results of the sediment quality analysis (the results of the supplementary survey are included for comparison). Results of the particle size analysis is attached as Appendix – 10.

Table 11-25 Results of sediment quality analysis (additional survey)

	Unit	DL	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Australia*1	Canada*2	Analysis method
			17.23	16.40	17.14	16.70	20.45	31.45	21.14	17.83	20.66	33.54	-	-	IS 2720 (Part 2):1973 (R.2010)
			47.9	58.8	60.0	54.5	62.3	42.2	52.0	55.6	58.2	58.0			Gravimetry
			0.84	0.85	0.92	0.88	1.01	0.40	1.01	0.45	0.84	0.95	-	-	FAO Method (Pg. No.61) 2007
			0.46	0.68	0.71	0.63	0.70	0.62	1.00	0.96	0.84	0.74			TOC meter
Particle size (>0.18 mm)	%	-	31.00	27.33	27.28	30.67	32.91	31.08	33.57	29.91	34.06	30.99	-	-	
Particle size (<0.18 mm)	%	-	69.00	72.67	72.72	69.33	67.09	68.92	66.43	70.09	65.94	69.01	-	-	
		2.0	2.84	2.68	BDL	3.21	2.86	2.61	2.42	2.92	2.78	2.85			EPA 3050B–1996 (Rev-2)/EPA 7130-1986
		AAS: 0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL			ISO11047:1998
		ICP/MS: 0.01	0.12	0.11	0.10	0.10	0.14	0.16	0.39	0.27	0.11	0.11			ISO16965:2013
		5.0	328.19	248.83	170.75	273.81	180.32	211.93	293.14	410.11	248.14	115.82			EPA 3050B–1996 (Rev-2)/EPA 7420-1986
		AAS: 8	14	11	12	10	16	14	71	34	9.2	9.9			ISO11047:1998
		ICP/MS: 1	16	12	13	11	15	17	81	42	11	11			ISO16965:2013
		0.01	0.042	0.024	BDL	0.045	BDL	BDL	0.041	0.096	0.032	0.040			CTP/SOP/SOIL/132-2014
		0.01	0.02	0.01	0.01	0.01	0.03	0.06	0.36	0.15	BDL	0.01			ISO13876:2013

Note may be taken that there is no reference value for Indian conditions. However, for the purpose of adhoc comparison, Australian/New Zealand and Canadian guidelines were used as reference standards.

*1: Australian and New Zealand Guidelines for Fresh and Marine Water Quality, $ISQG_L$: Interim Sediment Quality Guideline-Low, $ISQG_H$: Interim Sediment Quality Guideline-High

*2: Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, ISGG: Interim sediment quality guidelines, PEL: Probable effect level

Grey column: Results of JICA supplementary survey.

DL: Detection limit, BDL: Below Detection Limit, NA: Not available

Source: JICA Survey Team

Following are the main findings of the sediment quality survey:

- Particle size of the sediment samples were generally finer (i.e. more silty) compared to the supplementary survey.
- Cadmium concentration was less than 0.5 mg/kg at all the sites, which are lower compared to the supplementary survey (approx. range: 2～3 mg/kg). All sites were below the lower threshold of the Australian and Canadian guideline values.
- Lead concentration was in the range of 10～80 mg/kg, which are lower compared to the supplementary survey (approx. range: 100～300 mg/kg). Sites S7 and S8 are comparable with Australian and Canadian Standards and found exceeded the lower threshold of both the Australian or Canadian guideline value.
- While PCBs concentration was more or less similar to the supplementary survey, sites S5 to S8 were slightly higher than the supplementary survey (approx. range: < 0.01～0.1 mg/kg). Sites S5 and S8 exceeded the lower threshold of either the Australian or Canadian guideline value and site S7 exceeded the upper threshold of Canadian guideline value (0.189 mg/kg). Although PCBs values were relatively high for both surveys, these values are not at a level that will require immediate remedial action in case for example the values are compared with Japan's "Provincial Sediment Removal Standards (1975)" for PCBs, which is set at 10 mg/kg. After PCB Convention came into force in 1978, hardly any vessel contain PCB hence possibility of PCB source from recent vessels beached in last 10 years are scanty.

In the additional survey, cadmium and lead concentration were more or less an order of magnitude lower than the supplementary survey. Possible reasons for these differences are discussed below:

- According to yard operators, there are some seasonal variation in intertidal mud accumulation and distribution. This may be the reason why particle size of the samples was smaller in the additional survey.
- Although sediment samples were taken by referring to GPS data of the supplementary survey, there may have been some slight differences in the actual sampling locations.
- Although heavy metal analysis in the supplementary survey were conducted in accordance to EPA methodologies, erroneous results may be obtained in case the samples were not pretreated sufficiently (e.g. removal of impurities contained in the sample prior to measurement).

(6) Waste

1) Type and quantity of wastes and treatment and disposal methods

Figure 11-23 shows the volume of wastes received at TSDF and the number of beached ships of the past 10 years. Around 5,000-10,000 MT of wastes are received each year at TSDF.

Source: GEPIL

Figure 11-23 Volume of wastes received at TSDF and the number of beached ships

Table 11-26 shows the type and volume of wastes received at TSDF and treatment and disposal methods (statistics between 2015-2016). Volume wise glasswool is highest, occupying almost half of the total received wastes.

Table 11-26 Type and volume of wastes received at TSDF and treatment and disposal methods

Type	Category	Volume (ton)	Treatment/disposal method
Asbestos containing waste	Hazardous	22	Stabilization/Solidification
Bilge water	Hazardous	1,600	ETP
Puff, Thermocol, Booch	Hazardous	110	Incineration
Ceramic	Non-hazardous	10	Landfill
Contaminated sand	Hazardous	106	Controlled landfill
Garbage	Non-hazardous	34	Landfill
Glass	Non-hazardous	6	Landfill
Glasswool	Hazardous	2,362	Controlled landfill
Incinerator ash	Hazardous	8	Controlled landfill
Oily sludge	Hazardous	1	Incineration
Oily rags	Hazardous	42	Incineration
Oily water	Hazardous	2	ETP
Paints and coatings	Hazardous	25	Incineration / Controlled landfill
Plastics	Hazardous	1	Incineration
Others	Hazardous/Non-hazardous	667	Incineration / Controlled landfill
Total		4,996	

Source: GPCB

2) Storage and transport methods of wastes

Once collected from ships, hazardous wastes such as asbestos are packed into specialized containers/bags and temporary stored in the yard at a designated area prior to transportation to TSDF. Hazardous wastes are then transported to TSDF with specialized trucks of TSDF and then are either stored at TSDF waste storage area or undergo treatment/disposal. Bilge water is transported by specialized tank lorry to TSDF.

3) Waste composition survey

The JICA Survey Team conducted waste composition survey to study the chemical composition of wastes generated from ship recycling activities. The survey focused on two types of ships: bulk carrier (built in 1994) and container ship (built in 1996). Component analysis was conducted for PCBs, TBT, asbestos and heavy metals: Following are main findings of the survey:

- PCBs were not detected from the two ships.
- TBT was not detected from the two ships.
- Asbestos was detected from the bulk carrier (from insulation material used in the engine room pipes)
- Heavy metals such as Pb, Cd, As, Co, Mn, Ni and Zn were detected from paints used inside and outside of the ships. Table 11-27 shows the results of component analysis of ship paints.

Table 11-27 Results of component analysis of ship paints

Container						
	Unit	**Hull side**	**Upper side**	**Upper deck**	**Deck side**	**Side deck**
Pb	ppm	160	231	953	824	422
Cd	ppm	ND	44.8	15.8	ND	ND
Hg	ppm	ND	ND	ND	ND	ND
As	ppm	ND	ND	ND	ND	ND
Co	ppm	ND	ND	ND	ND	ND
Mn	ppm	27.3	152	15.7	26.2	86.6
Ni	ppm	ND	ND	ND	ND	ND
Zn	ppm	28,089	53,625	217,391	476	18,458
Cr+6	ppm	ND	ND	ND	ND	ND

Bulk carrier					
	Unit	**Control room**	**Hull side**	**Inside tank**	**Engine room**
Pb	ppm	64	4,501	13.4	442
Cd	ppm	ND	ND	ND	ND
Hg	ppm	ND	ND	ND	ND
As	ppm	ND	ND	16.6	ND
Co	ppm	39	ND	14.5	146
Mn	ppm	38.4	52.2	2,018	87.4
Ni	ppm	17.7	ND	79.9	ND
Zn	ppm	249	186	84	1,632
Cr+6	ppm	ND	ND	ND	ND

Source: JICA Survey Team

11.3.5. NATURAL ENVIRONMENT

(1) Protected area

The nearest protected area is Velavadar Blackbuck National Park which is approximately 75 km north from Alang.

(2) Terrestrial flora/fauna

The EIA conducted terrestrial flora/fauna survey (walk-through survey) in 2015 along the coast near the Project site. Twelve flora species were identified and none were classified as threatened under the IUCN red list. As for fauna, 6 mammal species and 27 bird species identified and none were classified as threatened under the IUCN red list. Table 11-28-Table 11-30 show the identified flora and fauna species.

Table 11-28 Results of EIA flora survey

		Family	Scientific name	IUCN status
1			*Acacia nilotica*	N/A
2			*Prosopis juliflora*	N/A
3		Fabaceae	*Leucaena leucocephala*	N/A
4		Agavaceae	*Agave americana*	N/A
5		Asclepiadaceae	*Calotropis procera*	N/A
6			*Cynodon dactylon*	N/A
7			*Paspalum spp.*	N/A
8		Commelinaceae	*Commelina benghalensis*	LC
9		Asteraceae	*Parthenium hysterophorus*	N/A
10		Chenopodiaceae	*Suaeda maritima*	N/A
11		Asclepiadaceae	*Chamar dudheli*	N/A
12		Zygophyllaceae	*Tribulus terrestris*	N/A

N/A: Not assessed; LC: Least Concern

Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

Table 11-29 Results of EIA fauna survey (mammals)

	Common name	Scientific name	IUCN status
1	Common Mongoose	*Herpestres edwardsii*	N/A
2	Golden Jackal	*Canis aureus*	LC
3	Bengal Fox	*Vulpes bengalensis*	LC
4	House rat	*Rattus rattus*	LC
5	Nilgai	*Boselaphus tragocamelus*	LC
6	Squirrel	*Funambulus pennanti*	N/A

N/A: Not assessed; LC: Least Concern

Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

Table 11-30 Results of EIA fauna survey (birds)

	Common name	Scientific name	IUCN status
1	Red Wattled Lapwing	*Vannelus indica*	N/A
2	Indian Reef Egret	*Egretta gularis*	LC
3	Whimbrel	*Numenius phaeopus*	LC
4	Common Sandpiper	*Tringa hypoleucos*	LC
5	Pariah Kite	*Milvus migrans*	LC
6	Common Crow	*Corvus splendens*	LC
7	Grey Partridge	*Francolinus pondicerianus*	LC
8	Black Ibis	*Pseudibis papillosa*	LC
9	White Ibis	*Theskiornis aethiopica*	N/A
10	Painted Stork	*Mycteria leucocephala*	NT

11	Little Egret	*Egretta garzetta*	LC
12	Drongo	*Dicrurus adsimilis*	LC
13	Koel	*Eudynamis scolopacea*	N/A
14	House Swift	*Apus affinis*	LC
15	White Breasted Kingfisher	*Halcyon smyrnensis*	LC
16	Jungle Babbler	*Turdoides striatus*	LC
17	Large Grey Babbler	*Turdoides molcolmi*	N/A
18	Green Bee-eater	*Merops orientalis*	LC
19	Chestnut Headed Bee-eater	*Merops leschenaulti*	LC
20	Shrike	*Lanius spp.*	-
21	Common Tern	*Sterna hindo*	N/A
22	Brahminy Kite	*Haliastur indus*	LC
23	Brahminy Mynah	*Sturnus pagodarum*	LC
24	Red Vent BulBul	*Pycnonotus cafer*	LC
25	Small Indian Cormorant	*Phalacrocorax niger*	LC
26	Kentish Plover	*Charadius alexandrinus*	N/A
27	Black Winged Stilt	*Himantopus himantopus*	LC

N/A: Not assessed; LC: Least Concern; NT: Near Threatened
Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

(3) Marine fauna

The EIA conducted marine plankton and benthos surveys along the coastal area of the Project site (100 m-2 km area from shore). For planktons, biota and species diversity were studied. For benthos, biota, biomass and species diversity were studied. Table 11-31 shows the location of the surveyed transects.

Table 11-31 Location of surveyed transects

Transect	Location
A	Coast adjacent to Jaspara village (approx. 3.5 km from north-end of ASSRY)
B	Coast adjacent to Sosiya
C	Coast adjacent to Alang Fire Station
D	Coast adjacent to south-end of ASSRY
E	Coast approx. 2 km south from south-end of ASSRY)

Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

Table 11-32 shows the results if the phytoplankton survey. Identified species were *Naviculas* spp., *Coscinodiscus* spp., *Nitzschia* spp., and *Surirella* spp. The Shannon Weaver Index was under 1 at all the sites.

Table 11-32 Results of phytoplankton survey

Stations 0.1 km, 0.5 km, ~2 km		Phytoplankton genera			Shannon Weaver Index
Station A	0.1 km offshore	*Navicula spp.*	*Coscinodiscus spp*	*Nitzschia spp.*	0.99
	0.5 km offshore	*Navicula spp.*	*Coscinodiscus spp*	*Nitzschia spp.*	0.99
	~2 km offshore	*Navicula spp.*	*Coscinodiscus spp*	*Nitzschia spp.*	0.90
Station B	0.1 km offshore	*Navicula spp.*	*Coscinodiscus spp*	*Nitzschia spp.*	0.96
	0.5 km offshore	*Navicula spp.*	*Coscinodiscus spp*	*Nitzschia spp.*	0.96
	~2 km offshore	*Navicula spp.*	*Coscinodiscus spp*	*Nitzschia spp.*	0.68
Station C	0.1 km offshore	*Navicula spp.*	*Coscinodiscus spp*	*Nitzschia spp.*	0.80
	0.5 km offshore	*Navicula spp.*	*Coscinodiscus spp*	*Nitzschia spp.*	0.80
	~2 km offshore	*Navicula spp.*	*Coscinodiscus spp*	*Nitzschia spp.*	0.68
Station D	0.1 km offshore	*Navicula spp.*	*Coscinodiscus spp*		0.69
	0.5 km offshore	*Navicula spp.*	*Coscinodiscus spp*		0.69
	~2 km offshore	*Navicula spp.*	*Coscinodiscus spp*	*Surirella spp.*	0.68
Station E	0.1 km offshore	*Navicula spp*	*Coscinodiscus spp*		0.50
	0.5 km offshore	*Navicula spp*	*Coscinodiscus spp*		0.50
	~2 km offshore	*Navicula spp*	*Coscinodiscus spp*		0.45

Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

Table 11-33 shows the results if the zooplankton survey. Identified species were foraminifera, copepods, decapods, polychaeta and gastropods.

Table 11-33 Results of zooplankton survey

Stations 0.1 km, 0.5 km, ~2 km		Zooplankton Groups			Shannon Weaver Index
Station A	0.1 km offshore	-	-	-	-
	0.5 km offshore	-	-	-	-
	~2 km offshore	Foramenifera	-	-	-
Station B	0.1 km offshore	-	-	-	-
	0.5 km offshore	-	-	-	-
	~2 km offshore	Copepods	Decapods	-	0.41
Station C	0.1 km offshore	Copepods	-	-	-
	0.5 km offshore	Copepods	-	-	-
	~2 km offshore	-	-	-	-
Station D	0.1 km offshore	Copepods	Foramenifera	-	0.64
	0.5 km offshore	Copepods	Foramenifera	-	0.64
	~2 km offshore	Copepods	-	-	-
Station E	0.1 km offshore	Copepods	Polychaeta	Gastropods	1.04
	0.5 km offshore	Copepods	Polychaeta	Gastropods	1.04
	~2 km offshore	Copepods	Polychaeta	Foramenifera	0.80

Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

Table 11-34 shows the results if the benthos survey. Identified species were polychaeta, bivalves and crabs.

Table 11-34 Results of benthos survey

Stations 0.1 km, 0.5 km, ~2 km		Benthic Groups		Total Biomass (g/m^2)	Shannon Weaver Index
Station A	0.1 km offshore	-	-	-	-
	0.5 km offshore	Polychaeta	Bivalves	5.5	0.27
	~2 km offshore	-	-	-	-
Station B	0.1 km offshore	Polychaeta	-	0.1	-
	0.5 km offshore	Polychaeta	-	0.1	-
	~2 km offshore	Polychaeta	-	0.05	-
Station C	0.1 km offshore	Polychaeta	-	0.1	-
	0.5 km offshore	Polychaeta	-	0.1	-
	~2 km offshore	Polychaeta	-	1.8	-
Station D	0.1 km offshore	-	-	-	-
	0.5 km offshore	-	-	-	
	~2 km offshore	Polychaeta	Crabs	27.8	0.37
Station E	0.1 km offshore	-	-	-	
	0.5 km offshore	-	-	-	-
	~2 km offshore	Polychaeta	Crabs	4.5	0.53

Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

In addition to the above surveys, the EIA conducted benthos survey in the more nearshore area of each transect. Main species identified were polychaetas, gastropods, bivalves and crabs. Table 11-35 shows the results of the nearshore benthos survey.

Table 11-35 Results of nearshore benthos survey

Transect	Identified species
A	Polychaete (*Neries* sp.), Gastropods (*Trochus* spp., *Telescopium* spp*), Bivalve (*Donax* spp., *Sunetta* spp.*), Rock Oyster*, Fiddler Crab, Hermit Crabs
B	Gastropods (*Trochus* spp., *Pseudomoris* spp., *Clavus* spp.), Acorn barnacles (*Balanus* spp.), Rock Oyster, Pistol Shrimp, Goby fish (*Parachaeturichthy* spp.)
C	Gastropods (*Cerithidae* spp.*), Bivalve (*Donax* spp .), Polychaete colonies
D	Polychaete colonies, Gastropods (*Trochus* sp., *Clavus* spp*, *Cerithium* spp*, *Clypeomorus* spp.*), Sea Slugs (*Sedadoris* sp.), Crabs (*Matuta lunaris*, *Graspu*s spp, *Macropthalamus* spp.)
E	Polychaete colonies, Gastropods (*Trochus* sp, *Cerithium* spp*), Bivalve (*Donax* spp.)

*: Empty shell
Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

The EIA also analyzed the heavy metal content inside a crab species (*Matuta lunaris*) caught near the Project site. Table 11-36 shows the analysis results.

