

HEALTH RISK ASSESSMENT OF THE WORKERS OF SHIP-BREAKING INDUSTRY: A CASE STUDY FROM CHITTAGONG

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Abstract - The lower health and safety regulations in Bangladesh makes it an ideal place to host a huge, but immensely hazardous ship-breaking industry in its second capital, Chittagong. Previous literature dictates that the health hazards faced by the thousands of low-wage, unskilled/semi-skilled workers in this industry are indescribable. To analyze these risks and present a summarized report of the current scenario of the workers to the public in general and relevant occupational safety monitoring authorities, specifically, this research was initiated. In-depth interviews and semi-structured questionnaires were used to collect necessary data/information using purposive sampling techniques from a total of 235 respondents (laborers and related personnel). The study areas were a few ship-breaking yards in Sitakunda, Chittagong and data collection was done from October of 2014 to July of 2016. The health hazards faced by the workers were divided into five categories, namely, Serious Accidents, Physical, Biological, Mechanical and Ergonomic and Psychological. From the primary analysis done it was found that the industry-related incidences of skin diseases, backbone pain, gastric problems, urinary problems, chest pains, eyesight problem and headaches are approximately 17%, 35%, 52%, 29%, 11%, 17% and 24%, respectively. Accidents from fire explosions were the most common at around 49%, followed by those from fallen heavy ship parts (25%), toxic gas inhalation (16%), falls from heights (8%) and others (2%); 17.39% of the accidents were fatal. It was also found that due to the larger profits generated from not addressing these issues, lack of work-rights awareness among workers and absence of government intervention to protect the workers, the scenario was not likely to change. Recommendations include immediate attention of the labor authorities towards these economically important industry workers' occupational health and safety standards, regular health and hazards inspection of the sites to establish sustainability of the regulations and training and awareness programs for the workers to help them raise their voices against being exploited.

Keywords - Ship-breaking, Chittagong, Sitakunda, health hazards, risk assessment

I. INTRODUCTION

Ship breaking or ship demolition is a type of ship disposal involving the breaking up of ships for either a source of parts, which can be sold for re-use, or for the extraction of raw materials, chiefly scrap. It may also be known as ship dismantling, ship cracking, ship recycling, or ship disposal. Ship breaking allows the materials from the ship, especially steel, to be recycled and made into new products. This lowers the demand for mined iron ore and reduces energy use in the steel-making process. Sea going vessels/ships have a normal lifespan of about 30/40 years after which any repair or renovation becomes uneconomical. These ships are then retired and sold for scrap to commercial ship breakers. Equipment on board the vessel can also be reused and so, while ship breaking is, in theory, sustainable, there are concerns about this industry in the poorer countries without stringent measures against health hazards of the occupation. Moreover, it is considered the world's most dangerous industries and extremely labor-intensive.

The lower health and safety regulations in Bangladesh, a developing nation which was until a few years ago a least developed country (LDC), makes it an ideal place to host a huge, but immensely hazardous ship-breaking industry in its second capital, Chittagong. Previous literature dictates that the health hazards faced by the thousands of low-

wage, unskilled/semi-skilled workers in this industry are indescribable. To analyze these risks and present a summarized report of the current scenario of the workers to the public in general and relevant occupational safety monitoring authorities specifically, this research was initiated.

II. BACKGROUND

There is evidence of the ship-breaking industry as early as 1838. Until the late 20th century, ship breaking took place in port cities of industrialized countries such as the United Kingdom and the United States. Those dismantlers that still remain in the United States work primarily on government surplus vessels. In the mid-20th century, low-cost East Asian countries began to dominate ship breaking, with countries such as Japan, then Korea and Taiwan and then China increasing their world share. For example, in 1977 Taiwan dominated the industry with more than half the market share, followed by Spain and Pakistan. Bangladesh had no capacity at all at that time, but they were the underdogs.

