Ministry of Transport
Myanma Port Authority
Inland Water Transport
The Republic of The Union of Myanmar

The Urgent Project for Rehabilitation of Yangon Port and Main Inland Water Transport in The Republic of The Union of Myanmar

FINAL REPORT

MAIN REPORT

January 2015

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Nippon Koei Co., Ltd. (NK)
Overseas Coastal Area Development Institute of Japan (OCDI)

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JR
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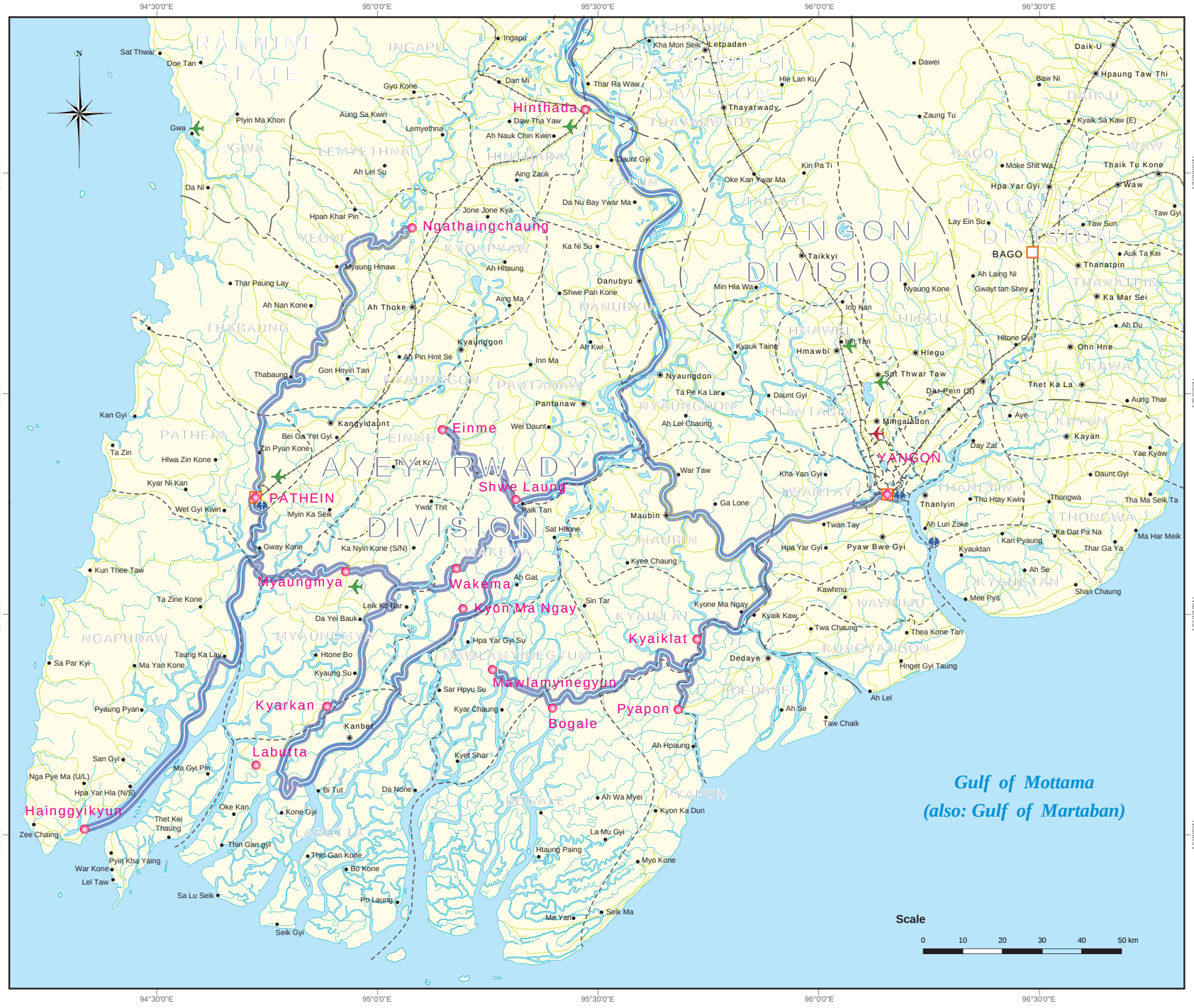
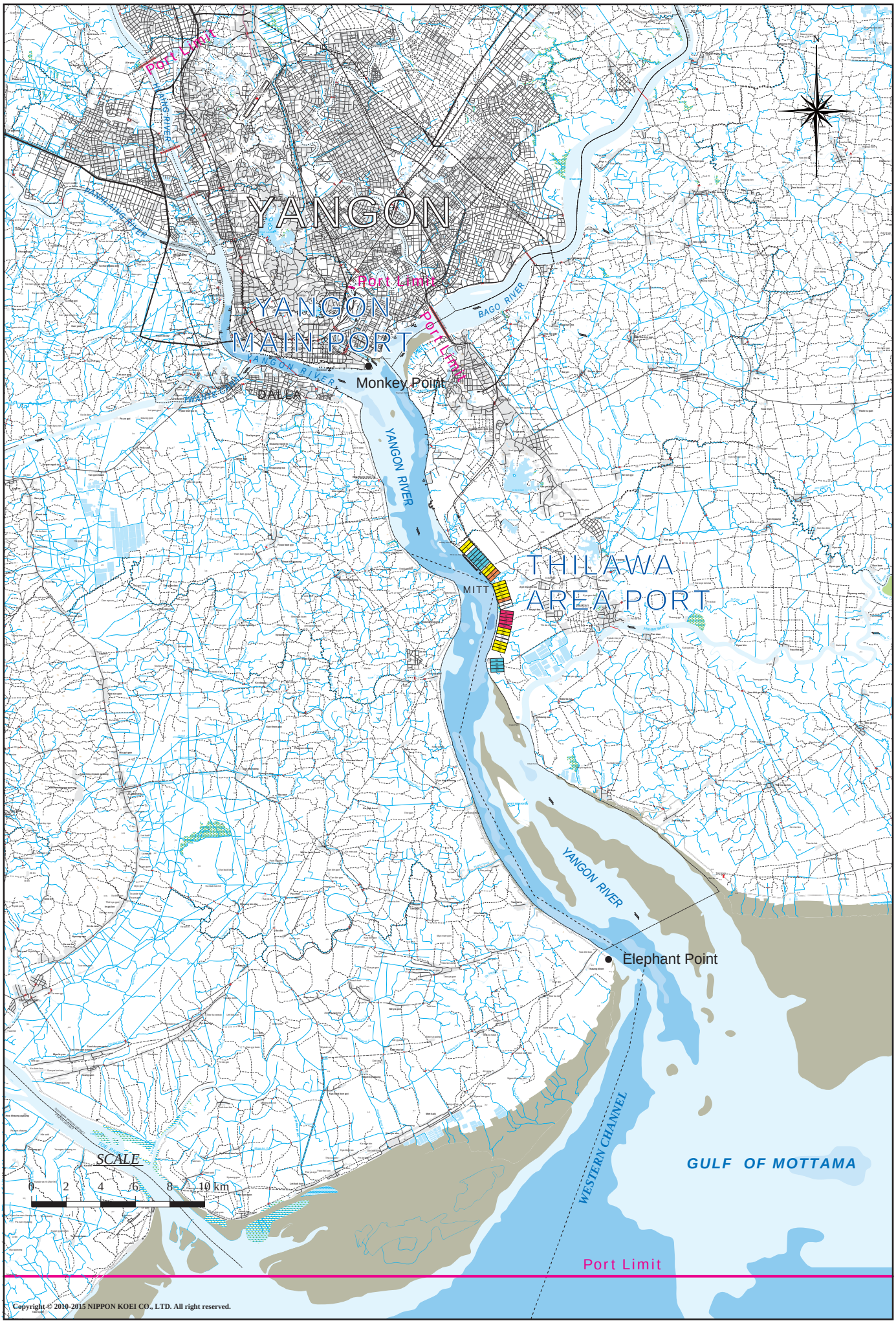
Legend

- Major Landing Stations of IWT
- State\Division Capital
- Main Town
- Other Town
- International Airport
- Domestic Airport
- International Port
- State/Region Boundary
- Township Boundary
- Railway
- Road
- Main Inland Waterway Route

MAIN INLAND WATERWAYS AND MAJOR LANDING STATIONS OF IWT IN DELTA





LOCATION MAP OF YANGON PORT

A
Capacity Development for Ship Crew and Navigation

For the safety of inland waterway transport and Yangon Port;

Step 1: Transfer navigation skills to IWT ship crew through lecture and practical training, and provide navigation instruments

Step 2: Transfer knowledge to MPA on international regulation of navigation aids system and Restore two leading lights and one sector light destroyed by cyclone Nargis.

Step 3: Transfer navigation skills to IWT ship crew through lecture and provide auto-recorded eco-sounder with GPS

B
Capacity Development for Repairing Ships and Metal Structures

For the improvement of repairing and construction skills through lecture and practical training;

Step 1: Transfer welding skills to engineer and skilled technicians and provide welding machines

Step 2: To achieve sustainable education from skilled technicians to unskilled workers through cradle construction practice

Step 3: Transfer CO_2 welding and the testing/inspection skills

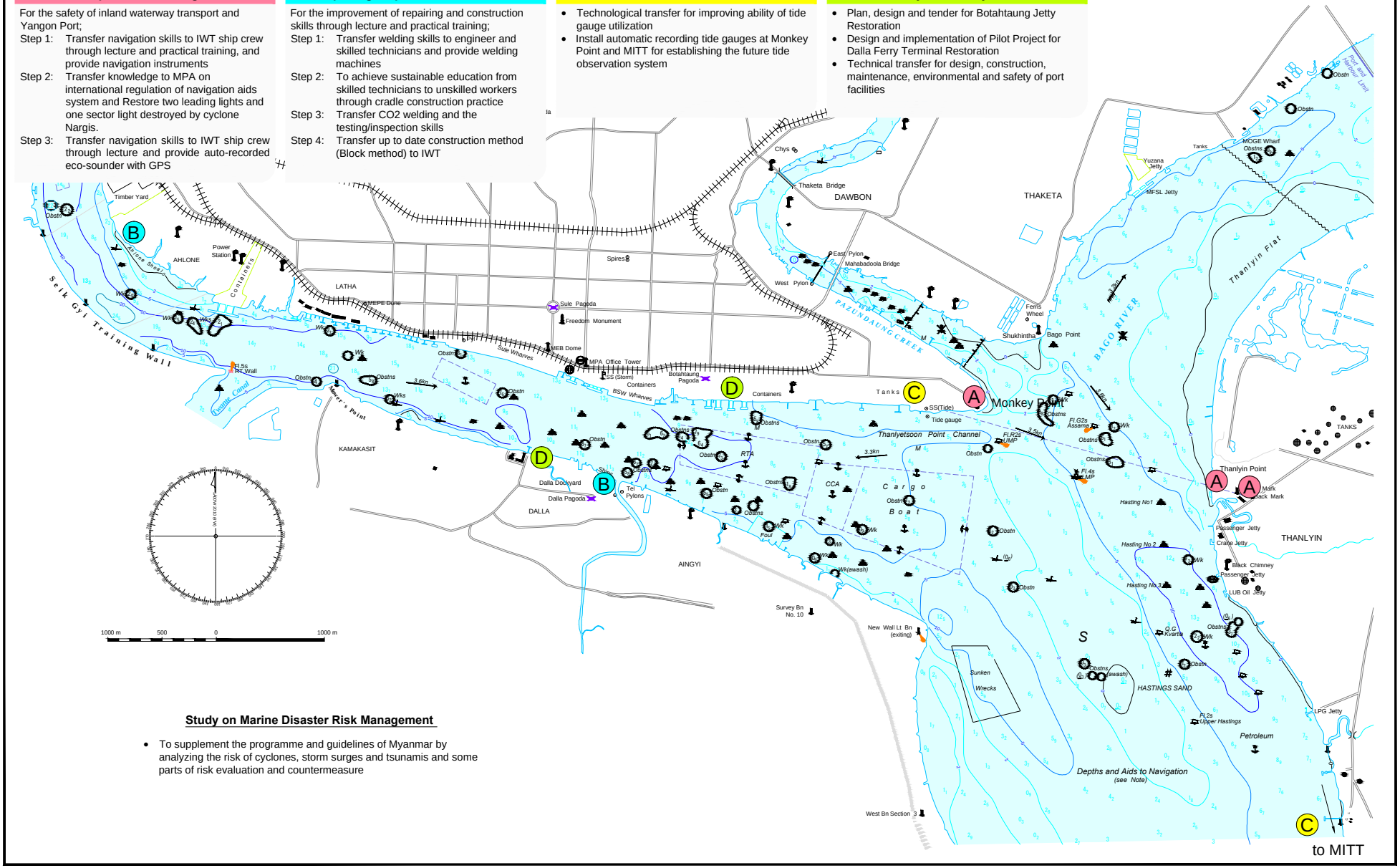
Step 4: Transfer up to date construction method (Block method) to IWT

C
Study of Tide Observation System

- Technological transfer for improving ability of tide gauge utilization
- Install automatic recording tide gauges at Monkey Point and MITT for establishing the future tide observation system

D
Design and Implementation of Pilot Project for Jetty Restoration

- Plan, design and tender for Botahtaung Jetty Restoration
- Design and implementation of Pilot Project for Dalla Ferry Terminal Restoration
- Technical transfer for design, construction, maintenance, environmental and safety of port facilities

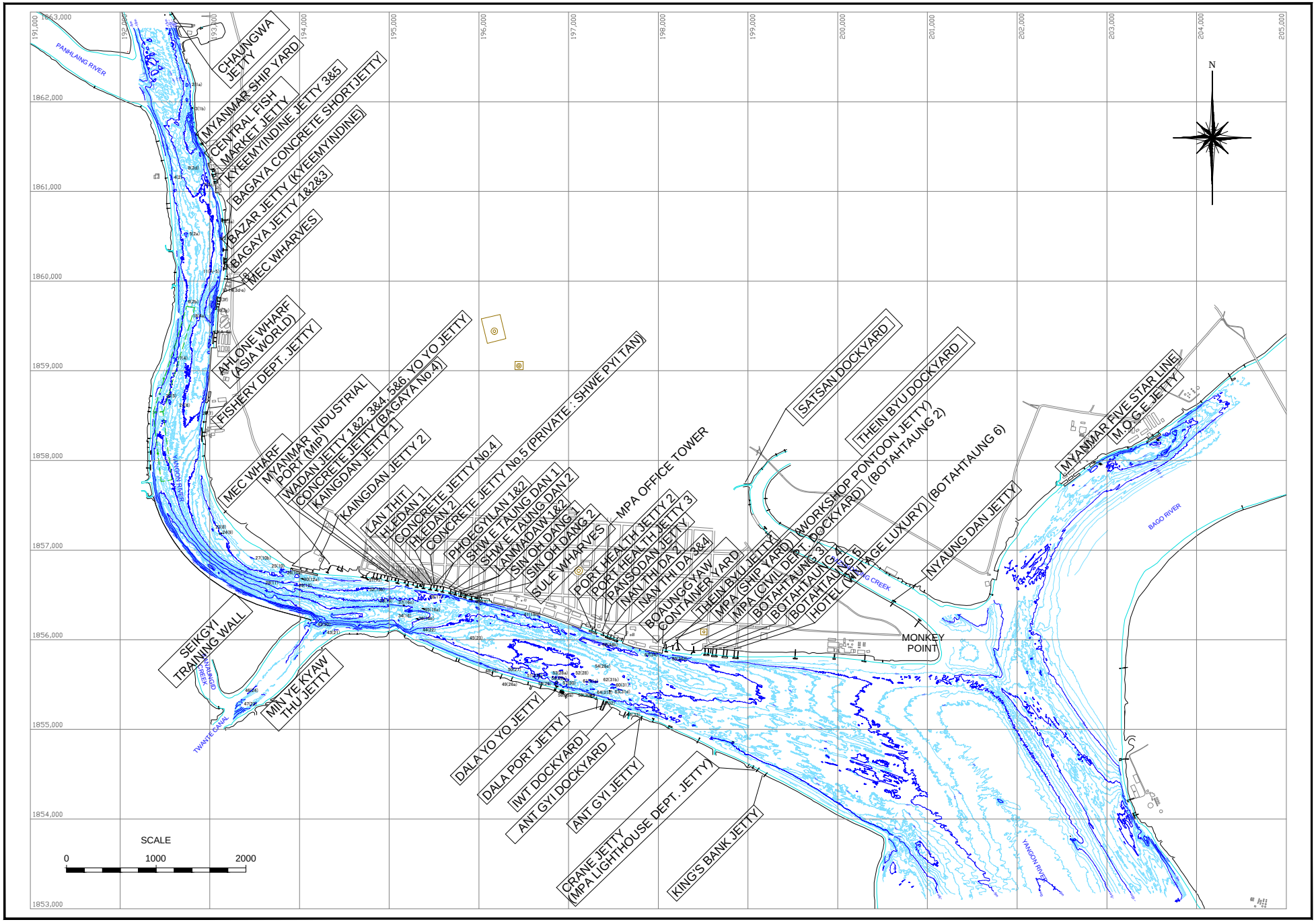


Study on Marine Disaster Risk Management

- To supplement the programme and guidelines of Myanmar by analyzing the risk of cyclones, storm surges and tsunamis and some parts of risk evaluation and countermeasure

to MITT

SUMMARY OF 2 CAPACITY DEVELOPMENTS, 2 STUDIES AND 1 PILOT PROJECT



LOCATION AND NAME OF PORT FACILITIES IN YANGON MAIN PORT

The Urgent Project for Rehabilitation
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The Republic of the Union of Myanmar

Final Report

Main Report

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ABBREVIATIONS

ADRC	Asian Disaster Reduction Center
AGCM	Atmospheric Global Climate Model
AIS	Automatic Identification System
AHTF	Asian Humanitarian Task Force
ASEAN	Association of Southeast Asian Nations
BH	Bore Hole
BRM	Bridge Resource Management
BTM	Bridge Team Management
BTTJ	Botahtaung Jetty
CD	Chart Datum
CDL	Chart Datum Level
COLREG	International Regulations for Preventing Collisions at Sea
DCA	Department of Civil Aviation
DFTJ	Dalla Ferry Terminal Jetty
DMA	Department of Maritime Administration
DMH	Department of Meteorology & Hydrology
DWIR	Directorate of Water Resources and Improvement of River Systems
DWT	Dead Weight Tonne
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMMP	Environmental Monitoring and Management Plan
EMP	Environmental Management Plan
FEC	Foreign Currency
FY	Fiscal Year
GDP	Gross Domestic Product
GOJ	Government of Japan
GOM	Government of the Republic of the Union of Myanmar
GPS	Ground Positioning System
GT	Gross Tonne
HF	High Frequency
HHWL	Highest High Water Level
HSE	Health, Safety and Environment
HWL	High Water Level
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ICD	Inland Container Depot
IEE	Initial Environmental Examination
IFC	International Finance Cooperation
IFI	International Financial Institutions
IMO	International Maritime Organization
ISM	International Safety Management
IUCN	International Union for Conservation of Nature
IWT	Inland Water Transport
JAXA	Japan Aerospace Exploration Agency
JFE	JFE Engineering Corporation
JICA	Japan International Cooperation Agency
JIS	Japan Industrial Standard
JMA	Japan Meteorological Agency
JSQS	Japanese Shipbuilding Quality Standard
JTCW	Joint Typhoon Warning Center

LED	Light Emitting Diode
LOA	Length Overall
LPG	Liquefied Petroleum Gas
LWL	Low Water Level
MDG	Millennium Development Goal
MDPC	Maritime Disaster Prevention Committee
MEPE	Myanmar Electrical Power Enterprise
METI	Ministry of Economy, Trade and Industry (Japan)
MIP	Myanmar Industrial Port
MOECAF	Ministry of Environment Conservation and Forestry
MOGE	Myanmar Oil and Gas Enterprise
MOT	Ministry of Transport
MPA	Myanma Port Authority
MRT/JMA	Meteorological Research Center/Japan Meteorological Agency
MSL	Mean Sea Level
M.S.T.	Myanmar Standard Time
N/A	Not Available
N/A	Not Applicable
NASA	National Aeronautics and Space Administration (USA)
NCEA	National Commission for Environmental Affairs
NCEP	National Center for Environmental Protection
NDT	Non Destructive Testing
NGO	Non-Governmental Organization
NK	Nippon Koei Co., Ltd.
PC	Pre-cast Concrete
PIANC	World Association for Water Borne Transport Infrastructure
PONJA	Post-Nargis Joint Assessment
PONREPP	Post-Nargis Response and Preparedness Plan
PT	Penetrant Test (welding)
RC	Reinforced Concrete
Ro/Ro	Roll on Roll off
RSMC	Regional Specialized Meteorological Center
RT	Radiographic Test
SMB	Sverdrup, Munck, Bretschneider method
SRTM	Shuttle Radar Topography Mission
SSHP	Security, Safety and Health Program
STCW	Standard of Training Certification and Watch keeping
SWM	Solid Waste Management
TCG	Tripartite Core Group
TOR	Terms of Reference
UN	United Nations
USGS	United States Geological Survey
UT	Ultrasonic Test
UTM	Universal Transverse Mercator (coordinate system)
VHF	Very High Frequency
VTS	Vessel Traffic Service
WGS 84	World Geodetic System 1984
WHO	World Health Organization
YSDC	Yangon City Development Committee

Common Measures and Technical Terms

Knots	Marine speed of one seamile per hour (1 knot = 1,852 m/hour = 0.51 m/sec)
Mph	Land mile per hour (1 mph = 1,609 m/hour = 0.44 m/sec)
USD or US$	United State Dollars
JPY or J Yen	Japanese Yen
K. or Ks	Kyat(s)
Inch	1 in = 2.54 cm
Feet	1 ft = 0.3048 m

Exchange rates as of the end of October 2009 are;
1 USD = 90 JPY
1 USD = 1,050 Ks

Exchange rates as of the end of October 2013 are;
1 USD = 102.19 JPY
1 USD = 980 Ks

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 BACKGROUND

On the 2nd and 3rd of May 2008, Cyclone Nargis struck the coastal areas of Myanmar and moved inland across the Ayeyarwady Delta, causing considerable human loss and damage to properties. The disaster caused widespread destruction of homes and vital infrastructures, including road and port facilities. The facilities and fleets of inland water transport were also battered severely, paralyzing its operation and the distribution of basic human needs and commodities.

In response to the official request of the Government of the Republic of the Union of Myanmar (hereinafter referred to as "the GOM") for the rehabilitation of Yangon Port and the main inland water transport, the Government of Japan (hereinafter referred to as "the GOJ") decided to conduct "the Urgent Project for Rehabilitation of Yangon Port and Main Inland Water Transport" (hereinafter referred to as "the Project"), in accordance with the relevant laws and regulations enforced in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency undertaking the implementation of the technical cooperation programs of the GOJ, has conducted the Project in close cooperation with the concerned authorities of the GOM.

On the part of GOM, the Myanmar Port Authority (hereinafter referred to as "MPA") and Inland Water Transport (hereinafter referred to as "IWT") have acted as the representatives of counterpart agencies to the designated Japanese Project Team (hereinafter referred to as "the JICA Project Team"). They were the coordinating body in relation with other concerned government and non-governmental organizations, to ensure smooth implementation of the Project.

1.2 PROJECT OBJECTIVES

The original objectives of the Project are:

- To make recovery plans of the Yangon Port facilities (Phase 1),
- To make recovery plans of the main inland water transport in the Project area (Phase 1),
- To develop the capacity of MPA and IWT, through the technical transfer to be provided in the course of JICA study by on-the-job training and the implementation of the pilot project (Phases 1 and 2),
- To ensure the performance of the pilot project facilities through maintenance inspection and the subsequent recovery work for defects, if found (Phase 3).

1.3 PROJECT AREA, SCOPE AND SCHEDULE

1.3.1 PROJECT AREA

The Project area shall cover Yangon Port and main routes of the inland water transport ways, operated by IWT and damaged by Cyclone Nargis as shown in the frontispiece map.

1.3.2 PROJECT SCOPE

The Project work for Phase 1 was performed in ten months. It was started at the end of February 2009, and completed after discussions on the Interim Report in November 2009.

The project work for Phase 1 is composed of following major work items:

- Submission and Discussion of Inception Report
- Collection and Analysis of Relevant Data and Information
- Recommendation of Urgent Measure in Securing Safety Navigation in Yangon Port
- Preparation of Recovery Plan of Port Facilities in Yangon Port
- Preparation of Recovery Plan of Main Inland Waterways in the Project Area
- Submission and Discussion of Progress Report
- Preparation of Disaster Prevention Program/Guideline against Cyclone in Yangon Port
- Preparatory of Pilot Project (Phase 1)
- Social and Environmental Considerations
- Capacity Development of Repairing Ships and Metal Structure (Step 1)
- Capacity Development of Ship Crew of IWT Ships (Step 1)
- Submission and Discussion of Interim Report

The Project work for Phase 2, which started in January 2010 was composed of following major work items:

- Capacity Development of Ship Crew and Navigation (Step 2 to 3)
- Capacity Development of Repairing Ships and Metal Structure (Step 2 to 4)
- Study of Marine Disaster Risk Management Enhancement
- Study of Tide Observation System Enhancement
- Preparation and Implementation of Pilot Project
- Social and Environmental Considerations
- Preparation and Submission of Draft Final Report and Final Report.

Phase 3 work is assistance to JICA Myanmar Office in performing technical inspection and advice in response to possible requests, if any.

Table 1.3.1 shows the work flow showing duration and timing of each phase.

1.3.3 SCHEDULE OF THE PROJECT

It is expected that the Project will be implemented within 81 months, and shall be carried out in three phases, as follows:

Phase 1: Preparation of urgent measures in securing safety navigation, and recovery plans for the Yangon Port facilities and for the main inland water transport in the project area. (Mar. 2009 to Dec. 2009, 10 months)

Phase 2: Execution of the recovery plans as defined in Phase 1 (Jan. 2010 to Feb. 2015, 63 months).

Phase 3: Defect liability period of the pilot project (Nov. 2014 to Nov. 2015, 12 months). If any defects are found, the situation and cause of the damage are investigated. However, should there be no defects, the inspection of completion are conducted at the end of the defect liability period.