Table 11-36 Analysis results of heavy metal content inside *Matuta lunaris*

Parameter	Concentration (µg/g)
Zn	0.23
Pb	0.08
Cu	8.6
Cr	$2.1x10^{-4}$

Cd	$3.2x10^{-5}$

Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

(4) JICA supplementary survey

The aim of the survey was to analyze the TBT concentration inside benthic species inhabiting the intertidal area of the ship recycling yards. However, the field survey team could only collect one live specimen namely a small crab. The crab was analyzed at the laboratory but no TBT was detected (DL: 0.01 mg/kg).

11.3.6. SOCIAL ENVIRONMENT

The JICA Survey Team conducted social survey (hereafter called "JICA Social Survey") in June 2016 to understand the current social and economic status of Alang, Manar and Sosiya village, the neighboring villages of Alang Sosiya Ship Recycling Yard. The survey was implemented by subcontracting Market Insight Consultants. At each of the three villages, 30 locals were randomly interviewed covering topics such as demography, livelihood, health and opinions on the Project. Section 11.2.2 provides an overview of the social environment of Alang, Manar and Sosiya villages based on the JICA Social Survey and existing information.

(1) Population

According to the Census 2011, the total population of Alang, Manar and Sosiya villages is approximately 13,000. Female sex ratio against 1,000 male is 918 (Alang-Manar village) and 935 (Sosiya village), which is similar to the average ratio of Bhavnagar district. Percent working population is around 40%, which is similar to Bhavnagar district. Table 11-37 shows demographic composition of Alang, Manar and Sosiya villages.

Table 11-37 Demographic composition of Alang, Manar and Sosiya Village

	Bhavnagar district	Alang-Manar village	Sosiya village
Population	2,880,365	8,309	3,467
Household	538,605	1,443	576
Female ratio (against 1,000 male)	933	918	935
Working population (%)	40%	40%	37%

Source：Census of India 2011

(2) Livelihood

Figure 11-24 shows the main source of income of the villagers interviewed in JICA Social Survey (30 people from each village of Alang, Manar and Sosiya). When the three villages are combined, 40% of the villagers were engaged in agriculture and animal husbandry, 30% in ship recycling related work and 16% in small shops. The results shows relatively high dependence on ship recycling at these villages, and in fact for Alang village and Manar village, ship recycling work was the most prominent source of income comprising 40% and 37% of the interviewees respectively. Some of the villagers that were engaged in small shops, work at the restaurants and retail shops along the road behind ship recycling yards, which mainly cater for ship recycling workers. These villagers are also indirectly dependent on the ship recycling industry.

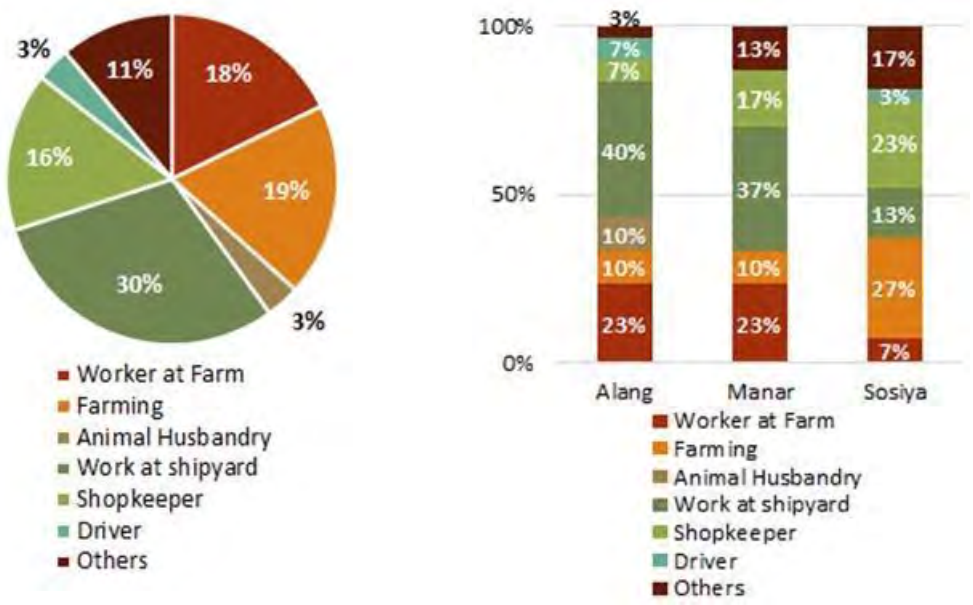


Figure 11-24 Type and ratio of income sources of interviewed Alang, Manar and Sosiya villagers
Survey subjects: 30 people in each village of Alang, Manar and Sosiya village (total of 90 people)
Source: JICA Survey Team

Table 11-38 shows the income level of villagers interviewed in the JICA Social Survey who are engaged in agriculture and ship recycling related work. Income level of owner farmers is the same level as experienced ship recycling workers which is in the range of INR 10,000 to 15,000 per month. Income of employed agriculture workers and inexperienced ship recycling workers are more or less at the same level which is around INR 5,000 to 8,000 per month.

Table 11-38 Income level of interviewed villagers engaged in agriculture and ship recycling related work

Occupation	Income level (INR/month)
Agriculture (owner farmer)	10,000-15,000
Agriculture (employed worker)	5,000-8,000
Ship recycling (experienced worker)	10,000-15,000
Ship recycling (inexperienced worker)	7,000-8,000

Survey subjects: 30 samples from each village in Alang, Manar and Sosiya village (total 90 samples)
Source: JICA Survey Team

(3) Fishery

Since the nearshore area around Alang/Sosiya Ship Recycling Yard is designated as a port area, fishing activities are prohibited inside the designated port areas. However, it is learnt that there is no fishing activities reported within the vicinity of Ship Recycling Yard towards sea side. While some fish traps were observed in the intertidal areas outside of the recycling yards, these are unlikely to be affected. None of the interviewed villagers in the JICA Social Survey were engaged in fishery.

(4) Land Use

Figure 11-25 shows the land use map around the project site. Large portion of the hinterland of ship recycling yard (red) are agriculture land (yellow) and horticulture land (light green).

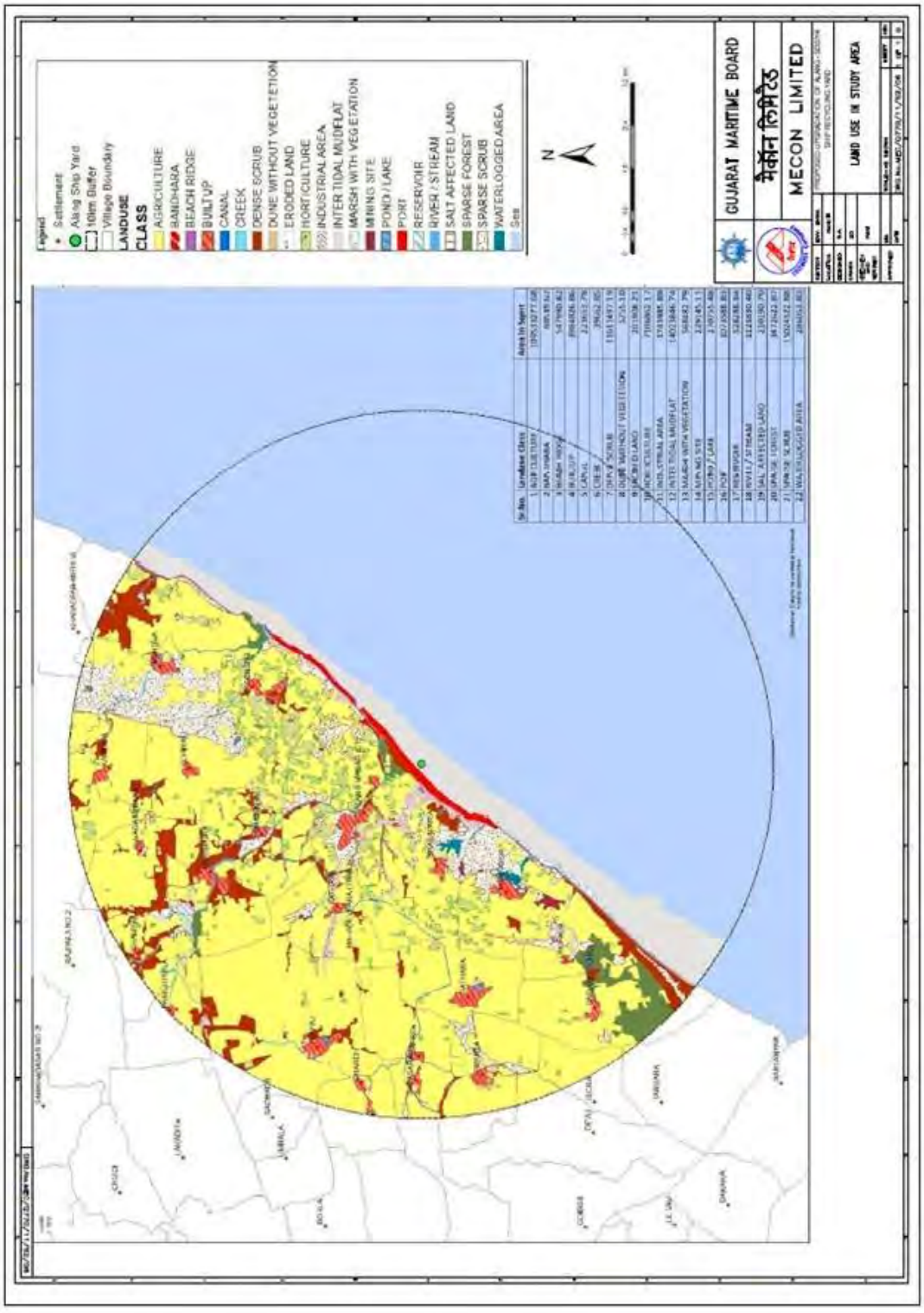


Figure 11-25 Land use around the Project site

Source : GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

(5) Social infrastructure

1) Water and sanitation

Water supply to Alang Yard is supplied through pipeline from Gujarat Water Supply Board. Capacity of the clean water supply is 3 million litre per day whereas requirement is around 1.6 to 1.8 MLD so as such there is no issue of water supply. However, during summer for about one month sometime there is shortage of water supply so fresh water supply through tankers are provided to fulfill the balance requirement. The sewage system is under planning.

2) Educational institution

Educational institutions in the villages are primary school to upper primary school and the highest class is 8 standards. There are 5 schools in Alang village, 3 schools in Manar village and 2 schools in Sosiya village.

3) Medical facility

Main hospitals in Alang Sosiya Ship Recycling Yard are Alang Hospital and Red Cross Hospital. Both hospitals cater for ship recycling workers and surrounding villagers. There are also small private clinics in the villages but are only capable of first-aid treatment.

(6) Level of education

According to Census 2011, male literacy rate in Alang-Manar village and Sosiya village are above 80% whereas female literacy rate is 55 to 60% which is lower than male. Table 11-39 shows the literacy rate in Alang-Marnar village and Sosiya village.

Table 11-39 Literacy rate of Alang-Manar village and Sosiya village

	Bhavnagar district	Alang-Manar village	Sosiya village
Average (%)	75.52	72.53	70.13
Male (%)	84.39	82.44	83.73
Female (%)	66.08	61.87	55.43

Source: Census of India 2011

(7) Religion

According to Census 2011, majority of the population in Alang-Manar village are Hindu (97.28%) and the rests consist of Muslim (2.47%), Jain (0.18%) and others.

(8) Caste

Table 11-40 shows the proportion of scheduled castes and scheduled tribes in Alang-Manar village and Sosiya village. Scheduled castes in Alang-Marnar village is 5% of the population which is higher than the average of Bhavnagar district. On the other hand, population of schedule tribe is 0.18% in Alang-Manar village and non-existent in Sosiya villages which are below the average of Bhavnagar district.

Table 11-40 Ratio of scheduled caste/tribes population in Alang-Manar village and Sosiya village

	Bhavnagar district	Alang-Manar village	Sosiya village

Scheduled castes (%)	2.99	4.12	0.43
Scheduled tribes (%)	0.50	0.18	0.00

Source: Census of India 2011

(9) Health

Health issues in relation to ship recycling industry were not confirmed from the interviewed villagers during JICA Social Survey.

(10) Opinions on the Project

Followings are the opinions on the Project expressed by villagers interviewed in JICA Social Survey.

- Increasing employment opportunities from ship recycling related work
- Improving living standard by having easy access to daily necessity goods
- Concern about traffic congestion, traffic accidents and pollution due to increase in vehicle traffic.
- Concern about noise and vibration from ship recycling yard
- Concern about possible disturbance of lifestyle and deterioration of public safety due to increasing influx of migrant workers

According to GMB, it is revealed that the Ship Recycling Yard is in operation since in 1982 and thereafter prosperity of village surrounding to the yard is many more time increased. Hence the above issues are common issues like other industrialization seen in any country.

11.3.7. WORKING ENVIRONMENT OF SHIP RECYCLING INDUSTRY

In order to understand working environment of ship recycling workers, total of 60 workers were interviewed as a part of JICA Social Survey. Based on the JICA Social Survey and existing information, following section outlines the current working environment in Alang Sosiya Ship Recycling Yard.

(1) Legal framework on working condition

1) Occupational safety

Occupational safety is regulated by India Factories Act 1948 and Gujarat Factories Rule 1963. In Gujarat Factory Rules 1963, industry wise safety regulations are specified and ship recycling industry falls under “ship building, ship repairing and ship recycling industry (68-H)”.

2) Labour insurance

In accordance to Employees’ State Insurance Act 1948, it is mandatory for workers to join labour insurance (Employees State Insurance: ESI). Under ESI, workers are entitled to receive financial support for their medical services[11]. Also, in case of an accident, compensation will be

[11] According to Alang Hospital, government is responsible for 60% of insurance whereas employers and employees cover 20% respectively. Some recyclers (employers) also covers the portion of employees.

made towards worker's families from the employers based on Public Liability Insurance Act 1991.

(2) Current condition of workers

1) Number of workers

The number of workers employed in ship recycling yards fluctuates depending on the ship recycling demand. Based on the information provided from GMB and Alang Sosiya Ship Recycling General Workers Association (ASSRGWA), the number of workers is usually around 20,000 of which most are male.

2) Home state of workers

Most of the workers employed in ship recycling yards are migrant workers from outside Gujarat state, majority of which are from impoverished states in northern India. Home states of the workers interviewed in JICA Social Survey were Orissa (47%), Bihar (27%), Jharkhand (13%) and Uttar Pradesh (12%). These four states constituted 99% of the total interviewed workers.

3) Age and year of experience of workers

Around 70% of the workers interviewed in the JICA Social Survey were aged between 25-40 years old. Around 70% of the workers had less than 10 years' experience in ship recycling work, and around 40% less than 1 year of experience. Workers with more than 10 years' experience were around 12%.

(3) Occupation type and wage

1) Occupation type

Based on the interview at the recycling yards, around 100 to 150 workers are required to dismantle one ship. Each yard employs workers in different positions including managers in charge of worker's safety and recycling processes, crane and winch operators, gas cutters, and unskilled workers handling non-ferrous metal, ropes and steel plates.

2) Workers' wage

Depending on the position of workers, required skill differs and so does their wage level. Monthly wage for supervisor level is INR 15,000, heavy equipment operator is INR 17,000, gas cutter is INR 10,000 and unskilled worker is between INR 8,000 to 10,000. Table 11-41 shows position-wise wage level of workers.

Table 11-41 Position-wise Salary Level of Workers

Position	Required skill	Wage (INR/month)
Health Safety Environment Manager	Related educational background	
Plot Manager	Skilled worker	
Safety Officer	Educational background &experience	17,000-20,000
Plot supervisor (Mukadam)	Skilled worker	15,000
Crane Operator	Skilled worker	17,000
Winch Operator	Skilled worker	15,000
Gas cutter（Battiwala）	Unskilled worker	10,000

Non-ferrous metal segregation (Malpani) Steel plate/ rope handling (Jodiwala) Loader Helper	Unskilled worker Unskilled worker Unskilled worker Unskilled worker	8,000-10,000 (depends on the years of experience)

Source: JICA Survey Team

(4) Occupational accidents

1) Status of accidents

Figure 11-26 shows the probable causes of fatal accidents in Alang Sosiya Ship Recycling Yard. Major causes of fatal accidents are fire and explosion (26.40%), falling from height (19.47%) and struck by falling objects (17.07%).

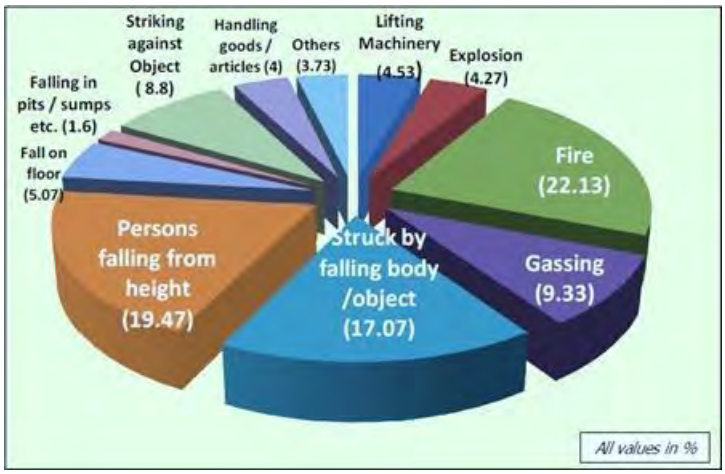


Figure 11-26 Causes of fatal accidents in Alang Sosiya Ship Recycling Yard

Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

Table 11-42 shows the statistics of accidents during 2011-2015 in Alang/Sosiya based on the report by European Community Ship owners' Associations (ECSA). There were 41 cases of fatal accidents and 19 cases of injury accidents during this 5 years period. Major causes of fatal accidents were fire and explosion, falling from heights, struck by falling object and breakage of winch wire and entrainment. The statistics shows that over 70% of the fatal accidents occurred onboard. Accidents caused by fire/explosion and falling from heights commonly lead to death.