The rise of the Asian countries in the arena of ship-breaking can be found in the fact that in 2013, Asia made up 92% of the tonnage of vessels demolished, out of a world total of 29,052,000 tons. India, Bangladesh, China and Pakistan now have the highest market share and are global centers of ship breaking, with Alang being the largest 'ships graveyard' in the

world (DNV, 2001). The largest sources of ships are states of China, Greece and Germany respectively, although there is a greater variation in the source of carriers versus their disposal. Furthermore, the ship breaking yards of the Indian subcontinent (which includes countries like Bangladesh and Pakistan) employ 100,000 workers as well as providing a large amount of indirect jobs. At present, the global center of the ship breaking and recycling industry is in South Asia. The three countries, Bangladesh, India, and Pakistan account for 70–80% of the international recycling market for ocean-going vessels, with China and Turkey covering most of the remaining market.

III. SHIP-BREAKING INDUSTRY OF BANGLADESH IN CHITTAONG: HISTORY AND TRAITS

In 1960, after a severe cyclone, the Greek ship M V Alpine was stranded on the shores of Sitakunda, Chittagong. It could not be refloated and so remained there for several years. In 1965, Chittagong Steel House bought the ship and had it scrapped. It took years to scrap the vessel, but the work gave birth to the industry in Bangladesh. During the Bangladesh Liberation War, a Pakistani ship Al Abbas was damaged by bombing. Later on, the ship was salvaged by a Soviet team who were working at Chittagong port at the time and the ship was brought to the Fauzdarhat seashore. A local company, Karnaphuly Metal Works Ltd bought it as scrap in 1974 and introduced commercial ship breaking in the country. The industry grew steadily through the 1980s and, by the middle of 1990s, the country ranked number two in the world by tonnage scrapped. In 2008 there were 26 ship-breaking yards in the area and in 2009 there were 40. From 2004 to 2008, the area was the largest ship breaking yard in the world (Goran, 2016).

Geographically, Chittagong ship breaking yard is situated near the port city of Chittagong which is connected to the Bay of Bengal. A gradual continental shelf, the width and depth of water allow even to accommodate the largest tankers of the world. Moreover, it is located in the middle hub of the main stream of east-west bound traffic routes, as well as at the intermediate distance from the main sale and purchase market of scrap vessels based in Singapore and Dubai. This allows ship owners to take advantage of the sailing time and cost for their vessels to be destined for beaching. Chittagong breaking yards are soft, sandy and muddy marshy land with an appropriate slope as better resting ground. It has an extended uniform long intertidal flat beach with 6 meter tidal gauge. Generally the weather is stable round the year and there is no particular sensitive area around the breaking yards. It is connected to main (Dhaka-Chittagong) highway giving easy accessibility for connecting transportation. Numerous linkage industries have developed on both sides of the

road centering the breaking industry. The industry also generates various job opportunities for the skilled, semi-skilled and unskilled workers. An estimation of 24, 41,000 workers with additional 8, 00,000 daily wage laborers are employed in the total linkage domains. If considering 6 persons in a family, than over 19 million people are earning their basic bread and butter from ship breaking and linkage industries (Shameem, 2012).

IV. METHODOLOGY

In-depth interviews and semi-structured questionnaires were used to collect necessary data/information using purposive sampling techniques from a total of 235 respondents (laborers and related personnel). The study areas were a few ship-breaking yards in Sitakunda, Chittagong and data collection was done from October of 2014 to July of 2016. The results and discussions of the study are based on the responses obtained from the surveys of the workers, interviews of officials and observations of the authors.

V. RESULTS: HAZARDS AND RISK FACTORS

To accentuate the hazards faced by the laborers of the yards, their responses were examined through graphical analysis was performed on certain risk parameters.

5.1. Condition of food, sanitation and habitat of laborers

In the case of food, 35% said the food is not good, while another 35% thinks that the sanitation facilities are very bad. Also, 30% laborers believe that the habitat facilities are not good. There was no specific range of the criteria very good, good, not good and very bad from questionnaire point of view; it was done by the opinion of a laborer's own point of view. None of the workers believed that their living conditions at the yards were proper, but they still lived there as it was the norm and they were too poor to change the situation. It is important to note that the yard contractor provides the sanitation and residence facilities, but the food arrangement is absolutely the laborer's responsibility.