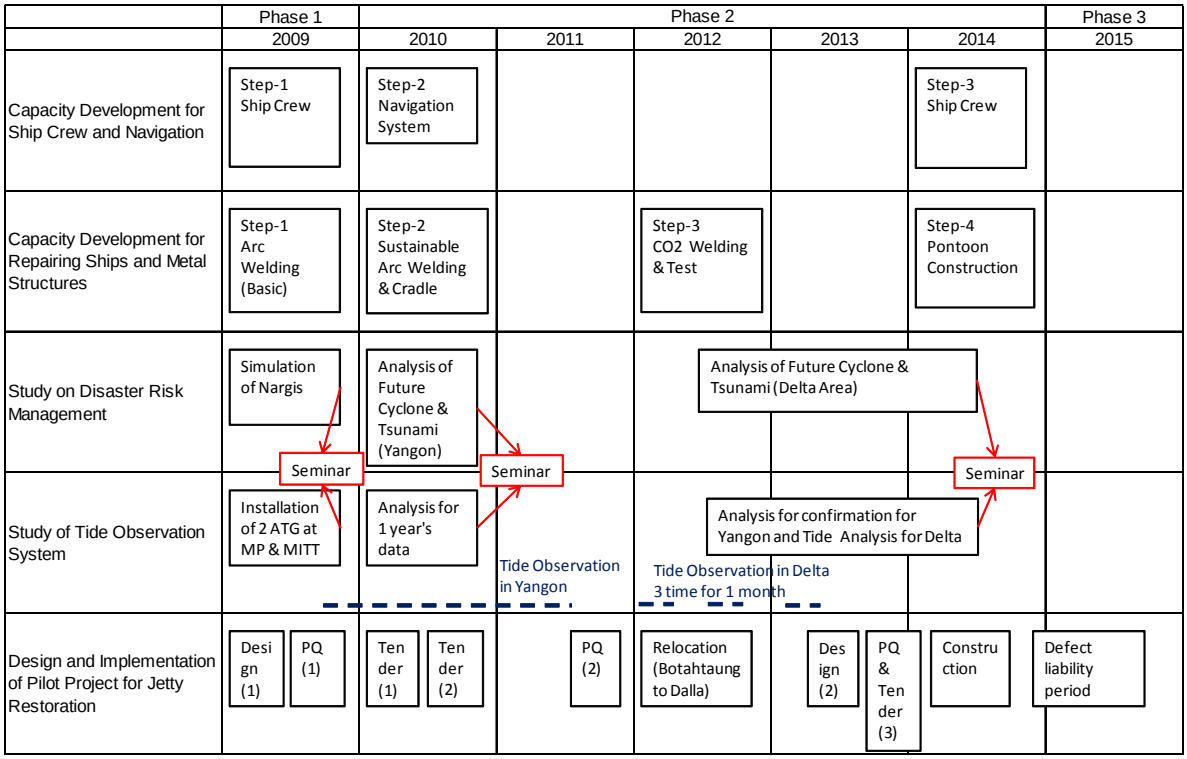
The flowchart for the implementation of the Recovery Plan is shown in Figure 1.3.1. The contents of the individual work items are described in the succeeding chapters.

Table 1.3.1 Schedule of the Project

Year	2009								2010	2011	2012	2013	2014				2015				
Month	3	4	5	6	7	--	11	12					1	--	11	12	1	2	3	--	11
Phase 1																					
Phase 2																					
Phase 3																					
Report	ΔIC/R				ΔPR/R		ΔIT/R									ΔDF/R	ΔF/R				

IC/R; Inception Report, PR/R; Progress Report, IT/R; Interim Report, DF/R; Draft Final Report, F/R; Final Report

Source: JICA Project Team



Source: JICA Project Team

Figure 1.3.1 Flowchart of the Execution of the Recovery Plans

1.4 COUNTERPART AGENCY

The counterpart agencies to the JICA Project Team are MPA and IWT.

The GOM and GOJ agreed to set up a steering committee and working group in order to implement the Project effectively and smoothly. The reports prepared by the JICA Project Team shall be presented and discussed in steering committee meetings to be held at each Project stage.

The steering committee will be chaired by the Vice Minister of the Ministry of Transport (hereinafter referred to as "MOT").

The steering committee is comprised of the following authorities and organizations:

1) Representative of MOT
2) Representative of MPA
3) Representative of IWT
4) Representative of Embassy of Japan
5) Representative of JICA Myanmar Office
6) Members of JICA Project Team

1.5 REPORT COMPOSITION

The scope of the Project is divided into the following two parts, which has been mentioned in Section 1.3.

Part 1: Preparation of Recovery Plan for Cyclone Nargis (2009)
Part 2: Capacity Development for the Counterpart (part of 2009 and afterward

The "Preparation of Recovery Plan for Cyclone Nargis", organization and responsibility of waterborne transportation in Myanmar is discussed in Chapter 2, and the characteristics of Cyclone Nargis are presented in Chapter 3.

The details of the facilities and damages of MPA and IWT, and the recovery plan, which was prepared in 2009, are elaborated in Chapter 4 to Chapter 6. The present data analysis, explanation of the problems, list-up of recovery plan, and the result of prioritization on the recovery list (emergency, short and medium –long term) are described in each chapter.

- **Securing Safety on Marine Traffic in Yangon Port (Chapter 4)**
- **Recovery Plan for Yangon Port and Port Facilities (Chapter 5)**
- **Recovery Plan for Main Inland Water Transport in the Project Area (Chapter 6)**

Capacity development for the counterpart through the recovery, and the background and summary of selected packages from the recovery plan based on the necessity and urgency for the capacity development of the counterpart is discussed in Chapter 7.

The implementation of the following five packages (two types of training, two types of survey, one type of pilot project) has been decided in 2nd Steering Committee. The extracted packages are as shown below. The study of environmental and social considerations for each package is presented in Chapter 8.

- **Capacity Development for Ship Crew and Navigation (Chapter 9)**
- **Capacity Development for Repairing Ships and Metal Structures (Chapter 10)**
- **Study on Maritime Disaster Risk Management (Chapter 11)**
- **Study of Tide Observation System (Chapter 12)**
- **Design and Implementation of Pilot Project for Jetty Restoration (Chapter 13)**
- **Summary (Output and Evaluation) (Chapter 14)**

Table 1.5.1 Report Composition

Chapter	Title	Main Components
1	Introduction	Background, Project Objectives, Project Area, Scope and Schedule, Report Composition, Project Team Member
2	General Situation of Myanmar and Waterborne Transportation	General, Coastal/ Domestic Transportation, Inland Waterway Transportation, Recent Tendency of Waterborne Transportation
3	Cyclone Nargis	Past Cyclones Experienced in Myanmar, Cyclone Nargis, Impact of Nargis, Post Nargis Recovery Plan
4	Urgent Measure in Securing Safety Navigation in Yangon Port	Navigation Assistance in Yangon Port, Analysis of Current Condition of Countermeasure for Safety Navigation, Examination and Recommendation of Measures for Solving Problems, Preparation of Recovery Plan for Securing Safe Navigation and Prioritization of Project Components, Water Depth Collection
5	Recovery Plan of Yangon Port	Planning Conditions Related to Port Facilities and Port Operations, and Identification of Problems, Formulation of Basic Concept for Restoration of Port Capacity, Examination and Recommendation for Solving Problems, Preparation of Recovery Plan for Port Facilities and Prioritization of Project Components
6	Recovery Plan of Main Inland Water Transport	Condition of IWT Facilities, Problems of IWT Facilities, Recovery Plans,
7	Recommendation of Capacity Development	Selection of Pilot Project and Capacity Development Training, Pilot Project, Capacity Building Training, Further Study, Implementation Schedule, Undertaking of Myanmar Side
8	Environmental and Social Considerations	Environmental Conditions for the Project, Existing Environmental Conditions
9	Capacity Development Scheme for Ship Crew and Navigation	Training Program for Capacity Development, Capacity Development of Ship Crew of IWT Ships, Capacity Development of Ship Navigation Training
10	Capacity Development Scheme for Repairing Ships and Metal Structure	Capacity Development on Repairing Ships and Metal Structures (Phase 1), Capacity Development on Repairing Ships and Metal Structures (Phase 2), Capacity Development on Repairing Ships and Metal Structures (Phase 3), Technical Transfer for Pontoon Construction
11	Study of Maritime Disaster Risk Management	Disaster Risk and Crisis Management, Maritime Disaster Prevention Programme and Plan in Myanmar, Storm Surge Simulation and Damage Estimation of Yangon Port, Safety Assessment of Ship Evacuation area, Tsunami Damage Estimation of Yangon Port, Tsunami and Storm Surge Simulation in Delta, Recommendation and Suggestion to Maritime Disaster Prevention Programme in Myanmar,
12	Study of Tide Observation System	Tide Observation Condition in Myanmar, Flow of analysis, Tide Prediction, Applicability of Predict result and existing tide table, Enhancement of Tide Observation System, Installation of Tide Prediction Software
13	Design and Implementation of Pilot Project	General, Natural Conditions, Design of the Project Facilities (Botahtaung), Design of the Project Facilities (Dalla), Procurement of Contractor, Construction, Seminar for Port Engineering

Source: JICA Project Team

1.6 PROJECT TEAM

The Project is implemented by the JICA Project Team, which is composed of 41 members as listed below.

Table 1.6.1 Project Members and Task Matrix

No.	Position	Name	Overall progress management	Data Collection (Transportation, Disaster, Natural Condition)	Urgent Measure in Securing Safety Navigation in Yangon Port	Recovery Plan of Yangon Port	Recovery Plan of Main Inland Water Transport	Capacity Development Scheme for Ship Crew and Navigation	Capacity Development Scheme for Repairing Ships and Metal Structure	Study of Tide Observation System	Study of Enhancement on Maritime Disaster Risk Management	Design and Implementation of Pilot Project	Environmental and Social Considerations
1	Team Leader/Inland Water Transport Planner	Ryoichi Nishimura	X				X						
2	Team Leader/ Disaster Risk Management Expert/ Marine Civil Engineer	Kazuhisa Iwami	X	X							X	X	
3	Co-Team Leader/Port Planner/Port Institution Expert	Tadahiko Yagyu				X						X	
4	Document & Procurement Specialist /Oceanographer/Cost Estimate	Kentaro Kimura		X				X	X		X	X	
5	Senior Marine Civil Engineer (1)	Toshihiro Kato										X	
6	Senior Marine Civil Engineer (2)	Tesuo Kawai										X	
7	Port Engineer (1)	Yushi Ando										X	
8	Port Engineer (2)	Nobuhiro Ochi										X	
9	Port Engineer (3) / Procurement Specialist (2)	Thiha										X	
10	Senior Civil Engineer	Hiroshi Otani										X	
11	Building Engineer	Masami Yonezawa										X	
12	Bridge Designer	Aoki Maruyama										X	
13	Bridge Installation Expert	Naomi Yoshida										X	
15	RC Maintenance Expert (1)	Kimitoshi Matsuyama										X	
14	RC Maintenance Expert (2)	Norihiro Ikawa										X	
16	Port Engineer	Masahiro Yokogawa				X						X	
17	Environmentalist	Shigeru Kanaya											X

18	Shipyard Operation Expert (1)	Yu Imaoka							X				
19	Welding Training Expert	Yasuo Namba							X				
20	Dockyard Facility Expert	Hiroshi Ooyama							X				
21	Inspection Expert	Tishitaka Namba							X				
22	Metal Structure Expert	Susumu Nogami							X				
23	Ship Construction Expert (2)	Kazuhisa Matsusaka							X				
24	Pontoon Designer	Yoshiaki Mitsumori							X				
25	Paint Specialist	Yu Sanya							X				
26	Shipbuilding and Dock Expert	Kojiro Emoto					X						
27	Salvage Expert	Shinsuke Sakai			X								
28	Ship Navigation/Channel Expert	Yusei Sakae			X			X					
29	Ship Navigation Aid Expert	Jihei Tamatani						X					
30	Ship Maneuvering/Safety Navigation Expert	Hisashi Okubo						X					
31	Nautical Instruments Expert	Kosuke Kawaguchi						X					
32	Storm Surge and Tsunami Expert	Masaaki Sakuraba								X			
33	Disaster Risk Evaluation Expert	Hisanari Ushirooka								X			
34	Earthquake Analyst	Seiichi Sato								X			
35	Meteorological Expert	Minoru Sugiyama								X			
36	Flood Expert	Tsutomi Mikami								X			
37	Oceanographer	Daisuke Toyama								X			
38	Tide Analysis Specialist	Katsumi Aoki								X	X		
39	Natural Condition/ Tide Observation Expert	Masaaki Uehara				X					X		
40	Logistic Planner	Shojiro Koga		X									
41	Transport Planner	Tsuyoshi Yamasaki		X									

Source: JICA Project Team

CHAPTER 2

SITUATION OF WATERBORNE TRANSPORT IN MYANMAR BEFORE NARGIS

CHAPTER 2 SITUATION OF WATERBORNE TRANSPORT IN MYANMAR BEFORE NARGIS

2.1 GENERAL

2.1.1 OVERVIEW OF MYANMAR

Myanmar is the second largest country in the Southeast Asia and is bordered with 5 nations, on the north and the northeast by the People's Republic of China, on the east and the southeast by Lao PDR and the Kingdom of Thailand, and on the west by the People's Republic of Bangladesh and India. The total land area is 677,000 square km while the coastline extends for 2,229 km. Myanmar is rich in natural resources such as arable land, forestry, minerals, and freshwater and marine fishes. Myanmar consists of 7 States and 7 Divisions including 65 Districts and 365 Townships.

2.1.2 POPULATION

The population of Myanmar in 2007 was estimated at 57.5 million of which 49.7% was male and 50.3 % was female. The annual population growth rate had remained constant at 2.02% per annum since 1999, but it drastically decreased to 1.75% per annum in 2007.

Table 2.1.1 Population of Myanmar and Annual Growth Rates

Year	Population as of October 1 (million)			Annual Growth Rate (%/year)
	Male	Female	Total	
1999	24.40	24.73	49.13	2.02
2000	24.91	25.22	50.13	2.02
2001	25.42	25.72	51.14	2.02
2002	25.94	26.23	52.17	2.02
2003	26.47	26.75	53.22	2.02
2004	27.00	27.30	54.30	2.02
2005	27.54	27.86	55.40	2.02
2006	28.10	28.42	56.52	2.02
2007	28.58	28.92	57.50	1.75

Source: Statistical Yearbook 2006, 2007 and 2008

Table 2.1.2 shows population by states/division in 2007. Yangon and Ayeyarwady state/division shared 11.7% and 13.7% respectively of the country's total population.

Table 2.1.2 Population by States/Division in October 2007

(Unit: thousand)

State/Division	Male	Female	Total
1. Kachin State	747	764	1,511
2. Kayah State	170	166	336
3. Kayin State	861	879	1,740
4. Chin State	260	273	533
5. Sagaing Division	3,084	3,190	6,274
6. Tanintharyi Division	814	818	1,632
7. Bago Division	2,912	2,881	5,793
8. Magway Division	2,653	2,739	5,392
9. Mandalay Division	3,984	4,078	8,062
10. Mon State	1,505	1,492	2,997
11. Rakhine State	1,586	1,597	3,183
12. Yangon State	3,338	3,386	6,724
13. Shan State	2,738	2,726	5,464
14. Ayeyarwady Division	3,934	3,929	7,863
Total	**28,586**	**28,918**	**57,504**

Source: Statistical Yearbook 2008

2.1.3 ECONOMY

Table 2.1.3 shows GDP in 2007/08 by sector at prices in 2009. The agricultural sector accounts for approximately one-third of the country's economy.

Table 2.1.3 GDP by Sectors in 2007/08

Sector	GDP (billion kyat)*	%
1. Goods		
Agriculture	8,253.5	35.4
Livestock & Fishery	1,766.2	7.6
Forestry	97.6	0.4
Energy, Mining, Electric Power	412.7	1.8
Processing & Manufacturing	3,468.8	14.9
Construction	893.7	3.8
2. Services		
Transport	2,530.1	10.8
Communication	228.8	1.0
Social & Administrative service	371.2	1.6
Rental & Other services	395.5	1.7
3. Trade	4,913.6	21.1
Total GDP	**23,331.7**	**100.0**

Source: Statistic Yearbook

GDP increased rapidly in the early 1990s after Myanmar started to liberalize certain sectors of her economy in 1989. However, growth rate has slowed down since 1996. After Myanmar became a member of ASEAN in July 1997, per capita GDP increased from 50,927 kyats in 2000/01 to 405,740 kyats in 2007/08. The average annual increase rate of per capita GDP during this period was estimated at 35.0%/year.

Myanmar's economy is mainly based on agro-industry, including fisheries and forestry, which employs more than 60% of the total labor force. To develop this sector, emphasis has been placed on ensuring self-sufficiency in rice production and expanding the cultivation of beans, cotton, sugarcane, and oilseed crops for export.

2.1.4 DEVELOPMENT PLAN

The first Short-Term Four Year Plan was implemented from 1992/93 to 1995/96 aiming at enhancing economic development of the country, during which time the economy achieved an average annual growth rate of 7.5%. The second Five-Year Plan was implemented between 1996/97 and 2000/01, during which time an average annual growth rate of 8.5% was realized. The third Five-Year Plan was implemented during the years 2001/02 and 2005/06, achieving an average annual growth rate of 12.8%.

According to the Ministry of National Planning and Economic Development, the fourth Five-Year Plan from 2006/07 to 2010/2011 targeted economic growth of 12.0 %. Main objectives of the fourth Short-Term Five-Year Plan are:

- To continue setting up agro-based industries and other required industries as part of industrialization,
- To develop the electric power and energy sectors to be in conformity with the developing trend of industries,
- To expand the agriculture, livestock and fishery sectors in order to meet the local demand for self-sufficiency and to promote exports,
- To meet the targeted yield per acre of the designated crops,
- To expand new cultivable land for agriculture use,
- To meet the demand of edible oil and lubricant oil,
- To promote the utilization of bio-diesel oil as a supplement to lubricant oil and fuel oil,
- To establish forest areas for greening.
- To conserve the natural environment,
- To enhance education and health sectors for human resource development,
- To make efforts for better roads and communication facilities in order to develop commerce and trade with momentum and for friendship among nationalities,
- To have continuous development for the infrastructure sectors,
- To meet the targets of the Special Development Zones,
- To continue the development of border areas,
- To continue the development of rural areas,
- To alleviate poverty,
- To exceed the targets of MDGs in implementing the national plans,
- To realize balanced economy and all-round development of the economy, and
- To let the continuation of the good foundation of economic and financial condition.

Source: Myanmar Millennium Development Goals, November 2006 by Ministry of National Planning and Economic Development

2.1.5 TRANSPORT

The transport network in Myanmar, which is mainly composed of waterway, road and railway, consists of the north-south trunk line with feeders in the east-west direction, due to the existence of rivers and mountain ranges in the north-south direction.

Inland Water Transport (IWT) under the Ministry of Transport (MOT) is a state enterprise which carries out river transport of cargoes and passengers. IWT operates cargo shipping services, passenger-cum-cargo shipping services and short distance river crossing ferry services for passenger and vehicles.

There are a total of 68 airports in the country managed by the Department of Civil Aviation (DCA) under the Ministry of Transport including two international airports, namely, Yangon International Airport and Mandalay International Airport.

A total of 4 airlines, Myanmar Airways, Myanma Airways International, Air Bagan Limited and Air Mandalay Limited, were in operation as of 2011. A domestic airline named Yangon Airways discontinued operations in 2010.

The total length of roads in Myanmar in 2007/08 was 19,314 miles of which 9,616 miles (49.8%) were with bituminous paving. Cargo transport service by road transport is mainly provided by private trucks.

Rail transport services are managed by a state enterprise of Myanma Railways. It extends the railway system between Yangon-Mandalay (620 km) and the circular commuter line within the city of Yangon.

The freight traffic volume by each public transport mode is shown in Table 2.1.4.

Table 2.1.4 Freight Traffic Volume by Public Transport Mode (1985/86 – 2007/08)

(Unit: Freight-ton by 1000 long-ton, Freight ton-miles by million ton-miles)

	Inland Waterways		Railways		Airways		Roads	
	Long-ton	ton-mile	Long-ton	ton-mile	Long-ton	ton-mile	Long-ton	ton-mile
1985/86	2,328	307.5	2,029	271.8	4.0	1.2	1,311	157.6
1990/91	2,491	325.6	1,930	306.9	2.0	0.7	914	76.8
1995/86	3,176	322.6	3,112	551.6	2.0	0.5	1,352	147.4
2000/01	3,863	344.4	3,551	750.0	2.0	0.7	1,485	189.9
2001/02	4,031	355.1	3,437	720.2	2.0	0.5	1,611	202.8
2002/03	4,171	370.9	3,442	723.1	1.2	0.4	2,041	212.5
2003/04	4,192	427.2	2,877	599.4	1.4	0.4	2,081	235.4
2004/05	4,307	453.4	2,878	544.6	0.9	0.3	2,108	247.0
2005/06	4,262	455.2	2,879	570.1	0.9	0.3	2,349	271.1
2006/07	4,284	520.0	2,822	551.1	0.6	0.2	2,380	282.3
2007/08	4,478	581.8	2,929	535.4	0.7	0.2	2,399	304.3

Source: Statistical Yearbook 2006, 2007 and 2008

Passenger traffic data by each transport mode including passenger number and passenger-miles are shown in Table 2.1.5.

Table 2.1.5 Passenger Traffic by Public Transport Mode (1985/86 – 2007/08)

(Unit: Passengers in mill. Passenger-miles in million passenger-miles)

	Inland Waterways		Railways		Airways		Roads*	
	PAX	Pax-mile	PAX	Pax-mile	PAX	Pax-mile	PAX	Pax-mile
1985/86	20.3	418.0	55.0	2,077.1	0.5	131.3	83.0	525.3
1990/91	27.5	482.2	53.1	2,442.4	0.4	112.2	97.4	947.8
1995/86	25.0	536.3	53.9	2,818.1	0.6	182.1	116.7	1,595.5
2000/01	23.3	457.2	60.5	2,763.2	0.4	143.8	37.1	842.5
2001/02	23.9	474.6	61.3	2,797.8	0.5	153.5	27.9	976.2
2002/03	24.2	480.7	61.8	2,926.4	0.5	161.7	37.4	1,323.8
2003/04	24.3	480.8	56.7	2,679.0	0.4	120.5	36.3	1,356.4
2004/05	24.7	516.3	58.2	2,604.4	0.3	101.1	25.5	1,364.0
2005/06	25.3	588.8	69.3	2,968.8	0.2	73.1	37.6	1,403.7
2006/07	26.3	654.8	72.7	3,297.6	0.2	75.3	37.7	1,428.1
2007/08	26.9	720.7	76.0	3,378.4	0.3	78.6	38.1	1,495.7

Note: Only Yangon city traffic.
Source: Statistical Yearbook 2006, 2007 and 2008

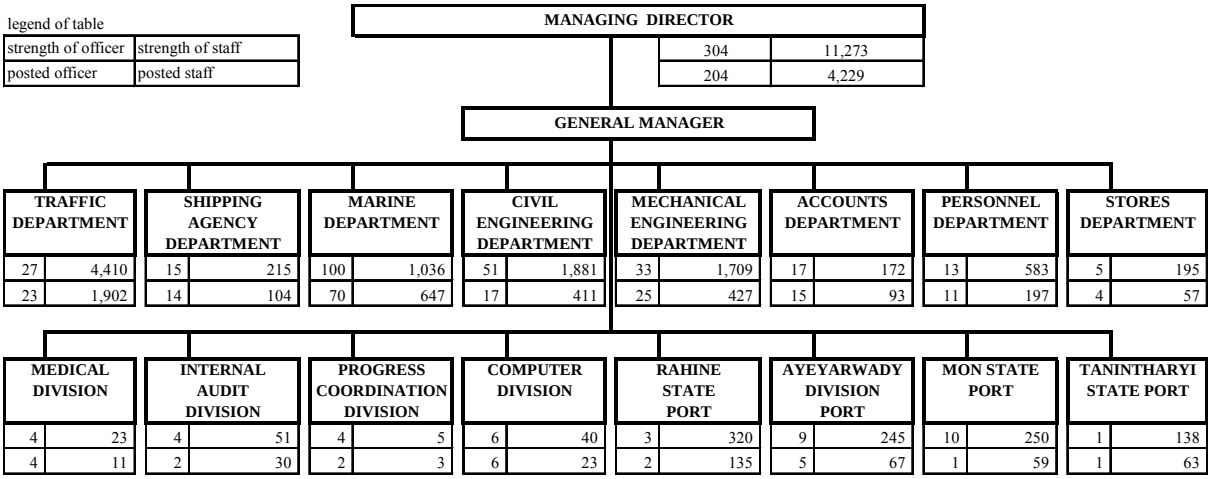
The total cargo volume handled by IWT was 4.3 million tons in fiscal year 2006/07 and estimated at 4.7 million tons in FY 2008/09. The number of passengers transported throughout the country was 26.3 million in FY 2006/07 and estimated at 27.4 million in FY 2008/09. Although Nargis disaster occurred in May 2008, the transport volume increased in FY 2008/09 compared to FY 2006/07. It is assumed that waterborne transport has increased to overcome the lack of land transport capacity due to Nargis damages. In order to cope with the need for waterborne transport after losing many ships in the Nargis disaster, IWT gathered ships from rural areas where no ships were damaged by Nargis to meet the transport demand around Yangon.

2.2 COASTAL/DOMESTIC TRANSPORT

2.2.1 RESPONSIBILITY AND ORGANIZATION OF MYANMA PORT AUTHORITY

Myanma Port Authority (MPA) is responsible for providing terminal facilities and necessary services such as pilotage, water supply, fuel bunkering and cargo handling. MPA's tasks are stipulated in the Rangoon (Yangon) Port Act enforced in 1905 and the Order conferring Duties and Power of Cooperation issued by the Ministry of Transport and Communications on 4 August 1976.

MPA has 8 departments, 4 divisions and 4 out-port offices. The organizational structure and the size of the potential work force and posted staff were as indicated in Figure 2.2.1. The total number of employees was 4,433 persons in 2009 composed of 204 officers and 4,229 staff members among the allocated potential work force of 11,577 persons. Vacancy rate was estimated at about 62%.



Position	Total Strength	Posted	Vacant	Occupancy (%)
(a) Officer	304	204	100	67.1%
(b) Staff	11,273	4,229	7,044	37.5%
Total	11,577	4,433	7,144	38.3%

Source: MPA

Figure 2.2.1 Organization Chart of MPA (28 Feb. 2009)

The Civil Engineering Department is responsible for planning, construction, maintenance and repair of all civil engineering works in the ports including Yangon and other out-ports. Through the dredging and survey division under it, the civil engineering department also undertakes the dredging and survey works in the channels and basins along wharves and other required sites in the ports.

