



**BRAZILIAN MARITIME AUTHORITY
DIRECTORATE OF PORTS AND COASTS**

**CASUALTY OF M/T "BAHAMAS" AT RIO GRANDE
- 30 AUGUST 1998 -**

INVESTIGATION REPORT



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CASUALTY OF M/T "BAHAMAS" AT RIO GRANDE

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SYNOPSIS

At 10:00 PM of 30 August 1998, Rio Grande Harbourmaster's Office was informed by a Port Sentinel that the M/T "BAHAMAS", loaded with sulfuric acid, was listing by the FERTISUL Terminal at Rio Grande.

During the night, the Engine Room flooded with acid mixture and the ship touched the bottom of the channel. Fumes were seen escaping from cargo tanks vent pipes, due to the contamination of the sulfuric acid with water.

At the morning of 31^a August, the crew abandoned the ship, lowering the Flags.

Due to the circumstances, the Harbourmaster's Office informed the Fire Department, the Environmental Agencies and the Attorney's Office and decided that the crew should stay in the vicinity of the ship in order to help the local authorities.

The Owners contracted the Dutch Salvage Company SMIT TAK in order to control the accident. After a brief survey, SMIT TAK suggested that the only alternative to avoid an accident of greater proportions was that the cargo of contaminated sulfuric acid should be pumped overboard.

On the 2nd of September, several local authorities formed a Commission in order to manage the situation. Taking into account the imminent risk of explosion and the risk of the ship's structure collapsing due to the corrosion caused by the acid, the Commission decided that the suggestion made by SMIT TAK should be carried out.

The investigation concluded that the beginning of the process that led to the accident was a human error committed by the Pumpman during the discharge operation, which was followed by a series of errors of operation and errors of judgement of the Master.

The incorrect installation and the unfitness of some equipment on board together with the lack of experience of the crew were contributing factors to the accident.

1 - GENERAL INFORMATION

1.1 - Particulars of the Vessel

Name	"BAHAMAS"
IMO Number	7028362
Port of Registry	Valletta
Flag	Malta
Classification Society	<i>Registro Italiano Navale</i> - RINA
Ship Type	Chemical Tanker
Gross Tonnage	12909
Deadweight	21.7801
Length Overall	162,37 m
Breadth	21,90 m
Depth	13,15 m
Crew	30
Building	1970, Nylands - Verksted, Oslo, Norway.
Main Propulsion	Akers (B&W) - Nylands of 10.600 HP thrustured by a fixed pitch propeller.
Owner	Génesis Navigation Limited, 171 Old Bakery Street - Valletta - Malta.
Company	Chemoil International Ltd, Grand Rue, 114 - CH 1820 Montreux - Switzerland.
P&I	Liverpool & London Protection and Indemnity Association Ltd.

1.1.1 - Description of the Vessel

The M/T "BAHAMAS" is a ship built to carry dangerous chemicals in bulk.

Her former names, in chronological order were "ORKANGER", "STAINLESS ORKANGER", "STAINLESS FIGHTER" and "QUEEN OF DUCHY".

The ship has twenty two stainless steel tanks (clad) (3P/S to 13P/S), two mild steel tanks (IP/S and 2P/S) and two tanks situated on the main deck.

The Cargo Tanks 11P/S, 12P/S and 13P/S are served by centrifugal pumps located in the Cargo Pump Room aft, which were driven by electric motors, and the other tanks are served by hydraulic pumps situated in a cargo tunnel. The general arrangement of the vessel can be seen in [Annex 1](#).

1.1.2 – Certification

On her arrival at Rio Grande, the ship had provisional certificates issued by *Registro Italiano Navale*, on 07 MAY 1998 and 07 AUG 1998, on behalf of the Government of Malta, valid until 30 SEP 1998.

It is interesting to note that on 19 JUL 1998, the Certificate of Fitness for the Carriage of

Dangerous Chemicals in Bulk was amended allowing the ship to carry sulfuric acid, as can be seen in [Annex 2](#).

1.2 - Characteristics of the Crew

Thirty men of different nationalities formed the crew and the Master, the Chief Officer and the Chief Engineer had been on board this vessel for less than five months and had little experience on board chemical tankers.

According to many statements, there were some Communications problems on board, since there was no common official language used to give orders.

