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Oil pollution in Nigerian waters and the need for a national contingency plan

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WORLD MARITIME UNIVERSITY

MALMO, SWEDEN

OIL POLLUTION IN NIGERIAN WATERS AND THE NEED FOR A NATIONAL CONTINGENCY PLAN

by

PIUS ETIM USORO

NIGERIA

A paper submitted to the Faculty of the WORLD MARITIME UNIVERSITY in partial satisfaction of the requirements for the award of a

MASTER OF SCIENCE DEGREE

in

MARITIME SAFETY ADMINISTRATION

(Marine Engineering)

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The contents of this paper reflect my own personal views and are not necessarily endorsed by the UNIVERSITY.

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DEDICATED TO MY GRANDMOTHER

"MADAM JANE KING USORO"

ACKNOWLEDGEMENT:

I sincerely express my profound gratitude to the International Maritime Organisation (IMO) for its tremendous, untiring efforts to establish international co-operation in maritime trade, set safe standard on safety of life at sea and marine environment protection, which has been demonstrated by the establishment of the World Maritime University, first of its kind. Long live IMO! Long live WMU!!

My deepest gratitude also goes to Professor E. Hansen-Tangen, MSA(E) Course Professor and other members of the staff of the World Maritime University, through whose helps this thesis was possible.

I wish to thank my employer, the Nigerian Ports Authority for the supports given to me and the informations abstracted from them, the Federal Ministry of Transport and my sponsor, the Federal Republic of Germany for making this course possible.

Finally, I would like to thank my family and special friends for all their moral supports and for bearing with me throughout my two years stay in Sweden to a successful end.

ABSTRACT:

The purpose of this paper is mainly to highlight the causes of marine pollution by oil on the Nigerian coastal waters which inclusively are deliberate operational discharges from cargo ships and tankers, and the exploitation and exploration of marine and submarine resources for oil and petrochemicals, especially exploitation of the seabed. The situation is worsened by sabotage induced oil spills.

Also to deliberate on ways and means of finding a proper and an effective solution to prevent damages to properties, lives, amenities, and the environment, or at least reduce the effects to the barest minimum.

The formation of contingency plan as a dictated presedent to protect the marine environment. This includes: component of a contingency plan, supporting studies, contingency plan activitation, equipment to be used, the containment and clean up operations.

The paper also takes a serious view of the establishment of a sound pollution policy common to all of the Nigerian coastal waters, backed up with a scientific pollution management approach with the associated legislations and result oriented projects implementation.

General conclusion is that, by establishing well balanced and practical occupational marine pollution policy, with the back ups legislations, scientific management approach and projects implementation, Nigeria serious membership of IMO, full participation in most of the international conventions, the implementation of the international rules and regulations and the updating of the National Maritime Legislation, the Nigerian Marine industries can substitute expensive sophistication by a highly pollution conscious society/staff who will be in a position to use basic pollution rules coupled with common sense to enhance Marine environment pollution prevention. This will ensure pollution free ports, beaches and clean marine environment or at least reduce pollution to the lowest minimum with the subsequent economy advantage for Nigeria.

MAP OF NIGERIA :

CHAPTER I

INTRODUCTION:

1.1 GEOGRAPHY:

Nigeria has unique geographical physical features and is a coastal state which lies almost to the end of the eastern broad sweep of West Africa coastline. It is located between latitudes 4 degrees and 14 degrees North, and longitudes 3 degrees and 15 degrees approximately East. It has an area of about 923.769 thousand square kilometres and a population of 100 million (FAO, 1985). Its greatest length from east to west is over 1,126 km and from north to south 1,046 km. Her neighbours, to the west the Republic of Benin, to the east Republic of Camerouns, to the north the Niger Republic and to the south is the Gulf of Guinea (see map).

The long coastline is characterisedby being relatively straight with few natural indentations. A strong longshore drift along the surf - beaten coast gives rise to the formation of sandbars, blocking entrances to harbours and this necessitates for constant dredging and sand - removing operations (Akin L. Mabogmije 1984). Its other feature is a large river delta which is flanked by a series of barrier islands and mangrove fringed lagoons with a few outlets to the Gulf of Guinea (Annex I)

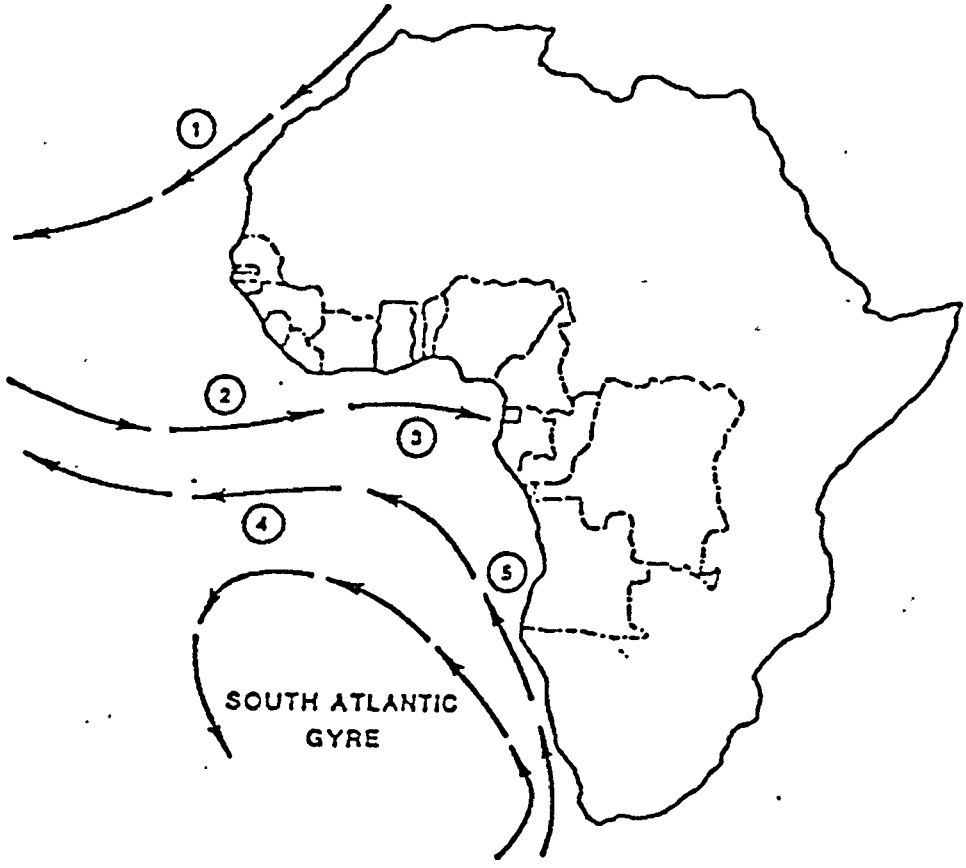
The most important of Nigeria's rivers is the Niger which has its principal tributary, the Benue, at Lokoja about 547 km from the sea. Essentially, two rich zones correspond to the shifting areas of the Northern and Southern sub-tropical fronts (To the north of Cape Verga and to the south of Cape Topez). These two areas enclose the considerably power Gulf of Guinea that is enriched seasonally by local up-welling. Nigeria's ocean space lies in this region of the Gulf of Guinea which is a rich fishing ground. (see figure I) and see Annex II).

1.2 NIGERIA'S OCEAN SPACE:

On the basis of present Nigerian ocean related programmes and policies, the ocean can be divided into separate jurisdictional zones, namely:

FIGURE 1

MAJOR OCEANIC CURRENTS



1 CANARY CURRENT
2 EQUATORIAL COUNTERCURRENT
3 GUINEA CURRENT
4 SOUTH EQUATORIAL CURRENT
5 BENGUELA CURRENT

SOURCE: IMCO/UNEP "The Status of Oil Pollution and Oil Pollution Control in the West and Central Africa Region". UNEP Regional Seas Reports and Studies, No. 4, UNEP 1982.

(see figure 2)

1.2.1 THE TERRITORIAL SEA

This is the segment and area of the ocean space over which Nigeria asserts full sovereign jurisdiction, although some residual international rights, such as the right of innocent passage, are provided in this area.

The Territorial Waters Amendments Act 1971 provides that "the territorial waters of Nigeria for all purposes extend to 30 nautical miles of the coastal waters of Nigeria (measured from low water mark) or of the seaward limits of inland water".

1.2.2 THE CONTIGUOUS ZONE

Articles 33 of the United Nation Convention on law of the sea provides that "In a zone contiguous to its territorial sea, described as the contiguous zone, the coastal state may exercise the control necessary to.

(a) Prevent infringement of its customs, fiscal , immigration or sanitary regulations within its territory of territorial sea.

(b) Punish infringement of the above regulations committed within its territory or territorial sea".

The contiguous zone may be executed up to a distance of 24 nautical miles from the baseline from which the breadth of the territorial sea is measured.

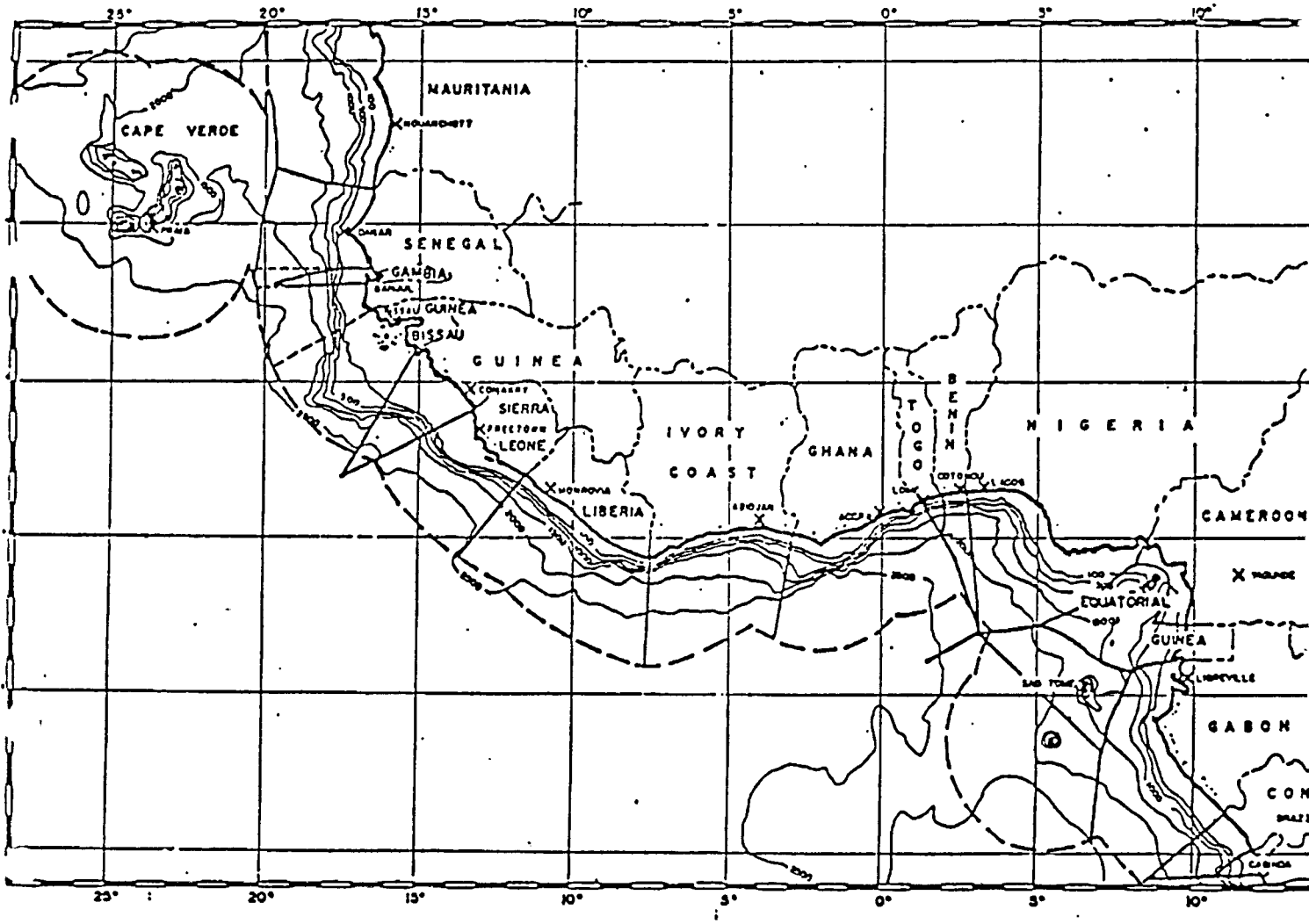
Nigeria's territorial sea thus covers and goes beyond the contiguous zone.

1.2.3 THE EXCLUSIVE ECONOMIC ZONE

The United Nations Convention on the law of the sea grants coastal states the right to establish an exclusive economic zone. This was precisely what the Military Administration of Nigeria did through the instrumentality of "the Exclusive Economic Zone Acts 1979"

Section 1 (1) of the Acts denominated "A zone to be known as the Exclusive Zone, which shall be an area extending from the external limits of the

FIGURE 2 THE 200 MILE ZONES OF WEST AFRICA (based on equidistance)



territorial waters of Nigeria up to a distance of 200 nautical miles from the baseline from which the breadth of the territorial waters of Nigeria is measured"

1.2.4. THE OUTER CONTINENTAL SHELF:

The Petroleum Act 1969 defines Nigeria's continental shelf to mean

Section 14 (1) "the seabed and subsoil of those submarine areas adjacent to the coastal area of Nigeria, the surface of which lies at a depth not greater than 200 metres (or, where its natural resources are capable of exploitation, at any depth) below the surface of the sea, excluding so much of those areas as lie below the territorial waters of Nigeria".

This definition follows the double criteria of geographical configuration and exploitability adopted by the 1958 Geneva Convention to which Nigeria is a party. It does not fix any other limit of the continental shelf. In this approach it differs from the law of the sea convention which in article 76(6) admits the possibility of a continental shelf extending up to 350 nautical miles(Obinna B. Okere, 1982).

With a coastline of 853 kilometres, the total sea area enclosed within Nigeria's Exclusive Economic Zone is approximately 210.9 thousand square kilometres. Comparing with the total land area of approximately 923.8 thousand square kilometres, Nigeria's ocean space is about 23 percents of its land's area.

1.3 VEGETATION IN RELATION TO POLLUTION:

The major centres of crude oil production are around Warri, Port Harcourt and Eket. The natural vegetation of this area is, starting from the coast mangrove forest, fresh water swamp (which is usually flooded), and lowland rain forest. The soils of the area are mainly ferralitic, formed from unconsolidated younger sands with the adjusted sand and clay ratio of the upper 25 cm below 0.25.

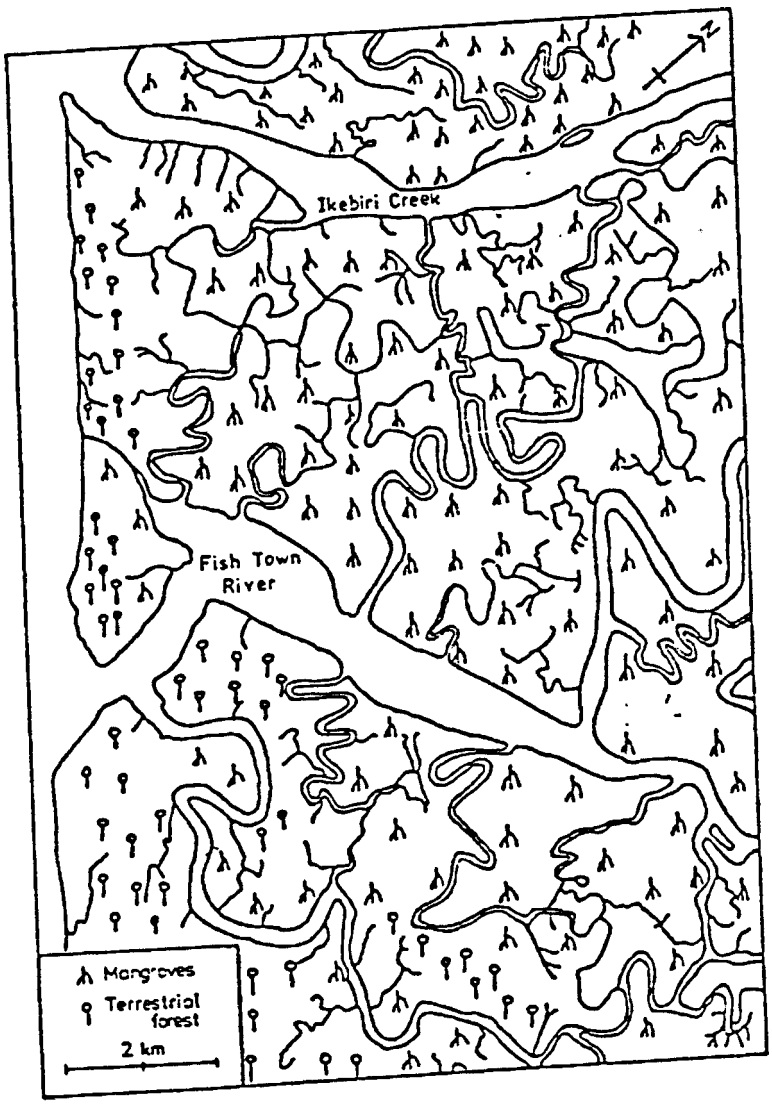


Fig.3, Map illustrating a small part of the Niger Delta mangrove swamps.

The great depth of the soil and its acid nature, due to intensive leaching, favours oil palm growth (see figure 3)

1.4 AGRICULTURE:

Cassava and yam are the major agricultural crops even though vegetable cultivation for urban consumption is prominent.

CHAPTER 2

PORTS, OIL TERMINAL AND REFINERIES

2.1 INTRODUCTION:

The most vulnerable and exposed areas as are seen as threatened by oil pollution are those in which Ports, Oil Terminals and Refineries are situated. This is purely restricting my discussion to some of the most urgent areas of maritime industrial activities which may contribute to oil pollution problem on the coastal waters of Nigeria. The ports and oil terminals are spread almost along the coasts (see figure 4 and 4A).

2.2 PORTS:

The Nigerian main ports are those at Apapa, Tincan Island, Rivers, Calabar and Delta ports.

2.2.1. APAPA PORT COMPLEX:

Apapa Port Complex is the largest and main port of the Federal Republic of Nigeria.

The complex embodies Apapa Quays, Third Apapa Wharf Extension, Apapa Petroleum Wharf, Ijora Wharf, Kirikiri Lighter Terminal, Lily Pond, Inland Container Depot at Ijora, and Atlas Cove Tanker Jetty.

2.2.2. TIN CAN ISLAND PORT:

This new port, is located North-West of Apapa Port. It has a quay length of 2,500 metres and handles about 3 million tonnes of cargo per annum with a total area of 73 hectres.

2.2.3. RIVERS PORTS COMPLEX:

This composes of the Port of Port Harcourt, the crude oil petroleum terminals of Bonny (on/offshore) and Brass. Also Okirika refined petroleum oil jetty.