Table 11-42 Statistics of accidents during 2011-2015

Causes of accidents	Location	Injury	Death
Fire and explosion (in pump, engine room and during gas cutting)	On board	2	11
Falling from heights	On board	—	10
Struck from falling object including cutting block (Gas cutting)	On board	5	9
Crane operation (Struck from falling object)	Yard	4	6
Winch operation (wire breakage, entrainment)	Yard	8	5
Total	-	19	41

Source: Prepared by JICA Survey Team based on ECSA Technical Report "ECSA Fact Finding Visit to Indian Ship Recycling Yards Alang-Sosiya, April 2016"

2) Safety measures

Followings are the main safety measures employed at recycling yards ("well-managed") to avoid above mentioned accidents.

a. Measures against fire and explosion

As per Ship Breaking Code 2013, as a condition of obtaining Breaking Permission from GMB, the ship recycler is required to obtain hot-work certificate from DISH. In addition, some yards double-check enclosed spaces with gas meters for presence of explosive and toxic gas mixtures prior to workers entering such areas.

b. Measures for working at height

Application of safety belts on workers and warning tapes at the deck edges are being practiced as a basic safety measures while working at heights. Since the majority of the accidents occur on board, those works are commonly assigned to workers having over 10 years of experiences.

c. Measures for winch operation

As a precautionary measure against winch line snapping, winch line and other parts are regularly inspected for any damage. The winch is also fenced to protect the winch operators from accidental snapping of the winch line.

d. Personal Protective Equipment (PPE)

In most yards, basic PPEs including helmet, shoes, clothes and gloves are worn by the workers throughout the recycling process. For gas cutting works, masks and safety goggles are also used by the workers.

e. Safety training

It is mandatory for the workers to take basic training courses at Safety Training & Labour Welfare Institute operated by GMB before they are employed at ship recycling yards. However, since there is limited practical training within the basic training courses, workers are further trained through OJT by HSE officers and skilled workers in each yard.

(5) Health status of ship recycling workers

As part of the JICA Social Survey, workers were interviewed regarding their health issues. However, no health issues or complains were raised by the interviewed workers. Therefore, in order to further investigate workers' health issues, results from past workers' medical checkup at the yards and information provided by the hospitals in Alang Sosiya Ship Recycling Yard were studied. In addition, past studies of Indian research institution were also reviewed.

1) Result of worker's medical checkup

India Factory Act (1948) and Gujarat Factories Rules (1963) stipulate that it is made mandatory for the employers to conduct medical examination of their workers at pre-employment stage and also periodically during the employment period by a medical doctor certified by Directorate of Industrial Safety and Health (DISH). In Alang Sosiya Ship Recycling Yard, as per the regulation, DISH certified medical doctor is conducting the medical checkup by visiting each yard at a frequency of once every 6 months. The checkup covers simple physical and medical examination

items as per Gujarat Factories Rules (1963). According to one of the DISH certified medical doctor who has been examining workers in Alang Sosiya Ship Recycling Yard for the past 10 years, common symptoms among the workers are skin diseases and hypertension.

In addition to the above medical checkup, one NK certified yard voluntarily had conducted further medical checkup of its workers for the past 12 years. According to the yard owner, some workers have cough and skin issues but no asbestos related symptoms have been identified so far. The owner informed that cough was noticed mainly among cigarette smokers and the main causes of skin issues was likely to be attributed to unhygienic living conditions. With regards to skin issues, the expert from National Institute of Occupational Health (NIOH) pointed out the possibility of exposure to glasswool fiber as one cause of skin issue as per their study in the year 2007 but presently no workers are exposed to glasswool fibers as workers are wearing PPEs. Table 11-43 shows further information on the above mentioned medical checkups including the examined items.

Table 11-43 Results of medical checkup of workers in Alang Sosiya Ship Recycling Yard

	DISH certified medical doctor (periodical checkup)	A NK certified ship recycler (occupational specific items conducted in addition to periodical checkup)
Years of medical checkup conducted	10 years	12 years
Medical checkup item	• Physical examination (height, weight, blood pressure, ear, eyes, skin) • Medical examination (Respiratory system, nervous system, circulatory system, endocrine system)	• All workers: Complete blood count (CBC), urine check • Jodi (plate loader often work close to winch): Auditory • Gas cutter: Pulmonary • Waste handler and cleaner [12] : Pulmonary, Sputum, Chest X-ray
Main symptoms	Skin disease, hypertension, etc.	Cough, Skin issues (itching and radish spot)

Source: JICA Survey Team

2) Information of patients visited the hospitals in the Alang/Sosiya

The main hospitals located in Alang Sosiya Ship Recycling Yard are Alang hospital and Red Cross hospital and both cater for ship recycling workers and surrounding villagers. In both hospitals, around 10% of the visited patients were for injuries sustained during ship recycling works. The proportion of workers and residents is unknown but other common symptoms reported by both hospitals were skin diseases and respiratory issues.

In addition, Red Cross Hospital has conducted chest X-ray test for ship recycling workers during 2006 to 2009. Based on the information provided, around 10-20% of workers showed some kind of abnormalities including bronchitis, pneumonitis and so on. According to the doctor in Red Cross Hospital, there were no cases of asbestosis identified from those tests. Table 11-44 shows the outline of patients visited and examined at Alang Hospital and Red Cross Hospital.

[12] Additional medical checkup items for waste handler and cleaner are in line with the requirement set for Asbestos removal workers by Gujarat Factories Rule 1963.

Table 11-44 Summary of patients visited Alang Hospital and Red Cross Hospital and major symptoms identified

	Alang Hospital	Red Cross Hospital
No. of patients	30-45 ppl/day (2015-16)	21,801 ppl/year (2015-16)
Main symptoms	• Minor injury: 2-5 ppl/day (6-10%) • Serious injury: 3-5 ppl/month • Respiratory • Skin disease • Others: high blood pressure, malaria, malnutrition, heat stroke, etc.	• Injury: 1,834 ppl (8%) (Sutures, broken bones, burns, etc.) • Skin disease: 1,500-1,600 ppl (6-7%) • Respiratory: 400-500 ppl (1-2%) • Others: cold, cough, fever, joint pain, diarrhea, swelling of legs, stomachache, etc.
Result of chest X-ray test	N/A	80-150 workers were examined during 2006-2009. Out of which, 10-20% showed abnormality including pneumonia, bronchitis, minor heart enlargement, etc.

Source: JICA Survey Team

3) HIV/AIDS

According to the annual report (2015-2016) published by National AIDS Control Organization (NACO), adult HIV prevalence rate in Gujarat state is 0.42% which is the sixth highest prevalence rate among India. In Alang/Sosiya, India Red Cross Society (IRCS) has been conducting statistical survey since 2012 and it is reported that the adult HIV prevalence rate in the area was 0.23% in 2015 which is the same level as the national average.

As for the ship recycling workers in Alang/Sosiya, Bhavnagar Blood Bank carried out the survey targeting 2,155 workers in 2004. Based on the survey, HIV prevalence rate was 0.70% which is higher rate than Gujarat state and the Indian national average.

(6) Living condition of workers

Residential facilities of ship recycling workers are clustered along the road behind the ship recycling yard. Majority of the workers are living in dormitories provided by ship recycling yards, self-made wooden house and rented shanty dwellings, etc. GMB is in catering sanitary facilities across the 10 km stretch of ASSRY. At present, there are total of seven such complexes in operation.


Dormitory provided by ship recycling yards


Self-made wooden house


Rented shanty dwellings

Figure 11-27 Workers' residential facilities located behind the ship recycling yard

Source: JICA Survey Team

(7) Construction Plan of Labor Housing Complex

At present, approximately 15,000 workers are directly employed in the ship recycling industry in the Alang/ Sosiya area. Depending on the season, the numbers of directly employed workers will vary from 15,000 to 50,000 and indirectly employed workers as many as 100,000 to 300,000 in related activities. Workers are mostly migrant workers from the country side such as Orissa, Uttar Pradesh, Bihar, Jharkhand, and West Bengal. These workers live in dormitory arranged by ship recyclers or nearby slums.

They stayed in the lodgings prepared by recycling yards of the employer and in the slums of neighboring villages, and their living environment is insufficient sanitary facilities and poor living environment. To improve the living condition of the workers, the residential facility was planned to be developed in several phases. According to the plan, 8 hectares will be developed in total and ultimately the facility will be capable of accommodating more than 6,700 workers.

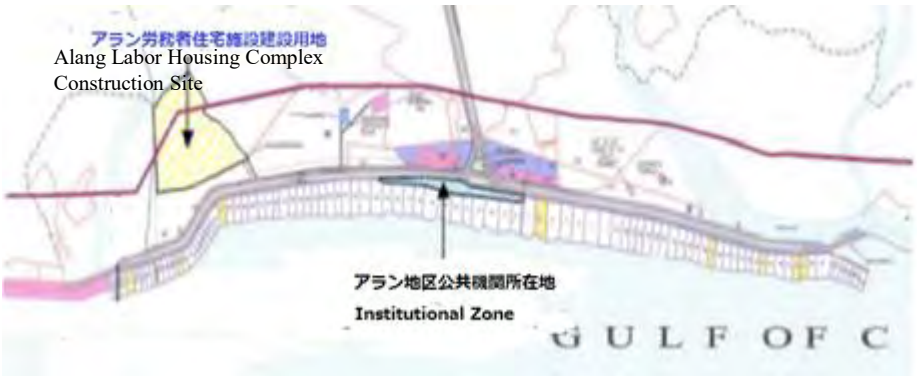


Figure 11-28 Location of the Labor Housing Complex
Source: JICA Survey Team

1) The First Phase of the Project

The construction plan for the first stage of labor housing is shown below. The ship recycling industry is supported by migrant workers from other states. In recent years as the development of industry in the whole country, securing workers who come to work in Alang / Soshiya gradually becoming difficult. Therefore the ship recycler raises the salary level to secure the labor force, striving to secure labor force by providing accommodation facilities, etc. Workers' colonization is becoming an urgent issue along with compliance with the Ship Recycling Convention. Also at SBC 2013, the recycler is obliged to prepare its own dormitory etc.

However, in reality, hinterland of the service road of recycling facility is owned and managed by GMB and since the regulation of CRZ is required within 500 m from the coastline, it is difficult to prepare accommodation facilities themselves, except for the recyclers who borrowed some hinterlands.

GMB has acquired 104,072 ㎡ of land at Alang for developing the labour housing project.
In 2012 GMB and SRIA decided to start the first phase of Alang Labor Residential Complex for 1,008 workers on the said land of GMB. The facility is planned to include seven (7) buildings of labors, dormitories, cafeteria, roads, water supply, sanitation facilities, electricity and other related infrastructures. On July 2016, the First Phase of the Project, construction of 7 buildings of Labors Housing Complex was completed successfully.

2) Details of phase -1

a. Area of each dormitory 450 sq.mt
b. 7 buildings of 3 floors – (G+2) dormitories
c. Total dwellers in each unit 144 (16 pers x 9 rooms=144 x 7 buildgs..= 1,008 pers.)
d. 1 Canteen Building, 1 Office Building
e. Total area / ground coverage 3,150 sq.mt
f. Total floors of each unit G +2

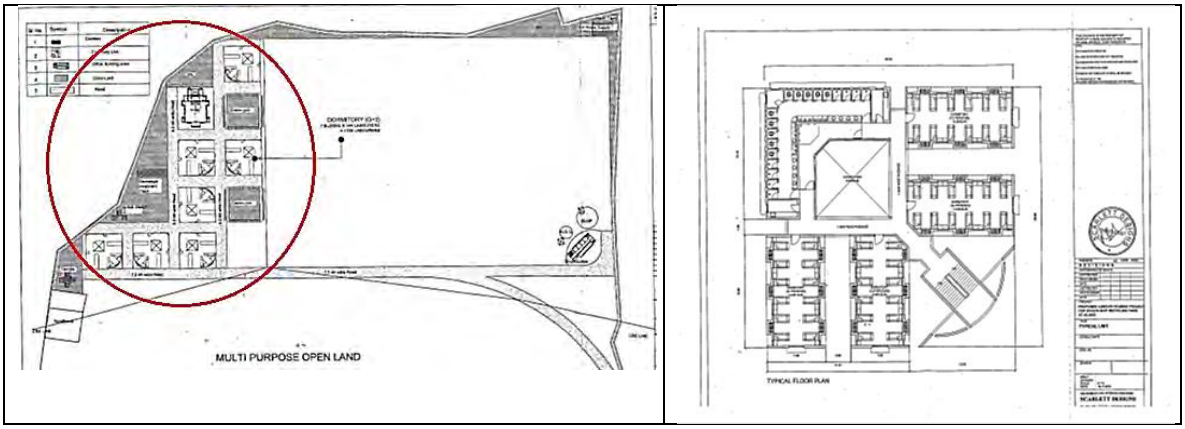


Figure 11-29 Construction of 7 Buildings and Ancillary Facilities, Floor Plan (12 beds x 4 rooms)

Labors Housing (June 2016)

Labors Housing (completed Aug. 2016)

3) Application of prospective dwellers for the Labours Housing Complex

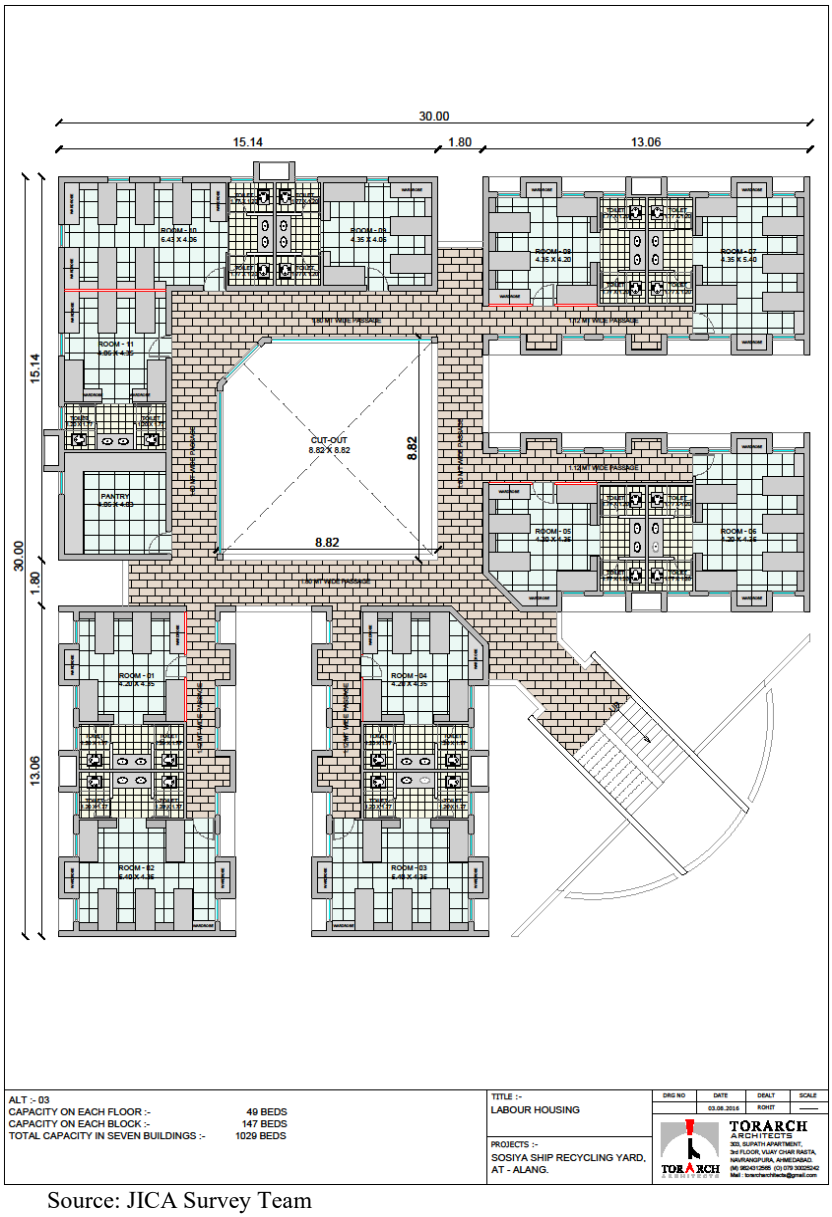
According to GMB and SRIA, they have started to call dwellers for the new housing. However this resulted only 180 applications for the capacity of 1,008 beds. Possible reason may be because of the workers from different home state, with different culture and religious background and further more different castes and different culture of eating and they do not want to live together. For some of the workers the colony is situated very far from their place of work.

In order to find measures to improve such issues, preparation for colonization of workers, safe and hygienic accommodation is required and following recommendation shall be considered as possible solution with the discussion between SRIA and GMB.

a. Since the workers are so diverse, the dormitory of 16 beds for 1 room is not realistic. It should be divided into smaller rooms for 4-5 dwellers.
b. Management system of the labors colony should be established in the earliest stage including management body, basic rules to be kept by the dwellers, basic assignment of the buildings, floors and rooms considering the diversities of the dwellers such as their native place, language, their present employers and their castes if necessary.
c. For each building and each room some security measures should be taken to avoid stealing or robberies of individual property.

d. Some change may be required for the canteens if necessary ;such as separate cooking space and separate dining space etc.
e. Construction of community center where the members of the labor community tend to gather for group activities, social support, public information and other activities such as functions of celebration of various occasions and traditions, open meetings and social gathering is required.

Among the above, it is proposed to change the present plan of a room for 12-person by dividing into a small room for 5 and 4 persons and to place a toilet and washroom between the above small rooms exclusively for each room.



Source: JICA Survey Team

Figure 11-30 Proposed Change of Room Plan for Workers

(8) Workers' opinions on the Project

Followings are the opinions and concerns towards ship recycling by workers interviewed in JICA Social Survey.

- Poor living conditions with issues of access to drinking water
- Concerns about the risk of accidents
- Compensation for injury is not paid as agreed amount or its delay in payment[13]
- No wage payment for sickness absence[14]
- Concerns about unstable employment

According to GMB, the above opinions and concerns are not true as present regulation about safety health and environment are already covered under Ship Breaking Code 2013 enforced.

11.4. ANALYSIS OF ALTERNATIVES

11.4.1. WITHOUT PROJECT OPTION

While there will be no construction related impacts, the following issues are likely to arise without this Project:

- The global ship breaking capacity will become limited if the number of HKC certified ship recycling yards in Alang/Soisya do not increase. This may result in a global increase in old and unsafe ships.
- The ASSRY may lose its competitiveness against other countries, which may result in the decline of the ship recycling industry in the region. This will subsequently lead to the decline in employment opportunities and regional economy.
- Environmental risks from ship recycling activities will remain as present.

11.4.2. ANALYSIS OF ALTERNATIVES OF SHIP BREAKING METHODS

The following four types of ship breaking methods are compared to analyze the most suitable option for the ASSRY, taking into account environmental impacts, costs, labor safety and so on. Table 11-45 shows the results of the alternative analysis.