1.3 - The Cargo

The sulfuric acid, UN number 1830, is shipped in concentrations usually above 95%, and has the characteristic of becoming more corrosive when it is diluted in water, creating a violent reaction. Under the concentration rate between 80% and 20% the sulfuric acid becomes extremely corrosive, without condition to be commercially handled or transported.

The M/T "BAHAMAS" arrived at Rio Grande loaded with 19,616.3 tons of sulfuric acid in concentration above 95%.

1.4 - The Voyage

The M/T "BAHAMAS" was loaded with sulfuric acid in *Austrália*, where she was inspected by a Port State Control Officer on 19 JUL 1998. No deficiencies related to the cargo transfer safety arrangements were found, as can be seen in [Annex 3](#).

According to the records, after leaving *Australia* on 21 JUL 1998, the ship moored in *Durban / South Africa*, to take on fuel oil and continued the voyage to Rio Grande. During this last passage, the vessel experienced heavy seas and pitched and rolled severely.

The vessel came alongside TREVO Terminal at Rio Grande, at 04:19 PM, on 24 AUG 1998, in a loading condition that was within the stability and stress limits, which could be verified by the use of the ship's computer.

An extract of a nautical chart of Rio Grande port area can be seen in [Annex 4-1 and Annex 4-2](#).

1.5 - The Accident

After mooring, the shore personnel took samples of the cargo and found it to be in good condition (above 95%).

At 06:50 PM, on 24 AUG 1998, pumping of sulfuric acid from Cargo Tanks 6P and 6S commenced. This transfer ended around 05:00 AM on 25 AUG 1998.

The vessel started to discharge from tanks 1 IP and 11 S. At approximately 07:30 AM, in order to increase the rate of discharge, the Chief Officer told the Pump man to open the regulating valve of Cargo Pumps 1 IP and 11S a little more. After completing the task, the Pump man told the Chief Officer the valves were fully open. According to the statements of the crew, supported by shore documents, around 08:00 AM of 25 AUG 1998, the Chief Officer noticed that the discharge rate had decreased too much and immediately asked the Pump man if he had really opened the valves. After the explanation given by the Pump man, the Chief Officer realized he had closed them almost completely instead.

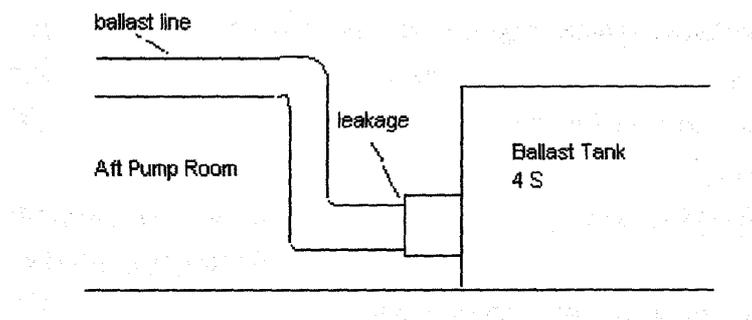
The Chief Officer went down to the aft Cargo Pump Room with personal protective equipment and checked that the regulating valves were, in fact, closed and noticed also a leakage of sulfuric acid through the packing of Cargo Pumps 1 IP and 1 IS.

In addition, there was a great amount of vapours emanating from the pump, which was also observed by shore personnel.

The Chief Officer immediately opened the valves. This operation stopped the escape of fumes as well as the leakage.

An attempt to pump out the liquid inside the Pump Room was made using an emergency pipe section connected to a flange located in the cargo pipe of the Pump 12S. This arrangement, as can be seen in [Annex 5](#), was used to pump the liquid to Cargo Tank 1 OS, which was empty at that time. This operation took about one and a half-hour and the liquid could not be completely removed from the Pump Room.

The ship continued to discharge and, at the end of this operation, began to receive ballast water in Ballast Tanks 4S and 4P, in order to trim the vessel. After some minutes, the Pumpman went down to the Pump Room and noticed a leakage through the sleeve of the ballast line of Ballast Tank 4S, as can be seen on the sketch below.



After seeing this leakage, the Pumpman informed the Chief Officer, who ordered to stop the Ballast Pump. The crew tried to stop the leakage by means of a clamp, but had no success. At this moment, the solution of acid and water had already gone to the Cargo Tunnel. The arrangement assembled on Cargo Pump 12S was used to pump the liquid to Cargo Tank 9S, which was empty at that time.