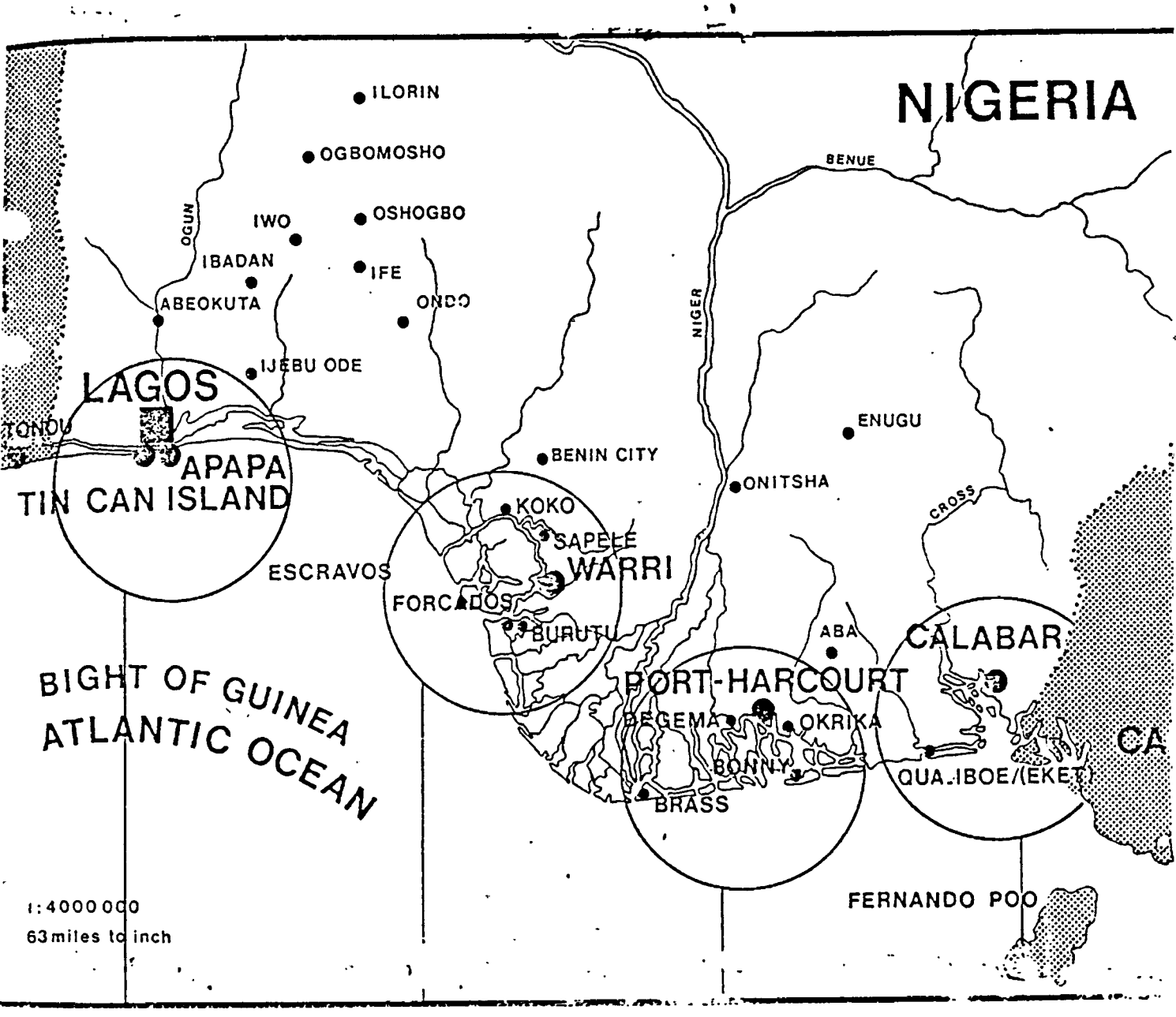


FIGURE 4

SOURCE: Nigerian Ports Authority

FIGURE 4A

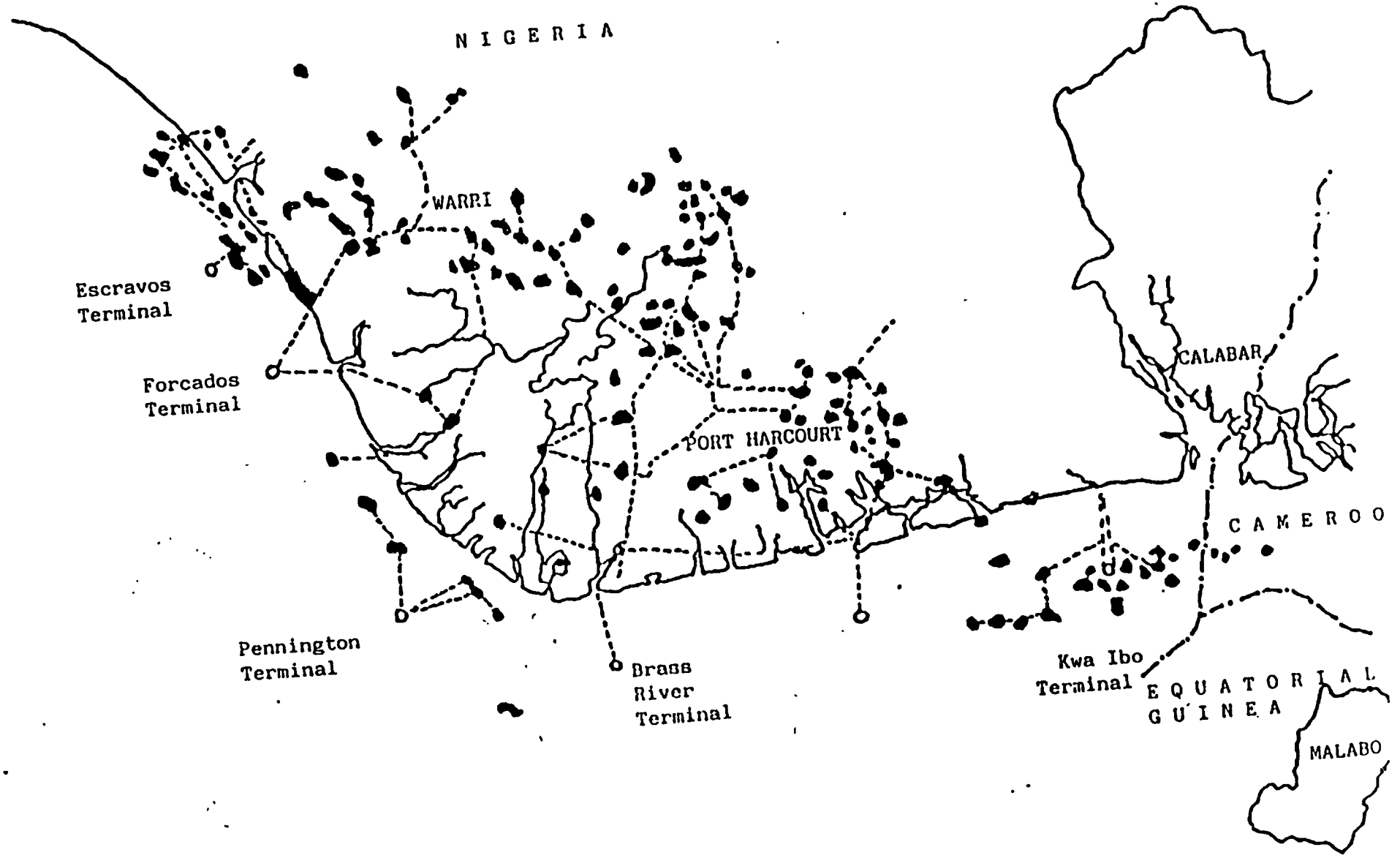


FIG SOUR S OF OIL SPILLS IN NIGERIA

2.2.4 DELTA PORTS COMPLEX

This constitutes the ports of Warri, Aladja Steel Jetty and Crude oil terminals of Escravos, Forcados and Pennington.
The second petroleum oil refinery and the steel reduction plant in Aladja are located in this region.

2.2.5 CALABAR PORT

This lies some 64 kilometres from the fairway buoy and 8 kilometres from the main entrance channel of the Cross River. Maximum draught is 7 metres and the channel is 150 metres wide.
It has a bulk oil installation on lease to shell company Nigeria Limited with a storage capacity of 305 tonnes.
Mobil Oil Nigeria Limited has five bulk oil plants.

2.2.5 QUA-IBOE OIL TERMINAL

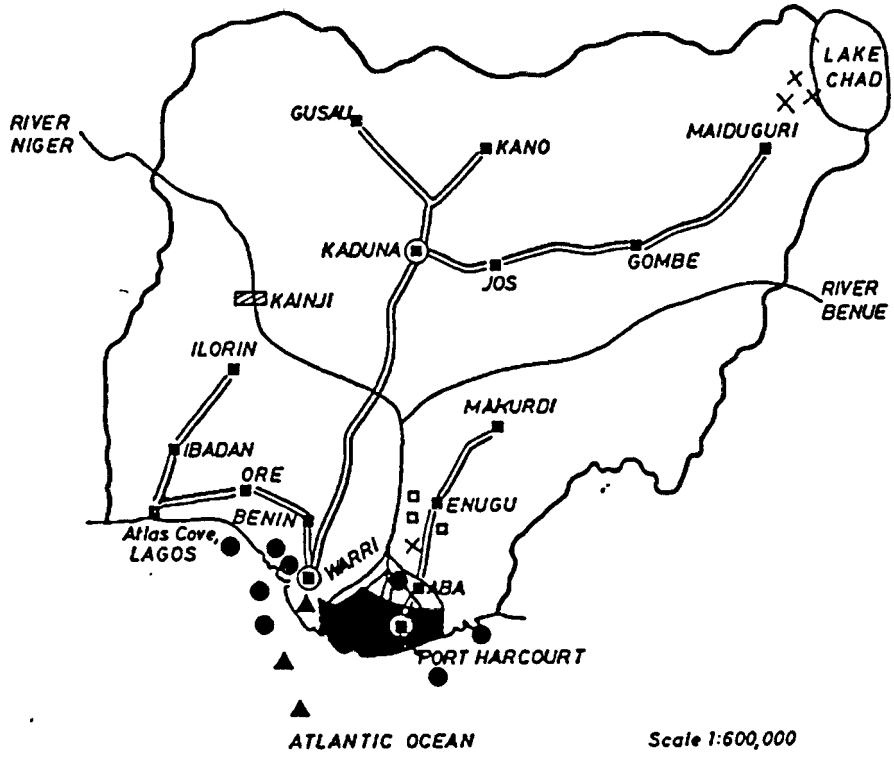
The terminal includes tank farm, pipeline system and loading berth, and is owned by Mobil Oil Producing (Nigeria) Limited; on 24 hours, seven - days week basis.
The crude oil storage facilities consist of seven tanks each of 500,000 barrel capacity.
The tanker loading facilities consist of two berths.
Loading rates vary from 30,000 barrels per hour to 65,000 barrels per hour.

2.3 REFINERIES:

At present Nigeria has three oil refineries (see figure 5), namely: The Port Harcourt Refinery, the Warri Refinery and Kaduna Refinery.
The Port Harcourt refinery, commissioned in 1965, has an on-stream capacity of 60,000 barrels per day of light crude.
The Warri refinery with a capacity of 100,000 light crude oil barrels per day was commissioned in 1978.
The Third refinery, built inland at Kaduna with a capacity of 100,000 barrels per day, started operations in 1980.
The Kaduna refinery is the largest and is capable of using both light basically naphthenic Nigerian crudes and heavier paraffinic crudes

FIGURE 5

SOURCE : O. ODEYEMI & O. A. OGUNSEITAN OPP VOL. 2 NO. 3, 1985



Location of the Nigerian oil and petrochemical industry.

imported from Kuwait, Venezuela and Brazil to produce lubricants, waxes and asphatt. The Kaduna refinery is fed with crude oil through a 600 km pipeline from the delta region oil fields(see figure 5)

CHAPTER 3

POLLUTION

3.1 INTRODUCTION:

Nigerian Coastal Waters are continuously and seriously polluted by various persons, individuals and activities. From the author's experience and limited literatures, a brief details would be given.

3.2. ACTIVITIES IN NIGERIAN COASTAL WATERS AS RELATED TO OIL POLLUTION:

Shell D'arcy, the pioneer oil company in Nigeria started commercial production in 1958 at a rate of 5,100 barrels per day. This quantity doubled in the following year, and 20 years later in January 1979, the rate of crude oil production reached a peak of 2.44 million barrels per day (AMU; 1982). At present, through OPEC agreements, the production has dropped to about 1.5 million barrels per day. The quantity comes from the activities of ten international oil companies working at a total of 122 fields containing over 970 wells(NNPC 1984).

3.2.1. OILS HANDLED IN NIGERIAN'S WATERS:

The total tonnes of crude petroleum shipped at all oil terminals from 1972/73 to 1986 is about 1,220,650,009 tonnes, that is an average of about 406,883,336 tonnes per annum

The total bulk refined petroleum handled at enumerated Nigerian Ports from 1975/76 to 1986 is:

	DISCHARGED	LOADED
TOTAL	40,774,353	22,429,209
PER ANNUM	4,077,435	2,242,921

(see Annexes III & IV)

3.2.2 SHIPS IN NIGERIAN WATERS:

An average of about 3,217 ships have been entering Nigerian Ports/ Terminals yearly. (see Annex V).

3.3 CAUSES OF OIL SPILLS IN NIGERIA:

Oil spills are a natural consequence of petroleum exploitation and are therefore, generally speaking, unavoidable. This is also true for normal oil "drips" during the production process. Further more, the production and transportation of oil involve mechanical processes whose continual efficiency may not be guaranteed. Oil spills are thus a prominent features of petroleum production in Nigeria.

3.3.1. SHIP OPERATIONS:

Operational ships in and around Nigeria waters discharge their bilges and oily wastes into the waters. Also, during their loading and discharging oil operations there are incidents of oil spills. There are, actually no formal records to quantify these. This is due to lack of infrastructure and human incapability by the Ports Authority or the Administration to monitor these activities and impose the necessary punishments and fines on the defaulters.

3.3.2 OTHER CAUSES:

Table I indicates that, in the eight year period between 1976 and 1983, there were 1,360 spills. The most spills were recorded in 1980, though a record high in terms of the quantity spilled, accounting for about 44 percent of the total was reached in 1979. Such spills are the result of various factors. Table 2 provides five broad categories of causes of spills over a three year period

Table 1 The incidence of oil spills in Nigeria, 1976–1983

Year	No. of Spills	Percentage	Quantity (BBls)	Percentage
1976	128	9.4	20,023	1.4
1977	104	7.6	31,144	2.2
1978	154	11.3	97,250	6.8
1979	157	11.5	630,405	44.2
1980	241	17.7	558,053	39.1
1981	233	17.2	22,840	1.6
1982	213	15.7	33,612	2.4
1983	130	9.6	32,467	2.3
Total	1,360	100%	1,425,794	100%

Table 2 The relative contribution of identified major causes of oil spills in Nigeria, 1977–1979

Causes	West		East		Total	
	% of No.	% of Quantity	% of No.	% of Quantity	% of No.	% of Quantity
Corrosion	31.5	16	36	45	35	45
Over-pressure/ Over-flow	24	28	17	4	19	4
Hose Failure	20.5	51	6	46	10	46
Vibration	Not Available	Not Available	8	3	5	3
Sabotage	24	5	33	2	31	2
Total	100	100	100	100	100	100

SOURCE: Sabotage and the Problem Of Oil Spill Management In Nigeria
(C. O. Ikporukpo)

and shows that except for sabotage they resulted from problem in mechanical production processes. Spills due to the corrosion of materials are the most important, accounting for 35 percent of the total. However, in terms of the quantity of oil spills, this cause is only second to hose failure which accounts for 40 percent of the total. This general pattern is reflected in both the eastern and western production centres.

3.3.3. SABOTAGE:

The percentage of the amount of oil spilled by sabotage is only two percent, although in the west it may reach as much as five percent, Nevertheless, sabotage accounts for 31 percent of all spills and is about three times as frequent as hose failure and more than six times as frequent as damages caused by vibration. Table 3 gives a further indication of the importance of sabotage in Nigeria's spills. Worldwide, accidents involving ships (Thanks to God, none yet in Nigeria) is the most important cause of spills. This accounted for 26 percent of the spills recorded in 1983. Corrosion of materials resulting in rupture, second in importance accounted for 23 percent. In countries such as the USA, this is responsible for about 36 percent of oil spills recorded.

Worldwide, sabotage only accounts for three percent of total spills and thus is not terribly important. Only three countries, Nicaragua, Nigeria and the USA recorded spills due to sabotage. The fact that four of the seven sabotage - caused spills were in Nigeria underscores the importance of SABOTAGE in the country. Indeed, in Nigeria, over 33 percent of spills recorded in 1983 were due to this cause. Two plausible but conflicting explanations have been provided for the apparent prominence of sabotage - induced spills in Nigeria.

Table 3 .ternational comparison of number of major spills in 1983 by cause .

Country	Number and (%) of incidents in each country by cause							
	Corrosion/ rupture	Equipment failure	Blow-out/ fire	Collision/grounding/ sinking	Intentional discharge/ human error	Attack	Sabotage/ vandalism	Undetermined
Angola						1(10)		
Australia				1(2)				
Brazil	1(2)		1(3)	1(2)				
Britain	1(2)	5(18)	1(3)	2(4)	2(12)			1(9)
Canada	2(4)	3(11)	1(3)	3(6)	1(6)			
Chile				1(2)				1(9)
China				2(4)				
Columbia		1(3.5)						
Denmark				1(2)				
Egypt			1(3)	3(6)				
France				1(2)	1(6)			1(9)
Greece				1(2)	1(6)			
Hong Kong				2(4)				
India			1(3)	1(2)				
Indonesia	4(8)			1(2)				1(9)
Iran		1(3.5)				5(50)		
Israel	2(4)							
Japan				7(12)	1(6)			
Lebanon						1(10)		
Malagasy				1(2)				
Mexico			1(3)					
Mozambique						1(10)		
Nicaragua			1(3)			1(10)	1(14)	
Nigeria	2(4)	4(14)	1(3)		1(6)		4(57)	
Norway								1(9)
Oman			1(3)					
P. New Guinea			1(3)	1(2)				
Philippines			1(3)					
Qatar			1(3)					
Romania			1(3)					
Singapore			1(3)					
S. Africa			1(3)					
S. Korea						1(10)		
Spain				1(2)				
Sri Lanka				2(4)				1(9)
Trinidad			1(3)					
Turkey			2(6)					
U.S.A.	35(76)	14(50)	1(3)					
Uruguay			11(40)	20(36)	10(58)		2(29)	5(46)
Venezuela			1(3)					
				1(2)				
Total	47(23)	28(14)	31(15)	53(26)	17(8)	10(5)	7(3)	11(6)

SOURCE: Sabotage and the problem of oil spill management in Nigeria

(C . O . Ikporukpo)

One theory is that such attempts are effected for the purpose of making "quick money". Since some form of compensation may accrue to the people of the affected areas, people will make money on the spills. The amount of compensation money paid is sometimes considerable. For instance, in the Forcados incident of July 6 1979 and the January 17, 1980 incident in Apol North (two of the most significant spills to date), the amounts involved were approximately USD 0.55 million and USD 14.4 million respectively. This theory of greed - incited sabotage is the one generally cited by the oil-producing companies.

The second theory is that such spills are a reflection of the general dissatisfaction by people in the oil-producing areas with the oil companies. People regard sabotage as a way of venting their anger.

3.4. CASE HISTORIES OF SOME OIL SPILLS:

Before the turn of the 1960s, there were probably less than 10 major blowout's incidents (Ikeagwuani, 1979). However, the first major reported pollution incident from the Nigerian oil industry occured in July 1970. Shell Bomu - 11 oil well (located in the delta region) which had been productive for 9 years suddenly blew out, impacting an estimated area of 607 hectres of land. The well was located more than 1.6 km from the nearest unhabited building but the area surrounding the location was mainly agricultural land.

The Shell Company at the time recognised the need for an investigation of the effects of the spilled oil on the land and vegetation. Consequently, a five year study project was arranged promptly and financed by the Shell Company, Odu and Udo (1975) reported, as one of their major conclusions, that recovery of the major part of the contaminated area took place after 1½ years. The recovery was aided by ploughing the soils to enhance aeration in favour of hydrocarbon - utilising bacteria and fungi which abound in the soils.

Within the eight-year period between 1976 and 1983 there were 1,360 spills, resulting in a total loss of about 1,337,000 barrels (or 56 million American gallon) to the environment(Awobajo 1981). (The most spill was recorded in 1980, though a record high in terms of the quantity spilled, accounting for about 44 percent of the total was reached in 1979).

About 20% of the number of spills involved incidents concerning more than 100 barrels of oil at a time. The total volume of oil spilled increased by 600% between 1978 and 1980. The majority of the spillages occured in the swamp zones of the Niger Delta, followed by offshore spills which subjected the creek and estuary waters to a large influx of oil slicks during the period.

In cases that involved significant losses of water, like the Forcados terminal incident in 1979 and the Funiwa oil well blowout (1980), chemical dispersants (mostly water and hydrocarbon based detergents) were used in addition to sawdust for surface absorption. In the swamp region, in-accessibility made clearing up and containment by use of floating booms essentially more difficult and over 836 acres of mangrove swamp forest suffered a major devastation. (Ekekwe, 1981).

In all cases, equipment failure accounted for at least 50% of annual oil pollution incidents. This included cases of burst pipelines due to high pressures and or corrosion. Also tank overflows, tanker loading operation, and single buoy mooring spills. The Nigerian National Petroleum Corporation (NNPC) claims that another 30% of total pollution cases were due to sabotage to well heads and flow lines. This is unique and rather alarming factor, considering the fact that there are over 2,839 km of exposed pipelines and flow lines running across all parts of the country (refer to figure 5). The remaining 20% of spills are classified under unknown causes or natural disasters (Awobajo 1981). Most of the spillage incidents occured in the months of May and June, possibly resulting from the heavy rainfall, (usually above 320 cm annually) that characterises this period of the year which may render handling operations less efficient.

During the eight-year period, 43% of the total spillage incidents occured in swamp regions while offshore incidents accounted for 21%. Another 21% was recorded for dry land and 9% for inland water (Awobajo, 1981).

More recently, in February 1984, inhabitants of a densely populated neighbourhood of Lagos city complained of oil-polluted water oozing out of the many bore holes (generally regarded as water wells because of their relatively shallow depth) that supply the neighbourhood with domestic water. It was only after about one month of investigation that the silent source of this pollution was found out. It was discovered that one of the subterranean tanks of the Lagos oil depot at Atlas cove was leaking profusely, probably due to corrosion. The seepage must have been going on for sometime to affect underground waters (Oten, 1981).

A similar case was reported in July 1984 by Kutelu at a creek town called Otujeremi in the suburbs of a Shell Petroleum Development Company oil field (Kutelu, 1984). An oil pipe leakage went undiscovered for about six days, during, which a substantial but yet unestimated quantity of oil was spilled. Serious damage was done to the economic, social and health conditions of the people of Otujeremi. For instance, marine life was paralysed and their cassava plantations became stunted. Absence of treated water forced them to drink from squalid wells which exposed them to all sort of diseases.

