Crisis Management Plan

Inland Waterways Authority of India

Final Report

pwc

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Date: 20th March 2019

Member Technical
Inland Waterways Authority of India
A-13, Sector-1, NOIDA, 201301, Uttar Pradesh – 110011

Project: "Project Management Consultant (PMC) for Inland Waterways Transportation (IWT) Development Project".
Project No.: 4117063
Partner: Sanjay Kumar Garg

Dear Sir,
Subject: Preparation of Crisis Management Plan for National Waterways

Dear Mr. Gangwar,

Our services were performed and final report is prepared in accordance with your **Letter of Engagement dated 23 January 2018**.

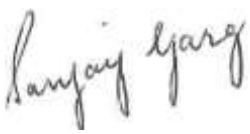
Our scope of work included review of applicable regulations along with Disaster Management Plans available at National and state level, identify crisis situations and develop the plan at program level to facilitate decision making on critical issues in a potentially stressful environment and define responsibilities and roles during a crisis situation.

For this purpose we had conducted stakeholder consultation with Captain of Ports Goa, Maharashtra Maritime Board, Marmugao Port Trust, Jawaharlal Nehru Port Trust, Mumbai Port Trust, North Goa Disaster Management Authority, Brihanmumbai Municipal Corporation, Kolkota Port Trust, National Institute of Disaster Management and IWAI officers. The report is based on information and documents made available to us from IWAI**.** Accordingly, changes in circumstances or information newly available after this date could affect the findings outlined in this report.

Our final report has been prepared in accordance with the agreed scope of work and deliverables as per the LOE dated 23 January 2018. This report is prepared solely for IWAI's information. This report is intended for distribution only to IWAI and may not be relied upon by other parties ("Third Party"). As part of this report, we have also recommended measures which should help IWAI in effectively implementing the crisis management plan, attached herewith the letter.

We appreciate the opportunity to assist you with this matter. If you may have any questions or would like to discuss our report, please contact me at sanjay.garg@pwc.com or you can reach out to Yasir Ahmad at yasir.ahmad@pwc.com

Yours sincerely,



Authorised Signator

List of abbreviations

CCS	Cabinet Committee on Security
CMP	Crisis Management Plan
CPCB	Central Pollution Control Board
CRF	Central Road Fund
DDMA	District Disaster Management Authority
DPR	Detailed Project Report
EIA	Environmental Impact Assessment
ENVIS	Environmental Information System
EWS	Early Warning Systems
GIS	Geographic Information System
IMD	India Meteorological Department
IMO	International Maritime Organization
IRS	Indian Remote Sensing
ISRO	Indian Space Research Organization
IWAI	Inland Waterways Authority of India
IWT	Inland Water Transport
LPG	Liquefied Petroleum Gas
MHA	Ministry of Home Affairs
MMI	Modified Mercalli Intensity Scale
MoEFCC	Ministry of Environment, Forest and Climate Change
MTPA	Million ton per annum
NCMC	National Crisis Management Committee
NCR	National Capital Region
NDMA	National Disaster Management Authority
NDRF	National Disaster Response Force
NEC	National Executive Committee
NGO's.	Non-Governmental Organizations
NHAI	National Highway Authority of India
NIDM	National Institute of Disaster Management
NITI Aayog	National Institution for Transforming India
NNRMS	National Natural Resources Management System
NW	National Waterways
PwC	PricewaterhouseCoopers Private Limited
SDMA	State Disaster Management Authority
SEB	State Electricity Board
SLUSI	Soil and Land Use Survey of India
SPCB	State Pollution Control Boards
SRDF	State Relief Disaster Fund
UNFCCC	United Nations Framework Convention on Climate Change
USGS	United States Geological Survey
VHF	Very High Frequency
WWF	World Wide Fund for Nature

1. Introduction

1.1. IWAI

Inland Waterways Authority of India (IWAI) was constituted on 27 Oct 1986 for regulation and development of Inland Waterways for the purpose of shipping and navigation.

The role of IWAI in the overall augmentation of IWT sector is pivotal. It has potential to be developed as an eco-friendly, cheap and viable mode of transportation to boost the economy of India as trade, commerce, employment generation, tourism etc. as well as satisfy aspirations of the teeming millions of society.

1.2. Plan for achieving national waterways development goals

Following are the outcomes of the interventions planned in Major NWs:

Vertical A – Existing 5 National Waterways

Table 1: Development works on NW 1, 2, 3, 4, 5

NW#	Waterway description	Development Outcome
1	Ganga: Haldia – Allahabad (1620 km)	The development will broadly include development & maintenance of – Fairway along Haldia – Varanasi stretch, multimodal terminals, new navigation lock and navigation aids. Traffic: The project would enable commercial navigation of 1500-2000 ton vessels from Haldia to Varanasi in Phase I and up to Allahabad in Phase II. This will facilitating potential cargo shift of 55.63 MMTPA by 2035
2	Brahmaputra: Sadiya – Dhubri (891km)	Capacity augmentation of NW2 by fairway development/maintenance, constructing various terminal and allied infrastructure facilities, procuring vessels & identifying Ro-Ro routes etc.
3	West Coast Canal: Kottapuram-Kollam, Udyogmandal & Champakara canals (205 km)	Capacity augmentation of NW3 by fairway development/maintenance, constructing various terminal and allied infrastructure facilities, procuring vessels & widening narrow stretches etc.
4	Godavari, Krishna rivers and Kakinada-Puducherry Canal (1078 km)	Develop, commission, operate, manage and maintain the inland waterways facilities for NW-4 in four phases
5	Brahmani, Mahanadi rivers & East Coast Canal (588 km)	Develop commission, operate, manage and maintain the inland waterways facilities for NW-5 in two phases. Traffic: The project would enable commercial navigation of 1500 – 2000 ton vessels and will

		facilitate potential cargo shift of 12 MTPA by FY 21-22.

Vertical B – 106 New National Waterways

New waterways will be developed in 3 categories:

Table 2: categorization of waterways based on the development of the waterway

Categories	Description
Category I	Comprising of 8 NWs. For these, detailed project reports have been prepared & development activities on 6 out of 8 NWs, which include Barak, Ghaghra, Gandak, Kosi, and Mandovi & Zuari, have already been initiated.
Category II	Comprising of 46 NWs, which are in coastal region & have tidal stretches. All preparatory studies (Feasibility & DPR) are completed. Development works on feasible waterways are initiated.
Category III	Comprising of 52 NWs, which are in remote, inaccessible & in hilly regions. All preparatory studies (Feasibility & DPR) are under process. Development works on feasible waterways are initiated.

With subsequent realization of traffic/ cargo on developed stretches during Phase I, Phase II development works will be initiated to match the growing demand over next 15 years from FY 17- 18.

Vertical C – Projects of International Connectivity

i. **Kaladan Project** – Development of inland waterway from Sittwe to Paletwa in Myanmar

ii. **Indo-Bangladesh Protocol Route** - The Protocol on Inland Water Trade and Transit with 5 years renewal process having next renewal scheduled in June, 2020

1.3. Review of Cargo/Passenger Data

Total cargo movement on NW 1, 2, 3 was 64.6 lakh Tons of material like cement, fly ash, metal ores, coal, oils, construction material, food, essential commodities, ethylene etc..

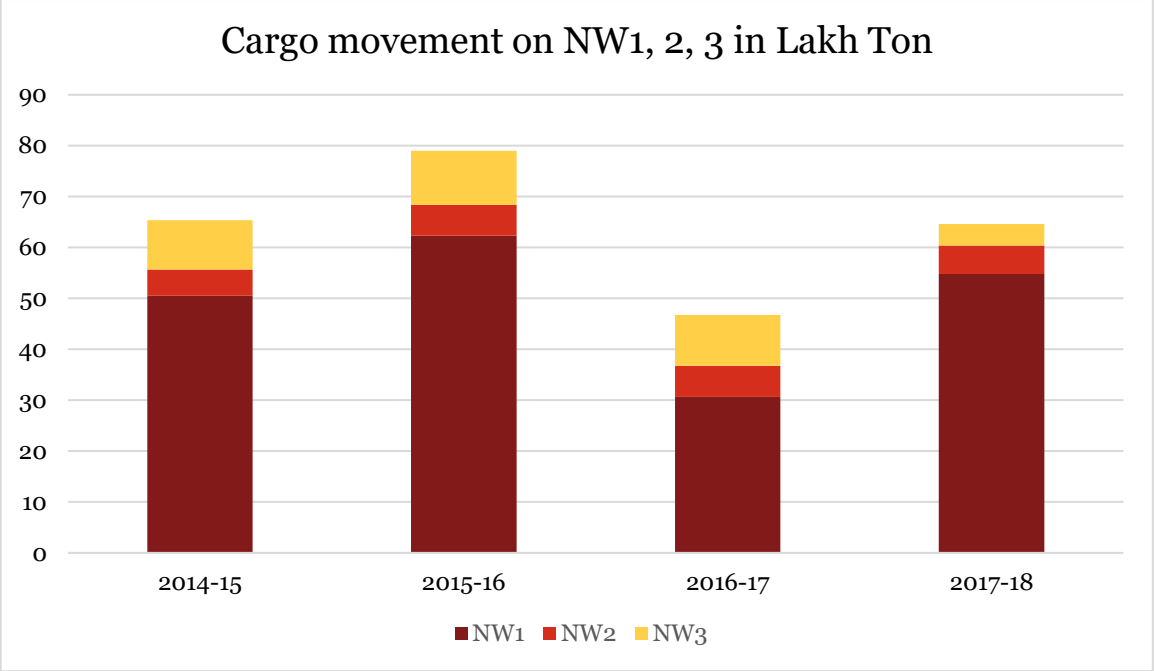


Figure 1: Cargo movement on National Waterway 1, 2 and 3 (Source: IWAI website)

1.4. Need for Crisis Management Plan (CMP)

The increase in likelihood of incidents due to growth in traffic, might affect the operations of vessels in national waterways, thereby creating a crisis. This effect on IWAI's operations and facilities, information systems, critical records or personnel can undermine the viability of IWAI. A Crisis Management Plan can act as a guide in various crises at the waterways and terminals, and help in swiftly recovering from the impact. Crisis Management Plan will have following benefits:

a) Increasing the safety and well-being by providing a list of key contacts

b) Minimizing downtime and increasing productivity by providing clarity on roles and responsibilities

c) Reducing the environmental damage by defining specific response procedures to a variety of incidents

d) Minimizing the economic loss by integration with emergency plans for various situations

e) Reducing the legal liabilities

The crisis management plan is imperative for IWAI to manage an unexpected event/disaster by minimizing the impact of crises and consequently tangible damages (like security breaches) and intangible damages (like reputational damages).

1.5. Objectives

Crisis Management Plan (CMP) provides framework to IWAI managing all phases of crisis management cycle i.e. Pre- crisis (prevention, mitigation, risk reduction and preparedness), during crisis (response, communication and co-ordination) and post- crisis (recovery). Objective of CMP is that IWAI:

a) Improve the understanding of crisis and disaster risk, hazards, and vulnerabilities

b) Strengthen crisis risk governance at all levels from sub-office to Head office level

c) Invest in disaster risk reduction for resilience through structural, non-structural and financial measures, as well as comprehensive capacity development

d) Enhance Crisis preparedness for effective response

e) Prevent crisis and achieve substantial reduction of disaster risk and losses in lives livelihoods, health, and assets (economic, physical, social, cultural and environmental) by adopting prevention measures

f) Prevent and reduce hazard exposure and vulnerabilities to disaster

g) Capacity development at all levels to effectively respond to multiple hazards

h) Provide clarity on roles and responsibilities of various Departments and other stakeholders involved in different aspects of crisis management

i) Empower to have prompt response to any threatening crisis situation or crisis

j) Enable in assessing the severity or magnitude of effects of any crisis, coordinate and respond accordingly

k) Enable staff to conduct evacuation, rescue and relief

l) Recovery of operations

1.6. Definitions

Reference

1. *Disaster Management act 2005*
2. *WHO definitions for emergencies*
3. *Merchant Shipping (Carriage of cargos) Rules 1995*
4. *Prevention of Collision on National Waterways Regulations 2002*
5. *Inland Vessels act 1917*
6. *Convention on International Regulations for Preventing Collisions at Sea (COLREG), 1972*

Disaster: Disaster is defined as catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man-made causes, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of property, or damage to, or degradation of environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area. [1]

Crisis: A situation that is perceived to be difficult. Its greatest value is that it implies the possibility of an insidious process that cannot be defined in time, and that even spatially can recognize different layers/levels of intensity. A crisis may not be evident, and it demands analysis to be recognized [2].

Affected Area: means an area or the part of NW and associated infrastructure affected by the crisis

Crisis Management: means a continuous and integrated process of planning, organizing, coordinating and implementing measures which are necessary or expedient for:-

a) Prevention of crisis or threat of any crisis

b) Mitigation or reduction of risk of any disaster or its severity or consequences

c) Capacity building

d) Preparedness to deal with any crisis

e) Prompt response to any threatening crisis situation or crisis

f) Assessing the severity or magnitude of effects of any crisis

g) Evacuation, rescue and relief

h) Recovery of operations

Local Authority: includes panchayat raj institutions, municipalities, a district board, cantonment board, planning authorities or Zila Parishad or any other body or authority, by whatever name called, for the time invested by law, for rendering essential services or with the control and management of civic services, within a specified local area. [1]

Mitigation: means measures aimed at reducing the risk, impact or effects of a disaster or threatening crisis situation [1]

Preparedness: means the state of readiness to deal with a threatening crisis and the effects thereof [1]

Prescribed: means prescribed by rules made under this Crisis Management Plan

Crew members: All personnel employed for operation or serving on an inland vessel other than Master and passengers as a part of performing the functions of manning.

Dangerous cargo: include dangerous goods in packaged form, explosive as defined in Explosives Act, 19884 and the International Maritime Dangerous Goods (IMDG) code, noxious or dangerous chemicals liquid in bulk, solid bulk cargoes, liquefied gas, harmful substances identified as marine pollutants in the International Maritime Dangerous Goods (IMDG) code. Deck cargoes including timber cargo and other such cargoes, which by reasons of their nature, quantity or mode of stowage are either singly or collectively liable to endanger the life of health of persons on or near the ship or liable to imperil the safety of the ship;[3]

Fishing vessel: A vessel fitted with mechanical means of propulsion, which is exclusively engaged in fishing for profit, within inland waters.

Hazardous chemical or obnoxious substance: means any chemical or substance, as the case may be which has been designated as pollutants under Inland Vessels Act.

Inland Port: Area designated and developed for the facilitation of activities of loading, unloading, embarking, disembarking and any other allied activities directly or indirectly involved in the functioning of vessels including trade activities and which act as interface between land area and inland

Master: includes any person including serang or such other person who is in command or in charge of any inland vessel, and does not include a pilot or harbor master.

Mechanically Propelled Inland Vessel: means every description of vessel propelled wholly or in part by electricity, steam or other mechanical power including dumb vessel towed by the mechanically propelled vessel and vessel propelled by outboard motor[4]

Navigable water: Any area or extent of water declared by the State Government or by Inland Waterways Authority of India constituted under Inland Waterways Authority of India Act 1985, as amended or by any authority constituted under such other laws in force in India, as navigable by the inland vessels, registered, recognized or identified, under this Act [5]

Non-mechanically Propelled Vessel: mean to include country boats, yachts or such other vessels that are put into movement by sole employment of human labor.

Passenger: shall mean any person carried on board a vessel except a person employed or engaged in any capacity on board the vessel in connection with the business of the vessel.

Passenger terminal: terminal designated for the embarking or dis-embarking of passengers or any other allied processes of such embarking or disembarking of passengers and the permitted cargo in a port, jetty etc.

Passenger Vessel: Any vessel permitted to or carrying passengers.

Pilot: any qualified person appointed by the owner of the vessel to assist the master or to steer the vessel in such area of inland water in accordance with the mandatory requirement as prescribed by the respective State Government.

Vessel: means every description of water craft, including small craft vessel under oars or sail, floating equipment and non-displacement craft [4]

Water line: Safety water line or any marks or lines with which any inland vessel is marked to denote the safe carrying or loading capacity of such vessel .

Dangerous goods or cargo: Means any cargo/goods which due to its nature, form or content as a whole or in part are declared as dangerous or potentially dangerous while carried on any class or category of inland vessels in inland waters under this Act or any other law in force.

Hazardous chemical or substance: means any chemical or substance, as the case may be, which has been designated as pollutants under this Act

Material Safety Data Sheet (MSDS): a document that contains information on the potential hazards (health, fire, reactivity and environmental) and how to work safely with a hazardous substance. It also contains information on the use, storage, handling and emergency procedures related to the hazards of the material. MSDS are prepared by the supplier or manufacturer of the substance and are intended to tell what the hazards of the product are, how to use the product safely, what to expect if the recommendations are not followed, what to do if accidents occur, how to recognize symptoms of overexposure, and what to do if such incidents occur.

1.7. Types of crisis/disasters

Primarily crisis are triggered by natural disasters or human-induced, or result from a combination of both. In particular, human-induced factors can greatly aggravate the adverse impacts of a natural disaster.

1.7.1. Natural Disasters

Natural disasters as defined under National Disaster Management Plan 2016 and having impact on national waterway are as follows:

Table 3: Impact of natural disasters on the national waterways and other assets of IWAI

S.No	Broad Category of Disaster	Disaster	Impact on National Waterways and other assets of IWAI
1	Geophysical	i) Earthquake	a) Urban fires triggered by earthquakes; b) Liquefaction - the transformation of (partially) water-saturated soil from a solid state to a liquid state caused by an earthquake and weakening foundations of terminal buildings c) Mass movement of earth materials, usually down slopes and increase silt and debris in waterways d) Surface displacement of earthen materials thereby weakening structural strength
		ii) Tsunami	Tsunami waves travel at very high speed across the ocean but as they begin to reach shallow water, they slow down and the wave grows steeper. Increase height of tidal waves and tidal current of water in inland waterways.
2	Hydrological	i) Flood	a) Sediment erosion impacts bank protection works , water structures and terminal structures b) Structural damage to water structures and terminal structures c) Increase in water current d) Debris and mud flows decreases navigability of main channel e) Damage to visual navigation aids f) Wave action decreasing navigability of small vessels and ferries g) Geomorphological changes changing course of main channel
3	Meteorological	i) Cyclone and storm surge	a) Structural damage to water structures and terminal structures b) Damage vessels and ferries c) Debris and mud flows decreases navigability d) Disrupt navigation and communication system
		ii) Fog, frost and hail	a) Decrease in visual navigability b) Increase in incidents of collision/ contact
		iii) Sand Storm	a) Decrease in visual navigability b) Increase in incidents of collision/ contact
		iv) Lightning and Cloud Bursts	a) Danger to structures b) Danger of Electrocution on the vessel

1.7.2. Human-Induced Crisis

IWAI is at risk of crisis induced by its own functioning and operations and from crisis induced by the other users of national waterways not directly under control of IWAI. Following are the types of human induced crisis which may have an impact on IWAI:

Table 4: Impact of human induced crisis on inland waterways and other assets of IWAI

S.No	Broad Category of Incident	Type of Crisis	Description	Impact on National Waterways and other assets of IWAI
1	Vessel Accident	i) Collision	An event where two navigating vessels or craft suffer an impact with each other.	a. Impact on waterway, wherever collision happens like approach channel, turning basin, berthing/ anchorage area, navigation channel b. Injury to personal c. Damage to vessels d. Cargo Spillage e. Fire f. Loss of Hull integrity g. Sinking h. Pollution in the channel
		ii) Contact	An event where a vessel or craft strikes something fixed, such as a navigation aid, berth, jetty	a. Damage to berth/jetty/buoy b. Damage to the vessel c. Injury to personal d. Loss of Hull integrity e. Problem in navigation in the approach channel
		iii) Grounding	It is the impact of a ship on riverbed or waterway side. It may be intentional, as in beaching to land crew or cargo, and careening, for maintenance or repair, or unintentional, as in a marine accident	a. Damage to vessel b. Loss of hull integrity c. Sinking d. Injury to personal e. Problem in navigation wherever grounding happens
		iv) Fire/ Explosion	Fire can occur when flammable material, oxygen and sufficient ignition energy are available. Explosion depends on an atmosphere of a mixture of flammable material with oxygen. Cargo leakage might also lead to fire or sudden explosion	a. Loss of Cargo/ passenger b. Loss of Hull integrity c. Damage to vessel d. Injury to personal e. Release of toxic fumes f. Pollution in the channel
		v) Problem in Navigation	Intentional or un-intentional failure of vessel to follow navigation instructions or protocols	a. Damage to marking buoys b. Impact on traffic movement

		Problem in cross over structure	Accident or maintenance problem in cross over structure which might impact operation of IWAI	c. Impact on structural integrity of the cross over structure d. Impact on traffic movement near the structure
		v) Capsizing	to (cause a boat or ship to) turn upside down by accident while on water	a. Mass casualty b. Damage to vessel c. Loss of hull integrity d. Sinking e. Problem in navigation wherever grounding happens
2	Pollution	i) Cargo Leakage/ Spillage	Accidental cargo leakage/ spillage during transportation, transfer or storage especially cargo identified as dangerous goods	a. Impact on navigation b. Threat of fire/explosion c. Pollution will impact uses of water in the downstream like water supply, fishing, ecosystem d. Injury
		ii) Oil Spill	Accidental spill of oil transportation, transfer or storing	a. Impact on navigation b. Threat of fire/explosion c. Pollution will impact uses of water in the downstream like water supply, fishing, ecosystem d. Injury
3	Function Failure	i) Structural Failure	Failure of structural strength for which it was designed. It will include incidents starting from development of cracks (difficult to detect) to actual disintegration of the structure	a. Impact on navigation b. Damage to vessel c. Injury to personal d. If the damage is on pipelines or gangway, this will impact transfer of cargo or passengers
		ii) Equipment Failure	Equipment failure refers to any event in which any equipment cannot accomplish its intended purpose or task. It may also mean that the equipment stopped working, is not performing as desired, or is not meeting target expectations	a. Depending on the function of the equipment the impact will be on that part of the operations like electrical substation failure would cause problem in operating transfer of cargo, communication system, RIS, emergency alarm systems b. Injury to personal c. Damage to cargo
4	Human related	Labor Action	Labor unrest like strike, demonstration	a. Difficulty in operations b. Injury to personal
		Civil Disturbance	Outside to IWAI agitation in society	a. Difficulty in operations b. Injury to personal

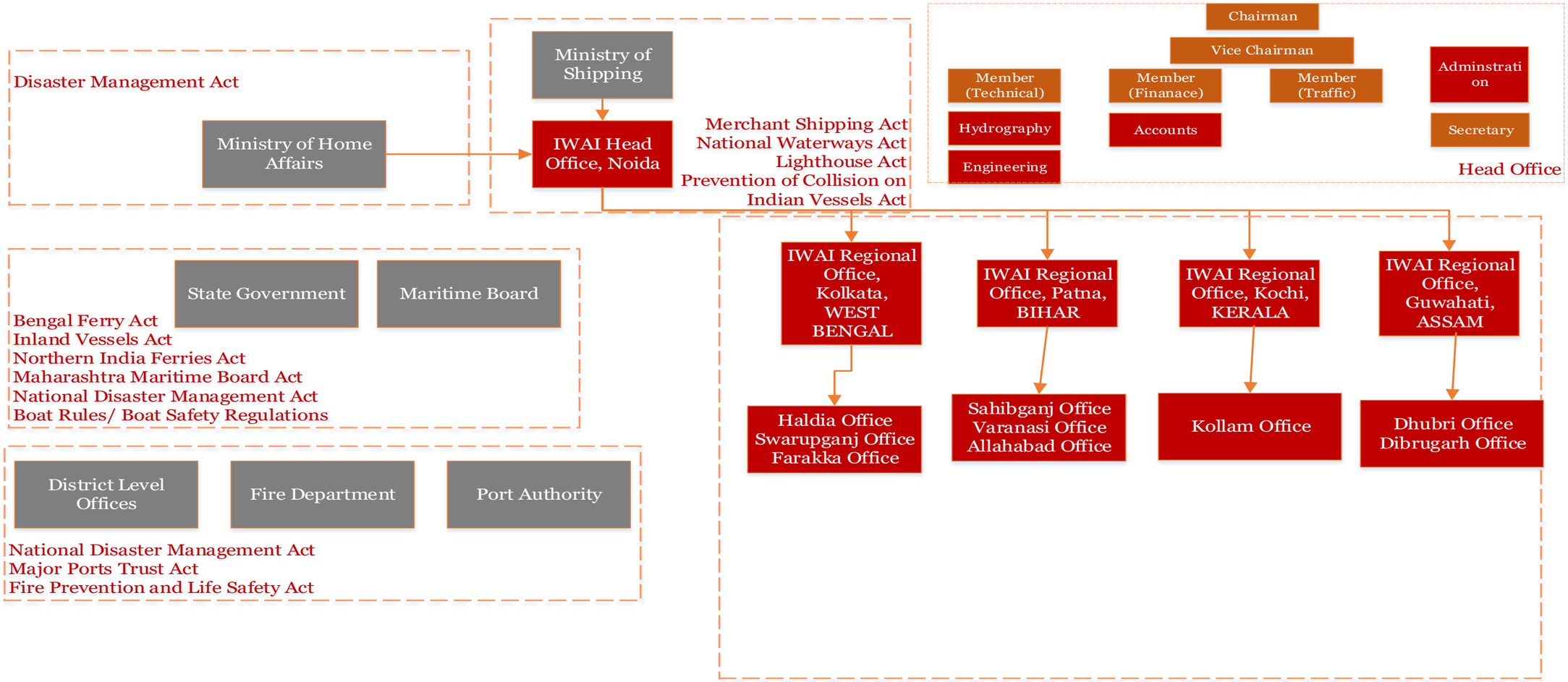
In section 3, of this document risk and vulnerability analysis of National Waterways and assets will be explained for the types of crisis mentioned above. Further, in section 4, crisis scenarios are developed based on occurrence of these crisis.

2. Existing Institutional and Legal Arrangements

2.1. Overview

IWAI was constituted under Inland Waterways Authority of India Act, 1985 for regulation and development of Inland Waterways for the purpose of shipping and navigation. It has its headquarters in Noida and Regional offices at Kolkata, Patna, Kochi and Guwahati, detailed organogram is provided under section 2.2 of this report. With the notification of the National Waterways Act 2016, 111 waterways have been declared as national waterways. All the national regulations applicable to Inland waterways are described under section 2.3. Whereas section 2.4 of this report outlines the Disaster Management Act 2005 and the institutional arrangement under the act.

2.2. IWAI organization structure and Institutional Arrangements



2.3. National Regulations applicable to Inland Waterways

1. The Inland Vessels Act, 1917 (as amended in 2007) & The Inland Vessels (Amendment) Act, 2007

An act to consolidate the enactments relating to Inland Vessels. The following are the chapters of this Act:

i. CHAPTER I: PRELIMNARY
ii. CHAPTER II: SURVEY OF INLAND MECHANICALLY PROPELLED VESSELS
iii. CHAPTER IIA: REGISTERATION OF INLAND MECHANICALLY PROPELLED VESSELS
iv. CHAPTER III: MASTERS AND ENGINEERS OF INLAND MECHANICALLY PROPELLED VESSELS
v. CHAPTER IV: INVESTIGATIONS INTO CASUALTIES
vi. CHAPTER IVA : REMOVAL OF OBSTRUCTIONS AND SIMILAR HAZARDS IN NAVIGATION
vii. CHAPTER V: SUSPENSION AND CANCELLATION OF CERTIFICATES GRANTED UNDER THE ACT
viii. CHAPTER VI: PROTECTION OF, AND CARRIAGE OF PASSENGER IN INLAND MECHANICALLY PROPELLED VESSELS
ix. CHAPTER VIA: INSURANCE OF MECHANICALLY PROPELLED VESSELS AGAINST THIRD PARTY RISKS
x. CHAPTER VIAB: PREVENTION AND CONTROL OF POLLUTION AND PROTECTION OF INLAND WATER
xi. CHAPTER VII: PENALTIES AND LEGAL PROCEEDINGS
xii. CHAPTER VIII: SUPPLEMENTAL

2. The Inland Waterways Authority of India Act, 1985

Act provide the constitution of an Authority for the regulation and development of inland waterways for the purposes of shipping and navigation and for the matters connected therewith or incidental thereto. The following are the chapters of this Act

i. CHAPTER I: PRELIMNARY
ii. CHAPTER II: INLAND WATERWAYS AUTHORITY OF INDIA
iii. CHAPTER III: PROPERTY AND CONTRACTS
iv. CHAPTER IV: FUNCTIONS AND POWER OF AUTHORITY
v. CHAPTER V: FINANCE, ACCOUNTS AND AUDIT
vi. CHAPTER VI: MISCELLANEOUS

3. The National Waterways Act, 2016

An Act to make provisions for existing national waterways and to provide for the declaration of certain inland waterways to be national waterways and also to provide for the regulation and development of the said waterways for the purpose of shipping and navigation and for matters connected therewith or incidental thereto.

i. CHAPTER I: PRELIMNARY
ii. CHAPTER II: INLAND WATERWAYS AUTHORITY OF INDIA
iii. CHAPTER III: PROPERTY AND CONTRACTS
iv. CHAPTER IV: FUNCTIONS AND POWER OF AUTHORITY
v. CHAPTER V: FINANCE, ACCOUNTS AND AUDIT
vi. CHAPTER VI: MISCELLANEOUS

4. The Bengal Ferry Act, 1885 and the Northern India Ferries Act, 1878

The act to regulate ferry in the states.

5. Multi Modal Transportation of Goods Act, 1993

The Act to provide for the regulation of the multimodal transportation of goods, from any place in India to a place outside India, based on a multimodal transport contract and for matters connected therewith.

i. CHAPTER I: PRELIMNARY
ii. CHAPTER II: REGULATION OF MULTIMODAL TRANSPORTATION
iii. CHAPTER III: MULTIMODAL TRANSPORT DOCUMENT
iv. CHAPTER IV: RESPONSIBILITIES AND LIABILITIES OF THE MULTIMODAL TRANSPORT OPERATOR
v. CHAPTER V: MISCELLANEOUS

6. Merchant Shipping Act. 1958

The Act provides regulations applicable to Indian mercantile vessel, which is registered in India including the territorial waters thereof. The act covers the Safety, Collisions, Accidents At Sea & Liability, and Prevention for Sailing Vessels, Fishing Boats and Nuclear Ships. It also cover the containment of pollution of the sea by oil. The following chapters of this Act details the prevention or mitigation measures

i. PART IX: Safety
ii. PART X: Collisions, Accidents At Sea & Liability
iii. PART XIA: Prevention And Containment Of Pollution Of The Sea BY OIL
iv. PART XIII: Wreck And Salvage
v. PART XV: Sailing Vessels
vi. PART XVA: Fishing Boats

7. The Lighthouse Act, 1927

The Act provides regulations on management of general lighthouses including light-vessel, fog signal, buoy, beacons, or any mark, sign or apparatus exhibited or used for the guidance of ships by the Central Government and delegation of management. Control of local lighthouses by the Central Government.

8. The Major Ports Act, 1908,

The Act applies to the major ports of Cochin, Kandla and Visakhapatnam and the Central Government may, by notification in the Official Gazette, apply2 the provisions of this Act to such other major port. The chapter V of this Act covers the works and services to be provided at ports.

9. The Indian Ports Act, 1908

This Act extends to the ports mentioned in the First Schedule, and to such parts of the navigable rivers and channels leading to such ports respectively as have been declared to be subject to Act XXII of 1855 (for the regulation of Ports and Port-dues) or to the Indian Ports Act, 1875. The following chapters of this Act details the prevention or mitigation measures

i. CHAPTER III: PORT-OFFICIALS AND THEIR POWERS AND DUTIES
ii. CHAPTER IV: RULES FOR THE SAFETY OF SHIPPING AND THE CONSERVATION OF PORTS
iii. CHAPTER V: PORT-DUES, FEES AND OTHER CHARGES

iv. CHAPTER VI: HOISTING SIGNALS
v. CHAPTER VIII: SUPPLEMENTAL PROVISIONS

10. Prevention of Collision on National Waterways Regulations, 2002

The following chapters of this Act details the prevention or mitigation measures

i. Chapter – II: STEERING AND SAILING RULES
ii. PART- I Conduct of vessels in any condition of visibility
iii. Chapter – II: PART- II Conduct of vessels in sight of one another
iv. Chapter – II: PART-III: Conduct of vessels in restricted visibility
v. Chapter – III; LIGHTS AND SHAPES
vi. Chapter – IV: SOUND AND LIGHT SIGNALS

11. The Inland Waterways Authority of India (Classification of Inland Waterways in India) Regulations, 2006.

Under the regulations, waterways are classified into 7 classes. It regulates horizontal and vertical clearances of bridges and other cross over structures across the NWs. It also categorizes the NWs for safe plying of self-propelled vessels up to 2000 tonne Dead Weight Tonnage and tug-barge formation in push-tow units of carrying capacity up to 8000 tonne.

12. The Inland Waterways Authority of India (National Waterway, Safety of Navigation and Shipping) Regulations, 2006.

The regulation for ensuring safety of navigation and shipping on the national waterways, following are the chapters included in it:

i. Chapter I: WATERWAYS AND SAFETY MEASURES ON WATERWAYS
ii. Chapter II: SAFETY OF VESSELS
iii. Chapter III: NAVIGATIONAL SAFETY AND THE RESPONSIBILITY OF THE MASTER AND THE OWNER
iv. Chapter IV: SUSPENSION, CANCELLATION AND APPEAL
v. Chapter V: PENALTIES AND LEGAL PROCEEDINGS
vi. Annexure I: MARKING OF THE WATERWAY
vii. Annexure II: SIGNS AND SIGNALS
viii. Annexure III: STORM WATER SIGNALS
ix. Annexure IV: DETAILS OF LIFE SAVING APPLIANCES TO BE CARRIED
x. Annexure V: SPECIFICATION OF LIFE SAVING APPLIANCES

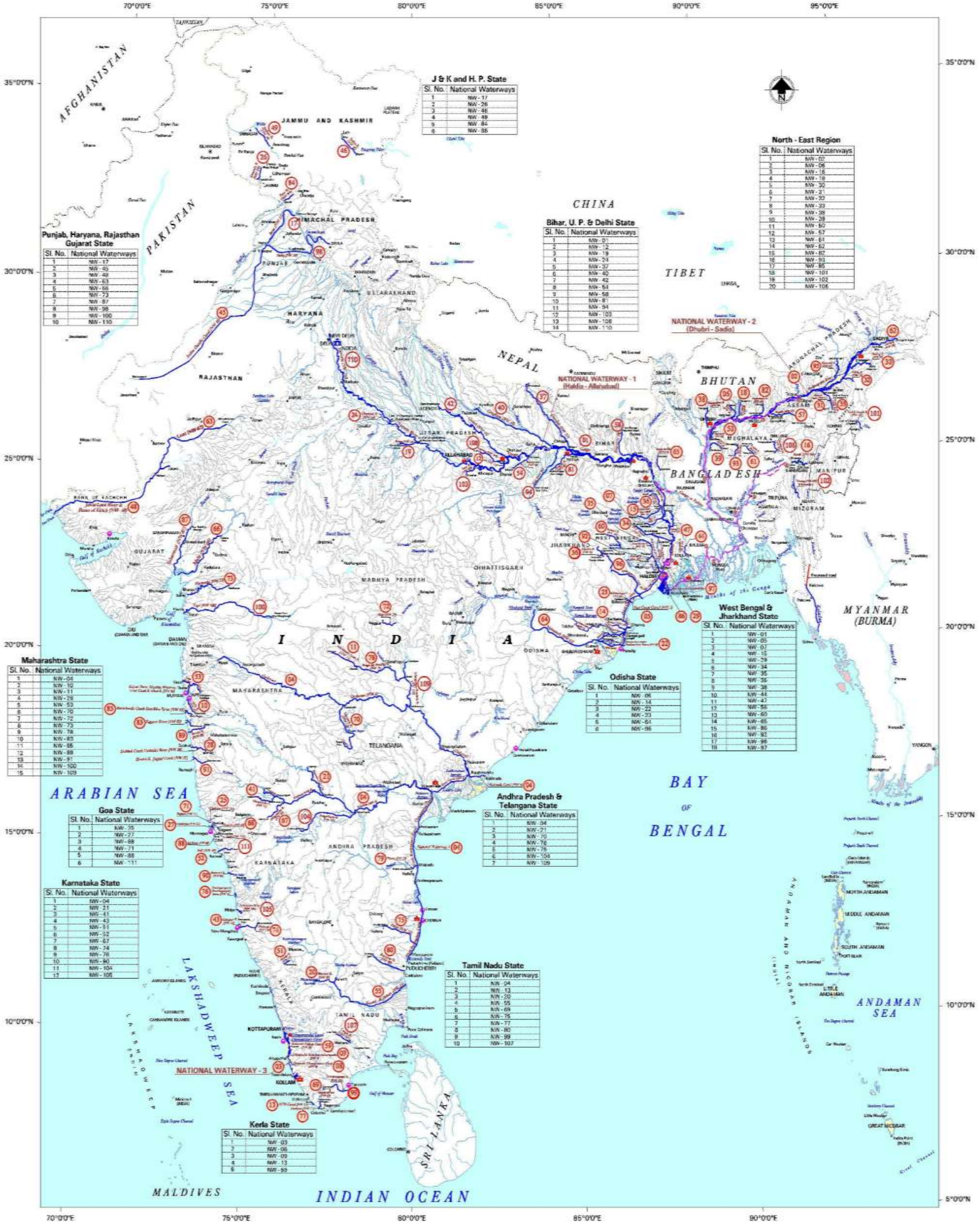


Figure 2: Map displaying the waterways of India

2.4. Disaster Management Act, 2005

The act defines disaster and disaster management. The overall coordination of disaster management vests with the Ministry of Home Affairs (MHA). The Cabinet Committee on Security (CCS) and the National Crisis Management Committee (NCMC) are the key committees involved in the top-level decision-making with regard to disaster management. The NDMA is the lead agency responsible for the preparation DM plans and the execution of DM functions at the national level. The figure 2.1 and 2.2 represents the institutional pathways for coordination, decision-making and communication for disaster management and does not imply any chain of command.