Once more, it was not possible to drain all the liquid from the Pump Room and some solution remained inside this compartment. The crew checked the Cargo Tanks after finishing the discharge and no problem was found. At that time, the crew supposed the problem had been solved and the ship proceeded to the PETROBRAS Terminal, coming alongside at 06:00 PM. However, due to the lack of hydraulic oil in the cargo system, it was not possible to discharge from Tanks 4P and 4S. On the same day, according to Logbook records, the Pumpman was dismissed from his job for having posed a danger to the vessel and to the environment.

On 26 AUG 1998, at 06:40 PM, the vessel received hydraulic oil. A new attempt was made to discharge Cargo Tanks 4P/S, but a new loss of pressure in the system made it impossible throughout the day.

The crew made many inspections in the Cofferdams, in the Cargo Tunnel and in the Ballast Tanks in order to find the reason for the leakage of the hydraulic oil, but nothing was found.

Only at 12:45 of 27 AUG 1998, when the crew thought the hydraulic oil system had been repaired, they started the discharge of cargo tanks 4P/S. But this operation was interrupted once more after discharging only 676 tons of acid, due to another loss of pressure of the hydraulic oil in the cargo system.

On 28 AUG 1998, at 09:00 AM, the vessel was moved to Porto Novo mooring area because the delay in her discharge operations was affecting the PETROBRAS Terminal's schedule.

At 02:00 PM, the ship arrived alongside Porto Novo and began to discharge Cargo Tanks 1 IP and 1 IS, which are served by centrifugal pumps driven by electric motors.

It is important to say that the Master of the ship justified the delay of the vessel as a problem with the hydraulic oil system. Up to that moment, the competent authorities were not informed about any problem with the ship.

At 10:40 PM, the vessel received more hydraulic oil to the cargo system.

On 29 AUG 1998, at 01:00 AM, the crew informed the Master that the vessel was taking a list to starboard. The discharge of Cargo Tank 1 IP was interrupted immediately and the ship started to receive ballast in Cargo Tank 12P through the Fire Pump.

At 01:10 AM, the crew inspected the Ballast Tanks, Cargo Tanks, Cofferdams but the cause

of the list was not found.

At 01:30 AM, there was a decrease in the level of Cargo Tank 2P and an increase in the level of Cargo Tank 2S. At 02:00 AM, the list of the ship changed rapidly to port.

At 03:05 AM, the crew noticed some liquid inside the Ballast Tanks 2S and 2P, which were empty before, and an abnormal communication between these tanks were also detected.

The level of the liquid inside the Cargo Pump Room reached the top of the cargo pump valves. The Chief Officer tried to operate them, in order to drain the liquid to the Cargo Tanks, but due to the presence of vapour and low visibility this was not possible.

From this moment on, the crew did many ballast transfers trying to control the list of the vessel. Attempts were also made to discharge the Cargo Tanks through the hydraulic pumps.

At 10:00 PM of 30 AUG 1998, a Port Sentinel informed the Harbourmaster's Office that the ship was listing.

The crew took the following actions:

- at 11:20 the cargo hose was disconnected;
- at 01:50 AM of 31 AUG 1998, the crew noticed a leakage of acid mixture to the Engine Room through a blank flange located at about 1.50 meters from the bottom of the electric motors floor;
- there were many attempts to stop that leakage, through a stay and a cement box, but it was not possible to do so;
- the crew tried to drain the liquid with bilge pumps and general service pumps, but the leakage was already of great proportions;
- before the liquid reached the main diesel generators, the crew switched on the emergency generator, but there was not sufficient power to supply the Engine Room bilge pumps; and at 05:00 AM, the crew abandoned the vessel by order of the Master.

1.6 - Measures Taken to Control the Situation

On 30 AUG 1998, at 10:00 PM, the Harbourmaster's Office sent an Officer to Porto Novo after receiving the information from a Port Sentinel that the M/T "BAHAMAS" was listing. The Master informed that the listing problem was under control and stated that external help was unnecessary.

Early in the morning of 31 AUG 1998, when the Harbourmaster arrived to Porto Novo (mooring place) he noticed the Master and the crew were leaving the port area. At that occasion he could observe sprays of liquid coming out from the vents of Cargo Tanks and Pump Room. Due to a strong wind, the ship was also drifting to the middle of the channel. The

Harbourmaster ordered the crew to stay in the vicinity of the vessel and to pass some wire ropes in order to secure the ship.