The three oil refineries and petrochemical plants in Nigeria continuously produce a large number of various pollutants especially within their effluent wastes. These pollutants from the refineries at Port Harcourt, Warri and Kaduna are usually disposed (after some treatment) into bodies of water, where they may produce detectable odour, taste and colour at very low concentrations. Some pollutants can cause edible fish to acquire an unpleasant taste (Anon, 1970). There are as yet, no exact data on the chemical nature of effluents from the Nigerian refineries. There is a need, therefore, for proper monitoring and treatment of refinery wastes to be discharged into waterways.

3.5 POLLUTION EFFECTS:

The effects that crude oil has on marine system fall broadly into two categories, toxic effects and smothering effects. Toxic effects are generally short lived because they are largely due to volatile or water soluble oil fractions which are rapidly lost from a crude oil slick by evaporation or water currents. The organisms affected are likely to be plankton (i.e green plants of the ocean) or fish eggs or fry which lack the mobility to escape.

Smothering effects are of greatest important when oil is washed ashore. Coastal zones are highly biologically active and few plants or animals can resist a severe coating of oil. The disruption of ecological balance of a coastline by a beach oil-slick may last for considerable periods of time (1-10 years). It is not only beach dwelling animals that are harmed by oil slicks. Fishes. birds mamals, all suffer from oil pollution (see figures 6,7).

3.5.1. AGRICULTURE:

Agriculture practice is usually inhibited by the activities of the oil companies during their exploring and drilling for oil. In Nigeria, the scanty land areas that characterise the delta regions are made unavailable even for normal agriculture. Apart from large spillages, the oil drilling wastes, which include drilling muds and salt water brines pumped out of the wells' crude oil, usually pollute both aquatic and terrestinal ecosystem. When the occasional massive oil spill do occur, affected soils are rendered temporarily sterile as microbial forms are seriously inhibited. Impairment of important soil biochemical processes such as organic matter decomposition, ammonification, nitrification, symbiotic and

Lagos harbor, Nigeria. Photo: R. Hassner/TIOFOTO.

FIGURE 6

FIGURE 7

non -symbiotic nitrogen fixation and the geo-chemical cycling of elements do occur, thereby rendering such soils agriculturally unproductive. Crude oil pollution in the delta region has been found to inhibit germination of seeds of Zea mays and capsicum frutescens. Crude oil also acts as a potent contact herbicide on these two plants and on Abelmoschus esculentus (Amakiri and Onofeghara, 1983).

3.5.2. MANGROVE SWAMPS:

Most of the Nigerian coastline, especially around the Niger Delta is dominated by mangrove swamps. They provide nurseries and feeding grounds for many commercially important species of fish and crustaceans. The stilt roots, lower trunks and mud surface usually support a varied fauna of oysters, snails, barnacles, crabs and invertebrates. The upper part of the mangrove trees are an essentially terrestrial environment with a varied but little known fauna of birds, mamals and insects.

The mangrove swamps are usually subjected to disturbances following blow outs, spills from damaged pipeline, normal ships/Tankers operations and clearing up exercises. Other oil industry activities which affect the mangrove swamps include the cutting of pipeline routes and also gas flaring. An overall impression from the author's experience and limited literature is that the acute short term effects of petroleum hydrocarbons are likely to be high mortalities of invertebrates, defoliation and death of seedlings. In the longer term oil is likely to weather comparatively quickly and both mangrove and invertebrate re-colonization have been observed (Baker, 1982).

Also during the exploratory phase for offshore oil and gas, seismic transects are run in the zones where the probability of finding oil-bearing structures seem high. The use of explosive charges for these surveys results in fish kills. However, this effect is reduced now by the use of more advanced accoustic and sound generating equipment.

3.5.3. HEALTH:

Human habitation of the areas adjacent to oil fields, depots and filling stations may be imperilled by the operations of the oil companies in the country. Funiwa oil well blow-out which occured in January 1980 (involving about 200,000 barrels of crude oil) and other incidents, deprived the inhabitants of the affected areas of access to potable water. It is pertinent to note here that treated pipe-borne water is a scarce commodity in most of these areas and the community, usually including employees of the oil companies, depends on bore holes and flowing streams for their supplies.

The inhabitants were also deprived of their fishing occupation (main source of protein), resulting in a massive displacement of thousands of farmers and fisherman. Medical doctors and dispensers in the area reported a prompt increase in the incidences of viginitis gastroenteritis, conjunctivitis, dermatitis and vulvitis among the people (Anon, 1980).

Apart from some natural portions of petroleum such as lubricating oil, asphalts and waxes which are resistant to microbial degradation, there are hundreds of other synthetic polymers produced from the petrochemical industries that are biologically resistant. Thus, plastic and polyethylene materials litter the streets and highways because they are not readily susceptible to microbial degradation.

The disposal of waste oil is another problem emanating from the Nigerian oil industry. For instance, factories, private workshops and numerous motor service stations all over the country make use of petroleum and petrochemical products. Quite often, their spent oil products are dumped carelessly and indiscriminately. These spent oils accumulate and the pollutions invariably spread through public drains to nearby rivers and streams where they may constitute public health hazards.

3.5.4 SOCIAL PROBLEMS:

The environmental problem seems to be well recognised by people in the oil producing areas of Niger Delta. For instance, in a study the author carried out involving two small communities around the Forcados oil Terminal, 86 percent out of 20 respondents in Odimati reported oil pollution as the most important problem when asked about social problems related to oil exploitation. A corresponding percentage for Ogulagha was 45% out of the 20 respondents.

Also for the people their main means of transportation and communication is the waterways which is also impeded by oil activities. The coastal inhabitants main means of income was large-scale commercial fishing, but now subsistence fishing is gradually replacing this in the areas because of declining productivity due to both faecal and petrochemical pollution. All these are objectional and a nuisance to the people's social life

CHAPTER 4

CONTINGENCY PLAN:

GENERAL:

The density of marine traffic especially oil tankers, in close proximity to the coast and offshore petroleum exploration and production activities presents a fairly high risk of marine pollution from blow outs, collisions, stranding and other marine accidents. Such pollution can threaten amenities, beaches, the tourist industries, sea birds, marine lifes in the inter-tidal zones, coastal installations and the fisheries with subsequent loss of revenue and protein sources.

4.1. SCOPE:

A contingency plan aims at timely and effective response in time of pollution incident to minimize the extent of environmental damages which may occur as a result of such an incident.
The plan must include.

(a) List of persons/organisations that must immediately receive primary report of an oil spill.
(b) List of sequential planned jobs to be carried out during oil spill.
(c) The designation of authority, identification of a chain of command and the assignment of qualified personnel to specific oil spill tasks.
(d) A communication network to assure cordination of efforts and efficient response.
(e) Reference materials, such as sensitivity maps and other technical data that will be useful.

(f) Data of oil movement patterns under a range of climatic and weather conditions.

(g) An inventory of the types and locations of all available oil response equipment.

(h) Training programme.

Summarizing, the purpose of a contingency plan is to identify oil spill, maintain a communication network, equipment and manpower necessary to stop, contain and clean up an oil spill.

4.2 SUPPORTING STUDIES FOR A CONTINGENCY PLAN:

The plan requires completion of a number of studies and surveys within the area covered as well as determination of the equipment, manpower and technical expertise needed to provide rapid response.

A major requirement is to catalogue the important or potentially sensitive physical and biological resources located within and adjacent to the areas where the plan is to be effected.
The studies then should include collection of data pertaining to

(a) Tides, currents and local climatic conditions such as wind pattern which may affect clean up efficiency.

(b) The locations/sites of access roads, recreational reserves, farmland, and /or sensitive areas.

(c) If possible, seasonal occurrence of wildlife resources, such as fish, shellfish, maritime mammals and birds. Also location and type of habitant required by these species.

The studies should not ignore collection of data for prediction of oil types in spills to occur within a given area and the possible physical/mental constraints which may affect the subsequent clean up operations

4.3 CONTINGENCY PLAN ACTIVATION:

The response actions within a contingency plan can be divided into:-

(a) Alerting and Reporting

(b) Evaluation and Mobilization

(c) Clean up and disposal

In a contingency plan activation, the first priority is to immediately report any oil spill to the primary response agency, in this case the ranking employee at the site of incident. The seriousness of the oil spill is evaluated and immediately reported to the responsible persons/organisations designated in the contingency plan. It is pertinent to note, that all oil spills, irrespective of the size must be reported to the responsible organisation who should take immediate necessary actions.

Actions include control, containment and clean up which must be initiated soonest on receiving any oil spill report. The operation as previously mentioned should be under one command of ideally, specially trained oil spill response team, On-scene commander as designated in the contingency plan or appointed by the responsible organisation. Prior to the time of arrival of the clean-up team, interim responsibility of initial containment and counter measure rests with the ranking employee at the site of spill.

Containment of the oil movement is priority counter - measure specified in all contingency plans. During the containment exercise, safety is paramount and much emphasis is on that. Petroleum products are highly inflamable and explosive, so it is important to determine the type of oil in the spill before going into action.

The equipment for the operation should be located through a specific special system as it is in the plan. All equipment must always be mobilized irrespective of the degree and size of the oil spill.

4.4 THE ON - SCENE COMMANDER AND RESPONSE TEAM:

The On - Scene Commander (OSC) must immediately take over responsibility for the co-ordiantion of response action as so designated. The OSC may be a representative of an oil company, a government official, or an independent oil spill clean-up contractor. The OSC is solely responsible for any decision on action taken throughout the clean-up operation. He should liase constantly with the appropriate government agencies to obtain support and to provide progress reports on all aspects of the emergency action.

A fully trained staff known as the response team, whose duties are clearly defined in the contingency plan should be the back up team for the on-scene commander.

The response team, when dealing with any oil spill generally, should include a number of supervisors to oversee specific facets of the operation, a public information officer and numerous work crews. There should also be a team of specialists or experts to advise on legal, financial, logistical and technical matters.

4.5. OIL SPILL CO-OPERATIVES:

When there are several oil companies operating in an area, co-operatives are often formed for the purpose of pooling equipment and personnel training to combat oil spills. The oil companies co-operative, rather than an individual oil company, purchase and maintain equipment and materials for the clean up and disposal exercises. They also sponsor training for this purpose. The oil companies with their administrative and technical expertise can easily through the co-operative develop enormous, effective and financially practical response programme.

4.6. INDEPENDENT OIL SPILL CONTRACTORS:

These independent contractors are valuable allies to the government, oil companies and other industrial organisations dealing with oil spills. They are mostly engaged in towing, marine salvage, and waste recovery activities which portraits their expertise on oil spill operations.

4.7. DETECTION AND TRACKING OF OIL SPILLS:

Detection and monitoring the presence of oil and its movement is really a pre-requisite to the development of oil spill counter - measures for large inland waters and offshore areas as of Nigeria.

Systematic surveillance, prediction and follow up are essential needs to detect and monitor potential oil spills, as they occur and to provide real - timely information and predictions on their movement and behaviour.

Essentially needed equipment in this aspect are airborne remote sensing systems such as infra red ultraviolent sensors supported by ship borne and land based installations (refer to 5.3.1. and 5.3.2).

4.8. COMMUNICATION:

It is established by now that good communication, strict command and cordination functions are of vital important for the deployment of all oil combating resources, as well as for handling operational information and documentation necessary for effective planning and the feed back. This includes ship to ship, ship to aircraft and vice versa communications. International Satelite Communication System is an added advantage to parties establishing a contingency plan. But this system is not fusible to Nigeria at present.

4.9 BASE AND MAINTENANCE FACILITIES:

These facilities are necessary to support oil combating operations. This covers permanent oil combating bases and temporary bases foremergency operations and in addition, the means for transportation of resources to and from the site, as well as repairs, maintenance and supply functions.

4.10 FINAL DISPOSAL:

This exercise can cause a very serious problem, especially in cases of large quantities of badly contaminated oil. Technical and organisational problems are both involved. This requires a thorough studies to focus oil away from sensitive areas, and the disposal to avoid any disruption of the whole clean up operation (refer to 5.6)

4.11 RESOURCES FOR COMBATING SPILLS IN NIGERIA:

At present Nigeria has no national oil spill contingency plan and there is no national legislation solely concerned with environmental protection.

However, the oil industry is required under the provisions of the Petroleum (Drilling and Production) Regulations 1969 to take all necessary pollution preventive measures and in the event of a spill take prompt remedial measures to control and remove the oil.

Accordingly, the individual oil companies operating in the country have prepared their own local contingency plans, produced in accordance with guidelines set out by the Petroleum Inspectorate of Nigerian National Petroleum Corporation (NNPC). The plan is intended to provide a first level response for minor spillages up to 250 barrels. For a second level responseup to 2,500 barrels, 11 oil companies including the NNPC signed an agreements establishing an association known as CLEAN NIGERIAN ASSOCIATES(CNA)

in November 1981. The association provides clean up equipment stock piles at Warri and Port Harcourt, due to their proximity to major producing areas and exploratory activities.

The association contracted Halliburton Nigeria Ltd., a division of the Halliburton company (USA) to procure and maintaine in 24 hour readiness the most advanced oil spill containment and clean up equipment available. The contractor provides trained personnel, and also trains personnel of member companies in the use of clean Nigeria Associate equipment.

4.12 NATIONAL POLLUTION CONTINGENCY PLAN IN NIGERIA:

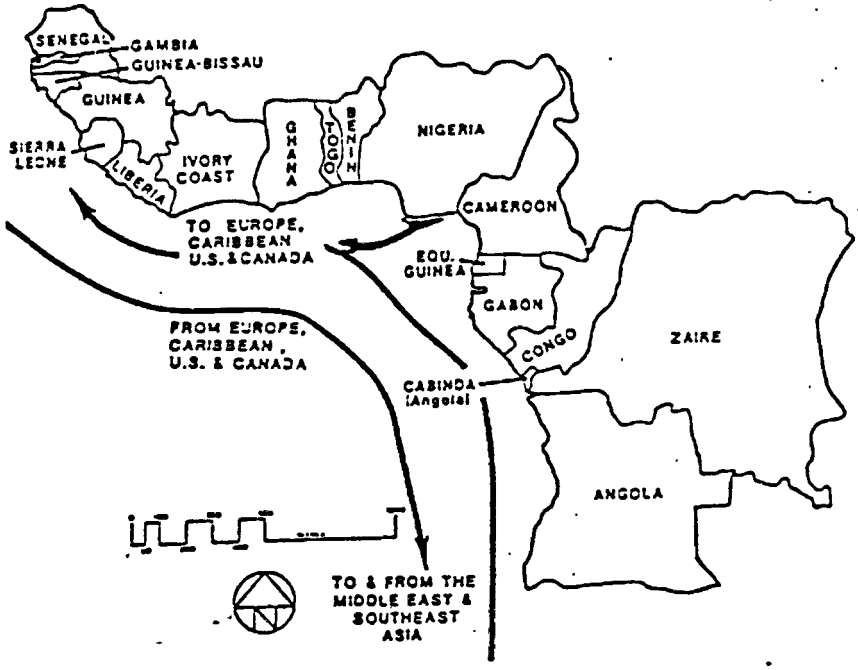
The increase in shipping traffic density, particularly oil tankers, within and near the coasts of Nigeria, the remarkable increase in oil production activities, the increasing number of spills, the ecological and other effects of pollution and the fact that the oil companies association can only handle a maximum spill capacity of 2,500 barrels dictates the necessity for a National Contingency Plan(figures 8 and 9). Further more the currents off coast of Nigeria are generally east flowing and the net movement of oil spill in the most eastern oil fields or main terminals serving them at Qua Iboe would likely affects coasts of Cameroun and Malabo(Equitorial Guinea).

4.12.1 FEDERAL MINISTRY OF TRANSPORT:

The Ministry which is the government arm on Maritime matters, should through its agency, the newly established National Maritime Authority, see to an immediate setting up of a National Contingency Plan. Within its set up, there should be a Permanent Oil Pollution Prevention Committee (POPPC) which should act as the advisory body. Its primary responsibility being to advise the National Maritime Authority on the drafting of the preparation of the contingency plan and the co-ordination of clean up measures.

FIGURE 8

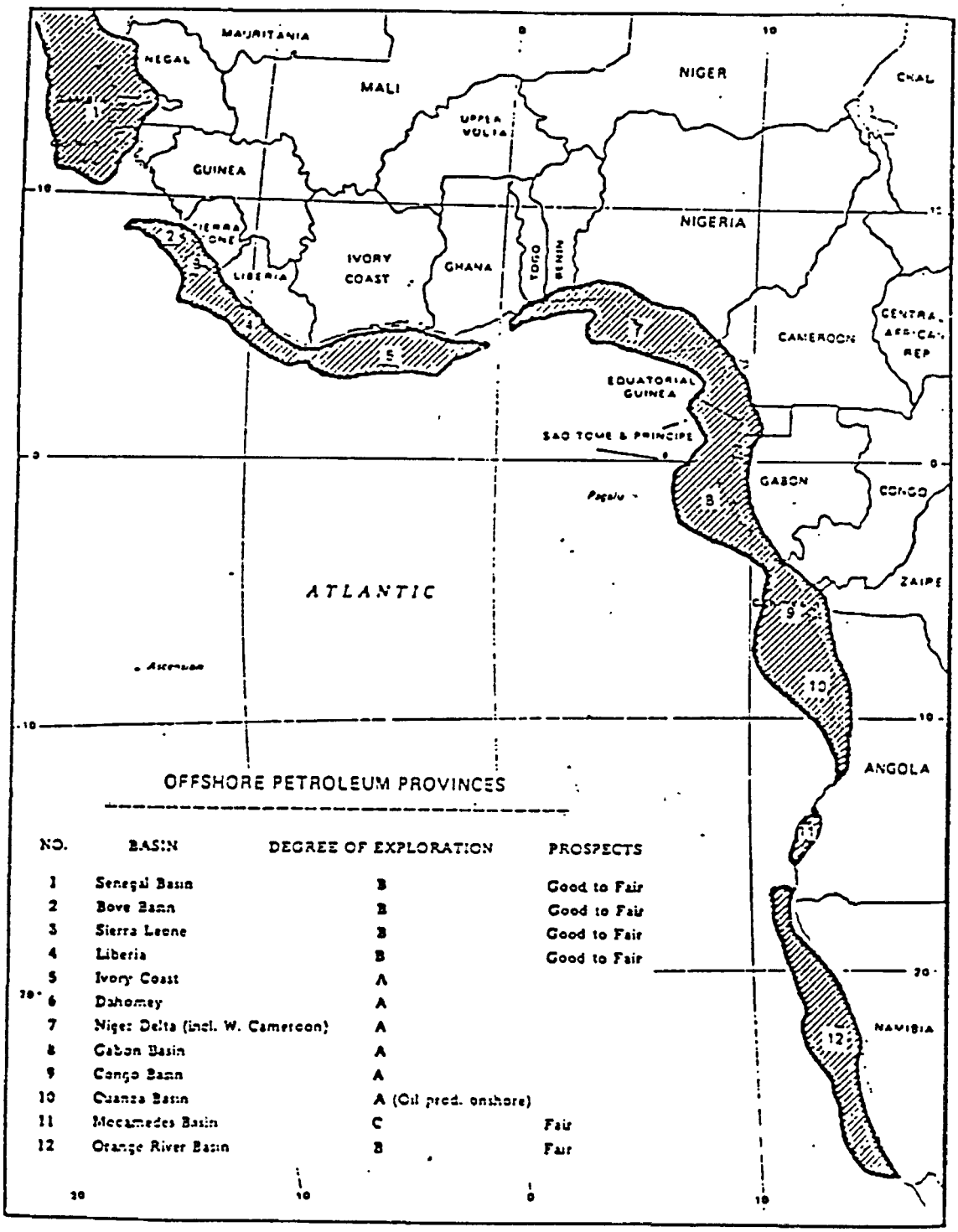
TANKER TRAFFIC THROUGH THE WEST AFRICA REGION



Source: "The Status of Oil Pollution and Oil Pollution Control in the West and Central African Region," UNEP Regional Seas Reports and Studies, No. 4, 1982.

FIGURE 9

OFFSHORE EXPLORATORY ACTIVITY



NO.	BASIN	DEGREE OF EXPLORATION	PROSPECTS
1	Senegal Basin	B	Good to Fair
2	Bove Basin	B	Good to Fair
3	Sierra Leone	B	Good to Fair
4	Liberia	B	Good to Fair
5	Ivory Coast	A	
6	Dahomey	A	
7	Niger Delta (incl. W. Cameroon)	A	
8	Gabon Basin	A	
9	Congo Basin	A	
10	Cuanza Basin	A (Oil prod. onshore)	
11	Mocamedes Basin	C	Fair
12	Orange River Basin	B	Fair

Sources : World Oil, Oil and Gas Journal and The World Energy Conference

There should be a national legislation setting up the committee thus making it legal.

4.12.2 THE PERMANENT OIL POLLUTION PREVENTION COMMITTEE: (POPPC)

This committee should be formed with members drawn from the Nigerian National Petroleum Corporation, Nigerian Ports Authority, Armed Forces, oil companies, Fire Service, Airways, and any Authority or organisation involved in maritime activity.
The committee should have the following advisory responsibilities:

(a) Providing of overall supervision

(b) Providing a co-ordinated and integrated response system amongst all involved or have interests in the marime environment, aiming at the protection ofthe marine environment from the hazardous consequences of oil spills.