Option 1: Ship breaking by beaching method as done presently

Option 2: Pre-removal of hazardous material at a new dry dock and then ship breaking by beaching method

[13] Compensation for injuries is within the scope of ESIC coverage, therefore medical benefits can be received by paying the insurance premiums. However, during JICA Social Survey, some workers informed that if the workers are uninsured by ESIC or if the treatment was performed in non ESIC registered hospitals, medical expenses shall be paid by workers first and then refunded by the yard owner.

[14] According to India Factory Act (1948) and Gujarat Factories Rules (1963), for those who have worked 240 days in the previous year are entitled to receive paid holidays or sickness absence by submitting a Medical Certificate with the information of the reason of absence and duration which is issued by registered or approved doctors. Also, ESIC will cover 70% of wages as sickness benefit to the workers who have contributed for about 3 months in the period of 6 months.

Option 3: Pre-removal of hazardous material at a new berthing facility and then ship breaking by beaching method

Option 4: Ships will be broken on land by constructing a new slipway at each yard

Table 11-45 Results of analysis of alternatives	**(1) Beaching method**	**(2) Dry dock + beaching method**	**(3) Berth + beaching method**	**(4) Slipway method**
Required construction works / facilities	・ Improvement of existing yard (concrete pavement, rainwater collection facilities etc.)	・ Construction of drydock ・ Capital and maintenance dredging ・ Improvement of existing yard (concrete pavement, rainwater collection facilities etc.)	・ Construction of berthing facility ・ Capital and maintenance dredging ・ Improvement of existing yard (concrete pavement, rainwater collection facilities etc.)	・ Construction of slipway and associated facilities (winch, cradle etc.) ・ Capital and maintenance dredging ・ Improvement of existing yard (concrete pavement, rainwater collection facilities etc.)
Construction / operation costs	Lowest as only yard improvement is required with minimum maintenance cost	Significantly higher than beaching method as construction and maintenance costs of dry dock are required	Significantly higher than beaching method as construction and maintenance costs of berthing facility are required	Significantly higher than beaching method as construction and maintenance costs of slipway are required
Main pollution risks	・ There is risk of pollution from ship paints as pre-removal is not possible	・ There will be no risk of pollution from ship paints as they can be pre-removed at dry dock ・ Water pollution associated with dredging	・ There is risk of pollution from ship paints as pre-removal is not possible ・ Water pollution associated with dredging	・ There is risk of pollution from ship paints as pre-removal is not possible ・ Water pollution associated with dredging
Main impacts on natural environment	・ Possible impacts on marine organisms through pollution of intertidal area	・ Loss of habitat due to construction of dry dock ・ Possible impacts on adjacent coastal areas (e.g. coastal erosion) due to construction of dry dock ・ Water pollution from dredging activities may impact marine organisms	・ Possible impacts on marine organisms through pollution of intertidal area ・ Loss of habitat due to construction of berthing facility ・ Possible impacts on adjacent coastal areas (e.g. coastal erosion) due to construction of berthing facility ・ Water pollution from dredging activities may impact marine organisms	・ Possible impacts on marine organisms through pollution of intertidal area ・ Loss of habitat due to construction of slipway ・ Possible impacts on adjacent coastal areas (e.g. coastal erosion) due to construction of slipway ・ Water pollution from dredging activities may impact marine organisms
Risk of accidents	No change in risks from present	Same level of risk as beaching method as ship breaking method does not change	Same level of risk as beaching method as ship breaking method does not change	Level of risk less than beaching method as ship breaking is

Table 11-45 Results of analysis of alternatives	**(1) Beaching method**	**(2) Dry dock + beaching method**	**(3) Berth + beaching method**	**(4) Slipway method**
				conducted on land where safety is easier to manage
Main health risk to workers	There are health risks associated with exposure to asbestos and gas-cutting fumes	Same as beaching method	Same as beaching method	Same as beaching method

Source: JICA Survey Team

As per the alternative analysis, beaching method is considered most appropriate for ASSRY for the following reasons:

- Technical aspect: High level of maintenance work is required for non-beaching methods.
- Cost: Beaching method requires the least investment for construction and maintenance and favorable in ASSRY in terms of geographical features.
- Social: High operational cost of non-beaching methods may result in loss of competitiveness of ASSRY, which may result in the decline of the ship recycling industry in the region.
- Environment: Dry-dock method will eliminate the risk of pollution by ship paints. The merit of dry-dock however is likely to become less in the future as ships using hazardous paints are likely to gradually decrease through recent enforcements. Non-beaching methods will have additional potential environmental impacts such as loss of habitats, coastal erosion and dredging associated water pollution.
- Labor: No major difference between the four methods.

11.5. SCOPING AND TOR OF THE EIA STUDY

The potential environmental impacts of the Project were identified initially through a scoping exercise, covering the construction and operation phases. The scoping process identifies the impacts that are likely to be of most importance and eliminates those that are of little concern.

Scoping was conducted by referring to the current environmental status, opinions of stakeholders and JICA's "Guidelines for environmental and social considerations (2010)", which provides a list of items to be considered in the scoping process. The potential impacts of each scoping item were rated in accordance to the following criteria:

A+/-: Significant positive/negative impact is expected.

B+/-: Positive/negative impact is expected to some extent.

C+/-: Extent of positive/negative impact is unknown.

D: No impact is expected

Table 11-46 shows the results of the scoping including the rationale behind the rating. Note that the alleviating effects of mitigation measures were not considered in the evaluation. The table also shows the TOR of the EIA study for items identified with potential negative impacts.

Table 11-46 Results of scoping

	Item	Phase	Rating	Rationale	TOR of JICA EIA study
		C	B-	Dust and exhaust gas emissions from construction works may temporary affect the local air quality.	・Consider impacts by identifying major air pollution sources by referring to the construction plan.
		O	B+	Fugitive dust emissions from ship recycling yards are likely to decrease due to new concrete pavement.	—
		O	A-	The following air pollution sources may have significant impacts on air quality: **TSDF:** ・Stack emissions from existing and new waste incinerators. ・Exhaust gas emissions from waste transport vehicles. **Yard:** ・Asbestos dispersion and leakage of refrigerants (e.g. ODS and GHG) through ship breaking activities. ・Emission of toxic fumes from gas cutting works.	**TSDF:** ・Consider accumulative impacts of waste incinerators by referring to the air dispersion simulation undertaken in the EIA. ・Consider impacts by predicting future traffic volume of waste transport vehicles. **Yard:** ・Consider impacts by investigating current asbestos handling practices and implementing asbestos survey. ・Consider impacts by investigating current refrigerant handling practices. ・Consider impacts by investigating current gas cutting practices.
		C	A-	The following pollution sources may have significant impacts on water quality: ・Uncontrolled dumping of polluted excavated soil from ship recycling yard. ・Uncontrolled discharge of concrete washwater.	・Consider impacts by investigating soil quality at selected ship recycling yards. ・Consider impacts of washwater by referring to the construction plan.
		O	A-	The following pollution sources may have significant impacts on water quality: **TSDF:** ・Effluent from existing and new ETP. **Yard:** ・Spills and leakage of pollutants (e.g. waste oil, bilge) through ship breaking activities in the intertidal zone. ・Rainwater runoff from polluted ship recycling yards. ・Discharge of treated effluent and oil spills from offshore tank cleaning barge.	**TSDF:** ・Consider impacts by investigating groundwater quality around TSDF and wastewater treatment method of existing and new ETP. **Yard:** ・Consider impacts by investigating pollution risks of ship breaking activities and how the Project can reduce such risks. ・Consider impacts by investigating pollution risks of offshore tank cleaning operation.

	Item	Phase	Rating	Rationale	TOR of JICA EIA study
3	Soil pollution	C	A-	The following pollution sources may have significant impacts on soil quality: ・ Uncontrolled dumping of polluted excavated soil from ship recycling yard. ・ Spills and leakage of oil from construction vehicles and machines.	・ Consider impacts by investigating soil quality at selected ship recycling yards. ・ Consider risks of oil spills and leakage by referring to the type of construction vehicles and machines.
		O	A-	The following pollution sources may have significant impacts on soil quality: **TSDF:** ・ Stack emissions from TSDF waste incinerators. **Yard:** ・ Oil and paint chips remaining on dismantled ship blocks and parts. ・ Oil leakages from heavy vehicles and machines.	**TSDF:** ・ Consider impacts by referring to the air dispersion simulation undertaken in the EIA and by investigating soil quality around TSDF. **Yard:** ・ Consider impacts by investigating pollution risks of ship breaking activities and how the Project can reduce such risks.
		C	A-	Various types of non-hazardous and hazardous construction wastes may be generated including potentially contaminated excavated soil.	・ Consider impacts by identifying the type of construction waste that will be generated.
		O	A-	The risk of pollution is high as various types of hazardous wastes will be generated such as asbestos, paint chip, glasswool, oil sludge and bilge water.	・ Consider impacts by investigating current waste treatment and disposal practices and how the Project can reduce such risks.
		C	B-	Noise from construction vehicles and machines may have some impacts.	・ Consider impacts by identifying major noise sources by referring to the construction plan
		O	B-	Ship breaking and associated activities may have some impacts.	・ Consider impacts by identifying major noise sources.
6	Ground subsidence	C, O	D	There are no activities that may cause ground subsidence.	—
		C	D	There are no notable odor sources.	—
		O	B-	TSDF may become a source of offensive odor.	・ Consider impacts by identifying whether there are any current odor issues.
		C	D	There are no activities that may cause sediment pollution.	—
		O	A-	Ship breaking activities and rainwater runoff from polluted ship recycling yards may contaminate bottom sediments.	・ Consider impacts by investigating pollution risks of ship breaking activities and how the Project can reduce pollution risks. Also implement sediment quality survey.
9	Conservation area	C、O	D	There are no conservation areas around the project area.	—

	Item	Phase	Rating	Rationale	TOR of JICA EIA study
10	Ecosystem, flora/fauna	C	D	Impacts on ecosystem are unlikely as construction works will be inside existing yards and TSDF.	—
		O	A-	Pollution from ship breaking activities may have significant impacts on marine ecosystem.	・ Consider impacts by studying the situation of marine life and how the Project can reduce impacts by reducing pollution risks.
		C	D	Impacts are unlikely as construction works will be inside existing yards and TSDF.	—
		O	D	No impacts are expected.	—
		C	D	Impacts are unlikely as construction works does not involve any major civil works.	—
		O	B-	Coastal erosion/accretion may occur through construction of jetty.	・ Consider impacts by studying the coastal erosion and accretion dynamics of the coastal area.
13	Involuntary resettlement	C, O	D	There will be no involuntary resettlement	—
14	Vulnerable social groups	C, O	D	No notable impacts are expected as the Project is upgrade of existing facilities.	—
		C	B+	Construction works will provide employment opportunities to the local people.	—
		C	B-	Job opportunities for ship breaking workers may reduce as ship breaking activities may be halted during construction works.	・ Consider impacts by referring to construction plan.
		O	B+	Job opportunities for ship breaking workers are likely to increase due to expected increase in demand of ship recycling.	—
16	Land use	C, O	D	There will be no significant change to current land use.	—
17	Local resource	C, O	D	All required resources (e.g. construction materials) will be procured from licensed suppliers and there will be no need for new local development for resource.	—
		C	D	Impacts are unlikely as construction works will be inside existing yards and TSDF.	—
		O	B-	. ・ Discharge of treated effluent from TSDF may affect downstream water use. ・ Operation of offshore tank cleaning barge may affect water use in the offshore sea area.	Consider impacts by studying water use of potentially affected areas.

	Item	Phase	Rating	Rationale	TOR of JICA EIA study
19	Social infrastructures and services	C	D	Impacts are unlikely as construction works will be inside existing yards and TSDF.	—
		O	B+	Living environment of workers will improve through the renovation of the worker's housing complex.	—
20	Social institutions	C, O	D	No notable impacts are expected as the Project is upgrade of existing facilities.	—
21	Misdistribution of benefit and losses	C, O	D	No notable impacts are expected as the Project is upgrade of existing facilities.	—
22	Local conflicts of interest	C, O	D	No notable impacts are expected as the Project is upgrade of existing facilities.	—
23	Cultural heritage	C, O	D	There are no cultural heritages around the project area.	—
24	Landscape	C, O	D	There will be no significant changes to current landscape.	—
25	Gender	C, O	D	There are no activities that may trigger gender issues.	—
26	Children's rights	C, O	D	There are no activities that may violate children's rights.	—
		C	B-	There is risk of infectious diseases spreading through influx of construction workers.	・ Consider risks by studying current situation of infectious diseases and by referring to construction plan.
		O	B-	The risk of infectious diseases spreading is relatively high as most workers will be from other regions.	・ Consider risks by studying current situation of infectious diseases.
		C	B-	There is a moderate risk of occupational accidents as construction works may proceed together with ship breaking works.	・ Consider risks by referring to construction plan.
		O	A-	The risks of occupational accidents and health impacts are high as ship breaking involves various dangerous works and exposure to pollutants.	・ Consider risks by identifying high risk works. ・ Consider risks by studying status of workers health.
		C	B-	Traffic accidents may occur due to construction vehicles.	・ Consider accident risks by referring to construction plan.
		O	B-	The risks of traffic accidents may increase with increase in heavy vehicles.	・ Consider accident risks by predicting future traffic volume.
30	Transboundary and climate change	C, O	D	Transbounadry and climate change impacts are unlikely	・ —

C: Construction phase, PC: Post-construction phase

A+/-: Significant positive/negative impact is expected.

B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown.
D: No impact is expected
Source: JICA Survey Team

11.6. IMPACT ASSESSMENT AND MITIGATION MEASURES

11.6.1. IMPACT ASSESSMENT

This Section assesses the impacts for items that were rated with potential negative impacts in the scoping exercise. Note that mitigation measures are not considered in the assessment. Table 11-47 summarizes the results of the impact assessment.

Table 11-47 Results of impact assessment

	Item	Rating of scoping		Rating after impact assessment		Rationale
		Construction	Operation	Construction	Operation	
1	Air pollution	B-	A-	B-	B-	**[Construction]** Rated from "B-" to "B-"as there is to some extent potential for air pollution through for example construction vehicle traffic, heavy civil works and concrete plant operation. **[Operation]** Rated from "A-" to "B-" as air pollution from TSDF incinerators are predicted in the EIA air pollution model to be negligible. However, there is still to some extent potential of air pollution such as through gas-cutting fumes, inadequate handling of refrigerants and asbestos .
2	Water pollution	A-	A-	B-	B-	**[Construction]** Rated from "A-" to "B-" as the JICA soil quality survey did not show any significant contamination of yard soil, which means the risk of water pollution from soil disposal is minimal. However, there is still to some extent potential for water pollution such as through uncontrolled discharge of concrete washwater. **[Operation]** Rated from "A-" to "B-" as risk of water pollution will reduce through the Project (e.g. yard improvement, use of MDS and large crane). However, there is still to some extent potential for water pollution such as through inadequate treatment of effluent from tank cleaning barge and new ETP of TSDF.

	Item	Rating of scoping		Rating after impact assessment		Rationale
		Construction	Operation	Construction	Operation	
3	Soil pollution	A-	A-	B-	B-	**[Construction]** Rated from "A-" to "B-" as the JICA soil quality survey did not show any significant contamination of yard soil, which means the risk of soil pollution from soil disposal is minimal. However, there is still to some extent potential of soil pollution such as through oil spill/leakages from construction vehicles and machines. **[Operation]** Rated from "A-" to "B-" as air pollution from TSDF incinerators are predicted in the EIA air pollution model to be negligible, hence risk of soil pollution low. However, there is still to some extent potential for soil pollution in the yard areas such as from gas-cutting fumes and paint chips.
4	Waste	A-	A-	B-	B-	**[Construction]** Rated from "A-" to "B-" as the JICA soil quality survey did not show any significant contamination of yard soil, which was a potential hazardous waste. However, there is still to some extent potential impacts as various other construction wastes will be generated. **[Operation]** Rated from "A-" to "B-" as the new TSDF facilities will contribute in reduction of waste volume, stabilization of hazardous wastes and so on. However, there is still to some extent potential impacts as by-product wastes will be generated from the new TSDF facilities (e.g. sludge, fly ash).
5	Noise	B-	B-	B-	B-	**[Construction]** Rated from "B-" to "B-" as there is to some extent potential of noise pollution from construction activities such as through frequent passing of construction vehicles. **[Operation]** Rated from "B-" to "B-" as there is to some extent potential of noise pollution from yard operation.
6	Odor	D	B-	D	D	**[Operation]** Rated from "B-" to "D" as no odor issues have been raised in the past and the Project will have no added significant odor source.

	Item	Rating of scoping		Rating after impact assessment		Rationale
		Construction	Operation	Construction	Operation	
7	Sediment	D	A-	D	B-	**[Operation]** Rated from "A-" to "B-" as less pollutants will enter the sea through the yard improvements works, deployment of MDS/large crane and so on. However, there is still to some extent risk of sediment pollution from ship paints.
8	Ecosystem, flora/fauna	D	A-	D	B-	**[Operation]** Rated from "A-" to "B-" as conditions for marine organisms are expected to gradually improve.
9	Topography	D	B-	D	D	**[Operation]** Rated from "B-" to "D" as the new jetty for the tank cleaning barge is expected to have minimal impacts on the littoral drift due to its limited length (around 50 m) and sufficient spacing between the piers (5 m spacing).
10	Livelihood, living environment	B-	B+	D	B+	**[Construction]** Rated from "B-" to "D" as yard construction works will be planned in manner to prevent any stoppage of ship breaking operation.
11	Water use	D	B-	D	C-	**[Operation]** Rated as C- as the effluent discharge location from TSDF and the operation area of the tank cleaning barge are undecided.
12	Infectious diseases (HIV/AIDS etc.)	B-	B-	B-	B-	**[Construction]** Rated from "B-" to "B-" as there will usually be around 100 construction workers, which could potentially spread infectious disease. **[Operation]** Rated from "B-" to "B-" as there will be constant influx of yard workers from other regions, which could potentially spread infectious disease.
13	Occupational safety	B-	A-	B-	B-	**[Construction]** Rated from "B-" to "B-" as there will be risk of occupational accidents mainly as construction works will proceed side-by-side with ship breaking works. **[Operation]** Rated from "A-" to "B-" as risk of occupational accidents is expected to reduce through strengthening of the current GMB safety training programs.

	Item	Rating of scoping		Rating after impact assessment		Rationale
		Construction	Operation	Construction	Operation	
14	Accidents	B-	B-	B-	D	**[Construction]** Rated from "B-" to "B-" as there is to some extent risk of accidents such as by frequent movement of construction vehicles. **[Operation]** Rated from "B-" to "D" as risk of accidents are not expected to increase through this Project.