The Mechanical Department undertakes all mechanical and electrical engineering works, namely building, maintenance and repair of service ships and other floating crafts, buoys and electrical installations.

The Marine Department provides pilotage, navigation lights and light houses, communications, mooring for ships and salvage of wreck within the port limits.

2.2.2 DOMESTIC WATERBORNE TRANSPORT NETWORK

Domestic waterborne transport network centering on Yangon Port consists of coastal and delta transport. The jetty-wise ship allocation of Yangon Port in terms of the transport network (IWT and Coastal) with their ship size as of 2009 is as shown in Table 2.2.1. Figure 2.2.2 shows the location of each jetty in Yangon Port as of 2009.

Table 2.2.1 Dimensions of Ships using Jetties

No.	Name of Jetty	Size			Remark
		"Length (feet)"	"Width (feet)"	"Draft (feet)"	
1	Chaungwa Jetty	200	40	8.0	Coastal
2	Kyeemyindine No. 3 Jetty	120	20	6.0	Delta
3	Kyeemyindine No. 5 Jetty	80	20	6.0	Delta
4	Kyeemyindine Bazar Jetty	120	20	6.0	Delta
5	Bagaya No. 1 Jetty	120	20	6.0	Coastal
6	Bagaya No. 2 Jetty	120	20	6.0	Coastal
7	Bagaya No.3 Jetty	120	20	6.0	Coastal
8	Concrete short Jetty	177	23	8.0	Public/Delta
9	Wardan No. 1 Jetty	120	20	6.0	Delta
10	Wardan No. 2 Jetty	120	20	6.0	Delta
11	Wardan No. 3 Jetty	240	40	8.0	Coastal/Delta
12	Wardan No. 4 Jetty	240	40	8.0	Coastal/Delta
13	Wardan Ro/Ro Jetty	275	18	NA	Public
14	Wardan No. 6 Jetty	120	20	6.0	Coastal
15	Between Wardan No. 6 & Kaingdan No. 1 Concrete short Jetty	105	62	NA	Public
16	Kaingdan No. 1 Jetty	120	20	6.0	Coastal/Passenger
17	Between Kaingdan No. 1 & No. 2 short Jetty	90	11	6.0	Public
18	Kaingdan No. 2 Jetty	120	20	6.0	Delta
19	Between Kaingdan No. 2 & Lan Thit Street Pier	101	11	6.0	Public
20	Lan Thit Street Jetty	120	20	6.0	IWT/Delta/Passenger
21	Hledan No. 1 Jetty	120	20	6.0	IWT/Delta/Passenger
22	Between Hledan No. 1 & No. 2 short Jetty	83	12	6.0	Public
23	Hledan No. 2 Jetty	120	20	6.0	Public/Delta
24	Between Hledan No. 2 & Phoegyilan Street No. 1 short Jetty	115	41	6.0	Public
25	Phoegyilan Street No. 1 Jetty	120	20	6.0	Delta
26	Between Phoegyilan Street No. 1 & No. 2 short Jetty	88	31	6.0	Public
27	Phonegyi Street No. 2 Jetty	120	20	6.0	IWT/Delta
28	Shwee Taung Dan No. 1 Jetty	120	20	6.0	IWT/Delta
29	Shwee Taung Dan No. 2Jetty	120	20	6.0	IWT/Delta/Passenger
30	Lanmadaw No. 1 Jetty	120	20	6.0	Delta
31	Lanmadaw No. 2 Jetty	120	20	6.0	Delta
32	Sin Oh Dan No. 1 Jetty	120	20	6.0	Delta
33	Sin Oh Dan No. 2 Jetty	154	40	8.0	Delta
34	Port Health No. 2 Jetty	294	40	NA	Coastal
35	Port Health No. 3Jetty	294	40	NA	Coastal
36	Pansodan Jetty	120	20	6.0	IWT/Passenger

No.	Name of Jetty	Size			Remark
		"Length (feet)"	"Width (feet)"	"Draft (feet)"	
37	Nam Thi Da Jetty	480	40	NA	MPA/Official
38	Ship yard Jetty	120	20	6.0	MPA
39	Botahtaung No. 3 Jetty (upper)	200	40	8.0	MPA/Public
40	Botahtaung No. 3 Jetty (lower)				
41	Botahtaung No. 4 Jetty (upper)	200	40	8.0	Public
42	Botahtaung No. 4 Jetty (lower)				
43	Botahtaung No. 5 Jetty (upper)	200	40	8.0	IWT/Public
44	Botahtaung No. 5 Jetty (lower)				
45	Botahtaung No. 6 Jetty (upper)	240	40	8.0	IWT/Public
46	Botahtaung No. 6 Jetty (lower)				
47	Nyaungdan Jetty Bridge	120	20	6.0	
48	Min Ye Kyaw Thu Jetty	120	20	6.0	IWT/Passenger
49	Dalla Ro/Ro Jetty	250	18	NA	IWT
50	Dalla Passenger Jetty	120	20	6.0	IWT/Passenger
51	Ant Gyi Jetty	120	20	6.0	Public
52	Thamada Beach Jetty	120	20		Private
53	Tak Wai Phyo Company Ltd. (Shwe Pyi Thar Industrial)	132	24		Private
54	Family Win Co. Ltd. (Aung Zeya Industrial)	72	24		Private
55	Shwe Zin Yaw Hein Company Ltd. (Yazak Win Kamayut)	324	108		Private
56	Thein Oo Co. Ltd. (Chaung Wa Kamayut)	72	36		Private
57	Myanmar Millennium Group Co. Ltd. (No. 1 Jetty of Kyeemyindine fish market)	150	160		Private
58	Myanmar Millennium Group Co. Ltd. (No. 1 Jetty of Kyeemyindine fish market)	88	144		Private
59	Sanpya Shwe Nga Co. Jetty Bridge (Kyeemyindine fish market)	90	123		Private
60	Man Myanmar General Trading Jetty (Kyeemyindine fish market)	180	104		Private
61	Htay Myanmar Trading Co. Jetty Bridge	144	104		Private
62	Yazana Industrial Fishiyng Products Co,Ltd Jetty (Nyaung Dan)	450	80		Private
63	Vicking Marine Products Co, Ltd Jetty (Thida port)	264	138		Private
64	Vicking Marine Products Co, Ltd Jetty (Pyidawthit)	144	48		Private
65	Yazana Edible Oil Alongside Jetty (Takeda)	254	72		Private

Source: MPA

Source: JICA Project Team

Figure 2.2.2 Location Map of MPA Jetties

The inland waterway transport covers the area along the rivers around Yangon and Ayeyarwady Delta. According to the fleet list of IWT published in March 2009, the maximum ship size is 240 ft (72 m) in length and 14 ft (4.2 m) in draft.

The coastal ship transport is operated by shipping companies belonging to a private organization of 'Coastal Cargo Transport Service' which is composed of 20 ship owners with 66 ships and a state owned company of 'Five Star Shipping'. The private company operated coastal shipping covers ports such as Sittwe, Mawlamyine, Dawei, Myeik and Kawthoung, and Kyaukpyu and Pathein occasionally. Ships used in coastal transport are about 100 DWT to 1,200 DWT which are about 20 ft (36 m) to 240 ft (72 m) in length, 20 ft (6 m) to 40 ft (12 m) in width and 12f (3.6 m) to 16 ft (4.8 m) in laden dra ft respectively. The average number of trips to/from Yangon Port by the private owned ships was 30 per day.

2.2.3 CARGO HANDLING VOLUME

In order to ascertain the impact of the damage to port facilities in respect of cargo handling capacity, it is important to identify changes in cargo handling volume before and after the damages.

Table 2.2.2 shows cargo throughput records of MPA facilities with a breakdown of import/export and coastal/inland waterway in the years of 2006, 2007 and 2008. The average annual throughput during the first two years was about 1.15 million tons which is equivalent to about 100 thousand tons per month. However, average cargo throughput during the first 4 months of 2008 was about 170 thousand tons which was larger than the average monthly throughput of previous years. In May when Nargis hit Yangon Port, the cargo throughput dropped to about 75 thousand tons, which was about 44% of the preceding months. However, average cargo handling volume after Nargis and until January 2009 increased to about 125 thousand tons which is about 74% of the average of the first 4 months of 2008 or even higher than the average monthly throughput of 100 thousand tons in preceding years. This means that cargo handling capacity of MPA jetties has only recovered to the 70% level.

Table 2.2.2 Cargo Throughput for Coastal/Inland Waterways Before and After Nargis
(Yangon Port only)

Year / Month	Import			Export			Total		
	Coastal	Inland	Total	Coastal	Inland	Total	Coastal	Inland	Total
2006/07	146,508	576,657	723,165	118,734	378,135	496,869	265,242	954,792	1,220,034
2007/08	112,788	492,561	605,349	116,017	365,621	481,638	228,805	858,182	1,086,987
2008									
January	32,362	61,772	94,134	42,458	46,333	88,791	74,820	108,105	182,925
February	72,284	49,218	121,502	32,601	33,099	65,700	104,885	82,317	187,202
March	76,062	43,645	119,707	32,924	27,981	60,905	108,986	71,626	180,612
April	22,176	46,605	68,781	29,472	24,929	54,401	51,648	71,534	123,182
May	13,334	34,235	47,569	12,526	14,709	27,235	25,860	48,944	74,804
June	16,294	29,313	45,607	31,410	5,340	36,750	47,704	34,653	82,357
July	62,418	47,618	110,036	29,841	6,715	36,556	92,259	54,333	146,592
August	63,967	32,568	96,535	25,374	16,004	41,378	89,341	48,572	137,913
September	21,688	35,558	57,246	32,710	18,253	50,963	54,398	53,811	108,209
October	23,276	51,670	74,946	27,074	7,386	34,460	50,350	59,056	109,406
November	61,059	29,103	90,162	32,276	16,005	48,281	93,335	45,108	138,443
December	67,320	38,824	106,144	36,277	5,677	41,954	103,597	44,501	148,098
2008/09	532,240	500,129	1,032,369	364,943	222,431	587,374	897,183	722,560	1,619,743
2009 Jan.	27,237	40,520	67,757	42,803	23,332	66,125	70,040	63,842	133,882

Source: MPA

Cargo volume handled by the coastal ships operated by private companies during the last 3 years from 2006 is shown in Table 2.2.3. According to the Table, average monthly cargo volume was about 17 thousand tons. In May 2008, after Nargis, it was reduced to 11 thousand tons which is about 65% of the past average volume.

In order to identify the characteristics and importance of each jetty, it is necessary to know the jetty-wise cargo handling volume with a commodity-wise breakdown. Unfortunately, there was no such data available

Table 2.2.3 Cargo Volume of Coastal Shipping through MPA's Jetties

	2006			2007			2008		
	Incoming	Outgoing	Total	Incoming	Outgoing	Total	Incoming	Outgoing	Total
January	8,944	5,360	14,304	6,715	9,598	16,313	8,697	8,361	17,058
February	7,290	12,008	19,298	7,812	10,848	18,660	8,293	6,239	14,532
March	8,039	10,248	18,287	7,118	12,770	19,888	10,048	7,509	17,557
April	5,240	9,578	14,818	8,803	13,540	22,343	7,457	4,380	11,837
May	6,750	13,220	19,970	4,775	10,710	15,485	5,967	4,190	10,157
June	7,350	7,290	14,640	7,597	9,077	16,674	4,529	6,997	11,526
July	4,820	10,160	14,980	6,865	10,244	17,109	7,236	5,325	12,561
August	8,100	9,790	17,890	7,501	8,585	16,086	8,494	6,163	14,657
September	7,042	9,650	16,692	7,605	8,959	16,564	7,607	9,442	17,049
October	5,675	10,198	15,873	5,405	6,836	12,241	9,643	5,232	14,875
November	6,900	12,818	19,718	7,713	8,700	16,413	9,811	7,926	17,737
December	7,970	11,058	19,028	8,909	6,690	15,599	8,866	6,638	15,504
Total	**84,120**	**121,378**	**205,498**	**86,818**	**116,557**	**203,375**	**96,648**	**78,402**	**175,050**

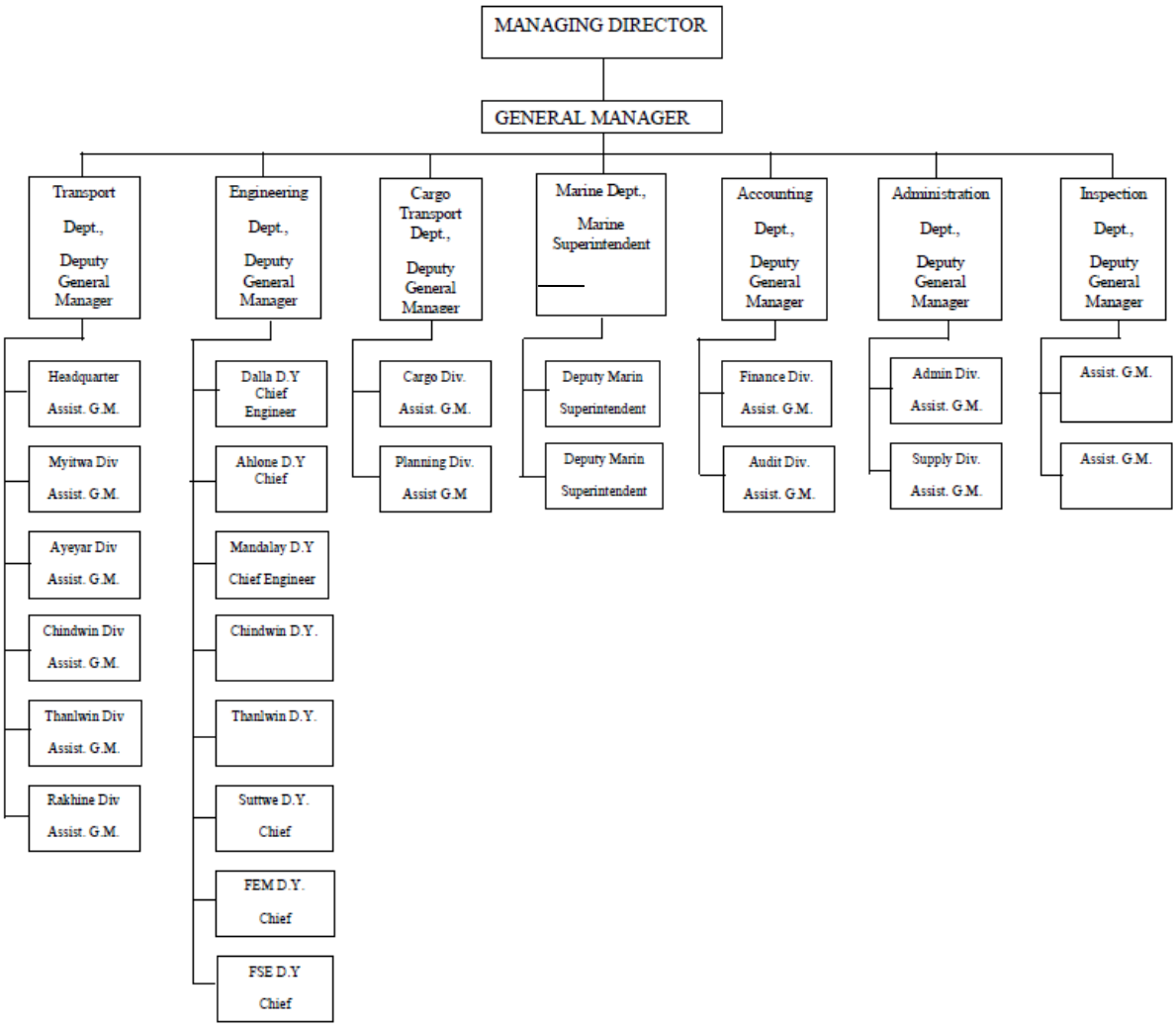
Source: Coastal Cargo Transport Service

2.3 INLAND WATERWAY TRANSPORT

2.3.1 RESPONSIBILITY AND ORGANISATION OF INLAND WATER TRANSPORT

Inland Water Transport (IWT) is responsible for providing river transport services in Myanmar which include transport of passengers, freight and vehicles along the navigable waterways of Ayeyarwady, Chindwin and Delta areas, Rakhine, Mon and Kayin states.

IWT has 9 departments, 12 divisions, and 8 dockyards. The organizational structure showing division level is shown in Figure 2.3.1.



Source: IWT

Figure 2.3.1 Organization Chart of IWT

The total number of employees was 5,157 persons composed of 186 officers and 4,971 staff members as of the end of October 2008.

The Transport Department is responsible for river transport to carry passengers and cargoes in inland waterways. The department also operates ferry services for the convenience of passengers and vehicles.

The Engineering Department is responsible for performing the repair of ships, annual docking surveys, design and construction of ships.

The Cargo Transport Department is responsible for the transport of break-bulk, bulk and liquid cargoes as well as the operation of market ships and the examination of cargo transport performance.

The Marine Department undertakes recruitment and training of ship crew, ensuring safety of own ships and securing of safe navigation.

The Accounting Department is responsible for preparing and controlling the budget, checking of receipt, payment and supervision about the state of conformity in documentation procedure with the financial rules and regulations, preparing annual accounting documents, and performing audit, payments and store.

The Administration Department provides overall administrative services, gives necessary orders and instructions, purchases and distributes necessary supply, implement targeted plans of the fiscal year.

The Inspection Department is responsible for inspecting the performance and work of departments, and supervising the work of departments in compliance with the orders, rules and discipline.

2.3.2 INLAND WATERWAY TRANSPORT NETWORK

There are many waterways in Myanmar which are navigable by comparatively flat bottomed inland water ships. Figure 2.3.2 shows navigable inland waterways in Myanmar. The principle inland water transport network is comprised of 4 systems: Ayeyarwady and Lower Chindwin rivers, Ayeyarwady Delta, the Thanlwin river in Kayin state and the Kaladan river in Rakhine state. The total length of navigable inland waterways is about 15,000km as shown in Table 2.3.1.

Table 2.3.1 Navigable Inland Waterways (Year 2001)

Division	Routes	Station	Length of Waterway
Cargo Division	1	20	961
Delta Division	25	124	4,701
Ayeyarwady Division	10	125	5,796
Chindwady Division	4	54	730
Thanlwin Division	11	30	338
Rakhine Division	11	46	2,307
Total	**62**	**399**	**14,833**

Source: IWT

Source: IWT

Figure 2.3.2 Inland Waterway System

The Ayeyarwady delta is a complex area of waterway system and influenced by both tide and fresh water. The characteristic feature of the tide is its diurnal variation, which allows ships to pass shallow areas by waiting until sufficient under-keel clearance is available to permit safe passage. There is a daily tidal window in which restrictions to movements of large ships apply. The draft limitation in respect of cumulative waiting days per year is shown in Table 2.3.2.

Table 2.3.2 Available Depth at Ayeyarwady and Lower Chindwin Rivers

Stretch	Draft Limitation (m) for Cumulative Waiting Days per Year							
	1 day	20 days	30 days	60 days	90 days	120 days	150 days	180 days
1. Yangon - Pyay	2.10	2.30	2.40	2.55	3.30	4.50	5.70	6.90
2. Pyay - Magwe	1.05	1.20	1.30	1.50	2.05	2.85	3.70	4.50
3. Magwe - Confluence	0.95	1.10	1.20	1.35	1.85	2.65	3.45	4.20
4. Confluence - Mandalay	0.95	1.25	1.35	1.50	2.10	2.95	3.85	4.75
5. Mandalay - Bhamo	0.75	0.95	1.10	1.25	1.80	2.65	3.50	4.40
6. Confluence - Monywa	0.75	0.90	0.95	1.10	1.45	2.05	2.70	3.35
7. Monywa - Mawlaik	0.75	0.90	1.00	1.15	1.50	2.05	2.70	3.45

Source: Comprehensive Transport Study, Annex III River Transport, 1993

2.3.3 CARGO AND PASSENGER HANDLING VOLUME

Table 2.3.3 shows passengers and cargoes transported by IWT for all service routes. Both passengers and cargoes had increased gradually since 2004, except for the passengers in 2008 due to the Nargis effect. Cargoes handled by IWT in 2008/09 reached 4,513,000 tons, an increase of 11% over 2004/05. Passenger volume by IWT in 2008/09 was 26,163,000 which is a 7.6% increase compared with that in 2004/05. This means that the cargoes and passengers recorded in 2008/09 were almost at the same level of previous years and the effect of damage to the inland water transport system by Nargis was minimal.

Table 2.3.3 Passengers and Cargoes Transported by IWT Ships (2004/05-2008/09)

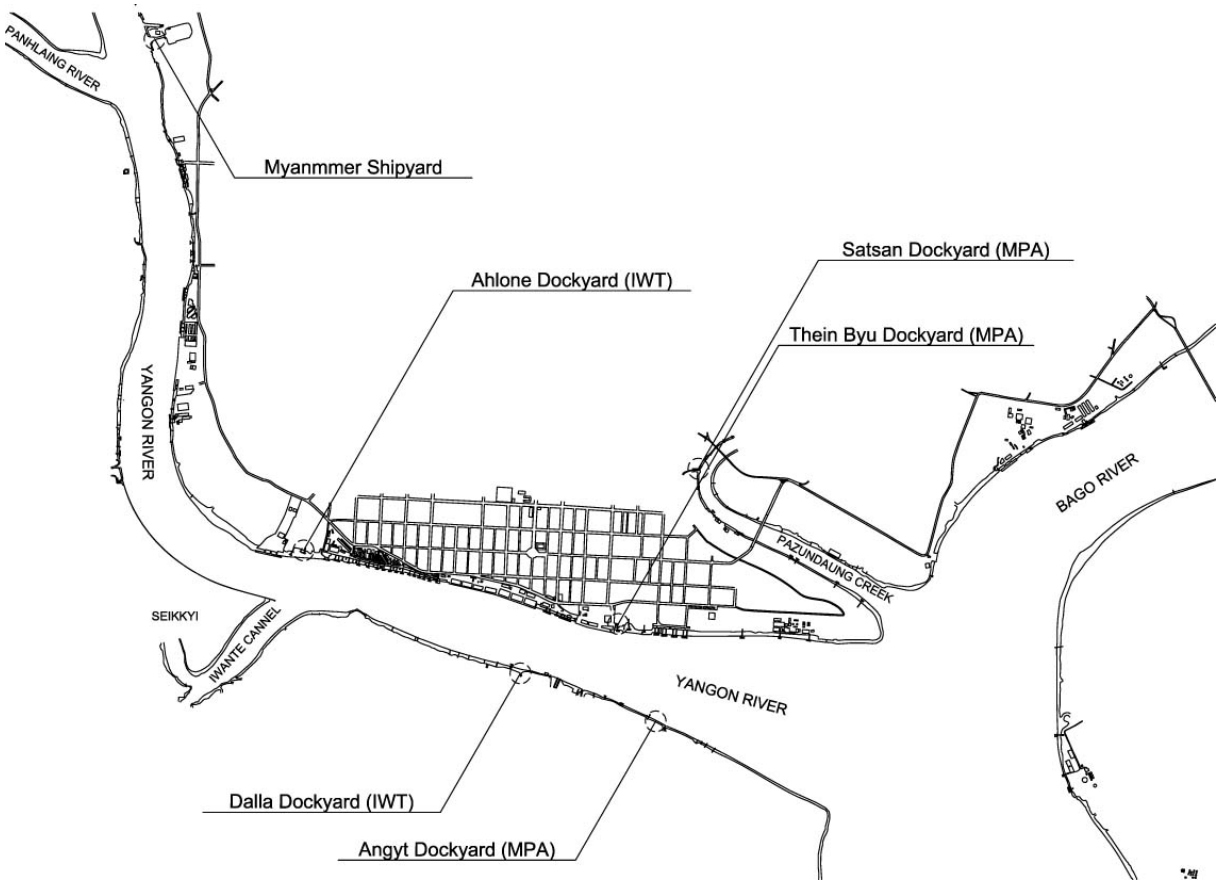
	2004/05	2005/06	2006/07	2007/08	2008/09
Cargo (1000 ton)	4,119	4,280	4,293	4,467	4,513
Passenger (1000 pax)	24,323	25,420	25,883	26,825	26,163

Source: IWT

2.3.4 DOCKYARD AND SHIP REPAIR OF IWT

Shipbuilding industry in Myanmar has been developed by three sectors. The first sector is the semi-government organization represented by Myanma Shipyard, which is engaged in shipbuilding and ship repair, together with other mechanical works on commercial basis. The second sector is composed of dockyards owned by the government organizations such as IWT, MPA, DMA and so on, where their own ships and fleets are maintained. The last sector is private dockyards. There are large number of dockyards along the Yangon River and the Bago River as well as Seikgyi village near the Twan Tay Canal.

The location of semi-government and government dockyards in Yangon is shown in Figure 2.3.3.



Source: JICA Project Team

Figure 2.3.3 Location of Dockyards in Yangon

IWT has 6 dockyards as listed in Table 2.3.4 under the administration of the Engineering Department. Dalla and Ahlone dockyards are located in Yangon city, while others are located in the strategic center of IWT for ship repair and maintenance.

Table 2.3.4 List of IWT Dockyards and Their Capacity

No.	Name of Dockyard	No. of Slipway	Docking Capacity	Maximum DWT for Docking
1	Dalla Dockyard (Yangon)	14	22 Ships	1,400
2	Ahlone Dockyard (Yangon)	7	16 Ships	250
3	Mandalay Dockyard	1	5 Ships	250
4	Thanlwin Dockyard	1	2 Ships	300
5	Sittwe Dockyard	1	5 Ships	250
6	Chindwin Dockyard	1	3 Ships	250
Total		**25**	**53 Ships**	

Source: IWT

2.4 RECENT SITUATION OF TRANSPORT SECTOR

As more than 4 years has elapsed since the preparation of the Interim 2 Report in Phase 1 Period of the Project, it is intended to update the trend of the transport sectors in Myanmar based on a recent statistic data.

2.4.1 SOCIO-ECONOMIC INDEX

(1) Population

The population of Myanmar in 2010 was estimated at 59.78 million with its annual growth rate 1.10 %. The population by states/divisions of the year is shown in the following table. The share of Yangon and Ayeyarwady state/division was 11.7% and 13.5% respectively, by which no remarkable change was observed from the year 2007.