The Master refused to answer the Harbourmaster's questions about the real situation of the ship, arguing he would only report to the Owners. He declared that ordered the crew to abandon M/T "BAHAMAS" due the risk of explosion of the ship.

Later, at this same day, the liquid ejected from the tanks was analysed by shore personnel and it was found to be sulfuric acid diluted in water. During the day, the Harbourmaster's Office informed the Fire Department, the Environmental Agencies and the Attorney's Office about the situation.

On 01 SEP 1998, technicians from SMIT TAK Company, contracted by the Owner, arrived in Rio Grande to attend the vessel. After a brief survey, SMIT TAK Salvage Master noticed that some tanks had not yet been contaminated and tried to discharge them to shore tanks. During this operation, the acid destroyed the hose, what showed those tanks were, in fact, being contaminated.

On the same day, many local authorities met with the Salvage Master of SMIT TAK in order to evaluate the situation and to determine what should be done. Due to the lack of sufficient information, the group could not come to a conclusive action.

On 02 SEP 1998, having gathered more information, the Harbourmaster Office, the Environmental Agencies, Civil Defense, SMIT TAK, IPIRANGA (a local refinery), FERTISUL (a local fertilizer's industry), Rio Grande Port Superintendence and technicians experts of the local university (*Fundação Universidade de Rio Grande - FURG*) formed a Commission to manage the situation, coordinated by local Civil Defense Representative.

The factors evaluated in order to make a decision were:

- the chemical reaction of the sulfuric acid with the vessel's structure was generating a great amount of hydrogen inside the contaminated tanks, posing a high risk of explosion, with consequent uncontrolled risk to people and to the environment;
- there was no shore reservoir suitable to receive the sulfuric acid mixture at the actual concentration (around 60%);
- the transfer of the liquid to the fertilizer industry's tanks was considered but, it was decided it would pose a greater danger to the local inhabitants;
- SMIT TAK and the P&I Representatives informed that, after contacting brokers all over the world, they came to the conclusion that there would not be a suitable ship available in short notice to receive the acid mixture;
- the corrosive process of the structure, due to the attack of the acid, could lead to

- an uncontrolled leakage of pollutants to the channel;
- the contact of the acid with the materials of the ship's structure could generate dangerous pollutants, like heavy metals; and
- the idea of neutralizing the solution by the use of an alkali or limestone was found to be not feasible, since the necessary amount of material ready to be used (powder) would not be available at short notice.

The Commission then decided to accept the solution that would cause minimum risk to the people and to the environment, and authorized SMIT TAK to discharge the acid mixture of the tanks of M/T "BAHAMAS" into the channel, in a monitored and controlled way by experts personnel of FURG.

The following parameters were established to control the dumping operation, in order to minimize the effects to the marine environment:

- the maximum rate of the pump would be controlled through the measurement of pH and the current in predefined locations;
- the current in the channel would be monitored in predefined layers, so that the pumping would only be authorized in the ebb tide; and
- the pH in some inhabited areas and in some areas environmentally important would be constantly monitored in a way that it could not fall below 6.5 or below the pH of the water upstream, whichever was less.

The pumping was carried out in accordance to the above parameters between 10:10 PM of 02 SEP 1998 and 09:00 AM of 13 SEP 1998, when it was interrupted due to Court order, considering a Report of the FURG Chemical Engineering Representative in the Commission. That Report pointed out there would be another way to solve the problem, once at that time the risk of explosion was already within acceptable limits.

As a consequence, since 13 SEPT the Civil Defense stopped to control the scene and passed on the coordination of the operations to the Federal Judge of First Lawcourt of Rio Grande, who assumed the control of the actions by carrying out public audiences and by delivering writs with the aim to grant safety of life, protection of marine environment and safety of navigation.

Since the day of the accident, the P&I and SMIT TAK tried to find a ship suitable and available to transfer the liquid of the cargo tanks of M/T "BAHAMAS", but no Company was interested in providing a vessel, even when the concentration of the acid fell below 10%.

The Article 5 of the Brazilian Federal Constitution states that, in case of imminent danger to the public, the competent authority may use a private property, being assured compensation to the owner, in case of damage to the property.

On 22 OCT 1998, the Federal Justice requested at Rio Grande the M/T "YEROS", registered in Panamá, on basis of Article 5 of the Federal Constitution, to receive the cargo from M/T "BAHAMAS" and discharge it on the High Seas, at a predefined área established by the Brazilian Environmental Authority. The Brazilian Maritime Authority issued a Special Authorization, as required by the London Dumping Convention.