(c) Buying, maintaining, and keeping stock - pile of equipment

(d) Provide a system for surveillance and follow ups.

(e) Liase with other agencies and governments for essential helps.

(f) Provide well trained and disciplined personnel needed.

(g) Keep a list of the officials which must be informed of any oil spill incident and the progress of operation as agreed upon.

(h) Maintain a very high public relationship in order to create awareness amongst citizens, casualties/ agencies of its existence at the lead office.

(i) Avail itself of all new developments concerning techniques and equipments on oil spill operation (continuous studies and research works).

4.12.3 COMPOSITION OF THE PLAN AS SUGGESTED: (See Annex VI).

The following organisations and authorities should be contributory to the execution of the plan.

Nigerian Ports Authority
Navy
Police
Airforce
Fire Service
Nigerian Airways
Institute of Oceanography
Maritime Academy of Nigeria
Ministry of Works
Ministry of Trade and Industry
Ministry of Petroleum
Ministry of Environment
Ministry of Justice (for legal matters)

The main body as the government arm in the execution of the plan should be the National Maritime Authority which should also be the lead office for decision making and actions.

4.12.4 AREAS TO BE COVERED BY THE PLAN:

The plan should cover all the sensitive coastal areas including ports, any adjacent areas and high seas, on which oil spill danger is eminent. This in mind, the plan should take this shape.

- Areas of oil activities e.g. oil terminals, pipelines, refineries, oil jetties, ports, rigs, etc.
- Ecologically sensitive areas, such asfisheries, wildlife and other marine resources benefits areas.
- Oceangraphic, meteorological, hydrographic, and geographic areas in order to forcast the effect of environmental factors, such as current and wind on oil spills.

4.12.5 COMMAND CENTRES:

The main command centre should be at Lagos nearer to all involved administrative headquarters.
The other command centres should be at Port Harcourt, Warri and Calabar which are nearer to oil operation activities.
There should also be sub-command centres in all the ports, since they also are involved in oil operation activities, such as discharging, bunkering, etc.

4.12.6. SPILL WARNING SEQUENCE:

The spill warning should be received at the main command centre through

(a) Navy via Ministry of Defence
(b) The Air Force
(c) Civil Aviation (Airways) as informed by aircrafts
(d) Operational petroleum companies
(e) Ports Authority as informed by the National or foreignships and ports/coastal radio stations.
(f) The general public

On receipt of the information, the designated agency (i.e the main command centre) should transmit an initial report as soon as possible to all interested parties according to an agreed alert procedure.
The format of such a report should be included in the plan and contain the following.

- Date and time of observation
- Position (e.g latitude and longitude or stretch of coast)
- Source and cause of the pollution (e.g name and type of vessel, collision or grounding)
- Estimate of amount of oil spilled and likelihood of further spillage.
- Description of oil slicks including direction, length, breadth and appearance.

- Type of oil spilled and its characteristics.
- Action, both taken and intended, to combat pollution and prevent further spillage
- Name and occupation of initial observer and any intermediate reporter and how they can be re-contacted.

It should be made clear that the initial report should not be delayed as long as the first three headings can be satisfied, the remainder being transmitted as soon as available.

4.12.7 ACTION TO BE TAKEN AFTER WARNING:

On receiving the spill warning at the main command centre the following procedure should be carried out.

(a) The seriousness of the spill should be checked and confirmed by all available means (Navy, Air-Force, Civil Aviation plane, ports radios, etc)

(b) Full information concerning the spill to be obtained i.e exact position, source of spill, approximate quantity, weather and sea condition and any useful information.

(c) All command centres must be alerted immediately for necessary action.

(d) The involved authorities and personnel mobilized, ready for the clean up operation.

(e) General public and all those whose activities take them to the area must be notified.

The use of sensitivity maps, technical informations, research studies and other materials should come into play.

4.12.8 RESPONSE DECISION:

The plan should provide forthe various response options to be considered:

- If no key resources are threatened, no response may be necessary beyond monitoring the movement and

behaviour of the slick (e.g such as if the current and wind are blowing the slick into the high sea).

- If key resources are threatened, decide whether their protection is best achieved by combating the oil at a distance or by the use of booms or other measures to defend specific sites.
- If no protection is feasible or if resources have already been affected, decide on the priorities for clean up.
- Select the necessary equipment and manpower required and determine availability and location.

In the plan manpower and equipment should be placed on standby.

4.12.9 COMMAND TEAM CALL LIST:

The main and other command centres must have call lists of their trained and capable personnel. Such teams should composed of

(a) Trained Personnel for transportation system
(b) " " " Communication "
(c) " " " clean up operation
(d) Fire Brigades and salvors.
(e) Marine Scientists.

4.12.10 TRAINING:

There should be a centre for the training and drilling of teams personnel on continuous bases. This will embrace them on modern techniques and research programmes on oil spills, it will also enable them remain fit and action ready all the time

4.12.11 EQUIPMENTS, CHEMICALS AND MATERIALS: (Annexes VII & VIII)

This is an area which must be critically viewed and care taken in choosing the equipment, chemicals and materials, having in mind the costs and effectiveness in application.

The climatic condition, the currents, wind, waves, geographical locations and the vegetations of the sites are some of the factors to be taken into consideration in making the choice.

The most involved equipment and materials in oil pollution contingency plan are booms, skimmers, portable pumps, tanks, shovels, sands, cement, wheel barrels, lorries and trucks, chemicals, etc. Brief descriptions of most of these are given in the subsequent chapter and their applications.

The author thus suggest a lists of equipment, chemicals and materials as considered suitable and conducive to Nigeria condition and environment as per Annexes. This was as a result of researches carried out by Clean Nigeria Associates as initiated by the Nigerian National Petroleum Corporation (NNPC) in 1983.

CHAPTER 5

SPILL CONTAINMENT AND CLEAN -UP PROCEDURE

5.1 GENERAL:

Experience has shown that oil spill incident is very damaging to marine environment and health. Winds and current can move oil slicks through a long distance and larger area in relatively a very short time. It therefore calls for a great value to deal with any oil spill, irrespective of the size. Therefore, the containment/cleaning up operation must be swift and effective.

Clean-up operation depends to large extend on the type of oil spill, thus it is very useful to have knowledge of the type of oil spill prior to the clean-up operation, to enable an effective method to be employed. Clean-up operation can be done by either mechanical means or by using chemicals.

5.2. NIGERIAN OIL TYPE:

Nigerian main crudes are "light and sweet" types with high API gravity and low sulphur contents. However, there are two types of classified crudes coming from the fields, namely Gulf's Escravos oil and shell's Ughelli Quality Control Centre(UOCC) crude oil. On average the elemental composition of the crude is as follows.
carbon = 85.92%; Hydrogen = 12.86%; Oxygen = 0.83%; Nitrogen = 0.07% and sulphur = 0.19% (Oluwole and Nwachukwu, 1984); n - alkanes make up about 57%; aromatics are about 29% and resins andasphaltanes are 14% by weight.
Aromatic sulphur ranges from zero to 0.50%. The sulphur content is below the general world production average of 2.07%(Tissot and Welter, 1978).

There are also the heavier paraffinic crudes imported from Kuwait,

Venezuela and Brazil to produce lubricants, waxes and asphalt.

5.2.1 OIL COMPOSITION:

Petroleum primarily consists ofa closely related series of complex hydrocarbon compounds that range from a light gas (methane) to heavy solid (asphalt). Hydrogen and carbon are the most important and prevalent elements, making up to 98% in some crude oils and 100% in many refined products. Other constituents of petroleum are oxygen, sulphur, nitrogen, vanadium, nickel and mineral salts.

Depending on the source of the crude oil, the products may vary from a light volative fluid to a viscous semi-solid. Refined petroleum products chemical and physical characteristics differ according to the source of the crude oil and subsequent refining process. These products include a variety of gasoline, fuel oils and lubricating oils.

5.2.2 CHARACTERISTIC OF OIL:

The characteristic, physical and chemical properties of the oil types largely determine the thickness and spreading rate of the slick, the formation of emulsions and consequently the most practical clean-up techniques. There is a considerable evidence that the nature of the biological damage resulting from an oil spill is also directly related to the oil type.

Breaking up of oil film and evaporation process are also related to the physical and chemical properties of the oil spilled. The physical and chemical characteristics of oil which affect its behaviour on water and the efficiency of clean-up operations include specific gravity, surface tension, viscosity, pour point, flash point, solubility in water and changes in these parameters with time.

5.3 THE BEHAVIOUR OF OIL ON WATER

The natural events that take place following an oil spill on water include spreading of the oil slick and its gradual weathering, which are influenced by the oil type and the ambient climatic condition (Nigeria has an average annual temperature of about 35°C) The dispersion, spreading of slick, gradual decomposition, and weathering occur simultaneously.

5.3.1. SPREADING OF THE OIL SLICK:

The first observable phenomenon, following an oil spill is the tendency of the oil to spread and form slick over the water surface Studies show that the horizontal spreading of oil over water surface will occur even when winds and water currents are completely absent. This is caused by the force of gravity and the surface tension of water which is generally greater than that of the floating oil mass. As time passes and the slick naturally spreadsinto a thinner layer, the force of gravity has a decreased role in the spreading process. Further slick spreading does not depend on the thickness of the oil film but rather on the difference between the oil and water surface tension forces. Consequently, surface tension is the dominant force influencing oil slick spread, in the absence of external forces, such as winds or currents.

The main forces limiting the spreading process are the viscosity of the oil and the inertia.

As a general rule, the oil slick spreads relatively quickly, immediately, following the spill. During the initial period of spreading, when the force of gravity has an important role, the spreading rate tends to be a function of the volume of spilled oil, with large spills spreading faster than smaller ones.

Spilled oil on water will form thin lens where the inner portions of the slick may be thicker than the edges.

5.3.2 MOVEMENT OF THE OIL SLICK:

In addition to the natural spreading tendency of oil, a slick will move in the same direction and at the same speed as the surface water. Currents and winds are the major factors governing this . To predict this movement, accurate currents and winds data must be available and computed into a computer bank from time to time, ready for use when necessary with data from the meteological centre and the institute of oceanography.

5.3.3 THE PROCESS OF WEATHERING:

Oil, when spilled on water, undergoes a progressive series of changes in physical and chemical properties which in combination is referred to as weathering. The weathering process starts immediately after the oil is spilled, and proceeds at the rates which vary according to the oil type and ambient climatic conditions. Studies reveal that the weathering rates are not constant throughout the duration of an oil spill, but usually high in the first few hours. The process of weathering occurs simultaneously with the spreading and movement of an oil slick.
Major factors contributory to weathering of spilled oil on water are, evaporation, dissolution, oxidation, emulsification and microbial degradation.

The light crudes and fuel oils weather at a much faster rate than heavy crudes or heavy fuel oils which contain a small proportion of light fractions.

5.3.3.1 EVAPORATION:

Through the process of evaporation, certain fractions of the oil are lost to the surrounding atmosphere. The lighter hydrocarbon will evaporate more rapidly than heavier components of the oil. The rate of evaporation primarily depends on the volatility of

various compounds in the oil and is influenced by some factors, such as air and water temperatures, water turbulence, wind and the spreading rate of the slick. The role of evaporation in the weathering of oil decreases with time and the less volatile components will form a residue which may sink due to its specific gravity (more than 1.0). Rough sea increases the rate of evaporation. High wind velocity and warm temperatures also increase evaporation rate.

5.3.3.2 DISSOLUTION:

Through the process of dissolution some components of oil are lost to the large volume of water surrounding the slick. Studies show that the loss of petroleum products from oil slick due to dissolution is low in comparism to the other weathering processes, because the majority of hydrocarbons present in oils have low solubility in water.

Dissolution starts immediately after an oil spill. It is a long term process which continues throughout the duration of the total weathering processes. This is due to the fact that oxidation and microbial degradation produce, constantly, compounds which are water soluble.

5.3.3.3 OXIDATION:

Oxidation is the chemical combination of hydrocarbon with oxygen. The reaction within the process occurs at the oil slick surface. Oil will oxidize more rapidly when it spreads into a thin film. Oxidation is slow in relation to other weathering processes since only a limited amount of oxygen is capable of penetrating the oil slick. The rate of oxidation increases by the presence of mineral salts dissolved in sea water and by some metals present in the oil itself

5.3.3.4 EMULSIFICATION:

Emulsification is the process by which one liquid is dispersed into another liquid in the form of small droplets. In the case of oil, the resulting emulsion can be either oil-in-water or water-in-oil. Emulsification is an important factor in the physical dispersion of the oil in water, and has an important role in both the weathering of oil and its subsequent clean-up operation.

5.3.3.5 BIO-DEGRADATION:

All gaseous, liquid and solid hydrocarbons are attacked by micro-organisms. The rate of bio-degradation is primarily dependent on the temperature of the oil and water mixture. Generally, rate of degradation tends to increase in a direct proportion to temperature.

5.4 THE CONTAINMENT OF OIL SPILL:

Containment of an oil spill is the process of preventing its spread by confining the oil to the area in which it has been discharged. The purpose of containment is to localize the spill and thus minimize pollution, and to facilitate the removal of the oil, by causing it to concentrate in thicker layers on the water surface.

There are various methods and types of equipment employed in this process, and each has its own inherent advantages and disadvantages depending on the conditions under which it is used.

Containment booms are an essential tool in any clean-up programme and are, generally, the first equipment to be mobilized at the scene of a spill and the last to be removed. There are various types of retention barriers, namely:

Commercial floating booms, sorbent barriers,
air or water streams, air or bubble barrier
and chemical barrier.

There are also wide variety of different designs of each major barrier types to suit particular operating conditions.

5.4.1 COMMERCIAL FLOATING BOOMS:

Booms are generally used in one of three ways:

(a) To enclose oil slicks, thus reducing the spreading rate and allowing build up of the oil into a layer of sufficient thickness to facilitate recovery.

(b) To protect specific areas, such as entrances to harbours and regions known or expected to contain biologically important or sensitive resources.

(c) To divert the oil to areas where recovery is possible.

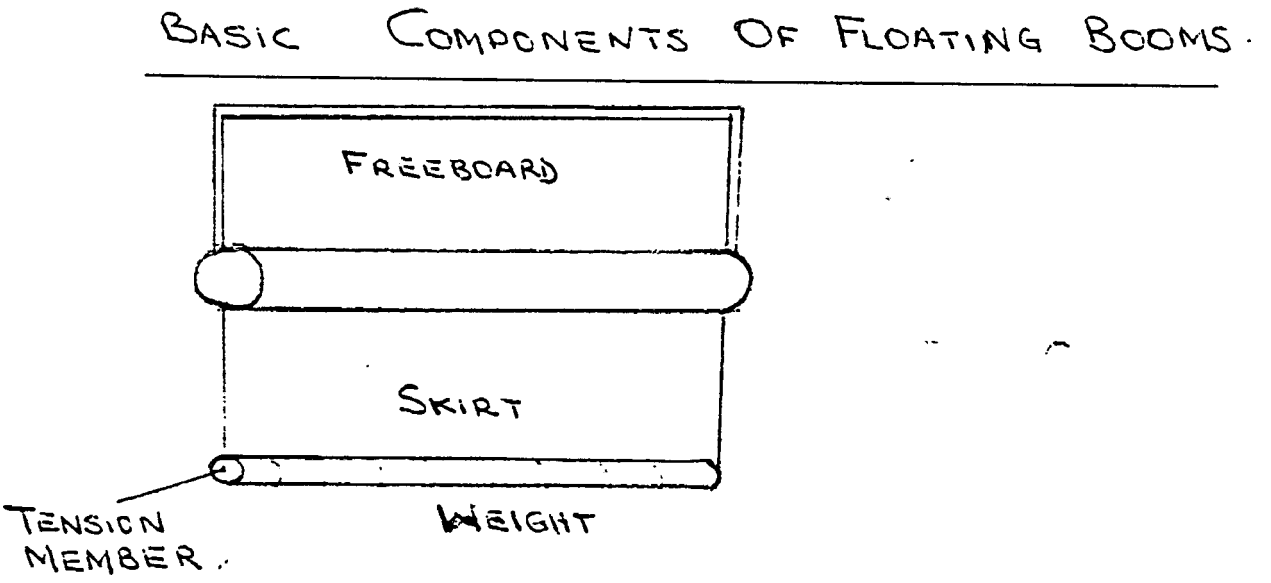
Floating booms resemble a vertical curtain with portions extending above and below the water surface; and all are designed to follow wave motions, so that, the lowest portion never rises above the bottom of the slick, and the uppermost portion never falls below the top of the slick.

The sucess of this principle is highly dependent on the conditions of the area of deployment of the boom.

Commercial floating booms have four basic components, namely, means of floatation, a free board to prevent waves from washing the oil over the top, askirt to prevent oil from being swept underneath and a longitudinal support member to allow the boom to withstand the force of winds, waves and currents (Figure 10)

Some booms have weights to keep the barrier perpendicular to the water surface, the greater the amount of floatation material in a boom, the greater the ability to ride on the surface of wave.

FIGURE 10


BASIC COMPONENTS OF FLOATING BOOMS.
FREEBOARD
SKIRT
TENSION MEMBER
WEIGHT

BENNEX
OIL RECOVERY SYSTEMS

THE NOAS OIL BOOM DESIGN PRINCIPLE

Bottom Tension

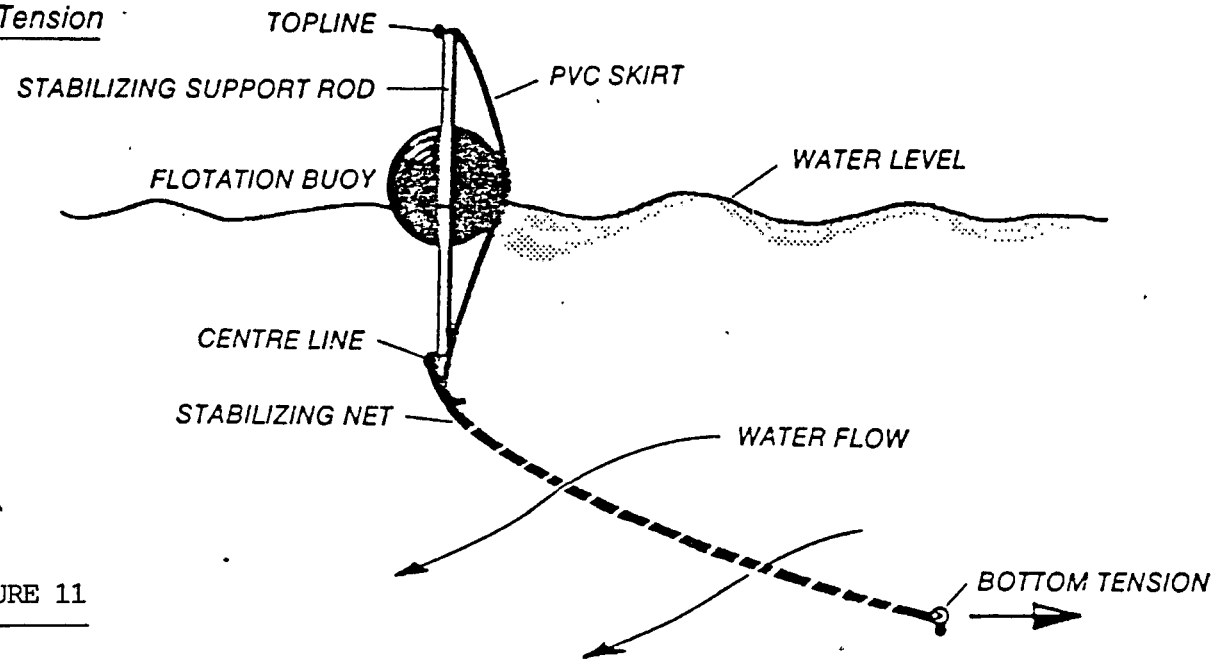


FIGURE 11

Dynamic Response Characteristic

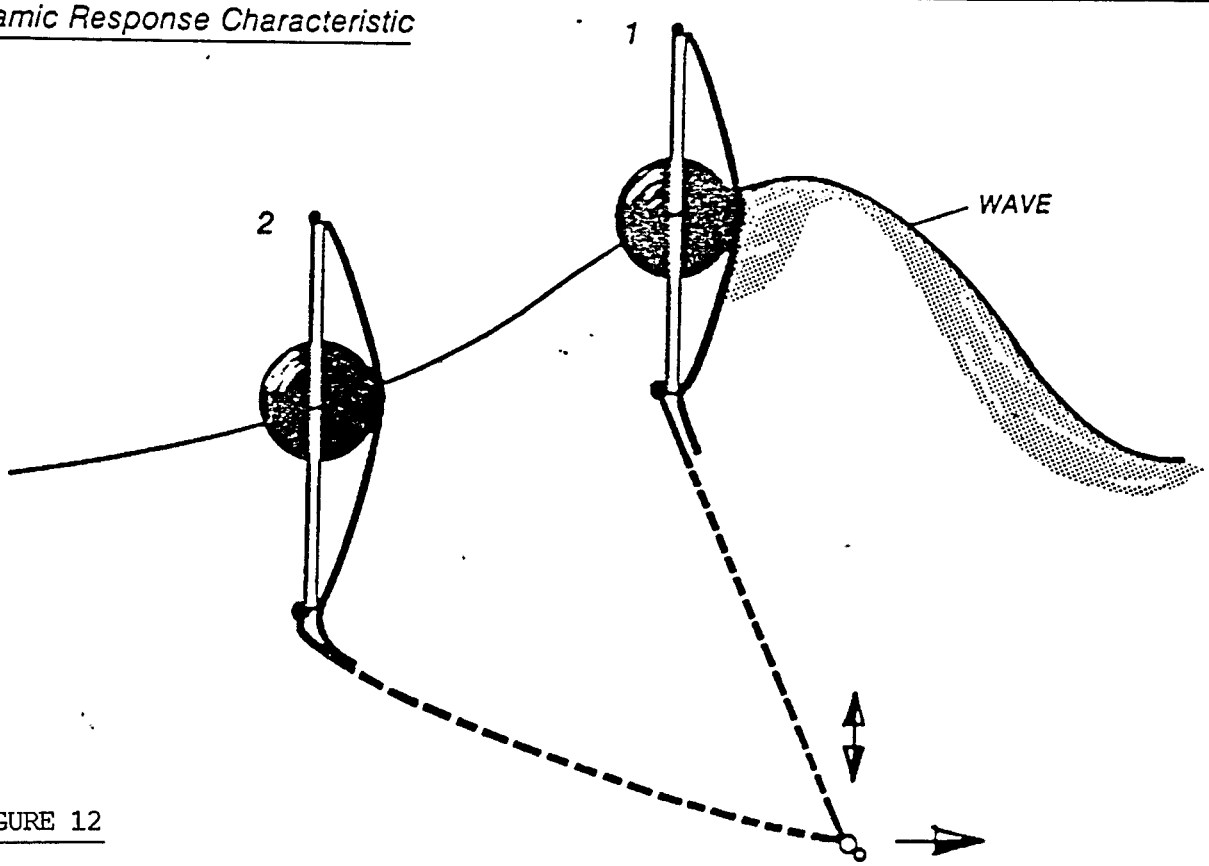


FIGURE 12

The skirt of the boom provides the basic barrier to the spread of oil. The depth of the skirt affects the efficiency of the boom in preventing the escape of oil.