In most cases, state governments carry out disaster management with the central government playing a supporting role. The central agencies will participate only on the request from the state government. Within each state, there is a separate institutional framework for disaster management at the state-level. The DM Act of 2005 provides for the setting up of NDMA at national level, and, the SDMA at the state level. The role, composition and the role of the key decision making bodies for disaster management at national-level are briefly described in the Table 5. The extent of involvement of central agencies will depend on the type, scale, and administrative spread of the disaster. If the situation requires the direct assistance from central government or the deployment of central agencies, the central government will provide all necessary support irrespective of the classification of the disaster

The act provides institutional framework for managing disaster, which is outlined in the figure below:

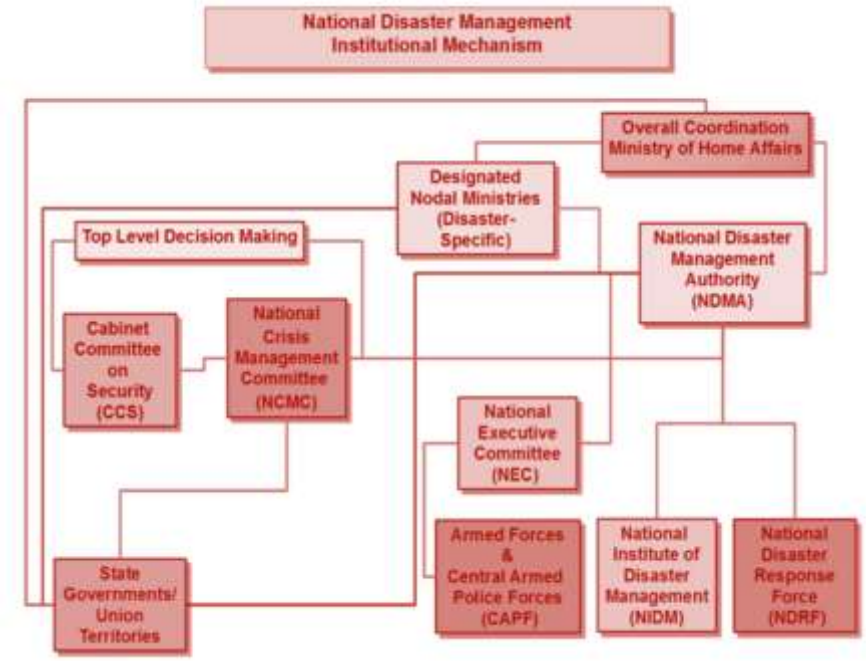


Figure 3: National Disaster Management Institutional Mechanism

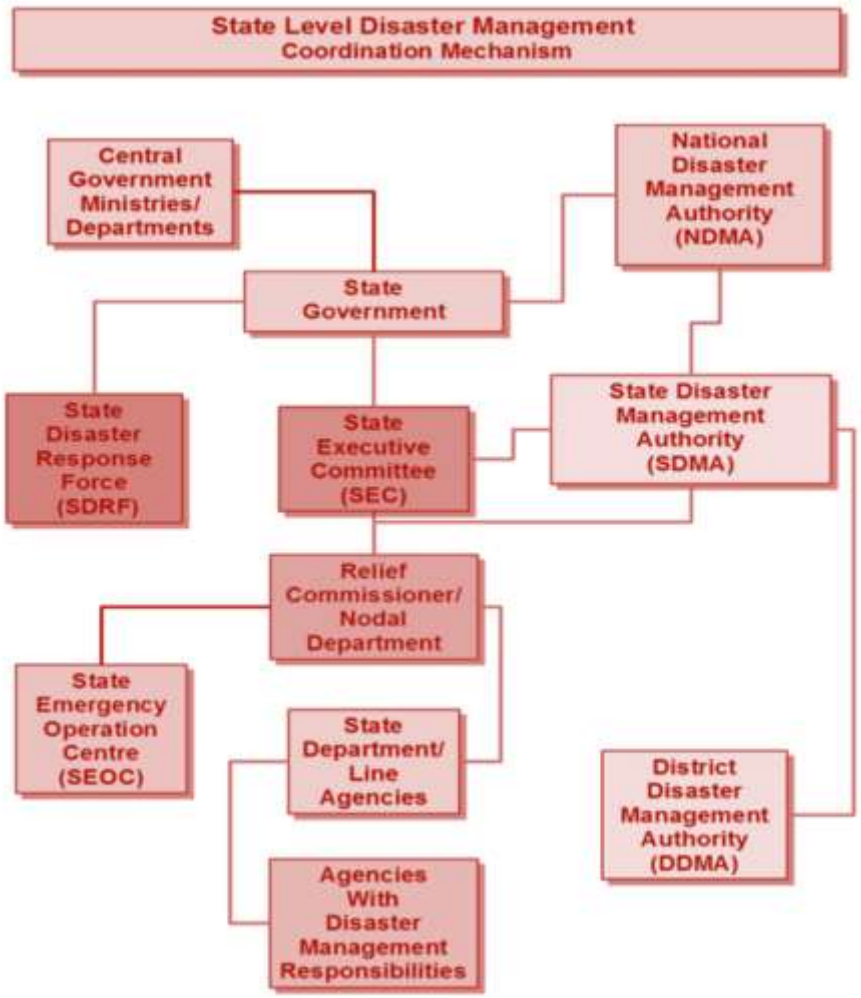


Figure 4: State Level disaster management institution

Institutional Framework under the Disaster Management Plan

Following table summarizes decision making bodies and the critical gaps in the crisis management on inland waterways:-

Table 5: Institutional framework under Disaster Management Plan

S. NO	Name	Vital Role
1	Cabinet Committee on Security (CCS)	i. Evaluation from a national security perspective, if an incident has potentially security implications ii. Oversee all aspects of preparedness, mitigation and management of Chemical, Biological, Radiological and Nuclear (CBRN) emergencies and of disasters with security implications iii. Review risks of CBRN emergencies from time to time, giving directions for measures considered necessary for disaster prevention, mitigation, preparedness and effective response
2	National Crisis Management Committee (NCMC)	i. Oversee the Command, Control and Coordination of the disaster response ii. Give direction to the Crisis Management Group as deemed necessary iii. Give direction for specific actions to face crisis situations
3	National Disaster Management Authority (NDMA)	i. Lay down policies, plans and guidelines for disaster management

		ii. iii. iv.	Coordinate their enforcement and implementation throughout the country Approve the NDMP and the DM plans of the respective Ministries and Departments of Government of India Lay down guidelines for disaster management to be followed by the different Central Ministries, Departments and the State Governments
4	National Executive Committee (NEC)	i. ii. iii. iv. v. vi. vii. viii. ix. x. xi. xii.	To assist the NDMA in the discharge of its functions Preparation of the National Plan Coordinate and monitor the implementation of the National Policy Monitor the implementation of the National Plan and the plans prepared by the Ministries or Departments of the Government of India Direct any department or agency of the Govt. to make available to the NDMA or SDMAs such men, 5material or resources as are available with it for the purpose of emergency response, rescue and relief Ensure compliance of the directions issued by the Central Government Coordinate response in the event of any threatening disaster situation or disaster Direct the relevant Ministries / Departments of the GoI, the State Governments and the SDMAs regarding measures to be taken in response to any specific threatening disaster situation or disaster. Coordinate with relevant Central Ministries/ Departments / Agencies which are expected to provide assistance to the affected State as per Standard Operating Procedures (SOPs) Coordinate with the Armed Forces, Central Armed Police Forces6 (CAPF), the National Disaster Response Force (NDRF) and other uniformed services which comprise the GoI's response to aid the State authorities Coordinate with India Meteorological Department (IMD) and a number of other specialized scientific institutions which constitute key early warning and monitoring agencies Coordinate with Civil Defense volunteers, home guards and fire services, through the relevant administrative departments of the State Governments
5	National Disaster Response Force (NDRF)	i. ii.	Provide assistance to the relevant State Government/District Administration in the event of an imminent hazard event or in its aftermath
6	National Institute of Disaster Management (NIDM)	i. ii. iii. iv. v. vi. vii.	Human resource development and capacity building for disaster management within the broad policies and guidelines laid down by the NDMA Design, develop and implement training programs Undertake research Formulate and implement a comprehensive human resource development plan Provide assistance in national policy formulation, assist other research and training institutes, state governments and other organizations for successfully discharging their responsibilities Develop educational materials for dissemination Promote awareness generation
7	State Disaster Management Authority (SDMA)	i. ii. iii.	Lay down policies and plans for DM in the State Prepare State Plan in accordance with the guidelines laid down by the NDMA Coordinate the implementation of the State Plan, recommend provision of funds for mitigation and preparedness measures and review the developmental plans of the different

			Departments of the State to ensure the integration of prevention, preparedness and mitigation measures
8	District Disaster Management Authority (DDMA)	i. ii.	Prepare District Plan in accordance with the guidelines laid down by the NDMA and SDMA Ensure that the guidelines for prevention, mitigation, preparedness, and response measures laid down by the NDMA and the SDMA are followed by all the district-level offices of the various departments of the State Government

While NDMA is responsible for assessing all the disasters, preparing disaster vulnerability maps and framing of guidelines, there are different ministries/ departments responsible for information gathering and dissemination of monitoring data. Following are the agencies with which IWAI needs to coordinate to get timely information about the crisis are as follows:

1. **Cyclone**: India Meteorological Department (IMD)
2. **Earthquake**: India Meteorological Department (IMD)
3. **Floods** Central Water Commission (CWC)
4. **Tsunami** India National Centre for Oceanic Information Services (INCOIS)
5. **Chemical (Industrial):** MoEFCC

2.5. Sendai Framework for Disaster Risk Reduction (2015-30)

Sendai Framework for Disaster Risk Reduction provides the way forward for the period 2015-30. As per the Sendai Framework, in order to reduce disaster risk, there is a need to address existing challenges and prepare for future ones by focusing on monitoring, assessing, and understanding disaster risk and sharing such information. The Sendai Framework notes that it is "urgent and critical to anticipate, plan for and reduce disaster risk" to cope with disaster. It requires the strengthening of disaster risk governance and coordination across various institutions and sectors. It requires the full and meaningful participation of relevant stakeholders at different levels. It is necessary to invest in the economic, social, health, cultural and educational resilience at all levels. It requires investments in research and the use of technology to enhance multi-hazard Early Warning Systems (EWS), preparedness, response, recovery, rehabilitation, and reconstruction.

The four priorities for action under the Sendai Framework are:

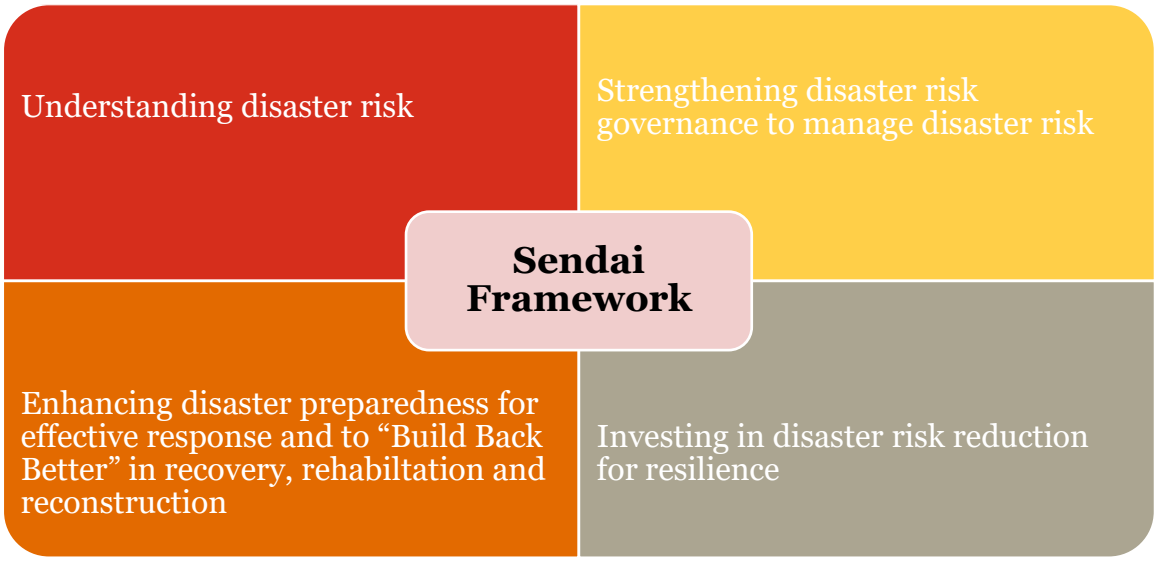


Figure 5: Sendai Framework

2.6. Integrating Sendai Framework, NDMP and SDMP into CMP

The CMP incorporates substantively the approach enunciated in the Sendai Framework and action plan from the NDMP and SDMP. The CMP has been aligned broadly with the goals and priorities set out in the Sendai Framework for crisis risk reduction. The framework states that to realize this outcome, it is necessary to prevent new and reduce existing crisis risk through the implementation of integrated and inclusive measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience. The incorporation of four priorities for action under the Sendai Framework into the NDMP is summarized in here for quick reference:

Table 6: Chapters that integrate the requirement of Sendai framework

Sendai Framework Priority area	CMP section
Understanding Crisis Risk	1.6, 3, 4
Strengthening disaster risk governance to manage disaster risk	5
Investing in disaster risk reduction for resilience	5
Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction	5

2.7. Critical assessment of current crisis management practice in IWAI

Institutional

1

- Doesn't have offices in many states where NWs are declared
- Yet to develop internal SOPs like distress alert, navigation etc.
- Yet to develop forms/ SOPs for cargo storage, transportation etc.

Infrastructure

2

- Doesn't have monitoring and control stations on most NWs
- RIS acts as information system but cannot be used for regulating traffic
- Doesn't have appropriate equipment to control crises like oil spillage, pollution etc.
- Doesn't have centralised resource database for registering crisis situation

Legal Framework

3

- Doesn't have regulation related to safety audits
- Prevention of pollution regulations don't cover the pollution caused by spillage or vessel incidents
- States have not implemented the Inland Vessels (Prevention and Control of Pollution and Protection of Inland Water) Rules, 2016

Coordination

4

- Lack of coordination for L3 disasters
- Lack of access to early warning and monitoring information from central agencies
- Integrate NDMP and SDMP with its development plan
- Coordinate with relevant departments in mobilizing critical resources to manage the crisis

3. Hazard Risk and Vulnerability Analysis

3.1. Overview covering National waterways, physical infrastructure and assets

Under National Waterway Act 2016, 111 National Waterways were declared which are as follows:

Table 6: Name of NWs and the states that it passes through

NW#	NW name	State
NW1	Allahabad-Haldia stretch of the Ganga-Bhagirathi-Hooghly Rivers	UP, Bihar, Jharkhand, West Bengal
NW2	Sadiya-Dhubri stretch of Brahmaputra River	Assam
NW3	Kollam-Kozhikode stretch of West Coast Canal and Champakara canal and Udyogmandal canal	Kerala
NW4	i. Kakinada-Puducherry stretch of canals and the Kaluvelly Tank. ii. (b) Nashik-Bhadrachalam-Rajahmundry stretch of Godavari River. iii. (c) The bridge near village Galagali-Wazirabad-Vijayawada stretch of Krishna River.	Tamil Nadu, Andhra Pradesh, Telangana
NW5	i. Talcher-Dhamra stretch of Brahmani River-Kharsua River-Tantighai River-Pandua Nala-Dudhei Nala-Kani Dhamra River. ii. Geonkhali-Charbatia stretch of East Coast Canal iii. Charbatia-Dhamra stretch of Matai River and Mahanadi Delta Rivers	Odisha, West Bengal
NW6	Aai River	Assam
NW7	Ajoy River	West Bengal
NW8	Alappuzha-Changanassery Canal	Kerala
NW9	Alappuzha-Kottayam-Athirampuzha Canal	Kerala
NW10	Amba River	Maharashtra
NW11	Arunavati River-Aran River	Maharashtra
NW12	Asi River	UP
NW13	AVM Canal	Kerala, Tamil Nadu
NW14	Baitarani River	Odisha
NW15	Bakreshwar River-Mayurakshi River	West Bengal
NW 16	Barak River	Assam
NW17	Beas River	HP & Punjab
NW18	Beki River	Assam
NW19	Betwa River	UP
NW20	Bhavani River	Tamil Nadu
NW21	Bhima River	Telangana & Karnataka
NW22	Birupa River-Badi River-Genguti River-Brahmani River	Odisha
NW23	Budhabalanga River	Odisha
NW24	Chambal River	UP
NW25	Chapora River	Goa

NW26	Chenab River	J&K & Punjab
NW27	Cumbarjua River	Goa
NW28	Dabhol creek-Vashishti River	Maharashtra
NW29	Damodar River	West Bengal
NW30	Dihing River	Assam
NW31	Dhansiri River-Chathe River	Assam
NW32	Dikhu River	Assam
NW33	Doyans River	Assam
NW34	DVC canal	West Bengal
NW35	Dwarakeswar River	West Bengal
NW36	Dwarka River	West Bengal
NW37	Gandak River	Bihar & UP
NW38	Gangadhar River	Assam & West Bengal
NW39	Ganol River	Meghalaya
NW40	Ghaghara River	Bihar & UP
NW41	Ghataprabha River	Karnataka
NW42	Gomti River	UP
NW43	Gurupura River	Karnataka
NW44	Ichamati River	West Bengal
NW45	Indira Gandhi Canal	Haryana, Punjab & Rajasthan
NW46	Indus River	J&K
NW47	Jalangi River	West Bengal
NW48	Jawai River-Luni River and Rann of Kutch	Rajasthan & Gujarat
NW49	Jhelum River	J&K
NW50	Jinjiram River	Meghalaya & Assam
NW51	Kabini River	Karnataka
NW52	Kali River	Karnataka
NW53	Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River	Maharashtra
NW54	Karmanasa River	UP & Bihar
NW55	Kaveri River-Kollidam River	Tamil Nadu
NW56	Kharkai River	Jharkhand
NW57	Kopili River	Assam
NW58	Kosi River	Bihar
NW59	Kottayam-Vaikom Canal	Kerala
NW60	Kumari River	West Bengal
NW61	Kumari River	Meghalaya
NW62	Lohit River	Assam
NW63	Luni River	Rajasthan
NW64	Mahanadi River	Odisha
NW65	Mahananda River	West Bengal
NW66	Mahi River	Gujarat
NW67	Malaprabha River	Karnataka
NW68	Mandovi River	Goa
NW69	Manimuthar River	Tamil Nadu
NW70	Manjara River	Maharashtra & Telangana

NW71	Mapusa River-Moide River	Goa
NW72	Nag River	Maharashtra
NW73	Narmada River	Gujarat
NW74	Netravati River	Karnataka
NW75	Palar River	Tamil Nadu
NW76	Panchagangavalli River (Panchagangoli)	Karnataka
NW77	Pazhyar River	Tamil Nadu
NW78	Painganga River-Wardha River	Maharashtra & Telangana
NW79	Penna River	Andhra Pradesh
NW80	Ponnaiyar River	Tamil Nadu
NW81	Punpun River	Bihar
NW82	Puthimari River	Assam
NW83	Rajpuri creek	Maharashtra
NW84	Ravi River	HP & J&K
NW85	Revdanda creek & Kundalika River	Maharashtra
NW86	Rupnarayan River	West Bengal
NW87	Sabarmati River	Gujarat
NW88	Sal River	Goa
NW89	Savitri River & Bankot creek	Maharashtra
NW90	Sharavati river	Karnataka
NW91	Shastri River-Jaigad Fort creek	Maharashtra
NW92	Shilabati River	West Bengal
NW93	Simsang River	Meghalaya
NW94	Son River	Bihar
NW95	Subansiri River	Assam
NW96	Subarnarekha River	Jharkhand, West Bengal & Odisha
NW97	Sunderbans waterways	West Bengal
NW98	Sutlej River	Punjab & HP
NW99	Thamirabarani River	Tamil Nadu
NW100	Tapi River	Maharashtra & Gujarat
NW101	Tizu River and Zungki River	Nagaland
NW102	Tlwang River	Mizoram
NW103	Tons River	UP
NW104	Tungabhadra River	Telangana, Karnataka & AP
NW105	Udayavara River	Karnataka
NW106	Umngot River	Meghalaya
NW107	Vaigai River	Tamil Nadu
NW108	Varuna River	UP
NW109	Wainganga River-Pranahita River	Maharashtra & Telangana
NW110	Yamuna River	Haryana, UP & Delhi
NW111	Zuari River	Goa

Table 7: List of existing and planned terminals

S.no	NW #	Name of Terminal	Terminal Type	State
1	1	Haldia	Floating Terminal	WB
2		Botanical Garden Jetty, Kolkata	Floating Terminal	WB
3		BISN Jetty & G.R. Jetty-1, Kolkata	Floating Terminal	WB
4		Tribeni	Floating Terminal	WB
		Shantipur	Floating Terminal	WB
5		Swaroopganj	Floating Terminal	WB
6		Kumarpur	Floating Terminal	WB
7		Pakur	Fixed Jetty	WB
8		Farakka	Floating Terminal, Fixed Jetty	WB
9		Manglahat	Floating terminal	WB
10		Sahibganj	Floating Terminal	Jharkhand
11		Manihari	Floating Terminal	Bihar
12		Bhagalpur	Floating Terminal	Bihar
13		Munger	Floating Terminal	Bihar
14		Hatidah	Floating Terminal	Bihar
15		Barh	Floating Terminal	Bihar
16		Patna Gaighat	Fixed RCC Jetty	Bihar
17		Ballia	Floating Terminal	Uttar Pradesh
18		Manjampur	Floating Terminal	Uttar Pradesh
19		Govindpur	Floating Terminal	Uttar Pradesh
20		Dharampur	Floating Terminal	Uttar Pradesh
21		Varanasi	Multi-modal station	Uttar Pradesh
22	2	Dhubri	Floating Terminal	Assam
23		Jogighopa	Floating Terminal (MMT)	Assam
24		Pandu	Floating Terminal	Assam
25		Amingaon	Floating Terminal (IMT with Ro-Ro)	Assam
26		Tejpur	Floating Terminal (IMT)	Assam
27		Biswnath Ghat	Floating Terminal (IMT)	Assam
28		Silghat	Floating Terminal (MMT)	Assam
29		Neamati	Floating Terminal (MMT with Ro-Ro)	Assam
30		Bogibil	Floating Terminal (MMT with Ro-Ro)	Assam
31		Dibrugarh	Floating Terminal	Assam
32		Sengajan/ Panbari	Floating Terminal	Assam
33		Karanchapari	Floating Terminal (IMT with Ro-Ro)	Assam
34		Oriumghat	Floating Terminal	Assam

Table 8: Vessels and equipment owned by IWAI

S.No	Type	Number
1	Cutter Suction Dredgers	14
2	Hydraulic Surface Dredger	3
3	Amphibian Dredger	3
4	Crane Pontoon	9
5	Work Boats/ Tugs	26
6	Survey Vessels/ Launches	18
7	Accommodation Boats/ House Boats	13
8	Anchor Pontoon	13
9	Patrol Boats/ Inspection Boats	7
10	Cargo Vessels	7

11	Ro-Ro Vessels	3
12	Floating Jetties/ Terminal Pontoons	38
13	Container Crane	2
14	Fork Lift	8
15	Mobile Hydraulic cranes	8
16	Shore Cranes	4

3.2. Overview of the other users of waterways

Traffic on the national waterways also comprises of vessels, boats or ferries other than the vessels that IWAI operates or monitors. This traffic also significantly increase risk of incidence of crisis because of its nature of operations and volume. The boats and ferries that ply on the waterways can be classified in following categories:

1. **Non- Mechanized:** are boats often referred to as country craft which have traditional gears. These are further classified into catarman, dugout-canoe, plank built canoes, masula boats, dhingi, outrigger canoes and built up boats. There are certain variations in design, which are named after maritime state like Coromandel type, Orissa or Ganjam type, Andhra or Visakhapatnam type. These boats do not come under purview of IWAI's regulations.
2. **Mechanized or mechanically propelled vessels:** these boats or ferries are either traditional non-mechanized crafts which are fitted with outboard motors or that are fitted with inboard vessels. Nowdays, most vessels are mechanically propelled. The size and design of the vessel depends upon the intended use of the vessel and local conditions. Like there are double or single hull ferry boats, flat bottom or keel barges, dol netters or gill netters fishing boats, water scooters or motor boats used for recreational purposes. There is variety of material used in constructing these vessels like wooden, metal, fiber glass reinforced polymer.

The local boats ply for shorter distances but greater in number or for crossing the channel to the opposite bank, are used for transporting passengers, vehicles, animals, cargo etc. Most of them register through state agencies and go through certification process. However, in very few places state agencies are able to keep vigilance on the safety equipment and load carried by them especially in case of country boats. Thereby have high chances of incidents. With increase in movement of heavy vessels with cargo, this unregulated traffic pose grave danger. It might also impede the flow of regular traffic for which IWAI is responsible.

In order to reduce these risks, IWAI has formulated regulations for safe navigation namely Prevention of collision on National Waterways Regulations, 2002 and National waterways, Safety of Navigation and shipping regulations, 2002, similarly states have also amended respective ferries acts to incorporate these safety norms and NIDM had issued boat safety regulations. However, local boats and ferries often flout the regulatory requirements. Dhubri ferry tragedy on Brahmaputra River in 2012 that accounted for the loss of over 250 lives is one such incident. IWAI can't control movement of this traffic directly, but with the help of state agencies (see Annexure 6) and certain preemptive measures can reduce occurrence of incidence and impact on its assets and waterways. Some of the pre-emptive measure are:

1. To conduct regular traffic study of all the National waterways which includes type of vessels plying on the waterway, their routes, volume, type of cargo transported and frequency
2. Analyzing factors that might lead to incidents like overloading, crossing of flow of traffic, coming closer to big vessel (in the wake) to catch fish, shifting of load (especially in case of animals)
3. Record cases of past incidences
4. Incorporating measures to prevent and manage accidents with boats and ferries while drafting individual waterway disaster management plan

5. All the fishing zones and ferry routes should be marked on the navigation charts.
6. There should be special training given to the drivers of these boats or ferries with the help of state agencies
7. There should be training on navigating in the busy and unregulated stretches for vessel operators and masters. The training should include knowledge of local practice and how to avoid incidents and altercations

3.3. Risk Mapping

As per ISO 31000 - Risk management "*risks affecting organizations can have consequences in terms of economic performance and professional reputation, as well as environmental, safety and societal outcomes. Therefore, managing risk effectively helps organizations to perform well in an environment full of uncertainty*".

For the hazard and vulnerability, the analysis we have adopted the **ISO 31010:2009 Risk Management Risk Assessment** techniques and developed a risk matrix based on the likelihood of crisis and the consequences. The response levels required for the crisis, have been derived from the risk matrix. The risk matrix can be used as a screening tool for identifying the risks leading to various crisis and to determine which risks need to be addressed first and help communicate a common understanding for qualitative levels of risks across the organization.

Consequences

The consequence of the crisis is classified into four levels (C1 to C4) based on the level of impact. To define the impact we have considered three factors namely personnel safety, environmental damage and economic impact (as shown in the table below).

Personal Safety: The consequence of the accidents caused by a crisis vary from minor injuries to multiple fatalities, which depends on the type of accidents. The seriousness of casualties and incidents have been considered for defining the consequence level.

Environmental Impact: The resulting environmental damage can be negligible as well as permanent loss of flora and fauna. The main parameters of environmental impact is the level of damage to the flora and fauna due to amount and type of cargo/fuel spill.

Economic Impact: There are direct and indirect economic impacts of the consequence based on the damage, liability and compensation. The economic impact of vessel may be due to traffic rerouting and/or reducing the speed in order to reduce the probability of vessel strikes or other negative impact to endangered marine species. It may be due to constraints and penalties from unexpected delays, in addition to the additional transit time cost.

Consequence		Personal Safety	Environmental Impact	Economic Impact
C1	Minor	Injuries requiring First- aid. Low-level physical effects. No medical Treatment.	Negligible, no loss of flora or fauna	Penalties due to unexpected delay, traffic re-routing, minor damage, possible water ingress (minor flooding)
C2	Moderate	Fatalities are less than 3 a, or human lives of this number are moderately threatened	Short term loss of flora and fauna	Cause damage to navigation or terminal operation facilities. Duration of channel or port interrupt is less than 4 or congestion of less than 6
C3	Major	Fatalities are more than 3 and less than 30, or human lives of this number are highly threatened	Long term loss of flora and fauna	Cause huge damage to navigation or terminal operation facilities. Duration of channel or port interrupt is more than 4 and less than 12 hours, or congestion of more than 6 and less than 24 hours
C4	Catastrophic	Fatalities are more than 30 or human lives of this number are severely threatened	Permanent loss of flora and fauna	Cause extreme damage to navigation or terminal operation facilities. Cause 12 hours' interrupt or 24 hours' congestion for the channel or terminal(Port)

Figure 6: The classification of the consequence based on personal safety, environmental impact and economic impact

Likelihood

The classification of likelihood depends on various factors. To evaluate the likelihood of vessel collision, we have considered four factors and classified them into four levels (L1 to L4). The factors are technical hazard due to technological disruption, hydro meteorological and geographic hazard, human error, traffic and operational area hazard. Although, the likelihood also depends on the vessel type (for example a study in Japan indicated that the fishing vessels have high likelihood of accidents compared to other passenger ship or cargos), we have ignored the factor, as the data for vessel collision in India is unavailable

Technical Hazard: Technological hazards are generally considered a subset of man-made hazards. Although the level of susceptibility of a certain ship type relating kind of technological disruption is different, the likelihood depends on all the components in complex socio-technical systems, which promote errors and accidents. For example, poor ergonomics of equipment design technical error in optimal design speed etc.

Hydro, meteorological and geographic hazard: The likelihood varies both with geographic location and with time, reflecting the intensity of maritime traffic during different periods. Hence, we have considered geographic hazard as an indicator. The regime of the river changes from season to season. In addition, the likelihood depends on the hydro meteorological hazard. During the monsoon, the width of the waterways increases to several kilometers but navigable channel is still generally narrow and it can be stuck whereas during flash floods there is sudden surge in water, which can imbalance a vessel. The level of likelihood also varies from cyclones, gusty winds & heavy

rainfalls. In case of inclement weather, strong wind creates pressure on lateral area of superstructure or lateral area of the vessel exposed to the weather, which tends to incline the vessel.

Human Error: It can another subset of human-induced hazards (which is defined as those "induced entirely or predominantly by human activities and choices". The major cause of human errors leading to crisis situations are error in control operation and errors due to failed communication. For example a study in Bangladesh, revealed that the majority of vessels plying the rivers do not have fitness certificates or route permits. Sometimes, the passenger vessel owners tend to overload by doubling or tripling the actual carrying capacity of their vessels, which causes the vessel unstable. A safe design of the vessel is prerequisite for the stability of the vessel. If a vessel inclines up to a certain angle (angle of vanishing stability), then it will not to be able to return of its upright condition thus it will incline more and losses its stability.

Traffic and Operational Area Hazard: The probability of incidents also increases with the increase of the traffic volume. Almost all material from terminal approach channel related maintenance dredging is relocated to offshore material placement areas. In many cases maintenance dredged material is high in silt and clay content, increasing turbidity of water, which leads to accidents.

LIKELIHOOD		Based on the data collected
L1	Highly probable	This is likely to occur in most circumstances
L2	Often	Most likely to occur in next 1 to 2 years
L3	Rare	Most likely to occur in next 2 to 5 years
L4	Never	Most likely to occur once in next 25 years

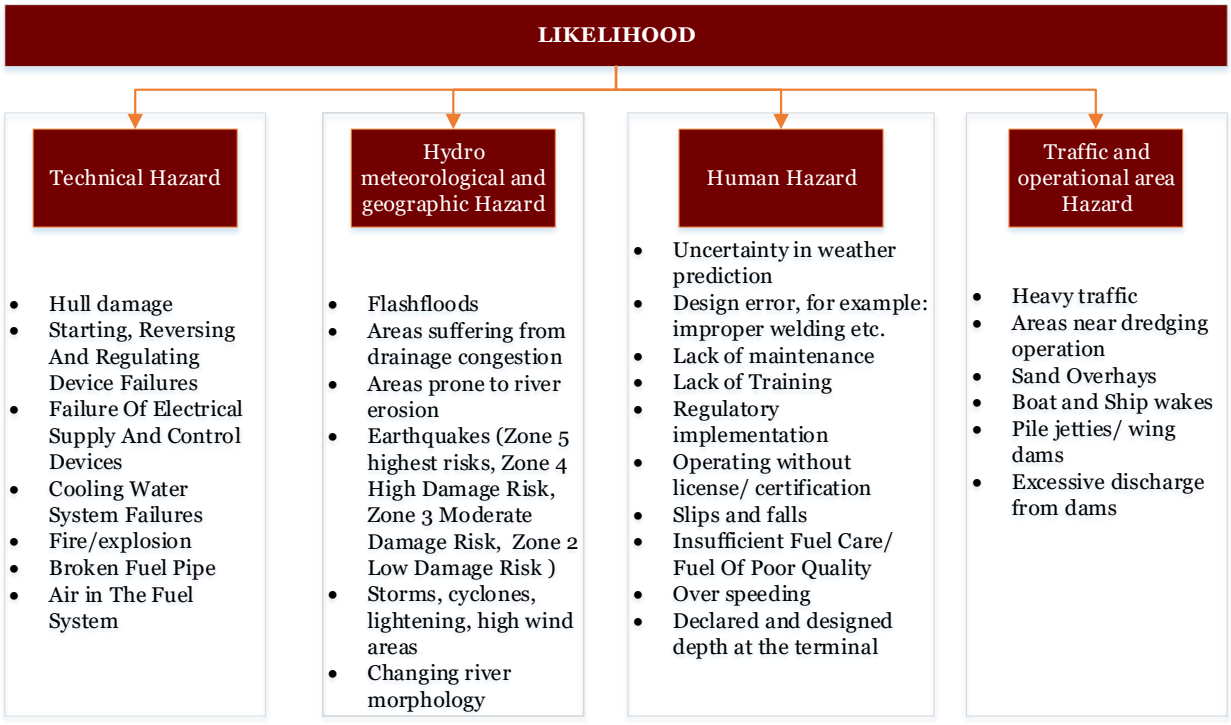


Figure 7: Classification of likelihood based on technical hazard, hydro meteorological and geographic hazard, human hazard and traffic & operational area hazard

Risk Matrix

The response level required for a risk matrix calculated based on likelihood and consequence of a crisis. The response levels have been classified as: Manageable (R1), Assistance required from local/

district authorities (R2), assistance required from State authorities (R3), assistance required from National authorities (R4).

The crisis management and its planning at various tiers must take into account the vulnerability of crisis-affected area, and the capacity of the local offices to deal with the situation. Using this approach, crisis can be classified basis the capacity of the offices and the coordination required from outside agencies

Level-R1: The level of crisis that is manageable by self-administration with the resources present.

Level- R2: The level of crisis that can be managed within the capabilities and resources at the Regional Office level. However, the Head Office and State administration will remain in readiness to provide assistance, if needed.

Level- R3: This signifies the crises that require assistance and active mobilization of resources at the Head Office level and deployment of State level agencies for crisis management. The Central agencies must remain vigilant for immediate deployment, if required by IWAI.

Level- R4: This corresponds to a nearly catastrophic situation or a very large-scale crisis that overwhelms the state administration and IWAI headquarters.

L1	R1	R2	R3	R4
L2	R1	R2	R3	R4
L3	R1	R2	R2	R4
L4	R1	R1	R1	R1
Likelihood / Consequence Level	C1	C2	C3	C4

RESPONSE LEVEL	
R1	Manageable by self-administration
R2	Regional Office level
R3	Coordination between the state level authorities and the district authorities
R4	IWAI headquarter and national authorities

Figure 8: Risk Matrix with authorization and escalation table

NOTE: The likelihood and consequence has been developed from the literature review of the data available of different countries and ports. The likelihood and consequence, and the associated risk might vary for the one waterway to another.

4. Review of crisis scenarios with possible triggers

4.1. Crisis Scenarios

In this section, we reviewed the consequence and likelihood of crisis mentioned in section 1.6 basis the vulnerable areas at Terminal, waterways and in vessels. Each cell depicts Response level based on the risk matrix (section 3.2) based on evaluation of intensity of consequence shown in yellow shades and likelihood in red shade. Crisis situations are broadly categorised between natural and human induced. The table below shows the crisis scenario with consequence, likelihood and response level required:

C1 **C2** **C3** **C4** **Consequence:**

L4 **L3** **L2** **L1** **Likelihood:**

Vulnerable Areas	Crisis Scenarios						
	Natural Disasters			**Human induced**			
	Geophysical Earthquake Tsunami	**Hydrological** Flood	**Meteorological** Cyclone & Storm Surge Fog, frost and hail Sand storm Lightening	**Vessel Accident** Collision Grounding Problem in Navigation Fire/ Explosion Capsizing	**Pollution** Cargo leakage/ spillage Oil Spill	**Function Failure** Structural Failure Equipment failure (Power, Transport Communication Infrastructure)	**Human Related** Labour Strike Civil disobedience Terrorism Cyber Threat
TERMINAL							
Approach Channel	R1	R1	R1	R1	R2		
Turning Basin	R1	R1	R1	R1	R2		
Berths	R1	R1	R1	R1	R2	R1	
Jetty	R1	R1	R1	R1	R2	R1	
Gangway	R1	R1	R1	R1			
Weigh Bridge	R1	R1	R1	R1			

Storage Area	R2	R2	R2		R2	R2	R4
Material handling equipment (Forklift, Mobile Harbour cranes etc.)	R1	R1	R1		R1	R1	R4
Oil Pipelines	R1	R2	R2		R2	R1	R4
Bulk Cargo Conveyor system	R1	R1	R1		R1	R1	R4
Buildings	R1	R1	R1		R2	R1	R1
Control Room	R1	R1	R1			R1	R1
Radar, Signal and Communication system	R1	R1	R3			R1	R4
Emergency services like firefighting facilities	R2	R1	R3		R2	R1	R4
Electric Substations	R1	R1	R1			R1	R2
Terminal tugs, crafts etc.	R1	R2	R2			R1	R2
Navigational aids	R1	R1	R1			R1	
Waterways							
Navigation Channel	R1	R1	R3	R3	R3		
Navigational aids	R1	R1	R1	R1			
Bank protection	R1	R1	R1	R1			
Floating jetty/ pontoon	R1	R1	R1	R1		R1	
Vessel							
Overall design and construction standard	R1	R1	R1	R2	R2		

Propulsion equipment and system	R1	R1	R2	R2	R2		
Navigational equipment and aids	R1	R1	R2	R2	R2		
Navigational safety	R1	R1	R2	R2	R2		
Life Saving equipment	R1	R1	R1	R2	R2		
Fire Safety equipment	R1	R1	R1	R2	R2		

Table 8: Crisis Scenario for IWIA

4.2. Possible triggers for human induced crisis

Table 9: Possible Triggers for crisis incidents

Human Error		***Poor Education and Training***		***Inadequate policies and procedures***		***External Factors***		***Technical Factors***	
H1	Lack of maintenance	**E1**	Lack of training of equipment	**P1**	Lack of regulatory implementation	**F1**	Heavy rainfall/ Flashfloods	**T1**	Problem in design
H2	Slips and falls/ Improper lookout/ Falling asleep/ ineffective presence at work shifts	**E2**	Poor communication between crew members	**P2**	Lack of certification	**F2**	Areas with drainage congestion	**T2**	Hull damage
H3	Over speeding/ Unsafe speed	**E3**	Fatigue due to improper use of PPE's	**P3**	Dissonance between work practice and written procedures	**F3**	Storms/Surges/Bores	**T3**	Insufficient fuel
H4	Starting the vessel	**E4**	Crew stress by company's pressure	**P4**	Faulty procedures being followed	**F4**	Cyclones/Tsunami	**T4**	Poor quality fuel
H5	Ignorance of navigation signals	**E5**	Faulty standards being followed/ Violation of rules	**P5**	Failure of watch arrangements	**F5**	High/Gusty wind	**T5**	Automation error
H6	Decision based on incomplete information/ Inappropriate route selection	**E6**	Inadequate knowledge of vessel's information	**P6**	Overloading of vessels	**F6**	Lightening/ Cloudbursts	**T6**	Signal arrow
H7	Hazardous working environment	**E7**	Interpretation error			**F7**	Landsides/ Tectonic plate movement	**T7**	Vessel engine failure
H8	Overloading/ Lack of tightening of load	**E8**	Outdated River Charts/Pilots /Faulty passage plan					**T8**	Drifting of buoys/Navigational Marks
H9	Faulty maneuvering	**E9**	Deficiency in safety management system					**T9**	Unmarked bridge supports
H10	Improper communication between cross structure and vessel	**E10**	Lack of emergency drills					**T10**	Failure of radar/Echo sounder/DGPS
H11	Using the vessel in the conditions it is not designed for							**T11**	Poor Quality construction standard
H12	Using the vessel even after expiry of fitness certificate							**T12**	Not conducting thorough inspection while giving fitness certificate

Mapping of possible triggers with crisis

Table 10: mapping the possible triggers with crisis

Event/ Spectrum / Scenario	Possible Triggers				
	Human Error	*Poor Education and Training*	*Inadequate policies and procedures*	*External Factors*	*Technical Factors*
Natural Disasters					
Geophysical- Earthquake				F7- Landsides/ Tectonic plate movement	
Hydrological -Flood				F1- Heavy rainfall/ Flashfloods	
Meteorological – Storm, lightening etc.				F3- Storms/Surges/Bores F4- Cyclones/Tsunami F5- High/Gusty wind F6- Lightening/Cloudbursts	
Human Induced Crisis					
Collision	H2- Slips and falls/ Improper lookout/ Falling asleep/ ineffective presence at work shifts H3- Over speeding/ Unsafe speed H6- Decision based on incomplete information/ Inappropriate route selection H9- Faulty maneuvering H10- Improper	E1- Lack of training of equipment E2- Poor communication between crew members E3- Fatigue due to improper use of PPE's E7- Interpretation error E8- Faulty passage plan	P1- Lack of regulatory implementation P3- dissonance between work practice and written procedures P4 - Faulty procedures being followed P5- Failure of watch arrangements	F3- Storms/Surges/Bores F4- Cyclones/Tsunami F5- High/Gusty wind F7- Landsides/ Tectonic plate movement	T1- Problem in design T2- Hull damage T5- High/Gusty wind T6- Lightening/Cloudbursts T7- Landsides/ Tectonic plate movement T11: Poor Quality construction standard T12: Not conducting thorough inspection while giving fitness certificate

Event/ Spectrum / Scenario	Possible Triggers				
	Human Error	*Poor Education and Training*	*Inadequate policies and procedures*	*External Factors*	*Technical Factors*
	communication between cross structure and vessel H11: Using the vessel in the conditions it is not designed for H12: Using the vessel even after expiry of fitness certificate				
Grounding	H2- Slips and falls/ Improper lookout/ Falling asleep/ ineffective presence at work shifts H3- Over speeding/ Unsafe speed H8- Overloading/ Lack of tightening of load H10- Improper communication between cross structure and vessel H11: Using the vessel in the conditions it is not designed for	E1- Lack of training of equipment E2- Poor communication between crew members E3- Fatigue due to improper use of PPE's E7- Interpretation error E8- Outdated River Charts/Pilots/Faulty passage plan	P3- dissonance between work practice and written procedures P4 - Faulty procedures being followed P6- Overloading of ships	F2- Areas with drainage congestion F7- Landsides/ Tectonic plate movement	T3- Insufficient fuel T7- Vessel engine failure T8: Drifting of buoys/Navigational Marks T10- Failure of radar/Echo sounder/DGPS

Event/ Spectrum / Scenario	Possible Triggers				
	Human Error	*Poor Education and Training*	*Inadequate policies and procedures*	*External Factors*	*Technical Factors*
Fire/Explosion	H1- Lack of maintenance H2- Slips and falls/ Improper lookout/ Falling asleep/ ineffective presence at work shifts H6- Decision based on incomplete information/ Inappropriate route selection H7- Hazardous working environment	E1- Lack of training of equipment E3- Fatigue due to improper use of PPE's E5 - Faulty standards being followed/ Violation of rules E6 - Inadequate knowledge of vessel's information E9 - Deficiency in safety management system E10- Lack of emergency drills	P3- dissonance between work practice and written procedures P4 - Faulty procedures being followed P5- Failure of watch arrangements	F3- Storms/Surges/Bores F4- Cyclones/Tsunami F6- Lightening/Cloudbursts	T1- Design Error T4- Poor quality fuel
Problem in Navigation	H2- Slips and falls/ Improper lookout/ Falling asleep/ ineffective presence at work shifts H5- Ignorance of navigation signals H6- Decision based on incomplete information/ Inappropriate route selection H10- Improper communication between cross structure and vessel	E1- Lack of training of equipment E2- Poor communication between crew members E7- Interpretation error E8- Faulty passage plan/River Charts not updated/corrected	P4 - Faulty procedures being followed P5- Failure of watch arrangements P6- Overloading of vessels	F1- Heavy rainfall/ Flashfloods F2- Areas with drainage congestion F3- Storms/Surges/Bores F4- Cyclones/Tsunami F5- High/Gusty wind F6- Lightening/Cloudbursts F7- Landsides/ Tectonic Plate movement	T6- Signal arrow T8- Drifting of buoys/Navigational Marks T9- Unmarked bridge supports T10- Failure of radar/Echo sounder/DGPS

Event/ Spectrum / Scenario	Possible Triggers				
	Human Error	*Poor Education and Training*	*Inadequate policies and procedures*	*External Factors*	*Technical Factors*
Cargo leakage/ Spillage	H3- Over speeding/ Unsafe speed H8- Position fixing/ Lack of tightening of load H9- Faulty maneuvering	E3- Fatigue due to improper use of PPE's E5 - Faulty standards being followed/ Violation of rules E6 - Inadequate knowledge of vessel's information	P3- dissonance between work practice and written procedures P4 - Faulty procedures being followed P6- Overloading of Vessels	F1- Heavy rainfall/ Flashfloods F3- Storms/Surges/Bores F4- Cyclones/Tsunami F5- High/Gusty wind F6- Lightening/Cloudbursts	T1- Design Error T2- Hull damage T5- High/Gusty wind T11: Poor Quality construction standard T12: Not conducting thorough inspection while giving fitness certificate
Oil Spill	H3- Over speeding/ Unsafe speed H8- Position fixing/ Lack of tightening of load H9- Faulty maneuvering	E3- Fatigue due to improper use of PPE's E5 - Faulty standards being followed/ Violation of rules E6 - Inadequate knowledge of vessel's information	P3- Dissonance between work practice and written procedures P4 - Faulty procedures being followed	F1- Heavy rainfall/ Flashfloods F3- Storms/Surges/Bores F4- Cyclones/Tsunami F5- High/Gusty wind F6- Lightening/Cloudbursts	T1- Design Error T2- Hull damage T11: Poor Quality construction standard T12: Not conducting thorough inspection while giving fitness certificate
Structural Failure	H1- Lack of maintenance	E5 - Faulty standards being followed/ Violation of rules E9 - Deficiency in safety management system	P1- Lack of regulatory implementation	F1- Heavy rainfall/ Flashfloods F2- Areas with drainage congestion F3- Storms/Surges/Bores F4- Cyclones/Tsunami F5- High/Gusty wind F6- Lightening/Cloudbursts F7- Landsides/ Tectonic plate movement	T8- off station buoys T9- Unmarked bridge supports

Event/ Spectrum / Scenario	Possible Triggers				
	Human Error	*Poor Education and Training*	*Inadequate policies and procedures*	*External Factors*	*Technical Factors*
Equipment Failure (Evacuation routes/ Fire Alarm/ Fire Station Communication system)	H1- Lack of maintenance	E5 - Faulty standards being followed/ Violation of rules E6 - Inadequate knowledge of vessel's information E9 - Deficiency in safety management system	P2- Lack of certification	F1- Heavy rainfall/ Flashfloods F3- Storms/Surges/Bores F4- Cyclones/Tsunami F5- High/Gusty wind F6- Lightening/Cloudbursts	T1- Design Error T4- Poor quality fuel T5- High/Gusty wind
Labor Action/Strike	H6- Decision based on incomplete information/ Inappropriate route selection H7- Hazardous working environment		P1- Lack of regulatory implementation		
Civil disturbance	H6- Decision based on incomplete information/ Inappropriate route selection H7- Hazardous working environment				
Terrorism	H6- Decision based on incomplete information/ Inappropriate route selection H7- Hazardous working environment				

Event/ Spectrum / Scenario	Possible Triggers				
	Human Error	*Poor Education and Training*	*Inadequate policies and procedures*	*External Factors*	*Technical Factors*
Cyber Threat	H2- Slips and falls/ Improper lookout/ Falling asleep/ ineffective presence at work shifts	E9- Deficiency in safety management system	P1- Lack of regulatory implementation P2- Lack of certification		

5. Prevention, Preparedness and Response Plan

Background

This chapter provides the preventive and response plans along with forecasting and early warning systems, roles and responsibilities during the crisis situation and trainings required for IWAI for different types of crisis arising due to natural and man-made disasters. The following have been described for each type of risk (section 5.2 to section 5.8)

i. **Prevention and Preparedness:** For appropriate prevention and preparedness measures the different types of early warning system, data required and the agency that provides data along with coordination agency for communicating warning has been covered.
ii. **Infrastructure required:** It also describes infrastructure design required with description on the type of impact due to a crisis situation at IWAI, impact area and design consideration.
iii. **Equipment required:** Existing Navigation Rules, critical gaps in the rules and recommended amendments/ rules/ practices. As per the precautions to be taken, the type of equipment and signal system which should be available, the impact area, and the type of warning signal/ communication.
iv. **Response Plan**: This describes immediate action, initial response to be taken by the command center, secondary response by the support team and the further response by the engineers/ survey team, on site action group, external action group.

