OIL SPILL RESPONSE CONTINGENCY PLAN

MUMBAI & JNPT HARBOUR

Prepared by SADHAV SHIPPING LTD

RECORD OF AMANDMENTS

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NOTE

1. Amandment to Plan is to be carried out by replacing the text, information or data contained in the relevent section, para or sub para.

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DATA DIRECTORY

ACRONYMS

BPCL	Bharat Petroleum Corporation Ltd
DNV	Det Norske Veritas
COC	Communication and Operations Center
ESI	Environmental Sensitivity Index
HM	Harbor Master
HPCL	Hindustan Petroleum Corporation Ltd
IC	Incident Controller
IM	Incident Manager
IMO	International Maritime Organisation
IOCL	Indian Oil Corporation
IPIECA	International Petroleum Industry Environmental Conservation Association
ITOPF	International Tanker Owners Pollution Fund
JD	Jawahar Dweep
JNPT	Jawahar Lal Nehru Port
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships 1973 as modified by the Protocol of 1978
MbPT	Mumbai Port Trust
NFPA	National Fire Protection Association
NOS-DCP	National Oil Spill Disaster Contingency Plan

ONGC	Oil and Natural Gas Corporation
OPRC Convention	International Convention on Oil Pollution Preparedness, Response and Co-operation 1990
OSC	On Scene Coordinator
OSD	Oil Spill Dispersant
OSR	Oil Spill Response
OSRO	Oil Spill Response Organisation
OSRO-M	Oil Spill Response Organisation - Manager
OSRO-S	Oil Spill Response Organisation – Specialist
PC	Port Control
POL	Petroleum, oil and lubricants
RIL	Reliance Industries Limited
SRV	Spill Response Vessel
UNCLOS	United Nations Convention on Laws of the Sea
TPC	Tata Power Corporation

1.0 CONTINGENCY PLANNING

In spite of best intentions to avoid oil spills through best and safe practices and rigid enforcement of good intentions in work place, the spills still occur and will keep on occurring. The next best post spill activity, then, is to address them in terms of containment and recovery within shortest possible time and through best available means that need to be planned and kept ready in advance and spelled through a Contingency Plan for the facility or area handling oil, oil products or other pollutants.

Increase in density of marine traffic, especially oil tankers and petroleum based installations along the Indian coast has increased the risks for occurrence of spills in harbour, coastal waters and during terminal operations apart from spills that could occur from collision, grounding of vessels and stranding. To address the fallout of incidents and accidents that could lead to pollution of marine environment, all countries handling polluting agents are required to have capabilities and create infrastructure and set up means that could handle the pollution response activity in case of any spill. The working parameters and strategy to address the response activities are spelled through a Contingency Plan.

1.1 PURPOSE AND OBJECTIVES OF CONTINGENCY PLAN

India being signatory to number of International agreements and conventions aimed at controlling marine pollution through measures and rules applicable to marine facilities or surface units, is under an obligation to honour and implement the same through municipal legislation and through adopting means, practices and rules in accordance with Article I of the Convention 73 and Protocol 78 i.e MARPOL 73/78.

The article has placed an obligation on the parties to the convention including India "to give effect to the provisions of the present convention and those Annexes

thereto by which they are bound, in order to prevent the pollution of the marine environment by the discharge of harmful substances or effluents containing such substances in contravention of the convention".

Apart from the specific obligations imposed by MARPOL, being a signatory to UN Convention on the Laws of the Sea (UNCLOS) , India has an obligation to protect and preserve the marine environment in addition to obligations under International Convention on Oil Pollution Preparedness, Response and Co-operation 1990 (OPRC Convention).

Accordingly, India too had to formulate rules or administrative directions giving effect to international procedures through structures to be developed by ports and facilities handling vessels and oil cargo.

While, regulatory procedures are expected to be put in place through rules-implementing the various provisions and annexure of MARPOL 73/78, the practical aspects of marine pollution to set up a mechanism on the ground are dealt by OPRC – National Oil Spill Disaster Contingency Plan being an instrument for the same.

NOS-DCP has its origin in IMO convention OPRC – 1990, ratified by India. As per the convention it is imperative upon each signatory state to have laws and mechanisms to respond to oil spills in its waters.

National Oil Spill Disaster Contingency Plan is aimed at coordination of resource agencies to combat an oil spill in Indian waters and also spells the actions required of oil handling facilities i.e to prepare contingency plans for respective facilities and to develop Tier I response capabilities and also to report oil spills. NOSDCP mandates a number of resource agencies comprising of 03 ministries and 15 departments apart from oil industry, off shore terminals etc. to an obligation to:

- Render resources for pollution response when called for,
- Report Oil Spills,
- Prepare contingency plans for respective spill scenario,
- Set up Tier I response facilities and
- Use of Oil Spill dispersants (OSD) in accordance with Plan.

Of the three tiers of response envisaged and planned to handle a spill situation in consonance with quantum of spill, Tier 1 is the primary and first step of responses, to be mounted by the facility where the spill takes place.

While, NOS-DCP outlines the response activities as per Tier system of addressal of spill, the facility plan is the instrument to address the spill scenario at local level. Tier 1 being the first and primary response level has to be executed and undertaken by the facility handling polluting cargo, for which purpose drafting of a CP is the primary requirement.

The National Oil Spill Disaster Contingency Plan was first drafted in India by Coast Guard during 1996 with an objective to put in place the machinery and mechanisms to combat oil spills in Maritime zones of India. The Plan has since been updated in 2002.

1.2 AIMS OF CONTINGENCY PLAN

The aims and objectives of the Oil Spill Response Contingency Plan (here after termed the Plan or CP) of a port or facility are to draw a methodology and strategy to indicate actions required to be taken by responders to:

- Ensure availability of timely, measured and effective response to incidents of oil spill in waters under jurisdiction of the port or facility,

- Take measures to control the spill within minimum area,
- Minimise volume of spill by securing the source in most appropriate way,
- Minimise extent of movement of released oil from the source by timely containment,
- Minimise environmental impact by timely containment and recovery response,
- Maximise effectiveness of recovery actions through selection of appropriate equipment and techniques,
- Maximize response effectiveness through trained and competent, operational and response teams,
- Guide response personnel through the process of managing a spill originating within their area of operation,
- Mitigate consequences of oil pollution incidents ,
- Allow those involved in rsponse to rapidly disseminate information to parties involved and to ensure optimum deployement of available equipment.

1.3 PLAN ELEMENTS

This Plan is a set of guidelines and instructions that outlines the steps that should be taken before, during and after an oil spill emergency. The Plan has to accordingly, pay attention to all the possibilities that could go wrong and "contingent" upon actual events, has the contacts, resource lists, and strategies to assist in response to the spill.

As incumbent by a reasonably workable plan, this Plan provides details of actions required to be initiated and taken to prepare for and respond to spills and address different situations that may arise during or after a spill. The Plan is structured on four major elements , viz:

1.3.1 Hazard Identification

While, it is impossible to know when an oil spill is going to happen and how much oil is likely to be spilled, however, it is possible to identify where oil is stored, the corridors through which it travels and the industries that use large quantities of oil.

Since, different situations can affect the ability of response personnel to contain and clean up an oil spill, such as weather and geographic conditions and spill size, this Plan has attempted to address actions and activities to be undertaken under different conditions.

The following information has been put into use as a part of hazard identification:

- Types of oils received, stored in or transported through the area of operation,
- Locations where oil is received in large quantities and mode of transportation used to receive the oil, such as vessels and pipelines etc,
- Weather conditions that would affect response operations in the area during different times of the year,
- Location of response equipment, trained personnel and other resources that could be called in for response to the spill.

1.3.2 Vulnerability / Sensitivity Analysis

The vulnerability analysis section of the Plan is an attempt to collate and provide information about resources and communities that could be harmed in the event of a spill. This information helps personnel involved in clean up operations to exercise identified reasonable, well-informed choices on protecting areas of high sensitivity - biological, economical and public utilities, that are vulnerable and of concern for public

health and environment. Vulnerability information taken into account for this Plan includes the following that have been indicated on concerned area maps -

- Shoreline types and ranking based on sensitivity to oil,
- Biological resources sensitive to oil or emergency response actions,
- Human use resources sensitive to oil or useful during response operations,

1.3.3 Risk Assessment

As required of a Contingency Plan, this Plan has tried to compare the hazard and vulnerability in a particular location to see the kind of risk that are posed and then to addresses those problems by determining how best to control the spill, how to prevent certain ecological elements or environments from exposure to oil, and how best to advise the local civil authority of the dangers that could be posed by the spill and how to address them and to repair the damage done by the spill.

1.3.4 Response Actions / Resources

As a part of this Plan, the port, facility or the identified OSRO is responsible to undertake spill mitigation operations apart from managing, acquiring and maintaining oil spill response equipment and resources appropriate for response. Equipment, resources and personnel will be stockpiled at one or more suitable location/s as necessary to meet response requirements within shortest period.

The team nominated by the executing authority (in this case the Chairman, Mumbai Port) or any OSRO nominated by the executing authority will give effect to all the response mechanisms and procedures identified by the Plan and maintain trained personnel to undertake the operations.

1.4 RESPONSE POLICIES - GIVING EFFECT TO PLAN

Objectives and aims of the Plan are achieved through formulation of oil spill response strategy for the area of operation and oil spill response plan to be addressed through Operations Manual. While, this Plan includes reference to wider concerns like Environmental Sensitivity etc, the Operations Manual will be the response activity guide along with other documents to ensure execution of each part of response and implementation .

The key deliverables to give effect to the Plan are:

(i) Action Planning - Tactical action strategies including initial containment and control procedures and locations for Tier 1 events are developed on geographic basis with resources located strategically within the area of operation at one or multiple sites.

(ii) Environmental Sensitivity Factors - Environmental sensitivity and risk factors having been taken into account through observations, secondary information sources and studies, the results are integrated into identification of high-risk areas / features and protection/cleanup priorities and selection of appropriate response procedures, resources and resource staging areas.

(iii) Response or Field Guide manuals - Describing procedures for containment and control actions, the manuals contain information on deployment of equipment etc as per the location of spill and safe practices that need to be adhered to by responders.

(iv) Availability of equipment, and employment and training – Response personal being the main key and element in any response, their expertise and knowledge of procedures and handling of spill is spelled through the CP.

1.5 LOCATION BASED RESPONSE

THE SCOPE OF THIS PLAN EXTENDS TO FOLLOWING LOCATIONS AND FACILITIES STRETCHED OVER A GEOGRAPHICAL AREA OF MORE THAN 400 SQ KMS WITH MULTIPLE OPS GOING ON AT THE SAME TIME

- PORTS OF MMB AND JNPT
- TRANSHIPMENT FACILITIES AT JAWAHAR DWEEP, PIR PAU, MUMBAI HARBOUR AND JNPT
- ONGC FACILITIES AT NHAVA AND LANDFALL POINT FOR URAN REFINERY

Protection of these areas requires rapid and well-planned tactical response actions. Considering the size and complexity of the area, the Plan has divided the area into manageable geographic segments. (Individual or multiple areas may be grouped into functional response zones, based on logistical issues including accessibility and driving times from resource bases). Geographical areas of concern in this Plan are :

(i) Anchorage/ Lighterage area

(ii) Alongside cargo berths at MbPT and JNPT

(iii) Jawahar Dweep

(iv) Pir Pau

(v) JNPT oil berths at Nhava and Sheva

1.6 INTEGERATION WITH WIDER AREA OPERATIONS (Spill classification and Tier Response)

This Plan is based on internationally accepted standards of Tier classification and response concept to describe different categories of oil spill events based on their severity and availability of response resources. Tier classifications are determined in

consideration of spill volume, sensitivity of threatened resources and other factors that can only be determined at the time of the incident.

This Plan, is first of the actions in the series to combat oil spill and is open to call for a bigger response activity at national level and is meant to address a spill of up to 7oo tonnes as per Tier 1. Accordingly, all calculations and illustrations in this Plan are as per a spill of 700 tonnes. Oil Spill Classification Standard (Tiers) definitions are:

Tier 1 (Minor Spills): The events include small operational spills, which can be dealt on site by local staff and contractors. Study of available spill data indicates that Tier 1 spills occur largely during operations such as bunker ops, refuelling, pig launching and receiving, valve and flange leaks, and routine operation and maintenance activities and are classified as spills up to 700 tonnes.

In most cases, containment and clean up is effected using the equipment held by facility operator or OSRO and also by use of Spill Response Kits maintained at the facility. All requirements of notification etc to Central authority are observed, though support from outside agencies is not required.

Tier 2 (Major Spills): Tier 2 incidents include larger spills that would require additional local (in-country) resources and manpower. Tier 2 spills usually result from large fuel losses, loading hose failure or small to medium pipe failures (hole size up to 50 mm).

Cleanup is effected by dedicated oil spill equipment from in country sources, equipment stockpiles, in-country oil spill response contractors and by sharing equipment held with other operators. In the event of Tier 2, support from the Central spill controller would be required to be called for.

Tier 3 (Crisis Event): Tier 3 incidents include very large, possibly ongoing spills, that would require additional resources from outside the country. Such spills are expected to be rare and may occur as a result of events such as full diameter pipe

rupture or an uncontrolled tank failure or a large tanker grounding. Response operation utilize all available in-country Tier 2 resources, augmented by additional assets from outside the country. Extensive support from the Central authority would be required in such an event.

1.7 PLAN FACTORS

The following factors are taken into account for the purpose of studying the risks and for preparation of the Contingency or response plan .

- Geographic location, coastline, area sensivity
- Type of oil/product, volume of traffic, quantities of cargo handled, frequency of handling
- Types of operation, terminal design, condition of facilities
- Quality of shipping/vessel types
- Weather, sea conditions, time of day, navigation hazards
- Response strategies, training programmes

1.8 REVIEW, REVISION AND UPDATES

Contingency Plan being a sequence and layout of dynamic operating procedures and parameters is subject to revision due changes in operational parameters of port, cargo, equipment innovations and changing response strategies. Exercises and real time drills being operational tasks might also necessitate a review of plan to be undertaken to incorporate the observations made, apart from the above mentioned.

Accordingly, a study in detail of observations made during every response operation would be undertaken by CMT with a view to incorporate the observations into the Plan for easy and flaw less implementation.

1.9 INTERFACE WITH OTHER PLANS

A spill situation may be, one of the emergencies arising out of an incident or a number of incidents. Such incidents could be natural or man-made leading to emergencies like fire, gas leak, threats or chemical spills. In the event of multiple emergencies, while the spill response will be undertaken as per this Plan, response to other emergencies will be as per the Disaster Management Plan of the particular facility, port, installation or terminal.

2.0 PLANNING AND ADMINISTRATION

In accordance with the National Oil Spill Disaster Contingency Plan (NOS-DCP) all Ports or facilities handling oil and oil products are required to maintain Tier-I Oil Spill Response (OSR) capabilities to undertake response activity within their area of operation.

Accordingly, the ports of Mumbai and Jawaharlal Nehru Port are required to set up and sustain Tier-I OSR facilities in Mumbai / JNPT Harbour in co-ordination with oil companies operating at these Ports. For this purpose, MbPT, JNPT and other Participating Oil Companies (POCs) viz. ONGC, BPCL, HPCL, IOCL, CTTL, TPC & RIL have executed a Memorandum of Understanding (MOU) for sustenance of Tier-1 OSR facilities for combating oil spills at and in surrounding area within Mumbai / JNPT Harbour.

Under the said MOU, it has been decided to put in place Tier-I Oil Spill Response Services in Mumbai and JNPT Harbour for conduct of oil spill operations and mitigation of pollution within the identified area of operation.

2.1 AREA LAYOUT

Since, the fall outs of any accident being addressed by any Contingency Plan cannot be confined and limited to geographical boundaries within the area of jurisdiction and are likely to have an impact on areas beyond the area of addressal, it is desirable to have a knowledge of the area. The area of operation of this Plan is a part of Mumbai Harbour an area encompassing Mumbai estuary.

Mumbai Harbour or Front Bay (Figure 2.1) is a natural deep-water harbour in the southern portion of Ulhas River estuary. The harbour is spread over 400 square kilometers (150 sq mi) and is protected by the mainland of Konkan to east and north

and the island city of Mumbai to west. The harbour opens to south to Arabian Sea. The narrower, northern part of the estuary is called Thane Creek .

Front Bay is the official name of the harbor, so named because the city started as a tiny settlement facing the harbor. The water body behind the original settlement, forming an arc between the former Colaba island and Bombay island, up to Malabar Hill promontory or peninsula, is called Back Bay.

Front Bay is home to Mumbai Port, which lies in the south section of the western edge of the harbor. Jawaharlal Nehru Port and Navi Mumbai lie to the east on the Konkan mainland, and the city of Mumbai lies to the west on Salsette Island.

There are six islands in Mumbai Harbor, a number of which are within the area of operation and are active in port activities.

(i) **Butcher Island**, also known as Jawahar Dweep , is used as an oil terminal by Mumbai Port. It has jetties for tankers and various other infrastructure for offloading crude oil and for loading refined petroleum products. The island is restricted to port employees, and not open to public. **C**rude oil is stored in tanks on the island and is piped to Wadala for refining . Most of the island is covered with dense vegetation with a hillock rising from the centre of the island. It is located 8.25 kilometres (5.13 mi) from Gateway of India.

(ii) The second island named, **Cross Island** is a small, uninhabited islet just off the coast of Dockyard Road.

(iii) **Gharapuri Island,** also known as Elephanta Island, is the best known of the islands in Mumbai Harbor and is a popular tourist destination because of the island's Elephanta Caves, that have been carved out of rock. The island has an area of 16 km^2 (6.2 sq mi) and is located at approximately 18.95°N 72.93°E. The area comes

under the jurisdiction of Raigad district and is thickly wooded with palm, mango, and tamarind trees.

The island is accessible by ferry from Mumbai, being about 10 kilometres (6.2 mi) from the south east coast of the island city. From the boat landing stage on the island, a walkway leads to steps that go up to the famous caves. There is also a narrow-gauge toy train from the boat area on the dock to the base of the steps leading up to the caves (about 600 meters).

(iv) Middle Ground is a small islet off Naval harbour. It features an antique coastal gun battery of the Indian navy. Gun salutes are exchanged with Indian Naval vessels as per ceremonials

(V) **Oyster Rock** is a small group of rock outcroppings in the harbor. The area has restricted access and is used for naval exercises.

(vi) **Salsette Island** is the largest island on which the cities of Mumbai and Thane are located. It is separated from the Konkan mainland by Vasai creek and the Ulhas river.

Creeks

The area is marked by a number of creeks that open into the harbour. The creek areas are ecologically sensitive and have thick mangrove vegetation and are navigable to some distances. The shallow mudflats stretch long distances all along the banks.

2.2. MUMBAI PORT

The Port of Mumbai is situated almost midway (Latitude 18° 54' N, Longitude 72° 49' E) on the West coast of India and is a natural deep water Harbour of about 400 square kilometres protected by the mainland of Konkan on its East and Island of Mumbai on its West.

The deep waters in the Harbour provide shelter for shipping throughout the year. The approaches to the Harbour are well lighted, with Prongs Lighthouse to the

North, visible 27 kilometres and Kennery Light House to the south visible 29 kms. The entrance to the Harbour which has approaches from the South-west is between Prongs Reef and Thall Reef lying off the mainland to the South-east, a distance of about 9 kilometres.

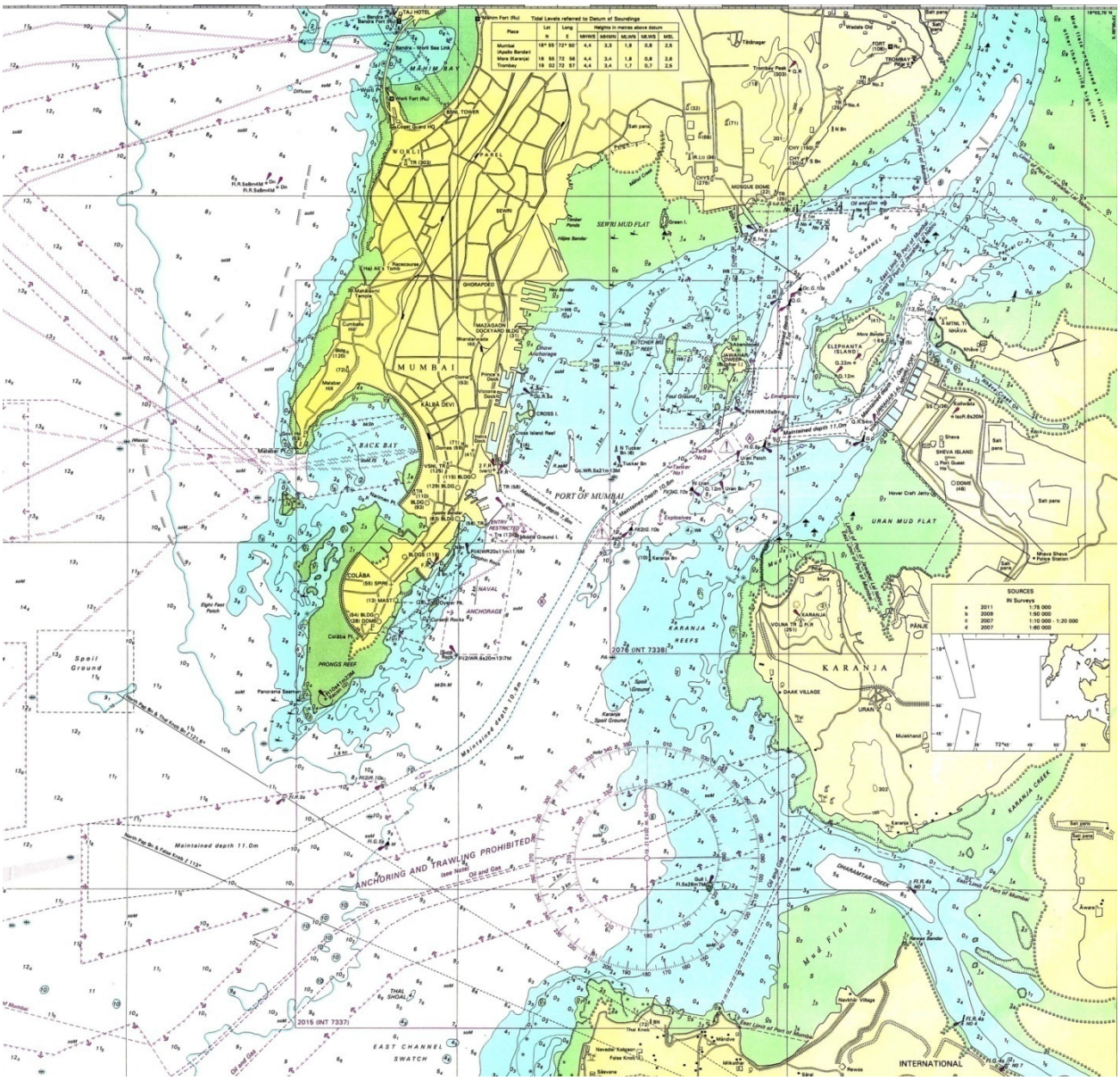


Fig 2.1 Mumbai Harbour

The main navigational Channel is, for the most part, a natural deep-water fairway. The channel has been deepened to 11 meters. With a mean high water neap tide of 3.3 meters, the channel is adequate to meet the requirement of a large number of cargo vessels, passenger ships and deep draft tankers. With good lighting arrangements navigation is allowed at the port round the clock.

The port is administered by Mumbai Port Trust (Mb PT), an autonomous corporation. The port is primarily used for bulk cargo, while most container traffic is directed to Jawaharlal Nehru Port (Nhava Sheva) across the harbour. The first of the present-day docks of Mumbai Port were built in the 1870s. Bombay Port Trust (BPT) was established as a corporation on June 26, 1873. The port and the corporation took their present names in the 1990s.

Over decades, the port has undergone tremendous expansion, with addition of berths and cargo handling capacities. Mumbai's expanding growth and population pressure has led to the establishment of Jawaharlal Nehru Port across Mumbai Harbour in Navi Mumbai on the Konkan mainland. This port began operations in 1989 and handles most of the container traffic.

Figure 2.2 - Mumbai PORT

2.2.1 Cargo Handling

The port handles both dry and liquid cargo at different jetties and locations apart from undertaking Lighterage operations through barges.

(i) Indira Dock

Indira Dock having a total water area of 24.04 hectares and a quay length of about 4000 meters is an enclosed wet dock . The Dock has an Entrance Lock 228.6 meters long and 30.5 meters wide though which vessels can enter or leave the docks at any state of tide. There are 21 berths inside the basin and 5 berths along the harbour wall with a designed depth of 9.14 meters and 7.5 meters respectively. Berthing depths inside the basin can be increased by 1.20 meters by pumping water.