The requisition of M/T "YEROS" was suspended on 20 JAN 1999, after 10 voyages to the dumping area, since the local authorities found the concentration of acid mixture on board M/T "BAHAMAS" to be within acceptable limits.

The dumpings took place at the following maritime áreas:

- First dumping: A ... Lat - 32° 05.5' S; Long - 046° 20.0' W
B ... Lat - 31° 00.0' S; Long- 045° 15.0' W
C... Lat - 31° 00.0' S; Long - 043° 30.0' W
D... Lat - 32° 05.0' S; Long - 044° 35.0' W
- Other dumpings: A ... Lat - 34° 05.0' S; Long - 050° 08.0' W
B... Lat-31° 17.0'S; Long-046° 53.0'W
C ... Lat - 32° 41.0' S; Long - 045° 16.0' W
D... Lat - 35° 30.0' S; Long - 048° 33.0' W

On 14 APRIL 1999, the Federal Judge of First Lawcourt of Rio Grande ordered to SMIT TAK, at Chemoil International Ltd. and Liverpool & London P&Fs expenses, to carry out the immediate removal of M/T "BAHAMAS" from Rio Grande port area.

On 20 APRIL 1999, the Brazilian Maritime Authority granted "Special Permit" to the removal of the M/T "BAHAMAS" from the port, for dumping her in a previously determined position in international waters, towed by tugboats provided by SMIT TAK.

On 22 APRIL 1999, in High Seas, according an Owner's decision, the towage operation was transferred to the tugboat "SALV AGE GIANT", contracted by the Owner. Further, the tug and the tow were seen heading the African Coast.

The Maritime Brazilian Authority issued a relevant communication (on 27 APRIL 1999), to the Office of the London Convention 1972 considering that M/T "BAHAMAS" posed a serious risk to the safety of navigation and to the marine environment.

1.7 - Personal Injuries

Nil.

1.8 - Damage to the Vessel

Since the date of accident until the date she was refloated (about seven months), Cargo Tanks and ali compartments of M/T "BAHAMAS", including Engine Room, remained interlinked and flooded with acid mixture. A complete evaluation of the extent of the damages suffered by the vessel could not be made properly, since the tanks and the Engine Room could only be accessed by divers, under poor visibility and difficult working conditions.

The reports elaborated by SMIT TAK indicated that there were many holes in the hull and in the Cargo Tanks. They also indicated a considerable thickness reduction of the ship's structure.

On 20 APRIL 1999 M/T "BAHAMAS" has been refloated (pressurizing air in her tanks and compartments) and towed away from Brazilian waters by SMIT TAK.

1.9 - Environmental Damage

The extension of environmental damage caused by the incident is still being evaluated. During the period M7T "BAHAMAS" remained at Rio Grande port area, the bottom's samples collected in the channel (where the pH was affected) were analyzed by technicians experts of FURG and did not indicate any environmental damage. Otherwise, no fish or marine mammals mortality were observed.

With regard to the release of heavy metals due to the corrosion of the ship's structure, various analysis were carried out and indicated that the concentration levels of the mixture on board, except iron compounds - FeS and Fe (OH)₃ - remained within the limits accepted by the Brazilian regulations.

In addition, in the Rio Grande port expansion program, it was already scheduled a dredging operation in the near future, in order to increase the draft of the channel (including the channel area where the pH was affected).

2 – ANALYSIS

2.1 - Introduction

This analysis is restricted to the various operations carried out by the crew members after the events of 25 AUG 1998 and to the loading and unloading systems of the ship. Attention will also be given to the procedures adopted by the Brazilian authorities after having been informed about the

accident.

2.2 - Handling of the Cargo Pump Valves

The cargo pumps serving Cargo Tanks 11P/S, 12P/S and 13P/S were Rheinütte Wiesbaden / Biebrich RICL 150/355 B type pumps, driven by electric motors, designed to operate with corrosive liquids.

There are records in the Logbook that the Pumpman, having received the order to open the regulating valves of cargo pumps 11P and 12P in order to increase the rate of discharge, closed them almost completely.

This operation made the pressure within the pump fall below the vapour pressure of the sulfuric acid. It caused the cargo to vaporize inside the cargo pumps, leading to the cavitation of the pumps. Due to the cavitation, the pumps started to vibrate, leading to a leakage of acid through its packings.