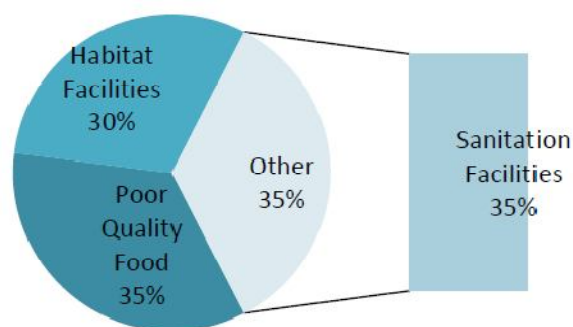


Fig.1. Condition of food, sanitation and habitat of laborers (%) at the yard

5.2. Medical facility of laborer

90% laborers don't get any medical facilities from the yard, 4% labor said that they get all medical facilities and 6% laborers get medical facilities, but in a nominal way like first aid treatment, small amount of money etc. This is tragic in the sense that this occupation is one of the riskiest and the workers at the yards are already paid low wages; to deprive them of medical facilities, which is a basic right in the moderately developed and developed nations is nothing short of oppression. It is important to note that this figure only shows general medical treatment facilities except the accidents at the yard.

5.3. Participation in Training

The workers participated mostly in Training on the job at 43%, which included cutting, carrying, fitting, etc., Personal Protecting Equipment training was taken up by only 28% and health & safety related training was participated in by just 11% (which was surprisingly low). Trainings decrease the occurrences of severe and fatal accidents, however, the authorities do not mandate it and so many-a-times the workers opt out of them.

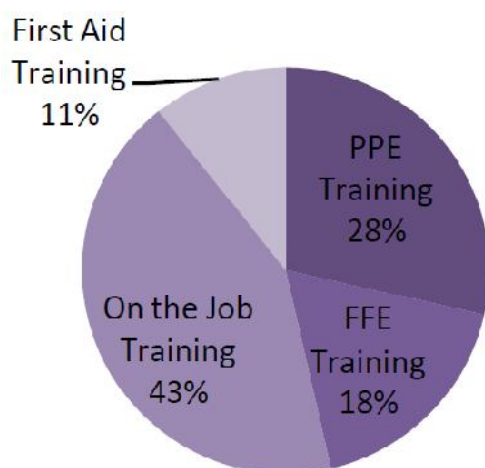


Fig.2. Participation of PPE, FFE, First Aid & On the Job Training (%)

5.4. Pains in Body Parts of Carrying Workers

To analyze whether the carriers of loads at the ship yards examined were too heavy for the workers, they were asked about pains they experienced in different parts of their bodies. A staggering 90% believed that most of their pains, including knee joint pains and headaches were attributable to long hours hauling heavy loads and working in the sun. The heavy loads are actually to be lifted by machineries, but due to the lack of the interest of authorities to invest in technology, the lowly paid workers pay directly through degradation of their health.

5.5. Health issues the workers suffered from

Due to their regular, hectic and often risky activities, the workers suffered from various health issues like Urinary (29%), Gastric (52%), Itching (10%),

Weakness due to deficiency of nutrition (3%) and Cough and Sputum (6%). Most of the issues are attributable according to health experts to high levels of pollutants like dust and smoke and lack of proper facilities at the yards.

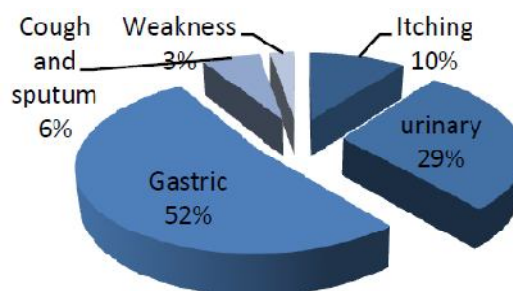


Fig.3. Health issues of laborers

5.6. Causes of fatalities among yard workers

Major percentage of deaths at the examined areas occurred due to Fire explosions in oil tankers (48.48%), Plate and part of ship fallen (25.25%), Toxic gas inhalation (16.16%) and Falls from ships (16.08%). What is important to note here is that most of these fatalities were preventable only if proper precautions like safety equipment, better technology and trainings were used/performed.