Table 2.4.1 Population by States/Division in 2010 (x 1000)

State/Division	Male	Female	Total
1. Kachin State	781	798	1,579
2. Kayah State	180	176	356
3. Kayin State	899	917	1,816
4. Chin State	270	284	554
5. Sagaing Division	3,215	3,326	6,541
6. Tanintharyi Division	855	859	1,714
7. Bago Division	3,020	2,988	6,008
8. Magway Division	2,767	2,856	5,623
9. Mandalay Division	4,162	4,260	8,422
10. Mon State	1,575	1,562	3,137
11. Rakhine State	1,647	1,659	3,306
12. Yangon State	3,487	3,536	7,023
13. Shan State	2,836	2,824	5,660
14. Ayeryarwady Division	4,029	4,012	8,041
Total	**29,723**	**30,057**	**59,780**

Source: Statistical Yearbook 2012

(2) Gross Domestic Product (GDP)

The GDP in FY2010/2011 was 39,846.7 billion kyat according to the "Statistic Yearbook 2012" indicating the annual growth rate of about 10.1%, which was 70.8% increase from FY2007/2008 (annual average growth rate 19.5%).

(3) National Budget and Expenditure in FY 2010/2011

National Budget and Expenditure in the FY2010/2011 were 5,693.0 billion kyat and 7,506.5 billon kyat respectively, accounting the financial deficit at 1,813.5 billion kyat.

2.4.2 TRANSPORT SECTOR

According to the Statistical Yearbook of 2012, the cargo traffic and passenger traffic during FY2007/2008 to FY2010/2011 were as follows;

(1) Cargo Traffic by Public Transport Mode (FY2007/08-2010/11)

Table 2.4.1 indicates a recent cargo traffic transported by each transport mode during FY2007/08 to FY2010/11. From the table it has revealed that the total domestic cargo volume handled in FY2010/211 was 10.6 million tons with a slight increase since FY2007/08 which accounts average annual increase rate of 2.7%, and the share of Inland Waterways among all the transport modes in the FY2010/11 was about 45% which was almost same with FY2007/08.

Although no notable changes were seen during the period, the Inland Waterways will continue to play an important role in the Domestic Cargo Transport of the Country.

Table 2.4.2 Cargo Traffic by Public Transport Mode (2007/08 – 2010/11)

(Unit: Freight-ton by 1000 long-ton, Freight ton-miles by million ton-miles)

FY	Inland Waterways		Railways		Airways		Road	
	Long-ton	ton-mile	Long-ton	ton-mile	Long-ton	ton-mile	Long-ton	ton-mile
2007/08	4,478	581.8	2,929	535.4	0.7	0.20	2,399	304.3
2008/09	4,658	639.4	2,952	569.9	0.5	0.16	2,416	314.9
2009/10	4,685	687.2	3,327	658.3	0.5	0.16	2,411	315.6
2010/11	4,786	753.4	3,408	697.8	0.5	0.15	2,421	315.8

Source : Statistical Yearbook 2012

(2) Passenger Traffic by Public Transport Mode (FY2007/08-2010/11)

Recent Passenger Traffic according to the transport mode during FY2007/08 to FY2010/11 is shown in the Table 2.4.2. In terms of passenger transport, Railways was mostly used with its share of over 50% continuously, and followed by Road transport.

Although the number of passengers transported by roadways has recently been decreasing, it is understood that this would be caused by a recent rapid increase of private cars, and this tendency may continue until a balanced comfortable share of each transport mode has been achieved.

On the other hand, the passengers using Inland Waterways have been slightly increasing in recent years with its share around 20% of all transport modes which is almost stable in these days.

Table 2.4.3 Passenger Traffic by Public Transport Mode (2007/08 – 2010/11)

(Unit: Passenger by mill. number, Passenger-miles by million passenger-miles)

FY	Inland Waterways		Railways		Airways		Road*	
	PAX	Pax-mile	PAX	Pax-mile	PAX	Pax-mile	PAX	Pax-mile
2007/08	26.9	720.7	76.0	3,378.4	0.3	78.6	38.1	1,495.7
2008/09	27.4	783.5	73.6	3,348.9	0.3	81.9	37.9	1,530.9
2009/10	27.1	820.2	71.6	3,337.7	0.2	71.9	37.9	1,530.1
2010/11	27.6	902.2	67.7	3,328.7	0.3	105.6	32.5	1,317.9

Note : Road* shows only Yangon city traffic.
Source : Statistical Yearbook 2012

CHAPTER 3

CYCLONE NARGIS

CHAPTER 3 CYCLONE NARGIS

3.1 PAST CYCLONES EXPERIENCED IN MYANMAR

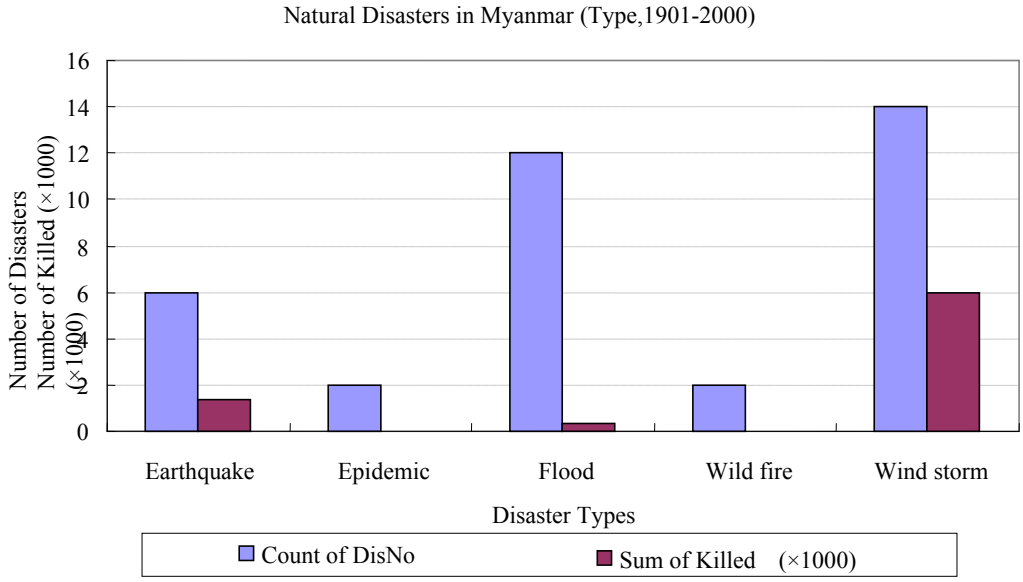
3.1.1 NATURAL DISASTERS IN MYANMAR

Asian Disaster Reduction Center (ADRC) is an organization managing statistic data of natural disasters in the Asian region. Data published by ADRC on damages by past disasters in Myanmar are shown in Table 3.1.1 and Figure 3.1.1. Flood and wind storms are the most prevalent types of natural disasters.

Table 3.1.1 Statistical Data of Natural Disasters in Myanmar

Disaster Types	Number of Occurrence	Total fatalities	Total of Injured	Total left Homeless	Total of Other Victim	Sum of Damage US$ ('000s)
Earthquake	6	1,342	136	0	160	37,100
Epidemic	2	10			800	
Flood	12	317	0	313,739	1,901,528	553,915
Wild fire	2	8		2,000	58,588	11,000
Wind storm	14	5,982	200	274,200	896,289	21,700

Source: Natural Disaster Data Book 1901-2000, ADRC



Source: Natural Disaster Data Book 1901-2000, ADRC

Figure 3.1.1 Sum of Damages by Natural Disaster in Myanmar

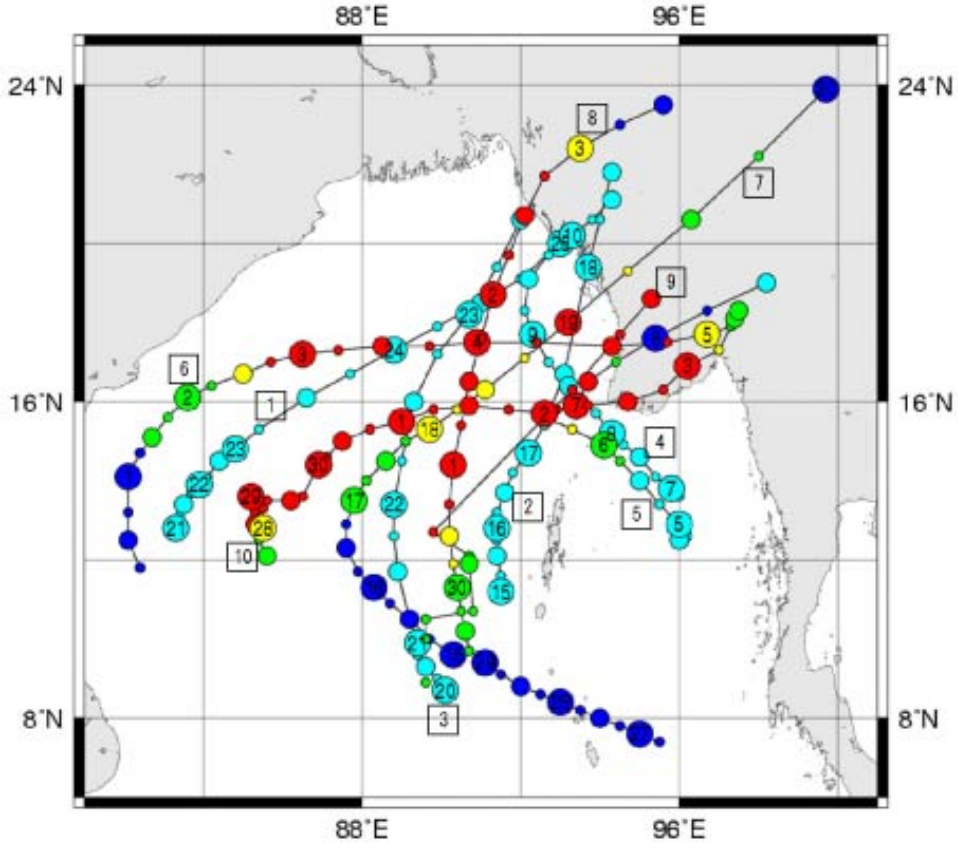
3.1.2 PAST CYCLONES IN MYANMAR

Names and tracks of cyclones which have hit Myanmar during the last 50 years are shown in Table 3.1.2 and Figure 3.1.2 respectively. Many cyclones have developed in Bengal Bay and traveled to Myanmar. However, very few cyclones have hit Ayeyarwady Delta and Yangon. Nargis traveled in the east direction and entered into the Delta area and Yangon.

Table 3.1.2 Past Cyclones which have hit Myanmar

No.	Cyclone	Day of landing	Number of deaths *	Number of victims*
1	196510	Oct 23,1965	100	500,000
2	196702	May 16,1967	100	130,020
3	196712	Oct 23, 1967	178	-
4	196801	May 10,1968	1,070	90,000
5	197503	May 7, 1975	-	-
6	198201	May 4, 1982	-	-
7	199201	May 19, 1992	-	-
8	199402	May 2, 1994	-	-
9	Mala	Apr 29, 2006	22**	-
10	Nargis	May 2, 2008	84,537	more than 2 million

Source: *EMDAT, **Wikipedia



Source: Japan Aerospace Exploration Agency (JAXA)

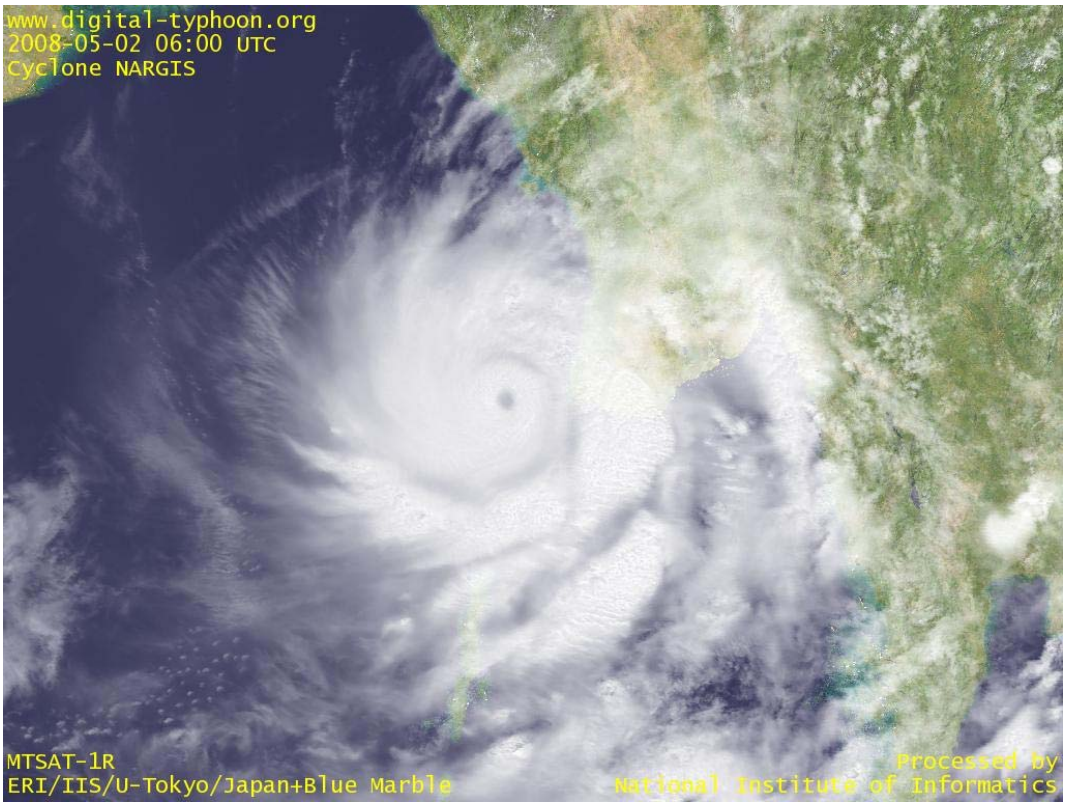
Figure 3.1.2 Tracks of Past Cyclones which have Attacked Myanmar

3.2 CYCLONE NARGIS

3.2.1 OUTLINE OF NARGIS

Cyclone Nargis which hit the Delta area in Myanmar in 2008 was responsible for the worst natural disaster in the history of Myanmar. More than 135,000 persons were reported dead or missing.

Nargis was not a particularly strong cyclone while it traveled over the Bengal bay. However, its power quickly grew and the eye of cyclone appeared clearly just before landing. The satellite image of cyclone Nargis just before landing is shown in Figure 3.2.1.



Source: Japan Aerospace Exploration Agency (JAXA)

Figure 3.2.1 Satellite Image of Cyclone Nargis

3.2.2 CHARACTERISTICS OF NARGIS

As mentioned above, Nargis traveled over the Delta area and Yangon. The characteristic features of Nargis are as follows;

- Nargis did not lose energy while traveling over land as the affected area is mainly covered with paddy land and rivers.
- Nargis had the high possibility of occurrence of flood in low ground area along the sea because big waves generated by strong wind attacked from the south to the west. These waves brought waters to the land.
- Nargis had the high possibility of occurrence of damage to houses, buildings and others because the strong wind area of Nargis passed over the densely populated area.

Nargis can be characterized by its large scale and slow speed. Data such as atmospheric pressure of the center and maximum wind speed was re-analyzed by the Joint Typhoon Warning Center (JTWC) as

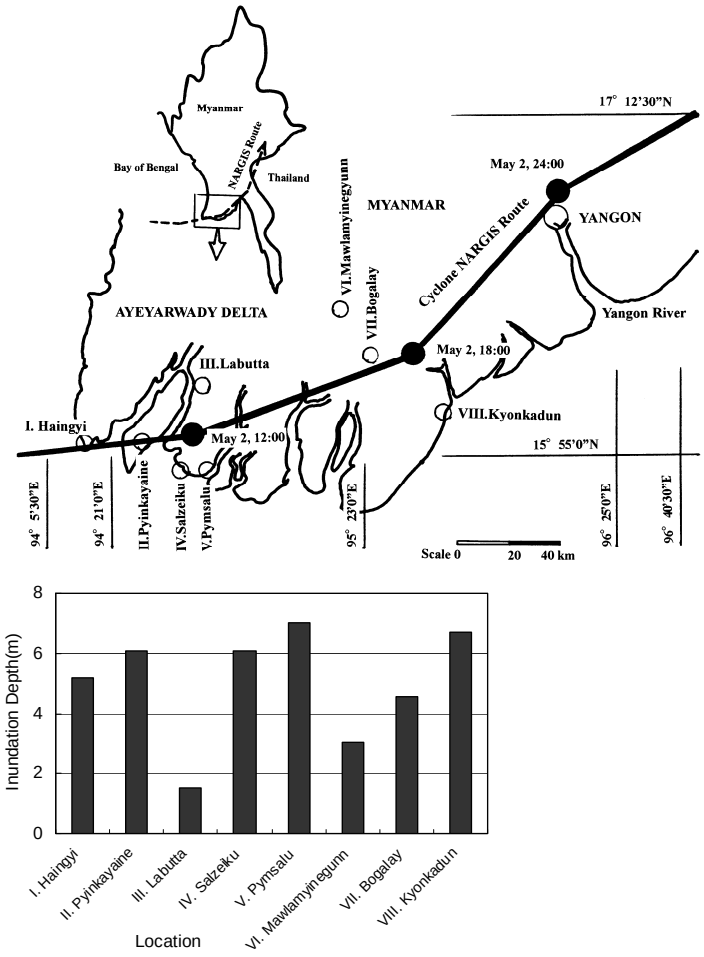
shown in Table 3.2.1. The maximum wind speed was recorded at 59.2m/s, the center atmospheric pressure was 937hPa and the travelling speed was 17km/h when Nargis landed at around noon on 2nd of May 2008.

Inundation depth and the course of Nargis is shown in Figure 3.2.2, while satellite images before and after Nargis are shown in Figure 3.2.3. A huge area was inundated with the maximum inundation depth reaching 7 m.

Table 3.2.1 Position, Center Atmospheric Pressure and Wind Speed of Nargis

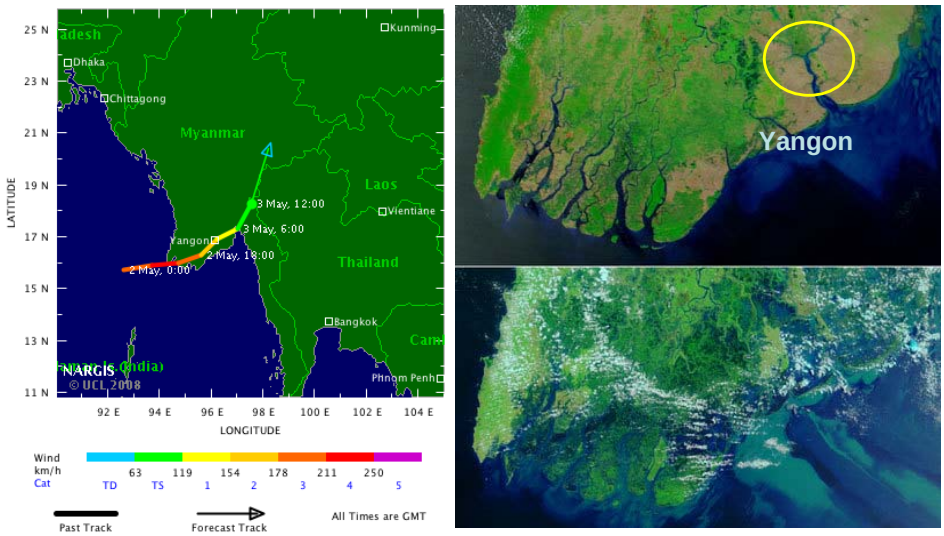
Date	Longitude (deg.)	Latitude (deg.)	Pressure (hPa)	Maximum Wind Speed (knots)
2008042512	90.3	10.5	1,007	20
2008042518	89.5	10.8	1,007	20
2008042600	88.7	10.7	1,007	20
2008042606	88.5	11.2	1,007	20
2008042612	87.9	11.5	1,007	20
2008042618	87.2	11.5	1,004	25
2008042700	86.7	11.6	1,002	25
2008042706	86.3	11.7	1,000	30
2008042712	85.9	12.2	996	35
2008042718	85.7	12.5	989	45
2008042800	85.6	12.8	982	55
2008042806	85.6	13.1	974	65
2008042812	85.3	12.9	970	70
2008042818	85.3	13.2	967	75
2008042900	85.6	13.3	967	75
2008042906	85.8	13.1	967	75
2008042912	86.2	13.5	970	70
2008042918	86.6	14	970	70
2008043000	86.7	14.4	970	70
2008043006	87	14.7	978	60
2008043012	87.5	15	974	65
2008043018	88.2	15.3	974	65
2008050100	89	15.6	974	65
2008050106	89.8	15.9	970	70
2008050112	90.7	15.9	948	100
2008050118	91.7	15.8	948	100
2008050200	92.7	15.8	941	110
2008050206	93.6	15.9	937	115
2008050212	94.7	16	937	115
2008050218	95.6	16.4	963	85
2008050300	96.4	16.8	970	70
2008050306	97.1	17.4	985	50
2008050312	97.6	18.3	993	40
2008050318	97.8	19.4	1,000	30
2008050400	98.5	20.8	1,004	25

Source: Joint Typhoon Warning Center (JTWC)



Source: Seminar on Storm Surge Mechanism and Its Mitigation by PARI at MPA

Figure 3.2.2 The Course of Nargis and Inundation Depth in the Delta Area

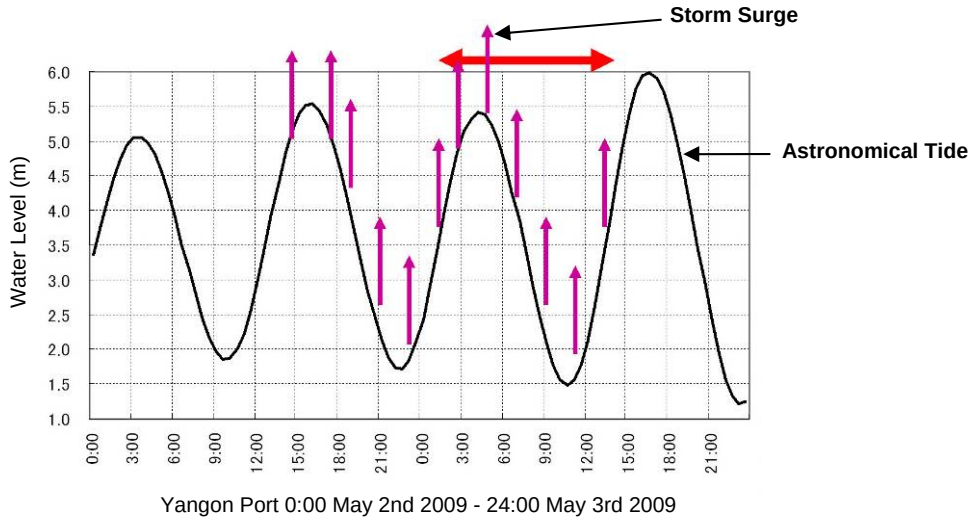


Source: Cyclone Nargis, Wikipedia

Figure 3.2.3 Satellite Images before and after Nargis

3.2.3 STORM SURGE IN YANGON PORT

Astronomical tide level and actual water level, including the effect of storm surge, while Nargis was traveling near Yangon port is shown in Figure 3.2.4. It seems that the storm surge started at Yangon port at 15:00 on the 2nd of May, with the deviation from the normal level registering around 1.0m to 1.5 m. A field survey on inundation height conducted immediately after Nargis revealed that the actual water level was 30 cm higher than the highest high water level ever recorded.



Source: Port and Airport research Institute (PARI), No.1192, 2009

Figure 3.2.4 Astronomical and Actual Water Level

Source: Port and Airport research Institute (PARI), No.1192, 2009

Figure 3.2.5 Trace of Inundation Height at Field Survey

3.3 IMPACT OF NARGIS

At the ASEAN-UN International Pledging Conference held in the aftermath of Nargis in Yangon on 25th May 2008, an agreement was reached to form Tripartite Core Group (TCG) to coordinate relief efforts among the Government of the Union of Myanmar, the United Nations, and the Association of Southeast Asian Nations (ASEAN). The TCG agreed to conduct a Post Nargis Joint Assessment (PONJA) to study the impact of Nargis and requirements needed for humanitarian assistance and the establishment of medium to long term recovery programs.

Based on the PONJA, the impacts of Nargis are summarized in the succeeding sections.

3.3.1 HUMAN DAMAGE

Nargis extended significant adverse effects on 37 townships in Ayeyarwady and Yangon Divisions. The most severe damage occurred in the Ayeyarwady Delta region, an area covering 23,500 km^2 and famous as a rice production area.

Nargis caused extensive loss of life and physical damage as shown in Table 3.3.1. Estimated casualties were 84,537 people, another 53,836 went missing, and 33,754 suffered injuries.

Table 3.3.1 Estimated Human Damage by Nargis (as of June 2008)

Type of Damage	Number of People
Casualty	84,537
Missing	53,836
Injury	33,754

Source: PONJA

3.3.2 ECONOMIC AND SOCIAL DAMAGE

The Delta region had an estimated population of 7.35 million people of which one-third or 2.4 million were severely affected by Nargis.

The people of the Delta area are primarily farmers and fishermen. Approximately 50-60 % of families are engaged in agriculture as their primary source of income. Nargis attacked the Delta paddy fields at the very last moment of harvesting the dry season crop which accounts for 25 % of annual production in the affected area.

Aside from the crop losses, the livelihoods of those who survived were seriously affected by the loss of livestock animals and farming implements, and seawater intrusion into the paddy fields. The loss of fishing boats and nets, degradation of infrastructures and the loss of household and artisanal equipment also adversely impacted affected communities.

The estimated total value added loss in the FY2008/09 from Nargis amounted to 857 billion Kyats. The economic losses are estimated at about 2.7 % of officially projected national GDP in 2008.

Table 3.3.2 Impact on GDP

	Nominal GDP 2008 Kyat billion	Gross Losses	Value Added Coefficients	Value Added Losses	Impact on Sector/Total GDP
Agriculture	10,632	225	0.8	185	1.7%
Livestock & Fisheries	2,330	160	0.6	98	4.2%
Industry	5,130	1,362	0.2	239	4.6%
Commerce	6,708	461	0.7	334	5.0%
Total GDP	**31,672**			**857**	**2.7%**

Source: PONJA

Government's finances and the budget deficit were expected to be seriously impacted by the damages caused by Nargis. The government deficit was expected to increase due to expenditures related to the relief and recovery initiatives and increase of capital expenditures towards reconstruction.

3.4 POST NARGIS RECOVERY PLAN

3.4.1 TRIPARTITE CORE GROUP (TCG)

To cope with the disaster, the Government worked closely with the international community to prepare assistance for the affected families and communities. The Special ASEAN Foreign Ministers' Meeting in May 2008 established the ASEAN Humanitarian Task Force for the victims of Cyclone Nargis (AHTF).