Natural Disasters

5.1.1. Geophysical (Earthquake & Tsunami)

India's high earthquake risk and vulnerability is evident from the fact that about 59% of India's land area could face moderate to severe earthquakes. Seismic Zones are classified into **Four** zones (as recommended in IS 1897 – 1984)

i. **Zone II: Least active**

ii. **Zone III: Moderate**

iii. **Zone IV: High**

iv. **Zone V: Highest**

Impact of earthquake will depend on the magnitude. Terminal operations and structures are at the greatest risk of damage; it can trigger fires in storage area, weaken foundations of terminal buildings, topple lifting equipment, damage jetties etc. Similarly, on waterways, damaged building material might flow to waterway and increase silt and debris or damage crossover structures like bridges as summarized in section 4.1.

Whereas there is very limited damage caused by Tsunami on inland waterways, yet there could be surge of water and debris from sea, which can interrupt operations. The crisis response plan for impact caused by Tsunami is similar to flood which is covered under section 5.3.

In this section, measures are mentioned which will minimize the impacts of earthquake and how IWAI should respond at the time of occurrence of earthquake.

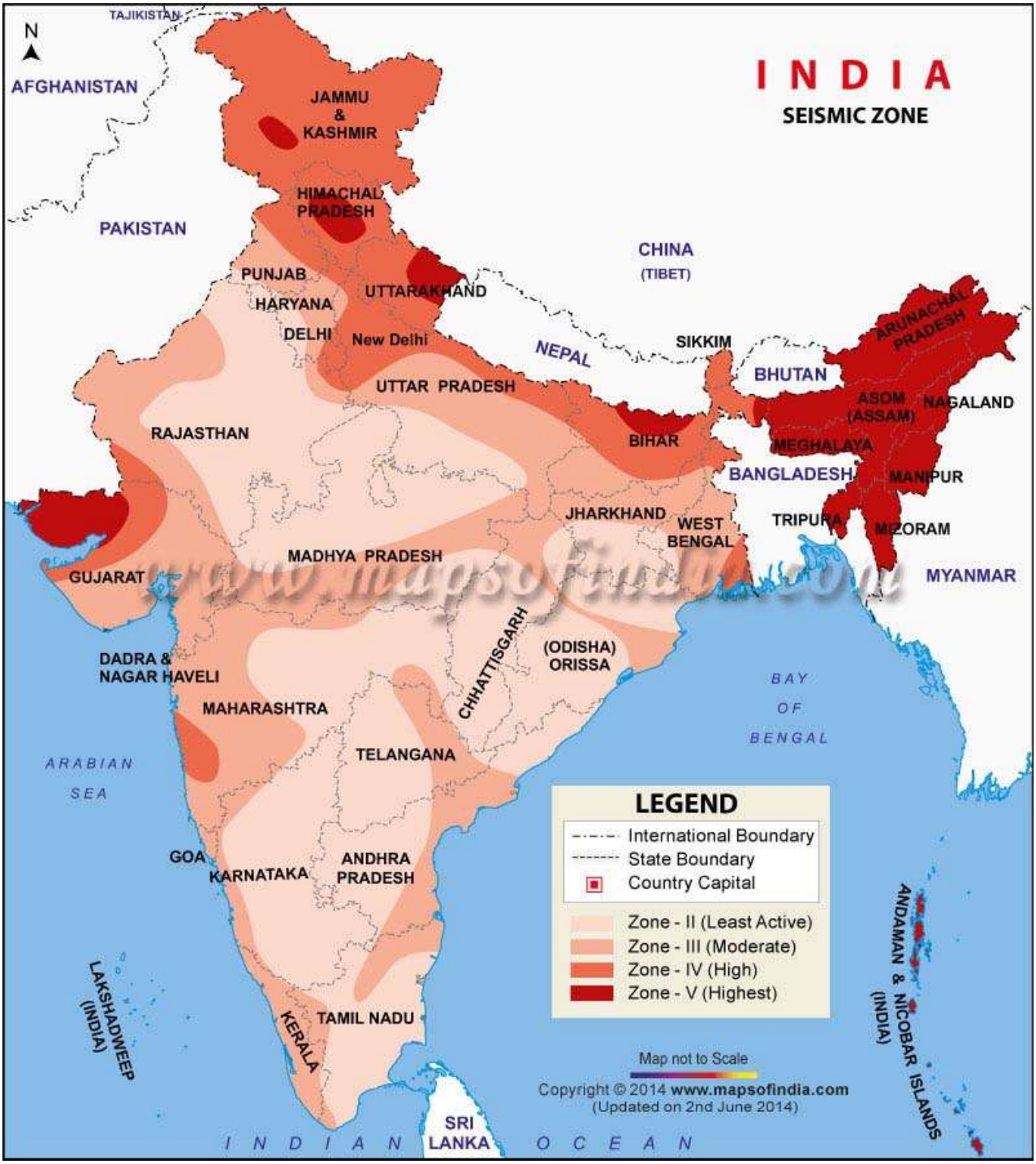


Figure 9: Earthquake Hazard Map

5.1.1.1. Prevention and Preparedness measures

a) Early warning system

S.no	Data required	Agency to provide data	Coordination agency for communicating warning
1	Seismic Zones corresponding to all Waterways and terminals	Ministry of Earth Sciences	Coordinate with MoES, IMD and National Centre for Seismology to get information on seismic zones and corresponding design codes (IS, BIS, IRC) to be followed
2	Magnitude of Earthquake	India Meteorological Department	Regular Earthquake predictions from IMD, INCOIS and Indian Navy Hydrographic department. Coordinate with corresponding District authorities at the time of earthquake: i. District Collector office ii. Electricity office iii. Fire department iv. District Emergency Operation Center v. Nearest Health Centers vi. SDRF (in case of alert is of > VI magnitude) At the time of any warning from IMD, IWAI should get prediction update in every 5-8 hour interval.
3	Location and distance from epicenter	India Meteorological Department	Prediction of epicenter by IMD, this will impact magnitude and damage caused.

b) Infrastructure design required

S.no	Impact	Impact area	Design Consideration	Precautions to be taken
1	Fire	Terminal Cargo Storage Units	i. IITK-GSDMA Guidelines for seismic design of liquid storage tanks ii. Installation of smoke detector, foam based fire extinguishers and fire exits iii. Install fire alarms which are connected to emergency control room and nearby fire station iv. Way to fire exits is marked v. Storage area is distant from other buildings vi. Fire hose (adjacent buildings) vii. Fire hydrant booster viii. Sprinkler system in buildings	i. First Aid for burn injury ii. Regular Mock Fire drills are conducted iii. All the Firefighting equipment must be maintained regularly iv. Staff trained on using Firefighting equipment v. Closure of area in case of fire vi. Staff must know local fire department emergency number vii. Fire station should be alert 24*7

			ix. Have secondary power supply for emergency response equipment	
2	Weakening foundations	Port Administration Buildings, Port Control room, Terminal storage units	BIS codes for design: IS 1893(Part 1):2002 - General provisions and Buildings, IS 4326: Earthquake Resistant Construction, IS 13920: Ductile Detailing of RCC Structures, IS 13935: Seismic Strengthening of structures Designate staff responsible for safe evacuation in each building	i. Direct staff to the safety exit at terminals and stand in assembly area ii. Train staff that if inside a building and not able to exit, move under the sturdy table or desk iii. Regular earthquake drills and emergency evacuation drill must be conducted iv. Inspection of all the buildings before starting the use again v. All types cracks be reported and analyzed further vi. Operating equipment should be automatically or manually shut down
3	Increase silt and debris in waterways	Navigation Channel, bank protection, water structures	IS 1893(Part 5):2002 - Dams and embankments	i. Issue advisor through RIS ii. Survey of navigation channel and reporting of debris to nearby districts and vessels iii. Salvage operations for debris
4	Weakening of structural strength	Jetties, berths, Gangway, water structures	All the structures should include loads caused by earthquake motion	i. Vessels should not be anchored ii. Vessels should not go anywhere near to cross-over structures iii. Material handling operations should be stopped iv. Determine the hazard potential of the terminal structures v. All types of fissures or cracks be reported and analyzed further
5	Uncontrolled movement of material handling equipment	Terminal operation area, forklifts, cranes, conveyor belts etc.	ISO 11031 code should be used to ensure seismic resistant material handling equipment is procured	i. Material handling operations should be stopped ii. Ascertain that there is no unsafe conditions due to loosely secured equipment iii. Inform and advice all contractors to remove their equipment from jetty area after use and safely park at shore

c) Equipment and signal system

S.No	Impact area	Equipment Requirement	Warning signal Communication
1	Terminal Storage	Fire alarms, extinguishers, sand, foam based extinguisher, fire hose, fire hydrant booster	Siren
2	Port Administration Buildings, Port Control room	Secondary arrangement, crack assessment equipment	Announcement, warning sign and boundary around weakened structure
3	Berth and Terminal Operation Area	Crane, forklifts etc. for removing debris	Siren
4	Inland Port Administration Buildings, Inland Port Control room	i. Emergency Exit ii. Life-saving devices iii. Fire entry suits iv. Gas masks v. PPE's: protection wear, gloves, boots vi. Disaster supplies kit: water, food, radio, flashlight, first aid kit, extra batteries, whistle, dust mask, pliers to cut off utilities, can opener for food, local map, layout, cell phone charger vii. First Aid Kit	Siren, Hand crank radio

5.1.1.2. Response Plan

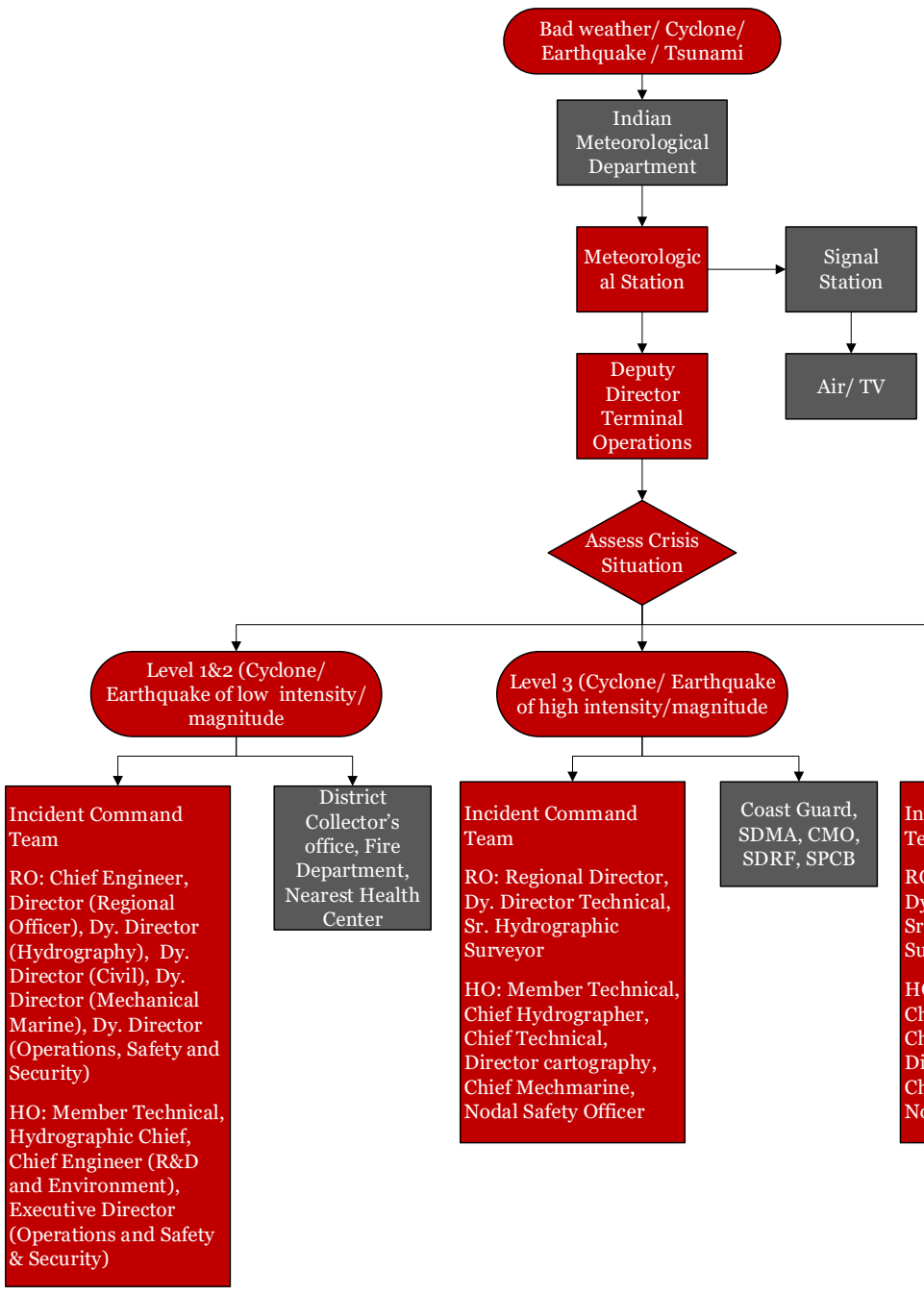
S.No	ACTION TO BE CONSIDERED	On site Action Group	External Action Group
1	**IMMEDIATE ACTION** i. Activate Crisis Management Plan ii. Assess immediate surroundings for dangers iii. Direct Staff to safe exit and to assembly points at terminals iv. Inform Terminal Control Room v. Sound Emergency Alarm vi. Operating equipment should be automatically or manually shut down vii. If required vessels should cast off from berth and proceed to safe waters, away from the immediate crisis or anchored in a safe zone viii. Cargo handling/passenger embarking/disembarking operations should be stopped ix. Ascertain that there is no unsafe conditions due to loosely secured gears/equipment x. Inform and advice all Contractors to remove their equipment from jetty area after use and safely park at shore	Asst. Director (Operations, Safety and Security), Officer (Operations, Safety and Security), Technical Assistant (Civil), Technical Assistant (Mech Marine), Pilot, Master (Vessel)	
2	**INITIAL RESPONSE-COMMAND CENTRE** i. Assist anyone having difficulty evacuating ii. Ensure all the buildings have been evacuated iii. Ensure all the material handling equipment are secure iv. Equipment are removed from jetty v. Keep Fire department alert vi. Keep District collectors office and State Pollution Control board on standby vii. Assess level of response required (R1/ R2/R3/R4)	Asst. Director (Operations, Safety and Security), Technical Assistant (Mech Marine), Control room Officer , Medical Officer	District Collector's office, Fire Department, Local Panchayat

3	**FURTHER RESPONSE-EMERGENCY TEAM** i. Ascertain evacuation information reported and relay it to key external responder's i.e. fire, police and ambulance ii. Monitor for IMD's information in press and other media iii. Flash alert messages on Vessel system and communicate through VHF if vessel are approaching cross over structures iv. Not allow anyone to re-enter buildings until the on-site Safety officer doesn't give "All Clear" Message v. Form incident command team for further action vi. Incident command team on further assessment escalate/ deescalate the response level requirement and communicate and coordinate with outside agencies accordingly vii. In case of injury inform medical officer for first aid and nearest health center for serious injuries viii. In case person is trapped under debris, evaluate whether incident command team can carry rescue operation or need help from external action group depending on the consequence ix. Deploy engineers to direct or guide earth moving equipment and cranes to remove the debris x. In case fire is detected, activate fire alarm and try to contain it from spreading using firefighting equipment xi. In case of high fire danger inform local fire department and keep state level agencies on standby xii. In case threat of pollution inform SPCB and known experts	Incident Command Team: Technical Assistant (Civil), Junior Hydrographic Surveyor (JHS)	L2: District Collector's office, Fire Department, Nearest Health Center L3: SDMA CMO, SDRF, SPCB L4: NDMA, NDRF, Army, Navy

4	**SECONDARY RESPONSE- SUPPORT TEAM** i. Assess vessel traffic in the jurisdiction area and respond to request sent by vessels ii. Complete rescue and recovery operations iii. Liaison with media on reporting of losses of life or damages iv. In case of injury to personal inform family members/ police v. In case of damage to cargo inform operators and jointly evaluate losses vi. Form incident command team for further action vii. Assist medical team to attend to injured personnel viii. Assist in clearing the debris ix. Assist in firefighting x. Assist Engineering team to assess structural strength of buildings and other structures to ascertain fitness for use xi. Assess when normal operations can be restored	Incident Command Team RO: Chief Engineer, Director (Regional Officer), Dy. Director (Hydrography), Dy. Director (Civil), Dy. Director (Mechanical Marine), Dy. Director (Operations, Safety and Security) HO: Member Technical, Hydrographic Chief, Chief Engineer (R&D and	L2: District Collector's office, Fire Department, Nearest Health Center L3: SDMA CMO, SDRF, SPCB L4: NDMA, NDRF, Army, Navy, CPCB, MoEF, MHA
5	**FURTHER RESPONSE-ENGINEERS/ SURVEY TEAM** i. Survey team should conduct navigation survey in case debris cause problem in navigation and demarcate zones which are dangerous for navigation ii. Survey team needs to select and coordinate salvage operation iii. Survey team needs to inform relevant external agencies if it is dangerous to use waterways and coordinate to clear the navigation channel iv. Assist Engineering team to assess structural strength of buildings and other structures to ascertain fitness for use v. Inspection of all jetties and moored vessels vi. Assess when normal operations can be restored vii. Assess the damages caused and the estimated fund required for restoration in case of L2, L3 and L4 type of crisis	Asst. Director (Operations, Safety and Security),Chief Engineer (Mech-Marine), Chief Engineer (Civil), Director(Finance)	

1: Earthquake and Tsunami

Crisis Response Flow Chart



Action to be taken

Coordinate and pass the information to the terminal and regional staff

Assessment of incident, significant impacts and respective agencies informed

Monitor for IMD's information in press and other media
Flash alert messages on Vessel system and communicate through VHF if vessel are approaching cross over structures
Not allow anyone to re-enter buildings until the on-site Safety officer doesn't give "All Clear" Message

Assist anyone having difficulty evacuating
Ensure all the buildings have been evacuated
Ensure all the material handling equipment are secure
Equipment are removed from jetty
Keep Fire department alert

5.1.2. Hydrological (Flood)

Floods have been a recurrent phenomenon in India and cause huge losses to lives, properties, livelihood systems, infrastructure and public utilities. India's high risk and vulnerability is highlighted by the fact that 40 million hectares out of a geographical area of 3290 lakh hectares is prone to floods. 80% of the precipitation takes place in the monsoon months from June to September. The rivers bring heavy sediment load from the catchments. These, coupled with inadequate carrying capacity of the rivers are responsible for causing floods, drainage congestion and erosion of river-banks. Cyclones, cyclonic circulations and cloud bursts cause flash floods and lead to huge losses. River Flooding is generally more common for larger rivers in areas with a wetter climate, when excessive runoff from longer-lasting rainstorms and sometimes from melting snow causes a slower water-level rise, but over a larger area. Floods can also be caused by ice jams on a river, or high tides. However, most floods can be linked to a storm of some kind.

During flood following consequences are felt:

i. Sediment erosion impacts bank protection works , water structures and terminal structures

ii. Structural damage to water structures and terminal structures

iii. Increase in water flow and current

iv. Debris and mud flows decreases navigability of main channel

v. Damage to visual navigation aids

vi. Wave action decreasing navigability of small vessels and ferries

vii. Geomorphological changes can change in the course of main navigation channel

viii. Bank erosion

In this section, measures are mentioned which will minimize the impacts of floods and response plan for the crisis.

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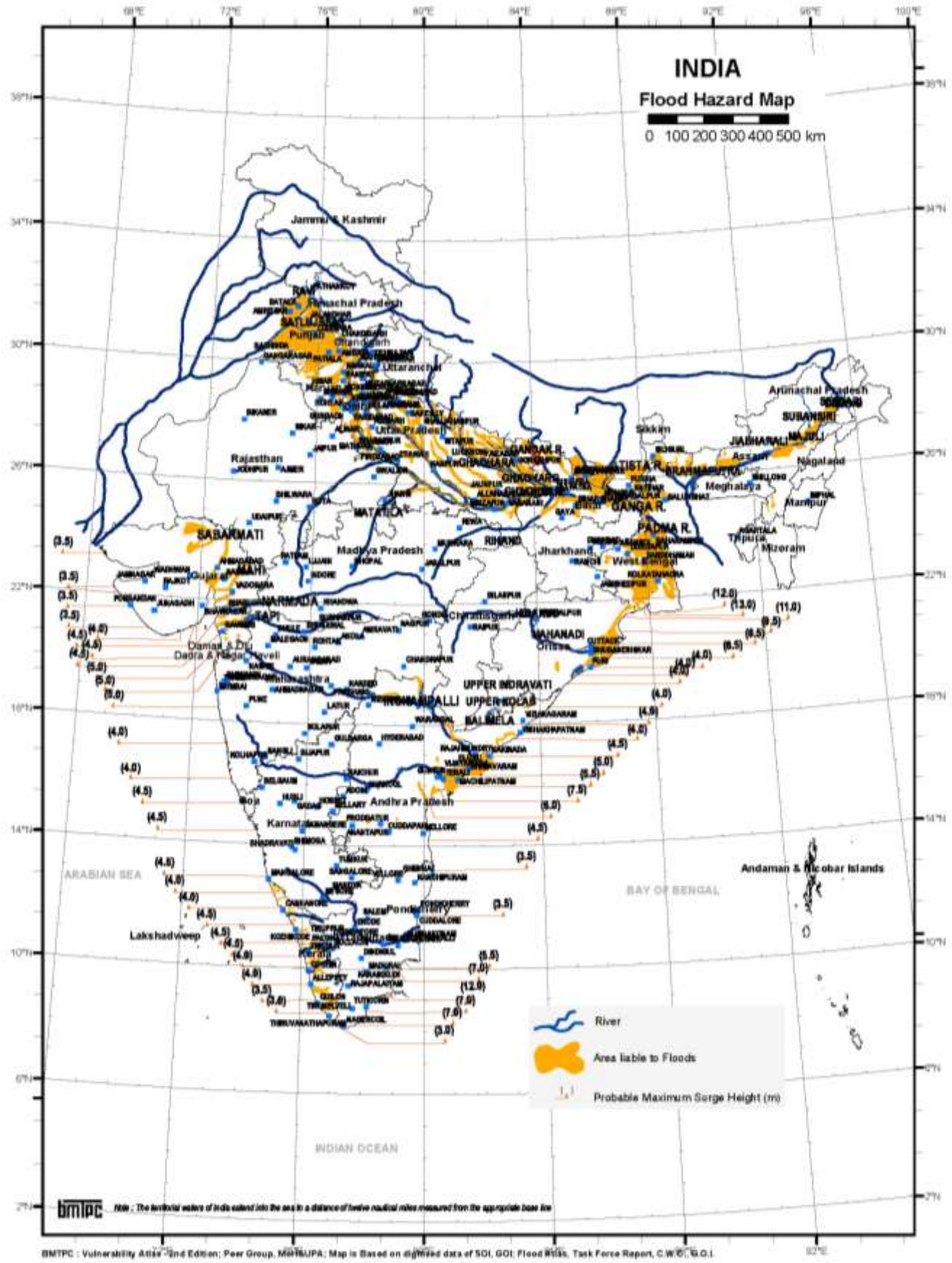


Figure 10: Flood Hazard Map

5.1.2.1. Prevention and Preparedness measures

a) Early warning system

S.no	Data required	Agency to provide data	Coordination agency for communicating warning
1	Flood prone area	National Remote Sensing Centre - ISRO, Decision Support Centre- ISRO MoWR, SDMA	Coordinate with the agencies to create flood maps for all the NWs along with their HFL, LAD and siltation data
2	Rainfall	India Meteorological Department, CWC, Internal Gauge	Regular rainfall and subsequent flood predictions from IMD, CWC and internal gauges. At the time of any warning from IMD, IWAI should get prediction update in every 4-hour interval or for every 10 cm rise in water above HFL. IWAI can also install water level monitoring gauges at all IWT terminal and at an interval of 10 km and downstream of tributary to main waterway.

b) Infrastructure design required

S.no	Impact	Impact area	Design Consideration	Precautions to be taken
1	Water level surge and increase in flow velocity	**Terminal** Terminal Storage Area, Berths , jetties and tow boats **Waterways** Navigation Channel Marking buoys Banks Drifting of vessels	i. At the time of planning all the designs should consider HFL, Lowest Water Level and fluctuation in water levels ii. Growing bio-shield for bank protection ii. Buildings shall be constructed with electrical, heating, ventilation, plumbing, and air-conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating - IS 13827:1993 v. Along with vertical shift there is horizontal shift, navigation channel should be marked according to stability of channel v. Clearance of cross over structures should be according to HFL	i. Sand bags to be used around sensitive areas including water supply ii. Make standby arrangements for transportation to evacuate staff in low lying areas to relief centers ii. Monitor gauges and initiate communication if readings approach danger limits/ crosses HFL v. Issue advisory to mariners about high water and drift potential and to minimize wake v. Consider restriction of moving certain zones in navigation channel, horse power requirement, dangers of down streaming, mooring arrangements and cross over structure clearance vi. Have arrangement of tow boats for assisting in case of drifting/ parting/ mooring

				ii. Have arrangement of rescue boats for assisting stranded passengers/ crew ii. Monitor alerts from dams and reservoirs in upstream
2	Disruption in communication systems, radar and signals	Terminal Control room	IS 13611(Part) 1 network services: Protocol Specification (first revision) ISO/IEC 8473 (Part 1): 1998	Prior assign of the weather message and broadcast alerts to mariners
3	Displacement of navigational aids	Berth and Terminals	BIS codes for design: IS 4967:1968	Drainage system of the terminal i.e. inside terminal area & outside terminal area should be cleared.
4	Electrical system failure	Port Administration Buildings, Port Control room	NATIONAL ELECTRICAL CODE 2011 (Part 62) : 1993/ IEC 60050 (212) : 1990 -Solid insulating materials (first revision) (Part 69) : 1993/ IEC 60050 (602) : 1993 Distribution of electricity — Generation (Part 70) : 1993/IEC 60050 (604) 1987 Generation, transmission and distribution of electricity —Operation (Part 71) : 1993/IEC 60050 (605) 1983 Generation, transmission and distribution of electricity Substations	All the outside installations and equipment shall be properly secured and there should be backup for emergency services

c) Equipment and signal system

S.No	Impact area	Equipment Requirement	Warning signal Communication
1	Terminal Storage, berths, jetties	Alarms, sandbags and strong mooring arrangement	Alarm
2	Inland Port Administration Buildings, Inland Port Control room	Secondary arrangement, crack assessment equipment	Announcement, warning sign and boundary around weakened structure
3	Berth and Terminal Operation Area	Crane, forklifts etc. for removing debris	Alarm
4	Inland Port Administration Buildings, Inland Port Control room	i. Emergency Exit ii. Life-saving devices iii. PPE's: protection wear, gloves, boots iv. Disaster supplies kit: water, food, radio, flashlight, first aid kit, extra batteries, whistle, dust mask, pliers to cut	Alarm, Hand crank radio

		off utilities, can opener for food, local map, layout, cell phone charger v. First Aid Kit	
5	Navigation channel	i. Dredgers ii. Tow boats iii. Rescue boats/Boat Ambulance iv. Divers v. VHF and RIS vi. Secondary communication system	Broadcast advisory alerts through RIS and Notices to Mariners, Geotag zones unsafe for navigation Marking buoys for zones unsafe for navigation

5.1.2.2. Response Plan

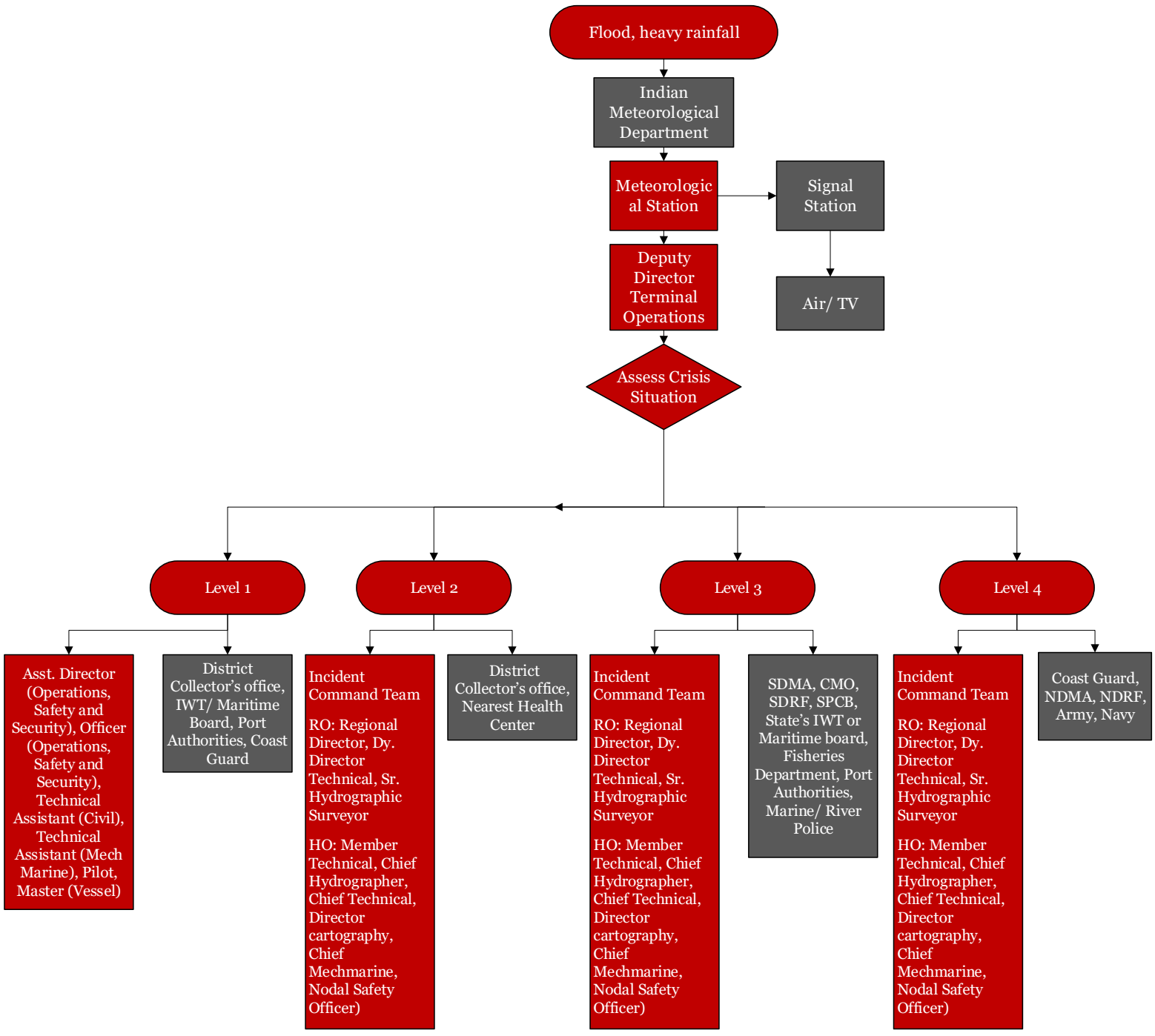
S.No	ACTION TO BE CONSIDERED	On site Action Group	External Action Group
1	**IMMEDIATE ACTION** i. Activate Crisis Management Plan ii. Assess immediate surroundings for dangers iii. Direct Staff to safe exit and to higher ground iv. Inform Terminal Control Room v. Sound Emergency Alarm vi. Operating equipment should be automatically or manually shut down vii. Material handling operations should be stopped viii. Ascertained that there is no unsafe conditions due to loosely secured equipment ix. Inform and advice all contractors to remove their equipment from jetty area after use and safely park at shore x. Conduct mooring inspection xi. Broadcast safety advisory to mariners xii. Declare restriction of moving certain zones in navigation channel, horse power requirement, dangers of down streaming, mooring arrangements and cross over structure clearance	Asst. Director (Operations, Safety and Security), Officer (Operations, Safety and Security), Technical Assistant (Civil), Technical Assistant (Mech Marine), Pilot, Master (Vessel)	

2	**INITIAL RESPONSE-COMMAND CENTRE** i. Assist anyone having difficulty in reaching higher ground ii. Ensure all the buildings have been evacuated iii. Ensure all the material handling equipment are secure iv. Equipment are removed from jetty v. Keep District collectors office and State Pollution Control board on standby vi. Assess level of response required (R1/ R2/R3/R4) vii. Assess distress signal from vessels and inform RO office if required	Asst. Director (Operations, Safety and Security), Technical Assistant (Mech Marine), Control room Officer , Medical Officer	District Collector's office, IWT/ Maritime Board, Port Authorities, Coast Guard, Local Panchayat
3	**FURTHER RESPONSE-EMERGENCY TEAM** i. Ascertain evacuation information reported and relay it to key external responder's i.e. police and ambulance ii. Monitor for IMD's information in press and other media iii. Broadcast alert messages on Vessel system and communicate through VHF if vessel are approaching cross over structures iv. Geotag unsafe zones for navigation v. Form incident command team for further action vi. Incident command team on further assessment escalate/ deescalate the response level requirement and communicate and coordinate with outside agencies accordingly vii. In case of injury to personnel inform medical officer for first aid and nearest health center for serious injuries viii. Deploy survey team to direct or guide dredgers to remove the debris ix. Keep terminal tugs and crafts ready for emergency response on waterway x. In case threat of pollution inform SPCB and known experts	Incident Command Team: Technical Assistant (Civil), Junior Hydrographic Surveyor (JHS)	L2: District Collector's office, Nearest Health Center L3: SDMA CMO, SDRF, SPCB, State's IWT or Maritime board, Fisheries Department, Port Authorities, Marine/ River Police L4: NDMA, NDRF, Army, Navy

4	**SECONDARY RESPONSE- SUPPORT TEAM** i. Assess vessel traffic around the jurisdiction area and respond to distress request sent by vessels ii. Complete rescue and recovery operations iii. Liaison with media on reporting of losses of life or damages iv. In case of injury to personal inform family members/ police v. In case of cargo damage inform operators and jointly evaluate losses vi. Form incident command team for further action vii. Assist medical team to attend personal injuries viii. Assist in clearing the debris from the waterways ix. Assess when normal operations can be restored	Incident Command Team RO: Director (Regional Officer), Dy. Director (Hydrography), Dy. Director (Civil), Dy. Director (Mechanical Marine), Dy. Director (Operations, Safety and Security) HO: Member Technical, Hydrographic Chief, Chief Engineer (R&D and Environment), Executive Director (Operations and Safety & Security)	L2: District Collector's office, Nearest Health Center L3: SDMA CMO, SDRF, SPCB, State's IWT or Maritime board, Fisheries Department, Port Authorities, Marine/ River Police L4: NDMA, NDRF, Army, Navy, MHA
5	**FURTHER RESPONSE-ENGINEERS/ SURVEY TEAM** i. Survey team should conduct navigation survey in case debris cause problem in navigation and demarcate zones which are dangerous for navigation ii. Survey team needs to select and coordinate salvage operation iii. Survey team to issue River notices for waterway dangerous for navigation iv. Assess navigation channel, prepare chart data, bathymetric data and mark changes in navigation channel or formation of shoals, bars or Chars or change in the bends v. Assess when normal operations can be restored vi. Assess the damages caused and the estimated fund required for restoration in	Asst. Director (Operations, Safety and Security),Chief Engineer (Mech-Marine), Chief Engineer (Civil), Director(Finance)	

2: Flood

Crisis Response Flow Chart



Action to be taken

Coordinate and pass the information to the Terminal and regional office

Assessment of incident, significant impacts and respective agencies informed

Monitor for IMD's information in press and other media
Flash alert messages on Vessel system and communicate through VHF if vessel are approaching cross over structures
Not allow anyone to re-enter buildings until the on-site Safety officer doesn't give "All Clear" Message

Assess vessel traffic around the jurisdiction area and respond to distress request sent by vessels
Complete rescue and recovery operations
Liaison with media on reporting of losses of life or damages
In case of personal injury inform family members/ police

Figure 11: Flow Chart of Flood Crisis Response

5.1.3. Meteorological (Cyclone, Fog, Sand storm and Lightning)

Hazard caused by short-lived, micro- to meso-scale extreme weather and atmospheric conditions that may last for minutes to days. About 10% of the World's tropical cyclones affect the Indian coast. Of these, the majority have their initial genesis over the Bay of Bengal and strike the east coast of India. On an average, five to six tropical cyclones form every year, of which two or three could be severe. Cyclones occur frequently on both the west coast in the Arabian Sea and the east coast in the Bay of Bengal. In India, tropical cyclones occur in the months of May-June and October-November. The cyclones of severe intensity and frequency in the northern part of the Indian Ocean are bi-modal in character, with their primary peak in November and secondary peak in May. The disaster potential is particularly high at the time of landfall in the northern part of Indian Ocean (Bay of Bengal and the Arabian Sea) due to the accompanying destructive wind, storm surges and torrential rainfall. Of these, storm surges are the greatest killers of a cyclone, by which sea water inundates low lying areas of coastal regions and causes heavy floods, erodes beaches and embankments, destroys vegetation and reduces soil fertility. During cyclone lightning can also occur which is fatal for vessels and structures.