The two berths on the Southward extension of East arm of Indira Dock are Ballard Pier Station and Ballard Pier Extension. Ballard Pier Extension berth is 244 meters long and has a modern passenger Terminal Building. It has a designed depth of 9.75 meters. Ballard Pier Station berth caters to container vessels and has a designed depth of 9.1 meters.

(ii) Liquid Cargo Terminal - Jawahar Dweep

There are four jetties at the island Jawahar Dweep for handling Crude oil and Petroleum products. One of the jetties at Jawahar Dweep, which was commissioned in 1984 can handle tankers with a maximum loaded draft of 12.5 meters corresponding to 125,000 Displacement tons. Two of the jetties (J-1 and J –3) can accommodate tankers up to 70,000 Displacement Tons and 228.6 m length, while, the third jetty can berth tankers of 213.4 m length and up to 48,000 Displacement Tons. The berthing dimensions and permissible parameters are as per table 2.1.

Dock	Dimension	Max. Normal Dimensions	Max oversize
JD marine Oil Terminal (3 Berths)	LOA	225.55	237.75
	Beam	39.62	
	Draft (designed)	10.97 to 11.58 (with tide)	
	Max. Disp	70,000 Tons (Berths1 &3)	
JD 4th Berth	LOA	300.00	
	Beam	39.62	
	Draft (designed)	12.25 to 14.30	
	Max	1,25,000 tons	

Table 2.1 - PERMISSABLE BERTHING PARAMETERS at JD

Jetty 1, 2 and 3 are provided with pipelines to handle both crude and products, namely, HSD, Naphtha, FO/LDO, SKO , ATF etc. The details are as per table 2.2.

Product	No of headers	Size (inches) & psi	No & dia of pipeline (inches)
Crude	8	10" / 150	2 / 24"
FO/ LDO	4	10" / 150	1 / 24"
Naphtha	2	8" / 150	1 / 16"
HSD	2	8" / 150	I / 16"
White oil	2	8" / 150	1 / 12"
Dirty ballast	2	8" / 150	1 / 16"

Table 2.2 - Product handling infrastructure

(iii) Liquid Cargo Terminal – Pir Pau

Chemical and POL products are handled at two jetties at Pir Pau. Old Pir Pau jetty can accommodate tankers of 170.69 m length, while, the new jetty commissioned in

December 1996 can handle tankers with a length of 197 m and a draft of 12.0 m. All the jetties are connected to Oil Refineries by a network of pipelines.

Dock	Dimensions	Max normal	Max. Oversize
Pir Pau (Old)	LOA (Day light)	170.69	178.30
	Beam	25.91	28.96
	Draft	6.40 to 7.5	
	Max Displacement	19,000 tons	
Pir Pau (New)	LOA (Day Time)	191.0	191.0
	Beam	28.0	28.0
	Draft	11.0	9.5 (Night)
	Max displacement	47,000 tons	

Table 2.3 - PERMISSABLE BERTHING PARAMETERS at Pir Pau

The cargo handled at Pir Pau and line sizes are as per table 2.4.

Product	Line size	Operated by
Lube Oil	8”	IOBL
LPG	8”	BPCL
LSHS	12”	BPCL
Chemicals	6”	AEGIS
	6”	CTTL
	8” and 4”	RCF

Table 2.4 – Cargo and line sizes at Pir Pau jetty

(iv) Bunders

Besides the wet docks, there are along the harbour front a number of bunders and open wharves where the traffic carried by barges/sailing vessels is handled.

(v) Storage

There are transit sheds at most of the berths and a number of warehouses in the Port area for storage of waiting cargo and pre-shipment storage of export cargo.

Figure 2.3 Jawahar Dweep

2.2.2 Cargo Statistics

The figures with respect to number of vessels and cargo handled for the years 2007-2014 at MbPT are as per table 2.5.

YEAR(Apr – March)	Vessels	POL vessels	POL cargo
2013-2014			35982
2012-2013	1949	1018	34785
2011-2012	2057	1102	33314
2010-2011	2156	1027	33229
2009-2010	1639	870	34496
2008-2009	1612	902	34371
2007-2008	1709	927	37074
2006-2007	2236	970	32171
2006- 2005	2153	834	

Table 2. 5 - Vessels and volumes of oil cargo handleded at MbPT

2.3 JAWAHALAL NEHRU PORT (JNPT)

The port lies along the eastern shore of Mumbai harbour off Elephanta Island on the Konkan mainland in location 18 56'43" North and 72 56'24" East .

The port shares a common 22.0 Km long main harbour channel with Mumbai Port up to No. 4 berth of Jawahar Dweep (J D) Terminal which is presently maintained to a depth of 10.7 to 11 mtrs. below Chart Datum.

The approach channel from J D to JNPT is 7.2 kms in length with maintained depths of 11 mtrs below Chart Datum with a width 350 meters at entry point i.e 460 meters off the berths. The available depth off the berths is 13.5 meters (Below Chart Datum)

Making use of tidal window, large size vessels having a draught up to 12.5 mtrs. are able to navigate through Mumbai harbour main channel and JNP channel. The Port is deepening and widening the existing channel to accommodate up to 14 mtrs.

2.3.1 Cargo handling

The cargo handling berths comprise of anchorage berth of 600 meters diameter and 2000 meter of quay length for Container Berth apart from 445 meters of quay length for Feeder Container / Cement / Project Cargo Ships.

Most of the container cargo is handled from this port only. Details of POL vessels and cargo handled at JNPT are as per table 2.6.

YEAR(Apr– March)	Vessels handled	POL vessels	POL cargo ('ooo
2013-2014			4566
2012-2013	2588	468	4125
2011-2012	2916	445	4926
2010-2011	3100	479	5135
2009-2010	3096	496	4916
2008-2009	2973	408	4552
2007-2008	3106	312	2189
2006-2007	2775	321	2625
2006- 2005	2395	356	

Table 2.6 - Vessel and volumes of oil cargo handled at JNPT

2.3.2 Liquid Cargo Berths

The port handles POL cargo for BPCL, IOC and ONGC through dedicated berths. Cargo for BPCL and IOC is handled at Sheva, while, ONGC handles its Mumbai High supplies and vessels from Nhava.

(i) Sheva

Liquid cargo is handled through the twin berth cargo jetty developed by M/s Bharat Petroleum Corporation Limited and Indian Oil Company Limited for handling liquid cargo including POL products. The jetty is 300 mtrs long with a width of 40.5 mtrs having capacity to accommodate twovessels of 85,000 DWT on seaside berth and 30,000 DWT on shore side berth.

Three dock lines are provided for white and black oil with a capacity of 5.5 million tonnes per annum. Jetty is provided wth six 12' marine loading and unloading arma (3each on sea and shore side) for working cargo. The deredged draught on seaside is 13.5 mtrs and 12 mtrs on shore side.

(ii) Nhava and Uran

Nhava is the main center for ONGC Mumbai High operations . The vessels operating in the High receive stores, fuel and lubricants from Nhava. The vessels calling Nhava are largely restricted to OSVs.

ONGC off shore facility – refinery and tank farm, is located at Uran and was established in 1974. The site is about 12 km east of Mumbai and is approachable by all-weather motor able roads.

The facility receives entire oil and part of natural gas produced in Mumbai offshore oil fields. Both the oil and gas received from offshore is processed at various units for producing value added products like LPG, C2-C3, LAN, apart from processing, storage and transportation of oil.

The unstabilized crude oil is received from offshore platforms through 3 oil trunk lines. 30" MUT oil pipeline from Mumbai High and 24" HUT oil pipeline from satellite off-

shore platform are the principal feed stock to plant. Processed product is shipped out through Jawahar Dweep.

Figure 2.4 JAWAHAR LAL NEHRU PORT

2.4 POL CARGO

Mumbai Port and JNPT are handling varied oil and oil product cargo including imported crude.

List of oil being handled at Mumbai within the area of ops of this Plan are placed at **Appendix 1.**

2.4.1 Chemical characteristics of different oils and their implications

Though, chemical characteristics of crude oil and gasoline remain confined within a small range of variations , yet different oils within the category of that ' oil' have a particular chemical signature defining the chemical properties of that class of oils. This signature is of great help to responders while planning response strategy. The processes that the oil would undergo post spill in terms of weathering processes depends on these base properties and weather conditions in the area at the time of spill.

The base properties of an oil will determine the physical and chemical changes that would occur when the oil is spilled onto water and will account for its persistence and toxicity. For this reason it is essential to have handy the list of properties of oils being handled in the area.

Many oils have a tendency to incorporate seawater and form a water-in-oil emulsion, which can increase the volume by a factor of three or four, and the viscosity by several orders of magnitude. Oils with asphaltene contents greater than 0.5 per cent tend to form stable emulsions, called 'chocolate mousse', which are particularly difficult to handle.

To study the probable behaviour on water and implications regarding effectiveness of different types of on-water recovery devices and chemical dispersants, all particulars of oil are required to be available to responders.

Broad classification of oils as per MARPOL 73/78 is placed at **Appendix 2**.(The list is not to be considered comprehensive).

Major characteristics of different classes of oil are placed at **Appendix 3.**

3.0 RISK AND SPILL ASSESSMENT

3.1 HAZARD RATING

National Fire Protection Association (NFPA) has accorded ratings with respect to degree of hazard posed by chemicals being handled in port. The rating is in numbers with respect to flammability (Nf), health hazard (Nh) and reactivity (Nr) . The rating of hydrocarbons (higher number being more hazardous) are as per table 3.1 -

Product	Nf	Nh	Nr
HIGH SPEED DIESEL	2	0	0
CRUDE OIL	3	1	0
GAS OIL	2	0	0
SKO	2	0	0
NAPHTHA	3	1	0
MOTOR SPIRIT	3	1	0

Table 3.1 - Hazard Ratings

Flammability (Nf) 3 – Liquids and solids that can be ignited under almost all ambient temperature conditions

2 – Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur

Health (Nh) 0 - Materials which on exposure under fire conditions would offer no hazard beyond that of ordinary combustible material

1 – materials which on exposure would cause irritation but only minor residual injury if no treatment is given

Reactivity (Nr) 0 – materials which in themselves are normally stable, even under fire exposure conditions and which are not reactive with water

It is apparent that risks to human life in terms of flammability, health and reactivity are not very significant and can be handled with some degree of expertise.

3.2 CAUSES OF OIL SPILL

The common causes of spill are

- Cargo operations- loading, discharge
- Ship collision, or grounding
- Bunker/ fuelling operations
- Ship distress / sinking
- Pipeline ruptures /accidental spills from sub-sea/over the sea/shore approach (in the tidal zone) pipelines

3.2.1 Location of spill within the scope of this Plan

Based on the location of vessel at the particular time of incident within the area of operation, the likely spill could occure at any of the following locations

(i) Sea or in channel due collission etc during passage

(ii) Close shore due grounding or

(iii) Alongside at jetty or at the terminal during cargo operations

Not withstanding the above locations, it is possible that an eventuality occuring at sea like a collission or mechanical failure could lead to a situation where the consequences would be felt in some other location at a coastal location.

3.3 OIL SPILLS - HISTORIC DATA

Historic data, oil properties, climate, local meteorology and environmental sensitivities are important factors in assessing the risk, behavior, fate and potential consequences of spilled oil.

Historic data being secondary data available in public domain is a good measure of causes, probabilities and averages of the happening of any scenario.

Historic data is of great help to responders and Contingency Planners since the study of this data helps in identifying trends and causes of spills which in turn help in identifying and implementing remedial approaches as per the gravity and frequency of incidents and plan appropriate response .

3.3.1 Analysis and figures

ITOPF has carried out extensive studies on all aspects of oil spill and compiled statistics over number of years. The causes have been annalyised under two heads viz. operations and accidents.

The data establishes that most spills from tankers result during routine operations such as loading, discharge of cargo, bunkering and normally occur in ports or at oil terminals and the majority of these operational spills are small, with some 92% involving quantities of less than 7 tonnes.

Accidents involving collisions and groundings generally give rise to much larger spills involving quantities in excess of 700 tonnes. Figures for the period 1974 to 2013 for spills of < 7 tonnes and 7 -700 tonnes are as per table 3.2 and 3.2A.

OPERATIONS	Loading /	Bunkering	Other	Unknown	TOTAL
Collisions	2	2	14	167	185
Groundings	2	0	14	224	240
Hull failures	324	10	47	195	576
Fires &	50	5	35	83	173
Eqpt failure	1125	104	251	202	1682
Others/unknown	1655	444	921	1971	4991
TOTAL	3158	565	1282	2842	7847

Table 3.2 – Incidences of spill , < 7 Tonnes (1974- 2013)

OPERATIONS	Loading /	Bunkering	Other	Unknown	TOTAL
Collisions	5	0	51	298	354
Groundings	0	0	25	246	271
Hull failures	36	4	14	46	100
Fires&	8	0	13	25	46
Equipment		6	17	38	203
Other/	200	22	49	106	377
TOTAL	391	32	169	759	1351

Table 3.2 A – Incidences of spill, 7 - 700 Tonnes (1974- 2013)

An analysis of available figures point out that major spills from exploration and production operations are far less common than those from oil tankers that usually take place in harbour or at terminals during routine operations.

Over 75% of marine oil spills that have occurred world wide have been within port or harbor area during routine ship operations such as loading, discharge of cargo and bunkering. Most of these are small in nature and less than seven tons.

3.4 RISK FACTORS FOR OIL SPILLS - TERMINAL / PIPELINE OPS

In spite of best intentions to conduct cargo work under best practices, a spill could still occur at a port or terminal during cargo work because of the failure of pipelines, loading arms, flanges or equipment. The potential accidents associated with a plant, port, terminal or pipeline can be divided into two categories in terms of Generic and Specific operating failures.

Generic failures are associated with mechanical component of the facility or terminal like vessels, pipelines, pumps or compressors. The failures under this category could be caused by factors as corrosion, vibration or external impact. A small event like a leak may escalate into a bigger event by itself causing a bigger failure.

The prime cause of **Specific operating failures** is human errors but they can also include accidents.

Every significant mechanical component that could fail with its operating conditions, contents and inventory, is a contributor to failure identification. The study of Generic failures requires consideration of each component under their normal operating conditions.

The possible range of failures being large in number are generally considered under the following heads and incidents

For vessel/ storage tanks

Rupture (Full bore)

Large leaks (20%mm equivalent leaks)

Medium and small leaks (due to corrosion, impact and other such cases)

For pipelines

Full bore ruptures

Large, medium and small leaks

3.4.1 Failure frequencies - Pipelines

The failure frequency of pipelines is subject to a number of factors like rate of corrosion, age of pipeline, duration of use, size of damage and length etc. Different value of any of these will give different figures for failure frequency.

The data as per table 3. 3 gives the failures frequencies in relation to type or size of leak and represents the chances of occurrence of mentioned type of leak per unit length of pipeline per unit diameter .

TYPE	% of cross sectional	Frequency per year
Small leak	< 1	$2.8x10^{-7}$ L/D
Big leak	5	$1.2x\ 10^{-7}$ L/D
Catastrophic leak	20	$5.0x10^{-7}$ L/D
Rupture(guillotine failure)	100	$2.2x10^{-7}$ L/D

Table 3. 3 - Pipe leak frequencies as per size of leak

With respect to causes of leak as per the failure of different systems , the frequencies are as per table 3. 4

SYSTEM	FREQUENCY
Flow line, Hoses, Arm failure	Partial rapture – 1.25×10^{-5} /year
Main oil line	Total rapture – 18-24" line 1.76×10^{-5} / yr
Hose Joints	3.94×10^{-5} / year
Block Valve	3 – 11" – 1.08×10^{-4} /year
Flange joints	3-11" – $5.56x\ 10^{-5}$/ year

Table 3.4 – Frequency of system failures

3.4.2 Cargo Ops or Transfer Spill Frequencies

Transfer spill is defined as an event where the oil is released to sea due to failure or error during loading/ unloading of cargo or fuel oil. This includes loading in port and ship-to-ship transfer also. Typical causes for this spill include overflow, hose failure, errors in setting valves etc.

As per figures compiled by DNV, during 2000-10, ten transfer spills on oil tankers with known quantities were reported. The oil tanker exposure during this period was 74,471 ship years. Based on an average of 80 port visits per ship year, a total of 5.6 million cargo transfers were undertaken. This figure gives a transfer spill frequency of 1.7×10^{-6} per cargo transferred.

3.4.3 Spill Volume Calculations – Pipelines

The quantity of oil spilled can be calculated in terms of total rapture and also for pin hole leaks using software taking into account the diameter of hole and flow rate . The formula for total rapture calculation is

Volume of Spill = 2 Pie X Radius of Pipeline X Length of Pipeline X Flow Volume

3.4.4 ONGC Pipeline Damage

As per risk assessment carried out for ONGC pipeline from Mumbai High to Uran plant, as carried out through " Oil Spill Contingency Plan- Western Offshore Unit", the rates of flow and pressures are continuously monitored at the platforms and Uran Terminal and in case of a rupture, the pumping will be stopped. At the instant of rupture, the oil being under pressure greater than the hydrostatic head due to seawater, will escape to sea. Once the pumps are stopped, the line back pressure would force out more oil that would join the escaping oil.

The expansion of gases entertained will also displace some oil from the pipelines to join the oil escaping to sea. Eventually, the hydrostatic head of sea water would be sufficient to hold in place the oil remaining in the pipeline, thus preventing any further escape of oil to sea. In case of a partial leakage, the oil release rate would be 23 - 34 m3/hour and in the case of a total rupture, the size of spill will be 1900 - 3600 m3/hour approx. In the case of sub-sea flow lines, the maximum capacity of the longest flow line is less than 250 m3/ hour. Assuming duration of one minute, before the line is shut down the estimated quantity of spill would be 20 m3 only.

3.4.4 ONGC Pipeline spill estimates

The main 30" diameter oil line from Mumbai High Field to Uran shore terminal if ruptured would cause a major oil spill. Any rupture in the oil line will be indicated by sudden loss of pipeline pressure from farthest pumping Platform Control Room and reduction in quantity of oil received at Uran terminal. The size of spill near the point of rupture would enlarge with passage of time in the manner as illustrated in Appendix 4 (as per Regional Contingency Plan, (W).

The quantity of oil to be recovered will depend on the loss due to evaporation. Studies in the Arabian Sea indicate that at the wind speed of 20 knots and sea temperatures of 23 to 30 deg C the loss due to evaporation is approximately 50% within first 2 hours of Oil Spill. After two hours of exposure evaporation does not increases significantly. The studies further establish that after a lapse of two hours the loss due to evaporation is not very significant.

In case of total rupture of the 36" bay line running from Uran to Trombay, the pump will be shut down automatically within few minutes and the volume of oil spill will be around 20 m3 only. The areas affected would be Trombay, Thane Creek, Elephanta and Butcher Island area.

3.5 SHIP ACCIDENTS AND FREQUENCY OF OIL SPILLS

Taking in account the total of world fleet and collision accidents during the period 2000-10 , DNV has carried out an in depth analysis of frequency of ship collision each ship type and oil spill there from, to calculate the probability of accident and oil spills. The figures arrived at with respect to eventualities are as per table 3.5

3.5.1 COLLISION

(i) Collision frequencies – vessel types

SHIP TYPE	NON SERIOUS INCIDENTS	SERIOUS INCIDENTS (total loss)	TOTAL LOSS
Oil tankers	1.3E – 03	3.0E – 03	9.4E – 05
Chemical tankers	1.4E – 03	3.4E – 03	1.6E – 04
Bulk carriers	1.6E – 03	4.3E – 03	2.0E – 04
General cargo ships	1.4E – 03	4.7E – 03	6.3E – 04
Container ships	2.1E – 03	7.1E – 03	5.1E – 05
Fishing vessels	1.4E – 03	3.7E – 03	1.0E – 04
Other ships	4.8E - 03	1.4E - 03	7.6E - 05
All ships	7.9E – 04	2.3E – 03	1.9E - 04

Table 3.5 - COLLISION FREQUENCIES (PER SHIP YEAR)

(ii) Oil spill probabilities - Collision

TABLE 3.6 shows oil spill probabilities due to collision for oil tankers during 2000 – 10. These figures are based on oil spills with known quantities and include ships that were loaded and in ballast. Hence, the figures include a 50% probability of the ship being fully loaded and a 50 % probability of it being in ballast with only bunker fuel onboard.

SEVERITY	OIL SPILLS	OIL SPILL PROBABILITY (per collision)	OIL SPILL FREQUENCY(per ship year)
Total losses	3	0.43	$4.0x\ 10^{-5}$
Serious casualties (total losses)	33	0.15	$4.4x10^{-4}$
Non serious incidents	3	0.03	$4.0x10^{-5}$
Total incidents	39	0.12	$5.2x10^{-4}$

Table 3. 6 - OIL TANKER SPILL FREQUENCIES DUE TO COLLISION, 2000-2010

(iii) Oil spill frequencies- Ship types

With respect to overall spill frequencies due to collision for each ship type, the probabilities are as per Table 3.7.

SHIP TYPE	IN PORT (per visit)	IN RESTRICTED WATER (per km)	AT SEA (per hour)	TOTAL (per year)
Oil tankers	8.8E-07	1.2E-08	3.1E-08	2.6E-04
Chemical tankers	1.0E-06	1.3E-08	3.5E-08	3.0E-04
Bulk carriers	1.2E-06	1.7E-08	4.3E-08	3.7E-04
General cargo ships	1.6E-06	2.2E-08	5.7E-08	4.8E-04
Container ships	1.9E-06	2.5E-08	6.4E-08	5.5E-04
Fishing vessels	1.7E-07	2.2E-09	5.8E-09	4.9E-05
Other ships	4.1E-07	5.5E-09	1.4E-08	1.2E-04

Table 3.7 - FREQUENCIES OF OIL SPILLS - SHIP TYPES, 2000- 10

3.5.2 VESSEL CONTACT

(i) Frequency

With respect to oil spill post contact with other objects than ship or the sea bottom, DNV has done further calculations with respect to tankers. The noted frequencies are as per Table.3.8

SEVERITY	CONTACTS	CONTACT FREQUENCY (per ship year)
Total losses	3	$4.0x10^{-5}$
Serious casualties (exctotal losses)	45	$6.0x10^{-4}$
Non serious incidents	26	$3.5x10^{-4}$
Total incidents	74	$9.9x10^{-4}$

Table 3.8 - Contact frequencies on Oil Tankers, 2000-10

(ii) Spill Probabilities

A total of 11 cases of oil spills from tankers having been reported due to contact during 2000-10, the average oil spill probability arrived at is 11/74 = 0.15. Oil spill frequency is 0.15x9.9x10 (raised to power -4) = 1.5x10 -4 per ship year.

OBSERVATIONS - HISTORIC DATA

Supported by statistics and frequencies, it remains a fact that the spills do occur from all types of vessels and at all locations but with varied frequency and need to be handled post occurrence.

3.6 MAX CREDIBLE SPILL VOLUMES

Calculation of volume of pollutants that could be spilled and the volume that will need to be responded to is undertaken taking in account the following :

(i) The rate of release - Taking into consideration of whether the release is instantaneous or occurs over a period of time,

(ii) The spill duration - The time period over which the release of pollution is likely to occur,

(iii) Oil weathering and behaviour – Slick volume losses through evaporation and volume increase through emulsification.

3.6.1 Volumes for maximum credible case scenario

Australian Maritime Safety Authority (AMSA) has issued figures and indicative maximum credible spill volumes to be used if actual volume cannot be or have not been calculated. These have been promulgated through AMSA Gguidelines and are as per table 3.9 below.

Scenario			Basis of Volume Calculation
Source	Incident		
Oil Tanker[1]	Collision	Major[2]	Volume of two largest outside tanks + one adjacent inner tank
		Non major[3]	100% of volume of largest wing tank (i.e. not double hull) 50% of tank protected by double hull
	Grounding	Major[4]	Volume of largest two consecutive potentially impacted tanks
		Non major[5]	100% of volume of largest wing tank (i.e. not double hull) 50% of tank protected by double hull
Other vessel[6]	Collision		Volume of largest tank
	Grounding	Major[7]	Total fuel volume + Cargo
		Non major[8]	Total fuel of one tank
MODU/ Production Platform	Blowout		Predicted flow rate per day x days estimated to get a relief rig on site + 20 days to cap well
	Refuelling (continuous supervision)		Transfer rate x 15 mts of flow[9]
	Refuelling (intermittent supervision)		Transfer rate x 2 hours [10]
Onshore pipeline	Rupture		100% of maximum flow for 1 hour + volume of affected pipeline section [11]
	Leak(above LoD)[12]		2% of maximum daily flow x 4 days or time taken to detect, reach and repair leak[13]
	Leak (below LoD)		2% of maximum daily flow x 90 days or time taken to detect, reach and repair leak
Offshore pipeline	Rupture		Maximum daily flow rate x 1 hour + volume of oil in the pipeline[14]
	Leak		2% of maximum daily flow x 1 day + time taken to clear flush the pipeline with seawater

Table - 3. 9 Determination of volumes for maximum credible case scenario

1. As per Table 3.10
2. Assumes penetration of external and internal hull at the water line and based on the loss of contents of largest potentially impacted cargo tank.
3. Based on the loss of contents of largest outside tank (including fuel tanks). In the case of tanks protected by double hull a maximum potential loss of 50% of the contents is assumed.
4. Based on the total loss of the vessel.