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown.
D: No impact is expected

11.6.2. MITIGATION MEASURES (CONSTRUCTION STAGE)

This Section describes the planned mitigation measures for items that are assessed to have potential negative impacts in the construction stage.

(1) Air pollution

1) Fugitive dust and exhaust gas emissions from construction vehicles

There will be frequent movement of construction vehicles to and from the construction site to transport construction materials. While it will be temporary, fugitive dust and exhaust gas emissions from these construction vehicles may deteriorate the surrounding air quality. Hence, the following measures will be implemented to minimize such impacts:

- ✓ Only use construction vehicles in compliance with vehicle emission standards set under Central Motor Vehicles Rules, 1989.
- ✓ Only use construction vehicles with "Pollution under Control Certificate".
- ✓ Conduct regular maintenance of construction vehicles.
- ✓ Covering of truck loading bed when transporting loose materials such as rock and soil.
- ✓ Avoid to the extent possible passing through sensitive areas (e.g. residential area, schools). If unavoidable, minimize dust dispersion through slow driving.

2) Dispersion of fugitive dust from yard improvement works

Yard improvement works will involve some heavy construction activities such as excavation and ground-levelling works, which may deteriorate the surrounding air quality through dispersion of fugitive dust. Hence, the following measures will be implemented to minimize such impacts:

- ✓ Regular water spraying of exposed surfaces.
- ✓ Covering of unused stockpiles such as excavated soil.

3) Dispersion of fugitive dust from concrete batching plant

A temporary concrete batching plant will be established in an area near the Project site. Concrete batching plant may deteriorate the surrounding air quality as there are various fugitive dust sources. Hence, the following measures will be implemented to minimize such impacts:

- ✓ Concrete batching plant to be established a sufficient distance away from sensitive areas (e.g. residential area).
- ✓ Concrete batching plant to be equipped with standard dust suppression measures (e.g. enclosed conveyor and hopper).
- ✓ Cement to be stored in sealed and dust-tight storage silos.
- ✓ Regular water spraying of exposed surfaces.
- ✓ Height of aggregate stockpile to be minimized to reduce wind erosion.
- ✓ Aggregate stockpile to be covered when not actively being used. In addition to the above, all conditions stipulated in GPCB consent to establish will need to be complied with.

(2) Water pollution

1) Pollution by uncontrolled disposal of excavated soil

Construction works at the ship recycling yards will generate excavated soil. While the JICA soil quality survey did not show any significant contamination, pollutants such as lead and PAHs were detected. Since uncontrolled disposal of such soil may cause water pollution, the excavated soil will be reused inside the yard as material for raising the yard ground level (e.g. road section). The raised areas (i.e. exposed excavated soil) will then be covered by geomembrane and clean soil layer to prevent exposure to rainwater and hence minimize risk of groundwater and seawater contamination. Figure 11-31 shows the how the excavated soil will be reused and covered.

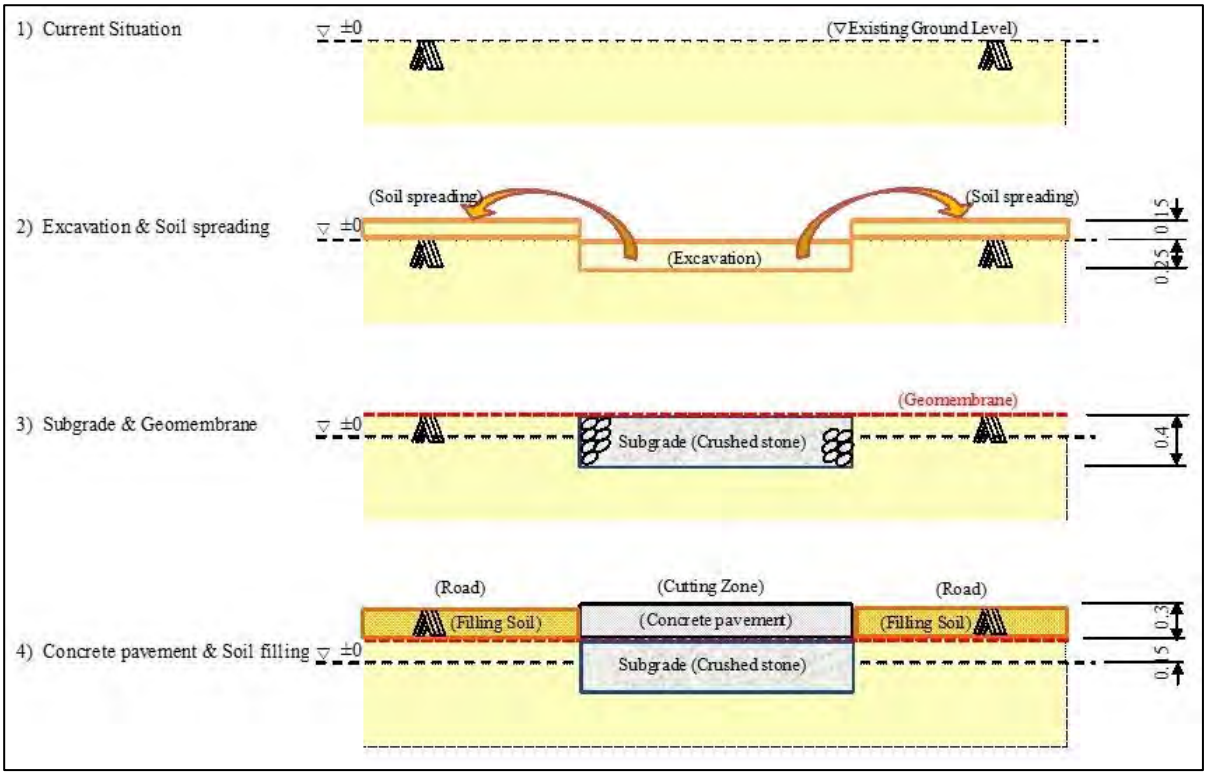


Figure 11-31 Process of excavated soil reuse

Source: JICA Survey Team

2) Pollution by uncontrolled discharge of concrete washwater

Concrete washwater generated from the construction sites and concrete batching plant (e.g. agitator washout areas) will be highly alkaline (typically around pH 12), which could cause water pollution if discharged in an uncontrolled manner. Hence, the following measures will be implemented to avoid such impacts:

- ✓ All concrete washwater generated from construction sites and concrete batching plant to be collected and treated through an impermeable settling pond installed inside the premises of the concrete batching plant.
- ✓ Recovered washwater to be reused inside the plant as much as possible to avoid or minimize discharge to the environment.
- ✓ Discharge of recovered water to be allowed only if pH levels are within effluent discharge standard set under Environment (protection) Rules, 1986, Schedule VI (pH 5.5-9.0).
- ✓ Settled solids in the settling pond to be removed regularly and reused or recycled to the extent possible. Disposal only to be allowed at TSDF.
- ✓ In addition to the above, all conditions stipulated in GPCB consent to establish will need to be complied.

(3) Soil pollution

1) Pollution by uncontrolled disposal of excavated soil

Soil pollution by excavated soil will be avoided by reusing inside the yard as material for raising the yard ground level (see Section 11.7.2 for details).

2) Pollution by oil leakages from construction vehicles and equipment

Various construction vehicles and equipment will be used during construction works, which if not well maintained may cause soil contamination through oil/fuel leakage. Hence, the following measures will be implemented to avoid such impacts:

- ✓ Regular inspection for oil and fuel leaks. Leaking vehicles and equipment to be removed until repaired.
- ✓ Repair and maintenance works to be undertaken at dedicated workshops. If not available, appropriate spill prevention measures (e.g. use of oil tray) to be used and oil spill response kit (e.g. absorbents) be readily available.
- ✓ Fuel storage and handling areas to be bounded with an impermeable base.

(4) Waste

Major construction wastes will be concrete debris, metal scraps, wood scraps and domestic wastes. These wastes will be handled as per Construction and Demolition Waste Management Rules 2016 and will be reused/recycled as much as possible to reduce waste volume. Hazardous wastes if any, will be handled as per Hazardous Waste (Management, Handling & Transboundary Movement) Rules 2008 and treated/disposed at GPCB authorized facilities after obtaining authorization from GPCB. Excavated soil from the ship recycling yard will be reused inside the yard as raising material, which as result will prevent generating large volume of waste.

Prior to the commencement of construction works, the Construction Contractor will be required to prepare a Waste Management Plan (WMP) and report to GMB and other waste authorities for approval. The WMP shall include among other the following information:

- ✓ Type and quantity of construction wastes and planned storage, treatment and disposal methods.
- ✓ Reuse and recycling plan.
- ✓ Hazardous waste management plan (if any).

(5) Noise

There will be frequent movement of construction vehicles to and from the construction site to transport construction materials, which may become a nuisance to local residents. Hence, the following measures will be implemented to minimize such impacts:

- ✓ Only use construction vehicles in compliance with vehicle noise standards set under Environment (protection) Rules, 1986: Part E Schedule VI.
- ✓ Regular maintenance of construction vehicles and machines.
- ✓ Avoid to the extent possible passing through sensitive areas (e.g. residential area, schools).

(6) Infectious diseases

There will usually be around 100 construction workers, and such influx of construction workers may raise the risk of infectious disease (e.g. HIV) spreading. To minimize such risks, the Construction Contractor will be required to prepare HIV/AIDS Prevention Plan and obtain approval from GMB and other relevant organizations. The plan shall among others include the following:

- ✓ Health check (2 times/year)
- ✓ Planned awareness programs for construction workers (2 times/year)
- ✓ Code of Conduct to be complied by the construction workers
- ✓ Other measures

(7) Occupational safety

There is a moderate risk of occupational accidents mainly as construction works will proceed side-by-side with ship breaking works. The Construction Contractor will therefore be required to prepare an Occupational Health and Safety Plan in accordance to Indian laws and regulations and JICA's "The Guidance for the Management of Safety for Construction Works in Japanese ODA Projects" and obtain approval from GMB and other relevant organizations if necessary. The plan shall among others include the following:

- ✓ Risk assessment and planned safety measures
- ✓ Training plan for construction workers
- ✓ Organizational structure
- ✓ Emergency response plan

(8) Accidents

There is a risk of traffic accidents as there will be frequent movement of construction vehicles such as for transporting construction materials. Hence, the following measures will be implemented to minimize such risks:

- ✓ Strict compliance to speed limits.
- ✓ Avoid to the extent possible using roads with high risk of accidents.
- ✓ Vehicle motion alarm to be installed on all construction vehicles.
- ✓ Placement of warning signs and traffic control officers at high risk areas.

11.6.3. MITIGATION MEASURES (OPERATION STAGE)

This Section describes the planned mitigation measures for items that are assessed to have potential negative impacts in the operation stage.

(1) Air pollution

1) Impacts of stack emissions from TSDF incinerators

The air quality around the Project area may worsen through the combined operation of the existing and new TSDF incinerators. The EIA predicts the future ground level air quality (PM_{10}, SO_2, NOx) around the Project area by considering the added emissions from the new incinerator. USEPA AERMOD air quality simulation model was used and the simulation was conducted under the following scenario:

- Emission rates from the new incinerator was computed based on the stack emission monitoring results of the existing incinerator.
- For NOx concentration, expected emissions from the 15 new recycling plots [15] and associated vehicles were incorporated into the simulation.
- For meteorological input, three-month observation data in the summer of 2015 was used.

Table 11-48 shows the predicted 24-hour average ground level concentration at the EIA air quality monitoring stations. Figure 11-32 shows the location of the EIA air quality monitoring stations.

Table 11-48 Predicted 24-hour average ground level concentration at EIA air quality monitoring stations (μg/m^3)

Station	PM_{10}			SO_2			NOx		
	Monitored *1	Predicted *2	Total*3	Monitored *1	Predicted *2	Total*3	Monitored *1	Predicted *2	Total*3
Alang Fire Stn.	79.8	0.30	80.10	7.3	0.45	7.75	31.7	0.43	32.13
Alang village	77.2	0.14	77.34	7.0	0.21	7.21	22.8	0.99	23.79
Sosiya village	73.7	0.07	73.77	6.1	0.10	6.20	20.5	0.24	20.74
Mathavda	67.0	0.17	67.17	6.3	0.26	6.56	21.4	0.24	21.64
Kathava	72.8	1.02	73.82	5.5	1.53	7.03	21.2	0.84	22.04

*1: Mean concentration recorded during EIA air quality baseline study (March-May 2015).
*2: Predicted contribution of the new incinerator (and others in case of NOx) to ground level air quality concentration.
*3: Predicted future ground level air quality concentration (sum of Monitored and Predicted values).
Source: GMB (2015), EIA of Proposed Upgradation of Existing Ship Recycling Yard at Alang Sosiya

Figure 11-32 Location of EIA air quality monitoring stations
Source: JICA Survey Team (prepared with Google Earth)

The EIA prediction shows that the new incinerator will have negligible impacts on the local air quality. For example, PM_{10}, SO_2 and NOx levels will only increase at maximum by about 1 μg/m^3, 1.5 μg/m^3 and 1 μg/m^3 respectively. The predicted sum concentrations are also below the

[15] The plan of constructing 15 new recycling plots is no longer included in this Project.

24-hour national ambient air quality standard (PM_{10}: 100 µg/m^3, SO_2: 80 µg/m^3, NOx: 80 µg/m^3) at all the stations.

Impacts of incinerating PCB containing materials are considered negligible as the new incinerator is designed to destruct PCBs into constituent elements through the high-temperature incineration process (minimum of > 1,100 °C with over 2 seconds retention time). Other measures to prevent or minimize impacts are as follows:

- The incinerator will be designed so that formation of hazardous incineration byproducts such as dioxins are minimized by rapid cooling of flue gas.
- Flue gas will be treated through a dust collector system so that stack emission gas complies with Indian emission standards (Emission standards for common hazardous waste incinerator set under Environmental Protection (Fifth Amendment Rules) 2008).
- An online monitoring system will be installed as per requirement of EC (Specific conditions xviii) for continuous monitoring of stack emission gas concentration and operation will immediately cease if exceedance of set standards is detected.
- Implementation of regular maintenance works.
- Treatment performance will be checked regularly by sampling and analysis of stack emission gas concentration when under critical operating conditions.

2) Impacts of yard operation

d. Impacts of asbestos handling

Currently asbestos are removed and handled in accordance to Ship Breaking Code 2013 which are conducted by qualified yard workers or by GPCB authorized operators. Some of the main measures employed are as follows:

- Asbestos handling in the yard area are undertaken only in dedicated facility equipped with negative pressure chamber and HEPA filter exhaust outlet.
- Wetting of asbestos parts during removal and handling works.
- Removed asbestos are contained in specialized leak proof bags and stored in dedicated storage facility until transport to TSDF.
- At TSDF, asbestos wastes are solidified with cement at a dedicated disposal site.

Providing these measures are implemented appropriately, the risk of asbestos pollution should be low. However, since relatively high levels of asbestos was detected at TSDF, TSDF operators should take extra precaution when handling asbestos so to prevent any tears in the leak proof bags, especially when temporary storing them at the TSDF storage area. Also asbestos handling facility in the yard should be placed as far as possible from the yard boundary so to minimize dispersion outside the yard premises. The asbestos handling facility should also be inspected regularly and recorded for the following to ensure asbestos dispersion is prevented / minimized:

- Negative pressure ventilation
- HEPA filter

e. Impacts of refrigerants handling

Refrigerants may contain ozone depleting substances (ODS) and green-house gases (e.g. HFC, HCFC), which if handled inappropriately may have significant impacts. Refrigerants are currently removed from ships by authorized persons and then sent to customs. This procedure may change as customs are expected to no longer accept refrigerants in the future. Hence instead of sending to customs, as per requirement of EC (Specific Conditions xx), yard operators will be

required to send recovered refrigerants to authorized recycler/reclaimer, and if recycling/reclaiming are not possible refrigerants will need to be sent to authorized destruction facilities. Yard operators must also ensure that refrigerants are recovered without leaking and stored safely.

f. Impacts of gas-cutting works

According to the JICA waste composition study, various heavy metals were detected in some paints used on the surveyed ships. Gas cutting of ship parts may therefore release toxic fumes into the atmosphere. According to the prediction of Deshpande PC et al., (2012)[16], gas-cutting works can potentially elevate yard area lead concentration up to levels of 8-30 μg/m^3, which significantly exceeds the Indian national ambient air quality standard for lead (industrial area 24 hours-average: 1.0 μg/m^3).

To prevent such release of toxic fumes it is recommended by GPCB to remove paints prior to gas cutting at least up to a distance of 10 cm from the cutting line. However, according to some yard operators such practice is too time consuming and impractical, unless some efficient paint removal methods are developed. For the time being, regular air quality monitoring will be conducted in the yard and surrounding areas to check the pollution status.

g. Impacts of waste transportation

There will be a slight increase in the waste transport vehicle traffic due to the transport of oily wastewater from the MDS and offshore tank cleaning barge to TSDF. However, the estimated increase in traffic volume will only be around 15 vehicles/day, which will have negligible impact on air quality. Nevertheless, to minimize impacts, it will be necessary to only use vehicles in compliance with vehicle emission standards set under Central Motor Vehicles Rules, 1989 and vehicles with a valid “Pollution under Control Certificate”.

(2) Water pollution

1) Impacts of ship breaking activity in the intertidal zone

The risk of water pollution in the intertidal zone during ship breaking activity is expected to decrease significantly through the employment of MDS and large mobile crane. Main reasons are as follows:

- MDS will be capable of removing oil residues from places inside ships that were previously difficult to completely remove before ship breaking such as inside fuel tanks and pipes. Figure 11-29 shows an image of fuel tank cleaned by MDS.

[16] Deshpande PC, Tilwanker AK, Asolekar SR. A novel approach to estimating potential maximum heavy metal exposure to ship recycling yard workers in Alang, India. Science of the Total Environment 438 (2012) 304-311.

Figure 11-33 Image of fuel tank before and after cleaning by MDS
Source: JICA Survey Team
(left: before cleaning, right: after cleaning)

- By employing large mobile crane it will be possible to avoid cutting off ship stern during the ship recycling process which is a common practice employed now especially for large ships. This will enable to prevent oil spills/leakage into intertidal zone from engine compartment.

2) Impacts of yard operation

The risk of water pollution from yard operation is expected to decrease significantly through the concrete pavement of the cutting area and storage area of dismantled parts. However, to be effective, it will be important that the rainwater runoff drains and collection tanks are regularly checked and cleaned to avoid any overflow.

3) Impacts of tank cleaning vessel

There is a risk of accidental oil spill during the operation of offshore tank cleaning barge as it will be conducted in rough offshore waters. The following oil spill response measures are planned so that water pollution can be minimized in case of such oil spill incidents:

- Installation of oil boom during tank cleaning works.
- Stand-by of oil spill response vessel during tank cleaning works.