Table 10: The classification used in India for cyclone

T. Number / C.I. Number	Wind speed in knots	Wind speed in km/h	Dp	Classification of cyclonic disturbance	Wind criteria in knots	Wind criteria in km/h
T1.0				Low	<17	<31
T1.5	25	46.3	3	Depression	17-27	31-49
T2.0	30	55.6	4.5	Deep Depression	28-33	50-61
T2.5	35	64.9	6.1	Cyclonic Storm	34-47	62-88
T3.0	45	83.4	10.0			
T3.5	55	101.9	15.0	Severe Cyclonic Storm	48-63	89-117
T4.0	65	120.5	20.9	Very Severe Cyclonic Storm	64-119	119-221
T4.5	77	142.7	29.4			
T5.0	90	166.8	40.2			
T5.5	102	189.0	51.6			
T6.0	115	213.1	65.6			
T6.5	127	235.4	80.0	Super Cyclonic Storm	120 and above	222 and above
T7.0	140	259.5	97.2			
T7.5	155	287.3	119.1			
T8.0	170	315.1	143.3			

Source: The Classification of cyclonic storms (Source: Ministry of Earth Sciences, IMD)

Storm surge is an abnormal rise of water generated by a storm, over and above the predicted astronomical tides. It should not be confused with storm tide. The rise in water level can cause extreme flooding in coastal areas particularly when storm surge coincides with normal high tide, resulting in storm tides reaching up to 6 meters or more in some cases. The degree of destructive potential depends on the storm surge amplitude associated with the cyclone.

The last stretches of the NWs especially the one's falling in Bay of Bengal will get gravely impacted by the cyclone and storm surge. It can damage water structures, terminal structures, vessels and ferries, there could be debris and mudflows decreasing navigability of channel and it would disrupt navigation and communication system.

Similarly, fog and sand storm are seasonal and localized hazard that occurs in parts of the country that experience winter or are dry respectively. Occurrence of fog increases with increase in humidity, pollution

level and persistent particulate matter whereas sand storm increases with increase in loose soil and construction activity. Both reduces visibility and increase chance of vessel accident.

Under this section, prevention measures for minimizing the impact of meteorological crisis and response plan is outlined.

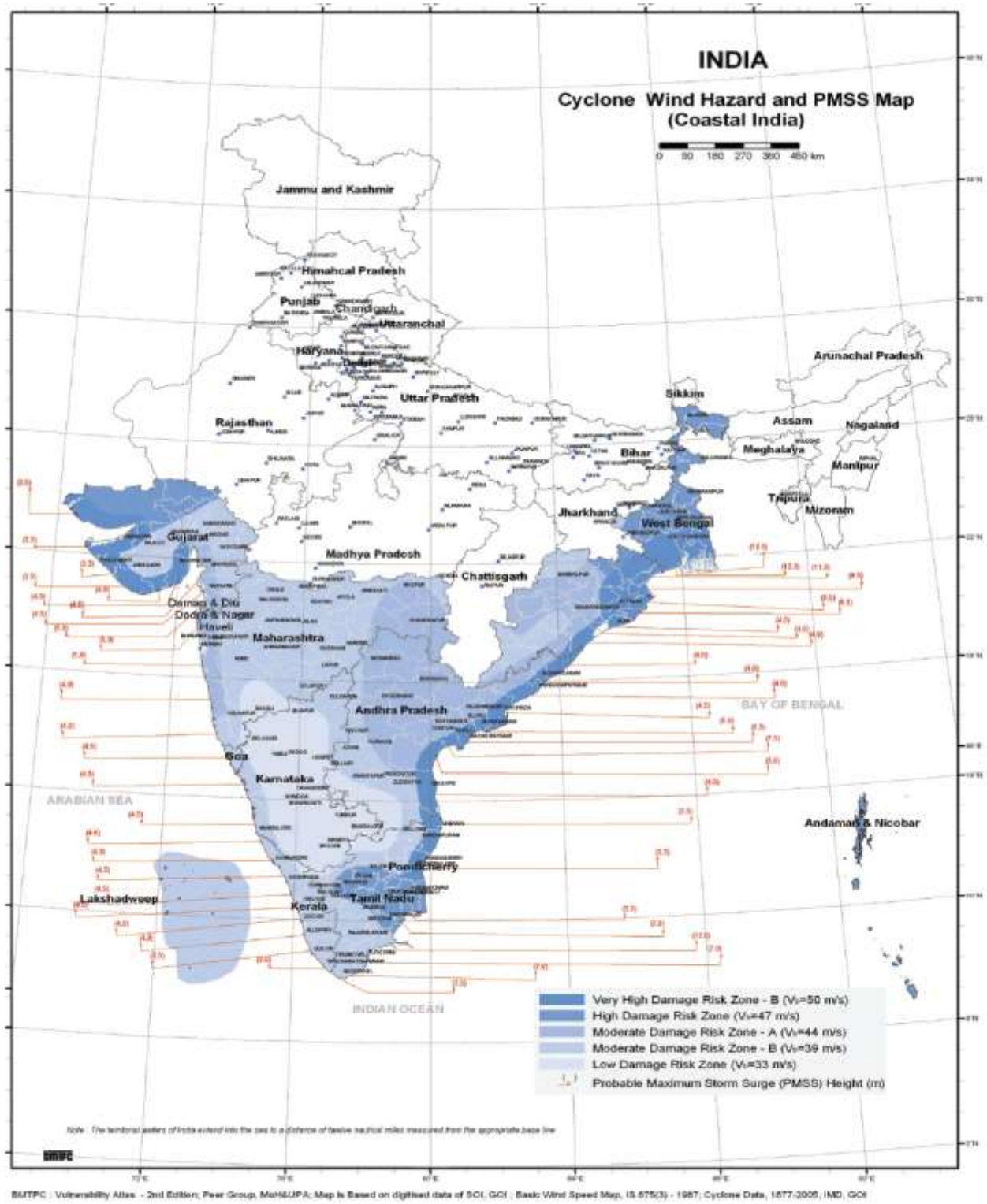


Figure 12: Cyclone and wind Hazard Map

5.1.3.1. Prevention and Preparedness measures

a) Early warning system

S.No	Data required	Agency to provide data	Coordination agency for communicating warning
1	Cyclone prone area	MoEFCC, NRSC, SAC, ISRO, MoST, SDMA	Coordinate with the agencies to map cyclone prone area on all the NWs along with wind speeds prediction and duration
2	Magnitude of Cyclone, surge storm, fog and sand storm	IMD, MoES, NRSC, ISRO, MoST, DOS, INCOIS	Regular weather predictions from IMD, ISRO and Indian Navy. Coordinate with corresponding District authorities at the time of cyclone: i. District Collector office ii. Electricity office iii. Fire department iv. Police v. River Police vi. District Emergency Operation Center vii. Nearest Health Center State authorities i. State Transport department ii. Inland Water Transport department or Maritime Board whichever is available in the state iii. SDMA iv. SDRF v. Coastal Police vi. Fisheries Department At the time of any warning from IMD, IWAI should get prediction update in every 96-12 hour interval before cyclone and hourly update after landfall of cyclone.
3	Area that will be affected	IMD, Cyclone Warning Centre, NDMA	

b) Infrastructure design required

S.No	Impact	Impact area	Design Consideration	Precautions to be taken
1	Fire	Terminal Cargo Storage Units	i. Installation of smoke detector, foam based fire extinguishers and fire exits ii. Install fire alarms which are connected to emergency control room and nearby fire station iii. Way to fire exits is marked iv. Storage area is distant from other buildings v. Fire hose (adjacent buildings) vi. Fire hydrant booster vii. Sprinkler system in buildings viii. Have secondary power supply for emergency response equipment	i. First Aid for burn injury ii. Regular Mock Fire drills are conducted iii. All the Firefighting equipment must be maintained regularly iv. Staff trained on using Firefighting equipment v. Closure of area in case of fire vi. Staff must know local fire department emergency number vii. Fire station should be alert 24*7
2	Weakening of structures	Port Administration Buildings, Port Control room, Terminal storage units, bank protection works, jetties, berths	i. IS 456 : 2000 Plain and Reinforced Concrete Code of Practice (reaffirmed 2005) ii. IS 875 : Part 3 : 1987 Code of Practice for Design Loads (other than Earthquake) for Buildings and Structures - Part 3 : Wind Loads (reaffirmed 2003) iii. IS 800 : 1984 Code of practice for general construction in steel (reaffirmed 2003) iv. IS 8237: 1985 Code of Practice for Protection of Slope for Reservoir Embankment (reaffirmed 2002) v. IS 10635: 1993 Freeboard requirements in embankment dams – guidelines (reaffirmed 2003) vi. IS 11532: 1995 Construction and maintenance of river embankments (levees) guidelines (reaffirmed 2005) vii. IS 12094: 2000 Guidelines for Planning and Design of River Embankments (Levees) (reaffirmed 2005)	i. Direct staff to the safety exit at terminals and take refuge in the nearest cyclone shelter ii. Make standby arrangements for transportation to evacuate population in low lying areas to cyclone centers and relief centers iii. Regular emergency evacuation drill must be conducted iv. Inspection of all the buildings before starting the use again v. All types cracks be reported and analyzed further vi. Operating equipment should be automatically or manually shut down vii. Vessels should be directed to move to safe zone of navigational channel viii. Vessels should not go anywhere near to cross-over structures ix. Material handling operations should be stopped x. Determine the hazard potential of the terminal structures xi. All types of fissures or cracks be reported and analyzed further

	Water level surge and increase in flow velocity disrupt of port operations. Minor damage to tugs, boats, shore structures	**Terminal** Terminal Storage Area, Berths , jetties and tow boats **Waterways** Navigation Channel Marking buoys Banks Drifting of vessels	i. At the time of planning all the designs should consider HFL, Lowest Water Level and fluctuation in water levels ii. Buildings shall be constructed with electrical, heating, ventilation, plumbing, and air-conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating - IS 13827:1993 iii. Clearance of cross over structures should be according to HFL iv. Buildings and other service facilities should be designed and/or located so as to prevent water from entering or accumulating - IS 13827:1993 v. Building Material Technology Promotion Council (BMTPC), 2007.	i. Sand bags to be used around sensitive areas including water supply ii. Monitor warnings from IMD and initiate communication if it approach danger limits ii. Issue advisory to mariners about high water and wind speed v. Consider restriction of moving in certain zones in navigation channel, horse power requirement, dangers of navigating, mooring arrangements and cross over structure clearance v. Have arrangement of tow boats for assisting in case of breakaway of vessels from moors vi. Have arrangement of rescue boats for assisting stranded passengers/ crew
3	Disrupt in communication systems, radar and signals	Port Control Room, Radar Station, Police Wireless Station, and vessels in storm/cyclone affected waterways	IS 13611(Part) 1 network services: Protocol Specification (first revision) ISO/IEC 8473 (Part 1): 1998	i. Assign of the weather message and broadcast alerts to mariners ii. Mark the unsafe zones prior to worsening of weather using light fitted buoys and also on the RIS system ii. Secure Secondary communication system
4	Displacement of navigational aids	Berth and Terminals	BIS codes for design: IS 4967:1968	Drainage system of the terminal i.e. inside terminal area & outside terminal area should be cleared.
5	Electrical system failure	Port Administration Buildings, Port Control room	i. NATIONAL ELECTRICAL CODE 2011 (Part 62) : 1993/ IEC 60050 (212) : 1990 -Solid insulating materials (first revision) (Part 69) : 1993/ IEC 60050 (602) : 1993 Distribution of electricity — Generation (Part 70) : 1993/IEC 60050 (604) 1987 Generation, transmission and distribution of electricity —Operation (Part 71) : 1993/IEC 60050 (605) 1983 Generation, transmission and distribution of electricity Substations	All the outside installations and equipment shall be properly secured and there should be backup for emergency services

			ii. NBC 2016: National Building Code of India: Part 8 Building Services, Section 2 Electrical Installations. iii. International Electro technical Commission standard: Protection against Lightning: Part -3 Physical Damage to Structure and Life hazard.	
6	Problem in navigation	Waterways	IV Act rules of navigation	i. Reduce to safe speed ii. Use of audio and visual aids on board iii. Follow navigation chart and instructions from nearest control room iv. Follow luminary navigation aids v. Request for help from nearest control room in case of distress through VHF

c) Equipment and signal system

S.No	Impact area	Equipment Requirement	Warning signal Communication
1	Terminal Storage, berths, jetties	Alarms, sandbags and strong mooring arrangement	Siren
2	Port Administration Buildings, Port Control room	Secondary arrangement, crack assessment equipment	Announcement, warning sign and boundary around weakened structure
3	Berth and Terminal Operation Area	Crane, forklifts etc. for removing debris	Siren
4	Port Administration Buildings, Port Control room	i. Emergency Exit ii. Life-saving devices iii. Fire entry suits iv. Gas masks v. PPE's: protection wear, gloves, boots vi. Disaster supplies kit: water, food, radio, flashlight, first aid kit, extra batteries, whistle, dust mask, pliers to cut off utilities, can opener for food, local map, layout, cell phone charger vii. First Aid Kit	Siren, Hand crank radio
5	Navigation channel	i. Dredgers ii. Tow boats iii. Rescue boats iv. Divers	Broadcast advisory alerts, Geotag zones unsafe for navigation Marking buoys for zones unsafe for navigation

		v. VHF and RIS vi. Secondary communication system vii. Buoys fitted with LED viii. Visual Signal on terminal buildings	

5.1.3.2. Response Plan

S.No	ACTION TO BE CONSIDERED	On site Action Group	External Action Group
1	**IMMEDIATE ACTION** i. Activate Crisis Management Plan ii. Assess immediate surroundings for dangers iii. Direct Staff to safe exit and to cyclone shelters iv. Inform Terminal Control Room v. Sound Emergency Alarm vi. Operating equipment should be automatically or manually shut down vii. Material handling operations should be stopped viii. Ascertained that there is no unsafe conditions due to loosely secured equipment ix. Inform and advice all contractors to remove their equipment from jetty area after use and safely park at shore x. Conduct mooring inspection xi. Broadcast safety advisory to mariners xii. Declare restriction of moving certain zones in navigation channel, horse power requirement, dangers of down streaming, mooring arrangements and cross over structure clearance	Asst. Director (Operations, Safety and Security), Officer (Operations, Safety and Security), Technical Assistant (Civil), Technical Assistant (Mech Marine), Pilot, Master (Vessel)	

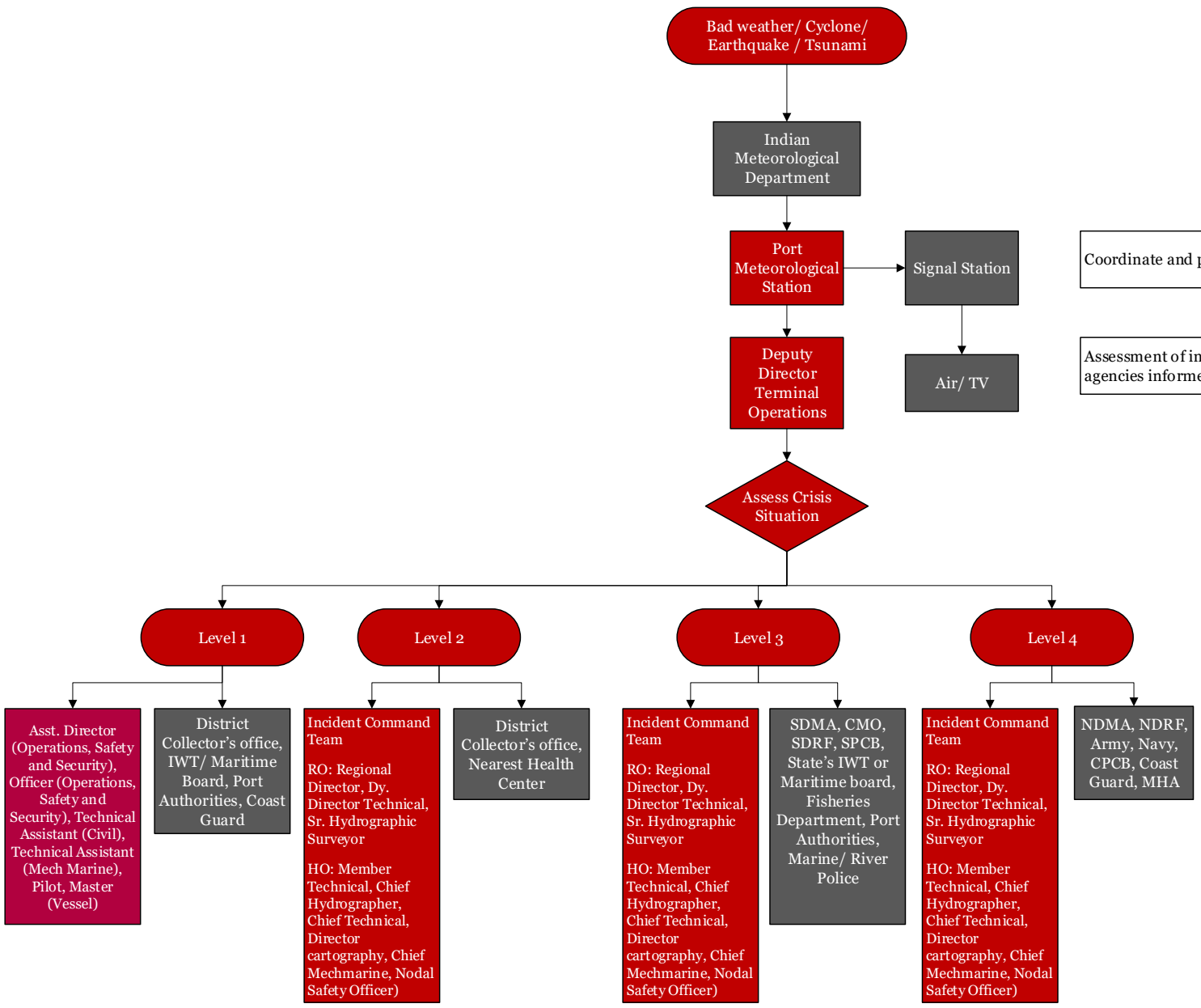
2	**INITIAL RESPONSE-COMMAND CENTRE** i. Assist anyone having difficulty in reaching higher ground ii. Ensure all the buildings have been evacuated iii. Ensure all the material handling equipment are secure iv. Equipment are removed from jetty v. Keep District collectors office and State Pollution Control board on standby vi. Assess level of response required (R1/ R2/R3/R4) vii. Assess distress signal from vessels and inform RO office if required viii. Escalate if the vessel doesn't respond to instructions or reliable communication is not established	Asst. Director (Operations, Safety and Security), Technical Assistant (Mech Marine), Control room Officer , Medical Officer	District Collector's office, IWT/ Maritime Board, Port Authorities, Coast Guard, Local Panchayat
3	**FURTHER RESPONSE-EMERGENCY TEAM** i. Ascertain evacuation information reported and relay it to key external responder's i.e. police and ambulance ii. Monitor for IMD's information in press and other media iii. Broadcast alert messages on Vessel system and communicate through VHF if vessel are approaching cross over structures iv. Geotag unsafe zones for navigation v. Form incident command team for further action vi. Incident command team on further assessment escalate/ deescalate the response level requirement and communicate and coordinate with outside agencies accordingly vii. In case of injury inform medical officer for first aid and nearest health center for serious injuries viii. Deploy survey team to direct or guide dredgers to remove the debris ix. Keep terminal tugs and crafts ready for emergency response on waterway x. In case threat of pollution inform SPCB and known experts	Incident Command Team: Technical Assistant (Civil), Junior Hydrographic Surveyor (JHS)	L2: District Collector's office, Nearest Health Center L3: SDMA CMO, SDRF, SPCB, State's IWT or Maritime board, Fisheries Department, Port Authorities, Marine/ River Police L4: NDMA, NDRF, Army, Navy, CPCB, Coast Guard, MHA,

4	**SECONDARY RESPONSE- SUPPORT TEAM** i. Assess vessel traffic around the jurisdiction area and respond to distress request sent by vessels ii. Complete rescue and recovery operations iii. Liaison with media on reporting of losses of life or damages iv. In case of injury to personal inform family members/ police v. In case of cargo damage inform operators and jointly evaluate losses vi. Form incident command team for further action vii. Assist medical team to attend personal injuries viii. Assist in clearing the debris from the waterways ix. Assess when normal operations can be restored	Incident Command Team RO: Chief Engineer, Director (Regional Officer), Dy. Director (Hydrography), Dy. Director (Civil), Dy. Director (Mechanical Marine), Dy. Director (Operations, Safety and Security) HO: Member Technical, Hydrographic Chief, Chief Engineer (R&D and Environment), Executive Director (Operations and Safety & Security)	L2: District Collector's office, Nearest Health Center L3: SDMA CMO, SDRF, SPCB, State's IWT or Maritime board, Fisheries Department, Port Authorities, Marine/ River Police L4: NDMA, NDRF, Army, Navy, CPCB, Coast Guard, MoEFCC,
5	**FURTHER RESPONSE-ENGINEERS/ SURVEY TEAM** i. Survey team should conduct navigation survey in case debris cause problem in navigation and demarcate zones which are dangerous for navigation ii. Survey team needs to select and coordinate salvage operation iii. Survey team needs to inform relevant external agencies if it is dangerous to navigate iv. Assess when normal operations can be restored v. Assess the damages caused and the estimated fund required for restoration in case of L2, L3 and L4 type of crisis vi. Assist District Collectors office in case there is some outside liability on IWAI	Asst. Director (Operations, Safety and Security),Chief Engineer (Mech-Marine), Chief Engineer (Civil), Director(Finance)	

3: Cyclone, Fog and Lightening

Crisis Response Flow Chart

Action to be taken



Coordinate and pass the information to the port authorities

Assessment of incident, significant impacts and respective agencies informed

Monitor for IMD's information in press and other media
Flash alert messages on Vessel system and communicate through VHF if vessel are approaching cross over structures
Not allow anyone to re-enter buildings until the on-site Safety officer doesn't give "All Clear" Message

Assess vessel traffic around the jurisdiction area and respond to distress request sent by vessels
Complete rescue and recovery operations
Liaison with media on reporting of losses of life or damages
In case of personal injury inform family members/ police

Figure 13: Flow Chart of Crisis Response during Cyclone, for and Lightening

5.2. Human Induced Crisis

5.2.1. Collision and Vessel related incidents

Collision is the physical impact that occurs between two vessels or a vessel and structure resulting in a damaging accident. This can occur between a vessel and a stable or a floating structure like an offshore drilling platform or even a port.

Collision: The different types of collision are

i. Side collision: This is when one vessel is struck on its side by another vessel. It is essentially the same principal as a T-bone type car accident.
ii. Bow-on collision: This occurs when two vessels strike each from their front ends, or head on.
iii. Stern collision: This type of collision is one vessel running into the rear of another.
iv. Allison: This collision involves one vessel striking a stationary object, such as a bridge, seawall, etc.

Grounding: Grounding means the vessel touching riverbed due to lack of depth of water or presence of protrusions from the riverbed. If the riverbed is soft, grounding may not cause any serious damage to the hull. However if hull touches any hard objects like rock, the shell plate may be dented deeply or even gashed. If the shell plate is cut open due to the grounding, river water will get into the space thus opened to it. This can result in ship taking dangerous list or even sinking unless proper action is taken immediately.

Contact: The vessel during mooring operation, can contact any object including aquatic mammel, which can result in a dent on hull and other damage to parking stoppers on the berth.

Capsizing: Capsizing in boats and ferries occur due to shifting of weights. Ferry disasters occur frequently in India, often because of overcrowding or poor maintenance.

Fire/Explosion: The fire/explosion in the vessel is due to various reasons. The most common reasons for fire/ explosion in a vessel are

i. Crankcase Explosion of Ship's Engine
ii. Over-Speeding of Generators
iii. Compressor Airline Explosion
iv. High Pressure Fuel Line Bursting
v. High Pressure Steam Leakages
vi. Hydraulic High Pressure Components Bursting
vii. Electrical Shocks

The common reasons for fire at the terminal are

i. Electrical outlets, circuit breakers panels and junction boxes are not covered
ii. There are no fire extinguishers or if there are fire extinguisher, they are not visible or they are not working.
iii. Sprinkler system has not been serviced properly by a licensed fire protection official.
iv. Hazardous material (chemicals, gasses, solids) are not properly stored or they are stored without the proper permits.
v. Fire alarm system has not been tested.

Problem in Navigation

i. Weather: Determining position and maintaining direction under routine conditions depended on knowledge of winds and currents. Turbulent weather or bad weather endangers crews, threatens vessels, and spoiled the best-laid navigation plans. There could be debris flowing in the channel making it unsafe for navigation.

ii. Navigation chart, bathymetric data and fishing maps not updated: If either of the maps have not been updated accurately there is increase in likelihood of occurrence of vessel accident.

iii. Vessel Accident: Due to some vessel/boat accident the navigation channel might not be fit for navigation

iv. Problem in lock gates or other water structures: Though there is only one lock gate at present but in future, more lock gates will be built to increase depth of the navigation channels. However, managing navigation around lock gates is difficult unless there is seamless communication between control room, vessel and the lock gate operators and proper scheduling of opening of gates.

Problem in cross over structure: A crossing is any bridge or culvert passing over a creek, river, stream or formed channel. Accident or maintenance problem in cross over structure might affect operation of vessels in inland waterways.

Sabotage: There are stretches in national waterways where there is presence of insurgents or dacoits, who might sabotage vessels. Due to nature of these incidents, it is advisable that IWAI seeks help of local authorities from the moment it gets the information.

Based on the above type of incidents that can happen with vessel, IWAI should collect following information on navigation channel to identify ***critical hotspots:***

a) Channel stretches susceptible to geo-morphological changes or high siltation
b) Narrow channel
c) Instability of banks
d) Vertical clearance from High tension lines in HFL conditions
e) Natural disaster profile of the channel
f) Not sufficient vertical (<10 m) or horizontal clearance at bridges or locks (in HFL conditions)
g) Stretches which are regularly dredged
h) Bends with curve <200 m
i) Presence of receptors and sensitive environmental receptors as defined in section 5.2.2
j) Stretches having high traffic
k) Spots of ferry crossing
l) Spots of high presence of fishing or country boats
m) Stretches where vessels might get sabotaged

5.2.1.1. Prevention measures

a) Legal

Human induced crisis incidents can be averted if proper legal framework is prepared and implemented. Following table summarizes gaps in existing legislations relevant to vessel related incidents.

S.No	Existing Navigation Rules	Critical gaps in the rules	Recommended amendments/ rules/ practices
1	Inland Vessels Act 1917	i. Non-mechanized and smaller mechanized ferry/ fishing boats are not covered	IWAI should coordinate with state departments to regulate safety measures and training of non-mechanized boats
2	Prevention of Collision on National Waterways Regulations, 2002:	i. Penalties and legal proceedings are not sufficient compared to damage they can cause ii. Enforcement and monitoring procedure of the regulations are not mentioned iii. It is not mentioned that Master (Vessel) and crew mandatorily trained on the regulations before getting certificate to ply on waterways iv. Supporting fishing maps are not available v. There are no guidelines on the standard forms required to be filled on inland terminals for transporting cargo/ passengers vi. Integration of type of goods transported and kind of containment equipment which will be required	i. Penalties and legal proceedings should be increased ii. Governance structure for implementation of the act should be added iii. Mandatory audio-visual training on navigation rules should be imparted to the masters and the crew members iv. Every state should prepare fishing maps and ferry routes and mark the zones on map as well on ground v. In case, big vessels have to cross marked zones, alert should be sent to state fisheries and ferry operating department so that it can be transmitted to local boats and they can avoid crossing the vessel vi. Similarly alerts to the vessels plying near dredging or maintenance area should be sent vii. Prepare forms of declaration of cargo being transported by the vessel, insurance and that have sufficient Fire safety equipment viii. Supporting SOPs should be prepared for vessel crew and terminal officers ix. Responsibility of wreck removal and salvage operations x. Responsibility to conduct search & rescue operations
3	National Waterway, Safety of Navigation and Shipping Regulations, 2002	i. Definition and role of competent officer is not defined properly ii. Penalties are defined but does not mention the methodology	Every state has it's own department or authority which deals with inland waterways, the mechanism of deciding

		to derive penalties and who will be liable to pay it	competent officer should be now defined in the regulation. Using the real crisis incidents, costs incurred should be reflected in the penalties
4	Guidelines for Boat Safety, NDMA State Ferries Act	i. No uniformity of regulations on ferries in different states ii. Acts are very old and outdated iii. Do not have provision for safety	i. IWAI can help state departments to adopt the guidelines in form of regulation

b) Early detection and communication system

S.No	Impact Area	Equipment	Communication
1	Terminal	RIS, a smoke signal, CCTV's, Radar System, mobile phone	VHF, Radiotelegraph alarm signal, radiotelephone alarm signal
2	Vessel	Radar, AIS, GPS, Light systems, CCTV's. Radio equipment's, Radio logs, Signaling lamps, mobile phone	VHF, mobile/ telephone, rocket parachute flare or a hand-flare showing a red light, sound signaling devices (whistle, air horn, bells and gongs), alarms

c) Infrastructure

S.No	Factors/ Causes	Prevention Plan
1	Navigation	i. Follow regulations ii. Follow instructions of pilot iii. Get training on safe navigation, especially for narrow channel and on turning bends maneuvering iv. Visual sign for safe speed, hotspots etc. should be installed by IWAI v. Fishing and ferry zones should be marked on navigation charts vi. Geotag the danger zones (plying of local boats, natural weather or geomorphological conditions), which can lead to instability of vessels. vii. Fairways marked with buoys to be established for safe entering/ leaving Inland Port/ Terminal viii. Keep check on vessel movement and report to next control center in case non-compliance of instructions ix. IWAI need to have tug vessels, pontoons with hozers, pontoon with cranes to unload vessel, rescue boats, skimmers, booms, dispersants etc.
2	High water and low water	x. Establish appropriate buoys/ river gauges in the navigation channel specially the areas where there are dangers of high or low water level xi. There should be log of danger levels both high and low water levels for all the stretches on the NWs xii. As the stage rises or discharge falls in series of gauges initiate communication to the regional level, terminals and local control and command centers xiii. Monitor river gages frequently xiv. Issue advisory to the vessels through RIS xv. Keep emergency response equipment like tug vessels and dredgers ready
3	Check of compliance	i. Proactive- periodic audits, reviews, safety inspection, safety committee meetings, checking Master (Vessel) and other crew member's knowledge on safety regulations, keeping record of past incidents and their analysis, periodic hull integrity assessment ii. Reactive- Accident/incident/near miss reporting, incident investigation

4	Design Error	i. Issue regulations on the maximum number of persons on ferry based on the capacity ii. Passenger vessels should be double hull design iii. Issue regulations on type of vessel can transport what kind of cargo and keep check on adherence
5	Outdated regulations	Update regulations as per the traffic movement and incident analysis reports
6	Natural Disaster	i. In case of natural disaster, follow advisory issued by IWAI and other agencies. ii. In case of distress, send communication to nearest control room iii. Crew should know Emergency procedures
7	Approaching vessel/ Low visibility	Distress Signal: As mentioned in the prevention of Collision on the National Waterways regulations. The following signals are widely used in sea either together or separately, indicating distress and need of assistance: i. a gun or other explosive signal fired at intervals of about a minute; ii. a continuous sounding with any fog-signaling apparatus; iii. rockets or shells, throwing red stars fired one at a time at short intervals; iv. a signal made by radiotelegraphy or by any other signaling method consisting of the group (SOS) in the Morse Code; v. a signal consisting of a square flag having above or below it a ball or anything resembling a ball; vi. Flames on the vessel (as from a burning tar barrel, oil barrel, etc.); vii. a rocket parachute flare or a hand-flare showing a red light; viii. a smoke signal giving off orange-colored smoke; ix. slowly and repeatedly raising and lowering arms outstretched to each side; x. the radiotelegraph alarm signal; xi. the radiotelephone alarm signal; xii. signals transmitted by emergency positioning-indicating radio beacons; xiii. Approved signals transmitted by radio communication systems, including survival craft radar transponders.
8	Piers and jetty	i. Marker buoys should be installed ii. Fenders should be mounted on the piers of cross over structure or jetty
9	Sabotage	i. Zones that have higher risk of such incidents should be marked ii. Pilots should be trained to remain calm and use distress signal without alarming the Saboteurs

d) Coordination

At the time of crisis, IWAI needs to coordinate with different agencies to contain the damages caused by the incident. Below table summarizes the agencies IWAI should coordinate and the form of coordination.

S.No	Main Role	Type of expertise/ role	Process of coordination
1	DM office of nearest district	Part of Incident Response team and salvage/ wreck removal operations	i. Update them about Crisis Management Plan of IWAI ii. Involve them in regular mock drills iii. Create Common Incident Group
2	State River Police		
3	Police		
4	Fire Department		
5	Pollution Control Board	Need to inform about pollution Need permission to use spillage containment mechanism like dispersant	

6	Department of Water Supply and Irrigation in the state	Inform to stop intake of water from the waterway Publish advisory in media so that private connections also stop using the water	iv. v. vi. vii.	Develop Incident reporting form Create mutually agreed SLA Create Common Incident reporting and analysis system Maintain a list of experts capable of performing emergency and/or remedial actions associated with a hazardous materials incident
7	Fisheries Department	Inform to publish advisory to fishing community		
8	Coast Guard, Indian Navy (marine)	Characteristics of different goods, their hazards and control requirements on water Equipment and resources personal for containing spillage Search & Rescue operation in wider area		
9	Directorate of Industrial Safety and Health (For land)	Characteristics of different goods, their hazards and control requirements on land		

5.2.1.2. Response Plan

S.No	ACTION TO BE CONSIDERED	On site Action Group	External Action Group
1	**IMMEDIATE ACTION** **Collision/Grounding/Contact/Capsizing:** i. Slow down and stop main engines ii. Sound Emergency Alarm: iii. Check for possibility of oil pollution/ leakage iv. Effect appropriate damage and pollution controls v. Ensures vessel is cleared of the channel / turning basin or berths to suitable area for normal traffic vi. Send distress signal to the nearby vessel and nearest control room vii. Control room should inform nearest terminal and command center viii. Should accurately report material spilled/leaked, environmental circumstances and location ix. Confirm appropriate pollution control and response measures are in place or standby and inform external agencies **Fire/Explosion:** x. Consider sounding Emergency Alarm xi. Initiate vessel emergency response procedure xii. Send distress signal to the nearby vessel and agents of the terminal **Problems in Navigation and due to Cross over Structure:** xiii. to look after navigational aids, fenders; along with necessary staff xiv. ensure that all blockades due to falling of trees, walls, sheds etc. are cleared immediately xv. send distress signal to the nearby vessel and agents of the terminal *In case of collision, it shall be duty of the Master (Vessel) or person in charge to move the crew/passengers to another vessel and provide details of the destination to the other vessel. He shall also enter the incident in the official log and report to the central government. **Sabotage** **i.** The crew should remain calm and try to use distress signal to inform the authorities	Asst. Director (Operations, Safety and Security), Junior Hydrographic Surveyor, Officer (Operations, Safety and Security), Technical Assistant (Civil), Technical Assistant (Mech Marine), Pilot, Master (Vessel)	

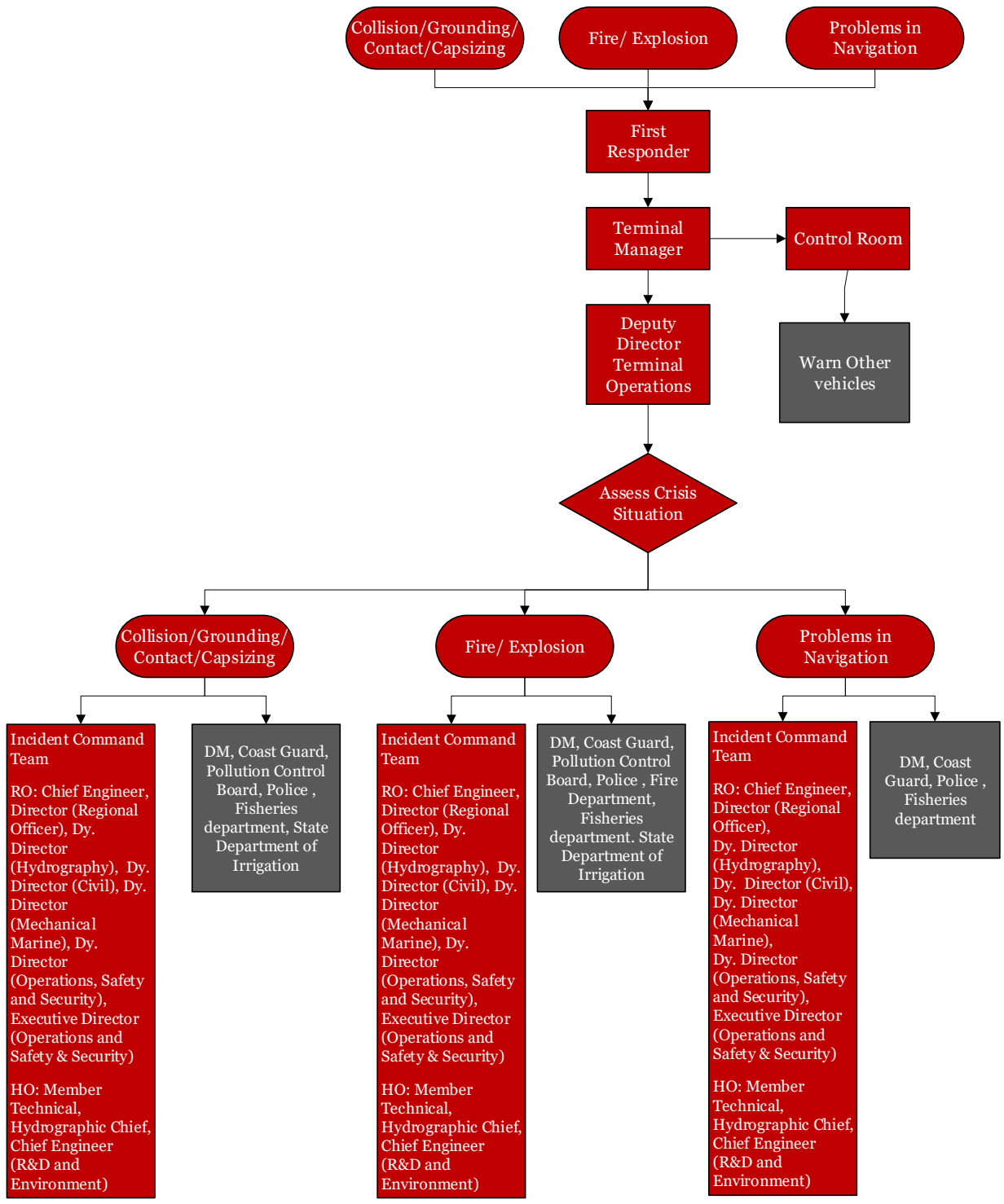
2	**INITIAL RESPONSE-COMMAND CENTRE** **Collision/Grounding/Contact/Capsizing/ Problems in Navigation and due to Cross over Structure:** i. Establish communication with terminal radio stations and other vessels ii. Advise other vessels to keep clear-Hoist NUC Lights/ Signals iii. Advise terminal for assistance iv. Secure evidence and maintain adequate records v. Movement of all other vessels/vehicles into or out of the navigation channel/ terminal area/ storage area should be supervised or restricted and alternative orders issued as necessary vi. Tugs should be put on standby vii. Fire Department should be informed and advised for the required action viii. Communications should be maintained and events are to be recorded as appropriate ix. Ascertain details of the incident, including the location of the incident, the vessel's particular's, direction of the vessels head, water level, extent of damage to vessel or terminal structure, prevailing and predicted weather conditions and damage to navigational aids x. Form Incident Command Team xi. Assess level of response required (R1/ R2/R3/R4) **Fire/Explosion:** Cease all cargo and / or bunkering operation: Close manifold valves: Fire squads to position deemed best for fighting the fire Inform terminal/loading master/bunkering personnel **Sabotage** **i.** Incident command team should inform local authorities immediately **ii.** Try to establish communication with saboteurs and negotiate their demand **iii.** Personal safety should be the priority **iv.** In case the cargo transported is of hazardous or dangerous in nature, fire squads should also be part of incident team	Asst. Director (Operations, Safety and Security), Junior Hydrographic Surveyor (JHS), Medical Officer	District Collector's office, IWT/ Maritime Board, Port Authorities, Coast Guard, Local Panchayat

3	**FURTHER RESPONSE-EMERGENCY TEAM** i. Ascertain evacuation information is reported immediately and relay it to key external responder's i.e. police and ambulance ii. Broadcast alert messages on Vessel system and communicate through VHF if vessel are approaching accident zone iii. In case of injury inform medical officer for first aid and nearest health center for serious injuries iv. Deploy survey team to direct or guide dredgers to remove the capsized or stuck vessel v. Send terminal tugs and crafts vi. In case threat of pollution inform SPCB and known experts vii. Incident command team on further assessment escalate/ deescalate the response level requirement and communicate and coordinate with outside agencies accordingly	Incident Command Team: Technical Assistant (Civil), Technical Assistant (Mech Marine)	R2: District Collector's office, Nearest Health Center R3: SDMA CMO, SDRF, SPCB, State's IWT or Maritime board, Fisheries Department, Port Authorities, Marine/ River Police R4: NDMA, NDRF, Army, Navy, CPCB, Coast Guard, MHA
4	**SECONDARY RESPONSE- SUPPORT TEAM** i. Provide First Aid ii. Prepare Lifeboats iii. Shut All W/T doors and vents iv. Assist as directed v. Conduct media briefing vi. Establish limit of liability of vessel operator vii. Undertake disposal of damaged cargo/oil viii. Organize specialist assistance & make necessary financial arrangements ix. Start salvage operations x. Report the incident in common incident database	Incident Command Team RO: Chief Engineer, Director (Regional Officer), Dy. Director (Hydrography), Dy. Director (Civil), Dy. Director (Mechanical Marine), Dy. Director (Operations, Safety and Security), Executive Director (Operations and Safety & Security) HO: Member Technical, Hydrographic Chief, Chief Engineer (R&D and Environment)	R2: District Collector's office, Nearest Health Center R3: SDMA CMO, SDRF, SPCB, State's IWT or Maritime board, Fisheries Department, Port Authorities, Marine/ River Police R4: NDMA, NDRF, Army, Navy, CPCB, Coast Guard, MoEFCC,

5	**FURTHER RESPONSE-ENGINEERS/ SURVEY TEAM** i. Report status of main engine and auxiliaries to Command Centre and Terminal Master (Vessel) ii. If vessels have blocked channel-tugs standby and vessels taken to repair berth/anchorage awaiting class surveyors recommendations iii. Analyze incident causes and impact and update/issue guidelines iv. Survey team will clear the navigation channels for normal operations	Asst. Director (Operations, Safety and Security),Chief Engineer (Mech-Marine), Chief Engineer (Civil), Director(Finance)	

4: Vessel Accident

Crisis Response Flow Chart



Action to be taken

Collision/Grounding/ Contact/Capsizing:

Slow down and stop main engines
Sound Emergency Alarm:
Send distress signal to the nearby vessel and nearest control room

Fire/Explosion:

Consider sounding Emergency Alarm
Initiate vessel emergency response procedure
Send distress signal to the nearby vessel and agents of the terminal

Problems in Navigation and due to Cross over Structure:

look after navigational aids, fenders; along with necessary staff
ensure that all blockades due to falling of trees, walls, sheds etc. are cleared immediately
send distress signal to the nearby vessel and agents of the terminal

Call for assistance using mobile phone/ telephone or VHF

Coordinate and pass the information to the port authorities

Assessment of incident, significant impacts and respective agencies informed

Collision/Grounding/ Contact/Capsizing

Advise other vessels to keep clear
Hoist NUC Lights
Inform incident command team

Fire/ Explosion

Cease all cargo and / or bunkering operation,

Close manifold valves,

Fire squads to position deemed best for fighting the fire,

Inform terminal/loading master/bunkering personnel:

Problems in Navigation

Communications should be maintained and events are to be recorded as appropriate
Ascertain details of the incident, including the location of the incident, the vessel's particular's, direction of the vessels head, water level.