5. Based on vessel with bottom tanks. If no bottom tanks are present then there is no anticipated volume loss.
6. If a supply vessel carrying fuel as cargo, treat as a tanker.
7. Based on rupture to all impacted tanks and/or loss of vessel.
8. Based on damage to one impacted tank. Note: If tanks cannot be holed, this scenario will result in no loss.
9. Estimated days to get a relief rig onsite should be supported by a Blow-out Management Plan or other documentation. Alternative strategies for well control may be used but should be supported.
10. If spills can only be to deck then volume held by scuppers etc. may be deleted from the total provided that this volume will be recovered.
11. Based on presence of leak detection system, block valves and automatic shutdown systems. Note one hour shutdown time may be reduced if effectiveness of systems can be supported.
12. LOD = Level of Detection, as stipulated by pipeline automatic detection systems.
13. Times taken to reach and repair leak sites may be reduced if shorter times can be demonstrated.
14. Based on ability to detect major faults but absence of block valves.
15. Assumes daily over flights that will detect sheens.

3.6.2 Maximum Credible Spill Volumes – Vessel Spill

International measures implemented through regulation 13 of MARPOL 73/78, have prescribed strict measures in Annex 1 that are required by industry and administration to be followed to mitigate oil pollution through modifications to design, structural requirements, and inspections etc.

Irrespective of size and tonnage, all tankers are required to have a series of wing and centre tanks that run along the length of the vessel to carry either cargo or ballast.

Measures to have SBT, double bottom tanks and narrow wing tanks and a wider center tank have been brought into force so that , in the event of a collision, the oil spill is limited to a particular tank only. Regulation 13G (4) of Annex 1 of MARPOL 73/78 specifies the requirements applicable to existing crude oil tankers of 20,000 tons DW and above and product carriers of 30,000 DW and above to reduce the accidental outflow of oil in the event of a collision or stranding.

Taking into account the limitaions and requirements imposed by MARPOL, the Impact of tanker size on credible spill potential in tonnes on vessels of different (tonnage as per studies carried out by IPIECA) would be as per table 3.10

Typical tonnage(DWT)	Slight grounding or collision (one wing tank)	Grounding with rupture(two wing plus one centre tank)	Bunker fuel
30,000	700	3,000	450
50,000	1,100	5,000	750
70,000	3000	12,500	1,800
1,00,000	5,500	21,000	2,300
2,00,000	10,500	45,000	2,750
2,40,000	15,000	60,000	4,000

Table 3.10 – Tanker size and spill potential

3.7 WORST CASE SCENERIO - OIL RELEASE FROM GROUNDING OR COLLISSION

Giving effect to provisions of MARPOL requirements and guidelines laid down under Annex 1 for evaluation of an alternattive tanker design concept, Marine Environment Protection Committee (MEPC) of IMO has carried out intricate calculations for oil outflow probabilities from actual tanker damage statistics and

tanker casuality statistics. The studies carried out under stringent assumptions to arrive at comparative standards of tanker design based on oil pollution prevention index, have computed the quantity of oil flow after side and bottom damages to the vessel for different conditions of tide and taking into account different damage posibilities.

The calculations can be considered the worst case scenerio for the particular type of damage since they are computed by applying the damage density distribution functions to determine each unique grouping of damaged compartments and the probability of oil outflow associated with that damage condition.

The volume of oil lost from a cargo tank assuming hydro static balance can be calculated as follows

$Zs.ps.g = g.zc.pc + 100\Delta p$

Where :

Zc = height of remaining oil in the damaged tank (m)

pc = cargo oil density (0.9 t/m3)

g = gravitational acceleration (9.81 m/s2)

Δp = set pressure of cargo tank pressure/ vaccum valves (0.05 bar gauge)

Zs = external sea water head above inner bottom (m)

ps = sea water density (1.025t/m3)

Taking into account that double bottom spaces below the cargo tank also hold oil, oil outflow is calculated .

The summary of oil outflow parameters arrived at for a vessel with 38491 m3 cargo capacity but loaded to 98% i.e 37721 m3 is as per table 3. 11 and 3.12.

Bottom damage	(40 %) 0.0 m tide	(50 %) 2.0 m tide	(10 %) 4.5 m tide	Combined
Probabality of zero outflow (P0)	0.8431	0.8431	0.8431	0.8431
Mean outflow (m 3)	2133	2752	3528	2582
Extreme outflow (m 3)	14767	18976	3528	17820

Table 3.11 - Oil outflow with bottom damage

Combined side and bottom damage	(40 %) Side damage	(60%) Bottom damage	Combined
Probabality of zero outflow(P0)	0.8380	0.8431	0.8411
Mean outflow (m 3)	4272	2582	3258
Extreme outflow (m 3)	30824	17820	23021
Mean outflow parameter (Om)			0.0864
Extreme outflow parameter (Oe)			0.6103

Table 3.12 - Oil outflow with side and bottom damage

For side damage, 100% of the oil in a damaged cargo oil tank is assumed to outflow into the sea whereas, for bottom damage, oil water in 50 % composition each is supposed to be retained in bottom tanks and can be calculated .

3.8 SPILL IN Mumbai HARBOUR - MODEL STUDIES

A number of spill model studies have been carried out by National Institute of Oceanography (NIO) for various locations within the area of operation of this CP to study the movement and trajectory of oil post spill . These studies include

1. OIL SPILL RISK ANALYSIS AND CONTINGENCY PLAN FOR BPCL, Mumbai, AUGUST 2003

2. OIL SPILL RISK ANALYSIS AND CONTINGENCY PLAN FOR JNPT, NAVI Mumbai, OCTOBER 2008

The results of these studies have been used in this Contingency Plan (Section 3.9 to 3.11), wrt to movement of oil

3.9 MOVEMENT AND TRAJECTORY STUDIES - Jawahar Dweep and Pir Pau jetty

The results are obtained by running the data on computer model Hydrodyn – OILSOFT, taking into account the actual weather conditions. A number of model studies to test the validation of tides and currents had also been carried out. The results obtained for tidal elevation and tidal currents at various points at JD, Pir Pau Jetty and Vashi (though different at these locations), agree with the tides measured at these locations and validate all the data. The results of model study are as per table 3.13 and as mentioned below.

It is observed that Trombay and surrounding areas are vulnerable to spill oil reaching during SW monsoon, whereas Vashi and surrounding areas are vulnerable during NE monsoon, for quantum of spills studied during modeling. Post monsoon, the areas at Mora coast are vulnerable to spill reaching the coast

3.9.1 Location – Jawahar Dweep – Jetty 2 and 4

Channel location close to JD jetty 2

Pir Pau jetty

3.9.2 Spill Scenarios

Instantaneous spill – 700, 25000 tons each of crude and furnace oil

Continuous spill – 2200 m3/h of crude and furnace oil for 15 minutes at Pir Pau

3.9.3 Oil types

Crude

Sp Gr – 0.9

Viscosity – 6.5 at 37.8 C

Wax content 12-19%

Furnace oil

Sp Gr 0.95

Viscosity 6.5 at 37.8 C

Wax content 12 – 19 %

3.9.4 SW Monsoon Period (May – September)

The behaviour of oil spilled at JD2, JD4 or at Pir Pau will be the same. 60 % of spilled oil will reach the coast within 2 to 4 hours. The likely area of impact for spills of less than 700 tonnes is Trombay coastal areas.

3.9.5 NE Monsoon (December – February)

During this period, the most vulnerable areas, where oil will have an impact are Vashi and east coast of Thane creek. 60% of spilled oil will reach the coast within 2 to 6 hours. For spills of higher magnitude, the impact zone would extend to 10 kms at Vashi coastline.

3.9.6 Post Monsoon

During this period, the oil spilled at jetty 2 and 4 would not reach the coast and will move west towards open seas, but any spill at Pir Pau jetty and JD4 will reach the coastline at Mora on the east coast of Thane creek within 4 to 6 hours.

Spill location	Spill volume (t)	Losses (t)			Time to reach Coast (hours)			Coastal impact		
		SW	NE	Post Monsoon	SW	NE	Post monsoon	SW	NE	Post
Jetty 2	700 crude	100	120	100	3	3.5	3	Trombay	Vashi Thane creek	To sea
	25000 crude	8000	7500	7000	4	5	4	Trombay	Vashi Thane creek	To sea
	2200m^3/h for 15 mts, continuous, crude	650	630	600	14	13	10	Trombay	Vashi Thane creek	To sea
Jetty 4	700 crude	100	120	90	14	13		Trombay	Vashi Thane creek	To sea
	2200m^3/h for 15 mts, continuous,	600	630	500	12	13	5	Trombay	Vashi Thane creek	To sea
Pir Pau	700 furnace	100	120	140	3	4	8	Trombay	Vashi Thane creek	Mora coast
	10000 furnace	2500	2600	2700	4	5	8	Trombay	Vashi Thane creek	Mora coast
	2200m^3/h for 15 mts, continuous,	600	630	730	12	14	15	Trombay	Vashi Thane creek	Mora coast

Table - 3.13. Oil spill matrix and impact areas – Mumbai Harbour

NOTE. In case of spill being in the approach channel near Jawahar Dweep, the areas of Elephanta Island are also likely to get affected by spilled oil.

3.10 MOVEMENT AND TRAJECTORY MODEL - JNPT

To study the spill movements, a spill scenario of 400 tonnes oil was run on the model. Based on oil spill analysis occurring at the jetty and along the pipelines, it is observed through trajectory modeling that a FO spill of 400 t will spread over an area of around 300 mtrs. within 2 hours.

Post spill movement analysis and oil spill impact , volumes and areas are as per Table 3.14 and 3.15.

3.10.1 Spill location

Container terminal at JNPT

3.10.2 Oil type - Furnace oil

Sp Gr – 0.92

Surface tension – 3.0 e – 03

Molar volume – 0.002

Viscosity – 275 cst at 37.8 deg C

Wax content – 12-19 %

Pour point of untreated crude – 30 deg C

Pour point of treated crude – 18 deg C

3.10.3 Pre - monsoon (January)

It is observed that during the pre monsoon period, the spill will move to south west towards open seas and will reach the open seas. The area of spread oil will differ depending on the surface quantity.

3.10.4 Monsoon period (July)

During this period, the spill will move towards port boundaries and part of it will move towards Sheva island crossing reclamations and mangrove forest areas within 1 to 2 hours.

3.10.5 Post monsoon (October)

During the post monsoon period, most of the spill will reach Mora at Karanjia Island. Part of the spill will move to south west open boundaries to reach within 15 to 24 hours.

JNPT Container terminal	400 t FO	% reaching port / open seas	Pre monsoon	Monsoon	Post monsoon
			81	89	80
		Extent of oiling in port/ open sea boundaries (mtrs)	1050	600	1200

Table. 3.14. Post spill movement analysis

Facility	Spill quantity	Losses		Time to reach coast / open seas (hrs)	Amount of oil on surface	Area of impact / movement
JNPT container terminal	700 t FO	Pre monsoon	5	17	355	Crossing to SW
		Monsoon	6	5	364	JNPT
		Post monsoon	4	24	346	Manora

Table. 3.15. Oil spill impact , volumes and areas

3.11 MODEL PREDICTIONS – ICMAM and NIO

Apart from above studies, ICMAM , Chennai as well as NIO have carried out model studies of the spill assuming leakage rate of 3 t/hr over 3 days. ICMAM has used OILMAP to predict the movement and spreading of spilled oil and ADIOS to evaluate the weathering processes at spatial and temporal scales in the Mumbai Harbour – Thane Creek model domain, while, NIO has used Hydrodyn-Oilsoft software with the project domain extended to coastal area between Versova and Revdanda up to a distance of 25 km from the coast.

The results in both cases predicted that the spilled oil would hit the shores of Colaba, Uran, JNPT, Vashi, Trombay, Sewri etc. within the Mumbai Bay. The results of NIO study also predicted the pollution of coastal areas south of the Bay mouth namely Mandva, Kihim, Alibaug etc within 3 days of the spill. These predictions broadly match the feedback of field observations made during Environmental and pollution studies undertaken post collision of vessels in Mumbai Harbour in 2010.

4.0 FATE OF SPILLED OIL AND SPILL ANALYSIS

The physical and chemical characteristics of spilled oil change almost immediately when spilled in the marine environment due to evaporation, dispersion, emulsification, dissolution, oxidation, sedimentation and biodegradation. All of these processes that set in together are collectively referred to as oil weathering and decide the final fate of spilled oil and quantities that would need to be removed physically. An uncertainty in a trajectory fore-cast builds over time due to these processes that the spilled oil goes through.

If the oil is persistent and does not vaporizes immediately or disperses and comes ashore, than the costs in terms of cleanup, damages and economic loses can be considerable.

4.1 WEATHERING PROCESSES AND TIME SCALES

Some of the weathering processes that spilled oil goes though and the time duration of these processes which are important for emergency response and need to be taken into account by the responders are placed at **Appendix 5.** The details of the processes that the spilled oil goes through and which affect the response activity are as under -

(i) Evaporation

The amount of oil evaporated post spill depends on the oil properties, wind speed and water temperature. Generally light refined oils like gasoline or jet fuel, evaporate faster than heavier products such as heavy crude oil. While most of the gasoline would evaporate in few hours some crudes being more persistent in the environment much of the product would be expected to remain on the water surface even after long duration.

(ii) Dispersion

The action of breaking waves can drive small droplets of oil into the water column. If the droplets are small enough (diameters less than 50-70 microns) natural turbulence in the water prevents the oil from resurfacing. The smaller drop-lets that stay in the water column are considered dispersed.

Dispersion is an approved procedure for removing oil from the water surface and is undertaken by application of dispersants to oil. However, with some conditions can be put forth by local administration for application. The amount of oil dispersed depends on properties of oil (the viscosity and surface tension, in particular) and water conditions.

Oil products with low viscosity, like gasoline or kerosene, are more likely to disperse into the water with breaking waves than a high-viscosity oil, like an IFO 380 or a heavy crude. Therefore, the dispersed fractions of gasoline or kerosene can be relatively large in heavy seas.

A possible treatment of oil spills is to spray the slick with chemical dispersant. Chemical dispersants enhance natural dispersion by lowering surface tension.

(iii) Dissolution

Dissolution begins immediately and is likely to continue throughout the weathering process. The loss of petroleum product from dissolution is minor when compared to the other weathering processes.

Less than 0.1% (very heavy oil) to 2% (gasoline) of the spilled oil volume actually dissolves into the water column. However, the components of oil that dissolve into the water column are often more toxic to the environment.

(iv) Emulsification

For many crude oils and some refined products, weathered oil reaches a stage where water droplets get mixed into the oil - forming a water-in-oil emulsion or "mousse." The emulsion can contain as much as 70 to 90% water, so that the combined volume of oil and water mixture required to be handled by responders could be much higher than the volume of original spill.

The ability to form an emulsion depends on water conditions and the chemical properties of oil. Oils with high wax and asphaltene content emulsify easily in sea conditions with breaking waves and leads to an increase in viscosity of the spilled product.

Generally, oils weather a certain amount before forming an emulsion. Although the onset of emulsification may take several days, the emulsification itself can occur within a few hours and classified by their stability. In unstable emulsions, water and oil separates easily under calm conditions with warm temperatures. In stable emulsions, water remains in the oil for weeks to months.

(v) Sedimentation

Sedimentation is defined as the adhesion of oil to solid particles in the water column. In this process, the oil gets absorbed onto sediments in the water column to find its way eventually to bottom .

Turbulent waters with high sediment load (~500 g/m3), such as a fast-moving, muddy river, can move the oil through the water column within hours of the initial release, while, waters with low sediment load (< 5 g/m3), as in open seas, will allow oil to remain on the surface much longer (weeks), spreading the slick over a wider area.

(vi) Photo-oxidation

This process occurring due changes to chemical and physical properties of spilled oil and sets in because of exposure to sunlight and is limited to the surface of oil, resulting in a thin, crusty ”skin” on slicks and tar balls. The “skinning” of oil, limits evaporation because the lighter oil components can no longer diffuse through the surface of the slick. Photo-oxidation may increase the ease of emulsification and is considered a long-term weathering process taking weeks to months.

(vi) Biodegradation

The spill is finally removed when the oil biodegrades. The microbes that degrade oil occur naturally in the environment. The rate at which the organisms degrade the oil depends on the properties of water, oil and microbial activity. This process is thought to occur over time scales of weeks to years.

4.1.1 Calculation of Weathering losses

The spilled oil being subject to above mentioned factors is amiable to loss in terms of quantity and also an increase in volume due emulsification.

Considering a spill of 700 tonnes of Bombay High Crude at Mumbai harbour (the maximum quantity required to be addressed by this Plan) in the month of May and the climatic conditions prevalent during the time, the various parameters and details of losses calculated through ADIOS- the spill software and the volume remaining to be manually addressed of 700 tonnes would be as per **Appendix 6.**

4.2 OIL THICKNESS AND APPEARANCE OF SLICK

Oil slicks form very thin films on open water. Depending on the properties of the product, the thickness can range from a tenth of a micron to hundreds of microns. The colour of oil film post spreading is a good measure of quantity of oil that may be contained within the slick.

When direct light from the sun contacts a very thin oil film (<0.1 micron; µm), much of the light is reflected back to the observer as gray or silver sheen.

If the film is thicker (perhaps 0.1 to 3 µm), the light passes through the film and is reflected off the oil-water interface and back to the viewer . The observer will then see a film that can range from rainbow to darker-colored sheens.

For very thick films (> 3 µm), the light is absorbed and the slick appears dark-colored (i.e., black or brown) to the observer. However, the viewer can no longer determine film thickness based on color. If the slick is dark-colored, the observer cannot tell whether the film is 3 µm or 100 µm thick.

In order to quantify oil thickness, the following is used as guidelines

Appearance	Thickness
Silver Sheen	0.0001mm
Rainbow sheen	0.003 mm
Light brown/ Black slick	0.1 mm
Dark brown/ Black slick	more than 1 mm

To determine an approximate quantity of spilled oil, the following formula is used

$$L \text{ (Length of slick) meters } X \text{ W (Width) } X \frac{\text{Thickness (mm)}}{100} = \text{Cubic meters}$$

The extent of spread in terms of length and breadth along with % of area showing a particular colour as per thickness can be used for calculation of quantity of spill through spill calculation soft ware. An illustration is placed at **Appendix 7.**

4.3 MOVEMENT OF OIL

Spreading and advection are the two major processes that transport oil on water. For small spills (<100 barrels), the spreading process is complete within the first hour of the release, whereas for bigger spills the spreading process could continue for larger durations of time.

Winds, currents, and large-scale turbulence (mixing) are advection mechanisms that transport oil to large distances. For calculation purposes, the oil movement is estimated as the vector sum of the wind drift (using 3% of the wind speed) and 100% of the surface current.

Spreading

The spreading process occurs quickly and for most spills, mostly within the first hour. In open waters , winds, currents, and turbulence act on and move the oil.

Spreading occurs faster for lighter and for less viscous oils in warm water temperatures and for warm oils. The slick does not spread uniformly but will often have a thick part surrounded by a larger, but thinner sheen. About 90% of the oil is found in 10% of the slick area . A spill is likely to keep spreading until a thickness of about 0.1 mm is reached. At this stage breaking up of slick into windrows is an important source of further spreading.

5.0 CLIMATIC CONDITIONS

Forecasting the movement of an oil spill depends on availability of accurate and reliable input data, particularly location, volume lost, product type and environmental conditions like wind and current observations and forecasts.

Therefore, it is important to have all the climatic and weather information available for the area of operation. The climatic conditions and hydrographic features of area of operation of this CP that are of importance to responders are as mentioned here under.

5.1 TEMPERATURE AND RAINFALL

The temperature starts rising from March and May is generally the hottest month of the year with mean daily max temperature of 32.9 degree C. With the onset of monsoon by about first week of June there is an appreciable drop in temperature. The month of January is the coolest month of the year with mean daily maximum and minimum temperatures of 29.1 and 19.3 degree C.

The region is subject to a regular seasonal climatic variation determined by the occurrence of two annual monsoons. The South-West monsoon period extends from June to September. Most of the annual rainfall occurs during South-West monsoon, the average monthly rainfall being about 45 cm. Rain during the North-East monsoon is slight.

The average rainfall in the area is about 2422 mm and annual mean number of rainy days is about 77.8. The period between June to September receives nearly 95% of the seasonal rain. The monthly variation in temperature, humidity and rainfall is as per table 5.1

Month	Temp (Max) ^{0}C	Minimum ^{0}C	Rainfall(mm)	No of rainy days average
January	30.6	16.4	0.6	0.3
February	31.3	17.3	1,5	0.1
March	32.7	20.6	0.1	0.1
April	33.1	23.7	0.6	0.3
May	33.3	26.1	13.2	1.2
June	31.9	25.8	514.1	15.4
July	29.8	24.8	868.3	23.5
August	29.3	24.5	553.0	19.1
September	30.1	24.0	306.4	12.8
October	32.9	23.1	62.9	3.7
November	33.4	20.5	14.9	1.0
December	32.0	18.2	5.6	0.3

Table 5.1 – Temperatures and rainfall in Mumbai Harbour

5.2 WINDS

General direction of wind is from the North to the West quarter, with seasonal variations are as per table 5.2.

Months	Directions	Speeds
1. Feb-May	Mainly from N.W.	(Max. 8 to 10 Beaufort Substantial 4-6 Beaufort)
2. June-Sep	Mainly from W.N.W.	(Max. 8 to 10 Beaufort Substantial 6-8 Beaufort)
3. Oct-Jan	Mainly from N.N.W.	(Max. 6 to 8 Beaufort Substantial 2-6 Beaufort)

Table 5.2 – Wind directions

Winds are generally light to moderate with some increase in force in the summer and monsoon seasons. During January to May winds strengthen in the afternoon. In the southwest monsoon season winds are mainly from west or north east. During rest of the years, winds are north easterly to easterly in the mornings and blow from directions between south west and north west in the afternoons. Summary is as per table 5.3

Month	Wind speed (knots/hr)
January	9.1
February	9.3
March	10.4
April	10.5
May	10.0
June	12.8
July	14.8
August	13.4
September	10.0
October	8.5
November	8.2
December	8.5
Total/average	10.5

Table 5.3- Wind speeds in Mumbai Harbour

5.3 VISIBILITY

In general, on the West Coast, above latitude 16° N sometimes mist develops during sunrise but disperses thereafter. From November to March, this area is prone to occurrence of smog clouds over land thus obscuring visibility. This happens only for short periods most often shortly after sunrise but also occasionally in the evenings. Visibility is generally good for most part of the year.

5.4 Ph VALUE

The pH value within the harbour surface samples is 8.0 to 8.3 at surface and 8.0 to 8.2 at the bottom. The water quality is slightly alkaline.

5.5 TOTAL DISSOLVED SOLIDS (TDS)

The TDS levels in the surface waters vary from 20,920 mg/I to 24800 mg/I. In bottom samples TDS values vary from 20900 mg/I to 24800 mg/ I.

5.6 WAVES

The predominant waves are the swell waves generated by deep sea storms. These mainly arise just before and during the South West monsoon. The statistical analysis indicates that most wave periods fall between 6 seconds and 10 seconds.

During the continuance of the North-East monsoon, North-Easterly winds known as "Elephantas" blow for short durations during the months of October-November. As the fetch and duration of these winds are limited, the "Significant height" of the resulting waves is not likely to exceed 1 meter with period ranging from 3 to 5 seconds.

The predominant wave direction during monsoon is from south west to west. During this period, waves of 4 to 5 m height normally occur, however, waves of 8.0 m height and period of 14 seconds have also been reported. October and November are transition periods during which the predominant wave direction changes to north and north east. During December and January the waves mainly occur from north to north east and from February to May waves predominantly come from the north west quadrant. The summary of wave data is as per table 5.4.

Parameter	Value	
	1 Year	100 Years
Significant Wave Height	0.6	1.6
Significant Wave Period	10.0	10.0
Max. Wave Height	1.0	3.0

Table 5.4 – Summary of Wave Data

5.7 TIDES

The quality of water-spread area of the Bay is mainly influenced by tides which induce flushing and dispersion of pollutants entering the system. The tides in Mumbai harbor are characterized by occurrence of two high and two low waters with marked diurnal variation in the levels.

The monsoon freshwater flow, though important in flushing the inner zone, is not high enough to cause significant changes in the hydrography of the outer Bay. Tides (1.2 - 5 m) in the region are semi-diurnal type with an appreciable diurnal inequality. The flood tidal front advances in north-easterly direction and ebbs to south-west.