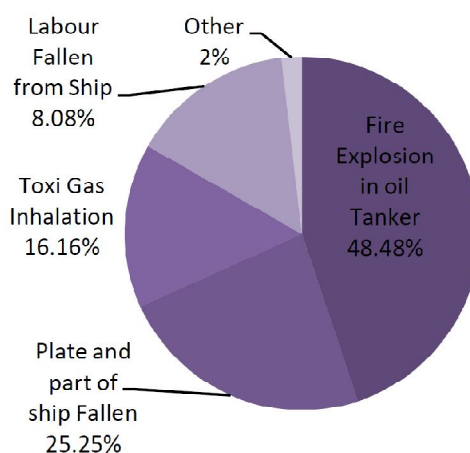


Fig.4. Major Causes of Deaths

To understand more fully the extent of the hazards' reality the lists of dead workers for the year 2015 (Appendix Table E) and severely injured workers (Appendix Table F) were constructed as well which shows a dimmer picture of the Sitakunda ship-breaking yards than previously thought.

VI. DISCUSSION: OCCUPATIONAL HEALTH HAZARDS OF WORKERS IN SHIP-BREAKING YARDS OF SITAKUNDA, CHITTAGONG

It was found through detailed surveys and observations that majority of the workers felt several health hazard risks, vulnerable due to working in the unhealthy and nauseous due to risky environment

round the clock in the study area. It was found from the surveys that direct physical hazards like Loss and Impact on Body Organs was high at 23.19%, followed by Spot Death (17.39%) and Skin Diseases (15.94%). Also, Gastric Problems were found in 11.59% of the respondents along with Muscle and

Chest pain (10.72%), Problem of Eyesight and Headache (8.84%) and Breathing Difficulty, Cold and Cough (7.54%) at the study area (Table 2). Additionally, it is observed from the surveys that on an average, every week, at least one worker dies or gets injured at the yards during the working period.

Type of Health Hazard*	Frequency (F)	Percentage (%)
Loss and breaking of body organs	320	23.19
Spot death	240	17.39
Problem of eyesight and headache pain	122	8.84
Breathing difficulty, cold and Cough	104	7.54
Skin diseases	220	15.94
Physical weakness, Muscle and chest pain	148	10.72
Diarrhea and water deficiency	66	4.78
Gastric problem	160	11.59
Total	1380	100

Table 2: Major health hazard risks of the workers in the study area
Source: Questionnaire survey * Multiple answers were considered

The major health hazard risks at the ship breaking workers from the present study are shown in Table 3. The observed common hazards of hazards and risks of ship breaking activities are divided into five categories namely, Serious accident-related hazards, Physical hazards, Mechanical hazards, Biological hazards and Ergonomic and Psychological hazards on

workers as well as residences near the breaking yards studied. Furthermore, the table lists the mechanisms through which the respective hazards take place. The authors had observed that many factors and issues area correlated with ship breaking accidents at Sitakunda's ship-breaking industrial area.

Category of Hazards	Mechanisms of hazards
Serious accident related hazards	Fire and explosion by explosives flammable materials Being stuck by falling materials Compressed between heavy materials Snapping of cables, ropes, chains, slings Handling heavy objects; poor access to progressively dismantled vessels (floor, stairs, passage ways) Falls from height inside ship structures or on the ground Stuck by moving objects Slipping on wet surfaces Sharp materials Oxygen deficiency in confined spaces. Lack of PPE, housekeeping practices, safety signs
Hazards	Noise pollution Extreme temperatures Vibration Poor illumination
Mechanical Hazards	Trucks and transport vehicles Scaffolding, fixed and portable ladders Impact by heavy an sharp-edged tools Power-driven hand tools, saws, grinders abrasive cutting wheels Shackles, hooks; chains Cranes, winches, hoisting & hauling equipment; Lack of safety guards in machines Poor maintenance of machinery and equipment.
Biological Hazards	Toxic marine organisms Risk of communicable diseases transmitted by pests, vermin, rodents, insects and other animals that may infest the ship Bitten by insects, snakes and others Infectious diseases (TB, malaria, dengue fever, hepatitis, respiratory infections etc.)
Ergonomic and	Repetitive strain injuries, awkward postures, repetitive and monotonous