Figure 14: Flow Chart of Crisis Response during Vessel Accident

5.2.2. Pollution

Pollution on NWs could occur from collision and vessel related incidents, disposal of waste and wastewater from vessels as well as the overall operations of vessels, terminals, ferry crossings, transshipment refueling stations and petroleum terminals along with the carriage, handling and storage of dangerous goods. However, it would qualify for being a crisis when it is sudden and has high impact on environment.

Until now only materials like cement, fly ash, metal ores, coal, oils, construction material, food, essential commodities, ethylene etc. was being transported but now Petroleum products and other dangerous goods are also being transported. If not managed properly, these cargoes have the potential to cause significant pollution and even cause major incidents such as fires and explosions affecting riparian communities. The Inland Vessels (Prevention and Control of Pollution and Protection of Inland Water) Rules, 2016 defines and lists hazardous chemicals or substances. The type of cargo that is been transported by the vessel is the biggest determinant factor of the impact it might have in case of incident. In case of spillage of dangerous goods, there will be impact on aquatic life and human health. Magnitude of impact will depend on the following parameters:

1. **Type of dangerous goods**
2. **Toxicity of the good**
3. **Characteristics of substance** like solubility, viscosity, flash point, Persistence etc.
4. **Form of the good** (gas/ liquid/ two phase)
5. **Volume released and dispersion type** (cloud dispersion, fire, explosion etc.)
6. **Location of incident**: ambient air quality, air speed and direction, water flow, turbulence, thermal radiation
7. **Receptors**: population density, other industrial establishments, archaeological site etc., water supply, irrigation channel, uses of water, aquatic life, critical infrastructure like railway bridge, highway etc.
8. **Presence of sensitive natural receptors**: Ecologically sensitive zone, habitat areas for threatened species like river dolphins, Kachua sanctuary, special ecosystems like mangroves, National Parks

Trans-boundary aspects of pollution need to be considered on NW1 and 2 where international laws will come into picture**.** The pollution crisis can be classified based on the impact as following:

1. High Impact Incident

This applies to any one or more of the following situations:

i. There is a significant and immediate threat to human life or property
ii. Located within any proclaimed Public Drinking Water Source Area, including Underground Water Pollution Control Areas, declared Catchment Areas and Water Reserves
iii. Could result in significant or immediate harm to native fauna and flora
iv. Observable harm has occurred to environmental receptors e.g. fish deaths
v. Located within water catchments that have recognized conservation or scientific values.
vi. The incident has the potential to persistently contaminate soil or water resources

2. Moderate Impact Incident

This applies to any one or more of the following situations:

i. There is a significant (but not immediate) threat to human life, amenity or property
ii. Located outside any proclaimed Public Drinking Water Source Area, but within close proximity to private water supply sources
iii. Chronic or long-term harm to native fauna and flora may result
iv. Long-term (but not immediate) observable impact may occur to environmental receptors

3. **Low Impact Incident**

This applies to any one or more of the following situations:

i. No perceived threat to human life or property.
ii. Located outside sensitive environments e.g. areas with recognized water resource values.
iii. Poses no immediate or long-term threat to environmental receptors

Under this section pollution caused by oil spill or cargo spillage/ leakage from vessel, during transferring operations and storage area are covered.

5.2.2.1. *Prevention measures*

a) Legal

Human induced crisis incidents can be averted if proper legal framework is prepared and implemented. Following table summarizes gaps in existing legislations relevant to vessel related incidents.

Existing Rules	Critical gaps in the rules	Recommended amendments/ rules/ practices
1. Environment Protection Act 1986 **2. Manufacture, storage and import of hazardous chemicals rules, 1989 and amendments 1994 and 2001** **3. The Petroleum Act, 1934; Petroleum Rules 1976 and amendments** **4. The Factories Act - 1948 and Amendments** **5. Oil Industry Safety Directorate (OISD)** **6. National Disaster Management Guidelines –Chemical Disaster Management** **7. Inland Vessels (Prevention and Control of Pollution and Protection of Inland Water) Rules, 2016**	i. None of the rules cover transportation of hazardous goods or petroleum by river navigation ii. There are no guidelines on the standard forms required to be filled on inland terminals iii. Integration of type of goods transported and kind of containment equipment which will be required on the vessel	**Regulation on cargo & Traffic in Inland terminals should include:** **1.** International Safety Guide for Inland Navigation Tank-Barges and Terminals, 2010 2. Revised Recommendations on the Safe Transport of Dangerous Cargoes and Related Activities in Port Areas 3. Classification of cargos/ POL based on persistence in environment, trajectory on waterway, characteristics and weathering and response technique to be used 4. SOP for transportation, transferring and handling at terminals 5. There should be rules of construction and color coding of vessels carrying dangerous goods 6. Vessels carrying dangerous goods should have safety equipment and containment equipment sufficient to handle accidental spillage. 7. Vessels need to have “Emergency plan” as per this document.

b) Early detection and communication system

S.No	Impact Area	Equipment	Communication
1	Terminal	RIS, mobile phone	VHF
2	Vessel	AIS, GPS, mobile phone	VHF, mobile/ telephone

c) Infrastructure

S.No	Factors/ Causes	Prevention Plan
1	Navigation	i. Follow regulations ii. Follow instructions of pilot iii. Give training on safe navigation iv. Buoyage/ fixed marks for safe speed, hotspots etc. should be installed by IWAI v. Keep check on vessel movement and report to next control center in case non-compliance of instructions vi. IWAI need to have tug vessels, pontoons with hozers, pontoon with cranes to unload vessel, rescue boats, skimmers, booms, dispersants etc. vii. IWAI should identify receptors and sensitive natural receptors on the navigation channel viii. For all the dangerous goods, IWAI should analyze liquid/ gaseous release events using dispersion models which uses physical properties of substance, meteorological data, leakage rate etc. to establish the level of impact of each type of release incident.
2	Check of compliance	Proactive- periodic audits, reviews, safety inspection, safety committee meetings, checking Master (Vessel) and other crew member's knowledge on safety regulations Reactive- Accident/incident/near miss reporting, incident investigation
3	Design Error	Issue regulation on type of vessel can transport what kind of cargo and keep check on adherence
4	Outdated regulations	Update regulations as per the traffic movement and incident analysis reports
5	Natural Disaster	In case of natural disaster, follow advisory issued by IWAI and other agencies. In case of distress, send communication to nearest control room Crew should know Emergency procedures
6	Mishandling of transfer of cargo	i. Follow instructions of terminal operations Asst. Director ii. Moor the vessels properly on the berth iii. Secure the loading/ unloading equipment or pipeline iv. Inspect the connection v. Transfer vi. In case of detection of leakage/ spillage, immediately stop transfer and inspect the cause vii. Do not start transferring operation till Engineering team doesn't gives "Go ahead" iii. Avoid risk related activities at times when weather conditions may magnify any harm caused by a spill e.g. outdoor unloading during rainfall
7	Storage of cargo	i. Maintain Material Safety Data Sheet ii. Store chemicals on hardstand flooring on safe racks or pallets in secure and weatherproof buildings iii. Place spill risk facilities away from sensitive environments with a sufficient buffer to allow for effective intervention prior to water pollution occurring iv. Use secondary spill control facilities such as bounded containment compounds v. Only authorized personals should be allowed to access the area vi. Installation of smoke detector, foam based fire extinguishers and fire exits

		vii. Install fire alarms which are connected to emergency control room and nearby fire station viii. Way to fire exits is marked ix. Storage area should distant from other buildings x. Provide Fire hose (adjacent buildings), Fire hydrant booster and Sprinkler system in buildings xi. Have secondary power supply for emergency response equipment xii. First Aid for burn injury xiii. Regular Mock Fire drills are conducted xiv. All the Firefighting equipment must be maintained regularly xv. Staff trained on using Firefighting equipment xvi. Closure of area in case of fire vii. Staff must know local fire department emergency number viii. Fire station should be alert 24*7 xix. In case of natural disaster, keep staff ready for fire emergency

d) Coordination

At the time of crisis, IWAI needs to coordinate with different agencies to contain the damages caused by the incident. Below table summarizes the agencies IWAI should coordinate and the form of coordination.

S.No	Main Role	Type of expertise/ role	Process of coordination
1	DM office of nearest district	Part of Incident Response team	i. Update them about Crisis Management Plan of IWAI ii. Involve them in regular mock drills iii. Create Common Incident Group iv. Develop Incident reporting form v. Create mutually agreed SLA vi. Create Common Incident reporting and analysis system vii. Maintain a list of experts capable of performing emergency and/or remedial actions associated with a hazardous materials incident
2	State River Police		
3	Police		
4	Fire Department		
5	Pollution Control Board	Need to inform about pollution Need permission to use spillage containment mechanism like dispersant	
6	Department of Water Supply and Irrigation in the state	Inform to stop intake of water from the waterway Publish advisory in media so that private connections also stop using the water	
7	Fisheries Department	Inform to publish advisory to fishing community	
8	Coast Guard, Indian Navy (marine)	Characteristics of different goods, their hazards and control requirements on water Equipment and resources personal for containing spillage Search & Rescue operation in wider area	
9	Directorate of Industrial Safety and Health (For land)	Characteristics of different goods, their hazards and control requirements on land	

5.2.2.2. Response Plan

S.No	ACTION TO BE CONSIDERED	ACTION GROUP TERMINAL	ACTION GROUP VESSEL	ACTION GROUP EXTERNAL
1	**IMMEDIATE ACTION** i. Slow down and stop main engines ii. Sound Emergency Alarm: iii. Immediately inform nearest control room about the incident iv. Effect appropriate damage and pollution controls v. Control room should inform nearest terminal and command center vi. Should accurately report material spilled/leaked, environmental circumstances and location vii. Confirm appropriate pollution control and response measures are in place or standby and inform external agencies	Asst. Director (Operations, Safety and Security), Officer (Operations, Safety and Security), Technical Assistant (Civil), Technical Assistant (Mech Marine), Pilot, Master (Vessel)	Master (Vessel), Pilot	R2: District Collector's office, Nearest Health Center, SPCB, Directorate of Industrial Safety and Health (For land), Coast Guard, CMG, Local Panchayat R3: SDMA CMO, SDRF, State's IWT or Maritime board, Fisheries Department, Port Authorities, Marine/ River Police R4: NDMA, NDRF, Army, Navy, CPCB, MoEFCC,

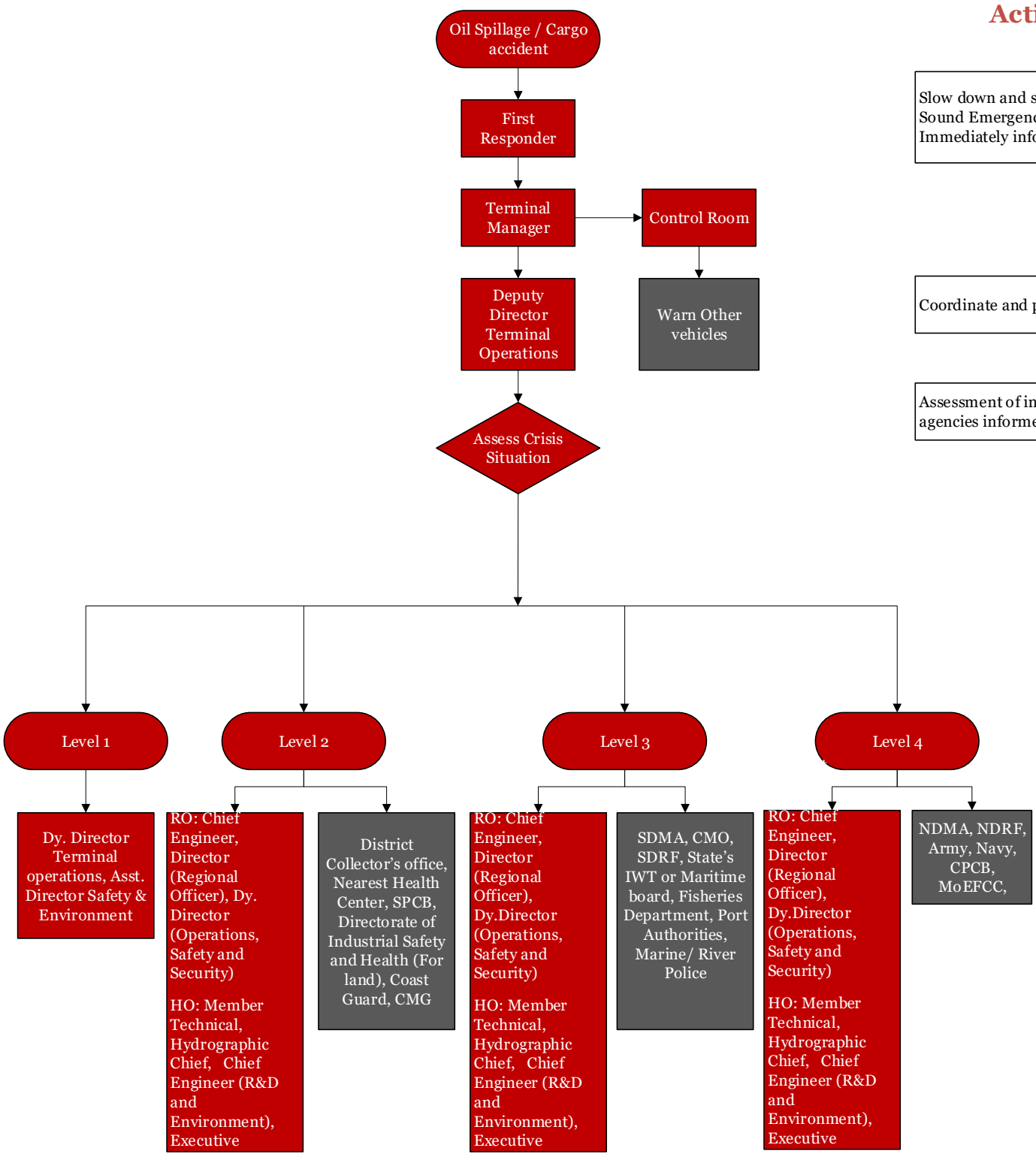
2	**INITIAL RESPONSE-COMMAND CENTRE** i. Movement of all other vessels/vehicles into or out of the navigation channel/ terminal area/ storage area should be stopped and alternative orders issued as necessary ii. Tugs should be put on standby iii. Fire Department should be informed and advised for the required action iv. Communications should be maintained and events are to be recorded as appropriate v. Ascertain details of the incident, including the location of the incident, the vessel's particular's, direction of the vessels head, water level, extent of damage to vessel or terminal structure, prevailing and predicted weather conditions and damage to navigational aids vi. Marine Police should be directed to proceed to the location of the incident and clear the area of fishing and other traffic vii. Confer with the master regarding plans for the refloating the vessel and the subsequent need for an alternative berth viii. Form Incident Command Team ix. Advise External Action Group on the form of pollution and seek permission from SPCB in using containment equipment which might harm sensitive environment like dispersants x. Pollution containment equipment should be deployed as necessary xi. Vessel operator should be informed	Asst. Director (Operations, Safety and Security), Technical Assistant (Mech Marine), Control room Officer , Medical Officer		R2: District Collector's office, Nearest Health Center, SPCB, Directorate of Industrial Safety and Health (For land), Coast Guard, CMG R3: SDMA CMO, SDRF, State's IWT or Maritime board, Fisheries Department, Port Authorities, Marine/ River Police R4: NDMA, NDRF, Army, Navy, CPCB, MoEFCC,

3	**FURTHER RESPONSE-EMERGENCY TEAM** i. Refer to NDMA Chemical Accident Management Plan, Online oil spill advisory and NOS DCP for guidance ii. Inspects/assesses damaged area-reports to Command Centre-In case oil leakage determine whether separating vessels will increase oil spill rate iii. Ascertains oil pollution-ascertains leak source- if pollution requests terminal for immediate assistance and level of response required iv. Asst. Director (Operations, Safety and Security) and Master (Vessel) board vessel to inspect both vessels with standby tugs v. Sounds all bilge, ballast and fuel tanks vi. Transfer oil/ cargo from the vessel into emergency barges vii. Checks damage stability and stress criteria viii. Effects damage control and temporary repairs to stop oil leakage with the assistance of port action group and underwater welding team or salvage group	Incident Command Team: Technical Assistant (Civil), Officer (Operations, Safety and Security) Junior Hydrographic Surveyor (JHS)		R2: District Collector's office, Nearest Health Center, SPCB, Directorate of Industrial Safety and Health (For land), Coast Guard, CMG R3: SDMA CMO, SDRF, State's IWT or Maritime board, Fisheries Department, Port Authorities, Marine/ River Police R4: NDMA, NDRF, Army, Navy, CPCB, MoEFCC

4	**SECONDARY RESPONSE- SUPPORT TEAM** i. Provide First Aid ii. Prepare Lifeboats iii. Shut All W/T doors and vents iv. Assist as directed v. Conduct media briefing vi. Establish limit of liability of vessel operator vii. Undertake disposal of damaged cargo/oil viii. Organize specialist assistance & make necessary financial arrangements ix. Start salvage operations x. Report the incident in common incident database	Incident Command Team RO: Chief Engineer, Director (Regional Officer), Dy. Director (Operations, Safety and Security) HO: Member Technical, Hydrographic Chief, Chief Engineer (R&D and Environment), Executive Director		MoEFCC, Coast Guard
5	**FURTHER RESPONSE-ENGINEERS TEAM** i. Report status of main engine and auxiliaries to Command Centre and Terminal Master ii. If vessels have blocked channel-tugs standby and vessels taken to repair berth/anchorage awaiting class surveyors recommendations ii. Analyze incident causes and impact and update/issue guidelines	Asst. Director (Operations, Safety and Security),Chief Engineer (Mech-Marine), Chief Engineer (Civil),		

5: Pollution/ Oil Spillage

Crisis Response Flow Chart



Action to be taken

Slow down and stop main engines
Sound Emergency Alarm:
Immediately inform nearest control room about the incident

Coordinate and pass the information to the port authorities

Assessment of incident, significant impacts and respective agencies informed

Movement of all other vessels/vehicles into or out of the navigation channel/ terminal area/ storage area should be stopped and alternative orders issued as necessary
Tugs should be put on standby
Fire Department should be informed and advised for the required action
Communications should be maintained
Report the incident in common incident database

Figure 15: Flow Chart of Crisis Response during Pollution/ Oil Spillage

5.2.3. Function Failure

Function failure is very common and can cause personal injuries and damage cargo thus it is very important to understand causes of failure. Function Failure can be broadly classified into:

Structural Failure

Structural Failure is defined as failure of structural strength for which it was designed. It will include incidents starting from development of cracks (difficult to detect) to actual disintegration of the structure. Following factors contribute to structural failure

i. Lack of appropriate professional design and construction experience, especially when novel structures are needed.
ii. Complexity of codes and specifications leading to misinterpretation and misapplication.
iii. Unwarranted belief in calculations and in specified extreme loads and properties.
iv. Inadequate preparation and review of contract and shop drawings.
v. Poor training of field inspectors.
vi. Compressed design and/or construction time.
vii. Static loading
viii. Corrosion of Reinforced Steel
ix. Carbonation of concrete
x. Roof Defects
xi. Foundation Failure

Equipment Failure

Equipment failure refers to any event in which any equipment cannot accomplish its intended purpose or task. It may also mean that the equipment stopped working, is not performing as desired, or is not meeting target expectations.

Mechanical equipment breakdown is due to

i. Oil contamination
ii. Misalignment
iii. Metal fatigue
iv. Operator error
v. Electrical disturbances
vi. Vibration
vii. Foreign material

Boiler and pressure vessel equipment is vulnerable to breakdown due to:

i. Pump failure
ii. Low water cut-off mechanism failure
iii. Control failure
iv. Scale build-up
v. Inadequate controls of safety devices

Electrical and electro-mechanical equipment is due to

i. Power surges
ii. Power interruptions
iii. Electrical line surges
iv. Insulation deterioration
v. Overload conditions

vi. Separation of assembled parts

Electrical problems, which can result in vibration, include;

i. Soft foot
ii. Uneven air gap
iii. Cracked or broken rotor bars
iv. Eccentric rotors
v. Loose phase connections

Fire Equipment failure can occur because of

i. Control failure
ii. Vibration
iii. Lack of lubrication
iv. Scale build-up
v. Rapid weather change

5.2.3.1. Prevention measures

a) Legal

Human induced crisis incidents can be averted if proper legal framework is prepared and implemented. Following table summarizes gaps in existing legislations relevant to vessel related incidents.

Existing Rules	Critical gaps in the rules	Recommended amendments/ rules/ practices
1. The Factories act, 1948 **2. The Dock Workers(Safety, Health and Welfare)** **3. Bureau of Indian Standards (BIS): Occupational Health and safety Management systems - Specification and Guidance for use, IS 15001:2000. New Delhi 2000**	• No rules on timely inspection of critical structures • Rules don't include safety precautions	SOP for all the operational activities Checklist for inspection of structures, buildings, material handling equipment and vessel's seaworthiness

b) Early detection and communication system

S.No	Impact Area	Equipment	Communication
1	Terminal	RIS	VHF
2	Vessel maintenance activity		Maintenance log
3	Vessel Operations	AIS, GPS, Radar, Echo sounder	VHF, mobile/ telephone

c) Infrastructure

S.No	Impact area	Factors/ Causes	Prevention Plan
1	Berths & Jetties	Design and review of design	All the DPR's should consider appropriate loads according to the design use and possible loads caused by wind or vibrations(earthquake)

		Corrosion & carbonation	Use of anti-corrosion paint, inspect structures periodically, report any cracks developed
2	Terminal Area and storage area	Design and Review	All the DPR's should consider appropriate loads according to the design use and possible loads caused by wind or vibrations(earthquake)
		Overloading	Make sure structures should not be used more than its designed loads and prepare alternate arrangement for greater demand
3	Material Handling equipment	Oil Contamination	Regular fitness check and maintenance
		Overloading	should not be used more than its designed loads
		Operator's error	Operators should undergo training on SOP Operator's should not work for more than designated hours Operators should undergo regular health checkup

d) Coordination

At the time of crisis, IWAI needs to coordinate with different agencies to contain the damages caused by the incident. Below table summarizes the agencies IWAI should coordinate and the form of coordination.

S.No	Main Role	Type of expertise/ role	Process of coordination
1	DM office of nearest district	Part of Incident Response team	• Update them about Crisis Management Plan of IWAI • Involve them in regular mock drills • Create Common Incident Group • Develop Incident reporting form • Create mutually agreed SLA
2	Police		
3	Fire Department		
4	Nearest Health Center		
5	Vessel/ equipment owner	Informed about the incident	

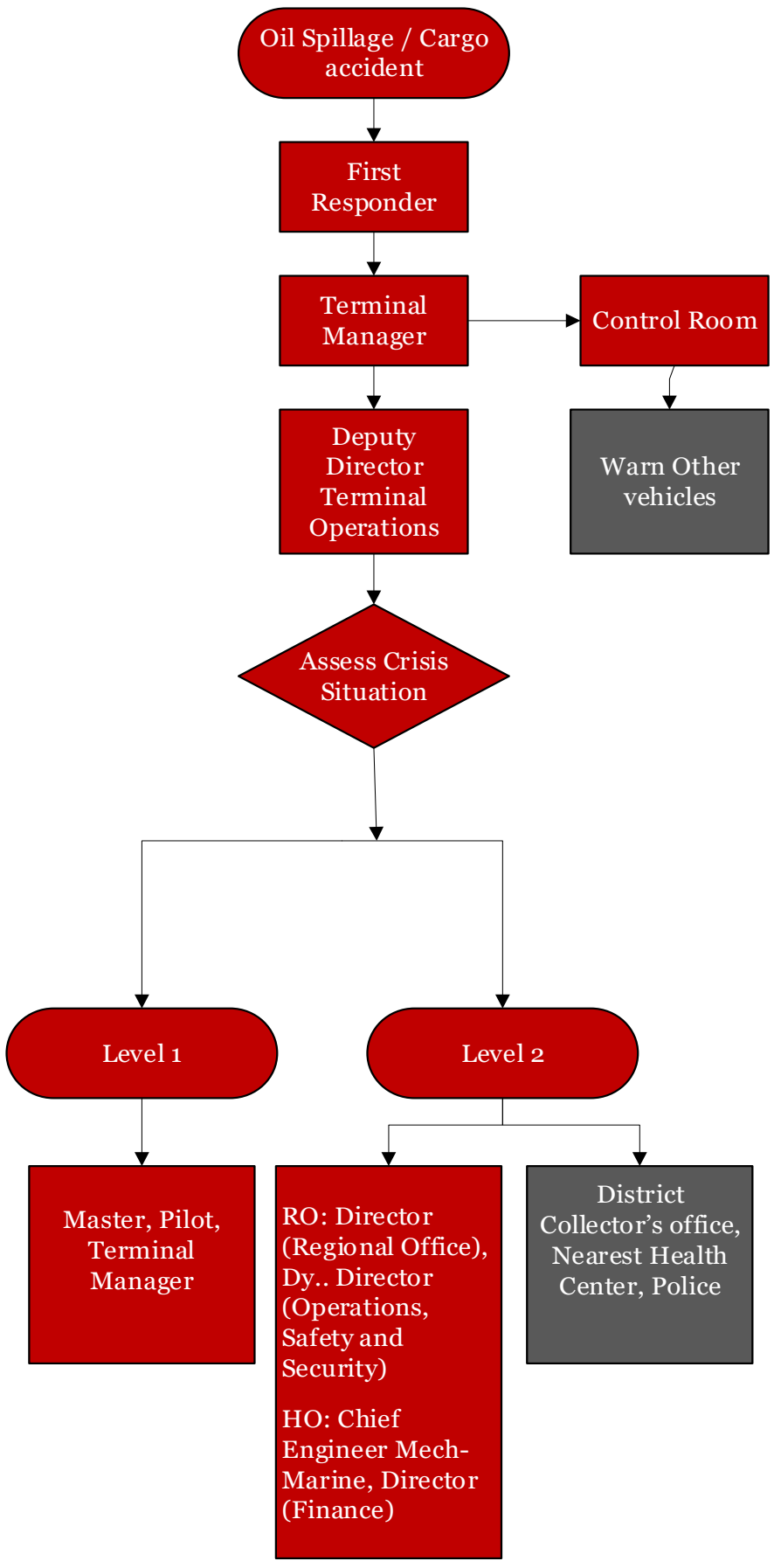
5.2.3.2. Response Plan

S.No	ACTION TO BE CONSIDERED	ACTION GROUP TERMINAL	ACTION GROUP VESSEL	ACTION GROUP EXTERNAL
1	**IMMEDIATE ACTION** i. Stop operations of that area ii. Demarcate the area and do not allow entry on vessel/ equipment iii. Attend to if some personal injuries with help of medical officer iv. Provide first aid v. Activate secondary structure/ equipment vi. If there is damage to cargo/container, unload it with the help of cranes and forklifts vii. Remove the debris/ equipment parts viii. Inspect the site and submit report	Asst. Director (Operations, Safety and Security),Officer (Operations, Safety and Security),Control room Officer, Medical Officer	Master (Vessel), Pilot	R2: District Collector's office, Nearest Health Center, Police, Local Panchayat

2	**INITIAL RESPONSE-COMMAND CENTRE** i. Scrutinize the incident report ii. Assess time required for recovery of normal operations iii. Provide permission to use secondary arrangements iv. Assess liabilities if any	RO: Director (Regional Office), Dy. Director (Operations, Safety and Security) HO: Chief Engineer Mech-Marine, Director (Finance)		

6: Structural and Equipment Failure

Crisis Response Flow Chart



Action to be taken

Slow down and stop main engines
Sound Emergency Alarm:
Immediately inform nearest control room about the incident

Stop operations of that area
Demarcate the area and do not allow entry on vessel/ equipment

Coordinate and pass the information to the port authorities

Assessment of incident, significant impacts and respective agencies informed

Scrutinize the incident report
Assess time required for recovery of normal operations
Provide permission to use secondary arrangements

Figure 16: Flow Chart of Crisis Response during Functional or Structural Failure

5.2.4. Civil Disturbance and Cyber Threat

Labor Action/Strike

i. **Economic Strike**: Under this type of strike, labors stop their work to enforce their economic demands such as wages and bonus. In these kinds of strikes, workers ask for increase in wages, allowances like traveling allowance, house rent allowance, dearness allowance, bonus and other facilities such as increase in privilege leave and casual leave.
ii. **Sympathetic Strike**: When workers of one unit or industry go on strike in sympathy with workers of another unit or industry who are already on strike, it is called a sympathetic strike. The members of other unions involve themselves in a strike to support or express their sympathy with the members of unions who are on strike in other undertakings. The workers of sugar industry may go on strike in sympathy with their fellow workers of the textile industry who may already be on strike.
iii. **Sit down Strike**: In this case, workers do not absent themselves from their place of work when they are on strike. They keep control over production facilities. However, they do not work. Such a strike is known as 'pen down' or 'tool down' strike. Workers show up to their place of employment, but they refuse to work. They also refuse to leave, which makes it very difficult for employer to defy the union and take the workers' places. In June 1998, all the Municipal Corporation employees in Punjab observed a pen down strike to protest against the non-acceptance of their demands by the state government.
iv. **Slow Down Strike**: Employees remain on their jobs under this type of strike. They do not stop work, but restrict the rate of output in an organized manner. They adopt go-slow tactics to put pressure on the employers.
v. **Sick-out (or sick-in)**: In this strike, all or a significant number of union members call in sick on the same day. They do not break any rules, because they just use their sick leave that was allotted to them on the same day. However, the sudden loss of so many employees all on one day can show the employer just what it would be like if they really went on strike

5.2.4.1. Causes

Causes of strikes:

i. Strikes can occur because of the following reasons:
ii. Dissatisfaction with company policy
iii. Salary and incentive problems
iv. Increment not up to the mark
v. Wrongful discharge or dismissal of workmen
vi. Withdrawal of any concession or privilege
vii. Hours of work and rest intervals
viii. Leaves with wages and holidays
ix. Bonus, profit sharing, Provident fund and gratuity
x. Retrenchment of workmen and closure of establishment
xi. Dispute connected with minimum wages

Civil disturbance

i. Disruption of key sea, rail, or road routes that link the port to the outside world, preventing access. This could follow a shipwreck in a critical channel, or river closure due to extended low (or high) water levels, or a landslip that closes the access road to an important customer's mine, quarry, or manufacturing facility.
ii. Damage at a key partner's port resulting in denial of access to that port.
iii. Loss of or damage to a customer's vessel or cargo.
iv. Political activity, civil disturbance, or strikes disrupting the flow of commodities to the port.
v. A utilities failure, either at the port itself or at a customer's premises.

Terrorism: Port, ferry, and cruise-ship terminals are often located in highly congested areas where large numbers of people live and work. Liquefied natural gas terminals and refineries that produce highly volatile petrochemicals

and convert crude oil into gasoline and heating oil are also often nearby. An attack that shut down a major port for even a few days could devastate the regional economy served by that port.

Cyber Threat: As the ports and terminal operations have interconnections and dependency on information and communications technology (ICT) systems and the internet, terminals are increasingly vulnerable to cyber-attacks. The difficulty with protecting automated terminals from cyber risks lies with their complexity. These terminals use industrial control systems that translate sensorial data and commands into mechanical actions. The network links between mechanical equipment and sensors are exposed to the same threats as data networks. The complexity is further increased by the months and years it can take to figure out and fix bugs and weaknesses in automated systems. In an automated system, different system components have to effectively work together as one stretching the time needed to figure out and fix bugs. This involves mainly software issues that have to be fixed while also moving boxes of cargo at the terminal.

While terminals have to secure themselves from a broad range of risks, cybercriminals can choose from a number of entry points. For example, external vendors, terminal operating systems, and unaware employees may be vulnerable to phishing attacks. Operational systems and data networks are not always up-to-date or properly secured, allowing criminals to gain comparatively easy access to information. To prevent the ports and shipping industry from most attacks, regular operating system updates, stronger passwords, secure satellite connections, resilience exercises, information sharing, and employee awareness campaigns should be practiced.