The dominant tide in the *Mumbai Harbour* is the semi-diurnal tide with a period of 12 hours and 40 minutes. Table 5.5 gives the particulars of tidal levels related to Chart Datum.

Tide	Above(+) or Below(-) Chart Datum
Highest High Water recorded	+ 5.39 m
Mean High Water Spring Tides	+ 4.42 m
Mean High Water Neap Tides	+ 3.30 m
Mean Sea Level	+ 2.50 m
Mean Low Water Neap Tides	+ 1.86 m
Mean Low Water Spring Tides	+ 0.76 m
Lowest Low Water recorded	- 0.46 m
Highest Low Water	+ 2.74 m

Table 5.5 – Tides in Mumbai Harbour

Statistical studies indicate that all high tides exceed + 2.70 m. and about 5% of all high tides would be less than + 3.20 m.

Variations in tides in Mumbai estuary are as per table 5.6 .

Location	Range (m)		Time lag from Apollo Bunder (min)
	Spring	Neap	
Apollo Bunder	5.0	1.6	-
Pir Pau	4.3	1.4	10 - 15
Vashi	4.2	1.2	10 - 30
Airoli	4.9	1.6	12 - 45
Thane	4.9	1.5	15 - 60

Table 5.6 – Tide variations in Mumbai Harbour

The tidal range decreases markedly up to Vashi as compared to that at the Apollo Bunder but increases in the inner creek, the range at Thane is only marginally

lower than that at Apollo Bunder. This increase appears to be due to the funnel shape geometry of the Bay that is conducive for accumulation of seawater with the advance of tidal front in the lower creek. The tide at Thane lags by 30 to 45 min with respect to the tide at Apollo Bunder with the lag more pronounced for neap tide.

Spring tides are important for spill response as oil beached during this time is likely to remain stranded on the upper portion of the shoreline until the next spring tide (about 14 days) or storm event. If there is a storm surge during a spring tide, the oil can remain stranded for a much longer period.

5.8 CURRENTS

The currents in Mumbai harbor and the near shore zone are tide induced with reversal at high and low waters. The current strength ranges from 1.5 to 3 knots.

Current speeds and directions within the Bay and associated tributaries are largely due to the tidal movements and show little variation from non monsoon to monsoon. The maximum current speed in the outer Bay exceeds 1 m/s and the variation in the water column at any given time is not significant.

Lateral variations in the speed however occur with current in the eastern area being somewhat stronger. The maximum current speeds decrease in the inner creek and are typically around 0.8 m/s, decreasing markedly during neap tide.

As characterized for a tide dominated system, the alongshore components are fairly strong with the dominance of seaward component while cross-shore components are relatively weak. Their relative magnitude and directions are indicative of net seaward movement over a tidal cycle though shoreward drift can be significant around the change of tide.

Excursion lengths and average current speeds observed for the Bay based on the available drogue trajectories are as per table 5.7.

Tide	Excursion length (km)		Av current speed (m/s)	
	Flood	Ebb	Flood	Ebb
Spring	11.5	11.5	0.5	0.55
Neap	5.5	6.0	0.25	0.3

Table 5.7 – Tide excursion at Mumbai Harbour

Excursion lengths during flood and ebb are more or less of a similar magnitude as expected for tidal creeks devoid of large volumes of external water inputs. The overall circulation pattern suggests that the pollutants entering the creek upstream of the bridge at Vashi tend to oscillate within the creek system and flushing to the sea is a delayed process. These pollutants would however be considerably diluted under the influence of tide induced turbulence and advection.

During monsoon however, the creek receives voluminous land run-off and the discharge of near freshwater through the Ulhas estuary, which flushes the inner creek to a large extent.

Current and tidal streams being of importance to study movement of spilled oils, the details thereof are mentioned here under.

5.8.1 Tidal stream (currents) on approaches to Mumbai Port

In approaches to Bombay' tidal streams are much influenced by winds and heavy rains. The rate of spring streams between Thal reef and Prongs Reef, 41/2 miles NNW is from 2 ½ to 3 knots and may attain 4 knots in rainy season.

Through the channel the tidal stream does not set fairly but is generally as under.

(i) In- going stream

The in-going stream, off the SW end of Prongs Reef, sets first in an ESE direction, but as the rate increases it changes to NE; there after E of the reef as far as Sunk Rock (18" 53''5 N, 72d 50'0E) it sets NNE.

Between Thal shoal and a position 4 miles WNW the in -going stream sets between ESE and ENE turning more N as the rate increases.

The in-going stream sweeps E over Thal Shoal. The in -going stream, in East Channel Swatch {18" 47'.5 N, 72d 49'5 E) sets NNE as it crosses the mouth of Dharmatar Creek 5 miles ENE.

(ii) Out going stream

The out going stream during the SW monsoon rains sets strongly W out of Dharmatar Creek. On the N side of the entrance to the harbour the stream sets S W from Sunk Rock until abreast Prongs Reef, from where it sets W changing to SSW as the rate increases.

The stream sets SW between Thal Shoal and a position 4 miles WNW. On the S side of the entrance to the harbour, the stream first sets WSW across Dharmatar Creek entrance altering towards SSW on nearing Thal Shoal then almost S as it goes further.

5.8.2 Tidal stream (currents) in Mumbai Harbour

Tidal stream within the port sets with rates of ¾ to 3 knots as follows

(i) East side of the harbour- In going stream

The stream sets North East abreast Karanja Island setting more ENE after passing Karanja beacon. Between Jawahar Dweep (JD) and Elephanta Island the stream sets N but towards Trombay island it becomes NE.

(ii) West side of harbour- In going stream

The stream sets NNE from Sunk rock to Cross island with a rate of 2 kn, north of Tucker beacon where the stream separates, a branch of it turns north until abreast Mazagaon Dockyard. Then the stream sets between NE and ENE to join the stream from the E side of the harbour N of Butcher Island.

(iii) East side of harbour- Out going stream

The stream starts later here than on the West side of the harbour.

The stream sets SW from the channel between Butcher Island and Elephanta Island along the NW coast of Karanja island. When abreast the entrance to Dharmatar Creek it sets WSW.

(iv) West side of harbour- Out going stream

The stream at ordinary tides starts 30 to 45 earlier than on the E side of the harbour. During strong spring tides the stream on the w side may start 40 minutes to 1 hour earlier. Inshore and near Indira dock wall during the SW monsoon, the stream starts about 45 minutes before Bombay high water.

The stream sets SW from Trombay Island to Mazgaon Dockyard and sets SSW from abreast Cross Island to W of Middle ground Islet. In the middle of the harbour, the set is S to SSW. The set is between S and SSW from Middle Ground Islet to Sunk rock but with the start of this stream the set off Sunk rock is more W going.

5.9 Model simulation and validation

A number of model studies to test the validation of tides and currents have been carried out. The results obtained for tidal elevation and tidal currents at various points at JD, Pirpau Jetty and Vashi , though different at these locations, agree with the data mentioned above.

6.0 ENVIRONMENTAL SENSIVITY

Spill movement predictions will determine which areas are under immediate threat from the slick after which the protection priorities will need to be determined, since it is unlikely that all the areas under threat can be successfully protected at the same time. The importance of the area both ecologically and socioeconomically is taken into account.

Areas such as coral reefs, mangroves, fish nursery areas, bird and turtle breeding areas are ecologically important. At times these areas are also socio-economically important. Other areas such as beaches and other facilities being recreational areas are also important and also provide revenue to the community.

Water intakes for industry or for inland aquaculture practices, shipyards and ports are commercially important but have limited biologically importance.

6.1 ENVIRONMENTAL SENSITIVITY MAPPING

Environmental Sensitivity Index (ESI) maps provide a summary of coastal resources that are at risk if an oil spill occurs in vicinity. Examples of at-risk resources include birds, shellfish beds, sensitive shorelines (such as coral reefs), and public beaches and parks.

Shorelines are color-coded to show their sensitivity to oil. Warm colors indicate the most sensitive shorelines, and cool colors indicate less sensitive shorelines. Large habitat areas (such as tidal flats and wetlands) are shown as polygons filled with a pattern of appropriate color. Symbols mark locations important to spill responders, such as areas where birds or sea mammals congregate or breed areas where different kinds of birds concentrate for feeding or nesting, and areas used by people.

Three kinds of information shown on the ESI maps are based on

(i) Shoreline ranking

Shorelines are ranked according to their sensitivity to oil, the natural persistence of oil, and the expected ease of cleanup after an oil spill. The ranking scale goes from 1 to 10.

Lower rankings represent shorelines that are less susceptible to damage by oiling; higher rankings become more likely to experience damage by oiling. A rank of 1 represents shorelines with the least susceptibility to damage by oiling. Examples include steep, exposed rocky cliffs and banks. The oil cannot penetrate into the rock and will be washed off quickly by the waves and tides.

A rank of 10 represents shorelines most likely to be damaged by oiling. Examples include protected, vegetated wetlands, such as mangrove swamps and saltwater marshes. Oil in these areas will remain for a long period of time, penetrate deeply into the substrate, and inflict damage to many kinds of plants and animals.

Shorelines on Environmental Sensitivity Index (ESI) maps are color-coded based on sensitivity to oil. Shorelines that are least susceptible to oil are ranked as 1 and are color-coded dark purple on ESI maps. Shorelines that are most likely to be damaged by oil are ranked as 10 and appear in red.

ESI shoreline rankings are defined using factors that influence sensitivity to oil including:

- Relative exposure to waves and tidal energy
- Biological productivity and sensitivity
- Substrate type (grain size, permeability, trafficability, and mobility)
- Shoreline slope

- Ease of cleanup
- Ease of restoration

A list of shoreline classifications for Environmental Sensitivity Index (ESI) maps for three types of environmental settings mentioned below along with colour coding is placed at **Appendix 08.**

(ii) Biological Resources

Categorizes and displays oil-sensitive animals and their habitats that are themselves sensitive to spilled oil (such as coral reefs). Each kind of animal has a designated color. Accordingly, the locations where each species is found is indicated using point symbols and/or polygons marked with appropriate colour.

Species that are especially vulnerable to the effects of oil spills are classified into seven general categories, such as Bird, Fish, and Marine Mammal. The categories are then further divided by grouping species together by similar taxonomy, morphology, life history, and/or sensitivity to spilled oil.

When a biological resource exists in a small area (such as a bird nesting site), it is indicated by a symbol. When a biological resource encompasses a larger area, it is represented by a polygon with a specific pattern and colour.

The table for all categories for biological resources and how the information is displayed on ESI maps are placed at **Appendix 09 and 9A.**

(iii) Human Use Resources

Human-use resources that may be either negatively impacted by an oil spills or used as access points for oil spill cleanup are typically marked with a symbol. Most human-use features (such as public beaches and aquaculture facilities) exist in a small

area and are represented by human –use point symbols. Larger areas such as parks, preserves, protected areas, and wildlife refuges are shown as polygons.

All categories of human-use resources displayed on ESI maps are placed at **Appendix** 10.

6.2 GEOGRAPHICAL & TOPOGRAPHICAL SENSITIVITY

The area of operation of this Plan i.e Mumbai harbour is enclosed by three districts of Maharashtra namely, Thane, Raigad and Mumbai. The shoreline shows variation with respect to sediment type, form and gradient and accordingly shows difference in shoreline energy and wetland use and distribution. The shoreline is a mix of exposed tidal flats, mudflats, sheltered rocky shores and thick mangrove vegetations.

The coastal stretches of Mumbai and the region around are variable with a number of creeks and bays. The creeks stretch deep inland and are a shelter to varied fauna and diverse commercial activity along the shoreline. The creek shores are thickly populated in stretches.

Historic data available with respect to pollution of shoreline in Mumbai estuary shows that differences in physical environment such as degree of exposure to waves and currents and geomorphic features like the terrain, greatly influence the distribution and persistence of pollutants. The pollutants are not able to flow out to sea but remain confined within the stretches of estuary.

In areas where the shoreline consists of sandy type of sediment, the movement of sand due to tidal action results in mixing of pollutants to deeper levels at impacted areas, thus increasing the persistence of pollutants being retained in the terrain for longer times increasing the risk of Environmental and biological hazards.

The major shoreline features are as per figure 6.1

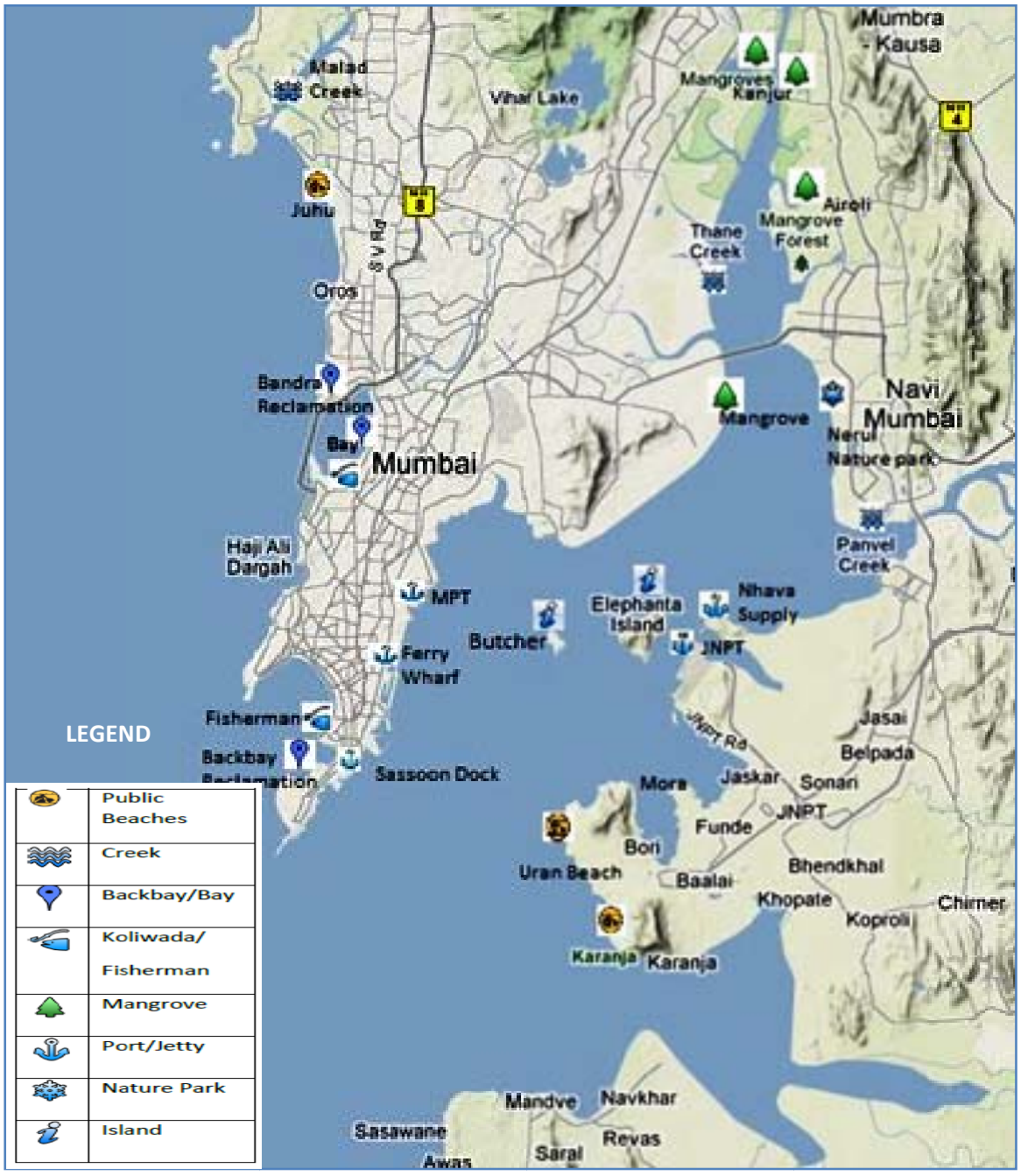


FIGURE 6.1 – Mumbai Sensitive areas - Overview

6.3 Shoreline sensitivity

Mumbai Area presents a high concentration of different kinds of sensitive zones to be protected or accorded priority. These zones under different classifications are –

(i) Ecological

Sewri – Mudflats
Thane Creek – Mudflats, marshes and mangroves
Nhava Sheva – Mudflats, marshes and mangroves
Mora – Marshes
Karnja – Mudflats and vegetation
Butcher Island North point - Mudflats and vegetation
Kolaba point - Prong Reef

(ii) Agricultural

Karanja – Crops
Mora – Rice Field

(iii) Fishing

Mumbai Inner Bay
West Coast of Mumbai
Panvel Creek (Oysters)

(iv) Industrial

Trombay Shore line (Water intakes to Refineries & nuclear plant)
Mumbai Harbour Installation
Mora (State Marshes)

(v) Tourist and Recreational

West Coast of Mumbai Beaches (Juhu – Mahim)

The area being large with varied coastline features and different commercial activities, is divided into sections for the purpose of Environmental Sensitivity. Maps indicating location of sensitive areas are placed at **Appendix 11.**

(i) Thaal knob - Navapada

Thaal knob - Ranjankhar Davali (West bank - Mouth of Dharmatar creek)

The extreme western part of the stretch (Mandva) is a sandy and rocky beach at geographical location 18°47′57.61"N, 72°55′56.42"E with a coastline length of approximately 8-10 km .

The jetty at Mandva is in use with boats plying regularly to Mumbai. The area has a sandy beach with minor rocky stretches. There are sand beaches on the side of the jetty with thick mangrove growths. The Geographical position of the jetty is 18°49′15.21"N, 72°56′47.58"E. The sediment in the area is mud and sand. Large swathes of mangrove stand along both sides of the Revas jetty and also in the creek- lets.

Ranjankhar Davali (Dharmatar creek) to Navapada

The area is a small bay with three creeks originating to east, south and south east. The creek stretching south to a distance of appro 8 kms up to Mothe Bal on the eastern bank is Dharmatar creek and has thick mangrove vegetation and mud flats. The second creek originating from within this bay and running inland south west is Patalganga river. The third creek running east is Karanja creek. All the creeks have thick stretches of mangrove vegetation.

The complete stretch from RK Davali to Navapada - situated on the southern end of Uran island, has thick growths of mangroves and mudflats and is not assessable from sea or shore. The mouth opening between RK and Navapada jetty is 1.8 km approx. (Appendix 11)

(ii) Navapada - Mora jetty – Juna Sheva Road (BPCL jetty)

(a) Navapada - Mora jetty

This stretch is a part of Uran Taluka. The geographic position of Uran is 18°52´42.45" N, 72°56´26.83"E. The stretch from Navapada to Mora consists of 3 fine sand beaches at Uran Pirwad, Uran Nagav and Kegav. The beaches are visited by large number of people and are popular spots. The stretch from Kegav to Karanja is hilly with rocky coastline and stretches of vegetation. ONGC Mumbai High pipeline land fall and other facilities are situated off Uran Pirwad beach.

The stretch has 3 jetties one each at Navapada, Karanja and Mora. The jetty at Navapada, situated at north entrance to Dharmatar creek has regular traffic with Mandava. The two jetties situated on north coast of Uran i.e. south extent of Mumbai Harbour have regular ferry service to Mumbai.

Mora jetty is in public use while the other at Karanja is under naval control. The sediment type of the area around Mora jetty is flat sandy and rocky (bed rock), while Karanja Land end to the east has thick growth of mangroves. There is thick mangrove vegetation along Mora jetty and Uran beach. One of the biggest extents of wetland tracts and mangroves in this part of India lies in this area. The area has developed into a special economy zone and has a large number of industries, namely JNPT, P&O, GTI and other shipping companies.

The stretch is accessible by road with certain stretches well connected with road running along the shoreline. The area is home to birds such as the Egrates, Carmorants, Seagulls and Crows. Crustaceans like crabs are also found over rocks and sediments. (Appendix 11A)

(b) Mora jetty - Juna Sheva road , JNPT

This stretch comprises of a small estuary and inlet running south from Mora Jetty or land head to Funde village and then north up to Panje Land Head and is named Boripkhadi, the stretch continues from Panje Koliwada further East up to starting of Juna Sheva road. The area consists of mud flats prone to flooding during high tide and is not accessible. The area has some of the thickest vegetation of mangroves in India and varied bird life. The Uran mangroves, about 60 km from Mumbai, are a vast stretch beginning from the northern end of Palm Beach Road in Navi Mumbai, up to Funde village in Boripkhadi. The mangrove area is considerably large, dominated by two species i.e. *Avicennia marina* and *Sonneratia alba*.

The small bay from Panje Koliwada to beginning of JNPT road leading to BPCL jetty, has thick mangrove vegetations. Reliance tank farm is situated on the western portion of this bay along the road. (Appendix 11B)

(iii) JNPT - Nhava - South entrance to Panvel creek (Sector 51)

The stretch from Juna Sheva to JNPT Nhava consists of the port and large number of associated manmade structures with metal approach roads and connections. The geographic position of the port is 18°56´56.00”N, 72°56´57.32”E. The port comprises of alongside berths and Sheva POL terminal being operated by BPCL and IOC. The port is the 6th largest port and largest container port in India.

The geographical position of Nhava island is 18°57□28.5□N and 72°59□11.45□E and Sheva is 18°56□05.34□N and 72°57□39.98□E .

The stretch extending from Nhava - where the facilities for ONGC vessel berthing and store supplies for Bombay high are created a tank farm is situated, is approximately 8 kms in length with mudflats and mangroves. The small water stream running south between JNPT and Nhava forms extensive JNPT backwaters that are thick in vegetation and mudflats. The internal areas of this small back water are not accessible either from Nhava or JNPT.

The complete stretch has thick mangrove vegetation and sea life. The stretch from Shivaji Nagar to Sector 3 on the south entrance to Panvel creek though well developed in terms of public utilities and manmade structures, the shoreline is muddy and has thick mangrove vegetation. Sector 51 forms the north entry point to Panvel creek. The shoreline is low lying mudflats with thick mangrove forests. Mangroves stretch inland along the Panvel creek on both banks to a considerable distance. (Appendix 11C)

(iv) Sector 51 to Vashi village

Sector 51 land head forms the north entrance of Panvel creek . The creek extending east is heavily polluted. The north entrance i.e. sector 56 to Vashi village is a strait stretch comprising Palm Beach road. Though, the road runs parallel to the coast, the areas west of the road are mudflats and thick with mangrove vegetations. The stretch has a few small sandy beaches.

The complete stretch is well developed in terms of man made structures.(Appendix 11D)

(v) Vashi village (E bank of Thane creek) to Vikhroli (W bank of Thane creek)

Thane Creek is part of the estuary of Ulhas River opening into Mumbai Harbour. It comprises the area stretching from Mumbra Retibunder to Mankhurd- Vashi Bridge. The creek (Lat 19 d 00 to 19d 15'N and Long 72d55' to 73d e) is connected to Ulahs river estuary (Lat 18d45' to 19d00 N and long 72d 45'N and 73d 20'E) in the north through a narrow shallow channel and is amongst the largest marine bodies in an enclosed area in India.

The Creek is one of the 500 significant bird conservation sites in India. With its rich natural resources and mangroves, the creek is home to over 205 species of birds. Rare birds such as whistling teals, golden plover, grey plover, hoopoe and avocet can be sighted here. Among the major waterfowls spotted here include lesser flamingo, greater flamingo, Asian open bill stork, white stork, pied avocet, eastern golden plover, ruddy turnstone and dunlin. The creek is recognized as an Important Bird Area by the Bombay Natural History Society being home to flamingoes and several other migratory and wading birds.

Water quality analysis of the creek and Ulhas estuary show increasing evidence of pollution due to anthropogenic discharges from surrounding areas. Areas between Balkum, in the north end of channel connecting the two water bodies and Vitawa has become a dead zone as per a 2006 report from the Municipal Council. However, the complete stretch has thick growth of mangrove vegetation.

Both sides of Thane creek have thick population and comprises of the areas of Bhandup, Kanjur, Vikroli and Airoli . The sediment is muddy in this area. The creek-lets have abundance of birds like Cranes and Egrets.

The area has thick mangroves along the eastern banks of the creek and Palm Beach road banks. Vashi- Thane creek cover a stretch of dense canopy of mangroves strands with a dominance of Aveccinia marina species in the fore-front of eastern banks.

As per NEERI report 2002, the creek has very low assimilating capacity. The waste water dispersed through the polluting units along the creek is not getting fully flushed. At the confluence of Thane creek and Ulhas river in the north, the basin of Thane creek is constricted and the geometry is such that water from Thane Creek is not getting discharged efficiently into Ulhas River during low tide.

The area is well developed and an industrial stretch. **(Appendix 11E)**

(vi) Vikhroli to BPCL refinery to Haji Bandar

Vikhroli stretch is a hook area of Thane creek comprising of regions of Vikhroli apart from Trombay and Mahul. The seabed sediment is largely muddy with some salt panes close to north extremity at Vikhroli. The stretch from Vikhroli (close to old Thane Creek bridge) to BPCL refinery comprises of mud flats and thick mangrove vegetation.