A boom performance is greatly affected by wind, waves and currents. These forces may lead to boom failure and potential loss of oil. The most common type of boom failure is due to the fact that the boom placed in moving water tends to act as a dam. For this reason, a large number of commercial floating booms are designed for use under different current conditions and sea states in different locations (figures 11 and 12). Floating booms are often used to protect areas of shoreline which are biologically sensitive (such as mangrove strands) or recreationally important.

5.4.2 IMPROVISED BOOMS AND BARRIERS:

Improvised booms can be used to contain relatively small spills which occur in sheltered waters or as a temporary measure until more suitable commercial booms have arrived at the spill site. Successful improvised booms can be constructed by inflating fire hoses. The major problem with the improvised booms is that oil can spill over the top or between sections when currents are strong. In some cases, improvised booms are also used in conjunction with the commercial floating booms.

5.4.3. SORBENT BOOMS AND BARRIERS:

Sorbent booms and barriers are specialised containment devices which absorb the moving oil slick in a porous material such as straw or one of many synthetic products. Sorbent booms and barriers are only used when the oil slick is relatively thin since their recovery efficiency decreases once the porous surface is saturated with oil. Booms constructed of sorbent materials require considerable additional support to avoid breakage under the force of water and also require some method of float-

ation to prevent sinking when saturated with oil and water. When removing the boom, care must be taken so that oil is not squeezed back into the water (Figure 13)

5.4.4. AIR OR WATER STREAMS:

Under some circumstances, the force of water stream from a fire hose or a pump can be used to contain or divert an oil slick. A high pressure air flow will produce the same result. Air and water streams are also used to direct oil slick towards the recovery site.

Another use of air and water streams is to adjust the oil booms once they are inplace. The major disadvantages of air and water streams are that they require a considerable skill and co-ordination when used as containment technique. In addition to the emulsion that may be caused by them.

5.4.5 BUBBLE BARRIERS

A rising curtain of bubbles can be produced when air is pumped into a perforated pipe located below the water surface. This rising curtain entrains water which spreads horizontally in the two directions perpendicular to the submerged pipe when it reaches the surface. This method is more suitable in calm water. (Fig.14)

The main disadvantages of such method include very high installation and maintenance costs, high power requirements to produce sufficient currents and problems associated with the redistribution of bottom slick.

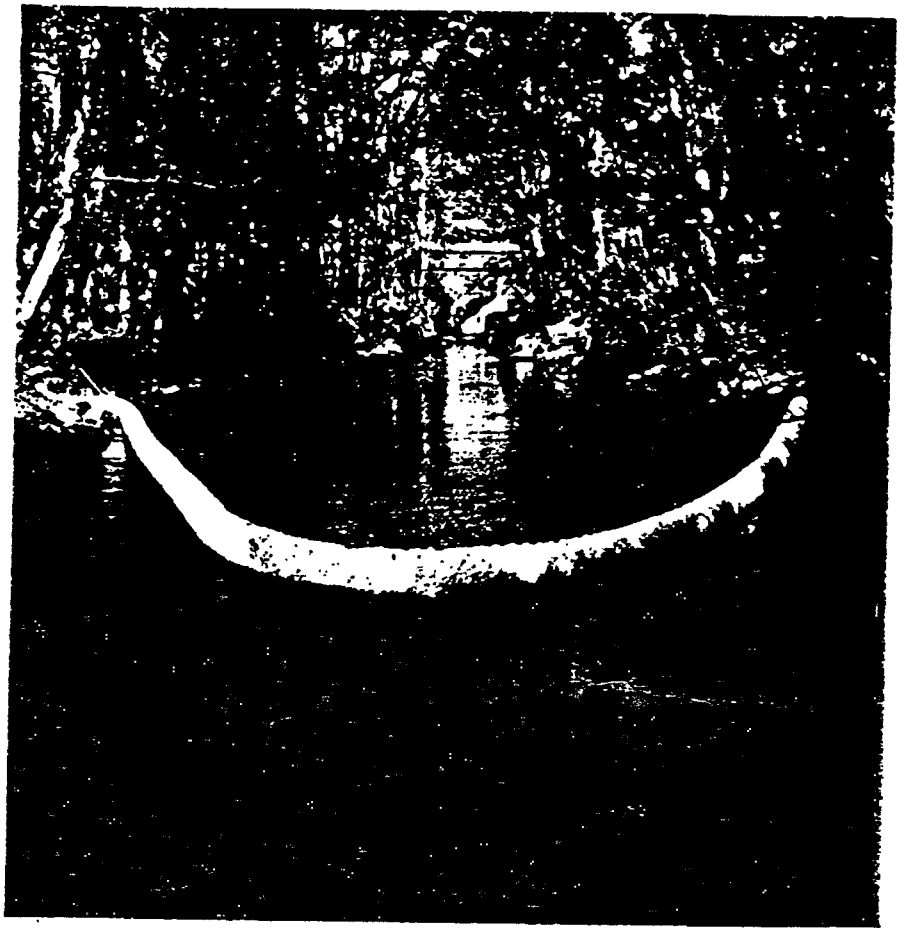


FIGURE 13

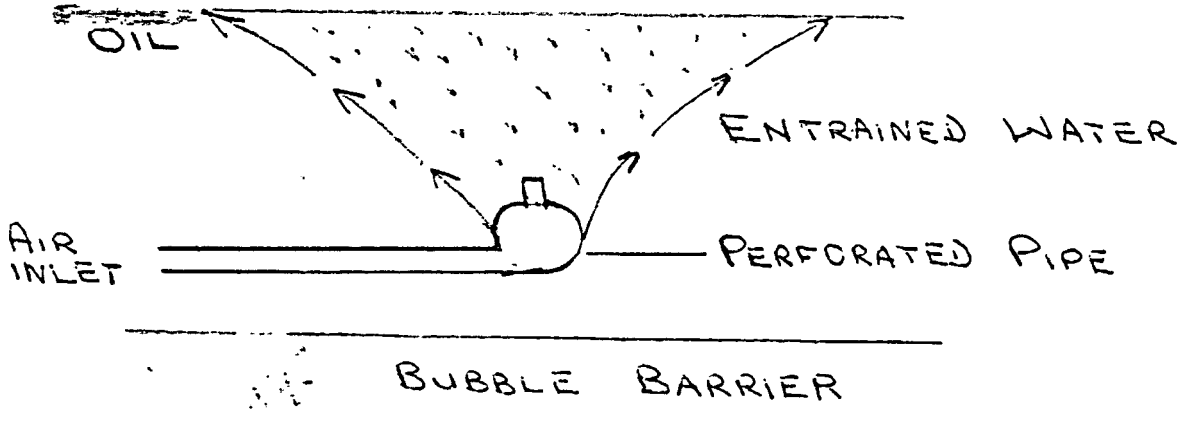


FIGURE 14

5.4.6 CHEMICAL BARRIER:

Certain chemicals act as surface tension modifiers and inhibit the spread of oil. When relatively small quantities of these chemicals are placed on the water surface next to the floating oil, the oil is pushed away as a result of the stronger spreading force of the chemical. In practice, chemical barriers are applied as a spray from a boat or helicopter in such a manner that the slicks to be surrounded are concentrated into thick layers which are easy to recover. Chemical barriers can be used to direct an oil slick to recovery areas. Chemical barriers act only on fresh oils and their effect lasts only a few hours. Therefore, recovery of oil must begin immediately, after the chemicals have been applied. Chemical barriers are less effective with viscous oils, and are generally unsatisfactory in areas where wind, currents or wave actions are significant.

5.5 THE RECOVERY OF OIL SPILLS:

Oil spill recovery is the second step, after containment, in a clean-up operation. In most cases, the containment and recovery phases proceed simultaneously. Oil recovery phase should be carried out as soon as boom are deployed at the site, to take the advantage of the increasing thickness of the slick and to avoid operating in weathered oil in addition to the minimizing of the losses of oil associated with boom failure and/or the decreased efficiency of the containment devices.

There are three approaches to the physical recovery of oil from water, namely: Mechanical skimmers, sorbent and manual removal. In most spills, each of these methods is used to a certain extend as the clean-up operation progresses. Each method has specific limitations depending on the geographical location of oil spill and the ambient climatic conditions.

5.5.1 SKIMMERS:

A skimmer can be defined as any mechanical device, designed to remove oil from the water surface without causing alterations in its physical or chemical properties. There are different kinds of thisdevice, namely. weirtype, suction type, centrifugal type and sorbent surface type.

The effectiveness of any skimmer depends on a number of factors, including the type of oil spilled, the thickness of the slick, the location of the spill the ambient climatic conditions and the current and waves (i.e calmness of the water) at the site of the recovery operation. Most skimmers function satisfactorily when the oil slick is relatively thick. If the oil layer entering the skimmer is very thin, the overall recovery rate and collection efficiency are significantly decreased. Therefore, mostly, skimmers are used in conjunction with containment booms which increase the thickness of the oil slick.

5.5.1.1 WEIR SKIMMER:

This type of skimmer takes advantage of gravity to drain the oil off the water surface. This device, in its simplest form consists of a weir or dam, a holding tank and an attachment which is connected to an external pumping equipment. The top edge of the floating weir is positioned at a certain level with respect to the water surface. The oil (containing water) plunges over the edge and into the holding tank. As oil on the water surface falls over the weir or is forced over by the prevailing currents, it is continuously removed by a pump. (Figure 15).

5.5.1.2 SUCTION SKIMMER:

This type sits on the water surface, uses an external vacuum pump system and is adjusted to float at the oil-water interface. This

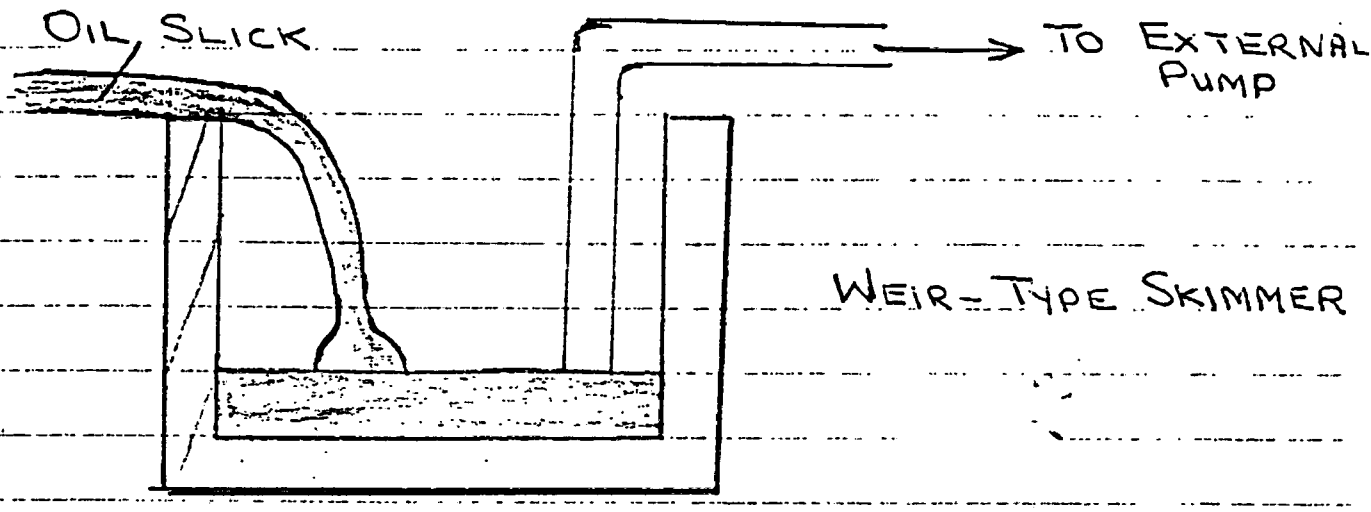


FIGURE 15

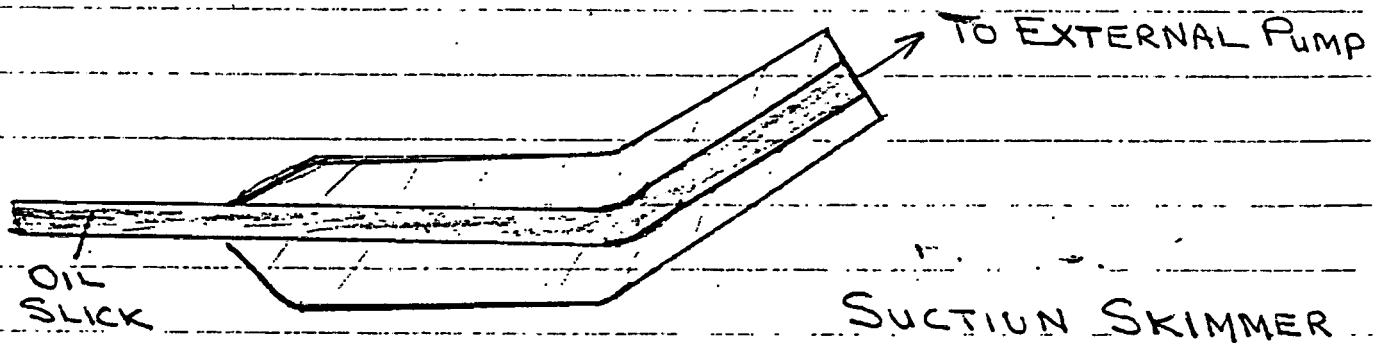


FIGURE 16

type is suitable in shallow waters (such as creeks) due to its compactness. (Figure 16)

The suction skimmer is simple to operate and requires little or no adjustment. It covers a wide range of different viscosity of oils. The overall capacity of most suction skimmers is determined by the size of the hose leading to the vacuum pump as well as the capacity of the pump itself.

5.5.1.3 CENTRIFUGAL SKIMMER:

This skimmer operates by creating a water vortex which draws the oil into a collection area and then, the oil is pumped to an oily water separator (Figure 17)

5.5.1.4. SUBMERSION SKIMMER:

With this type, the oil is forced beneath the water surface.

The belt forces the oil downward towards the mouth of a collection well where it rises to the surface due to its buoyancy. The oil-water collected passes under collection well and out at the discharge port. The oil adhering to the belt is removed by the mechanical scraping device located at the collection well opening or within the well itself. This is pumped to an onboard or adjacent storage facility. This type is effective with low viscosity oils and when the slick is relatively thin (Figure 18)

5.5.1.5 SORBENT SURFACE SKIMMER:

As the name implies, this type incorporates a surface to which oil can adhere to in order to facilitate its recovery from the water. The sorbent surface can be in the form of a drum, disc, belt or rope which is continuously moved through the oil film. Oil collected on the surface is removed by a wiper blade and

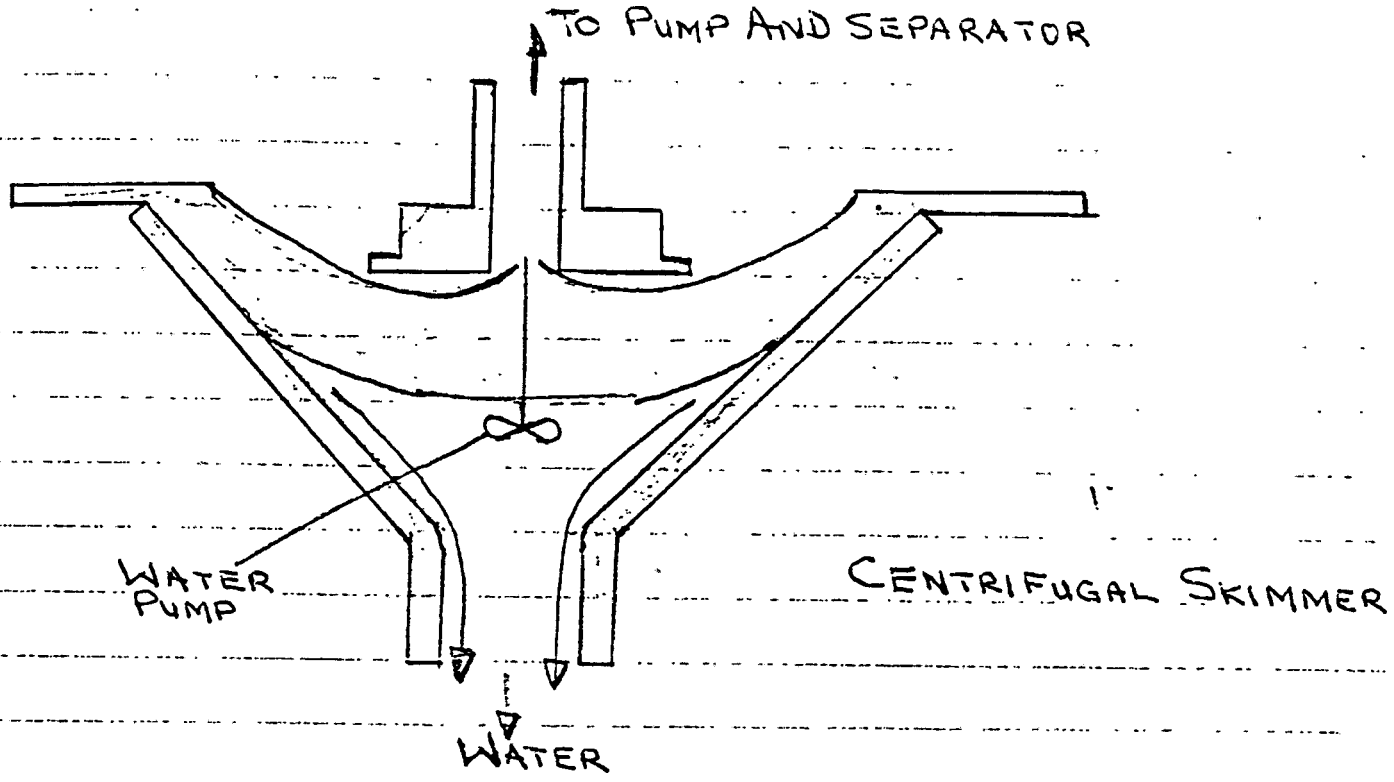


FIGURE 17

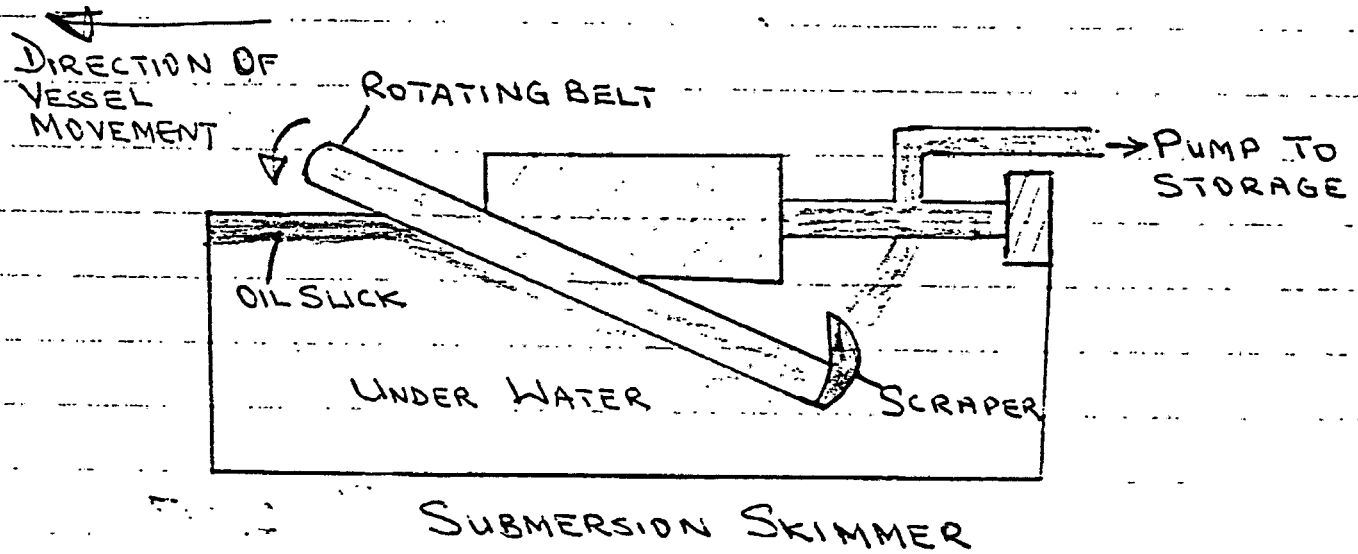


FIGURE 18

deposited into an onboard container (Figure 19 and 19A)

5.5.2 SORBENTS:

Another major approach to oil recovery is the use of sorbents. Sorbents are defined as any material which will recover oil through either absorption or adsorption. Generally, these materials do not play the primary role in oil spill clean-up operation and are most commonly used for final clean-up of traces of oil or to remove oil from areas which are inaccessible to skimmers (such as mangrove stands, swamps, etc). Some sorbents are highly efficient collectors of surface oil, while others tend to release oil during handling and therefore create more clean-up problems. So care must be taken when making a choice. The latter type is obviously not recommended for Nigerian environments.