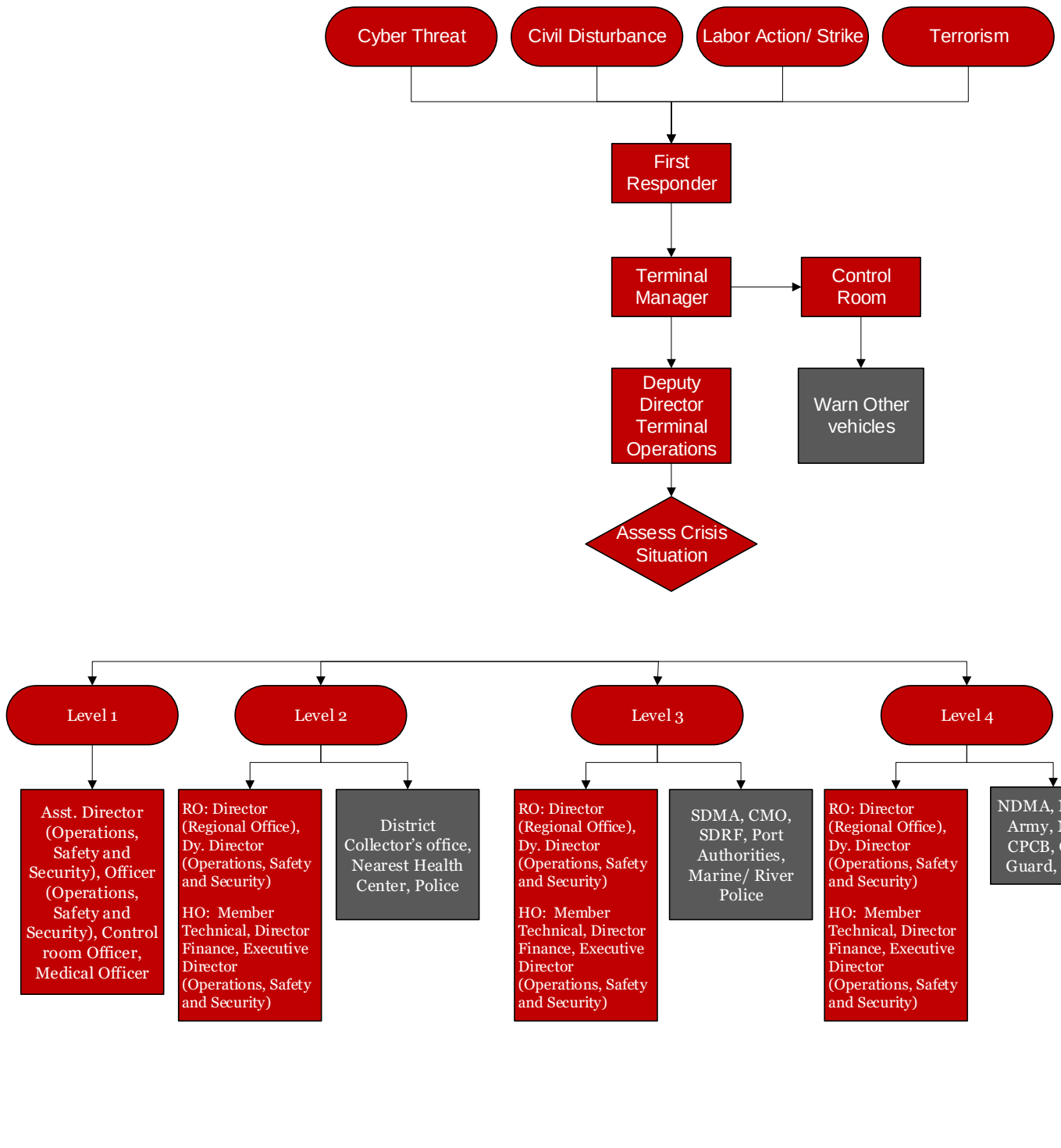
The detailed Cyber Security Plan is included in the Annexure 15

5.2.4.2. Response Plan

S.No	ACTION TO BE CONSIDERED	ACTION GROUP TERMINAL	ACTION GROUP VESSEL	ACTION GROUP EXTERNAL
1	**IMMEDIATE ACTION** i. Stop operations of that area ii. Evacuate terminal offices iii. Broadcast alerts to nearby vessels iv. Provide first aid v. Assess Response level required vi. Send incident report to RO and HO	Asst. Director (Operations, Safety and Security), Officer (Operations, Safety and Security), Control room Officer, Medical Officer	Master (Vessel), Pilot	R2: District Collector's office, Nearest Health Center, Police, Local Panchayat R3: SDMA CMO, SDRF, R4: NDMA, NDRF, Army, MHA
2	**INITIAL RESPONSE-COMMAND CENTRE** i. Scrutinize the incident report ii. Assess time required for recovery of normal operations iii. Provide permission to use secondary arrangements iv. Assess liabilities if any	RO: Director (Regional Office), Dy. Director (Operations, Safety and Security) HO: Member Technical, Director Finance, Executive Director (Operations, Safety and Security)		

7: Human related Crisis

Crisis Response Flow Chart



Action to be taken

Slow down and stop main engines
Sound Emergency Alarm:
Immediately inform nearest control room

Stop operations of that area
Demarcate the area and do not allow entry on vessel/ equipment

Coordinate and pass the information to the port authorities

Assessment of incident, significant impacts and respective agencies informed

Scrutinize the incident report
Assess time required for recovery of normal operations
Provide permission to use secondary arrangements

Figure 17: Flow Chart of Response during Human Related Crisis

6. Roles & Responsibilities

6.1. Vessel level

Floating Staff

Pilot

The pilot has a specialized knowledge of navigation in local waters. Duties of pilot at the time of emergency:

1. Understand and agree with Master (Vessel) on the distribution of responsibilities
2. Exercise right not to proceed to a point where the vessel would not be able to maneuver or would be in any danger
3. Assist Master (Vessel) to take precautions and safely navigate vessel during extreme weather conditions and take shelter in safe zone
4. Assist Master (Vessel) in communicating with terminal officer, control room officers and local administration at the time of distress
5. Assist Master (Vessel) to follow instructions given by control room officers

Master (Vessel)

1. Always take appropriate precautions for the safety of their vessels, passengers and crew. Follow precautionary instructions given by pilot on navigation
2. Ensure crew has understanding of their SOPs and Emergency response plan
3. In extreme weather conditions, closely follow pilot and control room instructions the in relation to the operation and movement of vessels
4. Familiarize themselves with this CMP plan, determine the most appropriate safety plan for their vessel and respond in accordance with any directions
5. Monitor developments to ensure that they have the most up-to-date information on weather conditions and any directions in place
6. Unless unavoidable, all owners of vessels on the water should ensure their vessel is capable of moving without assistance, particularly during recognized extreme weather event peak seasons (e.g. cyclone and flood seasons). Check all critical parts of the vessel are maintained and are operational. All safety and communication equipment are available and in working conditions. Firefighting equipment should be commensurate with the type of cargo transported by the vessel.
7. Securely stow all loose items
8. Provision vessels with fresh water, food and fuel and ensure all batteries are charges
9. During alert period, masters should review their safety plans and address any matters outstanding (e.g. fuel)
10. In the case of any vessel loading or discharging goods, including tankers, all such operations will cease immediately and not resume until the Assistant Director (Operations, Safety and Security) gives authorization. All the vessels carrying dangerous goods must be battened down or covered during an emergency.
11. Vessels must proceed as far as into the designated shelter areas so as not to impede the passage of other vessels
12. Vessels should not return to their normal berths until officially advised and it is safe to do so

13. In case vessel is small, it should be moored in their designated area and final preparations and tying off completed
14. Anchoring of large vessels upstream is not recommended due to water surges that could inundate the area, which, with high winds, may well strand vessels inland of the river system, making any salvage extremely difficult
15. In extreme weather conditions, Master (Vessel) should enact their vessel safety plans noting that the navigation is likely to be closed and/or vessel movements restricted commensurate with the threat to safety of vessel movements or the environment
16. Should maintain a listening watch on IWAI VHF frequencies and follow advice/directions from RIS control rooms
17. If a vessel is involved in an accident or emergency situation whereby the safety of life, vessel, cargo or the marine environment is threatened, Master (Vessel) is responsible for enacting vessels Emergency Response Plan and IWAI's Crisis Management Plan: Slow down and stop main engines
    i. Sound Emergency Alarm an hoist distress signal
    ii. Check for possibility of oil pollution/ spillage
    iii. Effect appropriate damage and pollution controls
    iv. Ensures vessel is cleared of the channel / turning basin or berths to suitable area for normal traffic
    v. Send distress message to the nearby vessel and nearest control room
    vi. Should accurately report material spilled/leaked, environmental circumstances and location
    vii. Confirm appropriate pollution control and response measures are in place or standby and inform external agencies
    viii. In case of fire, directions of all available firefighting aids, including the resources of tugs, other crafts and river bank installations, will be exercised by Master (Vessel) until the arrival of the fire brigade or IWAI firefighting tug vessel when overall charge will be assumed by IWAI incident team commander
    ix. Should any question concerning the safety or stability of the vessel arises in the course of fighting the fire, the Master (Vessel) and Senior Incident team commander will pay strict attention to the stability of the vessel and, in conjunction, will take necessary steps to ensure the vessel's safety and inform the Asst. Director (Operations, Safety and Security) (in charge of the incident) of action taken
    x. In case evacuation of vessel is required, it is duty of Master (Vessel) to move the crew/ passengers to another vessel
    xi. If immediate tug assistance is required, the Master has the right to make his own terms with whoever is able to assist him and inform nearest control room
    xii. In a salvage situation, the Master remains in command even when salvors are appointed
    xiii. Secure evidence and maintain adequate records and enter the incident in the official log and report to the IWAI and corresponding central agency

Driver

1. Always have his certificate with him during the voyage
2. Maintain the fitness of mechanical propulsion system
3. Keep records of running hours and maintenance schedule
4. Check inventory of safety equipment installed in the engine room
5. Understand and follow instructions given by master and pilot
6. If there is any leakage/ malfunctioning of engine or propulsion/ fire or any other incident in the engine room, the driver is responsible to enact initial response and inform the
    i. Slow down and stop main engines and the equipment with problem
    ii. Sound Emergency Alarm

iii. Check for possibility of oil pollution/ spillage
iv. Effect appropriate damage and pollution controls
v. In case of fire, follow directions of available firefighting aids in the engine room

Supervisory Staff

Maintenance assistant

1. Update and maintain, maintenance log with detailed records of any damage, change or repair in the vessel
2. Check fitness of the vessel before letting it start the voyage
3. Inspect and replace if required spare parts, life saving, navigation or fire safety equipment
4. Update master of the design and condition of the vessel
5. Inspect the loading/ unloading of the vessel

6.2. Sub Office (SO) Level

First responder

1. Upon noticing danger or incident immediately communicate to Asst. Director (Operations, Safety and Security)
2. Assess immediate surroundings for dangers
3. Inform Terminal Control Room

*If you hold knowledge of emergency and are trained then proceed to activate emergency Alarm and immediate respond to the incident

Assistant Director (Operations, Safety and Security)

1. The Assistant Director (Operations, Safety and Security) will use his statutory powers and make such decisions necessary to ensure safety of terminal, terminal infrastructure and vessels in the terminal jurisdiction including the casualty
2. In the event of an extreme weather event threat take the following action:
   i. Entrust officer who can take charge of terminal in his absence
   ii. Ensure that instructions regarding weather conditions and navigability should be communicated through control room to all the vessels in the jurisdiction area and that they are advised of relevant warnings and response requirements
   iii. Ensure that all vessels comply with the response requirements
   iv. Assess vessel traffic around in the jurisdiction area and respond to request sent by vessels
   v. Restrict the movement of vessels if necessary
   vi. Activate Crisis Management Plan at the time of crisis detection or early warning
   vii. Direct, monitor or oversee the evacuation of the terminal/vessel if applicable
   viii. Cease all cargo and / or bunkering operation, Close manifold valves, Fire squads to position deemed best for fighting the fire
   ix. Movement of all other vessels/vehicles into or out of the navigation channel/ terminal area/ storage area should be supervised or restricted and issue alternative orders as necessary
   x. Give timely update to Director (Regional Office) and Chief Engineer. And request for coordination if incident command team's assessment suggests
   xi. Review rescue and recovery operations
3. Form incident command team and act as head for further action
4. Assess situation and the response level required and take final judgement whether response level should be escalated or deescalated. Communicate and coordinate with outside agency
5. Conduct initial briefing and activate elements of Crisis management Plan suitable for incident in hand
6. In case of vessel accident, assess the distress signal, inform RO and control room and escalate if the vessel doesn't respond to instructions or reliable communication is not established
7. Ascertain details of the incident from master and control room, including the location of the incident, the vessel's particular's, direction of the vessels head, water level, extent of damage to vessel or terminal structure, prevailing and predicted weather conditions and damage to navigational aids
8. Co-ordinate action requests for additional resources with RO and HO and external agencies. Responsible for coordinating with following district authorities at the time of crisis
   i. District Collector office
   ii. Electricity office
   iii. Fire department
   iv. District Emergency Operation Center
   v. Nearest Health Centers
   vi. SDRF (in case of alert is of > VI magnitude)
9. Procedural decisions are to include following consideration
   i. Employees/ Terminal Users/ Public Safety
   ii. Protection of Environment
   iii. Protection of property
   iv. Restoration of terminal operations
10. At the time of crisis evaluate the danger and accordingly assess level of response required (L1/L2/L3/L4) and allocate resources accordingly

Technical Assistant (Mechanical Marine)

1. Conduct periodic mock drills and evacuation drills in the terminal
2. Designate area safe for evacuation at the time of natural disaster and fire incident
3. Make sure all the staff has training in handling safety equipment, firefighting equipment and Crisis Management Plan
4. Execute instructions/ directions given by Asst. Director (Operations, Safety and Security) and apply sound judgement while instructing staff in responding to crisis situation
5. Always inspect mooring arrangement and cargo dry/ liquid transfer equipment before starting any transfer of cargo takes place
6. Always Maintain Material Safety Data Sheet and allow vessels to transfer cargo at terminal only when all the requisite information are furnished by the operator
7. In case of detection of leakage/ spillage, immediately stop transfer and inspect the cause
8. Do not allow starting of transfer operation till Engineering team doesn't gives "Go ahead"
9. Avoid risk related activities at times when weather conditions may magnify any harm caused by a spill e.g. outdoor unloading during rainfall
10. In the event of an extreme weather event threat take the following action:
    i. Entrust officer who can take charge of terminal in his absence
    ii. Designate staff responsible for safe evacuation in each building
    iii. Ascertained that there is no unsafe conditions due to loosely secured equipment
    iv. Inform and advice all contractors to remove their equipment from jetty area after use and safely park at shore
    v. Operating equipment should be automatically or manually shut down
    vi. Secure the loading/ unloading equipment or pipeline
    vii. Vessels should not be anchored to avoid damage that can be caused by dragging of anchors. In case mooring of some vessels is required then inspect the mooring arrangement at the berths
    viii. Material handling operations should be stopped
    ix. Maintain communications with district authorities and events are to be recorded as appropriate

Technical Assistant (Civil)

1. Store chemicals on hardstand flooring on safe racks or pallets in secure and weatherproof buildings
2. Place spill risk facilities away from sensitive environments (terminal passenger handling buildings) with a sufficient buffer to allow for effective intervention prior to water pollution occurring
3. Use secondary spill control facilities such as bounded containment compounds
4. Only allow authorized personals to access the area and have periodic training on safe cargo handling practices and handling firefighting
5. Check all the buildings, structures and equipment for fitness and maintenance requirement
6. Make sure structures should not be used more than it's designed loads and prepare alternate arrangement for greater demand
7. Operators should undergo training on SOP
8. Operator's should not work for more than designated hours
9. Operators should undergo regular health checkup
10. In case of danger to terminal area, ensure all the buildings have been evacuated and communicate headcount to the Asst. Director (Operations, Safety and Security). Direct firefighting, operations shutdown, search for casualties, arrange first aid and hospitalization if required
11. Coordinate search and rescue operations
12. Inspect all the buildings before starting the use again after crisis. All types' cracks be reported and analyzed further by engineering team
13. Not allow anyone to re-enter buildings until the on-site Safety officer doesn't give "All Clear" Message

Junior Hydrographic Surveyor (JHS)

1. Direct and co-ordinate all field operations at the incident location
2. Communicate and coordinate with vessels when it is passing through zones unsafe for navigation like fishing zones, narrow channel, near bends, cross over structure, local weather conditions, maintenance work or location of incident which are geotagged by nodal Hydrography Chief

3. Keep secondary medium of communication with vessels
4. Inform nearest Asst. Director (Operations, Safety and Security) and next control room if vessel doesn't respond to instructions or reliable communication form is not established and geotag the vessel
5. In case of vessel accident, take note of all information from Asst. Director (Operations, Safety and Security)
6. Be part of inspection team along with Asst. Director (Operations, Safety and Security) and vessel master and report status of main engine and auxiliaries to Command Centre and Terminal Master. Analyze incident causes and impact and update/issue guidelines
7. If vessel has blocked channel put tugs on standby and vessels taken to repair berth/anchorage awaiting class surveyors recommendations
8. Arrange tugs, rescue boats and resources for vessel incident
9. Coordinate CMP termination and cleanup activities

Officer (Operations, Safety and Security)

1. In the event of an extreme weather event threat take the following action:
   i. Direct team to put sand bags around sensitive areas and make standby arrangements for critical operations and transportation of evacuated staff/ public
   ii. Review arrangement of tow boats for assisting in case of breakaway of vessels from moors and rescue boats for assisting stranded passengers/ crew
   iii. Monitor alerts from dams and reservoirs in upstream
   iv. Keep terminal tugs and crafts ready for emergency response on waterway
2. Activate emergency alarm system
3. Direct, gate security and facilitate evacuation, transport, first aid, and rescue
4. Control the entry of unauthorized persons and vehicles-disperses crowd.
5. Permit the entry of authorized personnel and outside agencies for rescues operations immediately and liaises with State police.
6. Allow the entry of emergency vehicles such as ambulances without any hindrances
7. Assist anyone having difficulty evacuating
8. In case person is trapped under debris, evaluate whether incident command team can carry rescue operation or need help from external action group depending on the consequence
9. Arrange for Crane, forklifts etc. for removing debris
10. Deploy engineers to direct or guide earth moving equipment and cranes to remove the debris
11. In case fire is detected, activate fire alarm and try to contain it from spreading using firefighting equipment
12. Ensure that the people are as per the head count available with the assembly point section of that area.
13. Carry out a reconnaissance of the evacuated area before declaring the same as evacuated and report to Asst. Director (Operations, Safety and Security)
14. Ascertain evacuation information reported and relay it to Asst. Director (Operations, Safety and Security), Director (Regional Office) and to key external responder's i.e. fire, police and ambulance
15. In case of injury inform medical officer for first aid and nearest health center for serious injuries
16. In case of capsized or grounded vessel, take help of survey team from RO to direct or guide dredgers to remove the capsized or stuck vessel. Send terminal tugs and crafts for rescue
17. Inspect vessel along with vessel master and check stability of the vessel
18. Command to transfer oil/ cargo from the vessel to emergency barges and damage control and temporary repairs to stop oil leakages with the help of underwater welding team or salvage group
19. Close and reopen the terminal if necessary. Assess when normal operations can be restored and inspect all the critical buildings and operation area of integrity before reopening of the terminal
20. Responsible in coordinating with state and central pollution control board and keep record of expert resources specialized in pollution control and recovery for different types of materials
21. Also responsible to inform state fisheries department and water resource department in case the water becomes unfit for other uses
22. Advise External Action Group on the form of pollution and seek permission from SPCB in using containment equipment which might harm sensitive environment like dispersants

23. Establish limit of liability of vessel operator and undertake disposal of damaged cargo/oil
24. Keeping the MSDS records updated
25. Responsible for conducting regular Mock fire drills and evacuation drills
26. Responsible for inspecting all firefighting equipment and must be maintained periodically, all staff are trained on using Firefighting equipment and evacuation procedure for different type of crisis
27. At the time of fire breakout in terminal area, responsible for closing of the area and informing local fire station
28. Direct staff to the safety exit at terminals and stand in assembly area
29. In case of potential pollution related crisis, keep District collectors office and State Pollution Control board on standby
30. In case of high fire danger inform local fire department and keep state level agencies on standby

Control Room Officer

1. Ensure that instructions from Asst. Director (Operations, Safety and Security) regarding weather conditions and navigability is communicated to all the vessels through alert messages on Vessel system and communicate VHF
2. Forward any distress signal received from vessel or movement of vessel without AIS and carrying suspicious activity
3. Communicate and coordinate with rescue team on conducting rescue operation on waterways
4. Monitor for IMD's information in press and other media and update Assistant Director (Operations, Safety and Security)

Medical Officer

1. Direct medical team
2. Set up casualty collection center arrange first aid posts.
3. Arrange for adequate medicine, antidotes, oxygen, stretchers etc.
4. Contact and cooperate with local hospitals and ensure that the most likely injuries can be adequately treated at these facilities e.g. burns.
5. Arrange for transporting and treating the injured.
6. Inform the nearest hospitals of the situation in case of a toxic release and appraise them of the antidotes necessary for the treatment.
7. Maintain a list of blood groups of each employee with special reference to rare blood groups.

6.3. Regional Office (RO) Level

Chief Engineer

1. Help Asst. Director (Operations, Safety and Security) in getting resources from state administration or HO if required
2. In case of pollution incident takes, place assist inform SPCB and known experts and organize specialist assistance in cleaning up. Also arrange for financial arrangements for the operation from IWAI side
3. Part of Incident Command team and salvage/ wreck removal operations if the crisis situation is of category L2 and above
4. Inform state water resource department to stop intake of water from the waterway
5. Publish advisory in media so that private connections also stop using the water
6. Inform to publish advisory to fishing community
7. Restrict or supervise movement of all other vessels/vehicles into or out of the navigation channel/ terminal area/ storage area and issue alternative orders as necessary
8. Take incident report from Asst. Director (Operations, Safety and Security) and give permission to restart operation upon satisfactory inspection

Director (Regional Office)

1. Ensure all the instructions and advisory from HO has been executed by all the terminals in its jurisdiction
2. Ensure all the Asst. Director (Operations, Safety and Security) are informed about the warning related to extreme weather conditions
3. Responsible for coordinating with following state authorities at the time of crisis
   i. State Transport department
   ii. Inland Water Transport department or Maritime Board whichever is available in the state
   iii. SDMA
   iv. SDRF
   v. Coastal Police
   vi. Fisheries Department
4. Coordinate between Asst. Director (Operations, Safety and Security) and Chief Engineer at the time of crisis

Deputy Director (Civil)

1. Assist Engineering team to assess structural strength of buildings and other structures to ascertain fitness for use
2. Inspection of all jetties and moored vessels after crisis incident
3. Assess when normal operations can be restored
4. Keep check on vessel movement and report to next control center in case non-compliance of instructions

Senior Hydrographic Surveyor

1. Be part of survey team after crisis incident reporting
2. Inform Director (Regional Office) and Chief Engineer of wherever maintenance dredging or surveying is going
3. Survey of navigation channel and reporting of debris to nearby districts and vessels after occurrence of crisis incident on waterway and inform Control room Officer in case debris cause problem in navigation and demarcate zones which are dangerous for navigation
4. Work with survey team to inform relevant external agencies if it is dangerous to use waterways and help to clear the navigation channel

Deputy Director (Mechanical Marine)

1. Ensure that all blockages due to falling of trees, walls, sheds etc. are cleared immediately
2. Salvage operations for debris
3. Direct or guide dredgers to remove the debris

Deputy Director (Operations, Safety and Security)

1. Liaison with media on reporting of losses of life or damages
2. In case of injury to personal inform family members/ police
3. In case of cargo damage inform operators and jointly evaluate losses

6.4. Head Office (HO) Level

Chairman

Responsible in establishing policies/ regulations and oversee all the matters pertaining to safe operations of the organization. However, as a crisis may occur at any time and, in all likelihood, without warning, it is prudent to have policies and procedures in place to assure the orderly operation and recovery of the operations in his absence. At such a time as Chairman is able to reconvene, it is likely crisis recovery activities underway will be reviewed and modified as deemed appropriate by him. Management of crisis management will lie with Crisis Management Group as appointed by him.

Vice Chairman

Responsible in guiding Chairman on issues of establishing policies/ regulations and oversee all the matters pertaining to safe operations of the organization. In absence of Chairman, Management of crisis incident will lie with Crisis Management Group as appointed by him and review the incident at various stages.

Member (Technical)

1. Head of Crisis Management Group at HO
2. Allocate responsibility in the crisis management group
3. Review actions taken by Crisis Management Group
4. Direct the crisis management team on the incident response procedure
5. Chief Engineer's Office will provide media and public information at the direction of Member Technical
6. part of survey team after crisis incident reporting
7. Revise and update CMP as and when required

Hydrographic Chief

1. Head of Hydrography Department
2. Responsible for making survey team monitor river gauges frequently and initiate communication if readings approach danger limits
3. As the stage rises or discharge falls in series of gages initiate communication to the regional level, terminals and local control and command centers
4. Issue advisory to mariners through Chief Engineer's and Control Room officer's about high water and drift potential and to minimize wake
5. Consider restriction of moving certain zones in navigation channel, horse power requirement, dangers of down streaming, mooring arrangements and cross over structure clearance
6. Prior assign of the weather message and broadcast alerts to mariners
7. Broadcast advisory alerts through RIS/ River Notices
8. Authorize team to Geotag zones unsafe for navigation
9. Overseeing installation of Marking buoys for zones unsafe for navigation, visual sign for safe speed, hotspots etc. should be installed by IWAI
10. Direct department to similarly alerts to the vessels plying near dredging or maintenance area should be sent
11. Review that all the Fishing and ferry zones are be marked on navigation charts
12. Review that all the danger zones (plying of local boats, natural weather or geomorphological conditions), which can lead to instability of vessels are geotagged
13. Establishing log keeping system of danger levels both high and low water levels for all the stretches on the NWs

Executive Director (Operations and Safety & Security)

1. Coordinate with all National level agencies listed in Annex. Coordinate with them to
    i. Update them about Crisis Management Plan of IWAI
    ii. Involve them in regular mock drills
    iii. Create Common Incident Group
    iv. Develop Incident reporting form
    v. Create mutually agreed SLA
    vi. Create Common Incident reporting and analysis system
    vii. Maintain a list of experts capable of performing emergency and/or remedial
2. Review characteristics of different goods, their hazards and control requirements on land and on water
3. Equipment and resources personal for containing spillage
4. Coordinate with outside agency for wider area Search & Rescue operation
5. Responsible for installation of safety equipment in all terminal buildings and IWAI vessels like smoke detector, foam based fire extinguishers and fire exits
6. Review of safety plans and SOP's for safe operations at terminals

Chief Engineer (Civil)

1. Responsible for reviewing that all the DPR's consider appropriate loads according to the design use and possible loads caused by wind or vibrations(earthquake) and all the applicable design codes are followed
2. Responsible for developing and updating the vulnerability maps for all the terminals, with approved DPR's
3. Review of all the construction work and final inspection for integrity
4. After crisis, review reports from engineering team on structural integrity and if required visit the site for inspection

Chief Engineer (R&D and Environment)

1. Coordinate with MoES, IMD and National Centre for Seismology to get information on seismic zones and corresponding design codes (IS, BIS, IRC) to be followed
2. Similarly coordinate with CWC, IMD and ISRO for flood and cyclone zones and corresponding design codes to be followed
3. Regularly take updates about Extreme weather predictions from IMD, INCOIS and Indian Navy Hydrographic department and inform Hydrographic Chief, Chief Engineers, Directors (Regional Office) and Asst. Director (Operations, Safety and Security)
4. Informing MoEF and Coast Guard about pollution
5. Issue advisory to Chief Engineer and Asst. Director (Operations, Safety and Security) based on the information provided by Chief Hydrographer to the Government of India
6. Review Crisis Command Team's action and issue instructions as and when required
7. Oversee Rescue and Salvage Operations
8. Update Member technical of the Crisis incident progress and if additional resources are required, how to allocate it through other regions or outside IWAI help will be required
9. Report the incident in common national incident database
10. Analyze incident causes and impact and update/issue guidelines

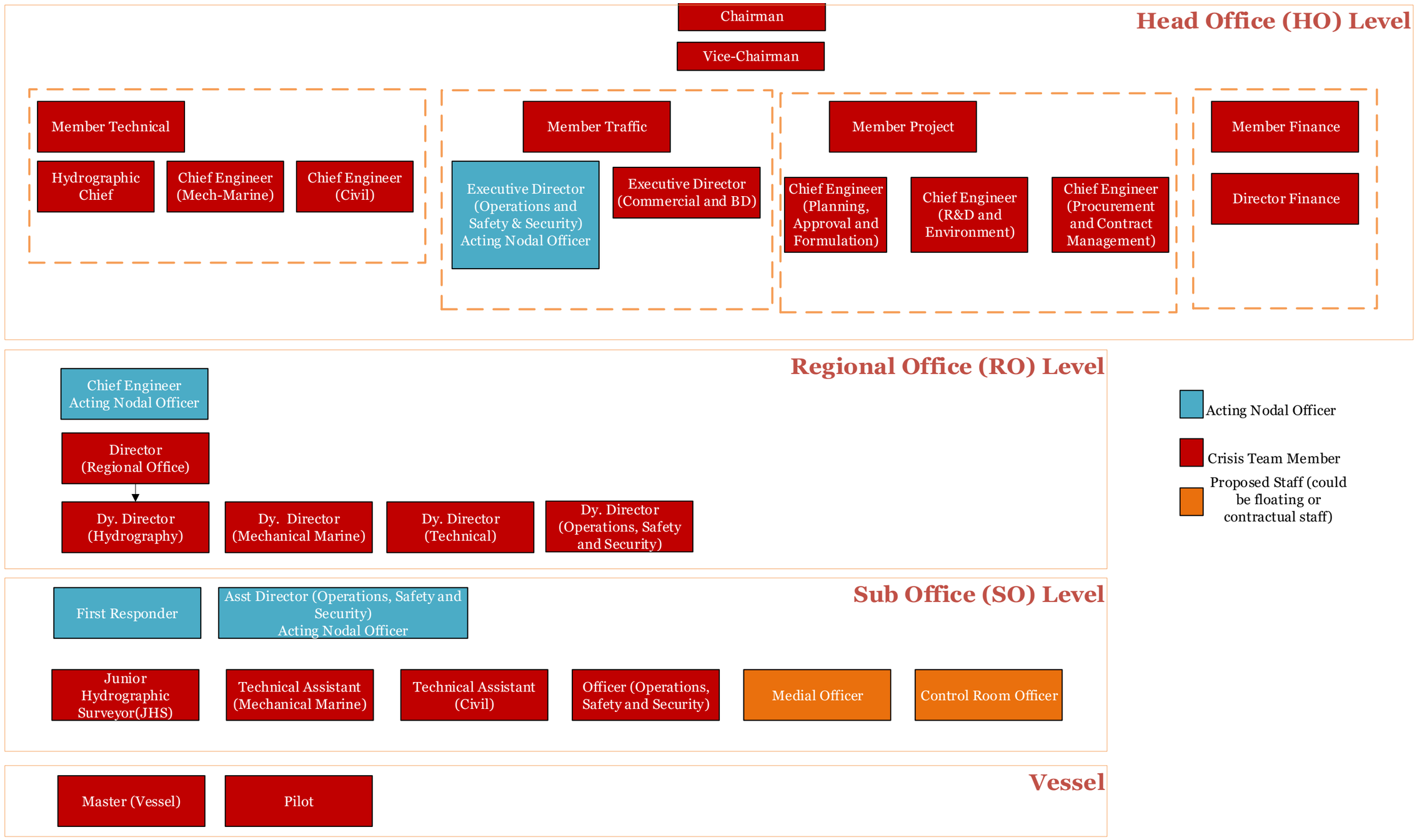
Chief Engineer (Mech - Marine)

1. Head of Mech-marine Department
2. Responsible for reviewing that all the procurement plans of equipment consider appropriate loads according to the design use and possible loads caused by wind or vibrations(earthquake) and all the applicable design codes are followed
3. ISO 11031 code should be used to ensure seismic resistant material handling equipment is procured
4. Procurement of safety equipment like Firefighting equipment, lifesaving equipment, PPEs, Disaster supplies kit, Siren, Hand crank radio, dredgers, tow boats, VHF and RIS etc.

Director (Finance)

1. Assess the financial loss due to damage caused and fund required for restoration in case of L2, L3 and L4 type of crisis
2. Assist District Collectors office in case there is some outside liability on IWAI

Crisis Management Group



7. Capacity Building

7.1. Recommended capacity development requirements

In order to implement the CMP, IWAI needs strategically develop capacity. The process involves awareness generation and training of the staff, appropriate institutional framework, putting adequate infrastructure and allocation of resources for efficient prevention and handling of disasters, bringing legally binding guidelines for safe operations and coordinating with outside agencies for crisis response.

Institutional

1

- CMP requires addition of responsibility at all the levels of staff
- Jurisdiction of RO and Sub-offices need to be clearly established such that whole NW stretches are covered
- List of SOPs which need to be developed are mentioned in Annex 5
- List of trainings to be provided to all the staff are mentioned in Annex 8
- Incident Reporting form description is given in Annex 3
- Update Navigational charts on suitable large scale and converted to Electronic Navigation Charts (ENCs) as per International Hydrographic standards
- Classify NWs requiring revision of charts frequently and updating them regularly. The stretches susceptible to high fluctuation at the time of flooding, geomorphological changes and high siltation. The changes in stretches should also accommodate +20-30m on both

Infrastructure

2

- IS codes and ISO standards for construction of infrastructure is mentioned in Annex 10
- All the NWs need to have RIS and radar system
- Enforcement of installation of AIS and other safety devices on all the vessels/ boats through the agencies responsible form registration (Annex 6)
- List of communication and safety equipment which need to be procured are mentioned in Annex 7 (b)
- Dedicated VHF channel and communication network between vessels and terminals
- Centralised resource database for crisis response has to be created as per Annex 2
- River atlas to provide complete information and details of civil authorities ashore (Annex 2)
- Vulnerability maps to be available for all the terminals of national waterways
- Identify and mark *critical hotspots* defined in section 5.2.1 and *sensitive natural receptors*

Legal Framework

3

- Mandatory check of awareness of navigation rules of the masters and the crew members through state departments
- Legal framework for states to prepare fishing maps and ferry routes and mark the zones on map as well on ground
- Prepare forms of declaration of cargo being transported by the vessel, insurance and that have sufficient Fire safety equipment
- Update IV Act 2016 section on wreck removal and salvage operations and conducting search & rescue operations according to CMP
- Law for prevention and liability of accidental pollution on NWs
- Establishing River policing, control and monitoring of Navigational aids
- Issue notification for small boats to keep safe distance from the main navigation channel

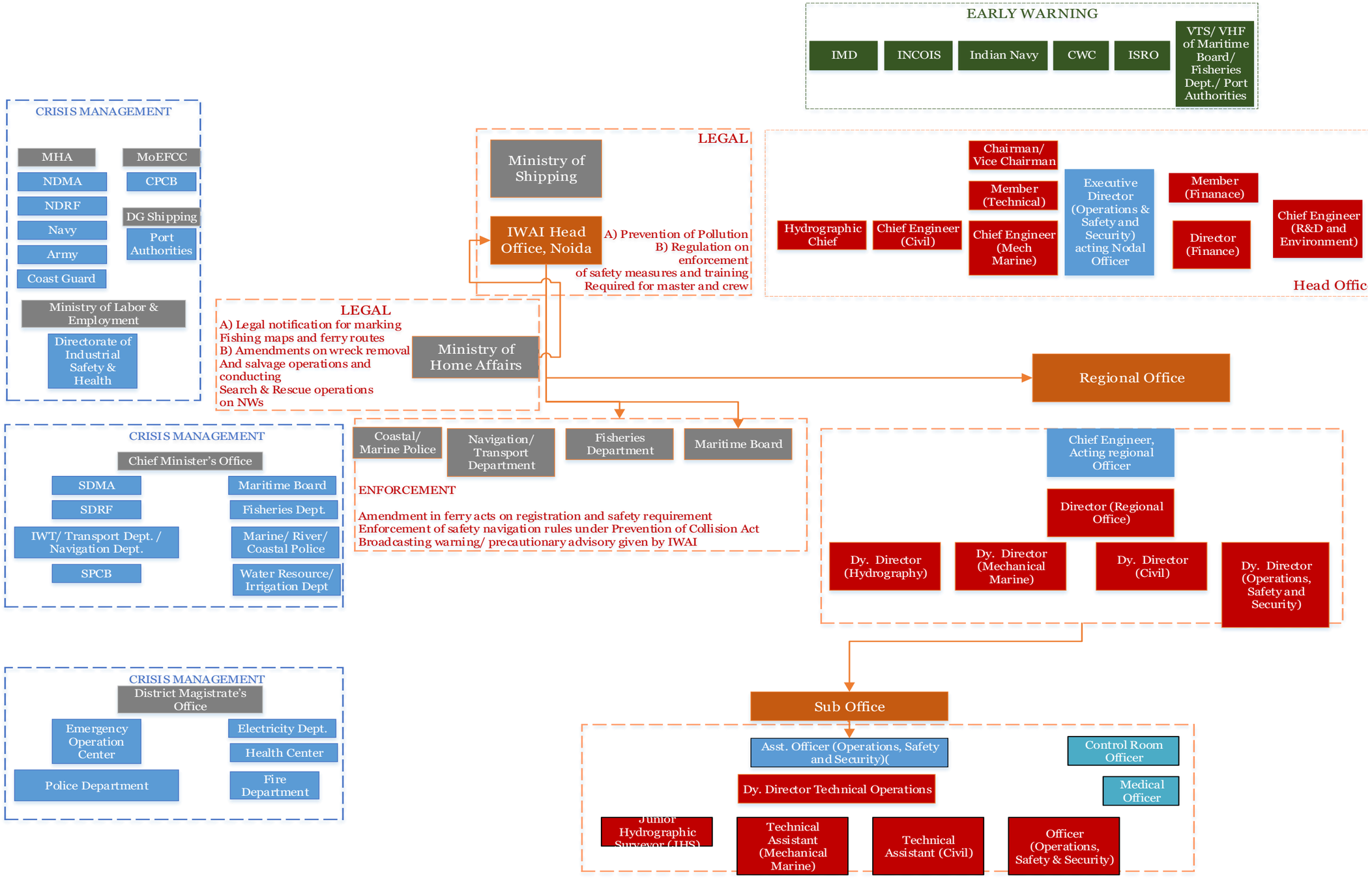
Coordination

4

- Coordinate with relevant departments and agencies at district, state and national level to mobilize critical resources to manage the crisis
- Have Service level agreement (SLA) with these agencies
- Early warning and monitoring information from central agencies (mentioned in 7.2)
- Emergency Contact Number to be dialed by first responder
- Emergency contact list as per Annex 2
- Integrate CMP with NDMP and SDMP through NDMA and SDMA respectively
- Capacity building programs to be carried out for boat operators/ fishing communities

7.2. Crisis Management Coordination Plan

IWAI need to coordinate with multiple agencies at different stages of the crisis management corresponding to the level of response requirement explained in chapter 3 & 4. The diagram below depicts the requirement of coordination from IWAI's side.



7.3. Crisis Management Implementation

IWAI is evolving at institution level and operations level therefore; it would be difficult to implement CMP at once. Hence, the section lays down the strategy for phase wise implementation of the CMP.

2018

01 SHORT TERM (in 3 months)

- Distribution of responsibilities according to CMP
- Adoption of internal SOPs and SLAs
- Initiation of Coordination with National Level Agencies
- Adoption of Incident Reporting Form and filing system
- Preparing DPRs according to applicable IS codes and ISO standards
- Pilot run of RIS and control room centres
- Creation of Resource database
- Procurement plan of Annex 7 based on development plan

02 MEDIUM TERM (in 9 months)

- Setting up of RO in states with major operational NWs
- Dedicated staff required for implementation of CMP
- Coordination with National Level agencies and initiation of coordination with state level agencies
- Legal notification to states to prepare fishing maps and ferry routes and mark the zones on map as well on ground
- Prepare forms of declaration of cargo being transported by the vessel, insurance and that have sufficient Fire safety equipment
- Supporting SOPs should be prepared for vessel crew and terminal officers are mentioned in in Annex 5
- Amendments for wreck removal and salvage operations and conducting search & rescue operations
- Frame Law for prevention and control of pollution on NWs through spillage
- Revision of CMP
- Regular upgradation of CMP

03 LONG TERM (in 24 months)

- Setting up of TO wherever terminals are built
- Recruitment of staff required for CMP at TO level
- Coordination with State Level agencies and initiation of coordination with district level agencies
- Integration of fishing maps and ferry routes on navigation charts
- Set up RIS and control rooms on all major NWs
- Enforcement of installation of AIS and other safety devices on all the vessels/ boats
- Have Service level agreement (SLA) with these agencies
- Early warning and monitoring information from central agencies (mentioned in 7.2)
- Emergency contact list as per Annex 2

2020

8. Recovery

Crisis recovery could be very difficult and long-drawn out. The recovery process will vary depending upon the actual crisis, location, pre-crisis conditions, and the potentialities that emerge at that point of time. It will consist of several related activities such as the following:

i. Inspecting the damaged area
ii. Damage assessments and termination of CMP
iii. Deciding which employees would report to work and notify the office
iv. Beginning of investigation into the causes of crisis incident
v. Transferring necessary operations to alternative locations
vi. Decontaminating the damaged area
vii. Restoring services to the damaged area
viii. Clearing up debris
ix. Salvaging the material and equipment affected by the emergency
x. Restoring the waterway stretch affected by the crisis incident
xi. Determining responsibilities and instituting possible insurance and damage claims

8.1. Damage assessments and termination of CMP

The decision to terminate a response procedure is taken by Director (Regional Office) (head of incident command team) in case of crisis incident categorised as R1 and in all other cases only after consulting with HO Crisis Management Group and Chairman. The response operations shall be terminated when:

i. Oil/ Chemical spillage has been recovered/ contained to the extent possible or Fire has been completely extinguished or in case of natural crisis as per the warning signals given by the agencies

ii. Area has been declared “Risk or hazardous or smoke” free

iii. Area is safe for operations

After termination of CMP, Asst. Director (Operations, Safety and Security) along with engineering and survey team should do thorough assessment of damages caused by the crisis in terms of physical damage to the IWAI structures, buildings and staff, loss of life and economic implications.

8.2 Stand down procedures

Upon completion of the response, Director (Regional Office) will:

i. Arrange recovery of all equipment, and unused material
ii. Ensure that all material are cleaned
iii. Ensure that all equipment are returned to the terminal office/ outside agency from where it was taken
iv. Debrief staff on the damage caused by the crisis incident and the possible contributing factors
v. Speed of Crisis Response activation and execution
vi. Health & safety issues (if any)

vii. Lessons learned and future remedial measures needed

viii. Incident Reporting for file keeping

8.3 Cost Recovery

1. All records of costs must be collated for submission to the Director Finance
2. For expenses incurred assisting third parties, costs should be kept and submitted to relevant authorities

9. Financial Arrangement

The financial aspects of Crisis Risk Management entail various factors ranging from IWAI's developmental and traffic growth projections to immediate response post disaster, followed by investments made for reconstruction. The funds required for preparedness, mitigation and reconstruction have to be allocated by IWAI in its annual budgetary allocations. Funds will be required under following measures:

i. Strengthening of institutional capacity including NINI

ii. Procurement and installation of safety equipment

iii. Installation of communication and allied infrastructure

iv. Equipment required for rescue operations and safety (e.g. firefighting equipment, tugs, boat ambulance and life rafts/ jackets/ buoys)

v. Adoption of new regulations and SOPs

vi. Training of staff and pilot at NINI and state IWT training centres

vii. Training of vessel operators and masters, engineers and crew at NINI

viii. Awareness trainings to terminal and NW users like fishermen, ferry operators and gram panchayats on the banks

ix. Responding to crisis, including Search & Rescue Operations

x. Emergency supply

xi. Repair/ Restoration of damaged infrastructure/ area/ waterways

xii. Contingency plan/ fund to make payment to third parties for coordinating in crisis response

xiii. Payment for outside liabilities during crisis

xiv. Insurance for IWAI Infrastructure and Assets

10. Maintaining and Updating the Plan

Regular maintenance is critical to ensure the relevance and effectiveness of the CMP. Plan maintenance is the dynamic process. The plan must be periodically updated at least once in 3 years to make it consistent with the changes in Government policies, growth plan of IWAI, internal initiatives, and priorities as well as to incorporate technological changes and global experiences. Evaluating the effectiveness of plans involves a combination of training events, exercises, and real-world incidents to determine whether the goals, objectives, decisions, actions, and timing outlined in the plan led to a successful response. In this way, the crisis preparedness exercises become an integral part of the planning process. The trainings, mock drills and exercises is crucial to evaluating the operational aspects of the plan, rectify gaps, and improving the efficiency of the plan. The likelihoods of crisis incidents specific to each of the NW and actual occurrences are also occasions for evaluating the plan, making innovations, and for updating the plan, SOPs and guidelines. At times, operations experience setbacks due to outdated information, ineffective procedures, incorrect role assignments, and outdated norms.

10.1. Training

IWAI has to impart training to internal staff and all other agencies involved in plan execution having specific responsibilities. IWAI has to associate with specific department and personal in these agencies and update them about IWAI's operations and CMP. Each RO in accordance with a mandatory timetable, training workshops with regular mock drills, at least twice a year. Such programs are crucial to ensure full preparedness and to maintain operational readiness of the crisis response operation team, institutional mechanisms, and the equipment. These drills will be organized to test their readiness to deploy within the shortest possible time following the CMP activation. They shall be conducted in a manner similar to that of the drills carried out by firefighting department. The objective of all these trainings and drills would be to familiarize the teams with the CMP and to increase their operational efficiencies. The trainings are crucial because they go beyond concepts and guidelines into inculcating in the individuals the critical importance of working as a coherent team for crisis response with a clear chain of command. The workshops and drills will also provide an opportunity to practice SOPs. These workshops would also give the teams an opportunity to develop all the stakeholders into a cohesive response unit. A regular course schedule to be planned and organized at NINI.

10.2. Testing the Plan and Learning to Improve

Evaluating the effectiveness of a plan involves a combination of training events, exercises and real time incidents to determine whether the goals, objectives, decisions and actions outlined in the plan led to a successful response. The purpose of exercises and drills is to promote preparedness by testing the plan with equal participation of all relevant stakeholders. The process of evaluation and remedial actions will identify, illuminate, and correct problems with the CMP. This process must capture information from exercises, post-disaster critiques, self-assessments, audits, administrative reviews, or lessons-learned processes that may indicate that deficiencies exist.

Remedial actions may involve revising planning assumptions and operational concepts, changing organizational tasks, or modifying organizational implementing instructions (i.e., the SOPs/SOGs). Remedial actions may also involve reassessment of capabilities, revisiting assumptions made in the CMP, and finding solutions to overcome the deficiencies. The final component of a remedial action process is a mechanism for tracking and following up on the assigned actions. As appropriate, significant issues and problems identified through a remedial action process

and/or the annual review should provide the information needed to allow the planning team to make the necessary revision(s) to the plan.