Pir Pau jetty - working chemical cargo is an extension stretching South into the Mumbai harbour from the land head adjacent to BPCL refinery. This stretch from BPCL refinery to Haji Bandar comprises of Mahul, Trombay, Sewri and Wadala. While, the inland area is well developed, the coastline is highly polluted and has large mangrove vegetation. BPCL tank farm is situated at Wadala and atomic power plant at Trombay.

A stretch of about 15 acres of mangroves exists between Sewri and Trombay. **Appendix 11F and G.**

(vii) Haji Bandar to Navy Nagar

The area includes shoreline of Mumbai port, Naval harbour, Colaba and INS Kunjali with geographical position 18°53□42.39□N and 72°48□35.07□E . The area is the hub of economic activity with thick population and embankments. Sasson dock is used by local fishing fleet for their activities and is the landing point for most of the fish for Mumbai.

The shoreline from INS Kunjali up to prongs reef light is mainly covered with bedrock, boulders and pebbles with few area covered with sandy sediment.

6.4 OBSERVATIONS

Overall, the area from Thal knob to Panvel creek is varied and marked by number of creeks, thick mangrove vegetation, mudflats, salt pans, JNPT installations and number of landing points. Public utility and marinas etc are not there.

The coastline from Panvel creak stretching north into Thane creek is highly developed in terms of manmade structures and has large extents of mudflats and thick mangrove vegetations. Thane creek is home to a number of species of birds and is ecologically sensitive.

The area from Vikhroli to BPCL complex though well developed in terms of man made structures has large stretches of shallow mudflats with mangrove vegetations. The further stretch up to Prongs reef is the hub of commercial activity and includes Mumbai Port and installations and number embankments like Gateway of India and Naval Harbour. The area from INS Kunjali to Prongs is rocky also comprising boulder shoreline.

6.5 PROTECTION PRIORITIES

While, it may not be possible to protect all the resources at the same time, the areas that need to be provided priority are

(i) Areas with presence of Mangroves
(ii) Elephanta island landing point
(iii) Entrance to Thane creek
(iv) Entrance to Naval and Mumbai port
(iv) Salt pans

PART II

RESPONSE OPERATIONS AND ORGANISATION

7. OPERATIONS AND RESPONSE STRATEGIES

Area of operation of this Plan being confined to Mumbai and JNPT Harbour all responses and actions would get limited to coastal zone and within the estuary.

Recommended action of NO RESPONSE as practised for off shore zones where the spill originates at a considerable distance from the shore and where movement is subject to a number of factors is not an option.

Taking into account the fact that the area of concern of this Plan is located within Mumbai Harbour where the spill would most likely originate alongside, at anchore or in the channel, taking of immediate action is a certanity.

7.1 RESPONSE ACTIONS

Response actions are required to be initiated by responders at the first notice or information about the spill. While, availability of all data and study of different parameters that affect a spill as compiled into this Plan are of benefit further acquisition of data can take place concurrently to launching of response operations.

Major actions that would be required to be taken when a spill occurs are mentioned below. While, some actions like containment are required to be initiated immediately following a spill, some actions like shore line clean up etc will get initiated in due time. The purpose of fast response is to minimize hazards to human health and environment. The following response are accordingly addressed through the Contingency Plan and Operations Manual :

- Stoppage of discharge and containing spill within a limited area,
- Defining size, position and content of spill, direction and speed of movement and likelihood of affecting sensitive habitats,

- Notification to private companies or government agencies responsible for cleanup actions ,
- Movement of trained personnel and equipment to site,
- Initiation of Response activity,
- Ensuring safety of response personnel and public,
- Oil removal and disposal.

7.2 OPERATIONAL PRIORITIES

Early hours of a spill being crucial and important for operations, all personnel involved with response, cargo operations, port or terminal have to be aware of the priorities to be followed. While, some of these actions are to be initiated and undertaken by responders, some actions would need to be initiated by personnel involved in cargo operations or persons ashore in case of clean up operations. The OPERATIONAL PRIORITES ARE

1. Stoppage of discharge. This action of primary responsibility can be achieved by terminating cargo operations, removal of vessel to a less vulnerable area, lightering of cargo, stopping the spill by patching , transferring the cargo to other undamaged tanks if possible and booming the ship with spill containment booms to retain the oil from spreading.
2. Prevent released oil from moving to shore. This would involve the use of mechanical means to contain the oil and remove it. It could also involve application of dispersants to floating oil keeping in view the area sensitivity.
3. Initiating action to protect sensitive environmental systems such as estuaries, mangroves, marshes or areas of high economic value. The containment activity could involve booming of the area or using deflection techniques to cause the oil to bypass sensitive areas to lesser sensitive areas. The activity could involve

closing the entrance to harbour or estuary , covering exposed walls with plastic sheets until the danger of contamination is over.

4. Removal of pooled oil from coastline. The coastline can be used as a natural boom to collect and pool the oil. In case of stranding of oil on shore, different processes would be required to be undertaken remove it. Where ever the use of mechanical means can be resorted to provide higher rates of recovery, priority to removal from the beach is to be accorded.
5. Removal of contaminated materials such as vegetation, trash, collected sorbents etc. after loose or liquid oil is removed.

7.3 OPERATIONS MANUAL / FIELD GUIDE

The strategy for handling a particular spill at terminal or at sea will be dictated by the OPERATIONS MANUAL. The Manual aims to provide information on the response measures to be taken in a particular spill situation and is a guide to deployment of equipment (and their limitations) and spells the philosophy of containment, recovery, spill cleanup and disposal with respect to different locations and origin of spill. Sections relevant to response operations covered in detail in Manuals (though not in mentioned sequence) are

- Containment – laying of booms and configurations
- Recovery – skimmers and their technical capacities
- Coastline cleaning – methods required to be used for different type of topography
- Disposal – of collected oil and debris

Ops manual would be used as an aid in contingency actions and would be available to all responders.

7.4 LIMITING AND ADVERSE CONDITIONS

(i) Weather

Weather, sea conditions and time factor play an important role in oil spill response operations. While, operations could continue at terminal or at the jetty most of the time, operations at sea would be largely restricted during night hours and sea conditions.

The area of operations of this CP is subject to rough and severe weather conditions during SW monsoon i.e June to September end. An appreciable weather change in the area is subject to heavy rains, high winds and waves. The sea conditions being rough, it is not possible to mount sustained operations or deploy equipment at the harbour mouth or in the channel. However, it is possible to continue operations at MbPT, JNPT, PP and JD, though at a restricted scale.

Best use of good weather windows would be required to be made to mount operations.

(ii) Terrain

A large portion of the area being mudflats is not accessible from sea and is constrained by availability of depths for vessels to approach.

(iii) Site approach

Certain areas specially mudflats and mangrove vegetations stretching long distances are not approachable by road or tracks from the shore.

(iv) Other limitations that might need consideration while planning response activity could include the following:

- Safety factors including vessel limits, night movements, risk of fire and explosion, toxicity (oil contact/inhalation/ingestion) and hazardous environments such as fast flowing rivers and steep terrain.
- Environmental conditions that can influence logistics including inclement weather, hazardous terrain and accessibility including condition of roads.

7.4 RESPONSE STRATEGY

Within the scope of this Plan, a response action required to be mounted could be at any of these locations

(i) Sea or channel, incident due collission etc during passage,
(ii) Close shore due grounding or stranding,
(iii) Alongside at jetty or at the terminal during cargo operations.

It is feasible that a casualty occuring at sea like a collission or mechanical failure could lead to a situation where the consequences would be felt in some other location or at a coastal location due movement of pollutants from the site of incdent.

The factors that would dictate immediate and long term strategies to deal with the spill are

(i) Location of discharge,
(ii) Spill movement and likely fate of spilled oil,
(iii) Time window available for response before hitting the coastline,
(iv) Nature of shoreline and priority for protection.

Keeping in account the location of spill, the response will required to be initiated either at the jetty / terminal or at sea and guided by OPERATIONS MANUAL. The actions required to be initiated would be immediate and long term depending on a study and analysis of spill movement.

7.4.1 Jetty/ Terminal /Vessel response interface – Jawahar Dweep, JNPT, Pir Pau

The reason for the spill would most likely be a failure of loading arm, flange or any failure on board. The operations being subject to facility operating procedures and as per facility manual, termination of operations is expect to be addressed at first notice. Port ship interface emergency checklist for use in case of oil pollution emergency is placed at Appendix 12. The check off list can be used for terminal operational procedures and guidelines also.

The spilled oil contained on the terminal/ jetty will be handled manually. While, use of vacuum pumps could be made, the absorbents will be required to be used to collect the spilled oil. In respect of oil released or introduced into water, response as per water body procedures are to be initiated.

7.4.2 On water response

The spill at sea could occur at anchorage or in channel due any eventuality or accident. An oil spill occurring due damage to vessel is a point source spill which would need to be addressed earliest. Taking into account the fact that a multiple response may be required, the vessel and responders will have to mount a rapid reaction.

(i) Vessel response

While, the first action is expected of the vessel operator in containing the spill by way of plugging of leak as far as possible, the first action of the response team is to be to contain the spill by placing booms attached to ships hull to isolate the damaged area. Recovery of spilled oil would also be required to be undertaken simultaneously.

(ii) OSRO response

The response team being stationed afloat with equipment placed on response vessel, would deploy the equipment to contain the spill. In the event of the spill originating from the ship side, the containment will be handled by placing booms along the ship side.

In case of a large spill, the actions to lighter the ship or transfer the cargo will be initiated by the port authority or ship owners.

While, Containment and recovery would be the preferred option, the other alternatives like dispersion could also be put to use subject to local restrictions.

7.4.3 Use of dispersants

Though, use of dispersants is not a much recommended option, there may be situations where the application may be required to be under taken. In a situation of priority response, where the spill is likely to hit a sensitive area, limited use of dispersants would be undertaken in accordance with the Guidelines issued by Coast Guard.

Application is to be dictated as per the procedures, calculations and methodologies recommended by Operations Manual. List of dispersants approved by Coast Guard for application is placed at **Appendix 13.**

7.4.4 Coastal and shoreline cleanup

The coastal stretches off Mumbai harbour are varied in terms of ecological sensitivity; with large stretches of mangroves inter spread with sandy beaches and rocky shores. Mumbai estuary shows differences in physical environment, the degree of exposure to waves and energy levels and currents. Geomorphic features like the terrain greatly influence the distribution and persistence of oil.

While, the first priority would be to stop the ingress of oil onto the coast, still the requirement of coastal or beach cleaning operations cannot be ruled out. The local administration being responsible for shore cleaning activity is to be notified in time about the movement of spill and advised about the strategy to be adopted.

Tactical beach cleaning ops are to be conducted as per the physical properties of the terrain with respect to retention of oil. Operations are to be guided as per OPERATIONAL MANUAL parameter.

Some stretches might require booming like at naval port and at Elephanta Island.

8.0 EQUIPMENT, SUPPLIES AND SERVICES

The typical response equipment required for mounting an operation consists of equipment for water response and shoreline operations and could include :

Off shore	**Shoreline**
Booms	Shovels
Skimmers	Diggers/loaders
Absorbents	Drums / skips
Sprayers & dispersants	Trucks/tankers
Radio communication	Plastic sheeting
Boats / tugs / response vessel	Protective clothing
Pumps / hoses	Communications
Tanks/ barges/storage	Control room
Aircraft	Transportation

8.1 LOCATION

(i) Off shore operations

The equipment required for response in terms of containment, recovery and disposal will be maintained at Jawahar Dweep and onboard the Oil Spill vessel. The equipment maintained on the vessel will be the first to be deployed for containment and would be augmented by movement of additional equipment as required by the situation. Details of total equipment held at these two locations is as per **Appendix 14.**

(ii) Shoreline operations

Shoreline operations will be undertaken by local civil administrative as per their contingency Plan. Taking into account the spill movement and area sensivity, the

equipment will be mobilized along with manpower to the site by the local administrative authority. The procedures laid down in Operations Manual will be available for reference to clean up teams along with expertise held with responders.

8.2 ADDITIONAL EQUIPMENT AND RESPONSE

While, the equipment held with response team will be available for initial and first response, the additional requirements would be met from equipment held by participating companies being addressed by this Plan.

In the event of a decision being taken by the team managing the spill, the equipment held with the participating units will be made available to response teams. The details of equipment held at different locations are placed at **Appendix 15.**

In the event of an ongoing spill or a spill that requires declaring of Tier 2 or 3 response, the additional equipment and manpower held with any other OSRO or facility will be sourced in an accelerating manner including resourcing from the international spill handling companies. Contact details of companies holding equipment in India and International OSROs are placed at **Appendix 16**.

8.3 INSPECTION, MAINTAINANCE AND TRAINING

As a matter of policy and prudence all equipment required for spill response is to be maintained at highest degree of readiness. For this reason, it is desirable that the equipment be periodically tried and tested through dry runs apart from actual deployment for training purposes.

Identified member/s of the response team will be responsible for maintenance and operational status of the equipment. In the event of an OSRO being appointed, the equipment will be maintained by the person appointed by OSRO as per laid down

schedule for each equipment, with records maintained as per preventive maintenance cards.

8.3.1 Exercises and drills

The purpose of exercises and drills is to test the knowledge of persons and members associated with response activity and maintain them in the highest state of readiness and professional competence. The exercises would aim to assess acquaintance of response teams with operationability and initiation of Plan and also the knowledge of operational parameters.

For this purpose it is required to conduct both in house training and evaluation exercises and also multi agency co-ordination exercises.

In addition to classroom training, the responders would need to go through regular internal and external exercises that would include deployment of equipment to demonstrate level of proficiency. With respect to management of operations in consonance with the plan, it is desirable to conduct real time CP exercises with all industrial stack holders involved. Such an exercise conducted at a large magnitude would need to incorporate the staff from MbPT, JNPT, Participating Oil Companies and the Indian Coast Guard and scheduled as mutually agreed.

The purpose of exercises and drill would be to check the following :

1. Organizational and Planning
a. Knowledge of Contingency Plan and Procedures
b. Personnel Notifications and Staff Mobilization
c. Ability to operate as per CP and Operations Manual
2. Operational Response
a. Oil spill assessment

b. Response equipment selection

c. Containment strategies

d. Spilled oil recovery techniques

e. Disposal of recovered oily water and contaminated material

3. Response Support

a. Communications

b. Logistics

c. Personnel support

d. Documentation

9.0 ORGANISATION

While, any response activity is envisaged to be undertaken by qualified team members on the ground, the larger issues of management of operations are to be handled by a core team of senior persons related to port operations.

The core operational team discharging the functions of incident control, administration and management is designated as Crisis Management Team/s (CMT) operating from the identified control center located in the Port Administrative building.

Apart, from the designated CMT, another senior level team designated as Core Management (CMG), headed by the respective head of MbPT, JNPT and ONGC will get activated in times of major spill crisis that may require liaison with senior level state, center authorities or other agencies. Apart from the respective head of organization, the other team members will be the heads of departments mentioned in 9.2.1. The functions of CMG will be the same as CMT (as mentioned in 9.1.1) with a view to provide support to operations in terms of administrative requirements. CMG will assemble on the recommendation of Chief Incident Controller.

This Plan formulates the policies and strategies to be followed in case of a response and to be executed on the ground by CMT along with response team or Oil Spill Response Organisation (OSRO).

The operational spill prevention provisions of this CP will be discharged by three CMTs - headed by Chief Incident Controller, one each for the area of jurisdiction of MbPT, JNPT and ONGC. Duties and responsibilities of all the three teams would largely remain the same- as spelled in this CP, with additions and amendments undertaken by each team as per operational situation and requirements particular to their area of

operation. Each team would be responsible for operations in their respective area of jurisdiction.

9.1 MANAGEMENT AND MANPOWER

Management, execution and delegation of teams to undertake duties with respect to discharge of this Plan and any other function that may come to notice is the responsibility of the respective Chairman, of Mumbai Port, JNPT and Head of ONGC establishment for their area of jurisdiction or any other person, persons or organization specifically appointed in writing or by identification through a notification or administrative order. Such delegation and notification will form an inherent part of this Plan-post issue.

While, the three respective heads will be the functional authority with respect to execution of this Plan, Chairman MbPT will be the custodian and administrative head of the Plan with respect to revisions and amendments as per recommendations of other members.

9.1.1 **Major functions of Crisis Management Team**

The major functions that would need to be carried out by CMT to discharge the Plan are as per table 9.1

Field ops	Initiation, Control of Operations and response activity Emergency Control room functions Implementing tired response and disposal Shoreline cleaning (when initiated through this CP) Planning and strategy
Admin and logistics	Victuals Transport Additional manpower and equipment Security
Technical matters	Cargo ops, availability of response items, repairs
Liaison	Communication- operational and with other Government / non govt. authorities , Media
Legal	Documentation of damages, claims and compensation, notifications
Health and safety	Medical assistance

TABLE 9.1 Major functions of Crisis Management Team

9.1.2 **Functional Designations**

Following functional designations stand identified and notified through the Plan, to give effect to this Plan:

(i) Crisis Management Team
(ii) Chief Incident Controller
(iii) Incident Controller (On Scene Commander)
(iii) Incident Manager / OSRO Manager
(iv) On Scene Co-ordinator / Response Specialist
(v) Responders

9.2 EXECUTION OF PLAN

Post activation, the execution of the Plan is to be carried out by following teams by giving effect to mentioned functions

9.2.1 Crisis Management Team and assembly

The team is the primary unit for incident management and is composed of senior managers from various departments for providing advice and resources and take 'on the spot decisions' to meet any immediate requirements arising during the response.

The composition of the team with respect to required functions would be to meet the requirements mentioned in 9.1.1 above and as per table 9.2

A typical organizational chart that usually gets followed in the event of a large spill response is placed at **Appendix 17**.

Details, composition and contact details of three CMTs (as detailed vide section 9) for operations in respective area of MbPT, JNPT and ONGC are placed at **Appendix 18, 18 A,B and C**.

	DESIGNATION	FUNCTIONS
	Chief Incident Controller(C IC)	Head, CMT (presently identified to be HM) Initiation, conduct and control of operations Emergency control room and response Implementing tired response and disposal Planning and strategy
	Incident Controller(IC)	On Scene Commander
	Member Admin & Finance	Admin and logistics Victuals / Financial reports and closing Transport Additional manpower Communication
	Member HSE & Media	Security, Medical advice and attention, Security and liaison
	Member legal	Legal advice, Damage compensations
	Member Tech	Technical matters
	Incident Manager / Manager OSRO	Incident administration
	OSRO/ Response Specialist	OS Co-ordinator

TABLE 9.2 Crisis Management Team Composition

NOTES

(i) Multiple duties and responsibilities as mentioned above can be assigned by IC to one or more persons as required,

(ii) In the event of multiple response operations, any response team member may be assigned the duties of OSRO specialist / OSCo-ordinator (OSCo) for that part of the operation,

(iii) Assembling of Crisis Management Team will depend on the severity or extent of incident, while, a major incident may require the whole team to assemble, a comparatively small spill may require part of team only to be assembled or may require action only of incident management team or operations team,

(iv) Assessing the gravity of spill, the Chief Incident Controller may call the whole team or part of team to assemble at Crisis Management Center,

(v) CIC may assign the responsibility or duty to administer or manage a small spill or part of spill to an Incident Controller (also termed On Scene Commander) - the person responsible for operational control of that part of the port or terminal. Accordingly, the appointed IC (OSC) will carry out the duties of CMT/CIC as mentioned in 9.3.1. However, CIC is to be kept informed of all actions taken and being planned by IC.

(v) Crisis Management Team being a permanent standing team of the Port authority remains identified and nominated at all times. The team members can be assigned a fixed tenure or duration, to be replaced in due time with other members competent to carry out the CMT duties.

(vi) **All CMT members are expected to keep themselves fully aware of all the contents and requirements of this Plan and to be aware of demands likely to be made on them in discharge of CMT functions.**

9.2.2 Operations and Response Team/ Teams

Incident operations and response team comprises of CMT or part thereof, as decided by CIC as per the magnitude of spill (Reference 9.2.1 Note iii). While, the CMT would be activated to meet in the event of a major accident, a comparatively small incident may need only limited action of CMT to be performed by a part of team.

i. **Chief Incident Controller (CIC)** - Harbour Master (H M) is nominated permanent Chief Incident Controller irrespective of the magnitude of spill. While, in the event of a large spill, major decisions and duties are expected of him to be discharged along with CMT, in the event where the spill can be handled by response team alone, the incident will be handled by Incident Controller (IC)(Reference 9.2.1, Note iv). **The appointed IC will carry out the functions of On Scene Commander for the operation.** However, the CIC is to keep account of the operation and ensure to be kept informed.

ii. **Incident Manager (IM)** – is a member appointed by HM or respective CMT leader to undertake the responsibilities associated with administration of operations and giving effect to decisions arrived at by CMT. He is to ensure timely execution of demands and decisions with a view to provide continuity to operations. To facilitate ease of operations and administration, a permanent IM is to stand nominated at all times by HM or CMT leader.

In the event, the response activity is assigned by the port to an OSRO, the OSRO will appoint a manager in addition to Incident Manager to undertake the responsibility of meeting the demands of response teams.

iii. **Operations Response Team (OSRO specialist/ Responder / OSCo)** - The response team is to have a permanent status and is to be nominated by CIC on behalf of CMT. The team would comprise of persons specifically nominated on account of their experience of response operations, their qualification or expertise in the matter. The nominated members could be employee of the port or any department in addition to nomination to response team. Being of permanent status, the details of identified members are to be available at Communication and Operations Center at all times and

are to be inserted as a temporary enclosure to this plan. All responders are to be qualified in term of having undergone IMO Level I course.

The functions of response team can be assigned to an identified and qualified OSRO also. In such an event of nomination, all functions with respect to response team and On Scene Co-ordinator will be carried out by the OSRO or OSRO representative, while, CMT and CIC will continue to function hitherto.

Response resources like equipment to be deployed having been identified in terms of quantity and location, additional resources like spill response vessel (SRV) and work boat etc along with responders would be as per identification and notification by CMT leader. In the event of an OSRO being assigned the responsibility to provide resources, OSRO will have to mobilize the different units.

The response team is to comprise of a Manager, Specialists, responders, response workers apart from the crew of the vessel or work boat assigned to response duties. The team and additional resource composition is

(i) Incident Manager / OSRO Manager
(ii) OSC- Incident Controller/On Scene Co-ordinator
(iii) SR Vessel and Captain
(iv) Responders
(v) Vessel crew
(vi) Work boat, master and crew

Additional responders or additional teams could be assembled during response ops as the requirement demands.

9.2.3 Shoreline clean up team

Shoreline clean up is usually the last of the response activity undertaken either at completion of response actions or at times in consonance with afloat actions as the situation demands.

While, the response is expected to be taken by the local administrative authority, there may be reasons and requirements that the same may be required to be undertaken by the port or facility. In such an event, the team or teams as required is /are to be nominated by CIC on behalf of CMT under the supervision of shoreline clean up advisor. The team response will be in accordance with the beach type response as dictated by Operations Manual.

The members of CMT will be responsible for providing support, equipment, advise and resources in the same manner as being provided to afloat operations team.

9.3 DUTIES OF CMT AND OTHER STAFF

CMT is constituted to provide support to operations, whether being carried out by nominated responders or by an OSRO. The primary duty of CMT is to provide logistics, equipment and resources to the operations.

All decisions taken by the CMT are to be logged with all details by the person appointed by CMT for providing administrative support.

9.3.1 CRISIS MANAGEMENT TEAM/ CHIEF INCIDENT CONTROLLER (CIC)/ IC

ANY ACTION/S UNDERTAKEN BY ANY TEAM OR MEMBER TO ACHIEVE THE OBJECTIVES OF THIS PLAN WOULD DEEMED TO HAVE BEEN TAKEN BY THE TEAM HAVING BEEN FULLY AUTHORIZED BY THIS PLAN.

In the event of a spill requiring response , Chief Incident Controller (CIC) as head of the CMT, supported by CMT is required to discharge the below mentioned responsibilities or part thereof as the situation may demand. The responsibilities are not exhaustive or all inclusive and could be amended or added to as the situation may demand.

Any of these responsibilities or part can be assigned by CIC to any other team member or members as the situation may require. Taking into account the operational demands, the CIC may nominate any members to be part of a team to carry out any of the CTM functions mentioned below. All actions undertaken by the members of the CMT are authorized by this Plan.