Type of sorbent:

(a) Natural organic materials - such as straw
(b) mineral - based material - such as pearlite
(c) synthetic organic - such as rubber, polyester foam, etc.

The absorptive capacity of a sorbent material depends on the surface area. The greater the surface area, the higher the absorptive capacity.

5.5.3. MANUAL RECOVERY:

It involves the use of buckets, shovels, rakes and similar equipment. It is a commonly used technique. Care must be taken when employing this technique for it easily destroys vegetation and upsets the marine ecosystem. So it must never be used on mangrove stands and swamps or muddy shore side. It is frequently used on small spills in ports and populated areas.

Viscous oils are readily removed by manual methods more easily

FIGURE 19

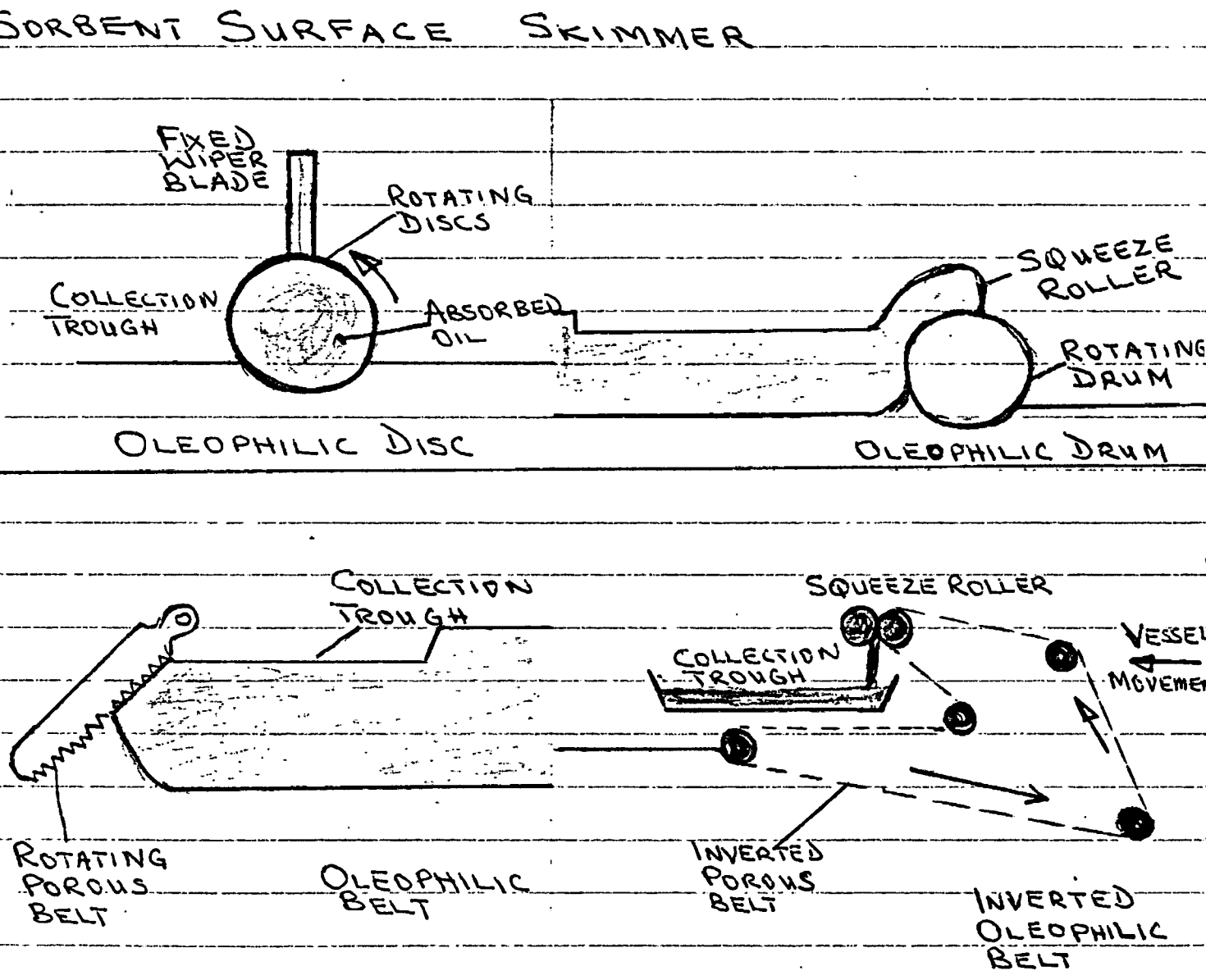
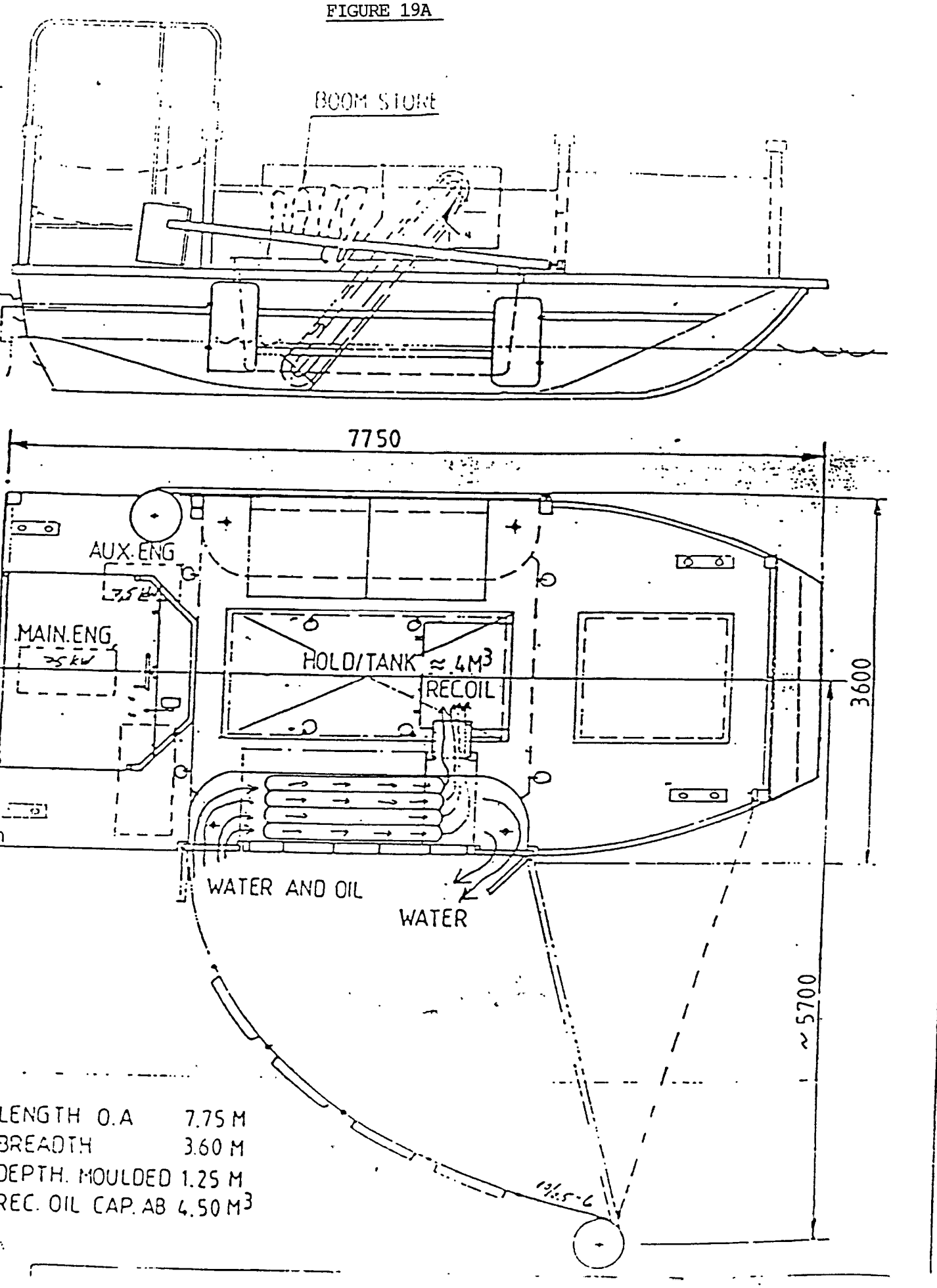

SORBENT SURFACE SKIMMER
FIXED WIPER BLADE
ROTATING DISCS
COLLECTION TROUGH
ABSORBED OIL
SQUEEZE ROLLER
ROTATING DRUM
OLEOPHILIC DISC
OLEOPHILIC DRUM
COLLECTION TROUGH
SQUEEZE ROLLER
COLLECTION TROUGH
VESSEL MOVEMENT
ROTATING POROUS BELT
OLEOPHILIC BELT
INVERTED POROUS BELT
INVERTED OLEOPHILIC BELT

FIGURE 19A


BOOM STORE
7750
AUX. ENG
MAIN. ENG
HOLD/TANK ≈ 4M³
RECOIL
3600
WATER AND OIL
WATER
≈ 5700
LENGTH O.A 7.75 M
BREADTH 3.60 M
DEPTH. MOULDED 1.25 M
REC. OIL CAP. AB 4.50 M³

than lighter oils. Available manpower and disposal facilities are the limiting factors in manual recovery.

It can also cause coastline erosion which will affect the vegetation and agriculture. So its use must be limited to less sensitive areas, such as sandy beach.

Another manual means is the use of portable pumps in creeks not accessible to skimmers. This is a more recommendable method than the earlier since it has no effect on the vegetations and the oils. (figure 20 and 21)

5.6 SEPARATION AND DISPOSAL:

It must be included in the plan means of disposal of oily debris because this is a particularly difficult problem. It would be desirable to plan an excavation of disposal pits close to the shoreline which could be lined with plastic and used as temporary storage until such a time as arrangements could be progressed to transport the oil to a refinery or processing facility (refer to Figure 20 and 21)

Arrangement should be made for reception, storage and disposal of recovered oil or oil in water emulsion. Depending on the type of oil, example, crude, refined or residual, it could be stored, separated and either refined or sold as fuel. With regards to disposal of oiled sand and debris, the high ambient temperature which prevails in Nigeria is conducive forthe use of land farming or sanitary land fill operations as environmentally acceptable disposal methods. However, some preliminary studies would be required to determine whether disposal sites are adjacent to water courses or if there is a danger of oil leaching into the water table or marine environment. Assistance should be obtained from the appropriate officials of the environment, health or agriculture ministries and/or Ministry of Fisheries in the selection of disposal sites close to the shore-line resources. Pre-selection of suitable sites is recommended and essential.

FIGURE 20

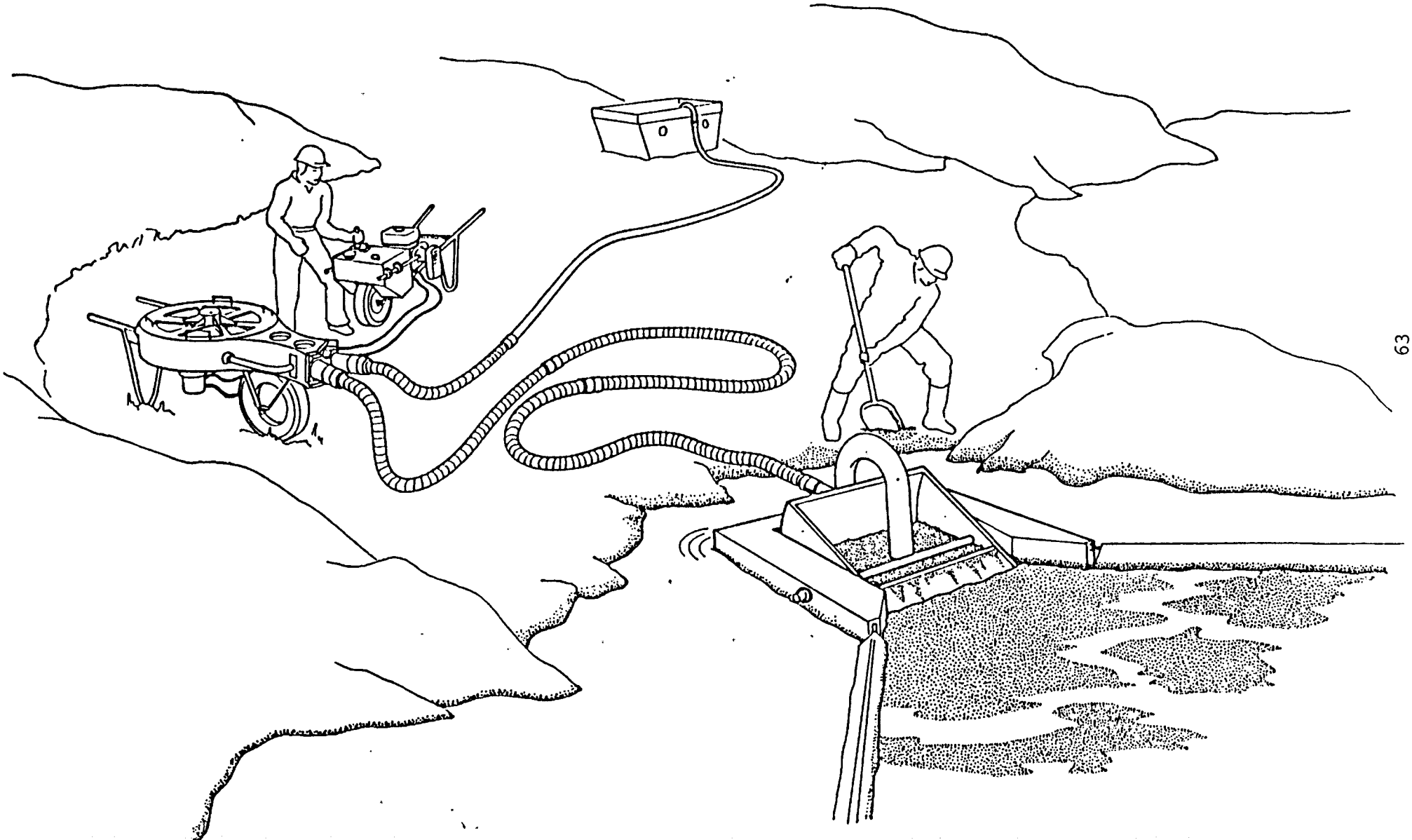
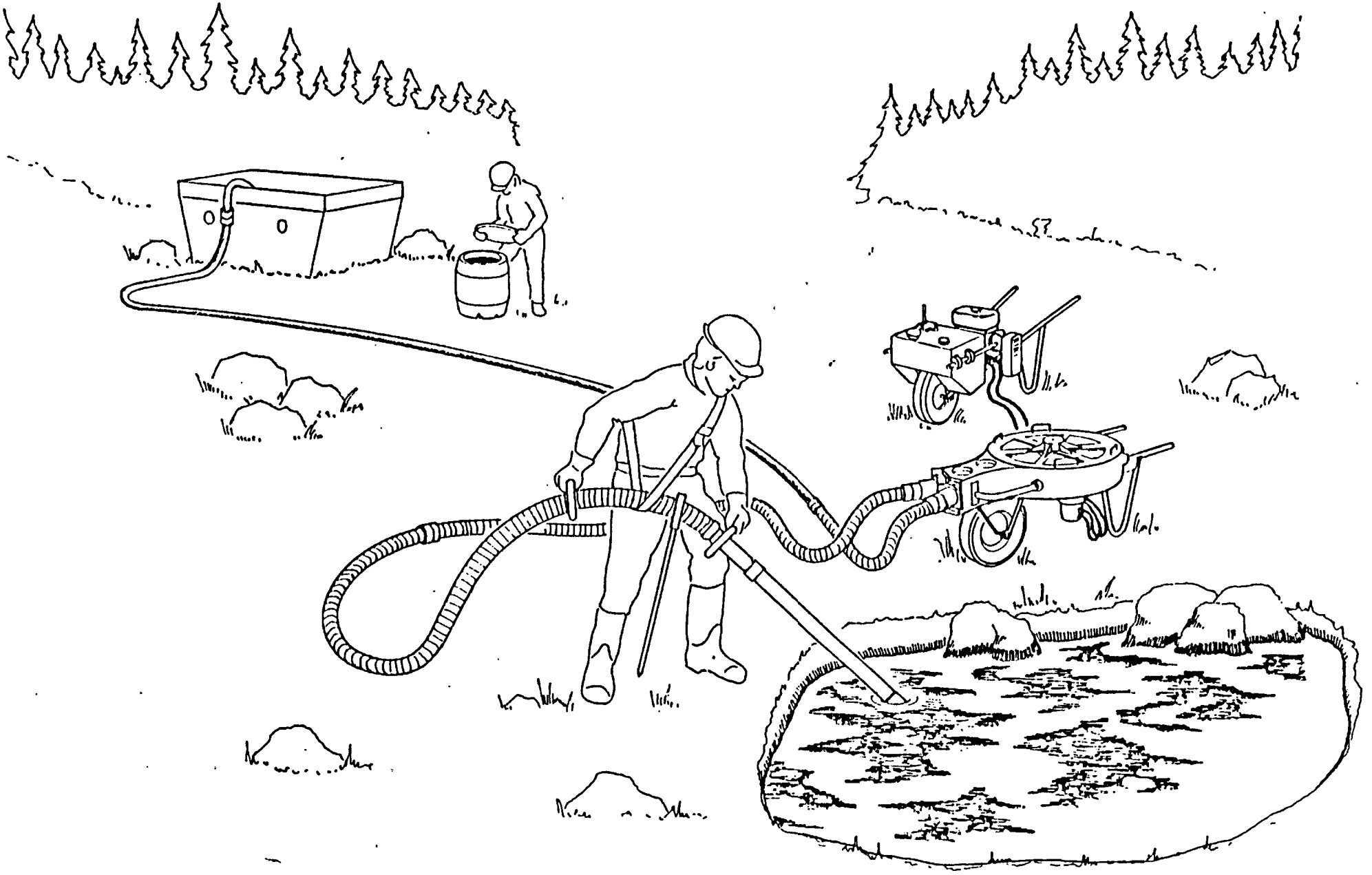


FIGURE 21



5.6.1. METHODS:

Oil recovery processes produce some mixture of oil and water. The oil must be separated from the mixture for disposal or re-use by petroleum industry.

Oil separation devices are often incorporated in skimmers in the form of settling tanks or gravity separators. In skimmers of this type, separated oil is transferred to barrels or temporary holding tanks, until it can be pumped to shore facilities (Figure 19A) The final disposal of the recovered oil is one of the most difficult problems associated with the clean-up operation. Incineration is a method of disposing of recovered oil and it can be done on the water surface or by transporting the recovered oil to another site for disposal.

The main advantages of incineration are its speed and that large quantities of oil can be disposed of at low costs. On the other hand, burning may produce un-acceptable level of air pollution, destroy plants and animals and leave a tarry residue. Additionally, this method kills the micro-organisms necessary for the bio-degradation of any residues. Another disadvantage of this method is that it often requires the addition of burning promoters, such as gaseline, in order to maintain combustion.