To reduce the volume of oily water treatment at TSDF, low-oil content oily water generated through the tank cleaning process is planned to be discharged to sea after treatment by onboard ETP as per Environment (Protection) Amendment Rules 2015: effluent standards for common effluent treatment plants (into sea). Treated effluent will be monitored continuously through online monitoring system and the water quality of the receiving sea area will also be monitored throughout the operation. In case of any detection of water pollution or exceedance of discharge standards, operation will be ceased immediately. Providing that effluents are discharged under set standards, it is expected that the effluent will quickly dilute to negligible levels through biological decomposition and current/wave actions. However, since the operation area is still undecided, there could be some impacts in case there are any sensitive ecosystem or fishing grounds nearby. A detailed impact assessment should therefore be implemented in the D/D stage taking into account for example the locations of sensitive ecosystem and fishing grounds and operation area shifted accordingly. The applicability of Environment (Protection) Amendment Rules 2015: Effluent standards for common effluent treatment plants (into sea) should also be considered. Stakeholders should also be consulted through the process especially GPCB in case the operation area lies inside territorial water which is under their jurisdiction.

4) Impacts of TSDF effluent treatment plant

The new ETP (120 m^3/day) will treat wastewater generated from MDS, offshore tank cleaning barge, sludge treatment plant, oil/water separation system and so on. Under full operational condition, the total effluent generated from the existing and new ETPs will add up to 150 m^3/day, which if not treated/discharged appropriately may contaminate the surrounding environment. To minimize such pollution risks, the following measures will be implemented:

- Wastewater will be treated to levels below the effluent standard set under Environment (Protection) Rules, 1986 (Schedule VI).
- Treated effluent will be reused as far possible within the TSDF facility so to minimize discharge outside TSDF.
- Continuous monitoring of treated effluent concentration through automatic/online monitoring system as per requirement of EC.
- Pre- and post-effluent concentration will be monitored regularly to check the effectiveness of the ETP.

Further studies will be required to estimate how much treated effluent can be reused inside TSDF. Currently to avoid groundwater contamination, non-reusable effluent is planned to be discharged into the rainwater drainage outside TSDF. However, the appropriateness of such discharge route should be studied in the D/D stage together with an impact assessment on downstream water use.

(3) Soil pollution

1) Impacts of TSDF incinerators

Uncontrolled stack emissions from the TSDF incinerators may contaminate soils of the surrounding area for example by PCBs and dioxins. However, the risks of such contamination is low as the existing and new incinerators are designed to prevent/minimize emissions of such pollutants. The EIA air quality simulation also predicts that emission gas from the TSDF incinerators will have negligible impact on ambient air quality, which also can be implied that potential for soil pollution from the incinerator emissions will be minimal including PCBs. Nevertheless, regular soil quality monitoring will be implemented around TSDF to check the soil pollution status.

2) Impacts of yard operation

The risk of soil pollution from yard operation is expected to reduce significantly through the yard improvement works as pollutants will be contained within the concrete flooring areas. The yard area will also be cleaned daily to remove any debris such as paint chips. Each yard will need to be equipped with an oil spill response kit in response to accidental spills.

Toxic fumes from the gas-cutting works may pollute the soil. While such pollution can be minimized by removing toxic paints prior to cutting, such practice is currently too time consuming and impractical. Therefore, for the time being, regular soil quality monitoring will be conducted in the yard area to check the pollution status.

(4) Wastes

The Project will have the following positive impacts regarding waste:

- The lifespan of the TSDF landfill will be extended significantly as waste volume can be reduced by the baler and high-temp incinerator.
- Oily sludge can be disposed at the TSDF landfill in a more stable state as most of the oily

content will be removed through the new oil sludge treatment plant.
- Hazardous wastes with persistent organic pollutants (e.g. PCB containing wastes) can be disposed at the TSDF landfill in a safer state through thermal treatment by the high-temp incinerator.

The new TSDF facilities will on the other hand create new wastes such as sludge from ETP and bottom/fly ash from high-temp incinerator. These wastes will be disposed through the following method to avoid/minimize any impacts:

- Sludge from ETP will be disposed at the TSDF landfill after drying.
- Bottom ash will be reused/recycled and fly ash will be disposed at TSDF landfill after containment inside specialized container.

(5) Noise

Noise levels from recycling activities are expected to be of similar level as present, as there will be no significant additional noise sources generated through this Project. Impacts if any will also be limited to daytime as no works are done in nighttime.

(6) Odor

TSDF could be a source of odor but no issues have been raised by the residents and GEPIL. Therefore, odor impacts are unlikely to occur as there will be no additional odor sources generated through this Project.

(7) Sediment

The risk of sediment pollution is expected to reduce significantly as less pollutants will enter the sea through the yard improvements works and introduction of MDS, large crane and so on. Paint chips however may still fall into the sea during ship breaking works, but this is somewhat impossible to fully prevent unless all paints are removed before ship breaking works. Meanwhile, regular sediment quality monitoring will be conducted in the sea area to check the pollution status.

(8) Ecosystem

According to the EIA study, marine life along the ship recycling yard area is relatively low in biodiversity and abundance, which may partly be attributed to ship breaking activities. However, this situation may change as risk of marine pollution is expected to reduce significantly through this Project. The abundance and diversity of marine life will be monitored regularly to see how marine life will change over time.

One other concern is impact of paint chips on benthic marine life, as there will still be risk of pollution by falling paint chips. Hence benthos TBT concentration will be regularly monitored to check the impacts of paint chips on benthos.

(9) Topography

The new jetty for the tank cleaning vessel may cause coastal erosion or accretion by interrupting the longshore littoral drift. However, the risk of such impacts is likely to be minimal due to its limited length (around 50 m) and sufficient spacing between the piers (5 m spacing)

(10) Infectious disease

According to existing information, HIV infection is not uncommon among the yard workers. To minimize spreading of HIV, HIV/AIDS awareness program will be implemented as part of the GMB training program.

(11) Occupational safety

1) Occupational accidents

The main causes of fatal accidents occurring in the ship recycling yards previously were due to fire/explosion, falling from height, hit by falling object, snapping of winching lines and so on. These types of accidents are preventable providing that standard safety practices are implemented as in certified yards. Training of yard workers and managers on occupational safety are also important and necessary approach to prevent accidents. In this respect, the Project will strengthen and improve the current GMB safety training programs.

2) Health impacts

c. Impacts of asbestos handling

Currently asbestos are handled by qualified yard workers or by GPCB authorized contractors wearing appropriate PPE. The results of the JICA asbestos survey imply that asbestos removal works are undertaken in a safe manner as asbestos concentration in work environment was below OSHA standard. Therefore, the health risk of asbestos handling will likely be low providing that current asbestos handling protocol is appropriately implemented. The GMB training program will also be strengthened through this Project, which will further enhance worker's awareness on asbestos risk.

Regular health checks are being done and also will be implemented for workers involved in asbestos handling for more than 30 days/year, which is a requirement under the EC (Specific conditions xiv) of this Project. Furthermore, as per Gujarat Factories Rule (Schedule XVII), in case symptoms of asbestos related disease is detected, those workers will be removed from such works and provided alternative work until certified as fit to work by a specialized doctor. Considering the long latency period of asbestos symptoms, asbestos workers should also be eligible for regular health checks even after leaving his job.

d. Impacts of gas-cutting works

Fumes emitted from gas-cutting works are potentially hazardous to worker's health as paints coated on ship plates may contain hazardous substances such as heavy metals as found in the JICA waste composition study. Although, gas cutters currently wear PPE and avoid fumes by positioning themselves on the downwind side of the fume, some gas cutters still do not wear appropriate PPE. Yard workers and operators will be trained though GMB's training program so to raise their awareness on the health risks and importance of employing appropriate safety measures.

Furthermore, each yard will implement regular health checks of gas cutters focusing on pulmonary function test and blood lead concentration. The OSHA occupational health standard (1910.1025) sets blood lead level concentration of 50 µg/dL, and workers exceeding this level are required to be removed from such works until blood lead levels return to below 40 µg/dL. Such rules will be established as a precautionary measure in all the yards. Ventilation equipment should also be used when gas cutting in areas with poor ventilation.

11.7. ENVIRONMENTAL MANAGEMENT PLAN

Based on the environmental impact assessment, an Environmental Management Plan (EMP) was prepared to ensure that construction and operation works are implemented with minimal environmental impacts. The EMP summarizes the planned mitigation measures against the anticipated environmental impacts, the responsibility for its implementation and supervision, and estimated cost. If necessary, the EMP should be revised in the detailed design phase in line with the progress of the Project plan and design. Table 11-49 and Table 11-50 show the EMP for the construction and operation stages respectively.

Table 11-49 Environmental Management Plan (Construction stage)

Item	Potential impact	Mitigation measures	Implementation responsibility	Supervision responsibility	Approx. cost
	Fugitive dust and exhaust gas emissions from construction vehicles	• Only use construction vehicles in compliance with vehicle emission standards set under Central Motor Vehicles Rules, 1989. • Only use construction vehicles with "Pollution under Control Certificate". • Regular maintenance of construction vehicles. • Covering of truck loading bed when transporting loose materials such as rock, sand and mud. • Avoid to the extent possible passing through sensitive areas (e.g. residential area, schools). If unavoidable, minimize fugitive dust through slow driving. • GMB to impose penalty in case of continuous non-compliance.	Construction contractor	Supervising consultant GMB	Included in construction base cost
	Fugitive dust dispersion from yard improvement works	• Regular water spraying of exposed surfaces. • Covering of unused stockpiles such as excavated soil.	Construction contractor	Supervising consultant GMB	Included in construction base cost
	Fugitive dust dispersion from concrete batching plant	• Concrete batching plant to be established at a sufficient distance away from sensitive areas (e.g. residential area). • Concrete batching plant to be equipped with standard dust suppression measures (e.g. enclosed conveyor and hopper). • Cement to be stored in sealed and dust-tight storage silos. • Regular water spraying of exposed surfaces. • Height of aggregate stockpile to be minimized to reduce wind erosion. • Aggregate stockpile to be covered when not actively being used. • In addition to the above, all conditions stipulated in GPCB consent to establish will need to be complied with.	Construction contractor	Supervising consultant GMB GPCB	Included in construction base cost
	Uncontrolled disposal of excavated soil	• All excavated soil to be reused as material for raising the yard ground level. • Raised areas to be covered by geomembrane and clean soil.	Construction contractor	Supervising consultant GMB	Under consideration
	Uncontrolled discharge of concrete washwater	• All concrete washwater generated from construction sites and concrete batching plant to be collected and treated through an impermeable settling pond installed inside the premises of the concrete batching plant. • Recovered washwater to be reused inside the plant as much as	Construction contractor	Supervising consultant GMB	Included in construction base cost

Item	Potential impact	Mitigation measures	Implementation responsibility	Supervision responsibility	Approx. cost
		possible to avoid or minimize discharge to the environment. • Discharge of recovered water to be allowed only if pH levels are within national effluent discharge standard (Environment (protection) Rules,1986, Schedule VI). • Settled solids in the settling pond to be removed regularly and reused or recycled to the extent possible. Disposal only to be allowed at TSDF. • In addition to the above, all conditions stipulated in GPCB consent to establish will need to be complied with.			
	Uncontrolled disposal of excavated soil	• All excavated soil to be reused as material for raising the yard ground level. • Raised areas to be covered by geomembrane and clean soil.	Construction contractor	Supervising consultant GMB	Included in construction base cost
	Oil leakages from construction vehicles and equipment	• Regular inspection for oil and fuel leaks. Leaking vehicles and equipment to be removed until repaired. • Repair and maintenance works to be undertaken at dedicated workshops. If not available, appropriate spill prevention measures (e.g. use of oil tray) to be used and oil spill response kit (e.g. absorbents) be readily available. • Fuel storage and handling areas to be bunded with an impermeable base.	Construction contractor	Supervising consultant GMB	Included in construction base cost
Waste	Generation of construction waste	• All excavated soil to be reused as material for raising the yard ground level. • Construction contractor will be required to prepare Construction Waste Management Plan (CWMP) as per Indian laws/regulations (Construction and Demolition Waste Management Rules 2016) and obtain approval from GMB and other relevant organizations when necessary. The CWMP shall among others include the following: ✓ Type and quantity of construction wastes and planned storage, treatment and disposal methods. ✓ Reuse and recycling plan. ✓ Hazardous waste management plan (if any).	Construction contractor	Supervising consultant GMB	Included in construction base cost
Noise	Noise from construction vehicles	• Only use construction vehicles in compliance with vehicle noise standards set under Environment (protection) Rules, 1986: Part E Schedule VI. • Regular maintenance of construction vehicles and machines. • Avoid to the extent possible passing through sensitive areas (e.g.	Construction contractor	Supervising consultant GMB	Included in construction base cost

Item	Potential impact	Mitigation measures	Implementation responsibility	Supervision responsibility	Approx. cost
		residential area, schools).			
Infectious diseases	Proliferation of infectious diseases due to influx of construction workers	• Construction contractor will be required to prepare HIV/AIDS Prevention Plan and obtain approval from GMB and other relevant organizations when necessary. The plan shall among others include the following: ✓ Periodical health check twice a year ✓ Planned awareness programs for construction workers (twice a year) ✓ Code of Conduct to be complied by the construction workers ✓ Other measures	Construction contractor	Supervising consultant GMB DISH	Included in construction base cost
Occupational safety	Risk of occupational accidents	• Construction contractor will be required to prepare an Occupational Health and Safety Plan in accordance to Indian laws and regulations and JICA's "The Guidance for the Management of Safety for Construction Works in Japanese ODA Projects". The plan shall among others include the following: ✓ Risk assessment and planned safety measures ✓ Training plan for construction workers ✓ Organizational structure ✓ Emergency response plan	Construction contractor	Supervising consultant GMB	Included in construction base cost
Accidents	Risk of traffic accidents	• Strict compliance to speed limits. • Avoid to the extent possible using roads with high risk of accidents. • Vehicle motion alarm to be installed on all construction vehicles • Placement of warning signs and traffic control officers at high risk areas.	Construction contractor	Supervising consultant GMB	Included in construction base cost

Source: JICA Survey Team

Table 11-50 Environmental Management Plan (Operation stage)

Item	Potential impact	Mitigation measures	Implementation responsibility	Supervision responsibility	Approx. cost
	Stack emission from TSDF incinerators	• Stack emission gas concentration to be kept within emission standards for common hazardous waste incinerator set under Environmental Protection (Fifth Amendment Rules) 2008. • PCB containing materials to be destructed through high-temperature incineration process (minimum of > 1,100 °C with over 2 seconds retention time). • Formation of hazardous incineration byproducts such as dioxins to be minimized by rapid cooling of flue gas. • Installation of automatic/online monitoring system for continuous monitoring of stack emission gas concentration. Operation to cease immediately in case of exceedance of emission standards. • Implementation regular maintenance works. • Confirmation of treatment performance though regular sampling and analysis of stack emission gas concentration.	TSDF operator	GPCB GMB	Included in operation base cost
	Dispersion of asbestos	• Asbestos handling to be undertaken only by GPCB authorized operators or qualified yard workers. • Asbestos handling in the yard area to be undertaken only in dedicated facility equipped with negative pressure chamber and HEPA filter exhaust outlet. • Wetting of asbestos parts during asbestos handling works. • Removed asbestos to be contained in specialized leak proof bags and stored in dedicated storage facility until transport to TSDF. • Asbestos when temporary stored at TSDF should be stored in a manner that will not cause tears in the leak proof bags. • Asbestos waste to be solidified with cement at TSDF's dedicated disposal site. • Placing of asbestos handling facility as far as possible from the yard boundary. • Regular inspection of asbestos handling facility especially for negative chamber ventilation and HEPA filter. •	Yard operator TSDF operator	GPCB GMB	Included in operation base cost

Item	Potential impact	Mitigation measures	Implementation responsibility	Supervision responsibility	Approx. cost
	Leakage of refrigerants	• Ozone depleting or greenhouse gas refrigerants (e.g. CFC-12, HCFC-22, HFC) to be recovered without leaking into atmosphere and stored safely. • Recovered refrigerant to be sent to authorized recycler/reclaimer. If recycling /reclaiming are not possible, then recovered refrigerant to be sent to authorized destruction facilities.	Yard operator	GMB	Included in operation base cost
	Dispersion of toxic fumes through gas-cutting works	• To minimize release of toxic fumes, toxic paints or coatings to be removed to the extent possible, up to a distance of 10 cm from the cutting line of the plate.	Yard operator	GMB	Included in operation base cost
	Fugitive dust dispersion from yard and access roads	• Water spraying of exposed yard area and roads. • Regular maintenance of access roads. • Establishment of green belt along the access roads wherever space is available.	Yard operator GMB (road maintenance and green belt establishment)	GMB	Included in operation base cost
	Exhaust emissions from waste transport vehicles	• Only use vehicles in compliance with vehicle emission standards set under Central Motor Vehicles Rules, 1989. • Only use vehicles with "Pollution under Control Certificate" and renew in accordance Central Motor Vehicles Rules, 1989.	TSDF operator	GMB	Included in operation base cost
	Ship breaking works in intertidal zone	• Oil spills/leakage into intertidal zone to be prevented/minimized by removing oil residues inside ships with MDS before breaking works. • Oil spills/leakage into intertidal zone to be minimized by avoiding cutting off ship stern through use of large mobile crane (only applicable to bulk carriers and container ships). • Use of oil booms when breaking oil tankers.	Yard operator	GMB	Purchase cost of mobile decontamination system and mobile crane included in Project budget
	Ship breaking works in yard area	• Cutting works and equipment maintenance works to be undertaken only inside dedicated concrete-floor cutting area. • Oily parts to be stored inside dedicated concrete-floor storage area. • Rainwater collection ditch and tanks to be regularly checked and cleaned.	Yard operator	GMB	Included in operation base cost