The responsibilities required to be discharged by CMT/CIC include

- Ensuring availability of mechanism in terms of manpower, equipment and infrastructure at all times to man Crisis Control room and receive reports of spill
- Receive details of incident from Port control/ OSRO control room, Incident Controller(On Scene Commander)/On Scene Coordinator
- Assess magnitude of incident and assemble CMT or part thereof as required
- Confer with IC/OSRO - S or and determine the most effective method of dealing with the spill
- Provide assistance to response team, IC/OSRO - S for surveillance of slick
- Ensure detailed recording of events
- Decide on safety & security of men and incident site in consultation with IM/OSC
- Liaise with OSC and team leaders for availability of resources and progress of response operations
- Mobilise additional response team members and equipment as may be required by OSC
- Coordinate response efforts between OSC and CMT

- Provide support to operations in terms of manpower, equipment, vehicles, watercrafts and other resources etc. (Sourcing of items not available is to be discussed with CMT for procurement and supply with demands justified.)
- Make weather forecast reports available to COC for further dissemination to response teams for both afloat and ashore operations
- Decide on requirement of medical cover
- Decide on mobilization of shore cleanup operations in consultation with OSC and advise state administration, if required
- Ensure availability of arrangements and facilities at ashore work site/s if operations are undertaken by CMT
- Consider use of external technical assistance in case of major emergency including decisions on lighterage, transfer of cargo, shifting of vessel etc
- Decide on requirement to suspend complete or part of port / cargo operations, traffic movement etc as the situation demands
- Initiate Mutual Aid Assistance Scheme, if such pact exists between different organizations (i.e ports, oil companies, etc.) beyond the MOU for this CP
- DECIDE on activation of tiered response and confer with Coast Guard to take over operations as per NOSDCP. In the event of tier response being initiated, confer with Coast Guard OSC or CIC to call for assistance from any OSRO – national or International
- Report spill details to National spill Reporting Centre i.e Indian Coast Guard
- In case of large spill, assess the risk to life and installation , size and consequences of spill , ability of the organization to handle the operations
- Instruct and direct additional teams and resources to act in consultation with OSC
- Advise state, private agencies of actions required to be taken by them in the event of threat by movement of spill

A common duty required to be performed by all members of CMT, Control Room, IC(OSC),OSCo, IM, Vessel Master, responders and any other person associated with the operations is to

- **Maintain personal detailed log of demands made on them and action taken or demands made or communication forwarded by them to any department or team member . Format is as per Appendix 19.**

NOTE

IN THE EVENT OF TIER RESPONSE BEING RESOTRED TO, WHILE THE OSC DUTIES MAY BE ASSUMED BY COAST GUARD MEMBER, THE CMT WILL CONTINUE TO FUNCTION AS EARLIER IN SUPPORT OF OPERATIONS.

HM WILL CONTINUE TO DISCHARGE THE DUTIES OF HEAD OF CMT, WHILE UTIES OF CIC MAY PASS TO OSC OR ANY OTHER CG PERSON SPECIFICALLY NOMINATED.

9.3.2 ADDITIONAL RESPONSIBILITIES OF TEAM MEMBERS

Apart from specific responsibilities mentioned above at 9.3.1 with respect to response activities, the appointed team members may be required to undertake the following tasks also in support of operations :

- Assessment of losses in terms of damages, cessation of operations etc
- Receive reports of damages to public utilities, loss to economic activity for compilation of compensation and demands
- Initiate compensation proceedings
- Authorization of expenses for spill response as per requirements raised by CMT
- Assist / Advise CMT in matters requiring financial approval

- Computation of expenses incurred by port on OSR activities(for compensation demands)
- Advise OSC/OSCo of dangers posed to port equipment and machinery from oil spill and advise on deciding priorities for response
- Brief breakdown/maintenance teams to be available to OSC in support of operations and making available mobile units, cranes, forklifts, tankers etc
- Advise OSC/OSCo on fire and safety matters which are likely to be encountered due to spill
- Making available equipment required for shore cleanup (to be discussed with shore clean up team leader/s)
- Order termination of all cargo operations or part thereof, if required
- Order removal of cargo from a location or locations
- Assist IC in addressing media and press
- Providing first aid in the event of injuries and evacuation of injured to medical center
- Advise on termination of Operations

9.3.3 ON SCENE COMMANDER and ON SCENE CO-ORDINATOR (OSCO)

As per requirement of this Plan, the Incident Controller appointed for response by CIC is designated as the On Scene Commander (OSC). He will report to Harbour Master, who is designated as CIC and Head of Crisis Management Team (CMT) for all operations, of whatever magnitude. OSC will be responsible for discharge of all response activity when the activity is being undertaken by the CMT or the Port. The appointed OSC can also be assigned the duties of Incident Manager required to be appointed.

In the event of an OSRO being appointed to undertake response actions within the jurisdiction of this Plan, the person appointed by the OSRO as OSRO specialist / OSRO responder will assume the duties of OSCo-ordinator and will be responsible for all response activity. However, the OSC will still remain nominated providing support to operations on behalf of the organisation.

Multiple operations

In the event of multiple response activities being undertaken at the same time, response team leaders appointed for each team would assume the duties of OS Co-ordinator for that part of response, while OSRO specialist will assume the duty of Chief OSCo. The IC will continue to discharge his duties of On Scene Commander hitherto. All OSCos thus designated will report to Chief OSCo who in turn will report to CIC.

The duties with respect to conduct of operation assigned and mentioned here under will accordingly be required to be discharged by each OSC (in the event of multiple ops).

On Scene Co-ordinator (OSCo)/ Chief OSCo is responsible for undertaking all possible and feasible actions to respond to spill and direct the response team / teams at site. He is to decide the best response action required to be adopted as per situation and guide the response team/ teams accordingly.

Every OSCo appointed for any part of the operation and OSCo would be responsible for the following duties or part thereof as per their activity, in the operation and area of operation :

- Determine whether the incident can be handled with resources available at site, on vessel or will require activation of CMT
- Advise CIC about activation and assembling of CMT

- Decide on most effective means to combat spill in most feasible manner within the limitations imposed by area
- Decide deployment of equipment and configuration to be adopted for containment of spill, recovery and disposal
- Use available resources, vessels and equipment to the best of capability and in the best manner for containment & collection of oil
- Safe and Effective deployment of OSRO team and equipment
- Deployment of response team/ teams and their turn around
- Co-ordinate multiple operations and vessel deployments
- Requisition additional manpower from CMT as required for land or water borne operations
- Initiate equipment deployment and undertake periodical review
- Ensure availability of operational non disruptive means of communication to all teams and establishing communication network between OSC, CIC , COC and team /s (in case more than one team is deployed)
- Assess spill scenario and advise CIC on declaration of spill as Minor or Major Spill of Tier-I, Tier-II or Tier-III magnitude
- Assess requirement and availability of consumables and response items and render timely advise to OSRO - M and CIC for further procurement
- Taking necessary preventive measure against Oil Fire arising or likely to arise out of any situation / action
- To monitor weather forecasts and carryout necessary changes to deployment of men and machinery, if required
- In case of large spill, assess risk to life and installation, size and consequences of spill and ability of the organization to handle the spill
- Advise CIC to decide on demanding support from external resource

- Take decision with regard to adequacy and effectiveness of response strategy and status of slick in terms of threats posed
- Availability of First Aid kit to all the teams at site of response
- Assist CIC in rendering report to National spill Reporting Centre i.e CG
- Ensure maintenance of equipment and undertaking of routines
- Conduct of training, drills and exercises for responders
- Prepare daily response activity log

9.3.4 Responsibilities of Incident Manager (IM) / O S R O - Manager

I M or OSRO- M will be in charge of all administrative activities required to be taken with regard to management of response team and running an actual incident response. IM or OSRO - M will be appointed by the CIC or OSRO as applicable.

Apart from additional responsibilities that an operation may demand of IM or OSRO M, some of his responsibilities are to

- Keep track of stock levels of consumables held by OSC and response team/ teams
- Initiate procurement action for stores as per demands and requirements from OSC as the case may be
- Ensure availability of victuals for teams at work site
- Availability of essential safety and personal protective gear to all team members
- Prepare duty roster of OSR personnel
- Turnaround of duty watch at ECR, responders and team members
- Coordinate movement of OSRO staff, personnel, equipment to incident spot
- Arrange for transport, stay, victuals etc for additional teams/ persons as required

- Arrange for boarding/lodging etc for any party/personnel arriving for undertaking OSRO activities
- Providing short notice back up support in terms of manpower for operations and activation of shore cleanup (as directed , if required
- Obtain necessary clearances for OSR personnel and equipment arriving from any national or international agency
- Execute requirements raised by CMT / OSRO S
- Provide support to vessel in terms of berthing, victuals and other requirements
- Arrange for and provide logistic support to operations
- Ensure maintenance of equipment as per laid down frequency and schedule
- Make available spares, tools and expendables to maintenance team
- Make available adequate number of first aid kits to all teams, vessels etc
- Carry out the duties of HSE Manager and ensure safety of personnel as per Safety Manual

9.3.5 Responsibilities and functions of Response Team

Composition of response team/s being identified in advance, the team/s would be available at all hours at the identified site for response activity.

In case of any spill, the first response is expected to be launched by the vessel master and responders - assigned the duty for spill response .

In the event where response activity is assigned to an OSRO, the OSRO responder and vessel will undertake the activity on first receipt of spill report. The functions of initial responder and vessel master would be to

- Render / receive preliminary spill report including extent, cause and quantity of spill

- Collect samples of spilled oil and assess the extent of spill and adequacy of equipment to address the spill
- Advise OSC, ECR and CIC on the situation and additional requirement of equipment
- Ensure non disruptive communication with ECR and rendering of reports as decided
- Advise the team to rig up containment recovery equipment in the best effective configuration
- Cooperate on rigging of equipment and maneuverability
- Co-ordinate with other teams operating in close vicinity
- Discuss equipment deployment strategy with the skipper / master of the vessel, so as to avoid last minute operational / navigational failures

9.3.6 Common duties - Responders/ OSC/ COSC / SR Vessel Master / Control room are as mentioned:

1. To maintain detailed daily log of activities undertaken by them and their team including deployment of equipment, advise rendered or demands raised. The log is to mention action taken daily (in narrative form) and observations made. **Appendix 20.**
2. The final report is to highlight achievements, failures, lessons learnt and specifically mention operational constraints and difficulties faced, changes to be made to operational doctrines, personal policies and training .
3. To be aware of deployment pattern of equipment and operational parameters
4. To be aware of the area layout including sensitive areas
5. Have in possession drawings and sketches of the area #
6. Be aware of the position of OSR equipment at each site along with all latest weather reports

7. To keep tide conditions in view and keep stores, vessel and other equipment safe from dangers imposed by tidal conditions
8. Knowledge of procedures and precautions for collection of spilled oil
9. To be conversant with the CP and responsibilities assigned to each through this section

Sensitive area sketches are to be available with OSC / COSC and Vessel Master at all times, Control room is to have adequate stocks available

(Members of a team undertaking operations under the supervision and orders of a responder, master of SR vessel or any other member of the team are exempted from maintaining the log. The log under these conditions will be maintained by the person supervising the part of operation.)

10. OPERATIONS CONTROL AND COMMUNICATION

Uninterrupted, clear and precise communication of information, situation, operational and demands is the basis for the success of any operation.

All functions related to any response operation will be planned and undertaken by CMT from the Communication and Operations Center (COC). While, activation of plan may be initiated by information to Port Control, the long term response decisions taken for protracted operations at any location away from COC, are to be passed to COC at the earliest . A working channel will be promulgated for the operations.

10.1 Communication and Operations Center

A permanent location is to be designated as Communication and Ops Center (COC) by the authority responsible for execution of this plan. Both functions are to be manned by different persons unless the magnitude of operations dictates manning of any particular operation by one operator only. (As far as practicable, both functions should be located at same site.)

The center has to be separate than the Port control and easily assessable to all the members of CMT and manned at all hours by persons qualified for such duties. In case the location has to be at the Port Control, the persons manning C O C are to be in addition to those manning the Port Control. Any information received in respect of an oil spill by any member associated with this CP is to be passed to the COC at the earliest.

In case the response activities have been assigned to an OSRO, the COC will be manned by OSRO rep and may be designated as Operations room also.

The person/ persons manning the center are to be fully acquainted with the contents and demands of CP.

10.2 Equipment and Publications

The communication center is to be provided the following equipment and publications

- VHF – 2 numbers
- Walkie talkies – as per the number of response teams and functional team leaders
- Telephone (landline or wireless) – 1
- Computer and printer with internet and projector facility
- Copy of CP and appendixes
- Details of CMT, OSRO organization and their contact details
- Charts of Mumbai harbour , Tide Table
- Large scale charts showing layout of POL and cargo berths
- GA plan of a typical oil tanker
- Location map of jetties, berthing and landing facilities available in Mumbai estuary along with facilities available
- Telephone contact directory of all emergency aid and medical services, port offices and local administration authority
- Disaster Management Plans of MbPT, JNPT, ONGC and BPCL

10.3 Actions required of COC

The actions required to be undertaken by COC at all times include:

- Continuous watch on working frequencies used by ships, port and terminal for POL cargo ops
- Watch on Ch 16 at all times

- Log all information in respect of an oil spill (with maximum details) received through keeping watch or from any other source
- In case of first receipt of information, pass all the details regarding spill to CMT leader to facilitate complete or partial activation of team or response actions by OSRO
- Pass all information regarding spill to OSRO and duty vessel or tug assigned response duties.
- Remain in constant touch with designated response team leader and response / support vessels as per working channel decided for operations
- Receive and pass information during operations to the authority identified through the message
- Collect latest information from MET dept on weather conditions in the area including wind direction & speed, tide condition and other weather parameters (all received information is to be logged)
- Provide weather data to operational teams as demanded
- Check the operational status of communication equipment periodically and bring the defects to attention of IM or OSRO M as applicable
- Details of vessels working cargo at different locations with quantity of cargo
- ETA, ETD of all vessels arriving/ leaving harbour
- Details of equipment location and stock pile

10.4 INFORMATION DISPLAY

The following latest information is to remain displayed at all times on wall boards in the Control and Operations Center :

- Vessels working cargo in port – quantity of cargo , location and expected times of completion
- Prevailing weather conditions and future forecast
- Vessels expected to arrive and depart port in next 24 hrs , cargo and quantity
- Important contact numbers of CMT, OSRO and other CP aid agencies

11. SPILL REPORTING AND PLAN ACTIVATION

Any person whether an employee of the port, vessel operator, appointed responder or not, can pass any information of any oil spill or a situation that could lead to an oil spill , held or observed by him or her, to any one of the identified centers to facilitate activation of this plan and initiation of response activity in accordance with the procedures laid down.

11.1 ACTIVATION

Any person who observes a spill or gets an information of a spill or observes a situation that could lead to a potential spill, may pass the available information with maximum possible details to any one of - Port Control, Control and Operations Room or Harbour Master, by fastest means available (All incidents of spill of whatever magnitude are to be reported to HM by Port Control Room or COC).

Contact details are as per table 11.1

Port Control	Landline - MbPT JNPT	
	VHF - MbPT JNPT	Marine channel 12 Marine Channel 13
COC	Landline number	
	Mobile	
	VHF	Marine Channel 12 and 13
Harbour Master /C IC	Landline- MbPT JNPT	
	Mobile	

Table 11.1 Contact details

11.1.1 Actions by Port Control / COC or HM

The following actions are to be initiated on receipt of information:

(i) Log information as per format at **Appendix 21(Incident Log)** with maximum information and details possible like position, source and reason of spill, likely quantity, action initiated by spill unit,

(ii) Pass all received information to other two incident receiving authorities,

(iii) Post receipt of information, the HM or CIC is to assess the magnitude of spill along with OSRO - M or S and decided whether CMT has to be assembled,

(iv) HM or CIC is to pass all available information to Chairman Port and other stack holders along with details of spill and decision to assemble CMT or not,

(v) Post confirmation of spill by any of the three mentioned sources, this Plan will stand activated in totality or a part thereof,

(vi) In the event, response action is initiated on first observation by OSRO, the information may be passed to Port Control Room and HM subsequently but at the earliest opportunity.

(vii) ALL RECEIVED INFORMATION IS TO BE REDUCED TO FORMAT AS PER POLREP REQUIRED TO BE PASSED TO SPILL INFORMATION CENTER i.e CG. POLREP FORMAT and contact details of center are placed at **Appendix 22 and Appendix 22A.**

11.1.2 Numbering of Incident Log

Any information received in respect of a spill is treated to be an independent incident and is to be docketed as under:

(i) Title identification – By name of vessel

(ii) Numbering - Report sequence for the day / date, month and year

In the event of a spill from an unidentified source only the numbering is to be mentioned along with place of observation and date, month and year.

11.2 COMMON DUTIES OF PORT CONTROL/ COC and HM

- Receive all details from person reporting the spill and start log of events
- Assess situation & take appropriate steps to establish source of leak/spill and render advise (if possible) on reducing / preventing further leak / spill

11.3 TEAM ACTIVATION

The following centers and teams associated with the discharge of this Plan will stand activated irrespective of the magnitude of spill or decision to assemble CMT.

i. Operations and communication center
ii. Response team and responder
iii. On Scene Commander(IC / IM) and On Scene Co-ordinator (OSCo)
iv. Vessel master and crew
v. Incident Controller / HM

In the event of a large spill and decision to assemble CMT being taken by CIC (HM), the CMT will join the above teams to take decisions with respect to conduct of operations. Composition of CMT and actions required to be initiated by different members and teams post activation of the plan are as per Section 9 of this Plan. Incident and information flow chart is placed at Figure 11.1

11.4 SPILL DETAILS

Any INFORMATION RECEIVED WITH RESPECT TO A SPILL, BEING OF IMPORTANCE TO ARRIVE AT A DECISION WITH RESPECT TO ACTIVATION OF CMT and RESPONSE REQUIRED TO BE TAKEN, HAS TO BE RECORDED WITH CARE AND WITH ALL POSSIBLE DETAILS.

Correct knowledge of the quantity of spill is a factor that would facilitate the CMT and other responders to decide on the scale of response action and also the requirements to decide on Tier responsibility. The information has to contain the following details

- Authority reporting spill (with all details)
- Time and position of spill
- Type of oil
- Assessed quantum of spill

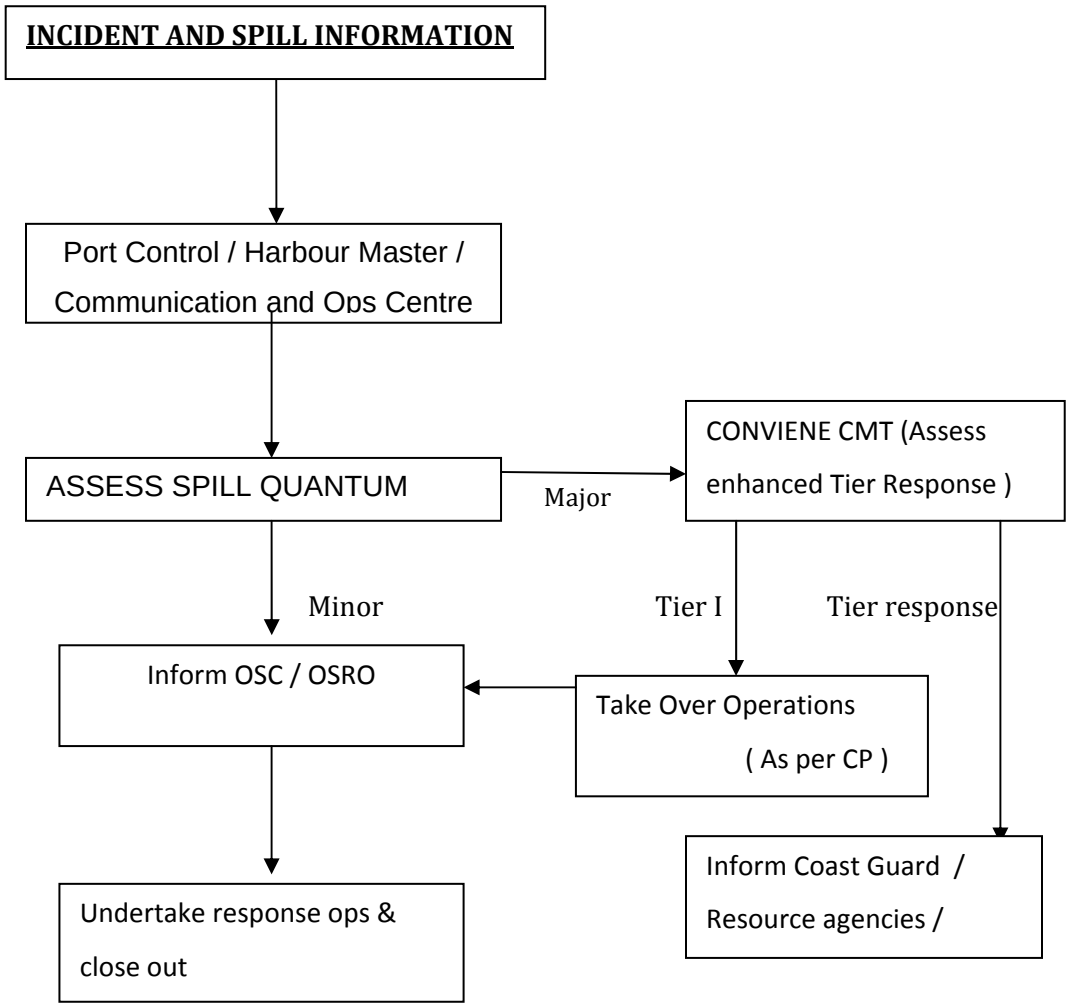


Figure 11.1 - INCIDENT AND INFORMATION FLOW CHART

11.4.1 Additional Information

In addition to the above information, following info is also to be recorded and provided to the responder or OSRO,

- Detailed weather conditions – wind, direction and speed
- Sea conditions

11.5 INFORMATION TO PUBLIC AUTHORITY

Based on information held with respect to parameters affecting the spill, like weather conditions and amount of spill, the CMT supported by OSC or IM has to arrive at the conclusion with respect to resources which are at risk at shore and need to be protected.

Information in regard to risks is to be passed immediately to the concerned resource management authority apart from information to respective district authority and CG.

The actions required to be initiated by the shore authority could be to prepare for beach operations, shut down a particular public utility plant, move economic resources like captive fisheries to other locations or prepare for any emergency action.

The contact details of civil authority are placed at **Appendix 23.**

11.6 INFORMATION TO MEDIA

Release of Information to media is to be as per 'Media policy' of the respective organisation heading the CMT for particular operation.

Information to media is to released by the person identified through respective Media policy of the organisation. In the event of non authorisation of any one person, the

media release will be made by CIC or by a person nominated by him after authorisation by head of the Organisation. The daily report of actions taken on a particular day as prepared by COC and OSC, is to be shared with the person nominated to brief the media. Each press brief is to cleared by CIC prior being provided to media.

While, providing factual details and information to media assists in passing the situational report to public likely to be effected by a spill, it is advisable not to sensalize the information with unwanted figures or actions that could shock or distress the public.

Most of the factual information like precautions required by public to be taken with respect to fishing activity, closure of beaches, demand for beach cleaning volunteers could be disiminated through media. A write up on good media practises is placed at Appendix 24.

12. TERMINATION AND COMPLETION OF OPERATIONS

TERMINATION AND COMPLETION OF OPERATIONS will be declared by CMT. The two phases of operations envisaged by this Plan are

(I) Spill response activity at terminal/sea and

(ii) Shoreline cleanup activity

Termination of operations is to be declared by Chief Incident Controller post discussions with CMT and OSC and is to be undertaken in steps as per the satisfactory completion of each phase .

In the event of multiple operations being undertaken, each operation is to be declared completed after satisfactory completion and post discussion with CMT.

In the event where both the activities are undertaken by the CIC, actions under each activity can be declared completed in phases post discussions with OSC and CMT. However, advise on termination is also to be sought from National Oil spill center ie. CG.

In the event of shoreline activity being conducted under the authority of local administration,that part of the activity will be declared terminated by the controlling authority.

12.1 Completion and Standing down

For declaring termination, the provisions outlined in Operations Manual with regard to assess different parameters espicially the Net Environmental Benefits (NEB) are to be taken into account.

While, all phases and activities (as dictated by para 11.1) of operation may be declared terminated on completion, the operations per say are to be declared completed after following activities have been completed

- Machinery and equipment accounting,
- Ensuring serviciability of equipment,
- Receipt of final report from OSC,
- Disussions about amendments, revisions, plans and procedures by CMT,
- Completion of actions arising out of final report on conduct of operations,
- Compilation of details with respect to compensations and damages.

12.2 Review of Plan and Procedures

Amandements as required to be undertaken to CP or Operations Manual are to be put up to CMT for review and approval for induction into the CP. Any member associated with response operations in any manner or otherwise may suggest amendements to COC / IM /OSRO-S or CIC. The amendmants will be undertaken by IM or OSRO-S as required for inclusion into the plan with authorization from CIC .

Amendments are to be inserted in the Plan by replacing the relevent page/s or section in the ring binder folder.