Relatively clean oil having a low water content should be transported to oil refineries for subsequent disposal in large commercial incinerators.

5.7. TREATMENT OF SPILLED OIL:

Some chemicals can be added to oil to facilitate its clean-up or removal from the water surface. In many instances chemicals are prohibited (because of the after effects) and may only be considered after all means fail.

Common chemical treatments include dispersants, sinking agents, gelling agents, burning and wicking agents and biological agents. The author would not recommend the last three chemicals because of their effects on the marine ecosystem. They kill the necessary planktons around the areas of their usage.

5.7.1. DISPERSANTS:

Dispersants contain chemicals which reduce the surface tension between oil and water and therefore resulting in the break-up and dispersal of the oil slick throughout the water in the form of oil-in water emulsion. As mentioned earlier, oil will disperse naturally as it spreads and weathers, chemical dispersants accelerate this process. Dispersants also prevent oil from adhering to solid surfaces, such as piers.

A variety of equipment such as spray applicators and portable pumps may be used to apply dispersant to the oil slick. The advantages of dispersant includes, less fire hazard, less contamination of beaches and solid surfaces.

5.7.2. SINKING AGENTS:

Special materials can be spread on the oil slick and the oil will be absorbed to their surfaces. The combination of oil and the sinking agents is heavier than water and therefore sinks. Sinking agents include treated sands, cement, silicon - treated material, chalk and special type of clay.

5.8. RESTORATION OF THE SPILL SITE:

The plan should include the restoration of the spill site to pre-spill conditions. This restoration will be determined by the regulatory agency(The National Maritime Authority) and the on -

scene co-ordinator involved.

Some examples of restoration are:

1 Replacing contaminated sand on beaches, sod along stream banks, saturated soils.
2. Restoring of agricultural land.
3. Restoring of lakes or streams
4. Removal of contaminated debris.
5. Replanting mangrove stands etc.

5.9. RECORD KEEPING AND PREPARATION OF CLAIMS:

In order that claims may be processed with minimal delays, it is essential that accurate records be maintained to support such claims. This claims should be based on expenses actually incurred which were made as a direct result of an incident and that the expenses incurred were reasonable. In the case of economic loss documentation supporting the claim should show how the claim has been calculated or evaluated. The claims follow this pattern:

1. Cost of prevention and clean-up of pollution
2. Replacement and repair costs
3. Economic loss.

CHAPTER 6

VALUE OF POLICY AND THE NEED FOR SCIENTIFIC MANAGEMENT

6.1. POLLUTION POLICY:

Pollution control could be economically enhanced through the establishment of a practical and well balanced pollution policy to back up the efforts to reduce marine pollution in Nigerian waters to the lowest acceptable level. In this light, this chapter considers the formation of such a policy based on national and international considerations.

At this point, the author wishes to say that , this paper is not intended to degrade the pollution efforts of the Administration (the government), but it is hoped that its contents will assist in establishing a sound marine pollution policy, in order to achieve a more efficient and productive maritime industries. It is sad to note, that Nigeria has not ratified the 1973/78 Marpol Convention of the International Maritime Organisation (IMO), a specialised agency of the United Nation, responsible for Maritime Safety and environmental protection. However, this shall be discussed latter.

6.2. THE OIL POLLUTION MANAGEMENT PROBLEM IN NIGERIA:

The general strategies for the management of oil pollution in Nigeria may be identified. These are the legislative and project implementation approaches. The first approach is more or less preventive, while the latter is curative.

6.2.1 LEGAL REQUIREMENTS:

To understand the legal requirements which necessitate the establishment of pollution policy, it is pertinent to mention the government legal obligation regarding safety, health and the environments. This can be complex and difficult to understand or explain, particularly in relation to the nature and extent of any liability for marine pollution, its obligation to provide clean environments and the associated duties and rights of pollution and safety inspectors.

In any society, the laws and its associated legislations encompass a dual function. These functions, the protection of the society the individual within the society are best comprehend taking into consideration how the particular society functions.

Marine Pollution: The author wishes to point out again that marine pollution can cause serious environmental damage as well as damage to ocean and amenties. It is also very emotional problem which does not always respond well to legal solutions. So considering its legal obligation to the society and the individual within the society, the government must seriously look into this matter.

Compensation: In order to obtain adequate compensation for damage caused by marine pollution, someone must be found liable. The problems that arise in this regard are common to other legal questions. First it has to be shown that damage occured and the damage must be quantified. Here it is a question of where to draw the line about indirect damage such as to the tourist industry, when beaches are closed, when ports are shut down and cannot generate revenue, losses to subsistence fishing, etc. Secondly, liability of the party that caused the pollution must be proven.

As the general legal principle which are used in relation to other marine damage liability and compensation are not considered

acceptable for marine pollution, a special legal regime must be developed. Strict liabiliy, with very limited exemptions, is the standard to be adopted for marine oil pollution. The strict liability is to act as deterence rather than punitive measure. However a ceiling must be placed on the liability imposed related to the tonnage of the vessel, which allows for effective insurability.

The goal of preventing marine pollution is being tackled on many fronts. IMO has introduced construction standards for ships and equiment. These are in addition to standards set by classification societies. IMO has also put forward guidelines for operational rules and procedures, in particular, standards of training marine manpower, as laid down principally in the STCW convention. There are also numerous international rules and regulations designed to further prevent marine pollution(refer to 6.5.1).

In addition five international compensation schemes have been developed since the Torry Canyon disaster in 1969, namely:

1) CLC 1969 by IMO
2) FUND 1971 by IMO
3) TOVALOP 1969 by the international tanker industey.
4) CRISTAL by the international oil industry.
5) PLATO is a product of the oil industry influence on the tanker market.

So when preparing any national legislation on marine pollution, all these points should be explored and exploited and included in the status.

6.2.1.1 REGULATIONS ON OIL POLLUTION IN NIGERIA:

The most note worthy law dealing with oil pollution is the law dealing with sabotage-caused spill under the criminal Decree of 1975. (It is in miscellaneous provision). The decree stipulates that anyone who willfully and unlawfully removes, damages or destroys an oil pipeline or any oil installation will, on conviction pays a fine twice the value of the property or the value of the oil that was spilled or 2,000 naira (USD 2,400) depending on which is highest. Alternatively, the individual may either be sentanced to ten years imprisonment or be imprisoned and pays the fine at the same time. The decree also deals with cases of willful and unlawful prevention or destruction of the flow of oil in pipelines and interference with any installation connected with the flow of oil. In such cases, the penalty is less stiff. The fine is only 500 naira, while the term of imprisonment is three years. The penalties may be imposed simultaneously.

There are several other laws which are directed at the oil producing companies. The most fundamental of these is the "oil in navigable waters" decree of 1968 and the petroleum decree of 1969. The laws are severely limited in their effectiveness. Apparently, there is also unwillingness on the part of the government to enforce the laws or perhaps the government is not capable of enforcing them. The result is the persistence of avoidable spills, especially those dueto sabotage.

It is pertinent to note that Nigerian statutes on oil and petrochemical pollution control are usually enacted piecemeal as pollution problems, especially those resulting in devastating consequences, arise. For instance, as a result of pollution resulting from spillages of oil from pipelines tampered with by thieves and saboteurs, the Federal Military Government in 1984, promulgated a decree called the Special Tribunal(miscellaneous offences) Decree 20 1984. The decree prescribes a death sentence

on a person or a group of persons convicted of bunkering activities and tampering with oil pipelines. It should be realised that, the cause of these nefarious activities may be deep rooted For instance, these acts of sabotage may be a manner of registering protests and seeking redress by some sections of the community with regard to the spread of development and social benefits therefrom, as previously mentioned in this text. This may also be due to a speculation (as by oil companies , in the revenue oil producing areas), that the compensation obtained from oil companies constitutes a panacea for pecuniary requirements of the affected area. These are areas that require attention of the government and people of oil-producing areas.

Yet, there are some aspects of oil operations that have no regulatory legislation. For instance, there are no regulations at present, either from the Petroleum Inspectorate or the Federal Ministry of Housing and Environment or the Federal Ministry of Transport, to safequard the people who live close to areas of oil activities, oil filling and service stations where large underground storage tanks are installed, sometimes close to bore holes used for drinking and other domestic activities. In addition to the hazards of fire incidents, unseen pollution by seepages from the underground tanks/pipelines and from openly disposed waste oil which are threatening areas close to these oil activities.

6.2.1.2. PROVISION IN NIGERIAN STATUTES AS REGARDS TO OIL POLLUTION:

Nigeria has provisions in a number of statutes designed to prohibit or control the pollution of water, air, and land, which prescribe sanctions to be enforced against persons or companies who infringe the provisions. However, it is regrettable that the provisions are not captioned as environmental laws and as such do not cover all types of environmental pollution. The statutory provisions are couched in general terms, with few or

no regulations made to detail the proper application of the statutes. It has been suggested that any enactment to control oil pollution should be considered in the context of other form of pollution and damage to the environment (Olisa, 1981). Therefore, Nigerian laws on oil and petrochemical pollution control, which are found scattered in the statute books, have been mixed and diffusive. There is an urgent need for an all encompassing re-evaluation of the existing, social, economic, ecological, and regulatory conditions under which the Nigerian Petroleum Industry functions, to collect the law into a specific and comprehensive environmental law of international standards. In these regards, it will be useful to borrow a leaf from other oil producing countries, who have enacted various laws to deal with their oil and petrochemical pollution problems. Example, in United Kingdom, there are statutes such as Petroleum Spirit Regulation 1966, Deposit of Poisonous Waste Act 1972, Pipelines Acts 1962 and Petroleum And Submarine Pipelines Act 1975, to deal with various aspects of oil and petrochemical pollution (Wardley Smith, 1979).

6.2.1.3 PROJECT IMPLEMENTATION REALIZATION IN NIGERIA:

The realization that spills cannot be solely controlled through legislation has apparently necessitated a shift in emphasis to management by investment in projects for the monitoring, control and clearance of spilled oil. This crystalized into a definite management plan with the inception of the Forth National Development Plan (1981-1983). The plan provided for an expenditure of 30 million naira by the Nigerian National Petroleum Corporation for monitoring environmental pollution by oil. Other oil producing companies were expected to implement such programs as well. This led to the much talked about clean-up corporative (clean Nigeria Associates) by the oil companies.

The Nigerian National Petroleum Corporation should take this task of monitoring to extremity, realizing that, the country expended

approximately USD 60 million on oil spill management alone in 1984. This actually demonstrated uneffectiveness on their part.

The Nigerian National Petroleum Corporation should closely monitor the operations of different oil companies in the country. However, the NNPC may find it difficult to carry out such an assignment effectively, since their own plants and installations, such as the refineries, are some sources, of oil pollution. It is also doubtful if the Inspectorate Division of the NNPC can perform efficient monitoring operations. Therefore, there is a need to establish a body of completely independent inspectors, who must ensure that the oil companies comply with the government directives and legislation on oil prospecting, drilling, mining, spillage, refining, transportation and storage. For instance, oil refining companies must be compelled to treat oil refinery wastes to remove dangerous pollutants prior to the disposal of such wastes into bodies of water. The inspector should be empowered to ensure that appropriate legal sanctions are imposed on all defaulters.

Transportation aspect should be closely looked into, since oil pollution resulting from ship or tankers accidents are always very devastating and account for the greatest percentage of oil pollution worldwide. The Nigerian Ports Authority which is responsible for safety of navigation and separation of traffics in Nigerian waters should reactivate and improve on their navigational aids which as at now, is in shamble. Such as lighthouses, location and marking of buoys, decca navigation radio stations, port radios, warnings to mariners. This is so because the money involved in carrying out this activities is exorbitant and the authority has no subsidy from the government. The government should subsidise them to ensure safety and clean environment, realizing that traffic separation and safe navigation are important factors in modern navigation and transportation with safety and clean environment in mind. Reception facilities should be provided in all the ports and oil terminals which is now not the case.

6.2.1-4 A FRAMEWORK FOR SPILLS MANAGEMENT IN VIEW OF PRESENT NIGERIAN SITUATION:

The confidence crisis in the oil-producing areas has been one of the factors working against an effective management and control of oil spills. One issue is the non-involvement of the people in the oil-producing areas in the management of spills. The current arrangement is such that only the government and the oil-producing companies have an effective role.

Government is essentially the legislator in spill matters, apart from giving directives to the oil companies from time to time. In certain cases, it serves as an arbitrator between the oil companies and the producing communities, especially in disagreement concerning compensation after a spill.

On the other hand, the oil companies are the major organs for implementing guidelines and directives, especially those contained in the various laws. The extent to which these companies obey such guidelines may depend on the strength of the government's monitoring apparatus. The current arrangement is largely inadequate as can be seen by the occurence of spills.

A redefinition of the roles of different actors in management attempts may be necessary and required. Trying another attempt, the production centres needs to be included in the management process. This means that there will be three levels of management and decision making. The role of government may remain unchanged. However, that of the oil companies should be modified to include people in the oil - producing areas. This means that the implementation of spill - control programmes will be at two levels, the first level comprising the oil companies and the second comprising the oil - producing communities.

The role of the producing communities could be implemented through a community oil spill committee. This could comprise recognised leaders in each of the producing communities. The general guidelines on the operation of the committee could be provided by the

government through the Nigerian National Petroleum Corporation However, the committee will be answerable to the oil companies that operate in the given area.

One of the basic functions of the committee would be to educate the people of a given locality about the need to stop sabotage induced spills. This may involve making the people realize that a spill does more damage to the environment and health, and hence the economy of the area than it does to the operations of the oil companies. It should be noted that even compensation is not likely to cover the entire damage caused, especially when long term effects are taken into consideration. An approach such as this may also ensure that spills are readily reported.

Environmental education is obviously of importance and has been one of the basic principles of fighting pollutions. Although, this alone may not necessarily take care of sabotage induced spills, requires the committee to perform a monitory and policing functions. This necessitates the involvement of the community who should report any case of sabotage to the committee. In such a case, the committee may ensure that the criminal Justice Decree is implemented. This penalty may be supplemented by sanctions, such as ostracism. In many comminities, such local sanctions have a very high deterrence value. There is therefore the possibility that once a case has been properly handled, a further occurence may be unlikely.

6.2.1.5 RESULT ORIENTED STUDIES TO BE CARRIED OUT:

Finally, the NNPC ought to commission general environmental impact studies, dealing with the impact of the oil industry on society and the environment. These should include studies on the economics of pollution, risk analysis, cost of safety, as well as the sociological and legal consequences of major spills. The NNPC should also initiate pollution assessment studies as a means of rapid estimation of damages that would result from oil

pollution of farms, terrestrial and marine environments by spillages, blow-outs, and pipelines leakages. A broad educational campaign for those who work directly with the products all over the country should also be undertaken.

6.3. TECHNOLOGICAL EFFECTS:

Another aspect which dictates exigency in the development of marine environment safety and protection policy is that of technological advancement. This can be further understood from the point of view of increase sizes of cargo ships and tankers carrying cargoes and oil in bulks with increased capacities. Certainly technological advancement in shipping whether developed at home or abroad, is soon transported to all countries due to the international character of shipping. This character can be envisaged over the years to universally harmonize (with regard to pollution control) the development of ships and their associated facilities namely, port, terminals and harbours.

From the foregoing paragraphs, a measure to induce pollution control practices in Nigeria becomes necessary. This can be in the form of a comprehensive but practical and flexible pollution policy. Such would introduce practical values.

6.4. PREPARATION OF THE POLLUTION CONTROL POLICY:

It is hoped that, at this stage, the need for pollution control policy has been established. Next step is to consider those aspects which could be considered helpful in developing an effective pollution control policy.

While up to date pollution control policy could be considered to be a primary condition for maritime industry development, in terms of protection and production, those items which necessitate its success should be understood and incorporated into the policy. This willmake thedocument workable and prevent the concept of pollution and health

from being undermined. In the opinion of the author, the primary items to be considered are, that the policy should be developmental, regulatory, and in conformity with relevant international standards.

6.4.1. DEVELOPMENTAL:

The policy needs to ensure adequate room for new improvements in marine environments protection since:

- The continued maritime development dictates that the methods of marine environment protection of today may not necessarily be in application in the near future and
- The ever increasing development of marine activities and operations, some highly dangerous under changeable conditions of handling, requires the policy compatibility with time and changes.

6.4.2 REGULATORY:

The regulatory aspect will ensure confirmation to standard such that safety to lives, port infrastructures, ships and properties, and the protection of environment are maintained and guaranteed This in the context of development and economic advancement will ensure.

- Maximum efficiency in the operation of ports and terminals with consequential economic advantages
- creation, development, protection and preservation of workers skills/environment
- conservation of national properties (ports, harbours, terminals, fishery, tourism, amenities, etc).
- Reduction in maintenance costs of ports, harbours,

terminals and environment.

- Avoidance of disasters and consequential loss or damage to lives, properties, marine environment/ resources, and heavy expenditure.
- Maintenance of marine activities/operations insurance premia at an advantageous level
- Provision of an overall impetus for ports/harbours, terminals, fishery and tourism developments.
- Conservation of foreign exchange for the nation as a whole and also

the protection of management's image and the Nigerian nation as a whole, in a more favourable light in maritime world with regard to high achievement in maritime protection.

6.4.3. INTERNATIONAL CONFORMITY:

Unlike other land - based industries, marine industries have always been international in character and nature. Therefore international conventions, regulations and codes of practices affecting marine industries should be considered, when establishing a pollution control policy. To achieve this, the policy should be flexible enough to cope with pertinent changes of IMO and ILO instruments.

Finally, in addition to the above primary aspects, the policy should be precisely and clearly worded with effective sanctions, capable of providing a law abiding atmosphere in Nigerian coastal waters, ports and terminals. Nonetheless the policy must ensure the prevention of marine pollution whatever the size.

6.5. CONTENTS OF THE POLICY:

The contents of the marine pollution policy are of vital important. They should claim the attention of the Administration (i.e the Government) because, the government will lay the basis for effective implementation of the pollution programme. Therefore, the

first and most important point, should be, to state in a clear andunequivocal terms that the safety and health of the nation are the responsibility of government. Also it should be stated that the pollution control programme has equal status with any other programme necessary for the successful implementation of government overall objectives.

- The next important point should establish a clear statement of marine safety administration duty, at all level of operation. The duty should ensure that reasonable and practical measure will be taken , to promote the avoidance of marine pollution and maintain a safe, clean environment.
- The fact that production and successful implementation of the policy are the responsibilities of the government it should be clearly emphasized that, the programme will become unworkable unless there exists close co-operation at all levels of the administration. Therefore the placing of duties on all concerned should be taken into consideration, when developing the policy.
- Further inclusion should be a clear statement emphasizing that government will not tolerate any breach of pollution control policy procedure.

Stringent punishment should be laid down for those in the habit of ignoring pollution control procedure. This will act as preventive rather than punitive measure. Also the policy must, perhaps more importantly stresses that nobody will be allowed to breach the pollution control policy.

The policy should incorporate a means to institute follow-up measures. This will enable people, being convinced of government seriousness, to form an attitude of mind that is conscious of marine pollution principles. In addition it will assure the people that if there is conflict between marine environment and pollution, he will be applauded for the choice of marine environment.

It should be precisely stated, with regards to who holds prime

responsibility in government for marine environment pollution and health. Generally speaking, for any policy to be weighty which is lacking in most of the past pollution policies, it would suffice that this person be of the rank of a "Director" or Director General" in person.

In agreement with literature on the matter, there can be no ideal standard in marine pollution policy. This is because for a policy to be effective, it must take into consideration the identified needs and location of the industry for which it is designed. In this light the author will refrain from providing contents for a model marine pollution policy, however, a suggested check list is provided to probe the applicability, strength and weakness of any marine pollution policy that should be designed for the administration.

(i) Is a competent person nominated to oversee the use of equipment and material which may pose marine pollution hazard.

(ii) Is adequate monitoring equipment available

(iii) Are records kept in accordance with statutory regulations.

(iv) Do the arrangements for control of marine pollution meet statutory requirements.

(v) Are there adequate arrangements in the purchasing stores, safety, medical and production departments for the identification of marine pollution and specific necessary precautions.

(vi) Are storage areas adequately protected

(vii) Are emergency procedures for handling spillage and escape laid down, kanown and tested.

(viii) Is the role of pollution representative agreed

(ix) Is there a properly constituted pollution committee

(x) Is the level of marine administration participation appropriate.

(xi) Is there a system for stimulating and maintaining

interest in pollution and safety.

(xii) What arrangements are there to advice people about the standard of the organisation's performance in pollution and health.

(xiii) Are there efficient arrangement s to process action on communication from the enforcing authorities.

(xiv) Who is nominated to co-ordinate pollution prevention activities. Does he have sufficient authority.

(xv) What arrangements are there for pollution prevention

(xvi) Is there an adequate pollution warning system

(xvii) Are pollution operation drills held and checked for effectiveness.

(xviii) What arrangement are thereto check compliance with statutory marine pollution certificates.

(xix) Are means of pollution prevention regularly checked and properly maintained.

(xx) What arrangements are there for medical advice

(xxi) Is it understood that monitoring will be carried out

(xxii) Are there sufficient staff with adequate facilities to carry out the monitoring.