Following a successful ASEAN-UN International Pledging Conference organized with the Government in May 2008 in Yangon, the AHTF decided to form a Tripartite Core Group (TCG) consisting of the Myanmar Government, ASEAN, and the United Nations to coordinate relief efforts. The Post-Nargis Joint Assessment (PONJA), released on 21 July 2008, was based on extensive fieldwork carried out by experts from the Government, ASEAN and the United Nations.

The assessment identified not only the damage caused by Nargis, but also immediate needs which guided the humanitarian and early recovery response. After completion of follow-up reviews and assessments, the PONJA report became an important source of baseline information.

3.4.2 RECOVERY PLAN OF PONREPP

The Post-Nargis Response and Preparedness Plan (PONREPP) was launched in February 2009 under a three-year framework to guide recovery efforts following the devastating impact of Nargis and the assessment done by PONJA. Covering the period from January 2009 through December 2011, PONREPP provided a platform for the transition from emergency relief and early recovery towards medium-term recovery and for guiding those efforts across nine sectors. The recovery needed amounted to USD 691 million over three years.

Sequencing for recovery involves three phases;

- Phase one: Early Recovery and Enabling,
- Phase two: Transition and Launching, and
- Phase three: Consolidation and Roll-out of Recovery.

The first phase has two components. The first is to ensure that ongoing early recovery activities are properly incorporated and funded. This early recovery activity has been undertaken sector-by-sector.

The second aspect aims at ensuring factors for managing, coordinating and funding the overall recovery plan to ensure efficiency and effectiveness in all sectors.

The second phase is the "transition and launching" of key sector activities in townships and villages.

The third phase is the "consolidation and roll-out of recovery" of the sector activities, with widespread mobilization of village groups and households to undertake activities that restore basic services, infrastructure and livelihoods. In some cases, this requires coherence with national programs, socio-economic and environmental surveys, early warning systems, professional staff replenishment and capacity building.

Based on the sector recovery plans, the following table summarized the recovery financing needs for the three-year period from January 2009 through December 2011.

Table 3.4.1 Summary of Recovery Needs

(USD million)

Sector	Total	Jan. – June, 2009	July – Dec., 2009	Jan. 2010 - Dec., 2011
1. Livelihoods	189.0	40.3	46.8	51.9
2. Shelter	173.6	31.3	39.3	103.0
3. Education and Training	157.0	6.3	12.7	138.0
4. Health	53.8	7.8	13.4	32.6
5. Water, Sanitation and Hygiene	50.0	7.8	10.0	32.2
6. Disaster Risk Management	32.0	7.0	9.5	15.5
7. Environment	2.0	0.3	0.6	1.1
8. Protection & Vulnerable Groups	23.1	5.0	4.2	13.9
9. Recovery Coordination	10.0	3.0	2.0	5.0
Grand Total	**690.5**	**108.8**	**138.5**	**393.2**

Source: TCG

The mandate of TCG involving Myanmar, ASEAN and the Unites Nations was extended for another year until July 2010 at the 14th ASEAN Summit held in March 2009. The decision of the extension reflected ASEAN's confidence that the mechanism is working efficiently in facilitating distribution and utilization of assistance from the international community to support the Myanmar government's relief and recovery efforts.

Implementation of PONREPP has been identified by TCG as one of its key activities over the next one year. The extension of the mandate will allow TCG to put in place coordination and funding mechanism and to monitor the first-year implementation of PONREPP.

CHAPTER 4

MEASURES FOR SAFE NAVIGATION IN YANGON PORT

CHAPTER 4 MEASURES FOR SAFE NAVIGATION IN YANGON PORT

4.1 NAVIGATION ASSISTANCE IN YANGON PORT

4.1.1 CONDITION OF MARINE TRAFFIC

The number of ship calls from 2004 to 2008 is shown in Table 4.1.1 and Table 4.1.2, while ship type and size are presented in Figure 4.1.1 and Figure 4.1.2.

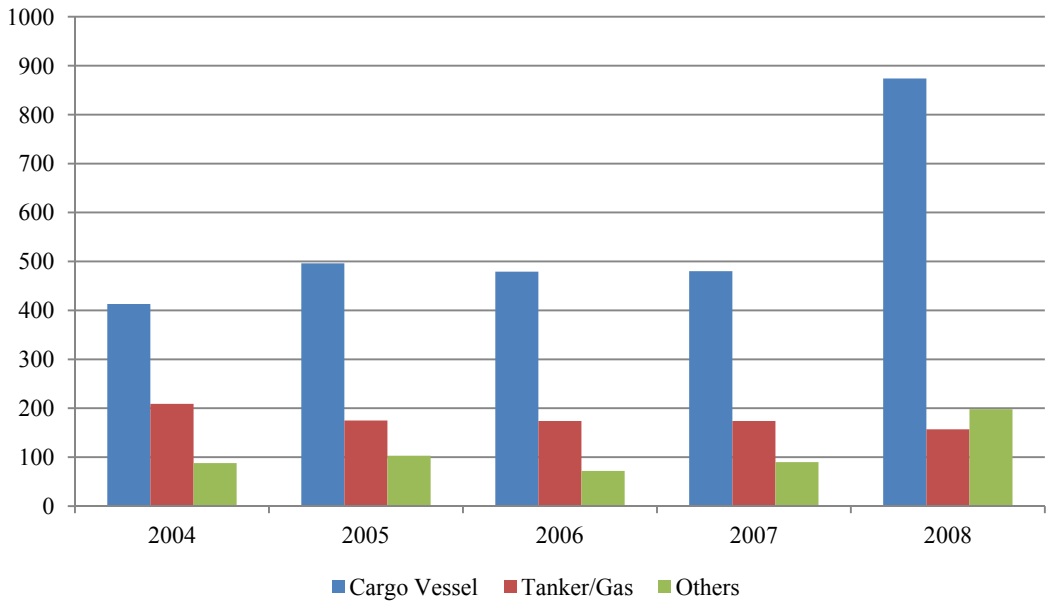
(1) Calling Ship Statistics (Ocean Going Ship) by Ship Type

Cargo ships account for about 50% of all ship calls. In 2008 when cyclone Nargis attacked, the total number of ships reached 1,501, an increase of 53% compared to the previous year. Ships from foreign countries bringing relief supplies led were responsible for this increase in ship calls (ports were not closed nor were routes damaged as a result of Nargis).

Table 4.1.1 Ship Calls by Ship Type

Year	Cargo Ship	Tanker/Gas	Others	**Total**
2004	413	209	88	**889**
2005	496	175	103	**965**
2006	479	174	72	**955**
2007	480	174	90	**980**
2008	874	157	198	**1,501**

Source: MPA



Source: MPA

Figure 4.1.1 Ship Calls by Ship Type

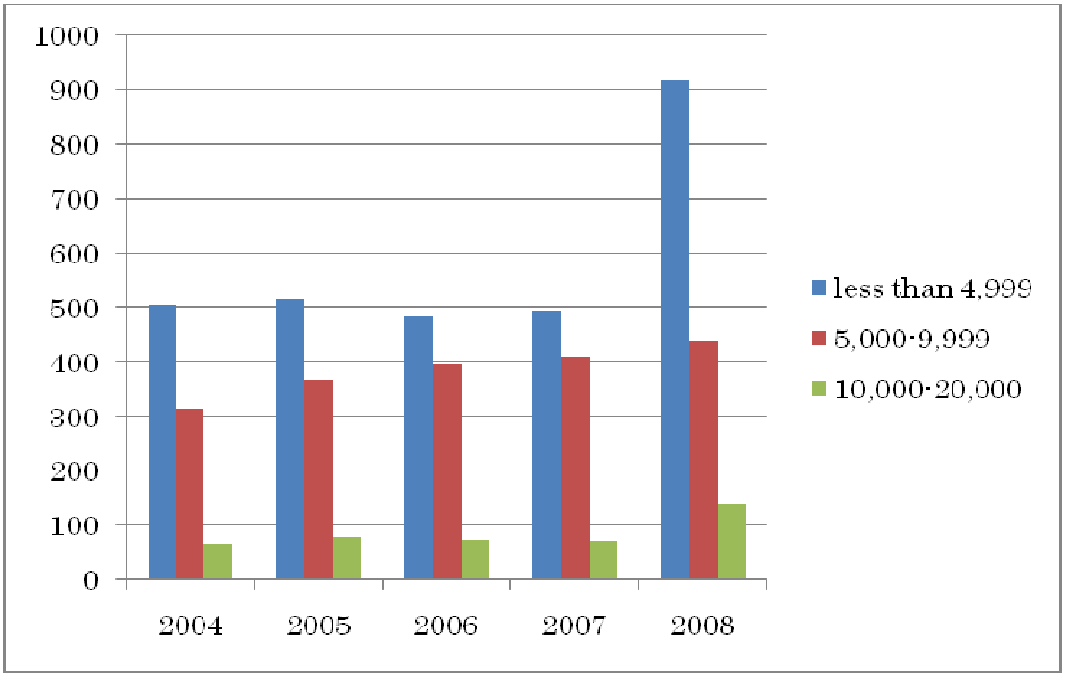
(2) Calling Ship Statistics (Ocean Going) by Ship Size (Gross Tonnage)

Ships under 5,000 G/T account for about 50% of calling ships at Yangon Port. The port is used mainly by small ships because the port is a river port on the Yangon River where great depth is not available.

Table 4.1.2 Ship Calls by Ship Size (Gross Tonnage)

Year	less than 4,999	5,000-9,999	10,000-20,000	**Total**
2004	507	315	67	**889**
2005	516	369	80	**965**
2006	483	398	74	**955**
2007	496	412	72	**980**
2008	921	440	140	**1,501**

Source: MPA



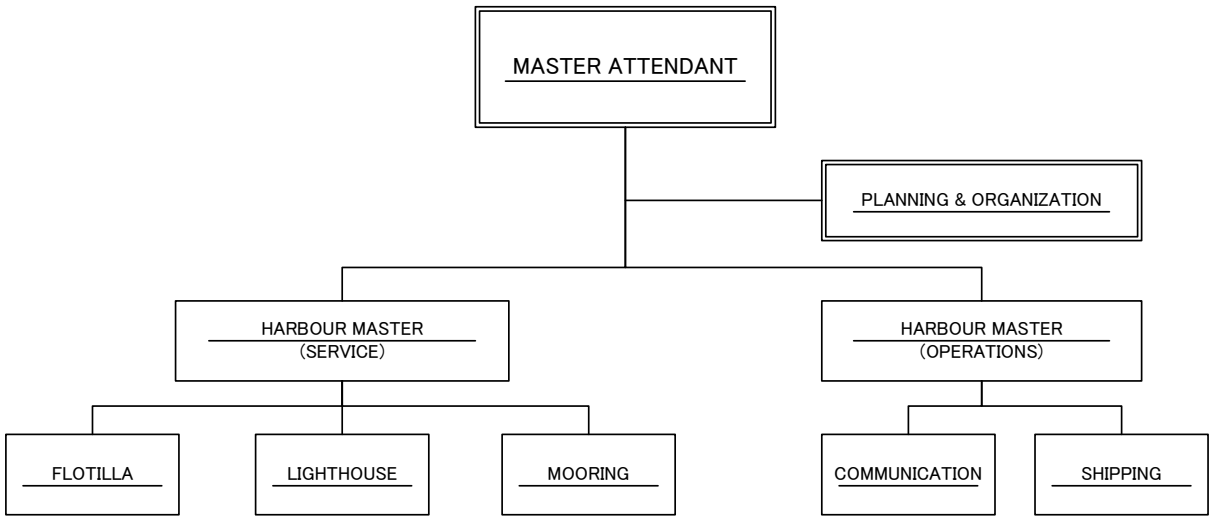
Source: MPA

Figure 4.1.2 Ship Calls by Ship Size

4.1.2 ORGANIZATION OF MPA

The structure of MPA organization is shown in Figure 2.2.1. The department responsible for the navigation assistance is the Marine Department.

Organization Chart of the Marine Department is shown in Figure 4.1.3.



Source: MPA

Figure 4.1.3 Organization Chart of Marine Department

The Marine Department is responsible for providing port facilities/equipment for safe navigation and shipping services. All the duties, functions, powers and obligations of the Marine Department are governed by Rangoon (Yangon) Port Act, 1905 and by the Order regarding the Duties and Power of corporations issued by the Ministry of Transport and Communications on 4th August 1976.

4.1.3 NAVIGATION AIDS AND FACILITIES

In order to clarify the current condition of navigation along the approach channel and in the port area, field inspection and hearing survey were conducted. Two navigation zoning areas were introduced to facilitate understanding of the following sections.

(1) Zoning of Water Area

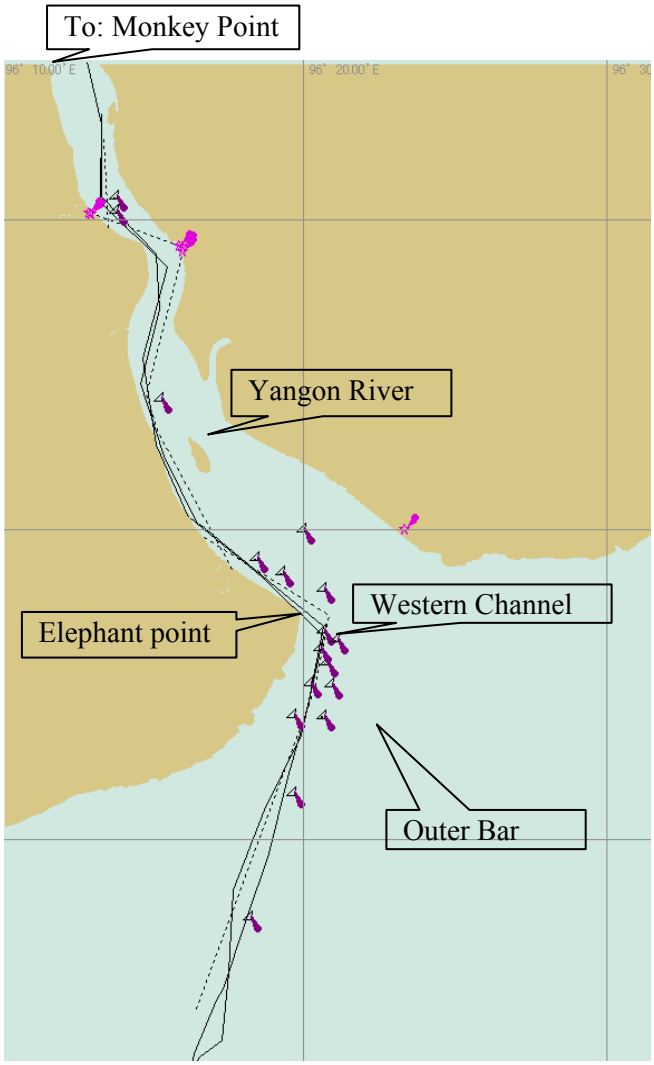
1) Zone No.1: Yangon Port (Area managed by MPA/IWT)

There are 9 ports in Myanmar: Sittwe, Kyaukpyu, Thandwe, Pathein, Yangon, Mawlamyine, Dawei, Myeik and Kawthoung. Yangon Port is a primary port which handles most of the import and export seaborne trade cargoes of the country. This port lies about 32km upstream from Elephant Point which located at the estuary of the Yangon River.

Pilotage is compulsory for calling ships of over 200GRT. Navigation is generally conducted at flood tides to secure sufficient water depth at both the Inner Bar and the Outer Bar.

2) Zone No.2: Approach Channel (Outer Bar to Monkey Point)

The area where the approach channel between the Outer Bar and the Monkey Point is located is defined as Zoning No.2 area. The alignment of the approach channel is shown in Figure 4.1.4.



Source: JICA Project Team

Figure 4.1.4 Alignment of Approach Channel

Since there is a very strong tidal current in the Yangon River as well as bends and narrow width, ship navigation is rather difficult.

The most difficult navigation points are the Western Channel near the Elephant Point and Monkey Point of entrance of Yangon Main Port due to the narrow width and strong current. In order to maintain navigational safety, MPA has been making efforts to carry out dredging works and install navigation buoys.

4.2 ISSUES RELATED TO SAFE NAVIGATION

4.2.1 SALVAGE WORK

(1) Progress of Salvage Work

Bathymetric survey of Yangon Port was carried out by the JICA project team to identify the location and characteristics of shipwrecks. The field survey was conducted between July and August 2008, and the final report was prepared in November 2008. It revealed that a total of 99 shipwrecks and/or underwater objects were found.

In order to salvage sunken ships and other riverbed obstacles caused by Nargis, a coordination committee was formed under the chairmanship of MPA by inviting related organizations and agencies as well as private ship owners. The committee was also monitoring the progress of salvaging work.

According to the committee, a total of 208 ships were either sunken or stranded (137 sunken and 71 stranded) as shown in Table 4.2.1.

Table 4.2.1 Sunken and Stranded Ships in Yangon Port

Stranded						Sunken						Grand Total
MPA	IWT	NAVY	Fishing Boat	Others	**Total**	MPA	IWT	NAVY	Fishing Boat	Others	**Total**	**Grand Total**
10	30	9	1	21	**71**	18	37	6	10	66	**137**	**208**

Source: MPA

Monthly progress of salvage work was as shown in Table 4.2.2. As of the end of November 2009, a total number of 207 ships have been salvaged while 1 ship of MOGE (Myanmar Oil and Gas Enterprise) remained under water.

Table 4.2.2 Monthly Progress of Salvage Work (as of the end of November 2009)

Month	Salvage Work of Stranded Ship						Salvage Work of Sunken Ship						Grand Total
	IWT	IWT	NAVY	Fishing Boat	Others	**Total**	MPA	IWT	NAVY	Fishing Boat	Others	**Total**	**Grand Total**
[2008]													
May	9	7	9	1	4	**30**	11	3	-	-	8	**22**	**52**
June	1	15	-	-	10	**26**	4	4	1	-	10	**19**	**45**
July	-	8	-	-	2	**10**	1	3	1	3	22	**30**	**40**
August	-	-	-	-	3	**3**	1	7	-	2	6	**16**	**19**
September	-	-	-	-	2	**2**	-	3	1	3	9	**16**	**18**
October	-	-	-	-	-	**0**	-	6	-	-	4	**10**	**10**
November	-	-	-	-	-	**0**	1	4	-	1	2	**8**	**8**
December	-	-	-	-	-	**0**	-	4	-	-	-	**4**	**4**
[2009]													
January	-	-	-	-	-	**0**	-	-	2	-	1	**3**	**3**
February	-	-	-	-	-	**0**	1	-	-	-	1	**2**	**2**
March	-	-	-	-	-	**0**	-	2	-	-	-	**2**	**2**
April	-	-	-	-	-	**0**	-	-	-	-	-	**0**	**0**
May	-	-	-	-	-	**0**	-	-	1	1	-	**0**	**0**
June	-	-	-	-	-	**0**	-	-	-	-	-	**0**	**0**
July	-	-	-	-	-	**0**	-	-	-	-	2	**2**	**2**
Aug.-Nov.	-	-	-	-	-	**0**	-	-	-	-	-	**0**	**0**
Total	**10**	**30**	**9**	**1**	**21**	**71**	**18**	**37**	**6**	**10**	**65**	**136**	**207**

Source: MPA

Out of 121 damaged IWT ships, 40 were sunken and 32 were stranded as shown in Table 4.2.3. It is noteworthy that 49 ships were involved in collisions after losing control and drifting.

Forty-four passenger/cargo ships were salvaged and brought to IWT dockyards by IWT. But eight of these salvaged passenger/cargo ships were scrapped as they were not worthy to repair. By the end of March 2009, IWT completed all salvage works.

Table 4.2.3 Damages to IWT Ships by Nargis

	Sunken	Stranded	Collided	**Total**
Passenger/Cargo Ship	15	6	23	**44**
Cargo Ship	2	4	8	**14**
RoRo Ship	2	9	8	**19**
Barge/Oil Barge	8	10	7	**25**
Powered Tug	10	3	2	**15**
Pontoon	2	0	1	**3**
Others	1	0	0	**1**
Total	**40**	**32**	**49**	**121**

Source: IWT

(2) Method Applied for Salvage Work

The salvage work was carried out by using a primitive method utilizing buoyancy of barges or floats which were attached to damaged ships. The wooden ships (mostly fishing boats) which were not considered valuable to repair were broken at shallow places of the river bank. Salvage work process generally applied for sunken and stranded ships is shown below (see Photo 4.2.1).

[For Sunken Ship]

1st step	Search and identify the precise position of ship.
2nd step	3 to 4 wire slings are placed at the bottom of sunken ship.
3rd step	Barges and/or floaters are set at both sides of sunken ship.
4th step	Slings placed under the bottom are tied with barges and/or floaters
5th step	During low tide, slings are tightened and ships float by buoyancy during flood tide.
6th step	When a ship is afloat, move toward a shallower place.
7th step	Repeat steps 5 and 6 until ships are moved out from navigation area.


Source: IWT

Photo 4.2.1 Salvage Work for Sunken Ship

[For Stranded Ship]

1st step	Excavate the bottom of stranded ship by manpower/excavator or using water jet until the ship becomes afloat.
2nd step	During high tide, ship is towed out by using pull force of winches and/or tug boats.
3rd step	Apply temporary repair works to secure the buoyancy of salvaged ship.
4th step	Tow the ship to a dockyard for repair works.

Source: IWT

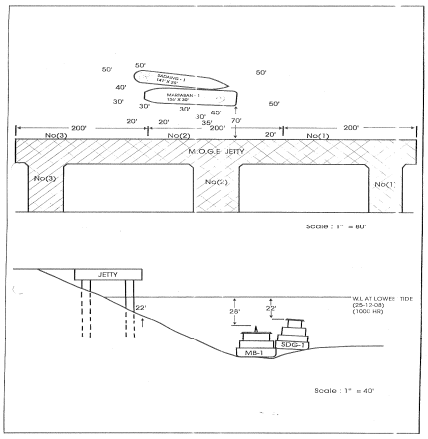
Photo 4.2.2 Stranded Ship at Yangon Port

IWT fully utilized its own machinery and manpower for salvaging stranded ships while some of the sunken ships were salvaged by sublet contracts as shown in Table 4.2.4.

Table 4.2.4 Salvage of Damaged IWT Ships

	Salvage by IWT directly	Salvage by Sub-contracts	**Total**
Sunken Ships	31	9	**40**
Stranded Ships	32	0	**32**
Total	**63**	**9**	**72**

Source: IWT

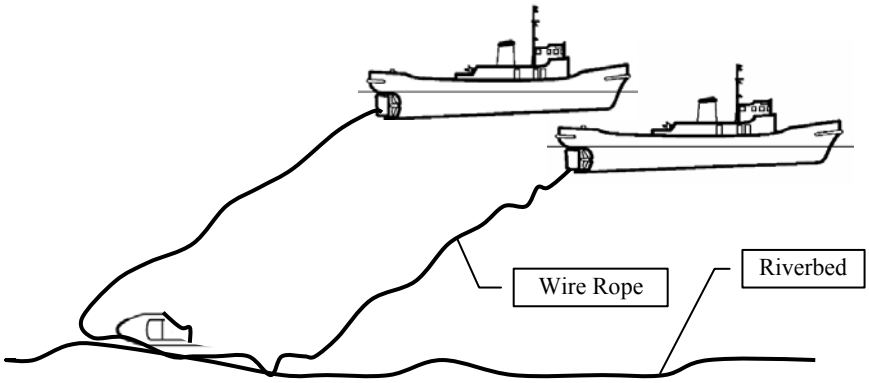


Source: MOGE

Photo 4.2.3 MOGE Jetty - 2 Barges Sunken by Nargis in Front of Jetty

(3) Method Applied for Sweeping Obstacles on Riverbed

In order to confirm the existence of riverbed obstacles, a sounding survey was performed to search location and size of sunken obstacles**.** After some suspected obstacles are found, a sweeping survey at the suspected area was carried out by toeing wire rope on the riverbed by two boats as shown in Figure 4.2.1 and Photo 4.2.4.



Source: JICA Project Team

Figure 4.2.1 Sweeping Survey of Riverbed Obstacles using Wire Rope

Source: MPA

Photo 4.2.4 Sweeping Survey Ships

4.2.2 NAVIGATION AIDS ALONG ACCESS CHANNEL

JICA Project Team carried out an on-board inspection to grasp navigational conditions along the access channel and Yangon Port area.

Inspection items are shown in Table 4.2.5. Details of the inspection are shown in Appendix B.

Table 4.2.5 Inspection Items of Navigation Aids

Items	Zone No. 1 Port	Zone No. 2 Channel
Condition of the Port, (max size, draft of ship)	○	○
Condition of the dredgers	○	○
Implementing criteria for dredging works	○	○
Condition of navigation aids	○	○
Maneuvering area	○	○
Tug boats	○	
Criteria for pilot acceptance	○	○
Pilot (Number, skill)	○	○
Navigation equipment installed ship	○	
Education and training for pilot and crew	○	

Source: JICA Project Team

(1) Navigational Condition of Yangon Port (Zone No.1)

1) Condition of the Port

General information is shown in the MPA brochure as below:

(a) Tidal Range

The average tidal range at spring tide is about 5.13 m at Monkey Point and 5.76 m at Elephant Point.

(b) Current Velocity

The velocity of the ebb current at Yangon River is about 4 to 6 knots at the spring. The flood stream continues for about 1 hour after the high water and the ebb current for about 30 minutes after the low water.

(c) Wave

Waves by usual weather condition at the Yangon River do not hinder ship operations. The wave height at the river mouth is lower than 2 m.

(d) Ships Size

Yangon Main Port accommodates ships of about of 15,000 DWT with 167m LOA and 9 m draft at the rainy season and 8.5 m draft at the dry season.

Thilawa Area Port accommodates ships of about 20,000 DWT with 200 m LOA and 9 m draft.

(e) Wharves and Jetties

Wharves and jetties at Yangon Port are as shown in Table 2.2.1 and Figure 2.2.1.

(f) Mooring Buoys

There were 4 mooring buoys for ocean going ships and 10 mooring buoys for IWT ships at Yangon Port (see Photo 4.2.5). IWT leased 10 mooring buoys from MPA before Nargis hit but 7 of these buoys were damaged by the cyclone. Due to the shortage of mooring buoys, many ferries were waiting at the anchorage area in the port which was dangerous due to the strong current of the Yangon River.


Source: JICA Project Team

Photo 4.2.5 No.9 Mooring Buoy

2) Channel Dredging

Maintenance dredging of the port and channels is very important for securing safe navigation.