Item	Potential impact	Mitigation measures	Implementation responsibility	Supervision responsibility	Approx. cost
	Offshore tank cleaning works	• Installation of oil booms during tank cleaning works. • Stand-by of oil spill response vessel during tank cleaning works. • Onboard treated effluent to be discharged in compliance with effluent standard set under Environment (Protection) Amendment Rules 2015: Effluent standards for common effluent treatment plants (into sea). • Continuous monitoring of effluent concentration through automatic/online monitoring system. • Immediately cease operation in case of exceedance of effluent standards or when water pollution is detected through water quality monitoring.	Operator of offshore tank cleaning barge GMB: Stand-by of oil spill response vessel and water quality monitoring	GMB	Purchase cost of offshore tank cleaning barge included in Project budget
	Effluent from TSDF effluent treatment facility	• Treated effluent to be reused as far possible within the TSDF facility. • Treated effluent to be discharged in compliance with effluent standard set under Environment (Protection) Amendment Rules 2015. • Continuous monitoring of treated effluent concentration through automatic/online monitoring system. • Regular sampling and analysis of pre- and post-treated effluent concentration.	TSDF operator	GPCB GMB	Included in operation base cost
	Stack emission from TSDF incinerators	• Ensure that stack emission gas concentration are kept within emission standards for common hazardous waste incinerator set under Environmental Protection (Fifth Amendment Rules) 2008, through regular maintenance works and confirmation of treatment performance though regular sampling and analysis of stack emission gas concentration.	TSDF operator	GPCB GMB	Included in operation base cost
	Ship breaking works in yard area	• Oil spill response kit to be equipped at each yard in response to accidental spills. • Yard areas to be cleaned daily to remove any debris such as paint chips.	Yard operator	GMB	Included in operation base cost
Waste	Wastes from new treatment facilities	• Sludge generated from the new treatment facilities to be disposed at TSDF controlled landfill after drying. • Bottom ash to be reused/recycled and fly ash to be disposed at TSDF controlled landfill after sealing inside specialized container.	TSDF operator	GPCB GMB	

Item	Potential impact	Mitigation measures	Implementation responsibility	Supervision responsibility	Approx. cost
Bottom sediment	Ship breaking works in intertidal zone	• Implementation of water pollution control measures such as by use of MDS and large mobile crane. • Regular monitoring of sediment quality.	Yard operator GMB (monitoring)	GMB	Purchase cost of MDS and mobile crane included in Project budget
Ecosystem	Deterioration of marine habitat through ship breaking works	• Implementation of water pollution control measures such as by use of MDS and large mobile crane. • Regular monitoring of marine life status.	Yard operator GMB (monitoring)	GMB	Purchase cost of MDS and mobile crane included in Project budget
Infectious diseases	Proliferation of infectious diseases	• Implementation of AIDS awareness program as part of GMB training course.	GMB	DISH	Included in training base cost
	Occupational accidents	• Implementation of occupational health and safety training.	GMB Yard operator	DISH	Included in training base cost
	Health impacts due to asbestos handling	• Use of appropriate PPEs (respirator, protective clothing, gloves) • Wetting of asbestos parts during asbestos handling works. • Removed asbestos to be contained in specialized leak proof bags and stored in dedicated storage facility until transport to TSDF. • Implementation of occupational health and safety training.	Yard operator GMB (training)	DISH	Included in operation base cost
	Health impacts due to gas cutting works	• Gas cutters to be positioned in downwind direction. • Use of appropriate PPEs (e.g. mask, goggles, protective clothing, gloves). • As far as possible, toxic paints or coatings to be removed up to a distance of 10 cm from the cutting line of the plate. • Use of ventilation equipment when working inside areas with poor ventilation. • Implementation of occupational health and safety training. • Regular health check of gas cutters.	Yard operator GMB (training) SRIA (health check)	DISH	Included in operation base cost

Source: JICA Survey Team

11.8. ENVIRONMENTAL MONITORING PLAN

An Environmental Monitoring Plan (EMoP) was prepared to check the effectiveness of the proposed mitigation measures, status of the surrounding environment and worker's health. The plan describes the monitoring objective, methodology, implementation responsibility, approximate cost and justification (for operation EMoP). The operation EMoP was developed based on approved EIA, conditions of EC, CPCB guidelines, draft monitoring plan of GMB and JICA Survey Team's technical judgement. Table 11-51 and Table 11-52 show the EMoP for the construction and operation stages respectively. Monitoring form to be used for reporting to JICA is attached as Appendix - 11.

Table 11-51 Environmental Monitoring Plan (Construction stage)

Item	Objective	Method	Frequency	Implementation responsibility	Approx. cost
	To check whether excessive exhaust gases are not emitted from construction vehicles and machines	• Inspection of whether construction vehicles have a valid Pollution under Control Certificate. • Visual inspection of exhaust gases emitted from construction vehicles and machines.	Daily	Supervising consultant	Included in supervision base cost
	To check whether excessive dust is not emitted from the yard construction sites and concrete batching plant	• Visual inspection of dust emission from yard construction sites and concrete batching plant.	Daily	Supervising consultant	Included in supervision base cost
	To check whether the water pollution control measures at concrete batching plant are appropriately implemented	• Visual inspection of concrete washwater treatment facility (e.g. settling pond).	1/month	Supervising consultant	Included in supervision base cost
	To check the water quality of treated concrete washwater (in case of discharge outside of the premises)	• Parameter: pH • Assessment criteria: 6.0-9.0 (Effluent quality standards for common effluent treatment plant set under Environment (Protection) Amendment Rules 2015)	Prior to discharge	Construction contractor	pH meter: US$ 600
Soil quality	To check oil leaks from construction vehicles and machines	• Visual inspection of oil leaks from construction vehicles and machines	Daily	Supervising consultant	Included in supervision base cost
Noise	To check noise impacts of construction vehicles	• Parameter: LAeq • Location: Residential area adjacent to construction access road (5 sites) • Assessment criteria: Noise Pollution (Regulation and Control) Rules 2000	1/month	Construction contractor	Noise meter: US$ 1,600
Waste	To check whether wastes are stored and handled in accordance to the contractor's Waste Management Plan	• Visual inspection of waste storage areas. • Checking of waste disposal records.	Daily	Supervising consultant	Included in supervision base cost
Infectious diseases	To check implementation status of HIV/AIDS prevention plan	• Confirmation of implementation date of health checks and awareness programs including number of participants.	2/year	Supervising consultant	Included in supervision base cost

Item	Objective	Method	Frequency	Implementation responsibility	Approx. cost
Occupational safety	To check whether safety measures are implemented in accordance to the contractor's OHS plan	• Visual inspection of compliance to labor safety measures • Confirmation of accident records	Daily	Supervising consultant	Included in supervision base cost

Source: JICA Survey Team

Table 11-52 Environmental Monitoring Plan (Operation stage)

Item	Objective	Method	Implementation responsibility	Approx. cost	Justification
		Method: Sampling and analysis of stack emission gas **Parameter:** PM, HCL, SO_2, CO, TOC, HF, NOx, Dioxins/furans, Cd+Td, Hg, Sb+As+Pb+Co+Cr+Cu+Mn+Ni+V, PCBs (PCBs for new incinerator only) **Frequency:** 4/year **Assessment criteria:** Emission standards for common hazardous waste incinerator set under Environmental Protection (Fifth Amendment Rules) 2008. PCBs: Interim emission standard for PCBs incineration set by Ministry of Environment Japan.	TSDF operator	Analysis cost: US$8,500/year	All parameters except PCBs are required under Indian regulation. Frequency is based on CPCB guideline* PCBs proposed by JICA Survey Team as the new incinerator will treat PCB containing waste. Technical capacity of PCB analysis may be an issue.
		Method: Continuous monitoring of stack emission gas **Parameter:** PM_{10}, NOx, SO_2, CO, HCL **Frequency:** Continuously during incineration **Assessment criteria:** Emission standards for common hazardous waste incinerator set under Environmental Protection (Fifth Amendment Rules) 2008.	TSDF operator	Included in operation base cost	Continuous monitoring requirement under EC of EIA. Parameters based on CPCB guideline* and EC of EIA.
	Confirmation of ambient air quality around TSDF	**Parameter:** • NAAQS parameters: PM_{10}, $PM_{2.5}$, SO_2, NO_2, O_3, CO, Pb, As, Ni, Benzene, Benzo(a)Pyrene • Others: Asbestos, VOCs and PAHs **Location:** • NAAQS parameters, VOC and PAHs: 3 sites around TSDF • Asbestos: 3 sites at boundary of TSDF **Frequency:** • PM_{10}, $PM_{2.5}$, SO_2, NO_2: 104/year • Other parameters: 2/year **Assessment criteria:** • National Ambient Air Quality Standards 2009 • VOC and PAHs: Baseline data that will be acquired prior to operation.	TSDF operator	Analysis cost: US$40,000/year	Monitoring of NAAQS parameters, VOCs and PAHs (including location and frequency) based on CPCB guideline*. Asbestos proposed by JICA Survey Team as it was detected during supplementary survey. Technical capacity of PAHs and asbestos analysis may be an issue.

Item	Objective	Method	Implementation responsibility	Approx. cost	Justification
		• Asbestos: 0.01 f/cc (Japanese standard set under Air Pollution Control Act: applied to boundary of asbestos handling factories)			
	Confirmation of ambient air quality around ship breaking yards and access road	**Parameter:** • NAAQS parameters: PM_{10}, $PM_{2.5}$, SO_2, NO_2, O_3, CO, Pb, As, Ni, Benzene, Benzo(a)Pyrene • Others: Asbestos **Location:** 6 sites **Frequency:** 4/year **Assessment criteria:** • National Ambient Air Quality Standards 2009 Asbestos: Baseline data that will be acquired prior to operation.	GMB	Analysis cost: US$12,000/year	Monitoring proposed in EIA. Parameters, location and frequency based on GMB monitoring plan. Technical capacity of asbestos analysis may be an issue.
	Confirmation of air quality inside ship breaking yards	**Parameter:** PM_{10}, $PM_{2.5}$, SO_2, NO_2, Pb **Location:** 1 site per yard **Frequency:** 1/month **Assessment criteria:** National Ambient Air Quality Standards 2009 (Industrial)	GMB	Analysis cost: US$2,000/year/yard	Monitoring proposed in EIA. Frequency based on EIA. Parameters except lead based on Consent to Operate of existing yard. Lead proposed by JICA Survey Team as gas fumes may contain lead.
	Confirmation of asbestos concentration inside ship breaking yards	**Parameter:** Asbestos **Location:** Adjacent to asbestos handling facility and yard boundary **Frequency:** During asbestos handling **Assessment criteria:** • Work zone: 0.1 f/cc (OSHA standard: 1915.100) • Yard boundary: 0.01 f/cc (Japanese standard set under Air Pollution Control Act)	GMB	Analysis cost: US$30/measurement	Based on requirement of EC of EIA. Technical capacity of asbestos analysis may be an issue.
Noise	Confirmation of noise around ship breaking yards and access road	**Parameter:** Equivalent sound level (LAeq) **Location:** 6 sites around ship breaking yards and access road	GMB	Cost of noise meter: US$1,600	Monitoring proposed in EIA. Frequency based on EIA.

Item	Objective	Method	Implementation responsibility	Approx. cost	Justification
		Frequency: 4/year **Assessment criteria:** Noise Pollution (Regulation and Control) Rules, 2000			
	Confirmation of seawater quality around the ship breaking yards	**Parameter:** • pH, DO, color/odor, oil, Fecal Coliform, BOD • Others: Temperature, turbidity, SS, salinity, T-N, T-P, Chlorophyll-a, heavy metals (Al, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Zn) **Location:** 6 sites (ship breaking yard) + 2 sites (Background), Surface and bottom layers **Frequency:** 4/year **Assessment criteria:** • Environment (Protection) Rules 1986: Primary Water Quality Criteria (Harbour waters) • Others: Baseline data that will be acquired prior to operation.	GMB	Analysis cost: US$58,000/year	Based on requirement of EC of EIA. Parameters, location and frequency based on EC and GMB monitoring plan.
	Confirmation of groundwater quality around TSDF	**Parameter:** • CPCB guideline: pH, colour, EC, Turbidity, SS, TDS, TOC, COD, heavy metals (Pb, Cd, Cu, Zn, Cr, Hg, Ni, Fe, Cn, F, As, Mn), Cl, NO_3, SO_4, T-N, Total Alkalinity, Total hardness, Total pesticides • Others: PCBs, PBBs, PAHs, TBT **Location:** 4 sites **Frequency:** 4/year **Assessment criteria:** IS:10500 (2012) and baseline data • IS:10500 (2012) • Parameters not listed in IS:10500 (2012): Baseline data that will be acquired prior to operation.	TSDF operator	Analysis cost: US$24,000/year	Parameters and frequency based on CPCB guideline* except PCBs, PBBs, PAHs and, TBT. PCBs, PBBs, PAHs and, TBT proposed by JICA Survey Team. Technical capacity of PCBs, PBBs, PAHs and, TBT analysis may be an issue.
	Confirmation of groundwater quality around ship breaking yards	**Parameter:** • CPCB guideline: pH, colour, EC, Turbidity, SS, TDS, TOC, COD, Pb, Cd, Cu, Zn, Cr, Hg, Ni, Fe, CN, F, As, Mn, Cl, NO_3, SO_4, TKN, Total Alkalinity, Total hardness, Total pesticides • Others: PCBs, PBBs, PAHs, TBT	GMB	Analysis cost: US$12,000/year	Monitoring proposed by JICA Survey Team as groundwater is used by locals. Parameters based on CPCB guideline*. PCBs, PBBs, PAHs,

Item	Objective	Method	Implementation responsibility	Approx. cost	Justification
		Location: 4 sites **Frequency:** 2/year **Assessment criteria:** • IS:10500 (2012) • Parameters not listed in IS:10500 (2012): Baseline data that will be acquired prior to operation.			TBT proposed by JICA Survey Team. Technical capacity of PCBs, PBBs, PAHs and, TBT analysis may be an issue.
		Method: Sampling and analysis of effluent **Parameter:** • pH, temp., colour, SS, Oil and grease, NH_3-N, BOD, COD, Cl, SO_4^{2-}, TDS, Phenolic compound, CN, F, As, Cr, Cr^{+6}, Cu, Pb, Hg, Ni, Zn, Insecticide/pesticides • PCBs **Frequency:** 4/year **Assessment criteria:** • Effluent quality standards for common effluent treatment plant set under Environment (Protection) Amendment Rules 2015 (into inland surface water) • PCBs: Uniform National Effluent Standards of Japan	TSDF operator	Analysis cost: US$10,000/year	Parameters based on Consent to Establish of existing TSDF PCBs proposed by JICA Survey Team as high levels were recorded in leachate in supplementary survey. Technical capacity of PCBs, analysis may be an issue.
		Method: Continuous monitoring of effluent **Parameter:** Temp., pH, oil, SS **Frequency:** Continuously during ETP operation **Assessment criteria:** Effluent quality standards for common effluent treatment plant set under Environment (Protection) Amendment Rules 2015 (into inland surface water)	TSDF operator	Included in operation base cost	Continuous monitoring requirement of EC of EIA. Parameters proposed by JICA Survey Team.
	Confirmation of effluent concentration from ETP of offshore tank cleaning barge	**Method:** Continuous monitoring of effluent **Parameter:** Temp, pH, oil, SS **Frequency:** Continuously during ETP operation **Assessment criteria:** Environment (Protection) Amendment Rules 2015: Effluent standards for common effluent treatment plants (into sea)	Operator of offshore tank cleaning barge	Included in operation base cost	Proposed by JICA Survey Team
	Confirmation of water quality around offshore	**Method:** Visual observation, *in situ* measurement, lab analysis **Parameter:**	GMB	Analysis cost: US$690/operation	Proposed by JICA Survey Team

Item	Objective	Method	Implementation responsibility	Approx. cost	Justification
	tank cleaning barge operation area	Visual observation: Oil slick, color/odor, floating matter *in situ* measurement: Temp. pH, DO, turbidity Lab analysis: SS, oil, heavy metals (Hg, Pb, Cd) **Frequency:** Visual observation and *in situ* measurement: Daily during operation Lab analysis: 3 times (pre-, mid-, post-operation) **Assessment criteria:** Primary Water Quality Criteria for Class SW-I and II Waters			
Sediment quality	Confirmation of sediment quality around the ship breaking yards	**Parameter:** Particle size, TOC, heavy metals (Al, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Zn), PAHs, PCBs, TBT **Location:** 8 sites (ship breaking yard) + 2 sites (background) **Frequency:** 4/year **Assessment criteria:** Baseline data that will be acquired prior to operation.	GMB	Analysis cost: US$36,000/year	Monitoring proposed in EIA. Frequency proposed in EIA. Parameters based on GMB monitoring plan. Technical capacity of PAHs, PCBs and TBT analysis may be an issue.
	Confirmation of soil quality inside the ship breaking yards	**Parameter:** Particle size, TOC, heavy metals (Cd, Cr^{+6}, Hg, Pb), PAHs, PCBs, TBT **Location:** 1 site per yard (composite sample of surface layer) **Frequency:** 1/year **Assessment criteria:** Baseline data that will be acquired prior to operation.	GMB	Analysis cost: US$580/year/yard	Based on GMB monitoring plan Parameters proposed by JICA Survey Team. Technical capacity of PAHs, PCBs and TBT analysis may be an issue.
	Confirmation of soil quality around TSDF	**Parameter:** Particle size, TOC, heavy metals (Al, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Zn), Dioxins/furans, PCBs **Location:** 4 sites (surface layer) **Frequency:** 1/year **Assessment criteria:** Baseline data that will be acquired prior to operation.	TSDF operator	Analysis cost: US$3,600/year	Based on CPCB guideline* Parameters proposed by JICA Survey Team. Technical capacity of PCBs and dioxins/furans analysis may be an issue.

Item	Objective	Method	Implementation responsibility	Approx. cost	Justification
Ecosystem	Confirmation of TBT concentration in benthos	**Parameter:** TBT **Location:** 5 samples from intertidal area **Frequency:** 1/year **Assessment criteria:** Baseline data	GMB	Analysis cost: US$500/year	Proposed by JICA Survey Team Finding appropriate samples may be an issue. Technical capacity of TBT analysis may be an issue.
	Confirmation of status of planktons	**Parameter:** Abundance and diversity of phytoplankton and zooplankton **Location:** 6 sites (ship breaking yard) + 2 sites (Background) **Frequency:** 1/year **Assessment criteria:** Baseline data	GMB	Analysis cost: US$4,000/year	Based on GMB monitoring plan
	Confirmation of status of benthos	**Parameter:** Abundance and diversity of benthos **Location:** 6 sites (ship breaking yard) + 2 sites (Background) **Frequency:** 1/year **Assessment criteria:** Baseline data	GMB	Analysis cost: US$4,000/year	Based on GMB monitoring plan
	Confirmation of health status of yard workers handling asbestos	**Parameter:** Pulmonary function test, sputum test, chest X-ray, chest HRCT test (if necessary) **Target:** Workers handling asbestos more than 30 days/year **Frequency:** 1/year	SRIA	Test cost: US$6/worker	Based on requirement of EC of EIA.
	Confirmation of health status of gas cutters	**Parameter:** Pulmonary function test, lead blood concentration **Frequency:** 1/year **Assessment criteria:** Lead blood concentration of 50 µg/dL (OSHA standard: 1910.1025)	SRIA	Test cost: US$10/worker	Proposed by JICA Survey Team
	Confirmation of occupational safety and accidents	**Method:** ・Inspection of occupational safety measures implemented at yards and TSDF. ・Record keeping of occupational accidents and cause investigation. **Frequency:** Daily	GMB	Included in operation base cost	Responsibility of GMB

Item	Objective	Method	Implementation responsibility	Approx. cost	Justification
	Confirmation of occupational safety and accidents	**Method:** ・Inspection of occupational safety measures implemented at yards and TSDF. ・Record keeping of occupational accidents and cause investigation. **Frequency:** Daily	GMB	Included in operation base cost	Responsibility of GMB

Source: JICA Survey Team

11.9. IMPLEMENTATION STRUCTURE

Various organizations will be responsible for implementation and supervision of the EMP/EMoP. The GMB's Environmental Cell will be responsible for the overall management and supervision of the recycling yards and TSDF and implementation of ambient environmental monitoring. Environmental monitoring and lab analysis are planned to be assigned to a research institution. The GMB Alang office will be responsible for inspection of recycling yards and implementation of GMB's training programs for the yard workers.