Finally, the policy should take into consideration all facts relating to special feature of the areas of application

6.5.1 SOME IMO/ILO CONVENTIONS/PROVISIONS TO ENHANCE MARINE POLLUTION POLICY:

It is established that Nigeria legislations on maritime industries are either abselete or scattered about in the legislation, thus not applicable to the modern standard/levels of the industries. So, here are numerous international conventions and regulations which Nigeria has not yet ratified and if ratified have not been included in the National Legislation or not properly implemented.

(1) International Convention for the safety of life at sea (SOLAS 74/78)

(2) International regulations for preventing collision

at sea 1972.

(3) International convention for the prevention of pollution 1973/78

(4) Internal convention relating to intervention on the high seas in cases of oil pollution casualties, 1969/73

(5) International convention on civil liability for oil pollution damage 1969 and its protocol of the same year, 1969.

(6) International convention on the establishment of an international fund for compensation for oil pollution damage 1971.

(7) International convention on standard of training certification and watchkeeping (STCW 1978)

(8) International convention on maritime search and rescue 1979.

6.5.2 MEMBERSHIP OF IMO AND PARTICIPATION:

To keep abreast with the modern developments and activities in the marine industries, with particular reference to safety and environmental protection, Nigeria must always be in full participation in all IMO meetings/sessions which has been commendable as regards the spirit of compromise and sense of accommodation exhibited by the representatives of governments.

It is pertinent to point out here, that to achieve the full benefits of participation Nigeria must be represented here by a knowledgeable and experienced person in maritime technical matters. This will enable full participation in the discussions, delibrations, interpretations and finally an effective implementations.

The benefits accrued to participating governments are:

(a) Technical assistance and the attendant funding assistance which are always made known and recognised.

(b) Additional knowledge and experience will be gained by the officials through discussions and consultations during the sessions, both formal and informal.

(c) Personal contacts are established with their colleaques from other countries leading to better understanding and co-operation.

If paucity of funds is the reason for non-participation of any kind, due consideration deserves to be given to the possibility of participation through the representative of a group of countries, or a subregion, or a region, to whom and through which specific view of each country or the group of countries can be conveyed.

SUMMARY AND RECOMMENDATIONS

Various works and literatures have established the fact that oil spills, which are common occurences in Nigeria, create havocs on the marine environment, such as vegetation, agriculture, mangrove stands, fishery, health, amenities and lives. Whereas, some types of spills cannot be avoided, such as pipelines leakages, explosions, etc. Other such as those due to sabotage, operational discharges from ship/tankers can be avoided.

The frequency of sabotage - induced spills in Nigeria seems to point to the dissatisfication ofthe oil -producing communities, with the actions of the oil companies. The problems have been exacerbated due to the apparent failure of management attempts. The involvement in management attempts by people in oil - producing areas would largely alleviate the sabotage problem. A management committee of community leaders which could educate people and monitor spills may be necessary. The success of this approach depends, however, on the rapport between the oil companies and the oil - producing communities.

Pollutions , such as operational discharges from ship/tankers can be avoided or reduced through legislation, policy and monitoring, and stringent punishment on the defaulters. Pipeline discharges, explosion, collision, stranding, grounding can be reduced through training and educating of the operational staff.

Most importantly, considering the fact that the present oil corporative by the oil companies can only cope with 2,500 barrels calls for the necessity of setting up as a matter of urgency a national contingency plan to deal with any spill above this quantity.

To achieve all these, there must be a revision of the nation's maritime regislation, manpower development and training, and the necessary infrastructures to enable an effective monitoring and enforcement of the laws.

Keeping a clean environment should be the duty of all and thus the following recommendations are complementory:-

(1) The National Maritime Authority should as a matter of urgency create a technical division, which should be given the most needed attention and developed to cope with the latest developments in maritime activities with particular emphasis on safety and environmental protection.

(2) The increase in maritime transport volume in Nigeria and range of oil production and other maritime activities need an effective, efficient and organised navigational system to avoid ship accidents resulting from collision, grounding, stranding etc.

Additional precautions should be taken because of the shore-based industries which contribute to no small extent to marine pollution, such as the refineries.

The government should subsidize the Nigerian ports Authority who at present is responsible for those activities to enable it improve on the system and projects.

(3) The permanent oil pollution prevention committee (P.OPPC) and the National contingency plan should be instituted without further delays.

(4) Sub- regional and/or regional co-operation between Nigeria and neighbouring countries should be given urgent consideration for dealing effectively with oil spills at earliest stage as a complement to the National Contingency Plan.

(5) In addition to above, the administration needs to ascertain from the Ports Authority that adequate reception facilities are provided to receive from ships, oily residues and to subsidise the authority to enable its immediate provision.

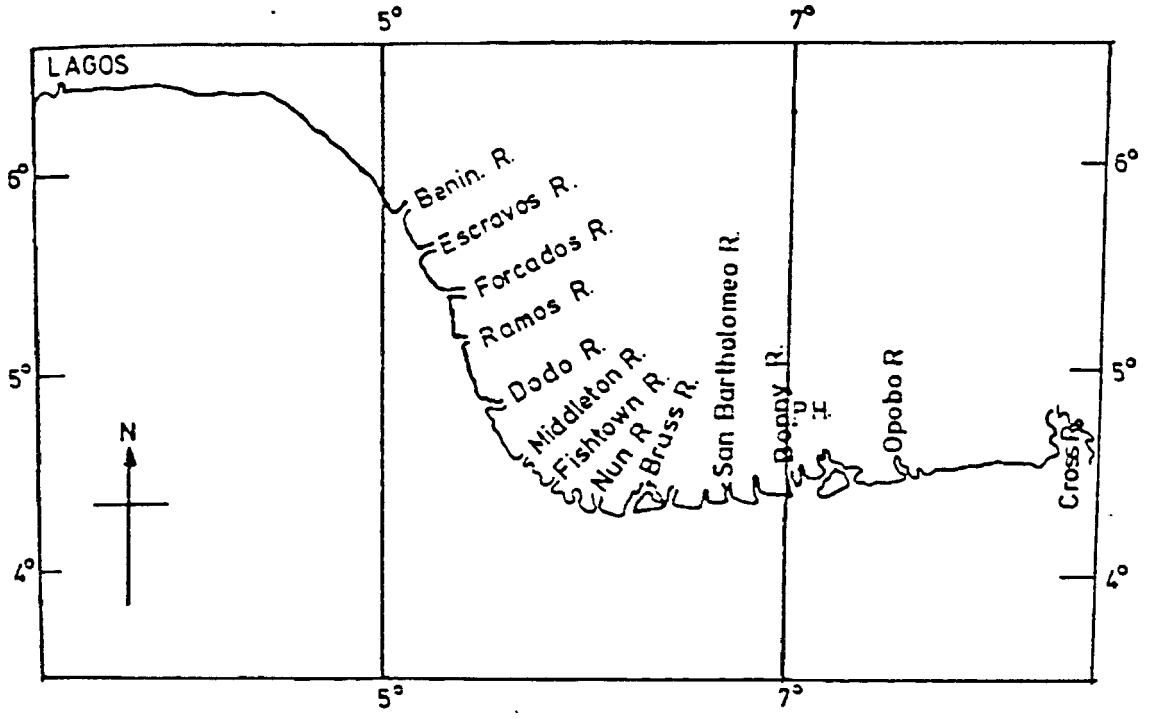
(6) Nigerian participation in international conventions/ sessions and the implementation of same is an essential incredient for safe and clean environment. Representation should be by a knowledgeable and experienced person on maritime technical matters.

(7) The government should as a matter of urgency ratify and legislate the essential international conventions on marine pollution as a base for a sound oil pollution prevention policy.

(8) The administration should develop adequate infrastructure and manpower and set into immediate action monitoring and policing of the Nigerian water against pollution and other legal activities that may lead to marine pollution.

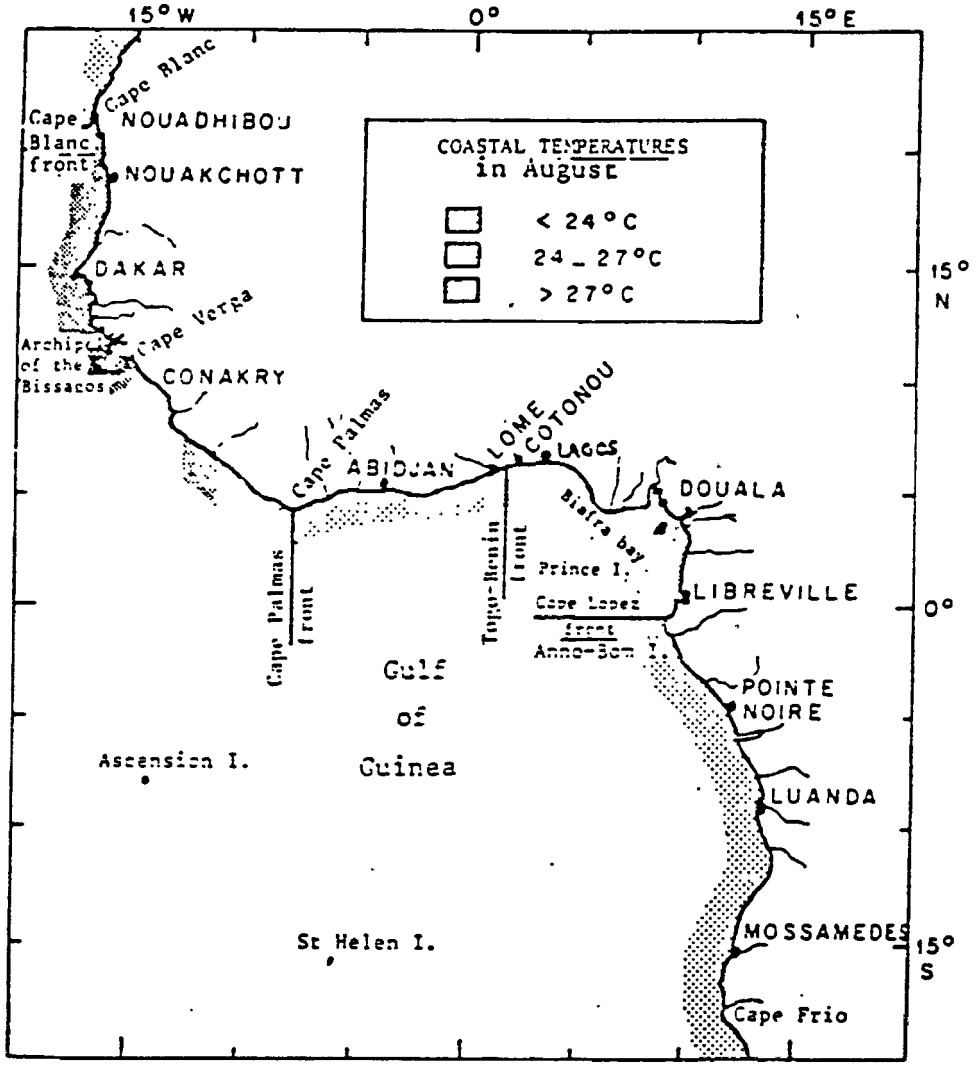
(9) The government should set up as a matter of urgency the oil producing communities management committee.

ANNEX I



The Nigerian Coast line Showing river mouths which mark the main Shrimping ground.

ANNEX II



- Location of the superficial layer and upwelling zones (surface T° > 24° C) during the Northern summer

(1)

ANNEX III

CRUDE PETROLEUM OIL SHIPPED AT ALL OIL TERMINALS 1972/73 TO 1986

YEAR	CRUDE OIL SHIPPED
1972-73	92,43o,684
1973-74	94,717,879
1974-75	102,375,308
1975-76	97,037,938
1976-77	100,313,452
1977-78	93,648,251
1978-79	102,37i,874
1979-80	105,262,756
1980	68,227,943
1981	61,153,673
1982	51,824,276
1983	60,897,345
1984	61,208,297
1985	61,313,539
1986	67,866,794
TOTAL	1.220,650,009

SOURCE: Nigerian Ports Authority Annual Report 1986

ANNEX IV

THE REFINED PRODUCTS HANDLED AT VARIOUS NIGERIAN PORTS:1975/76 TO 1986.

YEAR	TONNAGE DISCHARGED	TONNAGE LOADED
1975-76	2,563,269	1,798,343
1976-77	3,268,206	1,769,937
1977-78	4,138,242	1,595,016
1978-79	4,267,083	1,937,142
1979-80	3,945,383	1,612,191
1980	2,666,143	1,364,145
1981	3,387,921	2,047,066
1982	4,205,316	1,920,058
1983	3,498,134	2,080,619
1984	4,100,325	1,990,587
1985	3,597,985	2,146,673
1986	3,546,346	2,169,433
TOTAL	40,774,353	22,429,209

SOURCE: Nigerian Ports Authority Annual Report 1986

ANNEX V

NUMBER OF SHIPS AT NIGERIAN PORTS AND TERMINALS YEARLY

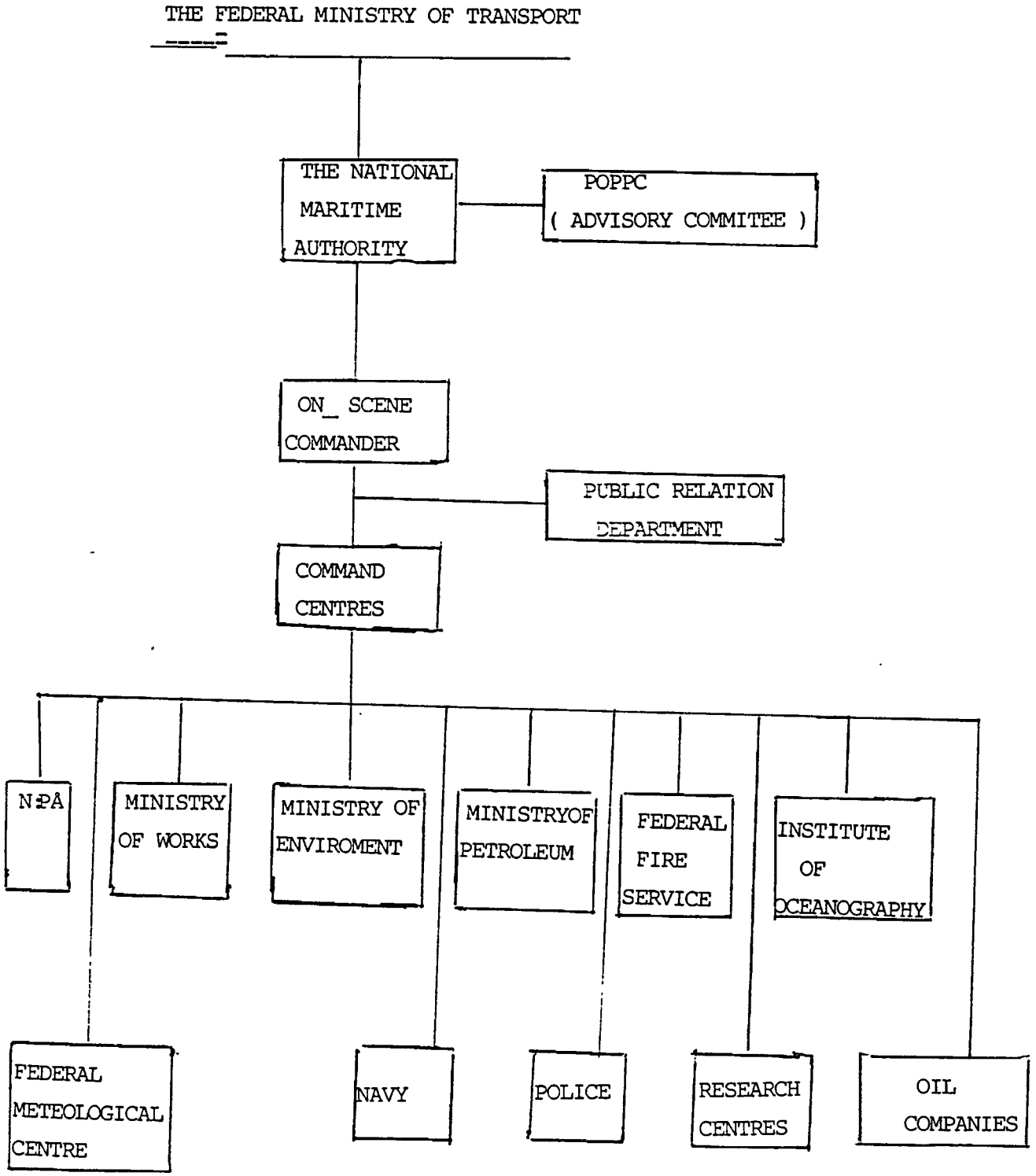
PORTS/TERMINALS	1986 TOTAL		1985 TOTAL	
	No	NRT	No	NRT
APAPA WHARVES AND ASSOCIATED BERTHS	740	4155170	933	5030001
TIN CAN ISLAND	415	2119770	512	2490332
PORT HARCOURT	174	777255	216	1231739
CALABAR	154	683827	137	798347
FEDERAL LIGHTER TERMINAL	53	359201	60	308316
WATERSIDE	51	205699	153	653759
BONNY- [illegible] TERMINAL	263	12779397	250	12074029
BRASS	64	4384805	59	4757188
WARRI	540	1133772	627	1627719
KOKO	20	19770	25	42092
BURUTU	-	-	-	-
SAPELE	39	109521	55	195741
ESCRAVOS	76	3479681	51	3923840
FORCADOS	168	9286322	195	11803464
DEGEMA	30	1334254	27	1192733
CALABAR	97	233963	104	459695
QUA IBOE/ESIT/ANTAN	56	4559862	43	3672698
GRAND TOTAL	2940	45583959	3493	50462293

FOOT NOTE: * ALL FIGURES ARE PROVISIONAL

SOURCE: Nigerian Ports Authorit Annual Report 1986

ANNEX VI

THE NATIONAL CONTINGENCY PLAN ORGANIZATION AS SUGGESTED:



ANNEX VII

PROPOSED EQUIPMENT AND MATERIALS (1983)

A) OPERATIONAL EQUIPMENT :

Medium size boom (m)
Small size river boom (m)
Offshore boom (m)
Absorbent pads (bales)
Absorbent rolls,sheets(bales)
Sea-size skimmers
Portable skimmers
Portable suction/sludge pumps (diesel driven)
Vacuum Trucks
Sea boom deployment boat
Shallow draft vessels
Chemical disersant (drums)
Dispersant spray units (back pack)
Dispersant spray booms(m)
Storage Dracone (offshore)
Supply boats
Handtools (shovels/rakes)
Protective clothing
Life jackets
Vehicles
Portable generators
Mobile containers
Flat bottom boats/barges

B) RECOMMENDED COMMUNICATION EQUIPMENT

1. Motorola-Micom HF_SS8 c70 SG 1184 RTTY
Contnuous duty, with tuner,control cable and antenna
2. Motorola Key Converter
3. Siemens Teleprinter T 1000

COMMNICATION EQUIPMENT (CONTD)

4, Motorrola Micom HF_SSB 170 SGC 1180,125W, 12 Channels, with T1968 antenna turner, TKN 8168 RF and control cable

5. Motorola Quick call_S Unit for Micom HF-SS8 radio set

6. Motorola VHF Mobile Radio 100W, with anienna, T4300A 1900h

7. Mötörola Maxer VHF L43 TR8 1130 with antenna

8. Motorola Portable, Intrinsically Safe, VHF radio - MX 300, 6W , H43AA U 1120H with battery , and battery charger

9. Transportable Container Units

ANNEX VIII

CURRENT LIST OF ACCEPTED OIL SPILL CHEMICALS (OCTOBER, 1983)

No.	TRADE NAME	TYPE OF PRODUCT
1	Gold Crew	Water-based oil dispersant concentrate
2	BP 1100WD	Concentrate hydrocarbon-based dispersant
3	BP 1100X	Hydrocarbon-based oil dispersant
4	Conco Dispersant K	Self-emulsifying concentrate dispersant
5	Corexit 7664	Water-based oil dispersant
6	Corexit 8667	Hydrocarbon-based oil dispersant
7	Shell Dispersant LTX	Hydrocarbon-based oil dispersant
8	Emulsol LW	Hydrocarbon-based concentrate dispersant
9	Gulf Agent 1009	Concentrate dispersant
10	Surflow OW-1	Water-based oil dispersant
11	Gamlen OSR 2000	Hydrocarbon-based oil spill dispersant
12	Agma OSD	Super concentrate oil spill dispersant
13	Corexit 9527	Concentrate dispersant
14	Slickgone LTE	Concentrate dispersant
15	Serxo CD2000	Hydrocarbon-based oil spill dispersant

SOURCE: Nigerian National Petroleum Coporation

LIST OF TABLE

ABBREVIATIONS :

IMO_ International Maritime Organization
WMU- World Maritime University
MSA(E)- Maritime Safety Administration (Engineering)
FAO- Food And Agriculture Organization
USA- United States Of America
NNPC- Nigerian National Petroleum Corporation
OSC- On-Scene Commander
POPPC- Permanent Oil Pollution Prevention Committee
NPA- Nigerian Ports Authority
UQCC- Ughelli Quality Control Centre
(m)- Metre
ILO- International Labour Organization

LIST OF FIGURES

LIST OF FIGURES CONTD:

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