The Monkey Point Channel is located at the confluence point of the Yangon River and the Bago River. Consequently, the channel flow becomes very complicated due to the meeting of the two river flows and severe siltation is a serious problem.

In order to maintain the channel depth of 4.5 m at the Monkey Point, MPA dredges (trailing hopper suction dredgers shown in Table 4.2.6) dredge the channel 1 mile (1,850 m) in length and 100 m in width at the Monkey Point every day.

Source: JICA Project Team

Photo 4.2.6 Dredger at Monkey Point

Table 4.2.6 Principal Particular of Dredgers

Sr. No.	Name	Type	Measurement			Country of Build.	Builder Co.	Year of Build.	Gross Tonnage	Horse Poser	Speed (Knots)
			Length	Width	Depth						
1	Yadana Theikha	Dredger	227'.76"	46'.6"	13'.3"	Japan	Mitsubishi	1998	1,669	3,000	10
2	Thiha-Dipa	Dredger	227'.76"	46'.6"	13'.3"	Japan	Mitsubishi	1998	1,669	3,000	10
3	Areindamar	Dredger	219'.16"	47'.4"	9'.8"	West Germany	DWE Co.	1989	1,532	1,475 x 2 (=2,950)	10
4	Ramanya	Dredger	217'.7"	46'.6"	9'.8"	West Germany	DWE Co.	1989	1,532	1,085 x 2 (=2,170)	10

Source: MPA

The dredging requirements at Yangon Port and the channel are as shown in Table 4.2.7.

Table 4.2.7 Dredging Requirements

No.	Location	Target Depth (Feet)	Frequency	Dredger Type
1	Monkey Point Channel	13.5	Everyday (Dry Season: Day &Night)	Trailing Hopper Suction Dredger
2	Yangon Port (Foreshore area)	5 - 12	Occasionally	Grab & Hopper Barge
3	Thilawa Port (Front of berth)	>30	Occasionally	Grab & Hopper Barge
4	Middle Bank Channel	Nil		
5	Western Channel (Elephant Point)	Nil		
6	Outer Bar	Nil (>15)	Occasionally (1 ~ 2 year interval)	

Source: MPA

3) Condition of Navigation Aids

(a) Navigation Buoy (Monkey Point Channel)

There are 2 navigation buoys, i.e. UMP Buoy and LMP Buoy, in the Monkey Point Channel to indicate the southern limit of the narrow channel. These buoys are very important for identifying the channel and consequently preventing the grounding of ships. Both buoys seem to be in good condition but both are painted brown. It is recommended to use red paint to help identify the portside limit of the channel for entering ships. In addition, a red light signal should be installed on the buoy for safe navigation at night.

Photo 4.2.7 Passing UMP Buoy on her starboard side

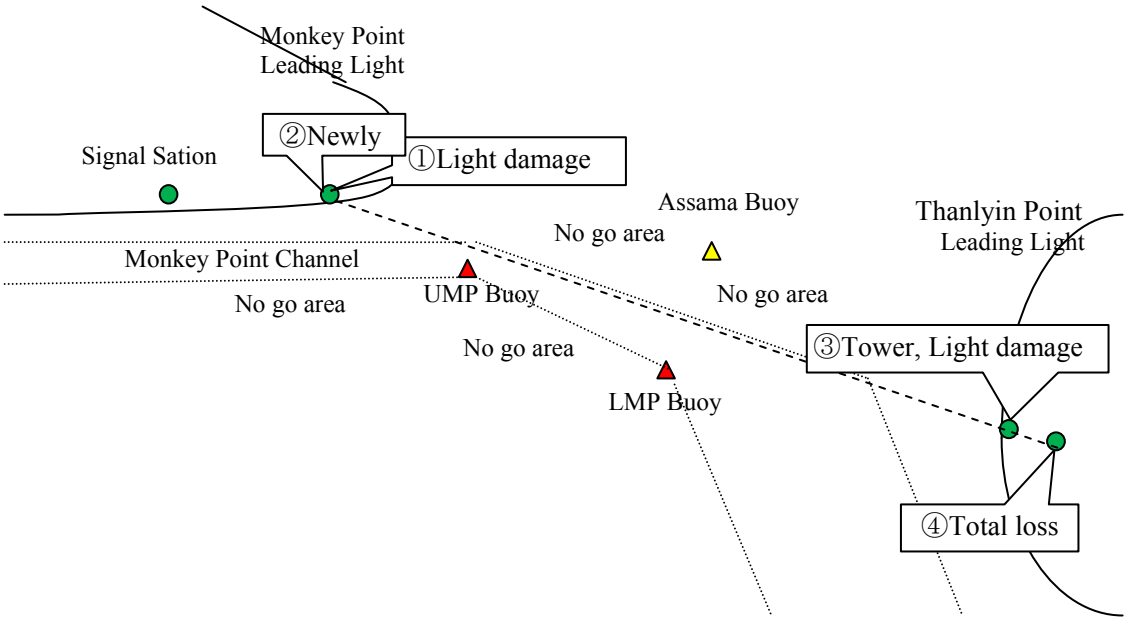
Photo 4.2.8 Passing LMP Buoy her starboard side

Source: JICA Project Team

(b) Leading Light (Monkey Point Channel)

Leading lights are very important navigation aids to maintain navigation safety at narrow channels and dangerous sections such as shallow water areas.

Ships entering Yangon Port must pass the narrow Monkey Point Channel. In order to maintain safe navigation at the channel, MPA had installed leading lights at 6 places along a 35 mile stretch from the pilot station to the Monkey Point Channel as shown in Figure 4.2.2. However all leading lights were damaged by Nargis (See Photo 4.2.9), and this makes it difficult for ships to enter Yangon Port safely.



Source: JICA Project Team

Figure 4.2.2 Location of Buoys and Leading Lights at Monkey Point Channel

Source: JICA Project Team

Photo 4.2.9 Damaged Back Leading Light at Thanlyin Point ④

(c) Tugboats

Due to the strong current at Yangon Port, ship maneuvering is very difficult.

When berthing or unberthing large size ships, pilots sometime have tugboats assist in ship-maneuvering. For the purpose of navigation assistance, MPA is equipped with tugboats as shown in Table 4.2.8. However, as all tugboats are aged and small horse power, it is preferable that new high-powered ones be procured.

Table 4.2.8 Tugboat Specifications

Sr. No.	Name	Type	Measurement			Country of Build.	Builder Co.	Year of Build.	Gross Tonnage	Horse Poser	Speed (Knots)
			Length	Width	Depth						
1	Haine Gyee	Tug	66'.6"	23'.3"	11'.66"	Japan	Ishil Co.	1998	132.00	1,076	10.0
2	Nat Thar	Tug	96'.6"	28'.6"	9'.83"	Myanmar	Myanmar	-	210.00	1,100	9.5
3	Kone Baung 1	Tug	66'	18'.6"	6'.6"	Japan	Nigata Co.	1964	165.47	450	6.0
4	Tay Za	Tug	75'.6"	20'	6'.6"	Hong Kong	Pacific	1956	140.00	400	6.0
5	May Ma	Tug	75'.6"	20'	6'.6"	Hong Kong	Pacific	1956	140.00	400	6.0
6	Wai la	Tug	75'.6"	20'	6'.6"	Myanmar	Thein Byu	1986	140.00	220	6.0

Source: MPA

(d) Pilot Boats

Pilotage is compulsory for ships of over 200 gross tons entering Yangon Port.

There are 24 pilots who belong to the Marine Department.

(2) Navigational Condition of Approach Channel (Zone No.2)

JICA Project Team carried out an on-board inspection in order to confirm condition of navigation safety at channels. Details of the inspection are shown in Appendix-A.

1) Condition of Navigation Aids

(a) Navigation Buoys

Navigation buoys are located at the Cross Sand Shoal, the Chokey Shoal, the D'silva Shoal, the Hmawun Lumps, the Middle Bank Shoal and the Western Channel. Many navigation buoys have been placed at the approach channel between the Outer Bar and the Monkey Point.

It is preferable to distinguish all navigation buoys by painting and lighting (either red or green) in addition to installation of a top mark on the buoy in accordance with regulation and guideline of IALA.

(b) Leading lights are located at the Chokey Shoal, the D'silva Shoal, the Hmawun Lumps and the Middle Bank Shoal (see Figure 4.2.3.)

Ships entering Yangon Port from the Outer Bar must pass narrow channels such as the Western Channel, the Middle Bank Channel and the Monkey Point Channel. In order to maintain safe navigation at these channels, MPA had installed 6 leading lights along the 35 mile stretch from the river mouth to the port, but all leading lights were damaged by Nargis.

(c) Pilot Ship at the Outer Bar

Pilot ship "MAY KHARL" which is very old and severely rusted anchors at the pilot station point (see Photo 4.2.10).

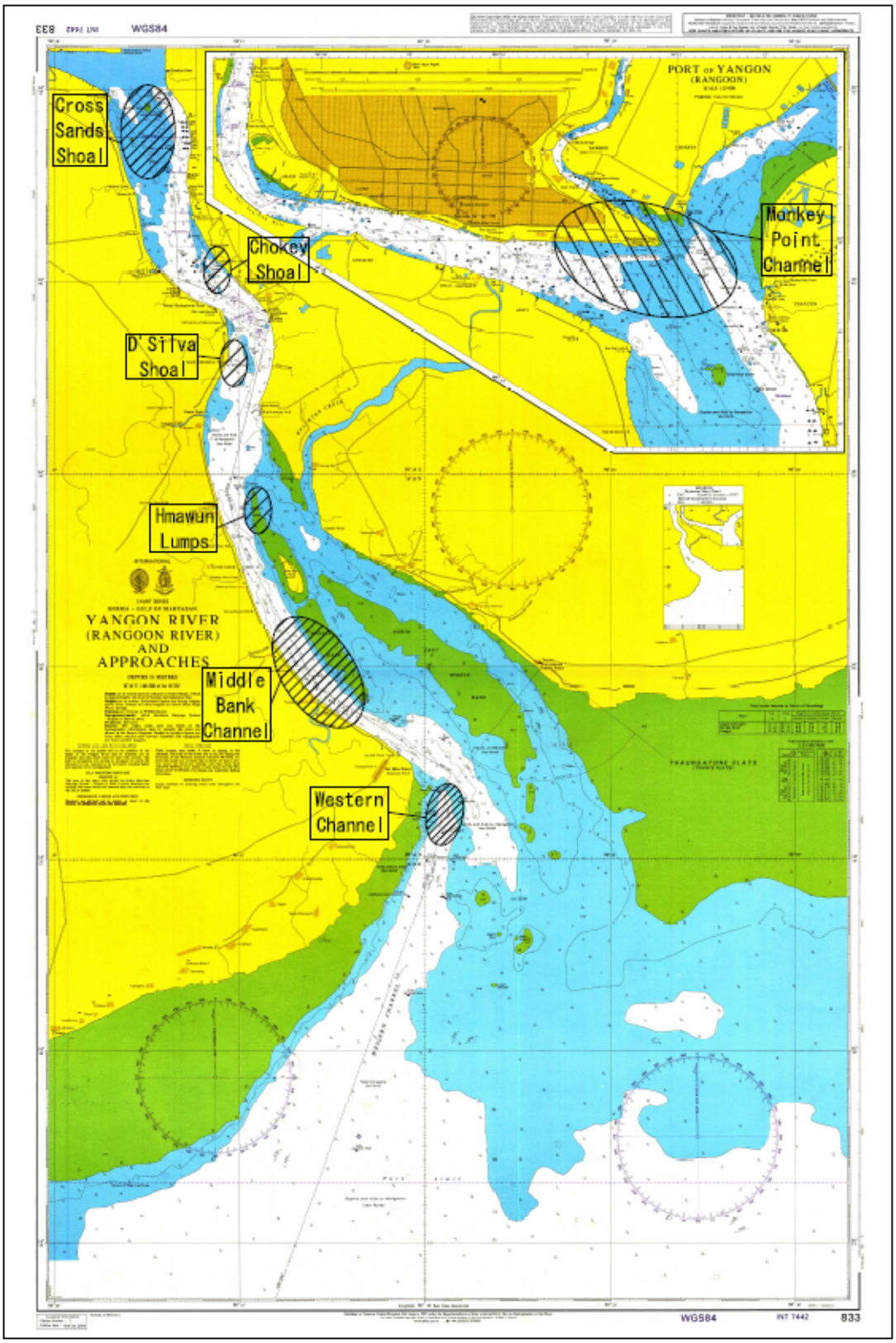
(d) Lanthaya and Dagon Light Ship

Both Lanthaya and Dagon Light Ship were damaged by Nargis and these were under repair at a dockyard in Yangon (see Photo 4.2.11).

Source: JICA Project Team

Photo 4.2.10 Pilot Ship "MAYKHARL" at Outer Bar

Photo 4.2.11 Lanthaya and Dagon Light Ship under repairing off a Dockyard



Source: JICA Project Team, BA chart 833

Figure 4.2.3 Location of Shoals and Channels

(e) Communication between Port Tower, Pilot Ship and navigating ships

VHF is used for communications among the Port Tower, the Pilot Ship and navigating ships.

4.3 RECOMMENDATIONS ON MEASURES FOR SAFE NAVIGATION

4.3.1 SALVAGE WORKS

Wrecks remaining within the Yangon Port limits are 2 ships of MOGE. MOGE applied to the Ministry of Energy for a budget to carry out the salvage works and was waiting for its approval.

The salvage works will not be completed until these shipwrecks are removed. However, these wrecks are located in front of MOGE jetty and are not considered obstacles for safe navigation to/from Yangon Port.

4.3.2 NAVIGATION ASSISTANCE AND MEASURES

(1) Evaluation of Navigation Facilities

Many port facilities and navigation facilities were damaged by Nargis. Though many port facilities were restored, many navigation facilities have not yet been restored. Through a site reconnaissance of the port, navigation facilities were evaluated from the viewpoint of navigation safety by the JICA Project team (see Table 4.3.1).

The following five rating levels were adopted to evaluate the condition of navigation facilities.

- Rating level-1 Very bad condition
- Rating level-2 Bad condition
- Rating level-3 Normal condition
- Rating level-4 Good condition
- Rating level-5 Excellent condition

Table 4.3.1 Evaluation of Navigation Facilities/Aids/Software (as of July 2009)

No.	Location	Navigation Facilities/Aids Software	Nos./Particular	Rating	Remark
1	Inner Harbor	Mooring buoy for MPA	4 Buoys	3	
2		Mooring buoy for IWT	7 Buoys	2	IWT needs 10 Buoys
3		Maneuvering Area for MPA		3	
4		Maneuvering Area for IWT		3	
5		Anchorage		3	
6		RTA Anchorage	1	3	
7		CCA Anchorage	1	3	
8		Dredger	4	3	
9		Tug Boat	6	2	200HP - 1100HP
10		Pilot Boat		2	
11		Communication (VHF) (Port Tower)	1	2	
12		Pilotage Criteria (Cyclone/Emergency)	Nil	1	
13		Guidelines for Maneuvering	Nil	1	
14		Pilot Training		2	
15		Tug master Training	Nil	1	
16	Monkey Point Channel	Channel Depth	13.5 ft	3	
17		Channel Width	95 m	2	
18		Dredging	every day	3	
19		Signal Station	1	3	
20		Leading Light	4	1	damaged
21		Navigation Buoy	UMP	2	
22	Cross Sands Shoal and Channel	Navigation Buoy	Kyartia	2	
23			LH	2	
24			ULS	2	
25			LS	2	
26	Chokey Shoal	Navigation Buoy	UC	2	
27			MC	2	
28			LC	2	
29		Leading Light WT Front, Pivot, St Front	3	1	damaged
30	D'Silva Shoal	Navigation buoy	D'Silva	1	
31		Leading Light D'Silva Front/back	2	2	damaged
32	Hmawun lumps	Nabigation Buoy	Khing Kyaw San	2	
33			Hmawun Lump	2	
34		Leading Light HmawunFront/Back	2	1	damaged
35	Middle Bank Channel	Navigation Buoy	UMB	2	
36			CMB	2	
37			LMB	2	
38		Leading Post Back South Post	1	1	damaged
39	Western Channel	Elephant Point Tower	1	1	damaged
40		Navigation Buoy	UW	2	
41			CW	2	
42			UP	2	
43			LW	2	
44			CS	2	
45			LS	2	
46			ALW	2	
47			Intermediate	2	
48	Outer Bar	Navigation Buoy	Upper Float	2	
49			Lower Float	2	
50		Pilot Vessel	1	2	
51		Dagon Light Ship	1	3	

Source: JICA Project Team

(2) Facilities Damaged by Nargis

Remaining issues of navigation facilities damaged by Nargis are discussed below.

1) Mooring Buoys

Four mooring buoys of MPA were in normal condition.

IWT leased 10 mooring buoys from MPA before Nargis but 8 of the buoys were damaged by Nargis. Seven buoys were restored but due to shortage of mooring buoys, many ferries are waiting at the anchorage which is a very dangerous situation. (Rating 3 for MPA Berths, Rating 2 for IWT)

2) Navigation buoys at the Cross Sand Shoal, the Chokey Shoal, the D'silva Shoal, the Hmawun Lumps, the Middle Bank Shoal and the Western Channel

It is preferable for all navigation buoys to be identical through painting and lighting (either red or green colors should be used) in addition to installing a Top Mark on the buoy in accordance with regulation and guideline of IALA. (Rating 2 for navigation buoys)

3) Leading lights at the Chokey Shoal, the D'silva Shoal, the Hmawun Lumps and the Middle Bank Shoal

Ships entering Yangon Port from the Outer Bar must pass narrow channels such as the Western Channel, the Middle Bank Channel and the Monkey Point Channel.

In order to maintain safe navigation at these channels, MPA had installed 6 leading lights along a stretch of 35 mile between the Pilot Station Point and the Monkey Point, but all leading lights were damaged by Nargis (Rating 1 for leading lights)

4) Fire-Fighting Ship

Fire-fighting ship which sunk due to Nargis was scrapped due to significant damage. MPA wished to acquire a new fire-fighting ship as soon as possible.

5) Dagon Light Ship

Dagon Light Ship was damaged by Nargis and repaired at a dockyard in Yangon. Since light ships have become obsolete, a lighthouse should be constructed.

6) Elephant Point Tower

Elephant Point is located at the entrance of Yangon Port. There was a 40-45 ft high tower with beacon at this location, but it was entirely destroyed by Nargis. The Thante Point lighthouse, located at the left bank, provides sufficient light to assist ships in navigation. Therefore, the priority of the Elephant Point Tower becomes lower.

(3) Other Issues on Navigation Facilities not related to the Nargis Damage

In order to secure safe navigation in Yangon Port and its access channel, several issues existed even before Nargis. These issues are rated as shown below.

1) Maneuvering Area nearby Berth

Space of Maneuvering Area: Though there was no ample water area to be used as a Ship Maneuvering Area nearby berths it is considered that the minimum space requirement is being secured for both MOT ships and IWT ships. (Rating 3 for MPA berths, Rating 3 for IWT jetties)

2) RTA Anchorage and CCA Anchorage

RTA Anchorage located off Botahtaung Jetties is used for foreign ships and CCA (Country Craft Anchorage) is used only for local ships.

Both Anchorage areas were not congested during the study period from March to May 2009. (Rating 3 for MPA Berths, Rating 3 for IWT Jetties)

3) Monkey Point Channel

Monkey Point Channel is located at the confluence point of the Yangon River and the Bago River. Consequently, the channel flow becomes very complicated due to the meeting of the two river flows and severe siltation is a serious problem. Siltation at the Monkey Point is also very severe due to the complicated river flows.

In order to maintain the channel depth of 13.5 feet at the Monkey Point, MPA dredges (trailing hopper suction dredgers shown in Table 4.2.7) dredge the channel 1 mile (1,850m) in length and 100m in width at the Monkey Point every day. (Rating 2 for Channel depth, Rating 2 for Channel width, Rating 2 for dredging)

4) Pilot Ship at the Outer Bar

The hull of the Pilot Ship "MAY KHARL" was rusted. (Rating 2 for Pilot Ship)

4.4 RECOVERY PLAN FOR SAFE NAVIGATION

Considering urgent needs of the restoration of damaged facilities, the restoration works shall be implemented in accordance with phase-wise recovery plans as shown in Table 4.4.1.

Table 4.4.1 Definition of Phased Plans

Phased Plan	Target
Urgent Recovery Plan:	Restoration for securing basic needs of the peoples' life urgently with small budget and relatively easy way (implementation before 2011)
Short-term Recovery Plan:	Restoration for recovering original functions and capacity in shorter time (implementation up to 2014)
Medium to Long-term Recovery Plan:	Complete restoration taking account future needs in medium to longer time with necessary budget allocation (implementation after 2014)

Source: JICA Project Team

(1) Urgent Recovery Plan (before 2011)

1) Leading Lights

Leading lights are important navigation aids to maintain navigation safety at narrow channels and dangerous sections such as shallow water areas.

Ships entering Yangon Port from the Outer Bar must pass narrow channels such as the Western Channel, the Middle Bank Channel and the Monkey Point Channel. Due to the damage of leading lights, it is hard for ships to enter Yangon Port safely. Since navigation at the Monkey Point is most important for Yangon Port, restoration works of leading light and sector light are quite high priority works, thus these works fall under the Urgent Recovery Plan, and recommended to teach international regulations and provide lights as a model of recovery plan by the Project. However, total restoration of other leading lights may take longer to complete; this recovery work will be continued in the stage of Short-term Recovery period.

(2) Short-term Recovery Plan (up to 2014)

1) Navigation Buoys

There are 48 navigation buoys along the approach channels to Yangon Port which indicate the navigation limit of the narrow channels. These buoys are very important to avoid grounding of ships. All buoys seem to be in good condition but it is recommended that they be painted red color indicate the portside limit of the channel for entering ships. In addition, lights shall be installed on buoys for night navigation in accordance with international regulations.

It is needed that training on IALA regulations and guidelines be given to MPA officials. MPA's navigation buoy system should be consistent with IALA Standards.

(3) Medium to Long-term Recovery Plan (after 2014)

1) Fire-Fighting Ship

The fire-fighting ship was used as a tugboat, but it sank during Nargis. The tugboats owned by MPA are quite old and lack sufficient power to cope with the increase in size of calling ships. Accordingly, it is necessary to procure new tugboats. In order to recover the fire- fighting function at the port, the new tugboat is recommended to be equipped with fire-fighting capacity.

2) Replace Light Ships

Dagon light ships are aged and are using a very old system. It is necessary to replace the light ships.

Schedule of recovery plans for main inland water transport is shown in Table 4.4.2.

Table 4.4.2 Recovery Plan for Safe Navigation

Recovery Work Components	Urgent Recovery Plan (before 2011)	Short-term Recovery Plan (up to 2014)	Medium to long-term Recovery Plan (after 2014)
1) Leading Lights	Provide leading lights for Monkey and Thanlyin points and teach planning and design of navigation aids	Restoration of remaining leading lights by MPA	
2) Navigation Buoys		Provide buoys with lights on top and teach_planning and design of navigation aids	
3) Tugboat/Fire-figthing ship			Procurement of tug boat with fire-fighting equipment
4) Renewal or replacement of Light Ships			Renewal or replacement of light ships

Source: JICA Project Team

CHAPTER 5

RECOVERY PLAN OF YANGON PORT

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5.1 SITUATION OF WATERBORNE TRANSPORT

5.1.1 MPA JETTIES AND DOCKYARDS

Jetties and piers are mainly situated on the left bank of the Yangon River. Wharves including privately operated ones for ocean going container or general cargo ships are located at five different locations, namely Hteedan (360 m long, private operation), Ahlone Wharf (614 m long, private operation) for container ships, Myanmar Industrial Port (MIP) (310 m long, private operation) for container ships, Sule Wharf (1,026 m long) for general cargo ships and Bo Aung Gyaw Street Wharf (457 m long) for containers or general cargo ships. In addition to the above, a container terminal is located on the left bank on the Yangon River about 15 km down-stream from so-called Monkey Point where the Pazundaung Creek and the Bago River meet the Yangon River. This terminal has a total wharf length of 1,200 m and it is known as Thilawa Container Terminal.

Main jetties or piers for coastal or delta ships are situated at widely spread areas across a distance of about 13 km. Major structures of jetties are composed of a set of an access pier, a truss bridge, a sponson and a pontoon or a tank pontoon.

MPA has three dockyards in Yangon, namely Thein Byu, Satsan, and Angyt dockyards, under the administration of Mechanical Engineering Department. They are engaging in mostly ship repair works for the ships belonging to MPA.

Locations of MPA jetties and dockyards are shown in Figure 2.2.2.

Outline of the dockyards are as below.

(1) Thein Byu Dockyard

This dockyard has six slipways in total. The maximum hauling capacity is 150 displacement tons ship.

In hull fabrication shop, there are sheering machines, bending rollers, 300-ton hydraulic press machine, angle bender and so on. The machine shop is equipped with lathes, milling machines, and radial drilling machines. Both oxygen and acetylene producing plants are found in the dockyard premises. These gases are used for flame cutting and navigation lighting purposes. Eighteen arc welding generators are now in operation. Total work force was around 450.

(2) Satsan Dockyard

Satsan dockyard was established in 1950 with one graving dock. The dimension of the dock is 243ft in length, 58 ft in width and 16.6 ft in depth.