13. Disposal

Disposal of recovered oily waste is an integeral part of the Operation Manual and is explained in detail in "WASTE DISPOSAL PLAN". The purpose of disposal is not only to direct the recovered oil and waste to a final processing facility but also to bring to attention of responders, the methods to mininmize the amount of waste generated during operations.

All disposal is to be undertaken keeping in view the provisions of different statutes and legal parameters like 'The Environmental Protection Act 1986' and the Hazardous Waste (Management & Handling and Transboundary Movement) Rules 2008. Disposal of certain waste like solids and debris etc that can not be processed by participating oil companies will be required to be undertaken in close consultation with local adinistrative authority.

In the event, where, spill originates from any unit of the participating oil companies, the custody of waste and recovered oil is to be handed over to the company for trasportation, storage and disposal.

The participating companies will make available adequate resources to take over the waste from the responers, so as to make free the resources being used for recovery and collection earliest.

Any dispute arising on this account will be settled by respective CMT, whose decision will be final and binding.

APPENDIX 1

(Refers to Para 2.4)

OILS HANDLED AT Mumbai HARBOUR

1. Bombay High Crude
2. Persian Gulf Crude
3. Motor Spirit
4. High Speed Diesel Oil
5. Naphtha
6. Furnace Oil
7. Light Diesel Oil
8. Industrial Furnace Oil
9. Reformate / Benzene

APPENDIX 2

(Refers to Para 2.4.1)

BROAD CLASSIFICATION OF OILS AS PER MARPOL 73/78

Asphalt solutions
Blending stocks
Roofers flux
Straight run residue
Oils
Clarified
Crude oil
Mixtures containing crude oil
Diesel oil
Fuel no. 4,5 and 6
Residual fuel oil
Road oil
Transformer oil
Aromatic oil (excluding vegetable oil)
Lubricating oils and blending stocks
Mineral oil
Motor oil
Penetrating oil
Spindle oil
Turbine oil
Distillate
Straight run
Flashed feed stocks
Gas oil
Cracked

Gasoline blending stocks
Alkylates- fuel
Reformates
Polymer - fuel
Gasolines
Casing head (natural)
Automotive
Aviation
straight run
Fuel oil no.1 (Kerosene)
Fuel oil no. 1-D
Fuel oil no. 2
Fuel oil no. 2-D
Jet fuels
JP-1 (Kerosene)
JP- 3, 4
JP–5 (Kerosene, heavy)
Mineral spirit
Naphtha
Solvent
Petroleum
Heart cut distillate oil

APPENDIX 3

(Refers to Para 2.4.1)

CHARASTRISTICS OF DIFFERENT CLASS OF OILS

OIL TYPE	DENSITY (kg/l) At 15C	Viscosity mPas at 20C	Pour point C	Flash point C
Crude oil	0.8- 0.95	1-100	+10 to – 35	Variable
Gasoline	0.70 – 0.78	0.5	Na	Less than 0
Kerosene	0.8	2	Less than – 40	38-60
Jet fuel	0.8	1.5-2	Less than – 40	38-60
Diesel oil	0.85	5	-5 to -30	More than 55
Light FO IFO60	0.9	60 at 50 C	+ 50 to -20	More than 60
Medium FO IFO 180	0.9	180 at 50 C	+ 30 to – 20	More than 60
Heavy FO IFO 380	0.99	380 at 50 C	+ 30 to – 20	More than 60

APPENDIX 4

(Refers to Para 3.4.4)

ONGC PIPELINE SPILL VOLUMES (m3)

Time in hours after rupture	Spill SIZE
1	1900
3	3400
6	5300
12	9000
24	13500
36	14100

NOTE - Figures are for 30" Mumbai High Crude pipeline to Uran

APPENDIX 5

(Refers to Para 4.1)

WEATHERING PROCESSES AND TIME SCALES

Process		Importance	Time frame
Evaporation	Conversion of liquid to gaseous state. Lighter factions are lost first	Major process accounting for loss of oil. At 15 C gasoline will evaporate completely over a 2 day period, 80% of diesel fuel and 40% of light crude , 20% of heavy crude and about 5- 10% of Bunker C fuel.	< 5 days
Emulsification or mousse formation	Small water droplets get mixed into liquid oil. Water content will reach 50-80%	Will increase the amount of pollutant to be recovered by a factor of 2-4.	Onset may be delayed but emulsification process will start rapidly.
Natural dispersion	Breakup of an oil sleek into small droplets	Removes oil from water surface	< 5 days
Dissolution	Mixing of soluble oil components into water	Water soluble components are most toxic	< 5 days
Biodegradation	Breaking of oil by microbes into smaller compounds and finally to water and carbon dioxide	Rate depends on oil type, temperature, nutrients, oxygen and amount of oil	Weeks to months
Formation of tarballs	Breakup of heavy crudes and refined oils into small patches with long persistence	Hard to detect	Days to weeks

APPENDIX 6

(Refers to Para 4.1.1)

CALCULATION OF WEATHERING LOSSES – ADIOS SPILL CALCULATOR

OIL type

BOMBAY HIGH Crude
Location – INDIA
API 39.4
Pour Point – 30 deg C
Density – 0.825 g/ cc at 30 deg C
Viscosity – 5.0 cSt at 30 deg C

Emulsification

Mousse begins to form when 19% of the oil has evaporated

Wind and wave conditions

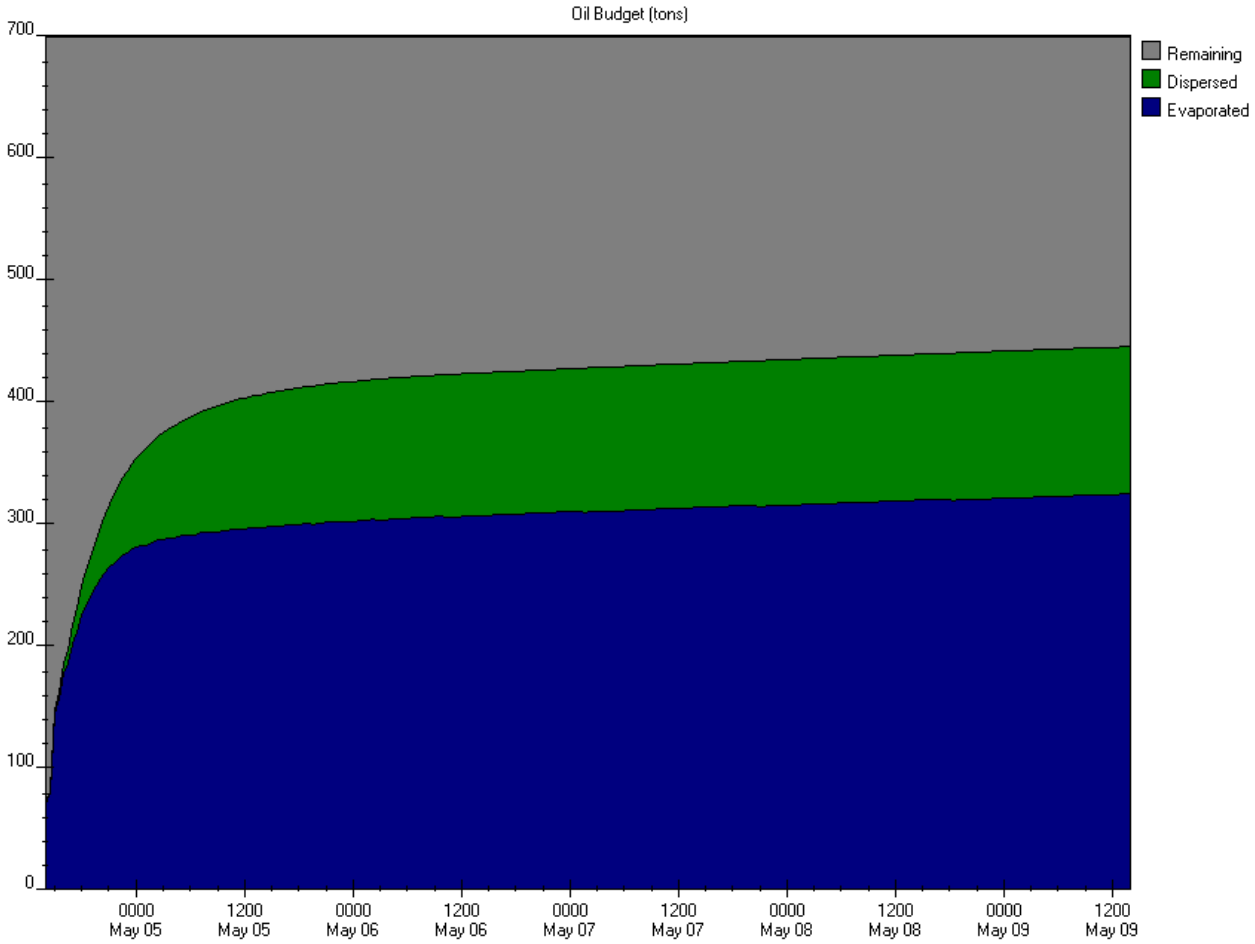
Wind speed – 10 knots from 245 degrees
Wave height – computed from wind speed, unlimited fetch (default)

Water properties

Temperature – 30 degree C
Salinity – 32 ppt
Sediment load – 500g/ m3 (muddy river)
Current – 3.0 knots towards 80 degree

Instantaneous release

Time - May 04, 2014
Quantity of spill – 700 tonnes



Loss at 0000 hrs / 05 May	**Loss at 1200 hrs / 05 May**
Evaporation 270 tonnes	280 tonnes
Dispersion 110 tonnes	190 tonnes
Remaining 320 tonnes	330 tonnes

APPENDIX 7

(Refers to Para 4.2)

CALCULATION OF SPILL QUANTITY AS PER SLICK CHARACTERISTICS

SPILL AREA AND OIL VOLUME

Average Slick Length	2.5	Km	TOTAL SPILL AREA	1,500,000	m^2
Average Slick Width	0.6	Km		1.50	Km^2

OIL TYPE	APPEARANCE	THICKNESS (mm)	LOADING m^3 / Km^2	COVER %	AREA Km^2	VOLUME m^3
Sheen	Silvery	0.0001	0.1	40%	0.60	0.060
Sheen	Rainbow	0.0003	0.3	30%	0.45	0.135
Slick	Yellow/Brown	0.01	10	20%	0.30	3.000
Crude/Fuel Oil	Black/Brown	0.1	100	10%	0.15	15.000
Mousse	Brown Orange	1.0	1000	0%	0.00	0.000
				100%	1.50	

TOTAL OIL VOLUME	18,195	L
	18.20	m^3

APPENDIX 8

(Refers to Para 6.1)

SHORELINE TYPES, RANKING AND COLOUR CODE

Vulnerability index of shores in order of increasing vulnerability to oil spill damage as per Gundlach and Hayes 1978

1. Exposed rocky headlands	Wave reflection keeps most of the oil offshore. No clean-up necessary.
2. Eroding wave- cut platforms Wave swept	Most oil removed by natural processes within weeks.
3.Fine-grained sand beaches	Oil does not usually penetrate into the sediment, facilitating mechanical removal if necessary. Otherwise oil may persist several months. (some evidence suggests that penetration can occur, depending on water table movements in sediments.)
4. Coarse-grained beaches	Oil may sink and/or be buried rapidly, making clean-up difficult. Under moderate to high-energy conditions, oil will be removed naturally from most of the beach face.
5. Exposed compacted tidal flats	Most oil will not adhere to, nor penetrate into, the compacted tidal flat. Clean-up is usually unnecessary.

6. Mixed sand and gravel beaches	Oil may penetrate the beach rapidly and become buried. Under moderate to low energy conditions, oil may persist for years.
7. Gravel beaches Same as above.	Clean-up should concentrate on high-tide/swash area. A solid asphalt pavement may form under heavy oil accumulations.
8. Sheltered rocky coasts	Areas of reduced wave action. Oil may persist for many years. Clean-up is not recommended unless oil concentration is very heavy.
9. Sheltered tidal flats	Areas of great biological activity and low wave energy. A number of interpretations of the 'biological activity' are possible. In this case, it is taken to mean a combination of high productivity, biomass and possibly bioturbation. Oil may persist for years. Cleanup is not recommended unless oil accumulation is very heavy. These areas should receive priority protection by using booms or oil-absorbing materials.
10. Salt marshes/mangroves	Most productive of aquatic environments. Oil may persist for years. Cleaning of salt marshes by burning or cutting should be undertaken only if heavily soiled. Protection of these environments by booms or absorbing material should receive first priority.

INTERTIDAL HABITAT RANKING

1A	Exposed Rocky Shores
1B	Exposed, solid man made structure
1C	Exposed rocky cliffs with boulder talus base
2A	Exposed wave cut Platforms
2B	Exposed scarps and steep slopes in clay
3A	Not Present in Study Area
3B	Scarps and steep slopes in sand
4	Sand Beaches
5	Mixed Sand and Gravel Beaches
6A	Gravel Beaches (Granules to Cobbles)
6B	Gravel Beaches (Cobbles to Boulders)
7	Exposed tidal flats
8A	Sheltered scarps in bedrock, mud or clay, sheltered rocky shore
8B	Sheltered, solid man made structures
8C	Sheltered riprap
8D	Sheltered rocky rubble shores
8E	Peat Shoreline
9A	Sheltered tidal flats
9B	Vegetated low banks
9C	Hypersaline tidal flats
10	Salt and brackish water marshes
10B	Fresh water marshes
10C	Swamps
10D	Mangroves

APPENDIX 9

(Refers to Para 6.1)

BIOLOGICAL RESOURCES ESI SYMBOLS

ELEMENT	COLOR	HATCH PATTERN ANGLE	SYMBOL
Birds	Green	45	
Habitats	Violet	90	
Fish	Cyan	135	
Invertebrates	Light orange	45	
Marine mammals	Light brown	0	
Reptiles and amphibians	Red	135	
Terrestrial mammals	Light brown	90	

APPENDIX 9 A

(Refers to Para 6.1)

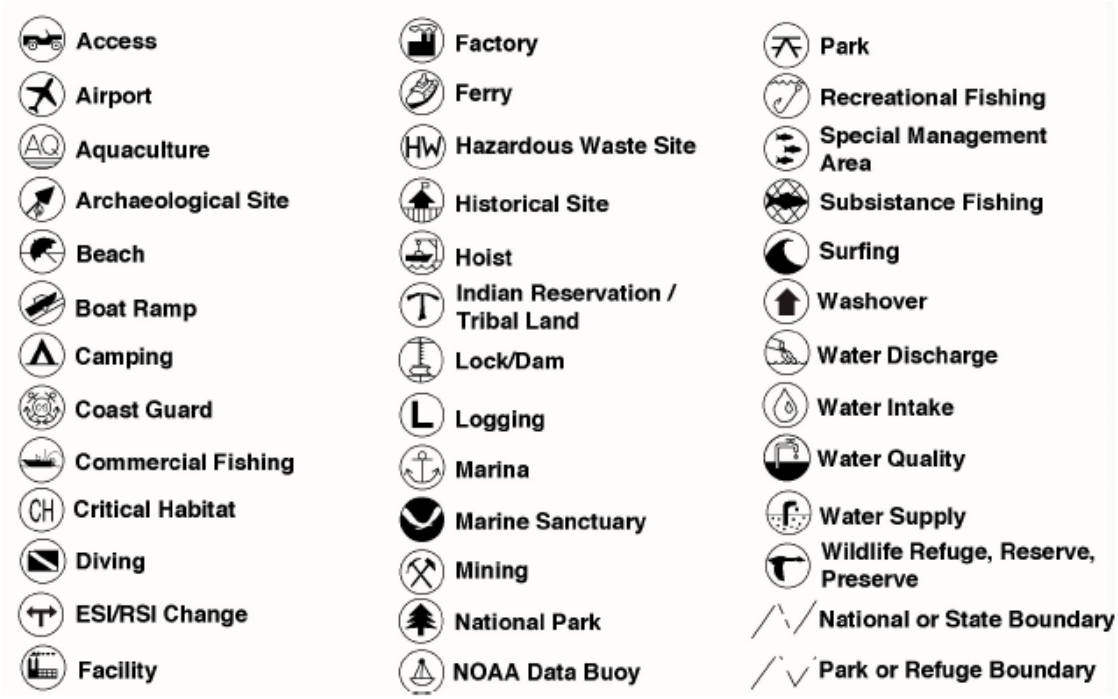
POINT SYMBOLS FOR BIOLOGICAL RESOURCES

When a biological resource exists in a small area (such as a bird nesting site), it is indicated on an ESI map by a symbol. When a biological resource encompasses a larger area, it is represented on ESI maps by a polygon with a specific pattern and colour.

APPENDIX 10

(Refers to Para 6.1)

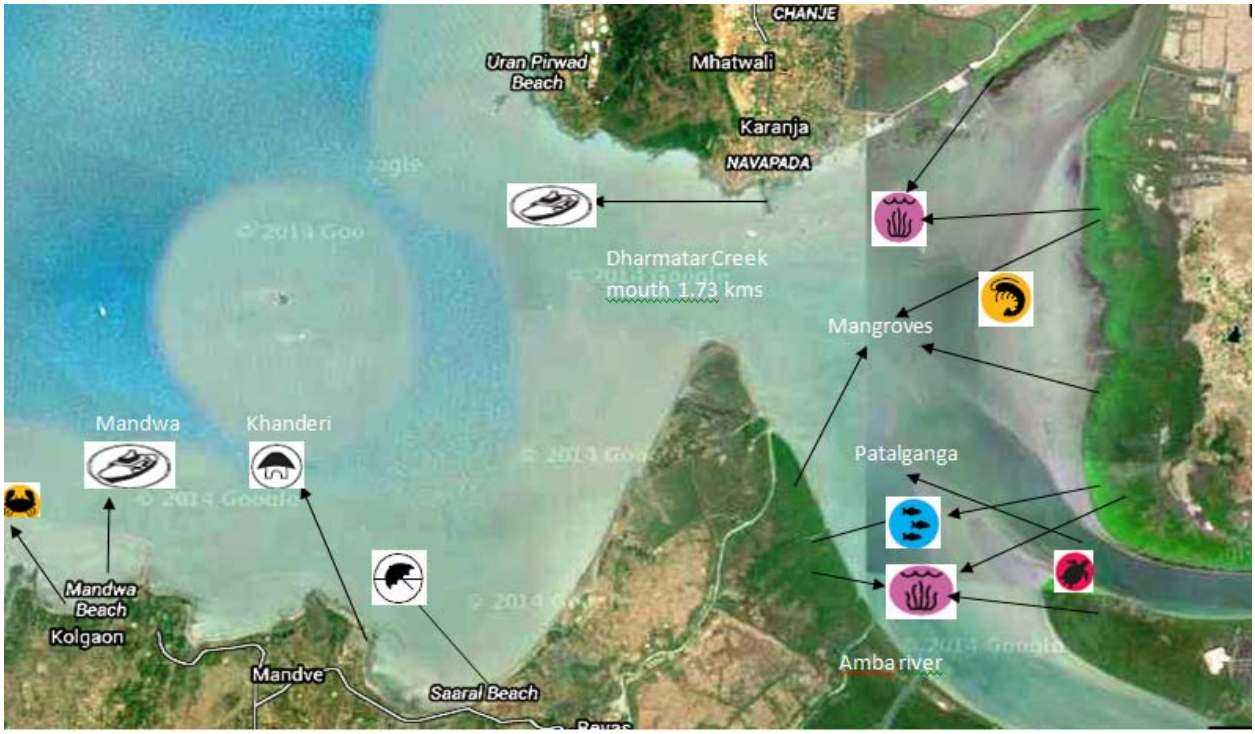
ESI HUMAN USE RESOURCE SYMBOLS



APPENDIX 11

(Refers to Para 6.3)

ESI MAP – THAAL KNOB TO NAVAPADA



Shrimp, Nursery areas; high concentrations

Crab, Nursery areas; high concentrations

Areas of submerged aquatic vegetation; sea grass beds, kelp, algae

Turtle, Nesting beaches; concentration areas

Spawning, nursery, and other concentration areas

Village

Beach

Ferry

APPENDIX 11A

(Refers to Para 6.3)

ESI MAP – NAVAPADA TO MORA JETTY

LEGEND

	Exposed rocky shore
	Mangroves
	Gravel beaches

- Diving bird, rookeries, roosting
- Alcid , Pelagic bird, roosting
- Passerine bird, threatened, endangered
- Areas of submerged aquatic vegetation; sea grass beds, kelp, algae
- Harvest areas; high concentrations, threatened, endangered, or rare species

APPENDIX 11B

(Refers to Para 6.3)

ESI MAP – MORA TO JUNA SHEVA ROAD, JNPT

	1A &B Exposed rocky shore and man made structures
	10 D Mangroves

Crab, high concentration

APPENDIX 11C

(Refers to Para 6.3)

ESI MAP- JNPT(NHAVA) TO SOUTH ENTRANCE TO PANVEL CREEK

Exposed rocky shore

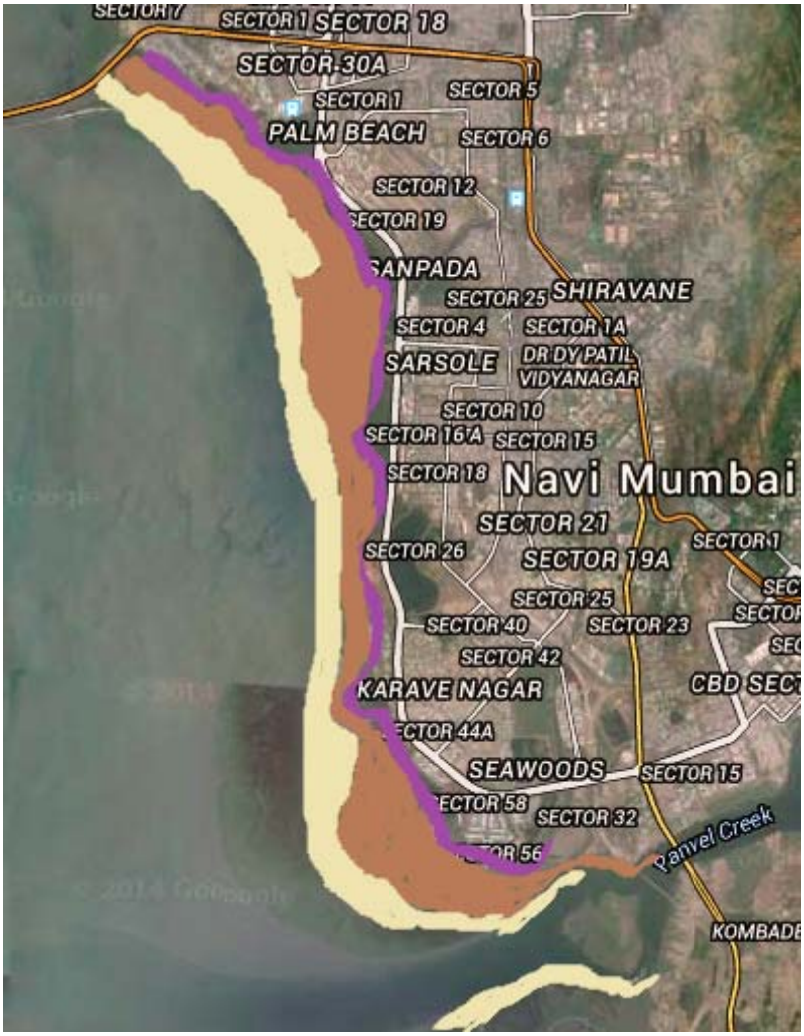
Mangroves

Port, Marina

APPENDIX 11D

(Refers to Para 6.3)

ESI MAP - SECTOR 51 TO VASHI VILLAGE



	1B Exposed solid man made structures
	10D Mangroves
	8B Sheltered solid , man made

APPENDIX 11E

(Refers to Para 6.3)

Vashi village (E bank of Thane creek) to Vikhroli (W bank of Thane creek)

- Diving bird, rookeries, roosting
- Alcid, Pelagic bird, roosting
- Passerine bird<threatened, endangered
- Wintering and migration concentration areas; nesting sites
- Harvest areas; high concentrations, threatened, endangered, or rare species
- Areas of submerged aquatic vegetation; sea grass beds, kelp, algae

APPENDIX 11F

(Refers to Para 6.3)

ESI MAP - VIKHROLI TO BPCL REFINERY TO HAJI BANDAR

Industrial cooling water Intake

Village

APPENDIX 11G

(Refers to Para 6.3)