Psychological Hazards	work, excessive workload. Long working hours, shift work, night work, temporary employment Mental stress, strained human relations (aggressive behavior, alcohol and drug abuse, violence) Poverty, low wages, under age, lack of education and social environment
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Table 3: Types of hazards and risks of ship breaking activities in the study area
Source: Questionnaire survey

Next, it was found that there were many responsible factors of health hazard risks round the clock at the study area (Table 4). Moreover, maximum workers were not familiar with or did not use life safeguard equipment. Toxic gas explosion and toxic oil (28.5%) was the most popular factor observed by the surveyors, followed by Lack of use of life safeguard

equipment's (19%), Lack of training (8.5%), Noise, air and water pollution (7.5%), Polluted environment (7%), Heavy work load (6%), Unhygienic food and Unhealthy toilet (6%), Risky works (5.5%), Lack of carefulness (4.5%) and heat or warm condition at the study area (4%).

Responsible Factor	Percentage (%)
Toxic gas explosion, Toxic oil	28.5
Not used of life safeguard equipment's	19.0
Heat/ warm condition	4
Polluted environment at ship breaking yards	7
Emit spark/ fire band	3
Too much working pressure and heavy work load	6
Carefulness	4.5
Lack of training	8.5
Noise, air and water pollution	7.5
Dust and sand	2.0
Smoke	3.0
Risky works	5.5
Unhygienic food and Unhealthy toilet in the yards	6.0
Non-responsibility of owners and contractors	3.5
Total	100

Table 4: Responsible factors at ship breaking activities for health hazard risks on workers
Source: Questionnaire survey

As per the risk ranking matrix given in Procedure for Identification of hazards, Assessments of Risks and Implementation of Controls (Appendix Tables A-D), a risk ranking matrix (Table 5) was constructed for assessing the risks and later (using responses from officials and workers and health organizations' information), for giving recommendations to minimize them.

Risk has been analyzed of ship-breaking yard associated with operational activity of ship dismantling once beached the scrap ship. The highest risk level was found to be 12 common for most of the activities associated with cutting operation like storing cylinders, ignition and actual cutting processes and also storage of hazardous materials like

oil, chemicals, asbestos and sludge. Activities like cutting sheet, cylinder handling, oil transfers, storage & preservation of glass wool had risk levels between 6 and 8, which are considered moderately high. Additionally, cable/electrical operations, pipe handling and machinery dismantling had a comparatively lower risk of level 4, followed by several other activities have a low risk level of just 1.

It was expressed by the respondents that especially during the high and moderately high risk activities extensive risk control method needed to be implemented, but were rarely done. In recent times many workers were reported to have suffered from fatal injuries or loss of limbs/sensory organs due to risk level 6-12 activities.

Activity	Risk	Hazards	Severity (S)	Probability (P)	Risk Level (S*P)	Present Practice
Beaching	Beaching & Disembarking	Health & Materials	2	1	2	Skilled Resources
Materials Dismantling	Pipe Handling	Health & Fire	2	2	4	Skilled Resources