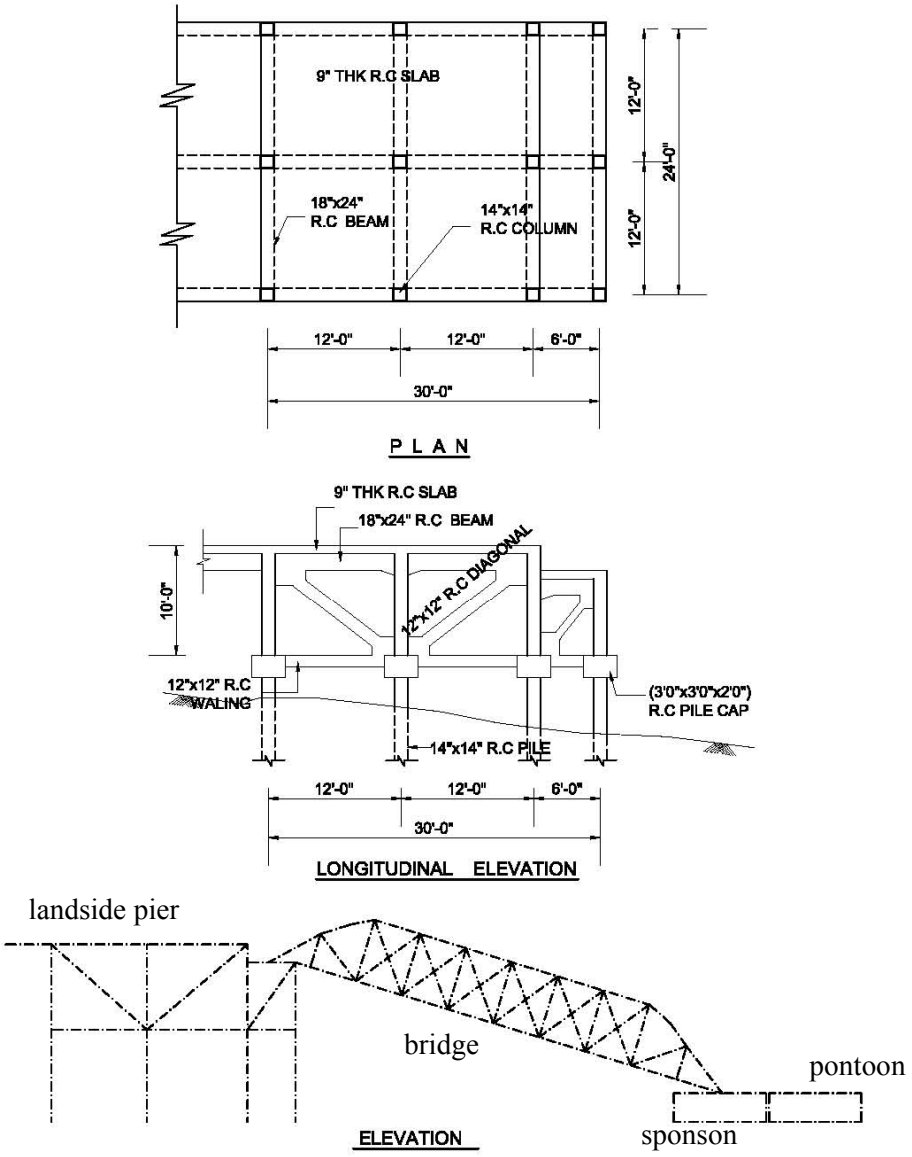
58 workers including engineers are engaged in ship repair, mainly for dredgers, tug boats and pilot ships. Annual repair performance is 6 ships on average.

(3) Angyt Dockyard

This dockyard is located in Dalla township across the Yangon River. There are four slipways capable of hauling ships of 150, 100, 30 and 30 displacement ton ships respectively. There is a small-sized lathe machine, shaper, drilling machines in the workshop. Seventy workers on average are engaged in ship repair works.

5.1.2 STRUCTURE OF MPA JETTY

A typical MPA jetty is composed of a landside concrete pier, a metal truss bridge, a steel sponson, a steel pontoon and a tank pontoon as illustrated in Figure 5.1.1.



Source: MPA

Figure 5.1.1 Standard Structure of Jetty Pier

A landside pier is a construction of cast-in-place reinforced structure on RC piles (14x14 inches). The length of a pier varies depending on the configuration of the land profile.

The sponson is a construction to support the bridge. The structure is a steel pontoon of 30 ft in length, 20 ft in width and 5 ft and 6 inches in depth. The sponson is anchored by four anchor chains of 180 ft in length with a diameter of one and a half inches, and one and a quarter inches with a one ton anchor extended from both sides.

The bridge is a construction of steel truss structure of 80 ft or 100 ft in length and about 10 ft in width and supported on each end by a pier and a sponson.

The pontoon is a construction of steel structure with a length of 120 ft, width of 20 ft and depth of 5 ft and 8 inches. The pontoon is anchored by two anchor chains of 180 ft in length with a diameter of 1 and a half inches, and one and a quarter inches with a one ton anchor extended from both sides and four anchor chains of 270 ft in length with diameter of one and a half inches, and one and quarter inches with one ton anchor extended on each from the both sides.

The tank pontoon is a construction comprised of a deck and supporting floaters. The deck is comprised of a wooden floor placed on steel frame of 240 ft in length and 40 ft in width. The desk is placed on 17 floaters of 40 ft in length, 10 ft in width and 5 ft in depth each. An anchoring system is similar to the pontoon jetty with heavier anchors.

Details of metal truss bridge, steel sponson, steel pontoon, tank pontoon and anchoring system are presented in Appendix A.

5.1.3 CONDITIONS OF MPA FACILITIES

In order to prepare a recovery plan of the damaged port facilities in Yangon Port owned by MPA, it is necessary to grasp the conditions of the facilities including measures taken as temporary repair works after the damages caused by Cyclone Nargis.

After the Nargis disaster, JICA study teams investigated the conditions of the damaged port facilities on two occasions; namely, in May 2008 immediately after the incident and in November 2008. The current JICA Project Team investigated the condition of the port facilities of MPA including conditions of temporary repair works undertaken by MPA since then.

The locations and name of the port facilities in Yangon Port area are shown in Figure 2.2.2. The port facilities subject to study by this study team are indicated in a same drawing as well. A list indicating the progress of the repair works and the present conditions of the MPA facilities subject to the study is shown in Table 5.1.1.

According to this table, it can be seen that 26 jetties equivalent to about 54% of the total 48 MPA jetties have been damaged by Nargis. Six months following the disaster in November 2008, 5 jetties out of the 26 damaged jetties have been repaired for temporary use. Urgently needed repair works to the damaged jetties have been conducted by MPA in all but about 12 jetties.

In November 2009, total of 19 jetties were completely or temporarily restored and repair works are being performed at 7 jetties.

Yangon Port has suffered from siltation for a long time due to sediment of the Yangon River. In the late 18th century, a right bank of the Yangon River near the Kanaungto Creek was eroded significantly by the river current due to a sharp left bend of the river. This erosion was supposed to be the cause of siltation in Yangon Port. Therefore, in 1904, Rangoon Port Trust decided to construct a training wall on an alignment at the bending portion in an attempt to reverse the effects of erosion. This resulted in increasing river flow velocity and subsequently reducing siltation at Yangon Port. The project was completed successfully in February 1914. This wall is called Seikkyi River Training Wall.

Table 5.1.1 Conditions of MPA Owned Port Facilities in Yangon Port

No.	Name of Jetty	Conditions of the Damages of the Facilities												User	Remark
		Pontoon (Judgments by JICA Teams)			Bridge (Judgments by JICA Teams)			Pier (Judgments by JICA Teams)			Others (Sponson) (Judgments by JICA Teams)				
		as of Nov. 2009	as of Nov. 2008	as of March 2009	as of Nov. 2009	as of Nov. 2008	as of March 2009	as of Nov. 2009	as of Nov. 2008	as of March 2009	as of Nov. 2009	as of Nov. 2008	as of March 2009		
1	Chaungwa Jetty	_	N	N, tank pontoon	_	N	N	_	N	N	_	N	N	Coastal	
2	Kyeemyindine Jetty 3	_	N	N	_	N	N	_	N	N	_	N	N	Delta/Fishing	
3	Kyeemyindine Jetty 5	_	N	N	_	N	N	_	N	N	_	N	N	Delta/Fishing	
4	Bazar Road Jetty	N	N	N	N	N	N	N	N	N	N	N	N	Delta	
5	Bagaya Jetty No.1	N	N	N	N	N	N	N	N	N	N	N	N	Coastal	
6	Bagaya Jetty No.2	N	N	N	N	N	N	N	N	N	N	N	N	Coastal	
7	Bagaya Jetty No.3	N	N	N	N	N	N	N	N	N	N	N	N	Coastal	
8	Bagaya Concrete Jetty	_	N	N	_	N	N	_	N	N	_	N	N	Public/Delta	
9	Wardan Jetty 1&2	_	N	N	_	N	N	_	N	N	_	N	N	Delta	MPA plan to change to concrete deck
10	Wardan Jetty 3&4	N	N	N	N, tank pontoon	N	N	N	N	N	N	N	N	Coastal/ Delta	
11	Ro/Ro Jetty	_	_	_	_	_	_	_	_	_	_	N	N	Public	
12	Wardan Jetty 5	_	D	D	_	D	D	_	N	N	_	D	D	Public	
13	Wardan Jetty 6	N	N	N	N	N	N	N	N	N	N	N	N	Coastal	
14	Concrete Jetty (1)	_	_	_	_	_	_	_		N	_	_	_	Public	
15	Kaingdan Jetty 1	N	N	N	N	N	N	N	N	N	N	N	N	Coastal/Passenger	
16	Concrete Jetty (2)	_	_	_	_	_	_	_	_	N	_	_	_	Public	
17	Kaingdan Jetty 2	N	D	N	N	P	N	N	P	N	N, Sponson	N	N	Delta	
18	Concrete Jetty (3)	_	_	_	_	_	_	_	_	N	_	_	_	Public	
19	Lan Thit	N	N	N	N	N	N	P, no pin		N	N	N	N	IWT/Delta/ Passenger	
20	Hledan 1	Already fixed	N	N	N	N	N	N	N	N	N, Sponson	N	N	IWT/Delta/ Passenger	
21	Hledan 2	N	N	N	N	N	N	N	N	N	N	N	N	Delta	
22	Concrete Jetty (4)	_	_	_	_	_	_	_	_	N	_	_	_	Public	
23	Phoegyilan 1	N	N	N	N	N	N	N		N	N	N	N	Delta	
24	Concrete Jetty (5)	_	_	_	_	_	_	_	_	N	_	_	_	Public	
25	Phoegyilan 2	N	D	D, removed	N	N	N	N	N	N	N	N	N	IWT/Delta	
26	Shwee Taung Dan 1	N	N	D	N	P	N	N	N	N	N	D	N	IWT/Delta	
27	Shwee Taung Dan 2	N	N	N	N	N	N	N	N	N	N	N	N	IWT/Delta/ Passenger	
28	Lanmadaw 1	N	N	N	N	N	N	N	N	N	¡	N	N	Delta	
29	Lanmadaw 2	N	N	N	N	N	N	N	N	N	¡	N	N	Delta	
30	Sin Oh Dan 1	N	D	N	N	D	N	P	N	N	N	D	N	Delta	
31	Sin Oh Dan 2	N	D	N	N	D	N	N	P	N	N	N	N	Delta	Temporary restoration
32	Port Health Jetty 2	N	D	N	N	P	N	N	N	N	N	N	N	Coastal	
33	Port Health Jetty 3	D	D	N	P	N	N	P	P	N	D, Sponson sunk	D	N	Coastal	Temporary restoration
34	Pansodan Jetty	N	N	N	N	N	N	N	N	N	N	N	N	IWT/Passenger	
35	Nan Thi Da 1 (upper & lower)	N	D	D	N, removed	D	D	N	N	N	N, removed	D	D	MPA/Official	Repairing
36	Nan Thi Da 2 (upper & lower)	N	N	N, tank pontoon	N	N	N	N	N	N	N	N	N	MPA/Official	
37	Thein Byu Jetty	D, 2 pontoon sunk	D	D	D	D	D	N	N	N	D, Sponson sunk	D	D	MPA/Official	Repairing
38	Workshop Pontoon Jetty	no pontoon	D	D	D	D	D	P	P	P	P, Sponson sunk	N	D	MPA/Official	Repairing
39	Botatoung 2	N/A	D	D	D	D	D	N	N	N	D, Sponson sunk	D	D	MPA/Official	Repairing
40	Botahtaung 3 (upper)	N	N	N, tempo'ry	N	N	N	N	N	N	N	N	N	MPA/Public	
	Botahtaung 3 (lower)	N	N	N, tempo'ry	N	N	N	N	N	N	N	N	N	MPA/Public	
41	Botahtaung 4 (upper)	D, tank p.	D	D	N	N	D	N	N	N	N	N	D	IWT/Public	Temporary restoration
	Botahtaung 4 (lower)	N	D	D	N	D	D	N	N	N	N	P	D	IWT/Public	
42	Botahtaung 5 (upper)	D, tank p.	D	D	D	D	D	N	N	N	D	D	D	IWT/Public	will be replaced with concrete pier
	Botahtaung 5 (lower)	N	D	P	N	P	N	N	N	N	N	N	N	IWT/Public	
43	Botahtaung 6 (upper)	N	D	D	N	D	D	N	N	N	N	P	D	IWT/Public	
	Botahtaung 6 (lower)	D, tank p.	D	D	D	D	D	P	P	P	D	D	D	IWT/Public	
44	Min Ye Kyaw Thu Jetty	N	N	N	N	N	N	N	N	N	D, m. chain damaged	N	N	IWT/Passenger	
45	Dalla Port Jetty	N	N	N	N	N	N	N	N	N	N	N	N	IWT/Passenger	
46	Ant Gyi Jetty	N	D	D	D	D	D	N	N	N	N	N	D	Public	Repairing
47	Crane Jetty in King's Bank	N/A	_	_	N/A	_	_	N	N	N	N/A	_	_	Public	
48	King's Bank Jetty	N	D	D	N	D	D	N	N	N	N	P	D	Public	

Legend :

N : Not Damaged or Recovered P : Partially Damaged or Temporally Recovered
D : Completely Damaged or Not Repaired yet N/A : Not Applicable
re-use : Available with Minor Repair

Note : "Delta" means IWT ships transport to/from Delta area and "IWT" means IWT ships other than Delta Ships.
"Coastal" means ships transport to/from domestic seaports. "IWT ships" include cargo cum passenger ships.

MPA owns four hopper suction dredgers used for the channel dredging at the outer bar and the inner bar. Among them three dredgers have a capacity of 1,000 m^3 each and one has a capacity of 800 m^3. In addition MPA has 3 grab dredgers which survived the Nargis disaster among previously owned 5 dredgers and are mainly used for dredging alongside wharves. The dredging works are conducted daily except during the rainy season. The dredging records are shown in Table 5.1.2, Table 5.1.3 and Table 5.1.4.

Table 5.1.2 Inner Bar Dredging Status of FY 2008 -2009

Month	Depth (ft)	Number of Trips of Dredger		Dredging Volume (m^3)
		per month	per day	
April 2008	13.0	412	14	246,614
May 2008	11.0	259	9	154,456
June 2008	12.0	420	14	249,632
July 2008	13.5	308	10	183,057
August 2008	13.5	155	5	90,615
September 2008	13.5	150	5	87,709
October 2008	13.5	155	5	90,320
November 2008	13.5	150	5	87,478
December 2008	13.5	226	8	133,185
January 2009	13.5	340	12	201,356
February 2009	13.5	368	14	216,245
March 2009	13.5	496	16	262,929
Total				**2,003,596**

Source: MPA

Table 5.1.3 Dredging Volume at Monkey Point (2004 - 2008)

(Unit: m^3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
2004	253,089	231,585	129,630	157,300	182,101	134,051	98,696	100,972	94,496	99,225	97,518	102,557	1,681,220
2005	93,664	61,564	102,037	118,446	132,166	186,326	115,045	64,609	58,208	59,282	56,888	58,965	1,107,220
2006	176,383	212,158	232,820	211,878	228,021	119,178	87,062	73,998	47,782	49,405	61,107	119,325	1,619,117
2007	193,751	186,154	202,417	227,238	177,756	130,315	107,227	67,004	66,548	71,515	99,661	164,716	1,694,302
2008	215,338	228,219	250,325	246,614	160,166	249,632	183,057	90,615	87,709	90,320	87,478	133,185	2,022,658

Source: MPA

Table 5.1.4 Dredging Volume at Wardan Jetty (2004 - 2008)

(Unit: m^3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
2004	42,300	32,400	48,900	51,900	44,250	23,550	16,350	8,400	14,400	7,950	15,300	29,550	335,250
2005	29,100	20,400	21,600	19,500	22,350	10,650	17,550	8,550	17,400	14,550	30,000	18,300	229,950
2006	6,150	7,500	22,200	16,200	7,200	11,550	14,400	16,350	1,500	28,500	21,450	16,350	169,350
2007	10,800	16,800	31,800	17,250	9,900	4,800	_	6,750	6,750	3,600	18,600	39,600	385,000
2008	32,400	27,750	24,600	21,600	3,150	7,200	8,500	9,900	15,150	20,550	25,950	21,600	218,350

Source: MPA

5.1.4 CHANGES IN PORT OPERATIONS

Before Nargis, IWT used 2 jetties of Botahtaung No.5 and No.6 for cargo handling and 5 jetties of Kaingdan No.1, Lan Thit, Hledan No.1, Phoegyilan No.1 and Phoegyilan No.2 for passenger transportation allocated by MPA in Yangon Port. Those have been reduced to 4 in total after the Nargis disaster. Currently jetties such as Kaingdan No.1, Lant Thit, Hledan No.1 and Shwee Taung Dan are available for IWT use.

IWT cargoes are transported mainly by 'Market Ship' which is composed of two barges of 65m in length and 2.5m in draft with one pusher. Due to the destruction of the jetties at Botahtaung where IWT cargo transport had been performed, IWT cargo is handled at Lanmadan area. It is desire of IWT, however, to use the berthing facilities in Botahtaung where their field office for the cargo handling operation management is located.

IWT passenger related transport through the above mentioned 4 jetties is about 4,400 persons with 550 tons of cargo per day by 8 incoming and outgoing trips. IWT desires to use jetties such as Kaingdan No.1, Kaingdan No.2, Lan Thit, Hledan No.1, Phoegyilan No.1 and Phoegyilan No.2 for passenger related transport where their field office for the passenger transport operation is located.

5.1.5 EVALUATION OF MPA PORT FACILITIES

The conditions of the Port facilities after the damage by Nargis were investigated and evaluated by the JICA Project Team. Results of the investigation and evaluation are shown in Table 5.1.5.

Steel structures are suffering from severe corrosion which results in making holes on the top or the side of pontoons and sponsons. Immediate repair works are required for some parts. Some concrete structures are also heavily deteriorated. Before conducting repair works, it will be necessary to make a detailed repair work plan after the secondary investigations on deteriorated parts.

Approximately 1,000 m out of the approximately 3,000 m long Seikkyi River Training Wall, constructed in 1914, was damaged by ships which had drifted from the port and were stranded on this part due to Nargis. In view of the importance of the effect of this training wall against the siltation of the port, MPA has started recovery works of the damaged part with its own funds. However, due to budget constraints only a 150 m section of the wall can be reconstructed each year. It will take about 6 years to complete reconstruction of the entire damaged section.

The details of the conditions of existing facilities including the results of investigations and evaluations are shown in Appendix A.

Table 5.1.5 Conditions of MPA Jetties (as of 2009)

as of November 20, 2009

No.	Name of Jetty / Type of Ship	No. of Berth	Name of Facility	Dimension at Present (X means repaire is not finished)	Damage Repair/Restoration History						Remarks
					Dimension before Nargis	Damage by Nargis	Situation of Damage	First Measure Taken	Restoration Type	Present Situation	
1	Chaungwa jetty		Pontoon	200'x40' (tank p.)	200'x40' (tank p.)	no damage					OK
			Bridge	100'	100'						
	coastal cargo		Pier								
			Sponson	40'x20'x5.5'	40'x20'x5.5'						
2	Kyeemyindine jetty	3	Pontoon	80'x20'x6.5'	80'x20'x6.5'	no damage					OK
			Bridge	80'	80'						
	central fish market jetty		Pier								
			Sponson	30'x20'x5.5'	30'x20'x5.5'						
3	Kyeemyindine jetty	5	Pontoon	80'x20'x5.5'	80'x20'x5.5'	no damage					OK
			Bridge	80'	80'						
	central fish market jetty		Pier								
			Sponson	30'x20'x5.5'	30'x20'x5.5'						
4	Bazar Road jetty		Pontoon	120'x20'x6.5'	120'x20'x6.5'	no damage					restoration completed
			Bridge	80'	80'	partial damage	stranded	small repair done	reuse	repaired	
	exclusive use for rice from Dalla area, Delta		Pier	N/A							
			Sponson	30'x20'x5.5'	30'x20'x5.5'	full damage	sunken	salvaged	reuse	repaired	
5	Bagaya jetty	1	Pontoon	120'x20'x6.5'	120'x20'x6.5'	no damage					OK
			Bridge	80'	80'						
	coastal cargo		Pier	short	short						
			Sponson	30'x20'x5.5'	30'x20'x5.5'						
6	Bagaya jetty	2	Pontoon	120'x20'x6.5'	120'x20'x6.5'	no damage					OK
			Bridge	80'	80'						
	coastal ship		Pier	short	short						
			Sponson	30'x20'x5.5'	30'x20'x5.5'						
7	Bagaya jetty	3	Pontoon	120'x20'x6.5'	120'x20'x6.5'	no damage					Ok
			Bridge	80'	80'						
	coastal ship		Pier	short	short						
			Sponson	30'x20'x5.5'	30'x20'x5.5'						
8	Bagaya concrete jetty		Pontoon	N/A		no damage					OK
			Bridge	N/A							
	general cargo from Delta area		Pier	OK							
			Sponson	N/A							
9	Wardan jetty	1&2	Pontoon	120'x20'x6.5'	120'x20'x6.5'	no damage					OK
			Bridge	100'	100'						
	genaral cargo ship for Delta		Pier	OK	OK						No.1 is RC Pile, No.2 is SPP
			Sponson	30'x20'x5.5'	30'x20'x5.5'						
10	Wardan jetty	3&4	Pontoon	240'x40' (tank p.)	240'x40' (tank p.)	no damage					OK
			Bridge	80'	80'						MPA Plans to change to Concrete Deck type
	general cargo for coastal and Delta area		Pier	30m	30m						in Future
			Sponson	30'x20'x5.5'	30'x20'x5.5'						
11	RO/RO jetty		Pontoon	N/A	N/A	no damage					OK
			Bridge	N/A	N/A						
	exclusive use for ferry		Pier	N/A	N/A						
			Sponson	N/A	N/A						
12	Wardan jetty	5	Pier	OK	OK						not used last 20 years
			Sponson	N/A	N/A						MPA plans to change to Concrete Deck type
13	Wardan jetty	6	Pontoon	120'x20'x6.5'	120'x20'x6.5'	full damage	sunken	salvaged	reuse	repaired	restoration completed
			Bridge	80'	80'	partial damage			reuse	repaired	MPA plans to change to Concrete Deck type
	coastal cargo		Pier	84'	84'						
			Sponson	30'x20'x5.5'	30'x20'x5.5'	full damage	sunken	salvaged	reuse	repaired	
14	Concrete jetty		slipway	higher: +24'		no damage					OK
			two stages	lower: +6'							
	public		Bridge	wooden bridge	wooden piles						
15	Kaingdan jetty	1	Pontoon	120'x20'x6.5'	120'x20'x6.5'	no damage					restoration completed
			Bridge	80'	80'	partial damage	half sunken	repaired in-situ		repaired	
	coastal ship		Pier	7'x12'	7'x12'	no damage					
			Sponson	30'x20'x5.5'	30'x20'x5.5'	full damage	sunken	salvaged	repair	repaired	
16	Concrete jetty		Bridge	62'x12'	wooden piles	no damage					OK
	public		Pier	N/A							
17	Kaingdan jetty	2	Pontoon	120'x20'x6.5'	120'x20'x6.5'	full damage	sunken	salvaged			restoration completed
			Bridge	80'	80'	partial damage	stranded	repaired		repaired	
	general cargo ships and passenger boats		Pier	60'	60'	no damage					
			Sponson	30'x20'x5.5'	30'x20'x5.5'	no damage					
18	Concrete jetty		Pontoon	N/A							restoration completed
			Bridge	100' (steel)	100' (wood)	full damage	stranded	replaced	replace	replaced	(new bridge is shifted from Port Heath jetty)
	public		Pier	72'	72'						
19	Lan Thit jetty		Pontoon	120'x20'x6.5'	120'x20'x6.5'	full damage	sunken	salvaged	replace	replaced	restoration completed
			Bridge	80'	80'	full damage	sunken	salvaged	replace	replaced	
	general cargo ship and passenger boats		Pier	50'	50'						
			Sponson	30'x20'x5.5'	30'x20'x5.5'	full damage	sunken	salvage	replace	replaced	
20	Hledan jetty	1	Pontoon	120'x20'x6.5'	120'x20'x6.5'	partial damage	stranded	repaired		repaired	OK
			Bridge	80'	80'	no damage					
	general cargo ships and high speed boats		Pier	50'	50'	no damage					
			Sponson	30'x20'x5.5'	30'x20'x5.5'	no damage					
21	Hledan jetty	2	Pontoon	120'x20'x6.5'	120'x20'x6.5'	full damage	sunken	salvaged	replace	replaced	restoration completed
			Bridge	80'	80'	full damage	sunken	salvaged	replace	replaced	
	general cargo ship and passenger boats		Pier	50'	50'	partial damage					
			Sponson	30'x20'x5.5'	30'x20'x5.5'	full damage	sunken	salvaged	replace	replaced	
22	Concrete jetty		RC pier	wing shape		no damage					OK
			RC pier	center staiers							
	cargo & passenger ships		Pier								
23	Phoegyilan jetty	1	Pontoon	120'x20'x6.5'	120'x20'x6.5'	no damage					OK
			Bridge	80'	80'						
	Delta ship		Pier	84'	84'						
			Sponson	30'x20'x6.5'	30'x20'x6.5'						
24	Concrete jetty		Pontoon	wing shape with center staiers	N/A	no damage					OK
			Bridge		N/A						
	cargo & passenger ships		Pier		ok						
25	Phoegyilan jetty	2	Pontoon	120'x20'x6.5'	120'x20'x6.5'	partial damage	stranded	pontoon was salvaged and trasfered to Botatoung		repaired	restoration completed
			Bridge	80'	80'	no damage					
	IWT/Delta ships		Pier	84'	84'	no damage					
			Sponson	30'x20'x6.5'	30'x20'x5.5'	no damage			reuse		
26	Shwee Taung Dan jetty	1	Pontoon	120'x20'x6.5'	120'x20'x6.5'	full damage	sunken	salvage	salvage work	repaired	restoration completed
			Bridge	60'	60'	partial damage				repaired	
	IWT/Delta ships		Pier	80'	80'	no damage					
			Sponson	30'x20'x6.5'	30'x20'x5.5'	full damage					