10.3. Update

This step closes the loop in the planning process. It focuses on adding the information gained by exercising the plan to the lessons learnt while executing, and start the planning cycle all over again. All the relevant stakeholders should establish a process for reviewing and revising the plan. Reviews should be a recurring activity. CMP must be reviewed periodically. It should also be reviewed and updated at least once a year or as indicated below:

i. Major review and revisions after each major incident

ii. After significant change in operational resources (e.g., policy, personnel, organizational structures, management processes, facilities, equipment)

iii. Subsequent to any notification or formal update of planning guidance or standards

iv. After every case of plan activation in anticipation of an crisis

v. After the completion of major exercises

vi. A change in the IWAI offices and assets hazard or threat profile

vii. Enactment of new or amended laws or ordinances

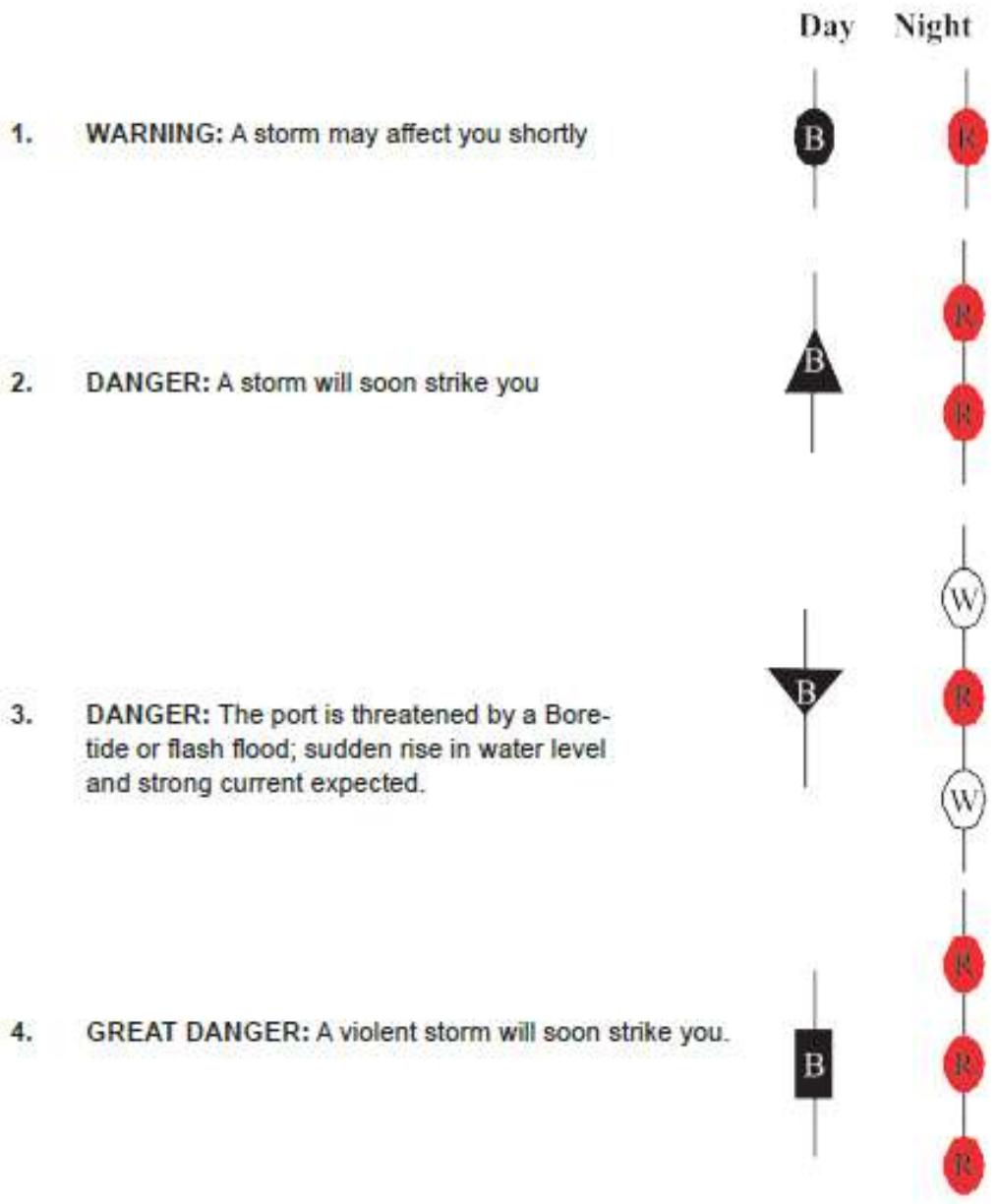
In exceptional circumstances where the magnitude of the incidence or the situation demands/ needs extra measures to be taken, appropriate Member will make necessary amendments.

ANNEXURES

11. Annexures

Annexure 1 – Signals to be used at waterways, terminals and by vessels as per the National Waterway, Safety of Navigation and Shipping Regulations, 2002

1 (a) Storm Signals



1 (b) Marking on the waterways

MARKING OF THE WATERWAY

A. Buoyage and marking of the waterway

(i) Direction of buoyage

The direction of buoyage shall be defined as follows:-

(a) The general direction taken by the mariner when approaching harbour, river or estuary or waterway from seaward.

(b) In case of non-tidal rivers the direction against the flow of the river.

(c) The direction in which the kilometer chainage increases in case of estuary.

(ii) Port hand Marks

These marks indicate the left side of the channel.

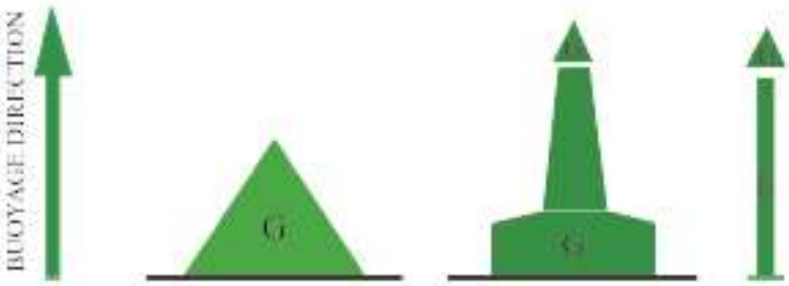
By day: Red Buoys, preferably cylindrical (CAN), or red spars. Red Cylindrical top mark is compulsory on the spars and on the buoys if they are not cylindrical.

By night: Rhythmic red lights, of any type.

(iii) Starboard hand Marks

These marks indicate the right side of the channel.

By day: - Green buoys, preferably conical, or green spars. A green conical top mark point upward is compulsory on the spars and on the buoys if they are not conical.



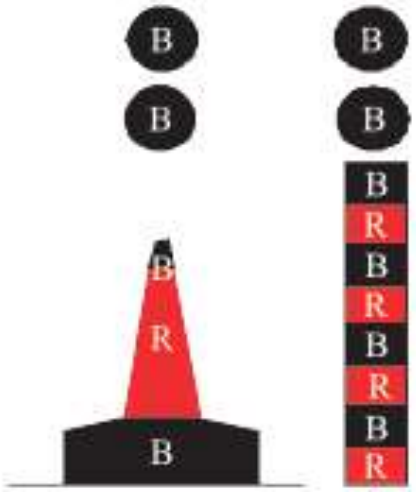
By night: - Rhythmic green lights, of any type.

R = RED
G = GREEN

(iv) **Isolated danger Marks**

An isolated danger mark is a mark created on, or moored on, or above an isolated danger which has navigable water, all round it.

Description of an isolated danger mark



a) Topmark : Two black spheres, one above the other.

b) Colour : Black with one or more broad horizontal red bands.

c) Shape: Optional, but not conflicting with lateral marks; pillar or spar preferred.

By Night : Rhythmic White Light - Group Flashing

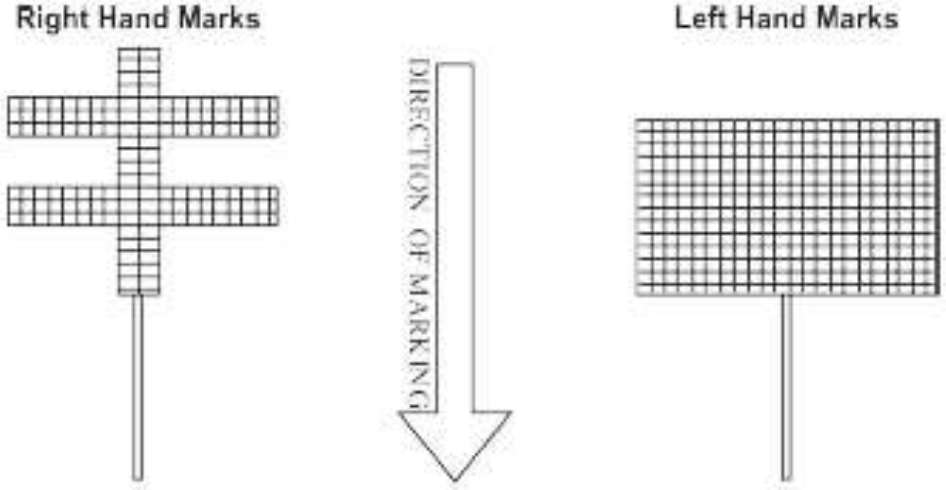
R = RED B = BLACK

B. Conventional Marks

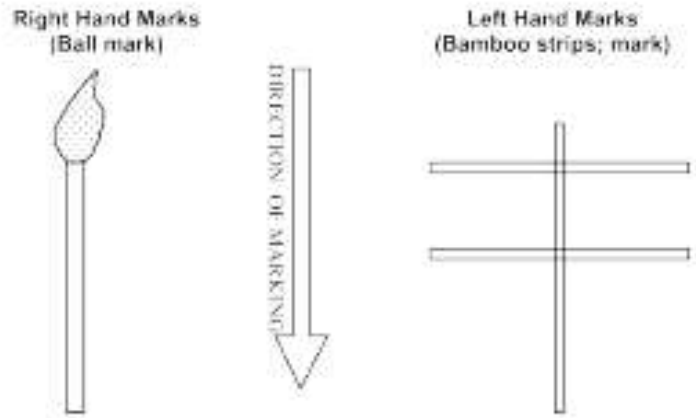
(i) Direction of marking

Conventional marks are made of bamboo strips and used only in rivers. The direction of marking will be downstream the river.

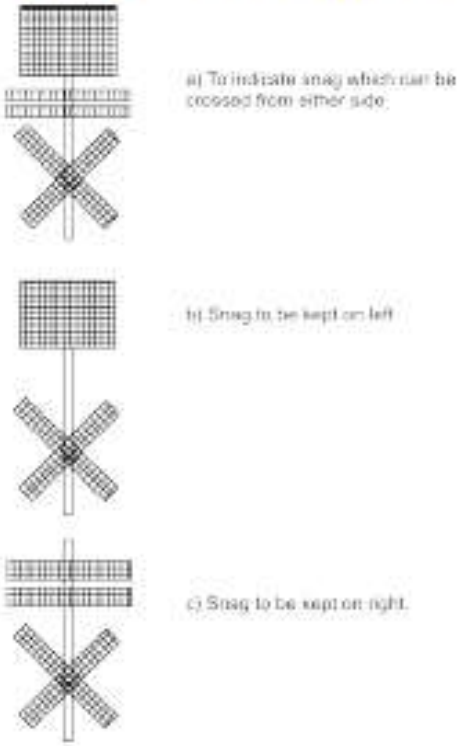
(ii) Bamboo mat marks at the beginning and end of the channel



(iii) Bamboo marks in between and marks



(iv) Under water snag marks (painted with lime)



(v) Closing of channel

1 (c) General Signs and Signals

1. Day and Night marking

Where the prescribed mark consists of: -

(a) Light only, the lights may be used by day and by night;

(b) Boards only, the boards may be used as night marks if illuminated. Boards shall be rectangular in shape of 1.5 metre x 1metre size minimum;

(c) Boards and lights, by day, either boards or lights may be used; by night either lights or illuminated boards may be used.

2. Lighting

Lights may be provided at night for lighting of the lower parts of a bridge, of the piers of a bridge, of the approaches to a lock, of a section of small canal etc.

3. Intensity of lights

The lights recommended in this rules shall be visible for a distance of at least 2 kms., and shall be distinct from the surrounding lights.

4. Fixed lights

(i) Single red light

"No passage"

Either to some of the channels or arms of the waterway, or to the whole of the waterway

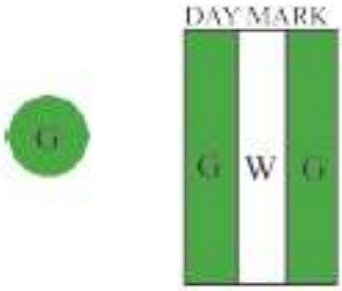
(ii) Two red light placed one above the other

Complete and prolonged stoppage of navigation (blockage of waterway bridges or locks out of service)

(iii) Two or more red lights set apart

"No passage" (between the lights).

(iv) Single green light



"Go ahead" (the green light is always placed at side of the navigable channel). The use of this signal shall however, be restricted to cases where a single green light is sufficient clearly to indicate the clear passage. In other cases, the use of two green lights set apart, and indicating the passage is recommended.

(v) Two green lights set apart

"Go ahead between the lights."

(vi) Single yellow light, along or between green lights

"Go ahead, but look out for traffic coming the other way". Vessels may steer towards the light, which is placed above the navigable channel.

Or

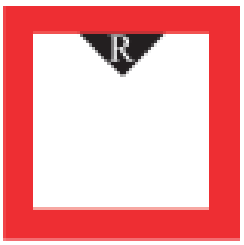
Proceed with caution.

(vii) A red light above a White light

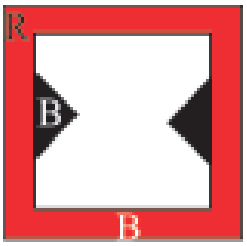
"Do not cause wash".

(viii)

Do not exceed the speed indicated (in km/hour).

(ix) 

Clearance above water level limit.

(x) 

Width of fairway or channel limit.

W = WHITE
R = RED
G = GREEN
Y = YELLOW
B = BLACK

Annexure 2 - Emergency Contact list to be present at terminals and on vessels

S.No	Vessel	Telephone Number
1	IWAI Emergency Helpline number	
2	District Magistrate's Office of every district	
3	District Police Station of every district	
4	Chief Medical Officer / Hospital (nearest) of every district	
5	Control room Officer	
6	Toll free number	
7	Vessel Traffic Services (VTS)	
8	Coast Guard	
9	Navy	

S.No	Sub Office (IWAI)	Telephone Number
1	District Magistrate's Office	
2	District Emergency Operation Center	
3	District Police Station	
4	Coast Guard	
5	Chief Medical Officer / Hospital (nearest)	
6	Ambulance	
7	Fire Fighting Department	
8	Vessel Traffic Services (VTS) of Port Authorities, Maritime Board and Fisheries Department	
9	Asst. Director (Operations, Safety and Security)	
10	Officer (Operations, Safety and Security)	
11	Control room Officer	

S.No	Regional Office (IWAI)	Telephone Number
1	Chief Engineer	
2	Hydrographic Chief - HO	
3	Chief Engineer (Mech- Marine) -HO	
4	Chief Engineer (Civil) - HO	
5	Executive Director (Operations, Safety and Security) - HO	

6	Chief Engineer (R&D and Environment)	
7	Chief Minister's Office	
8	IWAI sub Offices	
9	Control Room Center	
10	State Disaster Management Authority	
11	State Disaster Relief Force	
12	District Collectors	
13	Secretary Revenue	
14	IWT/ Transport Department	
15	IWT/ Transport Department	
16	State Pollution Control Board	
17	Port Authorities	
18	Local Meteorological Department	
19	Marine/ River/ Coastal Police	
20	Water & Irrigation Department	
21	Vessel Traffic Services (VTS) of Port Authorities, Maritime Board and Fisheries Department	
22	Fisheries Department	

S.NO	**Head Office (IWAI)**	**Telephone Number**
1	Secretary, Ministry of Shipping	
2	NDMA	
3	NDRF	
4	Army HQ	
5	Indian Navy HQ	
6	Coast Guard CMG	
7	Ministry of Home Affairs	
8	Director of Industrial Safety & Health	
9	Central Pollution Control Board	
10	Ministry of Environment and Forest	
11	Ministry of Water Resources, River Development & Ganga Rejuvenation	
12	Indian Meteorological Department	
13	INCOIS	
14	CWC	
15	ISRO	
16	Vessel Traffic Services (VTS) of Port Authorities, Maritime Board and Fisheries Department	

17	IWAI Regional Offices	
18	IWAI Terminal Offices	

Annexure 3 - Incident Reporting form for record keeping

INCIDENT REPORT FORM

1 Reporter details

Fill in your details (as the person reporting the accident or incident)

Name	
Preferred Contact	
Phone Number	
Address	

Your role during this accident or incident

☐Skipper / Master	☐ crew	☐ owner of vessel / craft involved
☐ driver	☐ operational manager	☐ passenger
☐ guide	☐ operational staff	☐ witness
☐ trip leader	☐ volunteer	☐ other
☐ paddler		

2 Vessel or craft

Provide details about the vessel (if applicable / known)

Name (if known)	
Vessel Number	

3 Type and category

Passenger	☐ fishing charter	☐passenger / freight ferry	☐sail training
	☐ chartered yacht	☐ tourism boat/ cruise	
Non-passenger	☐ ro-ro ferry	☐cargo	☐tanker
	☐ tug	☐dredger	☐barge
	☐ livestock carrier	☐support vessel	☐dive boat
	☐ others (please specify)		

4 Crew and owner

Who was the master of the vessel	
Who was Controlling the vessel	

5 Time and location

Where did the accident or incident take place?	
Location on the waterway	
Location with reference to the bank	
Water Depth	
Latitude / longitude	
Date of incident	
Time of incident	

6 Environmental conditions

Provide information about conditions around the scene of the accident or incident

Fill in information below if your accident or incident occurred on a river Describe the river flow

☐ **low**	☐**average**	☐**high**
☐ **flood**		

Other river characteristics

☐ **fast flow**	☐**rock rapid**	☐**deep single channel**
☐ **braided**	☐**drop pool**	

7 Accident details

From the below details choose the option that best suits the situation

☐ capsize	☐ explosion	☐ mooring line failure
☐ cargo sift	☐ extreme vessel movement	☐ near miss / close quarters
O chemicals or harmful substance spill	☐ fire	☐ oil spill
O collision	☐ foundered	☐ person overboard
O contact	☐ flooded	☐ propeller entangled
☐ dragged anchor	☐ grounding	☐ propulsion failure
☐ electrical power failure	☐ hit submerged object	☐ sewage discharge
☐ emergency dumping	☐ lifting / cargo gear failure	☐ steering gear failure
☐ equipment failure	☐ list	☐ structural failure

Your description of the events that took place

8 Injury details

Were there any injuries.

If yes, how many

Annexure 4 - Oil Spillage form for record keeping

OIL SPILLAGE FORM

1 Reporter details

Fill in your details (as the person reporting the accident or incident)

Name	
Preferred Contact	
Phone Number	
Address	

2 Vessel or craft

Provide details about the vessel (if applicable / known)

Name (if known)	
Vessel Number	

3 Type and category

Passenger	☐ fishing charter	☐passenger / freight ferry	☐sail training
	☐ chartered yacht	☐ tourism boat/ cruise	
Non-passenger	☐ ro-ro ferry	☐cargo	☐tanker
	☐ tug	☐dredger	☐barge
	☐ livestock carrier	☐support vessel	☐dive boat
	☐ others (please specify)		

4 Time and location

Where did the spillage take place?	
Location in this region	
Water Depth	
Latitude / longitude	
Date of spillage	
Time of spillage	

5 Type of Pollutant and Extent

Oil:	☐ bilge	☐ diesel	☐ crude
	☐ others (please specify)		

Size of spill (length & width in meters):	
Amount of pollutant, if known (liters):	

6 Environmental conditions

Fill in information below if your accident or incident occurred on a river Describe the river flow

☐ low	☐average	☐high
☐ flood		

Other river characteristics

☐ fast flow	☐rock rapid	☐deep single channel
☐ braided	☐drop pool	

Annexure 5 (a) - List of SOP manuals and other relevant documents to be available on vessel

S. No	Description	Objective of the document
1	Emergency Plan	It will provide guidance to the vessel floating staff to respond to different emergencies. Please note that response mechanism should correspond to each type of vessel and kind of load carried by vessel.
2	Hull and prop maintenance records	The maintenance record gives reference during the vessel inspection, fitness check and change of staff.
3	Oil usage log	This data is useful for the master to determine the fuel in the vessel and in case of accident, determining the quantity of fuel, which might leak and will need containment.
4	Garbage records	This data is required under prevention of pollution regulations
5	Bunkering Receipt	This data will help competent authorities to keep check on illegal bunkering and possible threat from oil spillage from inappropriate bunkering
6	SOP for bunkering	Proper bunkering procedures will reduce possible threat from oil spillage during inappropriate bunkering
7	SOP for handling goods	This SOP will help in seamless loading and unloading operations. Every type of material and its form will need separate SOP.
8	SOP for ballast water management	This data is required under prevention of pollution regulations
9	Fire Safety Manual for prevention of fire on board	For stipulating response mechanism for fire incident on board
10	Log of firefighting and lifesaving equipment on vessels	This will help competent authority while inspecting the vessel
11	SOP for action to be taken during grounding/ collision	Each type of vessel and type of load the vessel is carrying will determine the initial response required in case of grounding so that it doesn't result into sinking
12	SOP for action to be taken during oil/ chemical spillage	Each type of vessel and type of load the vessel is carrying will determine the initial response required in case of cargo/ oil leakage. The vessel also needs to have corresponding containment equipment.
13	SOP for action to be taken during flooding or breach of hull	Each type of vessel and type of load the vessel is carrying will determine the initial response required in case of flooding of water way and corresponding threat from possible damage to hull.
14	SOP for navigation	This is going to be a standard document for reference of all the vessel operators and floating staff on the rules of navigation and corresponding use of signals
15	License of the vessel	This is mandatory under IV Act

16	Emergency Contact List	This is explained under Annexure 2
17	List of safety trainings and mock drills	This will help competent authority while inspection whether the staff has received sufficient training on the SOPs and emergency response
18	Speed Log	This will help competent authority while investigating the incident, if the vessel was not following the instructions or advisory issued by competent authority
19	Material Safety Data Sheet (MSDS)	This document needs to have details as per Annexure 14. This is required because for vessel staff to understand what the materials characteristics contain spillage and use of fire safety equipment. In case of dangerous goods this document provides critical information.

Annexure 5 (b) - List of SOP manuals and other documents to be present at terminal

S. No	Description	Objective of SOP
1	Emergency Plan	IWAI will have to provide emergency plan for each terminal, which will have floor plan, exit gates and evacuation route marked on the map.
2	SOP for loading and unloading cargos	There has to be SOP for each type of cargo, and the type of facility available at the terminal. Adoption of these SOPs will help in reducing the risk of spillage of cargo during loading/ unloading operations
3	Fire Safety Manual for prevention of fire at terminal	The terminals which are going t have storage facility of oils or other dangerous goods need to have fire safety manual for each of the storage area and the other buildings. With the clear procedure on use of fire safety equipment, evacuation routes etc.
4	Log of firefighting and lifesaving equipment	The log will help authority to keep stock of whether the terminal has all the necessary provisions as per the current operation levels.
5	Traffic information records	This data will help terminal offices in planning for traffic movement and understanding fluctuation in traffic flow.
6	Records of vessels and ferries using the terminal	This record keeping will help terminal office in recording the vessel related data, which could be referred in case vessel has incident.
7	Compliance Checklist	For each vessel using the terminal, there should be recording of whether vessel is following all the rules and advisory issue by IWAI and state IWTs
8	List of cargos handles with details	This will help in understanding any change in the cargo transported through the NW.
9	SOP for crane operations	SOP will help the crane operator to follow instructions and not pose risk for other users of the terminal.
11	SOP for action to be taken during oil/ chemical spillage	Each terminal should have SOP for spillage that can happen in jetty or storage area or while cargo is loaded/ unloaded
12	SOP for action to be taken during flooding	Each NW can be sub-divided intro stretches based on the flooding level, fluctuation in water level etc. and corresponding advisory that can be issued to vessels voyaging the stretches
13	List of cranes and other operating vehicles	This is already recorded in the IWAI operated terminals
14	List of safety trainings and mock drills	This will help IWAI in keeping check whether terminal offices are practicing the mock drills and safety trainings
15	Emergency Contact List	As per Annexure 2
16	Employee records	This is captured in all the IWAI terminals and could be referred during the

		inspection carried out after the occurrence of crisis incident
17	Record of audits	This will help in record keeping the safety audits that has been carried out by terminal offices.
18	SOP for hot work/ repairs of vessels	In case, any of the terminals also provides the services for repair work, then it should have the SOP
19	Material Safety Data Sheet (MSDS)	This document needs to have details as per Annexure 14. This is required because for vessel staff to understand what the materials characteristics contain spillage and use of fire safety equipment. In case of dangerous goods this document provides critical information.

Annexure 6 - List of agencies available for vessel/ ferry/boat registration

S. No	License Providing bodies/ agencies in India
1	Inland Waterways Transport Assam
2	Captain of Ports Goa
3	Maharashtra Maritime Board
4	Gujarat Maritime Board
5	Himachal Pradesh Department of Transport
6	Registration And Licensing of Fishing Craft (ReALCraft)
7	Transport Department, Government of Bihar
8	Transport Department, Uttar Pradesh
9	Transport Department, Andhra Pradesh
10	Department of Commerce and Transport, Odisha
11	Department of Fisheries, Government of Kerala
12	Transport Department, Government of West Bengal
13	Department of Fisheries, Government of West Bengal
14	River Navigation Department, Government of Goa
15	Port of Chennai, Tamil Nadu
16	Transport Department, Jharkhand

Annexure 7 (a) - List of life saving and firefighting equipment to be available on the vessel as per State ferry Boat Safety guidelines, IV Act rules of navigation

S. No	List of PPE's and lifesaving equipment
1	Lifebuoy with line and light
2	Life rafts
3	Life jackets
4	Distress signals (line throwers, man overboard light and smoke signals)
5	Visual signals (daylight signaling lamps and flags)
6	Light signals (stern light, side lights, head lights, echo sounder)
7	Navigation Equipment (GPS, compass, radar system and log book)
8	Anchors and cables
9	Parachute rockets
10	Vessel's gangway or accommodation ladder
11	Fire hose, with jet/spray nozzles attached
12	Portable dry chemical extinguisher
13	Foam and/or dry chemical monitors
14	Flashlights
15	Portable VHF/UHF equipment
16	Protective Clothing, helmet, safety shoes for crew members on vessels
17	Safety hand gloves
18	Safety harness
19	Face mask
20	Fire and immersion suit
21	Welding Shield
22	Ear plugs
23	Goggles
24	First Aid Kit
25	Barometer
26	Binoculars
27	Anemometer

Note: The life saving and firefighting equipment have been covered in detail under various state ferry act and boat safety regulation issued by NDMA. In addition to that IV Act rules of navigation section 52, prescribes state governments to issue rules for safe navigation and navigation of dangerous goods

Annexure 7 (b) - List of Equipment required by IWAI for Crisis Management

S. No	List of Equipment
1	Fire Alarm
2	Portable dry chemical extinguisher
3	Fire hose, with jet/spray nozzles attached, fire hydrant booster,
4	Foam and/or dry chemical monitors
5	Lifesaving equipment mentioned in Annex 7(a)
6	Fire and immersion suit
7	Gas Masks
8	Protective Clothing, helmet, safety shoes and Safety hand gloves
9	Disaster supplies kit: water, food, radio, flashlight, first aid kit, extra batteries, whistle, dust mask, pliers to cut off utilities, can opener for food, local map, layout, cell phone charger
10	First Aid Kit
11	Portable VHF (Very High Frequency) equipment and dedicated channel for communication
12	River Information System (RIS)
13	DGPS, AIS and GPS
14	Dredgers
15	Tow Boats
16	Rescue Boats
17	Secondary Communication system through satellite phone and toll free number
18	Buoys fitted with LED
19	Marking buoys
20	River gauges
21	Pontoon with hozers and hand pumps
22	Pontoon with cranes (A-frame)
23	Oil containment equipment: Weir Skimmers, Disc Skimmers, Brush Skimmers, floating rigid booms(foam type) with connectors, dispersants and dispersant applicator with spray arms, flex barge (floating and towable), sorbent boom pack, sorbent pads, dumb barge, shovels and plastic bags
24	Incident Reporting system
25	Barometer
26	Binoculars
27	Anemometer
28	Boat ambulance

Annexure 8 - List of trainings to be provided to the staff working on vessels and at terminals

S. No	Trainings for crew members on vessels
1	Training on Distress Safety System
2	Radar Observer Course
3	Elementary First Aid
4	Medical First Aid
5	Basic Fire Fighting
6	Advanced Fire Fighting
7	Personal Survival Techniques (use of life saving equipment)
8	Proficiency in Survival Craft and Rescue Boat
9	Container/Oil/Gas tanker familiarization
10	Use of advanced navigational equipment (Radar, Echo Sounder, DGPS, ECDIS, AIS)
11	Trainings of Standards of Training, Certification and Watch keeping (STCW) code
12	Personal Safety and Social Responsibilities (PSSR)
13	Using VHF radio
14	Life saving
S. No	**Trainings for workers at terminals**
1	Use of Material Safety Data Sheet
2	Lock Out Tag Out (LOTO)
3	Operation of Fork lift trucks
4	Operation of Mobile cranes
5	Mock drills
6	Use of PPE's
7	Security at ports
8	Using VHF radio
9	Life saving
10	Training on handling, storing and transporting of goods (Port Logistics Management)

Annexure 9 – Information format of Crisis Situation in Inland Waterways

The basic information is required to be collected from the first respondent to support any vessel/ ferry during a crisis in inland waterways.

- ✓ Location (Position – Latitude/ Longitude, depth, waterway, chainage, etc.)
- ✓ Nearest Terminal
- ✓ Nearest Landmark
- ✓ Type of incident
- ✓ Type of vessel (passenger or non-passenger)
- ✓ In case of non- passenger, what types of goods are being transported
- ✓ Spillage description
- ✓ Size of spillage
- ✓ Speed of the vessel
- ✓ Was the vehicle moving Upstream or Downstream
- ✓ Brief description of the Scenario

Annexure 10 - IS codes and ISO standards

- IITK-GSDMA Guidelines for seismic design of liquid storage tanks
- IS 1893(Part 1):2002 - General provisions and Buildings
- IS 4326: Earthquake Resistant Construction
- IS 13920: Ductile Detailing of RCC Structures
- IS 13935: Seismic Strengthening of structures
- IS 1893(Part 5):2002 - Dams and embankments
- ISO 11031 code should be used to ensure seismic resistant material handling equipment is procured
- IS 13827:1993 : Buildings shall be constructed with electrical, heating, ventilation, plumbing, and air-conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating
- IS 13611(Part) 1 network services: Protocol Specification (first revision) ISO/IEC 8473 (Part 1): 1998
- IS 4967:1968: Navigational Aids
- NATIONAL ELECTRICAL CODE 2011 (Part 62) : 1993/ IEC 60050 (212) : 1990 -Solid insulating materials (first revision) (Part 69) : 1993/ IEC 60050 (602) : 1993 Distribution of electricity — Generation; (Part 70) : 1993/IEC 60050 (604) 1987 Generation, transmission and distribution of electricity —Operation; (Part 71) : 1993/IEC 60050 (605) 1983 Generation, transmission and distribution of electricity Substations
- IS 456 : 2000 Plain and Reinforced Concrete Code of Practice (reaffirmed 2005)
- IS 875 : Part 3 : 1987 Code of Practice for Design Loads (other than Earthquake) for Buildings and Structures - Part 3 : Wind Loads (reaffirmed 2003)
- IS 800 : 1984 Code of practice for general construction in steel (reaffirmed 2003)
- IS 8237: 1985 Code of Practice for Protection of Slope for Reservoir Embankment (reaffirmed 2002)
- IS 10635: 1993 Freeboard requirements in embankment dams – guidelines (reaffirmed 2003)
- IS 11532: 1995 Construction and maintenance of river embankments (levees) guidelines (reaffirmed 2005)
- IS 12094: 2000 Guidelines for Planning and Design of River Embankments (Levees) (reaffirmed 2005)
- ISO 6812:1983 Roll on/Roll off ship-to-shore connection – Interface between terminals and ships with straight stern/bow ramps.
- ISO 9367-1:1989 Lashing and securing arrangements on road vehicles for sea transportation on Ro/Ro ships – General requirements – Part 1: Commercial vehicles and combinations of vehicles, semi-trailers excluded.
- ISO/DIS 9367-2 Lashing and securing arrangements on road vehicles for sea transportation on Ro/Ro ships – General requirements – Part 2: Semi-trailers.
- ISO 3874:1988 Series 1 freight containers – Handling and securing
- ISO 8468:1990 Ship's bridge layout and associated equipment – Requirements and guidelines.
- ISO 8383:1985 Lifts on ships – Specific requirements.
- ISO 3864:1984 Safety colors and safety signs.
- ISO 5571:1973 Shipbuilding – Identification colors for schemes for ventilation systems.
- ISO 6309:1987 Fire protection – Safety signs.
- ISO 6790:1986 Equipment for fire protection and fire-fighting – Graphical symbols for fire protection plans – Specification.
- ISO 2801:1973 Clothing for protection against heat and fire – General recommendations for users and for those in charge of such users.
- ISO 6529 Protective clothing – Protection against liquid chemicals – Determination of resistance of air-impermeable materials to permeation by liquids.

- ISO 6530 Protective clothing – Protection against liquid chemicals – Determination of resistance of materials to penetration by liquids.
- ISO 6942 Clothing for protection against heat and fire – Evaluation of thermal behavior of materials and material assemblies when exposed to a source of radiant heat.

Annexure 11 - Other International Conventions and Regulations

Although, international conventions and regulations are not applicable to IWAI, there is similarity in the operations and facilities of IWAI and terminals. These conventions are used to prepare CMP. Following table summarizes the conventions and the relevant chapters along with highlight how they can be incorporated in the CMP:-

Information	Sections with details of scenarios for prevention or mitigation measures
Directive 2006/87/EC laying down technical requirements for inland waterway vessels	
Harmonized conditions for issuing technical certificates for inland waterway vessels throughout the Community's inland waterway network. In order to prevent distortions of competition and varying levels of safety, it is desirable, specifically in the interests of promoting harmonization at European level,	Article 10.03 b(1): Extinguishing agents Annex II: Safety requirements
Directive 2008/68/EC on the inland transport of dangerous goods	
Lay down uniform rules for safe transport of dangerous goods	Annexure 1: corresponding country rules on transporting dangerous goods
European code for Inland waterways 5th edition	
Outlines best practices from the existing traffic regulations of the river commissions and UNECE member States. In particular, this revision updates several articles in relation to small craft, radiotelephony, Inland Automatic Identification System (AIS), prevention of pollution of water and an annex on safety checklist for bunkering fuel is added	Chapter 1: General Provisions Chapter 2: Marks and Draught scales on vessels tonnage measurement Chapter 3: Visual signals on vessels Chapter 4: Sound Signals, radiotelephony, navigation devices Chapter 5: Waterway Signs & Marking Chapter 6: Rules of Road Chapter 7: Berthing rules
Central Commission for the Navigation of the Rhine - Basic concepts and standardisation of RIS based on PIANC guidelines on RIS (2004)	
The RIS Standards listed below: Electronic Chart Display and Information System for Inland Navigation (Inland ECDIS), Electronic Ship Reporting in Inland Navigation, Vessel Tracking and Tracing Standard for Inland Navigation Notices to skippers for Inland Navigation	
Central Commission for the Navigation of the Rhine – International Safety Guide for Inland Navigation Tank Barges and Terminals	
The purpose of this Guide is to improve safety of transport of dangerous goods at the interface of inland tank-barges with other vessels or shore facilities (terminals). This Guide makes recommendations for tanker and terminal personnel on the safe carriage and handling of such products that are normally carried in petroleum, chemicals or liquefied gas tankers and terminals handling those vessels.	Chapter 1: Basic Properties of Bulk Liquids Chapter 2: Hazards of Bulk Liquids Chapter 3: Static Electricity Chapter 4: General Hazards for Tanker and Terminal Chapter 5: Fire Fighting Chapter 7: Tanker Information Chapter 8: Ships equipment Chapter 9: Management of Safety and Emergencies Chapter 10: Enclosed Spaces Chapter 11: Shipboard Operations Chapter 12: Carriage and Storage of Hazardous Materials

Information	Sections with details of scenarios for prevention or mitigation measures
	Chapter 13: Human Element Considerations Chapter 15: Terminal Management & Information Chapter 16: Terminal Operations Chapter 17: Terminal Systems & Equipment Chapter 18: Cargo Transfer Equipment Chapter 19: Safety and fire protection Chapter 21: Emergency Evacuation Chapter 23: Mooring Chapter 24: Precautions on Tanker and Terminal During Cargo Handling Chapter 26: Safety Management
Convention on International Regulations for Preventing Collisions at Sea (COLREG), 1972	
COLREG has navigation rules to be followed by ships and other vessels at sea to prevent collisions between two or more vessels. The COLREGs include four annexes: Annex I - Positioning and technical details of lights and shapes. Annex II - Additional signals for fishing vessels fishing in close proximity Annex III - Technical details of sounds signal appliances Annex IV - Distress signals, which lists the signals indicating distress and need of assistance.	Rule 6: Safe speed, Rule 7: Risk of collision, Rule 8: Action to avoid collision, Rule 9: Narrow channels, Rule 12: Sailing vessels, Rule 14: Head-on situation, Rule 15: Crossing situation, Rule 19: Conduct of vessels in restricted visibility, Rule 34: Maneuvering and warning signals, Rule 35: Sound signals in restricted visibility, Rule 37: Distress signals
Convention on International Maritime Satellite Organization (INMARSAT), 1976	
The Convention on the International Maritime Satellite Organization was adopted by IMO in 1976 to establish and oversee satellite communications for shipping. Under the treaty, the International Mobile Satellite Organization (IMSO) has been established as the inter-governmental body that oversees the provision of certain satellite-based maritime distress communication services, specifically those used in the Global Maritime Distress and Safety System (GMDSS).	Part II – Functions, Article 2
International Convention for the Prevention of Pollution from Ships (MARPOL), 1973, as modified by the Protocol of 1978 relating thereto and by the Protocol of 1997 (MARPOL)	
The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes.	Annex I Regulations for the Prevention of Pollution by Oil, Annex II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk, Annex III Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form
International Convention on Standards of Training, Certification and Watch keeping for Fishing Vessel Personnel (STCW-F), 1995	

Information	Sections with details of scenarios for prevention or mitigation measures
The 1995 STCW-F Convention sets the certification and minimum training requirements for crews of seagoing fishing vessels of 24 meters in length and above. The Convention consists of 15 Articles and an annex containing technical regulations. The STCW-F Convention is the first to establish basic requirements on training, certification and watch keeping for Fishing Vessel Personnel on an international level. The Convention prescribes minimum standards relating to training, certification and watch keeping for Fishing Vessel Personnel, which countries are obliged to meet or exceed.	Chapter III deals with basic safety training for all fishing vessel personnel; and Chapter IV deals with watch keeping
SAR Convention 79 (India is under consideration and has not ratified)	
The 1979 Convention, adopted at a Conference in Hamburg, was aimed at developing an international SAR plan, so that, no matter where an accident occurs, the rescue of persons in distress at sea will be coordinated by a SAR organization and, when necessary, by co-operation between neighboring SAR organizations.	Chapter 2 - Organization and Co-ordination, Chapter 3 - Co-operation between States , Chapter 4 - Operating Procedures , Chapter 5 - Ship reporting systems and IAMSAR Manual
Torremolinos International Convention for the Safety of Fishing Vessels	
The 1977 Convention was the first-ever international convention on the safety of fishing vessels, recognizing the great differences in design and operation between these vessels and other types of ships. While other vessels load cargo in port, fishing vessels sail empty and load their cargo at sea. The Convention included safety requirements for the construction and equipment of new, decked, seagoing fishing vessels of 24 meters in length and over.	ANNEX 25: International regulations for the safety of fishing vessels
International Convention on Standards of Training, Certification and Watch keeping for Fishing Vessel Personnel (STCW-F), 1995	
The STCW-F Convention is the first to establish basic requirements on training, certification and watch keeping for Fishing Vessel Personnel on an international level. The Convention prescribes minimum standards relating to training, certification and watch keeping for Fishing Vessel Personnel, which countries are obliged to meet or exceed.	Chapter III deals with basic safety training for all fishing vessel personnel; and Chapter IV deals with watch keeping
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (LC), 1972 (and the 1996 London Protocol)	
One of the first global conventions to protect the marine environment from human activities and has been in force since 1975. Its objective is to promote the effective control of all sources of marine pollution and to take all practicable steps to prevent pollution of the sea by dumping of wastes and other matter.	-
International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC), 1990	

Information	Sections with details of scenarios for prevention or mitigation measures
As per convention, Ships are required to carry a shipboard oil pollution emergency plan. Operators of offshore units under the jurisdiction of Parties are also required to have oil pollution emergency plans or similar arrangements which must be coordinated with national systems for responding promptly and effectively to oil pollution incidents. Ships are required to report incidents of pollution to coastal authorities and the convention details the actions that are then to be taken.	Regulation 3. Mandatory minimum requirements for certification of skippers on fishing vessels of 24 meters in length and over operating in limited waters 11 Fire prevention and fire-fighting appliances, 12 Emergency procedures. 12.1 Precautions when beaching a vessel. 12.2 Action to be taken prior to, and after, grounding. 12.3 Action to be taken when the gear becomes fast to the ground 12.4 Floating a grounded vessel, with and without assistance. 12.5 Action to be taken following a collision. 12.6 Temporary plugging of leaks. 12.7 Measures for the protection and safety of crew in emergencies. 12.9 Abandoning ship. 12.10 Emergency steering, rigging and use of jury steering 12.11 Rescuing persons from a ship in distress or from a wreck.
Protocol on Preparedness, Response and Co-operation to pollution Incidents by Hazardous and Noxious Substances, 2000 (OPRC-HNS Protocol)	
The Protocol on Preparedness, Response and Co-operation to pollution Incidents by Hazardous and Noxious Substances (OPRC-HNS Protocol) aims to establish national systems for preparedness and response and to provide a global framework for international co-operation in combating major incidents or threats of marine pollution. Parties to the OPRC-HNS Protocol are required to establish measures for dealing with pollution incidents, either nationally or in co-operation with other countries. Ships are required to carry a shipboard pollution emergency plan to deal specifically with incidents involving hazardous and noxious substances. The OPRC-HNS Protocol ensures that ships carrying hazardous and noxious substances are covered by preparedness and response regimes similar to those already in existence for oil incidents.	Part III: Life Saving Appliances, Part IV: Dangerous goods

Annexure 12 - Vulnerability profiling

A vulnerability map provides precise location of sites where people, property and natural areas are at risk due to a potential of occurrence of crisis incident. Such maps are made by aggregation of information about different types of risks. Vulnerability maps are created with the assistance of geographic information systems (GIS) software and satellite imagery or survey data. To create the vulnerability map of inland waterways on India the following steps, shown in the figure 1 needs to be followed.