	Machinery dismantling	Health & Fire	2	2	4	Skilled Resources
	Furniture removing	Health	1	1	1	Skilled Resources
	Electrical equipment	Health	2	1	2	Skilled Resources
Cutting Operation	Cylinder Handling	Health, Fire, Explosion	2	4	8	Skilled Resources
	Storage Cylinders	Health, Fire, Explosion	3	4	12	Skilled Resources
	Ignition& Cutting	Health, Fire, Explosion	3	4	12	Skilled Resources
	Cutting Process	Health, Fire, Explosion	3	4	12	Skilled Resources
	Shut-down	Fire, Explosion	2	4	8	Skilled Resources
Materials mobility, Loading and Unloading	Cutting sheet Handling	Health	2	3	6	Skilled Resources & Machine use
	Drum Handling	Health	1	1	1	Skilled Resources
	Spares Handling	Health	1	2	2	Skilled Resources
	Oil Transfer	Health & Fire	3	2	6	Skilled Resources
	Chemical shifting	Health	2	1	2	Skilled Resources
Storage & preservation of Hazardous waste	Oil and Chemical	Health & Fire	4	3	12	Improper storage
	Asbestos	Health	4	3	12	Improper storage
	Glass wool	Health	4	2	8	Improper storage
	Sludge	Health & Fire	4	3	12	Improper storage
	Electrical cable, equipment	Health	2	2	4	Improper storage
Storage & preservation of non-Hazardous waste	Cutting sheet	Health	2	3	6	Improper storage
	Furniture, Machinery & Equipment	Health	1	2	2	Skilled Resources
	Spares	Health	1	1	1	Skilled Resources
	Stationery items	Health	1	1	1	Skilled Resources
	Consumable store	Health	1	1	1	Skilled Resources

Table 5: Risk Analysis

Reference: Risk Register, Mother Steel Limited, Ref No: MSL/SRMS/RR, Revision No: 00, Issue No: 01, Dated of Issued: 10 Aug 2010

CONCLUSION AND WAY FORWARD

Ship breaking is recognized as one the most hazardous occupations (ILO, 2004). Bangladesh ship-breaking industry has both challenges and opportunities with numbers of advantageous parameters specially abundance of cheap labor, technical know-how, shipping experience and expertise, local steel demand and second hand market utility. What is required is the immediate attention of the labor authorities towards these economically important industry workers' occupational health and safety standards. Ship recycling should be looked into with an international perspective. Much needed international co-operation with transfer of technology and information and sharing of responsibilities from various stakeholders is equally important with ongoing local efforts. In addition to a global ship breaking policy in Bangladesh, local initiatives have to be promoted and particularly those aiming to improve the working conditions in the breaking yards by training the workers.

Bangladesh has shipping experience and good expertise in Maritime Education and Training. So,

now with potentials for better sustainability, the industry needs logical support both internally and externally in various aspects such as technical, human oriented, organizational and financial. Moreover, regular health and hazards inspection of the sites to establish sustainability of the regulations are essential. Also, training and awareness programs for the workers will help them raise their voices against being exploited.

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APPENDIX

Severity of incident (or consequences)	MAJOR Personnel –fatality or permanently disabling injury Environmental-significant release with serious off-site impact and more likely than not to cause immediate or long term health effect Cost (Equipment damage)-major or total destruction to process areas estimated at a cost more than 2 crores. Production loss-More than 24 hours. Public image: National and International	SERIOUS Personnel –one or more serious injury/disabling injury Environmental-significant release with serious off-site impact Cost(Equipment damage)-major damage to process areas; estimated at a cost more than more than 1 crores Production loss- 12 - 24 hours. Public image: Industry wide attention	MINOR Personnel –single injury, not severe, possible down time Environmental-release which results in agency notification or permit violation Cost(Equipment damage)-some equipment damage at an estimated cost more than 0.5 crores Production loss- 06 - 12 hours. Public image: Area	INCIDENTAL Personnel –minor or no injury; no lost time Environmental-environmentally recordable event with no agency notification or permit violation Cost(Equipment damage)-minimal equipment damage at a minimal cost less than 0.25 crores Production loss-Less than 06 hours. Public image: Confined to installation
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Table A: Consequence factors

Severity of incident (or consequences)	MAJOR	SERIOUS	MINOR	INCIDENTAL
SCORE	4	3	2	1

Table B: Ranking

Probability of occurrence (or likelihood)	FREQUENT	OCCASIONAL	SELDOM	UNLIKELY
	The Occurrence of risks are continuously	The Occurrence of risks are 15 days	The Occurrence of risks are once in 3-6 Months	The Occurrence of risks are Once in a year or more
SCORE	4	3	2	1