ESI MAP - VIKHROLI TO BPCL REFINERY TO HAJI BANDAR

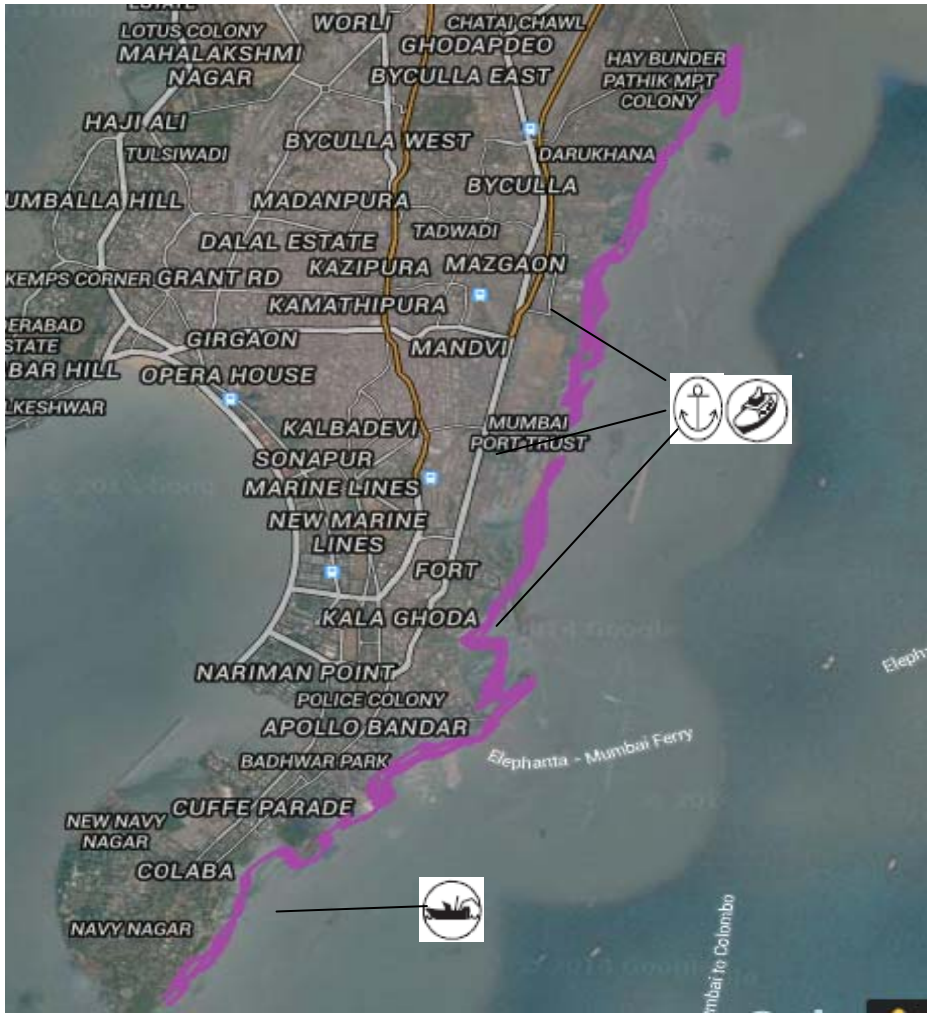
Industrial cooling water Intake

Harbour , Marina

APPENDIX 11H

(Refers to Para 6.3)

ESI MAP- HAJI BUNDER TO COLABA, NAVY NAGAR



Exposed solid man made structures

Harbour , Marina

Ferry

Commercial fishing

APPENDIX 12

(Refers to Para 7.4.1)

PORT- VESSEL POLLUTION EMERGENCY INTERPHASE

ACTION	RESPONSIBILITY
IMMEDIATE ACTION	
Sounding Emergency Alarm	Person noticing spill
Initiating Vessel Pollution Response Plan	Duty officer
INITIAL RESPONSE	
Suspend cargo ops	Ch. Eng./ Duty officer
Information to Terminal/Port Control / Master	Master / Duty officer/Ch Eng
Call crew to Pollution Response Positions	Master/ Duty officer
SECONDARY RESPONSE	
Location of source of spill	Chief officer
Assess & consider -	
Fire risk & manning of fire positions	Master
Stopping of air intake	Chief Engineer
Transfer of bunker to empty or slack tank, shore /barge	Master/ Ch Engineer
Prepare detailed report of spill and actions	Master/ Ch Officer
Inform agent, owners and PI club	Master/ Ch officer
FURTHER RESPONSE	
Call in external assistance to locate spill (if below waterline)	Master – Port
Consider stability of vessel	Master/ Ch officer
Follow directions of response authority	Master

APPENDIX 13

(Refers to Para 7.4.3)

LIST OF DISPERSANTS APPROVED FOR APPLICATION BY COAST GUARD

The NIO and Coast Guard approved list of oil spill dispersants (OSD) are enumerated below.

Type II - Water dilutable (1 part of dispersant: 10 parts of sea water is to be used in the ratio 1 part of diluted dispersant: 2-3 parts of oil)

COREXIT-9500 - (JAN 2003)
BG Exploration & Production India Ltd.,
1st Floor, Midas Sahar Palza
Kondivita, MV Road, Andheri (E), Mumbai - 400 059
Phone : 022-28395841 Fax : 022-28395201

Gold Crew - (Feb 2003)
MS Centerprise
Mayurpankh, 5th Floor
Agiany Lan, Jambli Naka, Thana (W) - 400 601
Phone : 022-25401010/25971880 Fax: 022-25373542

FireChem - (Feb 2003)
M/s Fire Chem Private Ltd
B-4, Rana Commercial Complex
Sector-20 B, Near Ajronda, Faridabad - 121 007
Phone : 0129-25288196/25288197 Fax : 0129-25288700

Spilcare-O - (Dec 2004)
Spilcare - O Metaclean Pvt. Ltd
AB-146, 3rd Main Road, Anna Nagar,
Chennai - 600 040, Phone : 044-26200482 Fax : 044-26281457

Type III - Concentrate (to be used neat in the ratio 1 part of dispersant : 25 parts of oil)

COREXIT-9500 - (JAN 2003)
BG Exploration & Production India Ltd.
1st Floor, Midas Sahar Plaza
Kondivita, MV Road, Andheri (E) Mumbai -400 059
Phone : 022-28395841 Fax : 022-28395201

Challenger-OSD EF III - (Aug 2003)
Challenger Chemicals & Polymers Private Ltd.
PR No. 6917, 3 Balasundaram Lay Out
Siddhanaidu School Raod,
New Siddhanaidu, Coimbatore - 641 044
Phone : 044-2216224 Fax : 0422-2213181

Spilcare-O - (Dec 2004)
Spilcare - O Metaclean Pvt. Ltd
AB-146, 3rd Main Road, Anna Nagar,
Chennai - 600 040
Phone : 044-26200482 Fax : 044-26281457

NOVA CHEMICALS - (JUNE 2005)
Pragji Vrindavan CHS
Room No.50, 4th floor, 20/24 Old Hanuman Lane
Kalbadevi, Mumbai - 400 002. Phone/Fax : 022-56347337

ICG requirements for selection of OSD :

Physical State	:	Flowing clear and homogenous liquid free from suspended solid.
Stability	:	Between 100-90%
Efficiency	:	Above 60% for Type-III Above 50% for Type-II after dilution
Flash Point	:	60°C Minimum
Cloud Point	:	0 to -5°C
Shelf Life	:	5 to 10 years
Validity	:	Should be in possession of valid NIO evaluation certificate
Date of Manufacture	:	Within 3 months of date of supply

APPENDIX 14

(Refers to Para 8.1)

EQUIPMENT DETAILS AND LOCATION

Onboard Spill Response Vessel and OSRO Centre

Sr. No	ITEM	QTY	CAPACITY
1	Fast Response Troilboom GP 750	2200 mtrs	
2	Weir Skimmer – Terminator DOP	2	50 m3
3	Multi Skimmer – DBD 40	2	50 m 3
4	Vacuum Skimmer – Desmi Mini Max	2	30 m 3
5	Floating storage tank	2	10 m3
6	Oil spill dispersant spray	1	
7	Dispersant Type III		10 KL
8	Personal protective Gear	15	
9	Oil Absorbent Kits	2	

APPENDIX 15

(Refers to Para 8.2)

ADDITIONAL EQUIPMENT AND LOCATION

Sr. No.	EQUIPMENT	Qty	Year	Operational Status	Remarks / Location
1	**OIL BOOMS SECTIONS**				
	a. Heavy Duty HDB 1500, **Make:** Lamor, freeboard 20"/ draft 28"	500 Mtr	2007	OK	S/Sevak
	b. Heavy Duty Oil Boom-DH 10Y-2, **Make:** Canadyne, freeboard 18" / draft 24"	500 Mtr.	2006	OK	Hal Anant
	c. Compactable Oil Spill cotainment Boom, **make:** Kepner Plastics Fabricators, freeboard 16" / draft 20"	500 Mtr.	2007	OK	Malviya -36
	d. Sea curtain Compactable, **Make:** Kepner Plastics Fabricators, freeboard 46cm /61 cm	500 Mtr.	300 Mtr - 2003	OK	Seamec-II
2	**SKIMMER UNITS**				
	(a) Type - Brush skimmer unit, Capacity- 3x50.2 CUM/Hr. **Make** Lamor	1	2007	OK	S/Sevak
	(b) Type - Multi disc skimmer, Capacity - 11 CUM / Hr. **Make -** Canadyne	1	2006	OK	Hal-Anant
	(c) Type - Weir skimmer, Capacity - 400 gpm, **Make –** Kepner Plastic	1	2007	OK	Malviya – 36
	(d) Type - Weir skimmer, Capacity - 400 gpm, **Make –** Kepner Plastic	1	2011	OK	Seamec - II
3	**OSD spray unit**				
	a. Anti Pollution Chemical Sprayer, Make Istanbul turkey, Capacity- 60lpm	1	2010	OK	Samudra Seavk
	b. Anti Pollution Chemical Sprayer, Capacity- 80lpm	1	2006	OK	Hal Anant
	c. Anti pollution Chemical Sprayer, Capacity- 68lpm	1	2007	OK	Malviya 36
	d. Anti Pollution Chemical Sprayer , Make Vikoma Intl, Capacity- 150lpm	1	2011	OK	Seamec-II
	e. Anti Pollution Chemical Sprayer, Capacity- 50lpm	1	2010	OK	S/Prabha
4	**Storage tank capacity for recovered oil**				
	245 M^3				S/Sevak
	103 M^3				Hal-Anant
	75 M^3				Malviya - 36
	112 M^3				Seamec - II

APPENDIX 16

(Refers to Para 8.2)

LIST OF ADDITIONAL RESOURCES AND INTERNATIONAL OSROs

1. Australian Marine Oil Spill Centre

PO Box 305
Victoria 3214
Australia
Tel + 61 3 5272 1555 Fax + 61 3 5272 1839
Mail : amose@amosc.com.au Web : http://www.aip.com.au

2. Fast Oil Spill Team

c/o PIM 40 G 23
Tour Elf
92078 Paris- La Defense Cedex
France
Tel : + 33 1 4744 5636 Fax : + 33 1 4744 2677
Mail : giefost@club-internet.fr

3. Oil Spill Response Ltd

Oil Spill Services Centre
Lower William Street Northam
Southampton SOI 1 QE, UK
Tel : + 44 1703 331 551 Fax : + 44 1703 331 972
Mail : osrl@osrl.co.uk Web : http://www.oilsillresponse.com

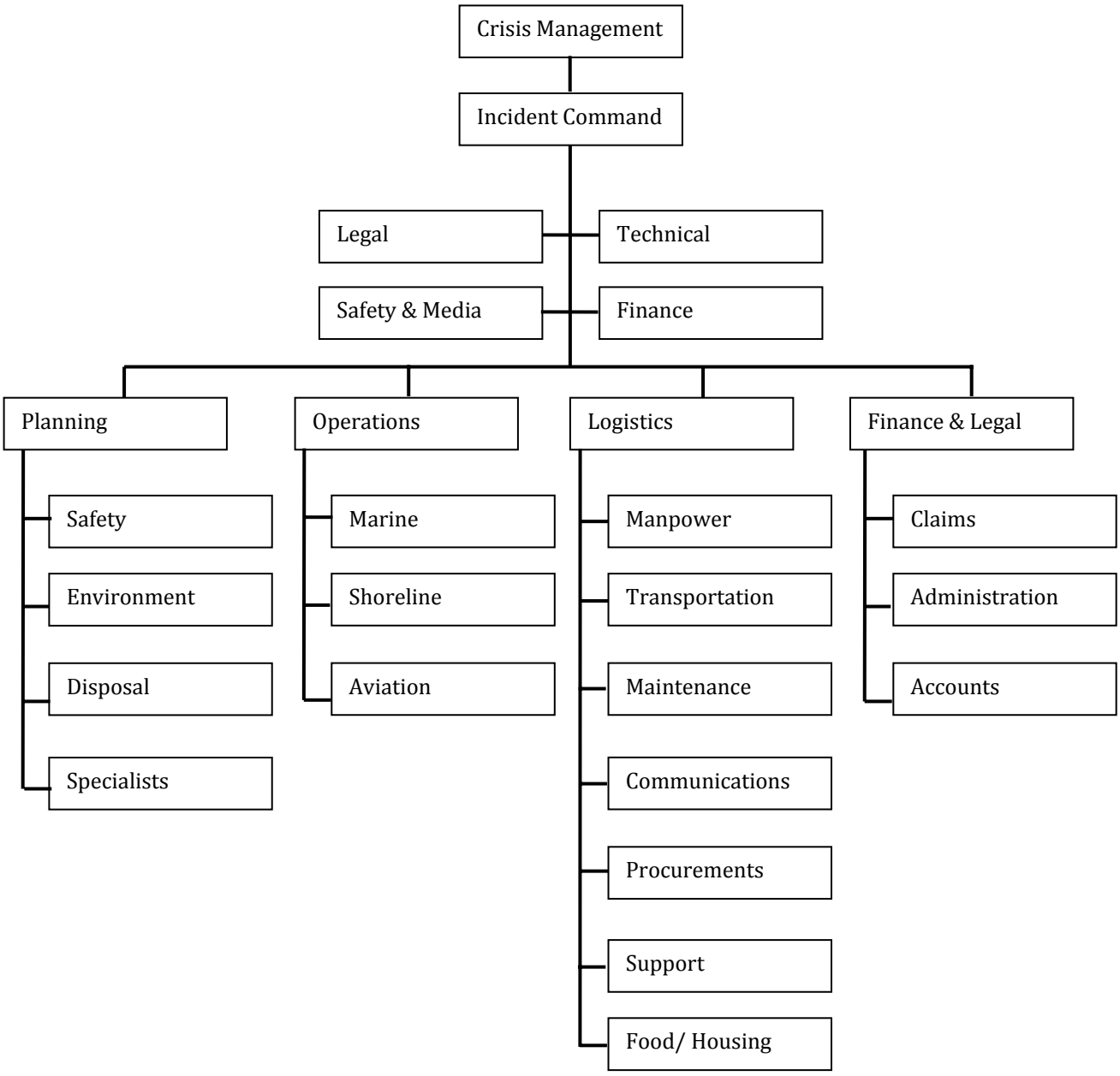
4. Petroleum association of Japan

Oil Spill response Department
Keidanren Building
9-4, 1 – Chome, Ohtemachi
Chiyoda- Ku,
Tokyo 100, Japan
Tel : + 81 3 3279 3819 Fax : + 81 3 3242 5688
Mail : mail@pcs.gr.ip Web : http://www.pcs.gr.ip

APPENDIX 17

(Refers to Para 9.2)

ORGANISATIONAL CHART



APPENDIX18

(Refers to Para 9.2)

COMPOSITION OF CRISIS MANAGEMENT TEAM

1. Mb PT

	DESIGNATION	APPOINTED MEMBER
	Chief Incident Controller(C IC)	Harbour Master
	Incident Controller(IC)/On Scene Commander	Respective operations/ dock /terminal in charge of JD/ PP / Indira Dock
	Member Admin & Finance	Dy Chief Accounts Officer
	Member HSE & Media	Port safety and Fire officer
	Member legal	Secretary
	Member Tech	Additional Chief Mechanical Engineer
	Incident Manager / Manager OSRO	To be appointed by OSRO, in case response being undertaken by OSRO
	OSRO/ Response Specialist	To be appointed by OSRO, in case response being undertaken by OSRO

APPENDIX18 A

(Refers to Para 9.2)

COMPOSITION OF CRISIS MANAGEMENT TEAM

2. JNPT

	DESIGNATION	APPOINTED MEMBER
	Chief Incident Controller(C IC)	Harbour Master
	Incident Controller(IC)/ On Scene Commander	Respective operations/ dock /terminal in charge at Sheva and JNPT berths
	Member Admin & Finance	Manager - Finance
	Member HSE & Media	Dy CMO
	Member legal	Secretary
	Member Tech	Manager-Technical
	Incident Manager / Manager OSRO	To be appointed by OSRO, in case response being undertaken by OSRO
	OSRO/ Response Specialist	To be appointed by OSRO, in case response being undertaken by OSRO

APPENDIX18 B

(Refers to Para 9.2)

COMPOSITION OF CRISIS MANAGEMENT TEAMS

3. ONGC

DESIGNATION	APPOINTED MEMBER
Chief Incident Controller(C IC)	Head HSE
Incident Controller(IC)/ On Scene Commander	Support Manager
Member Admin & Finance	Head - Finance
Member HSE & Media	Manager- Fire and safety ,Medical Officer
Member legal	Secretary
Member Tech	Head- Engineering services
Incident Manager / Manager OSRO	To be appointed by OSRO, in case response being undertaken by OSRO
OSRO/ Response Specialist	To be appointed by OSRO, in case response being undertaken by OSRO

APPENDIX 19

(Refers to Para 9.3.1)

PERSONAL LOG (ALL MEMBSERS OF SPILL RESPONSE ORGANISATION)

Incident Title ----------Number---------- ----(as per)

Date ----------

Name ----------Designation(as per C P)----------

Time of Rx / Forwarding Info	Activity requested by/ demanded of other member/s

Observations on days operations

Note – Copy of Personal Log is to be handed over to COC daily or as earliest as possible on completion of a schedule

APPENDIX 20

(Refers to Para 11.1.1)

IC/ OSC / VESSEL MASTER DAILY LOG

INCIDENT TITLE---------- NUMBER----------

DATE

Incident Severity - Minor/ Major/ Tier I/ Tier II/ Tier III

1. **RESPONSE RESOURCES AVAILABLE**

   VESSEL

   BOAT

   EQUPMENT

2. **ACTION INITIATED**

   CONTAINMENT

   EQPT DEPLOYED

3. **POLLUTANT COLLECTED and disposed**

   Today (Tonnes)

   Total (Tonnes)

4. **Reporting authority (Designation)**

APPENDIX 21

(Refers to Para 11.1.1)

INCIDENT LOG

INCIDENENT INFORMATION

INCIDENT TITLE (Name of Vessel)----------

Incident Number (Sq number/ d d /mm/ y y y y)----------

1.DETAILS

Time of recording …… (24 hr format) Date ……..

Day……

Person / Organisation reporting incident

Name …….. Designation ……..

Contact number ……

2.INCIDENT

Name of VESSEL …… Location ……..……..

Position (if not alongside) Latitude ……..

Longitude ……..……

Sounding……..

Incident details

Time …….. (of incident, 24 hrs format) Date ……..

Cause of spill

Type of oil

Estimated quantity of spill

Details of damage to vessel / installation

3.COMMENTS

1. Recorded by

Name ----------

Time ----------

Note: FOUR COPIES OF INFORMATION ARE TO BE RECORDED. RETAINING ONE FOR OFFICE RECORD, THREE COPIES ARE TO BE CIRCULATED ONE EACH TO -

CHIEF INCIDENT CONTROLER

OSC / RESPONDER/ INCIDENT CONTROLER

VESSEL MASTER

APPENDIX 22

(Refers to Para 11.1.1)

OIL SPILL REPORT FORM

Sl. No	DESCRIPTION	
1	Person	
2	Title	
3	Company	
4	Telephone number (Contact details)	
5	Fax number	
6	Date of spill	
7	Time of spill	
8	Type of oil	
9	Spill location	
10	Quantity	
11	Cause of spill	
12	Response	
13	Any other information	

APPENDIX 22 A

(Refers to Para 11.1.1)

CONTACT DETAILS OF SPILL INFORMATION CENTER

1. The Commander

   Coast Guard Region (West)
   Prabha Devi PO
   Mumbai - 400025
   Tel : 0 - 22 – 2437 9478
   0 – 22 – 2438 5089
   Fax : 0 – 22 24333727

2. The Commander

   Coast Guard Dist HQ 2
   Prabha Devi PO
   Mumbai – 400025
   Tel : 0-22 – 24222696
   Fax : 0 – 22 - 24222696

APPENDIX 23

Refers to Para 11.5)

CONTACT DETAILS OF LOCAL ADMINISTRATIVE AUTHORITIES

1. DISTRICT ADMINISTRATION

OFFICE	*ADDRESS*	*CONTACT*
RAIGAD	District Collector & District Magistrate District Collector's Office At/PO - Alibag District - Raigad Pin - 402 201	OFFICE 02141- 222001 RES 02141-222002 FAX 02141-222025 EPABX 02141-222118 collector_raigad@maharashtra.gov.in
Mumbai Suburban	Office of the Collector Mumbai Suburban District 10th Floor, Administrative Building, Bandra (E) Mumbai - 400 051	OFFICE 022- 26414742, 26556806 FAX (022) 26556805
MUMBAI CITY	Mumbai City Collectorate Old Custom House Fort , Mumbai - 400001.	OFFICE 022-22661231 22662440 FAX 022-22664232 collector.mumbaicity@maharashtra.gov.in mahbom@nic.in
THANE	Collector Office, Court Naka, Thane (West) Pin 400601	OFFICE 022 - 2534 3636 FAX 022 - 2534 9200 collector.thane@maharashtra.gov.in rdc.thane@thane.maharashtra.gov.in

2. FISHERIES

Maharashtra Fisheries Development Council
N.K.M. International House,
178, Backbay Reclamation,
Babubhai M. Chinai Marg,
Mumbai - 400 021.
Tel. / Fax No. : 022 - 22026014 / 20225022
Email - mfdc@rediffmail.com

3. STATE POLLUTION CONTROL BOARD – REGIONAL OFFICES

(i) MUMBAI

Maharashtra Pollution Control Board,
Raikar Chambers, "A" wing, 216, 2nd floor,
Deonar Gaon Road, Near Jain Mandir,
Govandi(E),
Mumbai-400 088
Tel : 022-22640346 Fax : 022-22640345
Mail : romumbai@mpcb.gov.in mpcbmumbai@mpcb.gov.in

(ii) NAVI MUMBAI

Maharashtra Pollution Control Board,
Raigad Bhavan, 7th floor,
Sector - 11, C.B.D Belapur,
Navi Mumbai
Tel : 022- 27572739 Fax : 022- 27571586
Mail : mpcbnavimumbai@mpcb.gov.in

(iii) RAIGAD

Maharashtra Pollution Control Board,
Raigad Bhavan,
6th floor, Sector - 11,
C.B.D Belapur, Navi Mumbai.
Tel : 022-27572620 Fax : 022-27562132
Mail : roraigad@mpcb.gov.in mpcbraigad@mpcb.gov.in

APPENDIX 24

(Refers to Para 11.6)

MEDIA COMMUNICATIONS

The degree of interest from the press in a specific oil pollution incident is unpredictable but normally closely related to the number of other news items at the time of the incident. Experience shows that even quite extensive pollution does not always attract the attention from the media, while minor, rather insignificant pollution can create a media storm when there is little else to report.

The media can be an effective means of ensuring that the public is kept informed of the incident, its effects and what is being done. Therefore, proper attention to the media and providing the correct information is very important.

The responsibilities of First Responders do **not** include dealing with the media. Though, it is advisable to refer all and any questions to the media liaison officer identified through the Contingency Plan, still the response leaders on all levels should be prepared to answer questions from the press because of media's persistence for news.

The lesson to be learned is that - unless otherwise instructed, it should always be remembered that even precise information can be misinterpreted or misunderstood. It is therefore recommended to obtain the name and telephone number of members of the press who have received information in order to verify or correct wrong news stories based on misunderstood information.

The basic questions from the press are likely to be:

- What happened?
- Why did it happen?
- What are the measures being taken by the authorities with respect to the pollution?
- What is being done to prevent such an incident happening again?

How to deal with these approaches is a matter of experience but the following guidelines can be used by First Responders:

- Tell the truth. If there is something you do not know, then say so to avoid getting chased by the press,
- comment only about your area of responsibility and do not speculate on other topics, avoid offering opinions,
- Emphasise the positive points of the operation like outcome of operations, objectives going to be achieved etc,
- Never make assumptions, your information must be verified and solid before released,
- Do not offer a personal opinion,
- Beware of language (e.g. it is better to say that two ships collided than one crashed into the other if it is not clear which was at fault),
- Be polite, patient and never get personal or sarcastic (you will normally be treated in the same way you treat a person and aggressive behaviour from your side can cause you a lot of unnecessary problems),
- Insist that the press observe local safety regulations.