Yard operators will be responsible for implementing HSE measures and environmental monitoring inside the yard area. SRIA will implement regular health checks under the supervision of DISH. GPCB will also conduct regular inspection at each yard.

TSDF operator will be responsible for implementing HSE measures and monitoring of TSDF facilities (e.g. effluent from ETP and emission from incinerator) and surrounding environment. GPCB will also conduct regular inspection at TSDF. Table 11-53 shows the main responsibilities of each organizations that will be involved in the implementation of EMP/EMoP. Figure 11-34 and Figure 11-35 show the implementation and reporting/feedback structure of EMoP for the construction and operation stages respectively.

Table 11-53 Main organizational responsibilities for implementation of EMP/EMoP

Organization	Main responsibilities
GMB	・ Supervision and inspection of recycling yards and TSDF ・ Implementation of ambient environmental monitoring ・ Review of monitoring results and feedback ・ Implementation of EHS training programs ・ Reporting of monitoring results to MoEFCC and JICA
GPCB	・ Inspection of facilities that require consent from GPCB ・ Review of monitoring results and feedback
TSDF operator	・ Implementation of environmental management and safety measurers ・ Monitoring of facility performances and surrounding environment ・ Reporting of monitoring results to GMB/GPCB
Yard operator	・ Implementation of environmental management and safety measurers ・ Monitoring of work environment ・ Reporting of monitoring results to GPCB/GMB
SRIA	・ Monitoring of worker's health
DISH	・ Supervision of labour safety and health ・ Review of monitoring results and feedback

Source: JICA Survey Team

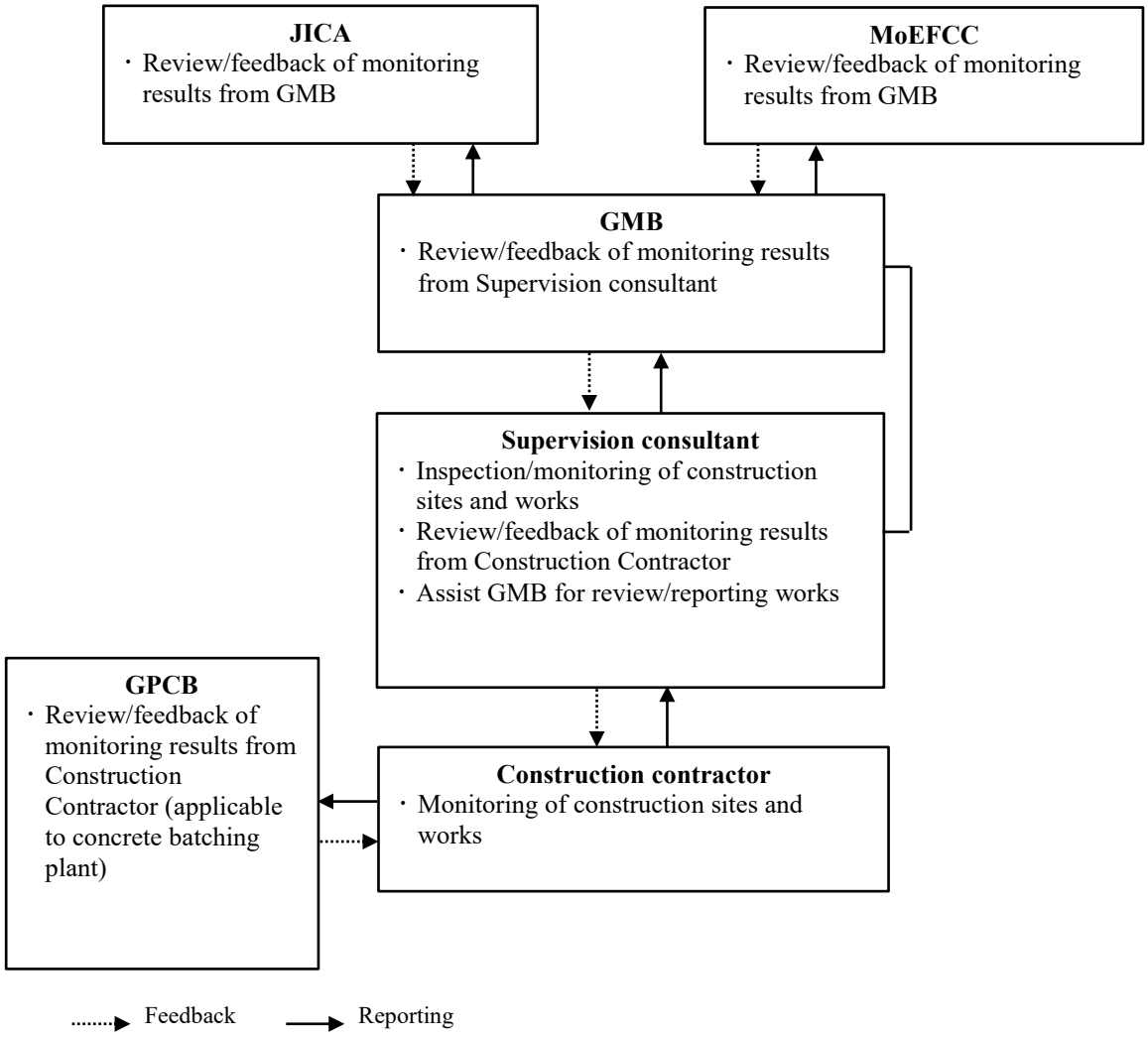


Figure 11-34 Implementation and reporting/feedback structure of EMoP (construction stage)

Source: JICA Survey Team

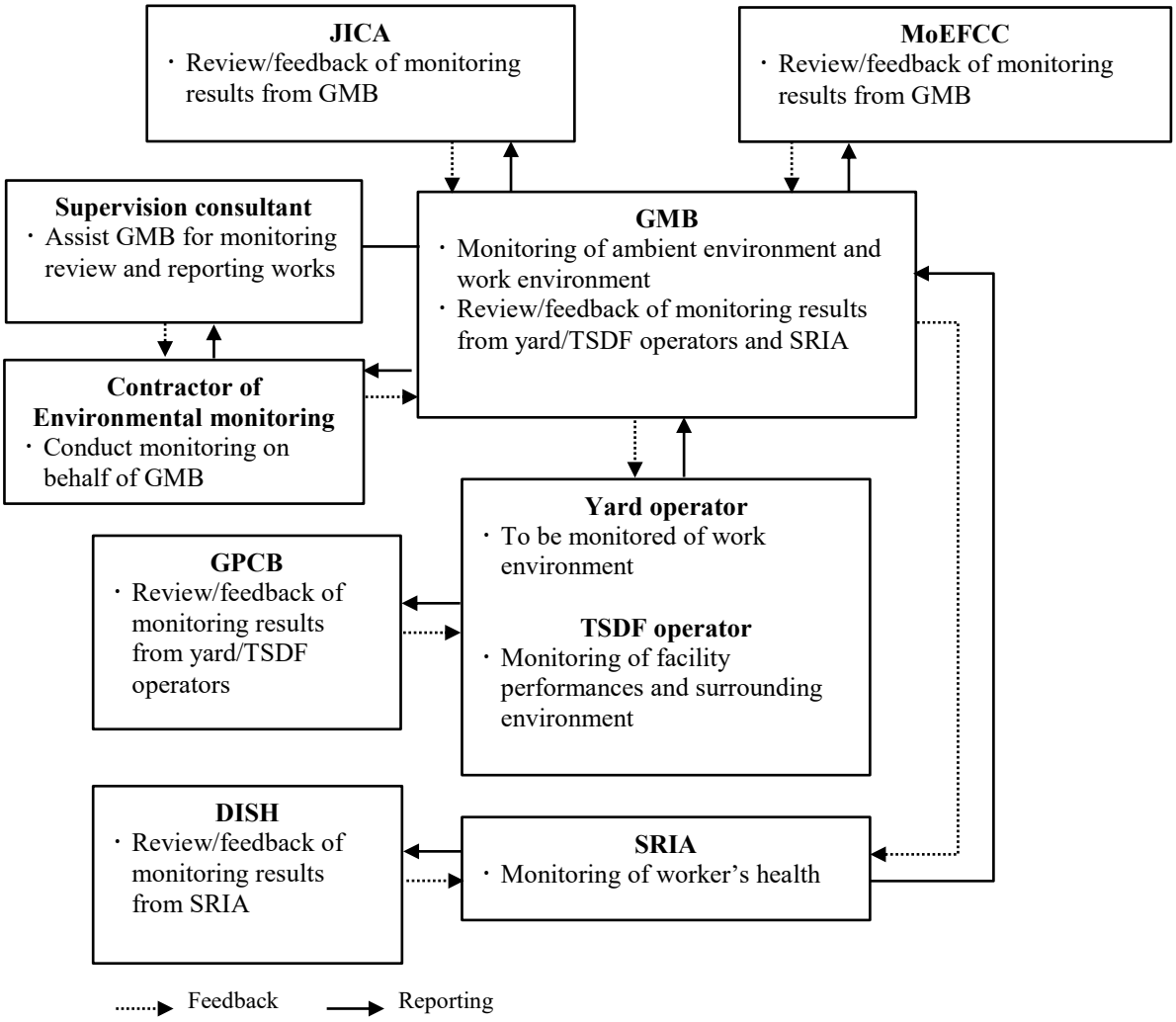


Figure 11-35 Implementation and reporting/feedback structure of EMoP (operation stage)

Source: JICA Survey Team

11.10. STAKEHOLDER MEETING

Two stakeholder meetings were held during the course of the study. The first meeting was held on July 2016 to introduce the Project and for scoping purposes. The second meeting was held on November 2016 to explain about the study results. Both meetings were held at the GMB meeting hall in Alang. The meetings were attended by representatives from SRIA, GPCB, ship recyclers, ASSRGWA, cash buyers and so on. Table 11-54 and Table 11-55 show the main questions and opinions raised by the participants and responses from GMB/JICA Survey Team during the 1st and 2nd meetings respectively. Minutes of both meetings are attached as Appendix - 12.

Table 11-54 Main questions and opinions raised during the 1st meeting and responses from GMB/JICA Survey Team

Organization	Comments/questions	Responses from GMB/JICA Survey Team

SRIA	SRIA: The JICA Study Team should provide technical criteria for yard improvement as some recyclers are planning to improve their yards in advance by themselves.	The JICA Survey Team will provide technical criteria at the DFR stage.
Cash buyer	Cash buyer: Request the JICA Survey Team to consider methods for collecting ship waste oil offshore, since construction of drydock is not in the plan.	The JICA Survey Team will consider methods to collect waste oil offshore.
ASSRGWA	ASSRGWA: The new labor colony with dormitory rooms are not appropriate for the labors, as they come from different regions and social background and may become a source of conflict.	The JICA Survey Team will consider appropriate design for the labor colony.

Source: JICA Survey Team

Table 11-55 Main questions and opinions raised during the 2nd meeting and responses from GMB/JICA Survey Team

Organization	Comments/questions	Responses from GMB/JICA Survey Team
	Customs may no longer collect Ozone Depleting Substances (ODS) from ships. Can the improved TSDF treat ODS?	TSDF will not be able to treat ODS. It is the first time we heard such news. If it becomes official, we will need to find another way to treat/dispose ODS.
	The new oil sludge treatment plant is a good plan. Hopefully, this will help to reduce illegal disposal of oily sludge.	Noted.
	Concrete batching plant will require Consent to Establish and Operate from GPCB.	Noted.
	Will new plant treat electric cable contained PCB?	TSDF will not treat insulation of the electric cable but as PCB contained, it can be incinerated.
	Is the plan for the labor colony included in the EIA?	The plan is within the scope of EIA.
	Result of the sediment investigation need to be justified with other data.	Noted.
	There are no Indian standard for discharging oily water in offshore waters as planned with the offshore tank cleaning barge. This may be an issue if discharge is undertaken within territorial water (i.e. 12 nm).	We are planning to apply MARPOL standard but will consider further what is most appropriate.
	Will recyclers need to take all waste oil to TSDF?	No. Sellable waste oil can be sold to other authorized facilities as practiced now.
	If health check for asbestos workers and gas cutters becomes compulsory it should be the responsibility of the government to implement and not recyclers.	This issue must be discussed among all stakeholders and find the appropriate way forward.
	How will recyclers be charged after introduction of the new facilities?	It will be based on use and pay system.
	Are 5 large mobile cranes sufficient for handling all the ships?	Since using the large mobile crane is a new approach to ship breaking, we think it is better to limit are purchase to 5 units. And if proved successful we can purchase more later.
	Considering the recent accident in Pakistan, we now fully support the introduction of	Noted and we expect that this will contribute in attracting oil tankers to Alang.

	offshore tank cleaning which will contribute in safer dismantling of oil tankers.	
	Will there be any additional financial burden on the Ship Recyclers on their current tariff (to be paid to GMB) once the JICA loan is sanctioned and the Project commences?	There shall not be any additional burden on the current Ship Recyclers tariff. However, the financial mechanism is still being finalized and will require further discussion with GMB, SRIA and other stakeholders.

Source: JICA Survey Team

11.11. CONCLUSION AND RECOMMENDATIONS

- One of the critical aspect for a successful environmental monitoring program is to have the capacity to produce accurate and reliable results. This is of particular importance to this Project as the EMoP covers a wide range of monitoring parameters in various fields which some may not have not been commonly monitored and analyzed locally in the past. Furthermore, some target parameters such as TBT are not included in any of the India's environmental standards and hence there are no nationally approved analysis methodology. In this respect, the JICA Survey Team strongly recommends GMB to establish a standard sampling and analysis protocol for the EMoP and at the same time strengthen the capacity of the organizations/personal that will be involved in the monitoring activities. A baseline survey should also be implemented prior to operation in accordance to the established standard sampling and analysis protocol, especially for monitoring parameters that will be compared with baseline data for the assessment. Table 11-56 shows the proposed specification of the baseline survey.

Table 11-56 Proposed specification of the baseline survey

Item	Parameter	Frequency
Ambient air quality (TSDF)	VOC, PAHs	2/year
Ambient air quality (yard)	Asbestos	2/year
Seawater quality	Temperature, turbidity, SS, salinity, T-N, T-P, Chlorophyll-a, heavy metals (Al, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Zn)	2/year
Groundwater quality (TSDF and yard)	EC, SS, TOC, COD, T-N, Total pesticides, PBBs, TBT	2/year
Sediment quality	Particle size, TOC, heavy metals (Al, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Zn), PAHs, PCBs, TBT	2/year
Soil quality (yard)	Particle size, TOC, heavy metals (Cd, Cr^{+6}, Hg, Pb), PAHs, PCBs, TBT	1/year
Soil quality (TSDF)	Particle size, TOC, heavy metals (Al, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Zn), Dioxins/furans, PCBs	1/year
TBT benthos	TBT	1/year
Plankton	Abundance and diversity	2/year
Benthos	Abundance and diversity	2/year

Source: JICA Survey Team

- Currently to avoid groundwater contamination, non-reusable effluent from the TSDF ETP is planned to be discharged into the rainwater drainage outside TSDF. However, the appropriateness of such discharge route should be studied in the D/D stage together with an impact assessment on downstream water use.
- Low-oil content effluent from the offshore tank cleaning barge is planned to be discharged into sea area after onboard treatment. Effluent standards of Environment (Protection)

Amendment Rules 2015 are planned to be applied as there are no other applicable national or international standards. A detailed impact assessment should be undertaken in the D/D stage taking into account for example the locations of sensitive ecosystem and fishing grounds, and the EMP and EMoP should be updated accordingly. The applicability of Environment (Protection) Amendment Rules 2015: Effluent standards for common effluent treatment plants (into sea) should also be considered. Stakeholders should also be consulted through the process especially GPCB in case the operation area lies inside territorial water which is under their jurisdiction.

- Regular health checks will be implemented for asbestos workers. However, considering the long latency period of asbestos symptoms, retired workers should also be eligible for regular free health checks. Since there is no such scheme now, GMB should initiate to establish such scheme.
- Due to certain changes in the Project plan and design, new potential impacts are generated which are not assessed in the approved EIA. Table 11-57 shows the new potential impacts. GMB should therefore submit to MoEFCC an amended EIA with an impact assessment and obtain approval together with CRZ clearance.

Table 11-57 Main changes of the Project from the approved EIA and additional potential impacts

Item	Approved EIA	Changes and additional potential impacts
New ETP of TSDF	Treatment capacity is 30t/day and treated effluent planned to be reused inside TSDF.	**[Changes]** Treatment capacity increased to 120t/day and non-reusable treated effluent planned to be discharged outside TSDF. **[Additional potential impacts]** Discharged effluent may affect downstream environment.
New incinerator of TSDF	Treatment capacity is 25t/day with similar design as existing incinerator	**[Changes]** Although treatment capacity is reduced to 5t/day, the new incinerator is planned to treat PCB containing material and the design has changed accordingly. GMB consider seeking opportunity to incinerate Ozone Depleting Substances (ODS) in the new incinerator during the detailed design stage. This option may be included the specification of new incinerator。 **[Additional potential impacts]** New impacts may arise through handling PCB.
Offshore Tank cleaning barge and associated jetty/access road	Not mentioned	**[Additional potential impacts]** Low-oil content effluent from the offshore tank cleaning barge is planned to be discharged after onboard treatment into offshore sea area, which may have impacts on surrounding environment.

Source: JICA Survey Team