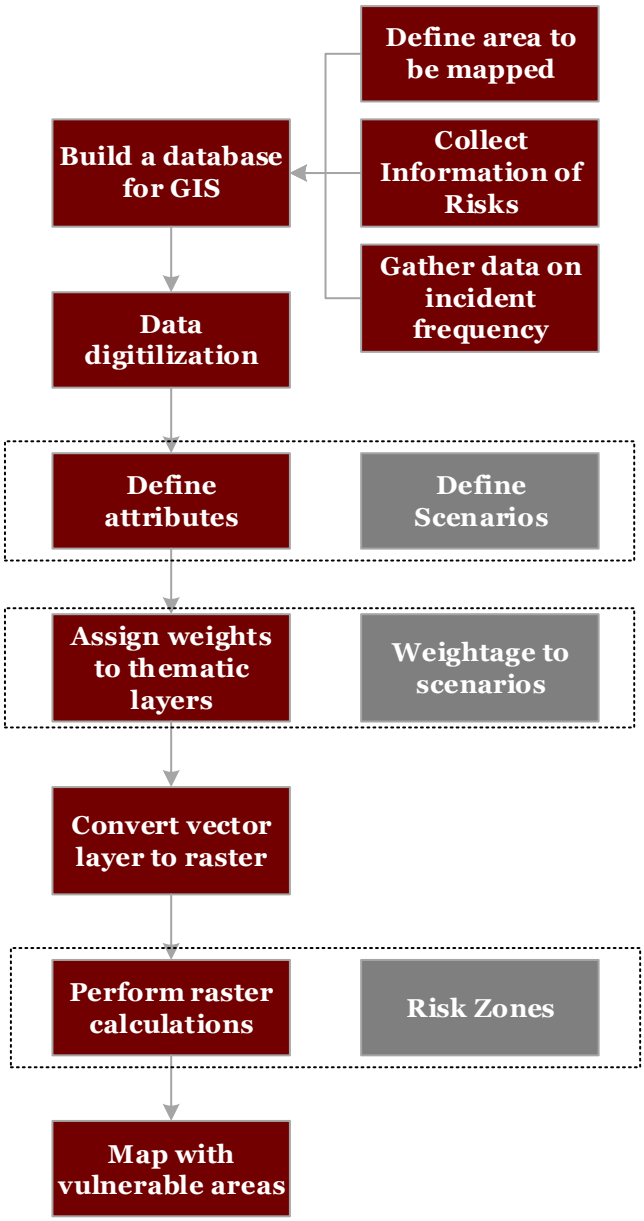


Figure 1. Steps required for vulnerability mapping (PwC methodology)

Steps for creating vulnerability map

i. Define the area to be mapped and gather information (data files on natural and human hazard, the frequency of hazards, location of the terminals, population density etc.)
ii. Digitalize the gathered data, for example if the frequency of the hazards/ incidents and the location of these incidents are available- map the information on the base map or a new layer.

iii. Define the crisis scenario for the terminals, vessels and waterways. Also create layers for different scenarios
iv. Based on data analysis give weightages to the layers representing different scenarios.
v. Convert the vector data into raster data and determine the risk zones using raster calculations.
vi. Perform the data validation of the result map showing the vulnerable areas due to crisis.

Importance of vulnerability map

i. Vulnerability maps can be used for improved communication about risks areas threatened
ii. It provides better visual presentations and understanding of the risks and vulnerabilities for decision -makers for determination of resources.
iii. The vulnerability maps helps on decide the mitigating measures to prevent or reduce loss of life, injury and environmental consequences.
iv. Vulnerability maps can be of use in all phases of crisis management (Prevention (Planning), mitigation, preparedness, operations, relief, recovery and lessons-learned).
v. Vulnerability maps can also be used to mark high-risk zones and to test the effectiveness of the evacuation routes.
vi. During a post crisis, the consequences of the disaster can be easily assessed with the help of field data using theses maps. The evaluators can see if an accurate assessment of vulnerable areas.

Data required for vulnerability mapping

S. No	Data Required	Source (Data Provider)
1	All NWs, proposed stretches and terminals	IWAI – shape file
2	Digital Elevation Model	National Remote Sensing Agency
3	Land use and flood hazard	Bhuvan – ISRO/ CWC
4	Earthquake prone zones	National Centre of Seismology- Ministry of Earth Science/ GSI publications
5	Bridges over the NWs	Ministry of Road Transport and Highways/MoR/IWAI
6	Industrial and Residential Area / LULC data	National Remote Sensing Centre
7	Soil and Land Use pattern	SLUSI
8	Soil type map	National Remote Sensing Centre
9	Eco zones of India	WWF- freely available
10	Population density	NITI Aayog
11	Water level data(GIS File) Least Available Depth Width of channel Siltation rates	WRI - freely available IWAI IWAI MoWR/IWAI Survey data
12	High resolution image for base map	USGS
13	Cyclone Prone Areas	IMD/ NDMA
14	Dams (existing and proposed)	MoWR/IWAI

Annexure 13 – Contingency Plan for LNG carriers

Emergency Response Plan for LNG carriers: LNG spillage leads to generation of high thermal stress and can result in the fracture of the steel. In case of

i. **Leakage on the Cargo**: In case of leakages that cannot be easily stopped by operational routines, rupture in a pipe.

a. Advise the nearest port authority about the Location and dimension of the leak
b. Immediately stop cargo operations and activate ESDS
c. Change course in order to get rid of vapor gas
d. Advise terminal as to why ESDS has been activated
e. Try to stop the leak if that is possible by using wrapping with wet rugs, tightening bolts, etc.
f. Isolate leakage using closing valves
g. Flush water in the leakage area
h. Check for ignition source, lit it off and check for dry powder system fire extinguisher
i. Ensure that all doors, opening to the upper deck from the accommodation area are closed
j. Stop ventilation fans if necessary
k. Activate water spray system if necessary
l. Look for alternatives to continue loading/discharging operations
m. When the situation is stabilized, consider - repairs (temporary or permanent)
n. Contact all parties involved Owners, Agent, Terminal, if situation required

ii. **Collision of LNG cargo:** In case of collision of LNG cargos, which is mostly hypothetical. In the loaded condition with failure of the primary and secondary membranes, liquid cargo will pass through the primary, secondary barriers, inner hull and the ruptured ballast tank and out to the river.

a. Attempt should not be made for the separation of vessel from the colliding vessel or any other structure due to the high concentration of vapors which might lead to ignition
b. Isolate all the ignition sources and clear the deck
c. In case of separation from the vessel and no gas concentration maneuver to a place where there is no vapor cloud
d. Ensure the damaged tank is isolated from other tanks and barriers
e. Ensure flooding of ballast tank with river water to reduce the effect of embrittlement
f. Use water sprays and curtains to reduce the possibility of ignition on deck due to gas leakage
g. Before attempting to fight large fires, due consideration should be given to the possible options:
   i) Allowing a fire to continue to burn thus running the risk of the fire spreading and greater damage being caused.
   ii) Extinguishing the fire and running the risk of damage to life and property if unignited vapour is allowed to drift under light wind conditions to areas of high ignition risk.
h. Where cargo is jettisoned, personnel should be aware of the Rapid Phase Transition (RPT) phenomenon. When LNG, particularly if the LNG is aged, is spilled on to water, a violent interaction can occur.
i. Maintain a careful check on all intact cargo tanks, barriers and adjacent compartments.
j. After stabilization of the situation, decide what to do with the remaining cargo, the location of vessel, cargo containment.

Annexure 14 – Material Safety Data Sheet (MSDS) format

Section 1: Identification of the Substance/Mixture & of the Company / Undertaking

1.1 Product Identifier

1.2 Product Name .

1.3 Relevant identified uses of the substance or mixture and uses advised against Identified uses

1.4 Details of the supplier of the safety data sheet Supplier

Section 2: Hazard Identification

2.1 Classification of the substance or mixture Classification

2.2 Physical and Chemical Hazards

2.3 Health Hazards

2.4 Environmental Hazards

2.5 Human health

2.6 Environment

2.7 Physical and Chemical Hazards

2.8 Label Elements

Hazard Statements

Precautionary Statements

Other hazards

Section 3: Composition / Information on Ingredients

Classification

Section 4: First Aid Measures

4.1 Description of first aid measures

General information

Inhalation

Ingestion

Skin contact

Eye contact

4.2 Most important symptoms and effects, both acute and delayed

4.3 Indication of any immediate medical attention and special treatment needed

Notes for the doctor

Section 5: Fire Fighting Measures

5.1 Extinguishing media

5.2 Special hazards arising from the substance or mixture

5.3 Advice for firefighters

Section 6: Accidental Release Measures

6.1 Personal precautions, protective equipment and emergency procedures

6.2 Environmental precautions

6.3 Methods and material for containment and cleaning up

6.4 Reference to other sections

Section 7: Handling and Storage

7.1 Precautions for safe handling

7.2 Conditions for safe storage, including any incompatibilities

7.3 Specific end use(s)

Section 8: Exposure Control / Personal Protection

8.1. Control parameters

Occupational exposure limits

Ingredient Exposure Limits

Ingredient comments

8.2 Exposure controls

Appropriate engineering measures

Personal protection

Hygiene measures

Respiratory protection

Section 9: Physical and Chemical Properties

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9.2 Other information

Section 10: Stability and Reactivity

10.1 Reactivity

10.2 Chemical stability

10.3 Possibility of hazardous reactions

10.4 Conditions to avoid

10.5 Incompatible materials

10.6 Hazardous decomposition products

Section 11: Toxilogical Information

11.1 Information on toxicological effects

Section 12: Ecological Information

12.1. Toxicity

12.2. Persistence and degradability

12.3. Bio accumulative potential

12.4. Mobility in soil

12.5. Other adverse effects

Section 13: Disposal Considerations

13.1. Waste treatment methods

13.2. Disposal methods

Section 14: Transport Information

14.1 UN Number

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14.3 Transport Hazard Class (es)

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14.5 Environmental hazards

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15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

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Revision comments

Revision date

Revision

Risk Phrases in Full

Hazard Statements in Full

Annexure 15 – Cyber Security Plan

1. Executive Summary

Inland Waterways Authority of India (IWAI) was constituted on 27th October 1986 vide Inland Waterways Authority of India Act, 1985 for regulation and development of Inland Waterways for the purposes of shipping and navigation.

Besides, IWAI is developing and maintaining the Indian side of the designated waterway routes under the Indo-Bangladesh Protocol for transit and trade through inland vessels of one country to the other country and is also assisting Ministry of External Affairs (MEA) in development & maintenance of Kaladan Multi Modal project in Myanmar.

The role of IWAI in the overall augmentation of the IWT sector is pivotal. It has potential to be developed as an eco-friendly, cheap and viable mode of transportation to boost the economy of India as trade, commerce, employment generation, tourism, etc. as well as satisfy the aspirations of the teeming millions of society.

2. Objective and scope

Inland Waterways Authority of India (IWAI) have to secure their information and water transport from trending cyber security attacks in Inland waterways happening now days.

In order to protect and prevent Inland waterways and keep operations running successfully with maintaining confidentiality, integrity and availability, need to prepare a Cyber Security Plan with details of actions to be taken during development of National Waterways under IWAI.

The scope of this cyber security plan only includes National waterways sites and IT infrastructure that would be setup for information communication at remote sites and sea shores, excludes Head office infrastructure.

PwC performed certain number of activities / assessments which comprises of:

• Discussions with stakeholders for understanding of scope and identify respective point of contact

• Gathering existing information and documents available

• Analysis of current developing state of National waterways

*Activities performed on sample basis for understanding and analysis purpose only.

For understanding global standards and industry best practice guidelines, reference IALA-AIS, PIANC, IMO, cyber security guidelines for on-board ships, NIST cyber security frameworks, NCIIPC guidelines for critical infrastructure and other relevant documents seen and collected within IWAI.

3. Importance of Cyber Security in Inland Waterways

Cyber security in Inland waterways is outmost important as it plays critical role in managing and navigating traffic flow at different locations.

Ships/vessels are increasingly using systems that rely on digitization, integration, and automation, which calls for cyber risk management on board. As technology continues to develop, information technology (IT) and operational technology (OT) onboard ships/vessels are being networked together –and more frequently connected to the internet.

This brings the greater risk of unauthorized access or malicious attacks to ships' systems and networks. Risks may also occur from personnel accessing systems on board, for example by introducing malware via removable media.

- Cyber-attack has potential **to affect the safety of onboard personnel, ships, and cargo**.
- Cyber security is concerned with the **protection of IT, OT and data** from unauthorized access, manipulation and disruption.
- Cyber incidents can arise as the result of:
    - A cyber security incident, which affects the availability and integrity of OT, for example corruption of chart data held in an Electronic Chart Display and Information System (ECDIS)
    - A failure occurring during software maintenance and patching
    - Loss of or manipulation of external sensor data, critical for the operation of a ship. This includes but is not limited to Global Navigation Satellite Systems (GNSS).

Types of cyber-attacks which can affect companies and on-board ships/vessels:

Attack type	Description
Targeted Attack	-where a company or a ship's systems and data are the intended target. -Targeted attacks may be more sophisticated and use tools and techniques specifically created for targeting a company or ship. Examples of tools and techniques: • Brute force • Denial-of-service(DOS) • Spear-phishing • Subverting the supply chain
Untargeted Attack	-Where a company or a ship's systems and data are one of many potential targets. -Use tools and techniques available on the internet which can be used to locate, discover and exploit widespread

	vulnerabilities which may also exist in a company and onboard a ship. -Some tools and techniques used are: • Malware • Social engineering • Phishing • Water holing • Scanning

Examples of attack are not exhaustive or limited to these only, cyber-attacks continue to evolve as per advancement of technologies and tools used.

Recent Cyber Attacks and Incidents in Inland waterways happen globally

With target ratio of **14%** cyber-attacks observed in waterways industry sector over other industries, impacting huge organizations with severe losses of monetary and data with life threating consequences. Data value source: Statista report, September 2017.

Iranian Shipping Line (IRISL) attacked - resulting in huge cargo data and monetary loss

Damaged all data related to shipping rates, loading, cargo number, date and location.
Loss of company's internal communication network.
Significant disruptions in operations, severe financial losses.

CyberKeel 15, October 2014

Ground container tracking system outage

Impacted facilities ability to load new containers onto awaiting tractor trailers for over 6 hours.
More than 350 truck movements impacted due to this outage.

Root cause found was -'bad update' of a software.

GPS disruption attack in United States

GPS disruption lasted for over 7 hours. Disruption caused two ship to shore cranes to cease operations due to lack of position data. Operation of two additional cranes degraded.

Attacker tilt floating oil rig off the coast

Attacker managed to tilt floating oil rig off the coast of Africa. This forced facility to shut down.
It took one week to identify cause and mitigate effects.

Reuters: April 2014

Cyber terrorists could shut down North Sea rigs

Cost-cutting measure by Power companies have left North Sea Installation vulnerable to attack by cyber terrorists, it has been warned.

Scotsman – Nov 2013

Belgian port IT systems hacked by cyber criminals

The U.S. Government Accountability Office's report highlights an incident in 2013 where criminals allegedly hacked into IT systems at the Belgian port of Antwerp and smuggled drugs into the country.

Ukraine cyber-attacks 'could happen to UK'

A recent cyber-attack on Ukraine's electricity network could be replicated in the UK, according to a member of a US investigation into the resulting blackout.

BBC News -2017

Baku Tbilisi Ceyhan (BTC) Pipeline case

The Attacker found vulnerability in the software of the system and placed malware in it. The attacker got access to servers essential to BTC pipeline and can control temperature, pressure. The pipeline exploded on 6 August 2008 and gave a new trend to Cyber war

#	Term	Description
1	Malware	Malicious software which is designed to access or damage a computer without the knowledge of the owner. There are various types of malware including Trojan, ransomware, spyware, viruses, and worms.
2	Ransomware	Ransomware is kind of malware which encrypts data on systems until a ransom has been paid.
3	Exploit	Exploit usually refers to the use of a software or code, which is designed to take advantage and manipulate a problem in another computer software or hardware. This problem can, for example, be a code bug, system vulnerability, improper design, hardware malfunction, and error in protocol implementation
4	Social Engineering	A non-technical technique used by potential cyber attackers to manipulate insider individuals into breaking security procedures, normally, but not exclusively, through interaction via social media.
5	Phishing	Sending emails to a large number of potential targets asking for particular pieces of sensitive or confidential information. Such an email may also request that a person visits a fake website using a hyperlink included in the email.
6	Water Holing	Establishing a fake website or compromising a genuine website to exploit visitors.
7	Scanning	Attacking large portions of the internet at random.
8	Brute force	An attack trying many passwords with the hope of eventually guessing correctly. The attacker systematically checks all possible passwords until the correct one is found.
9	Denial-of- service (DOS)	Prevents legitimate and authorized users from accessing information, usually by flooding a network with data. A distributed denial of service (DDoS) attack takes control of multiple computers and/or servers to implement a DoS attack.
10	Spear-phishing	Like phishing but the individuals are targeted with personal emails, often containing malicious software or links that automatically download malicious software.

11	Subverting the supply chain	Attacking a company or ship by compromising equipment, software or supporting services being delivered to the company or ship.

Possibilities of Threat Actors

In current dynamic and competitive environment, there are motives for organizations and individuals to exploit cyber vulnerabilities. The following examples give some indication of the threat posed and the potential consequences for companies and the ships they operate:

Group	Motivation	Objective
Activists (including disgruntled employees)	• Reputational damage • Disruption of operations	• Destruction of data • Publication of sensitive data • Media attention • Denial of access to the service or system targeted
Criminals	• Financial gain • Commercial espionage • Industrial espionage	• Selling stolen data • Ransoming stolen data • Ransoming system operability • Arranging fraudulent transportation of cargo • Gathering intelligence for more sophisticated crime, exact cargo location, off vessel transportation and handling plans, etc.
Opportunists	• The challenge	• Getting through cyber security defenses • Financial gain
States, State sponsored organizations, Terrorists	• Political gain • Espionage	• Gaining knowledge • Disruption to economies and critical national infrastructure

4. Existing Cyber Security posture

Inland Waterways Authority of India (IWAI) regulating and developing defined National waterways across geographically diverse coordinates.

Inland Waterways Authority of India (IWAI) has taken up installation of RIS initially in National Waterway-1 (NW-1) on river Ganga, in three phases, viz. Haldia-Farakka, Farakka-Patna, and Patna-Varanasi. RIS in the Haldia-Farakka stretch has already been operationalized and in the other two stretches.

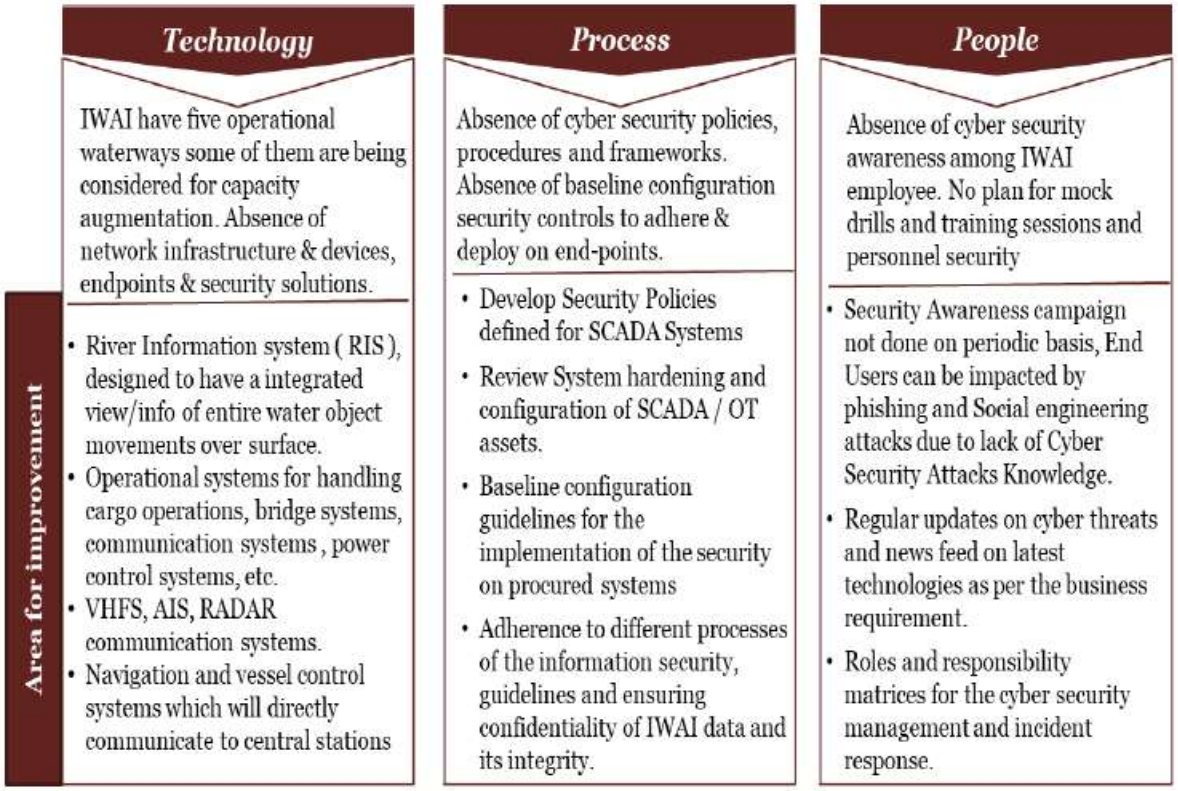
All the vessels plying on National Waterways (NWs) need to be made compatible for using RIS. As RIS ensures safety of vessels in navigation, as per the Inland Vessel Act, it will be the responsibility of the states to direct all the vessels to be equipped with RIS compatible equipment. So far, all vessels of IWAI and the vessels of private operators deployed for imported coal movement for Farakka power plant are RIS compatible.

Out of the existing five National Waterways, NW-1, 2 and 3 have been developed with targeted depth, navigational aids and terminal facilities with storage and mechanized handling facilities. These NWs have been made operational and vessels are plying on them. "Jal Marg Vikas" project for capacity augmentation of NW-1 between Haldia and Allahabad (1620 km), has been initiated. The project, inter-alia envisages three multi-modal terminals with rail and road connectivity at Varanasi, Sahebganj and Haldia.

NW- 4 and 5 are yet to be made operational for which various studies/ developmental works are underway.

Dredging of fairway and construction of temporary terminals has recently started in NW-5.

In terms of cyber security, current state of IWAI is described as Technology, Process and People.



5. Vulnerable areas, target systems, equipment and technologies

To get understanding and identifying vulnerable areas, systems, equipment and technologies, following list provide examples of them, which can be, but not limited to, target of cyber attackers and may impact business operations or huge loss.

Stand-alone systems would be less vulnerable to external cyber-attacks compared to those attached to uncontrolled networks or directly to the internet.

1. River Information System

River Information System (RIS) is a combination of tracking and meteorological equipment with specialized software designed to optimize traffic and transport processes in inland navigation.
The system enables swift electronic data transfer between mobile vessels and shore (base stations) through advance and real-time exchange of information so as to ensure navigation safety in inland waterways. It also provides virtual navigational aids to guide the vessel during navigation.

The communication protocols, web servers, laptop/ desktop and other equipment required in establishing RIS should comply with cyber security guidelines so as to prevent and protect system from external threats and malware practices.

Fig. Graphical representation of Communication in RIS

2. Cargo management systems:

Digital systems used for the management and control of cargo, including hazardous cargo, may interface with a variety of systems ashore. Such systems may include shipment-tracking tools available to shippers via the internet. Interfaces of this kind make cargo management systems and data in cargo manifests vulnerable to cyber-attacks.

- Cargo Control Room (CCR) and its equipment
- Level indication system
- Valve remote control system
- Ballast water systems
- Water ingress alarm system.
- Navigational lock system

3. Core infrastructure systems:

Core infrastructure systems components includes network protection equipment, network devices, remote communication channels, and other management systems to have monitoring and protection of core infrastructure of organization with secure accessibility of required data.

- Security gateways
- Routers
- Switches
- Firewalls
- Virtual Private Network(s) (VPN)
- Virtual LAN(s) (VLAN)

- Intrusion prevention systems
- Security event logging systems.

4. **Bridge systems:**

The increasing use of digital, network navigation systems, with interfaces to shore side networks for update and provision of services, make such systems vulnerable to cyber-attacks.
Bridge systems that are not connected to other networks may be equally vulnerable, as removable media are often used to update such systems from other controlled or uncontrolled networks.
A cyber incident can extend to service denial or manipulation, and therefore may affect all systems associated with navigation, including ECDIS, GNSS, AIS, VDR and Radar/ARPA.

- Positioning systems (GPS, etc.)
- Electronic Chart Display Information System (ECDIS)
- Dynamic Positioning (DP) systems
- Systems that interface with electronic navigation systems and propulsion / manoeuvring systems
- Automatic Identification System (AIS)
- Radar equipment
- Voyage Data Recorders (VDRs)
- Integrated navigation system, other monitoring and data collection systems.

5. **Propulsion and machinery management and power control systems:**

The use of digital systems to monitor and control onboard machinery, propulsion and steering make such systems vulnerable to cyber-attacks.
The vulnerability of these systems can increase when they are used in conjunction with remote condition-based monitoring and/or are integrated with navigation and communications equipment on ships using integrated bridge systems.

- Engine governor
- Power management
- Integrated control system
- Alarm system
- Emergency response system

6. **Access control systems:**

Digital systems used to support access control to ensure physical security and safety of a ship and its cargo, including surveillance, shipboard security alarm, and electronic "personnel-on-board" systems.

- Surveillance systems such as CCTV network
- Bridge Navigational Watch Alarm System (BNWAS)
- Shipboard Security Alarm Systems (SSAS)

- Electronic "personnel-on-board" systems

7. **Passenger servicing and management systems:**

Digital systems used for property management, boarding and access control may hold valuable passenger related data. Intelligent devices (tablets, handheld scanners etc.) are themselves an attack vector as ultimately the collected data is passed on to other systems.

- Property Management System (PMS)
- Electronic health records
- Financial related systems
- Ship passenger/seafarer boarding access systems
- Infrastructure support systems like domain naming system (DNS) and user authentication /authorization systems.

8. **Administrative and crew welfare systems:**

- Onboard computer networks used for administration of the ship or the welfare of the crew are particularly vulnerable when they provide internet access and email.
- They can be exploited by cyber attackers to gain access to onboard systems and data.
- These systems should be considered uncontrolled and should not be connected to any safety critical system on board.
- Software provided by ship management companies or owners is also included in this category

9. **Passenger facing public networks:**

Fixed or wireless networks connected to the internet, installed on board for the benefit of passengers, for example guest entertainment systems. These systems should be considered uncontrolled and should not be connected to any safety critical system on board.

- Passenger Wi-Fi or LAN internet access
- Guest entertainment systems
- Passenger Wi-Fi or Local Area Network (LAN) internet access, for example where onboard personnel can connect their own devices
- Guest entertainment systems

10. **Communication systems:**

Availability of internet connectivity via satellite and/or other wireless communication can increase the vulnerability of ships.
The cyber defense mechanisms implemented by the service provider should be carefully considered but should not be solely relied upon to secure every shipboard systems and data.

- Integrated communication systems
- Satellite communication equipment
- Voice Over Internet Protocols (VOIP) equipment
- Wireless networks (WLANs)
- Public address and general alarm systems.

6. Approach to implement Cyber Security

Cyber security plays very critical role at every stages during development of Inland waterways system. To ensure confidentiality, integrity and availability of systems and data, feasible and safe security approach required. Though, approaches to cyber security will be company- and ship-specific, but should be guided by appropriate standards and the requirements of relevant national regulations

1. Identify threats

The cyber threats could be specific to the company, ship, operation and/or trade. When identifying the threats, companies should aware of any specific aspects of their operations that might increase their vulnerability to cyber incidents.

- Understand the external cyber security threats to the ship
- Understand the internal cyber security threat posed by inappropriate use and lack of awareness

2. Identify vulnerabilities

- Identification of the potential threats that may realistically be faced in Inland waterways
- Assessment of the systems and onboard procedures to map their robustness to handle the current level of threat
- Develop inventories of on-board systems with direct and indirect communications links
- Understand the consequences of a Cyber Security threat on these systems
- Understand the capabilities and limitations of existing protection measures

3. Assess risk exposure

- The level of cyber risk will reflect the circumstances of the company, ship (its operation and trade), the IT and OT systems used, and the information and/or data stored.

- Determine the likelihood of vulnerabilities being exploited by external threats.
- Determine the likelihood of vulnerabilities being exposed by inappropriate use.
- Determine the security and safety impact of any individual or combination of vulnerabilities exploited.

4. Develop protection and detection measures

- Cyber security protection measures may be technical and focused on ensuring that onboard systems are designed and configured to be resilient to cyber-attacks.
- Protection measures may also be procedural and should be covered by company policies, safety management procedures, security procedures and access controls.
- Reduce the likelihood of vulnerabilities being exploited through protection measures.
- Reduce the potential impact of a vulnerability being exp loited.

5. Establish contingency plans

- Important to understand the significance of any cyber incident, particularly for IT and OT systems and prioritize response actions accordingly.
- Appropriate contingency plans for cyber incidents, including the loss of critical systems and the need to use alternative modes of operation, should be addressed by appropriate operational and emergency procedures included in the safety management system.
- Develop a response plan to reduce the impact of threats that are realized on the safety and security of the ship.

6. Respond to and recover from cyber security incidents

- Respond to and recover from cyber security incidents that are realized using the response plan.
- Assess the impact of the effectiveness of the response plan and re-assess threats and vulnerabilities.

7. Steps to improve cyber security posture across IWAI

With development of waterways under Inland Waterways Authority of India, advance systems and equipment used for increasing efficiency and better communication and growth.

In order to maintain confidentiality, integrity and availability of the data & systems, appropriate cyber security controls need to be implemented. We have categorized them in Technology, People and Process.

Technology:

On basis of security requirement of technology in IT infrastructure of waterways operations, categorized solutions in 'Network Infrastructure, Endpoint security and Applications'.

Network Infrastructure:

- Design network architecture / network diagrams for communication in Inland waterways system.
- Secure review of Network architecture and its implementation at sites and connectivity with various locations and network segments
- Deployment of security solutions for protection of network from external threats such as Firewall, IDS / IPS, DMZs, etc.
- Secure review of configuration of network devices such as firewall, switches, routers, etc.
- 24*7 security monitoring of critical systems in use for operating and monitoring waterways. This provides real time notification of unwanted traffic and attack alerts or any abnormal activity incur across IT environment.
- Segregate networks, between IT systems and OT systems (System used for operating machines, industrial equipment, etc.) OT networks may include operational systems, vessels system, etc.
- Adequate security controls at RIS (River Information System) and AIS (Automated Information System) networks having integrated VHF (Very High Frequency) mechanism.

Endpoint security:

- Install Antivirus software solution in end user systems
- Deploy Servers and application as per OEM and IWAI requirements under secure zone
- Patch management system to update latest patches
- Password and Account lockout security controls
- Prepare minimum baseline configuration guidelines to adhere before provisioning of systems in to production environment of IWAI.
- Implement baseline security controls at SCADA systems handling mechanical operations.
- Data storage encryption
- VPN solution for remote access and email security

Application security:

- Security testing of applications and software deployed, OEM application security testing
- Authorization control testing over critical applications such as SAP, ERP, RIS, AIS, etc. (Names of application mentioned for illustration purpose, name or identification of applications not limited to these only.)

Process:

- Develop information security policies for Inland waterways
- Develop procedures to implement policies across the IWAI
- Develop cyber Risk assessment framework for Inland waterways

- Define a governing body under IWAI to manage Cyber security implementation process and programs
- Develop plan and Implement security controls for physical security (Access control, CCTV,etc)
- Develop processes to record accountability of users
- Establish Log management and monitoring process
- Develop Access Management process
- Develop Asset Management process
- Establish Backup and Recovery process for systems and operations.
- Regular Audits for cyber security implementation
- Business contingency and management plan

People:

- Conduct mock drills for security alertness among people of IWAI working at sites
- Conduct emergency drills for the purpose of safety and action response.
- Conduct Cyber security awareness sessions and training workshop for site personnel
- Conduct Cyber security Training for operator personnel specifically for protecting end operation SCADA systems.
- Define roles and responsibilities of people of every department across IWAI.

River Information System Security Control

- Deploy network devices such as firewall, DMZs, WAF, etc., to protect network, applications and servers from external threats, having connected to internet for other business related operations.
- Inter communication between base stations, central operation Centre and on-board systems via internet or lease lines connectivity should be protected.
- USB or any external media connection should be restricted to prevent unauthorized / malware intervention.
- Develop Backup and recovery process for web servers, time server, application server, etc.
- Secure communication channel to transfer data from one station to other and to vessels, etc.
- Authorization control to access critical systems.

8. Cyber Security implementation roadmap

With development of national waterways, steps need to be implemented such that impact on business reduced and mitigated prior to successful running operations.

#	Steps to perform	Way to perform	When
1	Establish a governing body under IWAI to manage and govern cyber security posture across Inland waterways to protect organization and data from cyber threats and incidents	Identify team members to be part of Cyber security governance team from IWAI and consult cyber security experts for subject matter guidance	During development of National waterways
2	Identification of established network connections required for the business operations including - satellite links, - vessel-to-shore communications and vice versa, - operator stations to servers and applications - segregation of different networks (IT - information technology & OT - Operational technology) - Other network integrated to critical infrastructure, technology and equipment.	Assign IWAI team or external agency to establish and run operations in the defined stretch of NW. They should ensure appropriate preparation of network architecture diagrams with all relevant details along with appropriate implementation	During establishment of network infrastructure at sites, estimated time will defined by assigned team/agency.
3	Testing of then developed network and IT infrastructure for strengthening cyber security posture in Inland waterways by performing Vulnerability assessments and penetration testing of network and security assessment of applications. Secure configuration reviews of network devices deployed in infrastructure such as firewalls, switches, routers, access points, etc. DMZ setup, for best security practice.	IWAI may built capability to perform or Contract should be given to third party organization having cyber security experts to perform vulnerability assessments and testing along with all relevant activities described for strengthening cyber posture.	Post development of IT infrastructure at sites
4	Establish strong security controls over the critical devices provided by the OEM for running operations and give collective information. Preparation of baseline information security guidelines for systems. Ensure proper testing of systems and machines before going for real-time operations to reduce the possibility of any incident.	OEM vendors to ensure implementation of strong security controls and baseline security guidelines with testing of systems and machines before commissioning them in to operational environment to run real-time operations.	Prior to Commencement of real time operations at sites with establishment of IT infrastructure
5	Prepare cyber security policy approved by the IWAI authority and procedures to	Contract vendor for performing these activities and prepare	When National waterways

	implement these policies across Inland Waterways such as assessment frameworks, risk management and treatment plans, analysis of threats and vulnerabilities with their likelihood of occurrence, log management and monitoring process, physical & environmental security guidelines, backup and recovery plans Business contingency and management plan and other relevant requirement of information security best practices guidelines.	comprehensive useful documentation to follow as per industry best practices	operations initiated with establishment of technologies and IT infrastructure
6	Deploy endpoint security solutions and establish process to protect systems and prevent from threats and malware, such as - Antivirus software solution Patch management systems Remote access controls (VPN- Virtual private network) solutions Access and authorization management solutions/controls	Consult OEM /vendor for deployment of solutions compatible with their operational applications. For non-OT systems, consult vendor or IWAI team to implement controls and establish system across Inland Waterways.	During establishment of IT infrastructure at sites
7	Establish 24x7 system and event monitoring setup which provide real-time alerts and monitoring of real time events and help in protecting network from external threats vectors	IWAI establish central monitoring center & develop capabilities in-house or should contract vendors for providing establishment and 24x7 monitoring services	Post initiation of National waterways operations and site establishment having IT infrastructure operational.
8	Conduct periodic cyber security audits of network, applications, critical devices configurations and equipment for analyzing gaps in implementation of security controls. Conduct physical surveys of all sites to ensure the correct implementation of cyber security controls.	Engage technical auditors to identify the gaps and help in recommending best practices.	Post establishment of IT infrastructure and executing operations at National waterways sites.
9	- Define roles and responsibilities of cyber team and escalation matrices, conduct self-assessments for cyber security concerns across sites of Inland waterways. Organize mock drills for security awareness and analyze incident and response plan for inland waterways Establish cyber policy awareness and training sessions across Inland waterways	Consult expert vendors for assisting in preparing strategy and conduct training & awareness programs across organization	Post establishment of IT infrastructure and executing operations at National waterways sites.

Annexure 16 - Secondary data used for vulnerability analysis (Both Sea-going and Inland Vessels)*

Country	Year	Collision	Contact	Grounding	Sinking	Flooding	Capsizing	Fire/ Explosion	Facility damage	Fatality/Injury	Others	Total
Japan	2018	36	14	30	8	6	7	6	2	23	0	132
	2017	201	93	181	13	20	55	29	20	136	0	749
	2016	217	94	163	4	20	46	29	21	144	0	739
	2015	244	102	202	5	11	56	41	20	122	1	804
	2014	265	116	213	7	11	61	36	37	150	3	899
	Average of 5 years	192.6	83.8	157.8	7.4	13.6	45	28.2	20	115	0.8	664.6

Country	Year	Collision	Contact	Grounding	Sank	Flooding	Capsize	Fire/ Explosion	Unfit for purpose	Accidents aboard ship	Other shipping accident types	Accidents
Canada	2012	77		69	10		6	34	16	52	3	267
	2013	79		62	14		8	31	43	61	1	299
	2014	88		61	26		3	29	41	52	1	301
	2015	57		59	16		10	33	36	35	2	248
	2016	87		65	26		7	44	31	49	1	304
	Average of 5 years	77.6	#DIV/0!	63.2	18.4		6.8	34.2	33.4	49.8	1.6	283.8

Country	Year	Collision	Contact	Grounding/ Stranding	Sinking/Foundering	Flooding	Capsized/Listing	Fire/Explosion			Others	Total
Hong Kong (Within)	2017	144	46	25	30		20	17			86	368
	2016	112	53	25	16		24	16			73	319
	2015	147	41	26	29		17	19			40	319
	2014	156	40	38	24		18	13			69	358
	Average of 4 years	140	45	29	25		20	16	#DIV/0!	#DIV/0!	67	341

Country	2017	38	16	17	3		0	10			46	130
Hong Kong (Outside)	2016	49	19	13	0		1	9			30	121
	2015	28	22	21	0		1	11			23	106
	2014	26	20	13	3		0	9			25	96
	Average of 4 years	35	19	16	2		1	10	#DIV/0!	#DIV/0!	31	113

Country	All causes of loss	Collision (involving vessels)	Contact (e.g. harbor wall)	Wrecked/stranded (grounded)	Foundered (sunk, submerged)			Fire/ explosion	Hull damage (holed cracks, etc.)	Machinery damage/failure	Miscellaneous	**Grand Total**
(World)	2012	5	2	26	55			13	7	15	1	**124**
	2013	2		21	70			15	1	2	1	**112**
	2014	2	1	18	50			6	4	5	2	**88**
	2015	6		19	65			7	2	2		**101**
	2016	1		15	46			8	4	8	1	**85**
	Average of 5 years	3	2	20	57			10	4	6	1	102

Country	All causes of loss	Collision (involving vessels)	Contact (e.g. harbor wall)	Wrecked/stranded (grounded)	Foundered (sunk, submerged)	Storm	Overloading	Fire/ explosion	Hull damage (holed cracks, etc.)	Machinery damage/failure	Miscellaneous	**Grand Total**
Bangladesh												
	decade average	138			11	20	14		11	2	11	207

Annexure 17 – Boat Safety Guidelines

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