as of November 20, 2009

No.	Name of Jetty / Type of Ship	No. of Berth	Name of Facility	Dimension at Present (X means not finished)	Damage Repair/Restoration History						Remarks
					Dimension before Nargis	Damage by Nargis	Situation of Damage	First Measure Taken	Restoration Type	Present Situation	
27	Shwee Taung Dan jetty	2	Pontoon	120'x20'x6.5'	120'x20'x6.5'	no damage					restoration completed
			Bridge	80'	80'	partial damage	half sunken	salvaged	reuse	repaired	
	IWT/Delta		Pier	50'	50'	no damage					
			Sponson	40'x20'x5.5'	40'x20'x5.5'	full damage	sunken	salvaged	reuse	repaired	
28	Lannadaw jetty	1	Pontoon	120'x20'x6.5'	120'x20'x6.5'	no damage					OK
			Bridge	80'	80'						
	Delta cargo and passenger ships		Pier	50'	50'						
			Sponson	30'x20'x6.5'	30'x20'x5.5'						
29	Lannadaw jetty	2	Pontoon	120'x20'x6.5'	120'x20'x6.5'	no damage					OK
			Bridge	80'	80'						
	Delta cargo and passenger ships		Pier	50'	50'						
			Sponson	30'x20'x5.5'	30'x20'x5.5'						
	Between 29 and 30		others		A part of revetment was collapsed by sliding						
30	Sin Oh Dan jetty	1	Pontoon	120'x20'x6.5'	120'x20' x6.5'	full damage	sunken	salvaged	reuse	repaired	restoration completed
			Bridge	80'	80'	partial damage	half sunken	salvaged	reuse	repaired	
	Delta cargo and passenger ships		Pier	20'	20'	no damage					
			Sponson	30'x20'x6.5'	40'x20'x6.5'	full damage	sunken	salvaged	reuse	repaired	
31	Sin Oh Dan jetty	2	Pontoon	120'x20'x6.5'	157'x40' (tank p.)	full damage	sunken	salvaged and moved to bank	repair	replaced	restoration temporarily completed using smaller pontoon
	Delta cargo and passenger ships		Bridge	100'	80'	full damage	sunken	salvaged	reuse	replaced	MPA plans to change to Concrete Deck
			Pier	30'	30'	no damage					in future
			Sponson	40'x20'x6.5'	40'x20'x6.5'	full damage	sunken	salvaged	repair	replaced	
32	Port Health jetty	2	Pontoon	240'x40' (tank p.)	296'x40' (tank p.)	full damage	sunken	salvaged	transfered to other place	replaced	restoration completed Pontoon transferred from Nan Thi Da No. 1
			Bridge	100'	100'	full damage	sunken	salvaged	replace	replaced	bridge transfered to No.18 concrete jetty (3)
			Pier	20'	20'	no damage					Combined with Port Health jetty No. 3
			Sponson	40'x20'x6.5'	40'x20'x6.5'	full damage	sunken	salvaged	repair		
33	Port Health jetty	3	Pontoon	X	296'x40' (tank p.)	full damage	sunken	salvaged			Operation resumed using access from Port
			Bridge	X		partial damage	stranded	small repair done			Health No. 2 and two jetties combined.
			Pier	20'	20'	no damage					
			Sponson	X	40'x20'x6.5'	partial damage	stranded	repaired			
34	Pansodan jetty		Pontoon	120'x20'x6.5'	120'x20'x6.5'	no damage					OK
			Bridge	80'	80'						
	Dalla passenger		Pier	ok	ok						
			Sponson	30'x20'x5.5'	30'x20'x5.5'						
35	Nan Thi Da jetty	1	Pontoon	157'x40' (tank p.)	240'x40' (tank p.)	full damage	sunken	salvaged	moved to workshop	replaced	under repair and expected to complete soon Restore using smaller pontoon temporarily
	Tourism berth		Bridge	80'	80'	no damage					
			Pier	ok	ok						
			Sponson	30'x20'x5.5'	30'x20'x5.5'	no damage					
36	Nan Thi Da jetty	2	Pontoon	240'x40' (tank p.)	240'x40' (tank p.)	no damage					OK
	Exclusive MPA										
	tug boat, service		Bridge	80'	80'						
	boats, etc.		Pier	ok	ok						
			Sponson	30'x20'x5.5'	30'x20'x5.5'						
36'	SBM										no damage
	Step slipway		step slipway			area of basin : 20m x 30m					many fishing boats are staying
	for small boat(marina)										
37	Theh Byu jetty		Pontoon	2x(100'x20'x6.5')	2x(100'x20'x6.5')	full damage	sunken	salvaged	replace	replaced	expected to complete in January 2010
			Bridge	80'	80'	full damage	sunken	salvaged	workshop		
	MPA use		Pier	ok	ok						
			Sponson	30'x20'x5.5'	30'x20'x5.5'	full damage	sunken	salvaged	workshop		
38	Workshop Pontoon jetty	2	Pontoon	N/A	N/A						under repair
			Bridge	X	80'	partial damage	stranded	workshop	scrap		
	MPA use		Pier	X	ok	partial damage			no repair		
	ship bulding, repair shop		Sponson	X	30'x20'x5.5'	partial damage	stranded				
39	Botatoung jetty	2	Pontoon	N/A	N/A						under repair
			Bridge	X	100'	partial damage	stranded	launching	no repair		
	MPA use		Pier	X	ok	no damage					
	staff, workers,		Sponson	X	40'x20'x5.5'	full damage	stranded	launching	no repair		
40	Botatoung jetty (upper)	3	Pontoon	120'x20'x6.5'	120'x20'x6.5'	full damage	sunken	salvage	replace	replaced	restoration completed
			Bridge	80'	80'	partial damage	stay	transport	reuse	repaired	
	IWT/other ministry		Pier	40m	40m	no damage	stay				
			Sponson	30'x20'x5.5'	30'x20'x5.5'	partial damage	stay	transport	replace	replaced	
	Botatoung jetty (lower)		Pontoon	120'x20'x6.5'	200'x40' (tank p.)	full damage	sunken	salvaged	replace	replaced	temporary restoration completed using
			Bridge	80'	80'	partial damage	half sanken	salvaged	reuse	repaired	smaller pontoon
	MPA use		Pier	40m	40m	no damage	stay				
			Sponson	30'x20'x5.5'	30'x20'x5.5'	full damage	sunken	salvaged	reuse	repaired	
41	Botatoung jetty (upper)	4	Pontoon	100'x20'x6.5'	200'x40' (tank p.)	full damage	sunken	salvaged	replace	replaced	temporary restoration completed using
			Bridge	100'	100'	partial damage	half sunken	salvaged	reuse	repaired	smaller pontoon
	IWT use		Pier	40m	40m	partial damage	stay	repaired		repaired	
			Sponson	40'x20'x5.5'	40'x20'x5.5'	full damage	sunken	salvaged		repaired	
	Botatoung jetty (lower)		Pontoon	100'x20'x6.5'	200'x40' (tank p.)	full damage	sunken	salvaged	replace	replaced	temporary restoration completed using
			Bridge	100'	100'	partial damage	falling down	repaired	reuse	repaired	smaller pontoon
	IWT use		Pier	40 m	40 m	no damage					
			Sponson	40'x20'	40'x20'	partial damage	stay	repaired	reuse	repaired	
42	Botatoung jetty (upper)	5	Pontoon	X	200'x40' (tank p.)	full damage	sunken	salvaged	reuse		under restoration
			Bridge	X	100'	partial damage	half sunken	salvaged	reuse		
	IWT use		Pier	40 m	40 m	no damage					
			Sponson	X	40'x20'	full damage	sunken	salvaged	euse		
	Botatoung jetty (lowaer)		Pontoon	120'x20'x6.5'	200'x40' (tank p.)	full damage	sunken	salvaged	replace	replaced	under restoration
			Bridge	100'	100'						
	IWT use		Pier	40m	40 m						
			Sponson	40'x20'x5.5'	40'x20'						
43	Botatoung jetty (upper)	6	Pontoon	100'x20'x6.5'	200'x40' (tank p.)	full damage	sunken	salvaged	replace	replaced	temporary restoration completed
			Bridge	100'	100'	partial damage	half sunken	salvaged	replace	replaced	
	IWT use		Pier	40m	40 m						
			Sponson	40'x20'x5.5'	40'x20'	full damage	sunken	salvaged	replace	replaced	
	Botatoung jetty (lower)		Pontoon	X	200'x40' (tank p.)	full damage	sunken	salvaged	replace	replaced	under restoration
			Bridge	X	100'	full damage	sunken	salvaged	replace	replaced	
	IWT use		Pier	X	40 m	partial collapse	no repair				
			Sponson	X	40'x20'	full damage	sunken	salvaged	workshop		
44	Min Ye Kyaw Thu jetty		Pontoon	120'x20'x6.5'	120'x20'x6.5'						restoration completed
			Bridge	80'	80'	minor damage	stay	repair at site	reuse	repaired	
	passenger with cargo		Pier	ok	ok						
			Sponson	30'x20'x5.5'	30'x20'x5.5'						
45	Dalla Port jetty		Pontoon	120'x20'x6.5'	120'x20'x6.5'	full damage	sunken	salvaged	reuse	repaired	restoration completed
			Bridge	80'	80'	full damage	sunken	salvaged	replace	replaced	
	Passenger boats		Pier	90'	90'	damage	stay	in-situ repair			
			Sponson	20'x30'x5.5'	20'x30'x5.5'	full damage	sunken	salvaged	replace	replaced	
46	Ant Gyi jetty		Pontoon	N/A	100'x20'x6.5'	no damage				replaced	under restoration
			Bridge	80'	80'	full damage	stay	workshop			
	Dockyard MPA		Pier	no good							
	for stuff & labour		Sponson	40'x20'x5.5'		partial damage	stay	transport	repair	replaced	
47	Crane jetty in Kings Bank		Pontoon	N/A		no damage					OK
			Bridge	N/A							
	Marine Department use		Pier	ok	Delik crane on deck						
			Sponson	N/A							
48	Kings Bank jetty		Pontoon	80'x20'	N/A				replace	replaced	restoration completed
			Bridge	80'	80'	full damage	stay	workshop			
	Marine Department use		Pier	ok	ok	partial damage	stay	repair		using	
			Sponson	30'x20'x5.5'	30'x20'x5.5'	full damage	sunken	salvage	repair	replace	

Source: JICA Project Team

5.2 BASIC CONCEPT FOR RESTORATION OF PORT CAPACITY

5.2.1 CAUSE OF DAMAGE TO JETTIES

The pontoons for jetties are moored by anchor chains which may allow some vertical displacement of the pontoon associated with the rising of water surface when it exceeds normal water level fluctuations. When Nargis came close to Yangon, the water level was at a state of high water spring level astronomically. Due to Nargis, the water level in Yangon Port is estimated to have risen to about 1.8m above the normal astronomical water level.

As there are limited allowances in the vertical displacement of pontoon exceeding the normal water level fluctuations which are estimated at about 2.55m during neap tides and about 5.95m during spring tides, the additional water level rise by Nargis forced the chains of pontoons to become elongated. This resulted in exerting excess stress over the breaking stress on the anchor chains of pontoons. In addition, it should be noted that jetties with moored ships suffered much more severe damage compared to pontoons with no moored ships. This implies that waves and current forces exerted on moored ships and pontoon increased tensions on the anchor chains of pontoons due to its excessive vertical as well as horizontal displacement and resulted in the destruction of the jetty as a whole. This is supposed to be the main cause of the destruction of the pontoons.

During Nargis, some ships were anchored in the midstream of the Yangon River. Due to strong winds, waves and currents, anchored ships received forces exceeding the holding capacity of their anchors. Those excessive forces finally resulted in the drifting of the ships. Some drifted ships were stranded on the banks and some ships collided with the jetties as shown in Photo 5.2.1 attached. The collision of ships with the jetties was the other cause of damage to the jetties.

In terms of geographical distribution of the damaged pontoons, Botahtaung area was located at the eastern end of the group of jetties in Yangon Port and faced the long fetch over the Yangon River was entirely damaged. Whereas Bagaya Jetties located at the inner most area among MPA jetties were only slightly damaged by Nargis. Since the basic structures were similar in shape for both Botahtaung and Bagaya, differences in damage were assumed to be a result of the different natural conditions such as waves and currents. As explained above, due to differences in geographical location, Botahtaung area was exposed to rough water conditions with higher waves and faster water currents compared to those at Bagaya Jetties area located at the inner part of the port.

5.2.2 DESIGN SHIP AND CARGO HANDLING

The dimensions of ships using the MPA jetties are shown in Table 2.2.1. The dimensions of IWT ships are between 120ft and 240 ft in length, 20 ft and 40 ft in width and 6 ft and 8 ft in draft and the maximum draft of cargo ships is 14 ft (4.2 m).

Based on the above findings, design ship size can be determined as below;

- Maximum length of IWT passenger cum cargo ship : 240 ft (72 m)
- Maximum draft of cargo ships : 14 ft (4.2 m)

Because the jetties are mainly floating type which cannot allow employment of any mechanical cargo handling equipment, cargoes of IWT ships are handled manually at all jetties currently except some cargo ships with their own gear. This practice is assumed to be maintained unless the structure of jetties is changed to fixed type construction such as a concrete type pier. Another reason that manual cargo handling may continue is to secure working opportunities for workers.

5.2.3 BASIC CONCEPT FOR RESTORATION OF PORT CAPACITY

The basic concept was described in the interim report as follows;

Among 48 MPA jetties, 12 jetties (about 25% of the total) still need to be repaired. Reflecting the shortage of jetties as explained in Section 2.2.3 "Cargo Handling Volume", the cargo handling volume through the available jetties has reached only 74% of the cargo volume handled before Nargis. This means that urgent recovery works of the damaged jetties are needed.

As explained in Section 5.2.1 "Cause of Damages on Jetties", the jetties located near the access channel were damaged tremendously due to exposure of the jetties to severe natural conditions such as strong winds, strong currents and high waves. Botahtaung Jetty area, in particular, which faces the most severe natural conditions, suffered heavy damage. In the future this jetty might experience similar or more severe natural conditions. In order to avoid a recurrence of the damage to the structure of the jetty due to possible cyclones in future, it is recommended to use a stronger structure than the previously installed tank pontoon structure in the recovery works of Botahtaung Jetties. Concrete pier type and concrete pile supported pontoon type structures are considered the most recommendable structure among others. For the implementation of cost effective and prompt recovery works, it is necessary to apply up-to-date technology including the technology being used in Japan. The up-to-date technology to be demonstrated in pilot projects can be transferred to MPA. By the application of the transferred technology, MPA will be able to implement recovery works economically, efficiently and promptly.

There are several tank pontoon type or pontoon type jetties which need to be repaired. MPA has made efforts to salvage sunken pontoons or sponsons from the river bed and repair them by its own funds and technology. Those facilities can be recovered without any other assistance. For such kind of structure, MPA is capable of recovering from the damage using its own funds and technology.

5.3 EXAMINATION AND RECOMMENDATION FOR SOLVING PROBLEMS

5.3.1 PROBLEMS TO BE SOLVED

There are problems to be solved for the complete recovery of MPA port facilities which caused damaged by Nargis. MPA has also various issues to be achieved for the efficient port operation even though it is not directly connected with Nargis damage.

Situation related to the Pilot Project implementation has changed tremendously as shown in 8.2. Hence, it is necessary to revise the recommendation prepared in the interim report.

(1) In respect of Facilities Damaged by Nargis

The issues raised in the interim report relevant to the restoration works for damaged facilities caused by Nargis were as below;

1) Restoration work of Botahtaung Jetties No. 5 & 6,
2) Restoration work of 5 jetties at Workshop Pontoon Jetty No. 2, Nan Thi Da jetty No. 1, Thein Byu jetty, Ant Gyi jetty and Botahtaung Jetties No. 2,
3) Permanent restoration of temporarily restored port facilities in Botahtaung area, Port Health Jetty and Sin Oh Dan Jetty,
4) Restoration of jetties with fixed concrete deck type in future, and
5) Repair of the Seikkyi River Training Wall.

As of January 2015, items of 2) and 3) are almost completed and 5) is in progress.

(2) In Respect of Facilities Not Damaged by Nargis

Following issues have adversely affected the port operation for long time even before Nargis.

1) Recover of the capacity of two heave-up-boats (used for lifting chain and/or anchor) including replacement of winches and engines,
2) Capacity development of tidal level prediction knowledge,
3) Proper maintenance of steel structure repairing facilities and equipment in the MPA ship yards in connection with the reconstruction works of jetties,
4) Renewal of heave-up boats, and
5) Formulation of port master plan of Yangon port.

As of January 2015, items of 1) and 2) are almost completed and 3) is in progress.

5.3.2 RECOVERY WORK OF PORT FACILITIES BY MPA

After Nargis, MPA urgently conducted recovery works on the damaged facilities. The total recovery cost was estimated at about 3 million US$ equivalent as shown in Table 5.3.1.

In accordance with the revenue and expenditure of MPA during the last five years (shown in Table 5.3.2), the average annual capital expenditure for all MPA ports is estimated at about 2.6 million US$ equivalent. This means that the recovery cost is a heavy burden to MPA in terms of capital expenditure.

Table 5.3.1 Damaged Sections and Recovery Cost of MPA Jetties Damaged by Cyclone Nargis

No.	Name of the Jetty	Recovery Cost million Kyats (about thousand $)	Remark
1	Kyimyindaine Bazar Road	25	Sponson, Bridge
2	Wadan No. 6	100	Pontoon, Sponson, Bridge
3	Kaingdan No.1	25	Sponson, Bridge
4	Kaingdan No.2	50	Pontoon
5	Lanthit	80	Pontoon, Sponson, Bridge
6	Hledan No. 6	50	Pontoon
7	Hledan No. 7	80	Pontoon, Sponson, Bridge
8	Shwetaungdan No. 1	80	Pontoon, Sponson, Bridge
9	Shwetaungdan No. 2	30	Pontoon, Bridge
10	Sintohdan No. 1	38	Pontoon, Sponson, Bridge
11	Sintohdan No. 2	200	Pontoon, Bridge
12	Port Health No. 2 & 3	350	Pontoon, Sponson, Bridge
13	Nanthida No. 1 &2	300	Tank Pontoon
14	Marine Department (Theh Byu)	150	Pontoon, Sponson, Bridge
15	Workshop pontoon	25	Pontoon, Bridge
16	Botahtaung No. 2	30	Pontoon, Sponson, Bridge
17	Botahtaung No. 3 Upper & Lower	250	Tank Pontoon, Sponson, Bridge
18	Botahtaung No. 4 Upper & Lower	280	Tank Pontoon, Sponson, Bridge
19	Botahtaung No. 5 Upper & lower	280	Tank Pontoon, Sponson, Bridge
20	Botahtaung No. 6 Upper & Lower	380	Tank Pontoon, Sponson, Bridge
21	Thamada Beach	25	Pontoon, Bridge
22	Antgyi Dockyard	30	Pontoon, Bridge
23	Dalla Port	80	Pontoon, Sponson, Bridge
24	Min Ye Kyaw Thu	6	Bridge
	Total	**2,944**	

Source: MPA

Table 5.3.2 Revenue and Expenditure of MPA (Yangon+8 Out-ports)

(Kyat in million)

Particular	2004-05		2005-06		2006-07		2007-08		2008-09
	Estimate	Actual	Estimate	Actual	Estimate	Actual	Estimate	Actual	Estimate
Total Revenue	3,846	3,256	4,047	3,684	6,269	5,895	8,263	7,629	8,692
Government Subsidy	2,106	1,570	2,227	1,923	4,414	3,821	6,343	5,034	6,618
Income (dues, charges)	1,740	1,686	1,820	1,761	1,855	2,074	1,920	2,595	2,074
Total Expenditure	3,846	3,256	4,047	3,684	6,269	5,895	8,263	7,629	8,692
Administrative Expenditure	1,738	1,605	2,223	1,927	4,401	4,122	5,440	4,855	5,431
1. Staff Salaries and Labour Wages	342	339	368	331	2,115	1,842	2,113	1,906	2,124
2. Maintenance and Repairs	293	278	303	318	308	357	264	327	445
3. Operating Expenses	1,103	987	1,552	1,278	1,978	1,923	3,062	2,622	2,862
Capital Expenditure	2,108	1,651	1,824	1,757	1,868	1,774	2,823	2,774	3,261

Income: Dues (Goods, Ships), Demurrage Charges, Stevedoring Charge, Ship Hireing Charge, Cargo Handling Charge, Licence, Sales of Water, Rent

Source: MPA

As explained in Section 5.2.4 "Basic Concept for Restoration of Port Capacity", the repair works of sponsons, pontoons and bridges are able to be conducted by MPA's technology and budget.

5.4 PREPARATION OF RECOVERY PLAN OF PORT FACILITIES

Considering urgent needs of the restoration of damaged facilities, the restoration works shall be implemented in accordance with phase-wise recovery plans as shown in Table 5.4.1.

Table 5.4.1 Definition of Phased Plans

Phased Plan	Target
Urgent Recovery Plan:	Restoration for securing basic needs of the peoples' life urgently with small budget and relatively easy way (implementation before 2011)
Short-term Recovery Plan:	Restoration for recovering original functions and capacity in shorter time (implementation up to 2014)
Medium to Long-term Recovery Plan:	Complete restoration taking account future needs in medium to longer time with necessary budget allocation (implementation after 2014)

Source: JICA Project Team

Judging from urgency and budgetary restriction, the issues identified for restoration of port facilities are categorized into four phase-wise recovery works as follow.

Due to the elapse of 4 year time and considering the current situation, the recovery plans shall be revised as below;

(1) Urgent Recovery Plan (before 2011)

1) Restoration work of Botahtaung Jetties No. 5 & 6

Following plan has been recommended in the interim report;

Port facilities at Botahtaung area have been destroyed completely by Nargis. Due to the inferior location for berthing at this site in terms of natural conditions such as high waves and/or strong currents compared to the inner parts of the port, the conventional pontoon facilities revealed weakness of its structure.

A concrete pier type structure is considered suitable for this site. Contrary to the pontoon type structure which can accommodate ships at any tidal situations, the high crown elevation concrete pier type structure would make it difficult for small ships or ships without cargo handling gears to use during a low tide situation in particular. In order to overcome this drawback, it is recommended to provide a pontoon pier with rigid anchoring device in the vicinity of the concrete pier to be used for berthing and cargo handling corresponding to any tide situations.

Due to the change of situation related to Pilot Project, the above recommendation shall be reviewed and revised as below;

Through discussions of the steering committee meetings about the candidate location of Pilot Project, Dalla ferry terminal area was selected as an appropriate place. At this location, only a pontoon pier is considered as a suitable structure taking into account type of design ship, namely, ferry boat with a small free board while coastal ship with a large free board was expected to use Botahtaung jetty.

As of January 2015, Botahtaung Jetty has rehabilitated for berthing of hotel ship by a private company.

2) Restoration work of 6 Jetties

Out of 26 jetties damaged by Nargis, MPA completed restoration of about 19 jetties by November 2009. MPA was working on the restoration of Workshop Pontoon Jetty No. 2, Nan Thi Da Jetty No. 1, Thein Byu Jetty, Ant Gyi Jetty and Botahtaung No. 2 Jetty. It was expected to be completed in the first quarter of 2010.

As of January 2015, the above restoration work has been completed.

3) Permanent Restoration of Temporarily Restored Port Facilities

As of the end of 2009, in Botahtaung area, temporary restoration works have been conducted with smaller pontoons at jetties No. 3, 4 and 6. Also at Sin Oh Dan jetty berth No.2 has been restored with smaller pontoon of 120 feet long instead of previously installed 157 feet type pontoon. Port health jetty No. 3 was operated temporarily by connecting with jetty No. 2, thus it was required to conduct permanent restoration in the future. MPA planned to replace though temporarily installed smaller pontoons when original size pontoons would have been available.

As of January 2015, this measure has been completed.

4) Repair of the Seikkyi River Training Wall

The 3,000m long Seikkyi River Wall was constructed at a bend of Yangon River aiming at diminishing siltation at the port. The construction began in 1903 and completed in 1914 by the United Kingdom which governed Myanmar during this period. A 100 years old facility which has been deteriorated

with subsidence was damaged in a total length of 1,000m by ship drifted and stranded on the training wall by Nargis. This facility plays an important role in reducing the siltation of Yangon Port.

In order to maintain the port function of Yangon port, it is very important to recover damaged training wall with durable structure as soon as possible.

As of January 2015, this repair work is in progress.

(2) Short-term Recovery Plan (up to 2014)

1) Restoration of Jetties with Fixed Concrete Deck Type

As of the end of 2009, MPA had a plan to restore some jetties with fixed concrete jetty type. Such remodeling work were planned to be carried out at Wardan jetties No. 3 to 6, Sin Oh Dan Jetty No. 2, and Botahtaung Jetties No. 3 and 4.

Since then, MPA changed their objective at them invested by private fund. As of January 2015, most of the projects have not started.

2) Renewal of Heave-up Boats

MPA needs grade up capacity and renew winch of its heave-up boats to perform replacement of anchor chains of pontoons and sponsons safety and effectively. Since it was recognized that Yangon port was experiencing comparatively higher corrosion rate probably due to mixture of sea water and fresh water from the river high temperature, high turbidity and fast current, the function of heave-up boats is important for Yangon port. The winch and other mechanical equipment were aged and lower their capacity, thus it was necessary to renew or replace winch of heave-up boats.

As of January 2015, renewal of equipment has been completed.

(3) Medium to Long-term Recovery Plan (after 2014)

1) Formulation of Port Master Plan of Yangon Port

Since existing Yangon Port facilities are located within a strip of narrow land area adjacent to the present business district of town area. In the existing port area, several port master plans are prepared for small coastal shipping and trade with inland regions. On the other hand, port development plan exists in Thilawa area to accommodate larger ships up to 15,000DWT. In Thilawa terminal, 22 plots each measuring 200m x 750m of land are earmarked for the extension of port investment.

In the above circumstances, it is urgently necessary to prepare port master plan harmonizing port development in both Yangon main port area and Thilawa area. The port master plan shall include necessary land transport infrastructure improvement between Thilawa and Yangon.

Schedule of recovery plans for Yangon Port is shown in Table 5.4.2.

Table 5.4.2 Schedule of Recovery Plans for Yangon Port

Recovery Work Components	Urgent Recovery Plan (before 2011)	Short-term Recovery Plan (up to 2014)	Medium to long-term Recovery Plan (after 2014)
1) Restoration work of Botahtaung Jetties No. 5 & 6	Restore damaged facility with rigid structure by JICA (location changed to Dalla ferry terminal)		
2) Restoration work of 6 Jetties	Pontoon restoration works is to be conducted by MPA		
3) Permanent restoration of temporarily restored port facilities	Restore temporally recovered facilities by MPA		
4) Repair of the Seikkyi River Training Wall	Restore damaged portions of facility by MPA		
5) Restoration of Jetties with Fixed Concrete Deck Type		Restore jetties with rigid concrete structure	
6) Renewal of Heave-up Boats		Replace winches with new ones	
7) Formulation of Port Master Plan of Yangon Port			Providing a master plan to avoid duplication of investment in the future by utilizing foreign financial assistance

Source: JICA Project Team