Table C: Probability Assessment Sheet

SCORE	
9-16	EXTREME RISK-cannot accept this risk
06-08	HIGH RISK-must implement extensive risk control
03-04	MODERATE RISK-may require risk control
01-02	LOW RISK-some risk control may still justified

Table D: Risk Levels

SL#	Name	Designation	Age	Yard Name	Ship Name	Date on Accident
1	EnamulHaq	Fitter	42	Ferdous Steel	Leo 1	26 May 2015
2	Saddam Hossain	Fitter	20	Crystal Shipper	Lianhua	6 June 2015
3	NurUddi	Helper	22	M/S RA Shipbeaking Yard	Jawaharlal Nehru	8 June 2015
4	Borhan	Helper	23	Ziri Subedar	Eurus Lisbon	27 June 2015
5	Mohammad Ali	Helper	18	Zuma Enterprise	PSU Second	6 July 2015
6	Md. Elias	Fitter	30	SN Corporation	Suneses Xi	25 August 2015
7	Al Amin	Fitter	26	Shital Enterprise	SCF Arctic / Aman Trader	5 September 2015
8	Khokon	Fitter	24	Shital Enterprise	SCF Arctic / Aman Trader	5 September 2015
9	Muksedul	Fitter	26	Shital Enterprise	SCF Arctic / Aman Trader	5 September 2015
10	Shajahan	Fitter	30	Shital Enterprise	SCF Arctic / Aman Trader	5 September 2015
11	Md. Rasel	Fitter	20	MS/RA Shipbreaking Yard	Jawaharlal Nehru	13 October 2015
12	Khairul Islam (Rafikul)	Fitter	22	MS/RA Shipbreaking Yard	Jawaharlal Nehru	13 October 2015
13	Aminul Isla	Fitter	30	MS/RA Shipbreaking Yard	Jawaharlal Nehru	13 October 2015
14	Salauddin	Helper	32	SN Corporation	Bulk Discovery	27 October 2015

Table E: Workers to death in the year of 2015

Source: Murder in the ship-breaking yard, Chittagong, Bangladesh, 26 May 2015 (article)

SL.#	Name	Designation	Age	Yard Name	Date of Accident	Injured
1	Nizam Akon	Helper	24	Shima Ship Breaking	22 March 2015	Fractured right hand
2	Idris	Cutter	42	Ferdous Steel	10 April 2015	Left leg amputated. Lost sight in right eye.

3	Azhar Uddin	Cutter	34	S Trading Corporation.	6 April 2015	Left leg crushed.
4	Nasir	Foreman	45	Crystal Steel Ship Breaking	13 August 2015	Left hand amputated.
5	Julhass	Fitter	32	S N Corporation (Unit 3)	25 August 2015	Severe burns.
6	Shopikul	Fitter	28	S N Corporation (Unit 3)	25 August 2015	Severe burns.
7	Ismail	Fitter	48	S N Corporation (Unit 3)	25 August 2015	Severe burns.
8	Nazim Uddin Roki	Helper	17	MM Ship Breaking	22 August 2015	Severe burns to face.
9	Mannan	Fitter	24	Shital Enterprise	5 September 2015	Severe burns over much of body
10	Badsha Sheik (Pasha)	Fitter	25	Shital Enterprise	5 September 2015	Severe burns over much of body
11	Nadim	Fitter	26	Shital Enterprise	5 September 2015	Severe burns over much of body
12	Abdur Rob	Fitter	25	Shital Enterprise	5 September 2015	Severe burns over much of body
13	Feroz	Cutter	23	MA Ship Breaking	9 September 2015	Head injury from fall.
14	Md. Jahangir	Cutter	42	S Trading Corporation	31 October 2015	Compound fracture to right leg, hit by falling metal slab.

Table F: Record of Workers Severely Injured in the Ship Breaking Industries of Bangladesh in 2015

Source: Murder in the ship-breaking yard, Chittagong, Bangladesh, 26 May 2015 (article)

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