The Chief Officer's action of fully opening the valves showed to be correct, since it eliminated the cause of the leakage.

Analyzing the pump installation against the manufacture's instruction manual, it is possible to conclude that the cargo pump valves were not operated properly. The manufacture's manual states the rate of discharge must be controlled through a regulating valve installed at the discharge line and not at the suction line, as installed on board M/T "BAHAMAS".

According to page 6 of the manual, which can be seen in [Annex 6](#), the operation of the suction valve should be omitted, since such operation can result in irregularities and cavitation. It also states the suction valve should be fully open during discharge operations.

On board M/T "BAHAMAS", the valve installed on the discharge line was an air valve, which can only be fully opened or fully closed. Therefore, the control of the rate of discharge could only be made through the operation of the valve installed on the suction nozzle of the pump or the valve installed on the manifold.

2.3 - Leakage in the Cargo Pump Room

After noticing that the water leaking through Cargo Tank 4S ballast line was reacting with the acid left in the bottom of the aft pump room, thus generating a highly corrosive substance, the crew only tried to drain that liquid to a Cargo Tank and was not able to evaluate the risks this situation could pose to the ship.

The remaining liquid inside the Pump Room corroded the Ballast Lines located in the bottom of that compartment and, subsequently, the Cargo Lines, allowing a communication

between the Ballast Tanks and the Cargo Tanks through the aft Pump Room, originating a violent chemical reaction inside the ship.

2.4 - Loss of Pressure in the Hydraulic Oil System

The cargo system of Tanks 1-10, as previously explained, includes hydraulic FRAMO pumps. This cargo system is built in such a way that the hydraulic oil circulates through the entire plant and it is not possible to by-pass part of the plant.

The FRAMO pumps are located in the Cargo Tunnel, except for those serving Cargo Tanks 9P and 9S, which are deepwell pumps. This system can be seen in [Annex 7](#).

When the Chief Officer ordered the corrosive liquid to be pumped out to Cargo Tank 9S, there was a close contact of that substance with 9S Cargo Pump, which probably led to the destruction of its seal and, consequently, to the leakage of hydraulic oil to the Cargo Tank. This hypothesis was confirmed by a survey made after the accident, when a large amount of hydraulic oil was found inside Cargo Tank 9S. Considering the hydraulic oil used in the cargo system circulates in the entire plant, such leakage made the operation of all the FRAMO pumps impossible. Consequently, Cargo Tanks 1-10 could not be unloaded.

2.5 - Actions Taken to Control the Accident

The monitored dumping of the contaminated cargo to the Porto Novo access channel proved to be an adequate measure, bearing in mind the existing situation immediately after the accident, the local conditions and the lack of other feasible action that could be taken in short notice.

Such measure, while carried out, led to a rapid decrease of the concentration of sulfuric acid mixture inside the ship, reducing the violence of the chemical reaction and the generation of hydrogen gas.

It is important to notice that, during the operation, the monitoring of the sensitive areas, where there are some residences and some fishing activities, indicated that there was no significant change of the pH. University of Rio Grande (FURG) experts observed that the acid dumped into the channel dispersed itself almost completely in the waters of the channel and flowed rapidly to the open sea. The area affected by the dumping of the contaminated cargo can be seen on [Annex 8](#) and on its Appendix.

The interruption of this procedure for a long period of time (40 days), without the adoption of another solution, allowed the continuous reaction of the acid mixture with the metallic structure of the ship, generating heavy metals inside the ship. Nevertheless, it was verified that

the concentration levels remained within limits accepted by Brazilian regulations for that area. Another immediate action taken to prevent marine pollution of considerable proportions, was the removal of 230 tons of fuel oil and lubricant oil from the ship to trucks.

3 - PRELIMINARY LESSONS LEARNED

In reviewing all the acts related to the technical circumstances of the casualty, the experience gained should permit that some studies should be held to amend the IBC and the BCH codes, as follows:

I - Ballast pumps and ballast Unes should be located in order to avoid contact with any possible leakage of cargo lines and cargo pumps.

II- When the discharge of the ship is made through hydraulic pumps where the hydraulic oil runs through ali the system, there should be means of by-passing any section of the hydraulic oil line or the ship should have an alternative method of discharge.

III - When the discharge of the ship is made by centrifugal pumps, valves located in the suction nozzle should be built in order to work folly open or fully closed.

Some particular aspects in this incident must be also emphasized:

- a) the real importance of having a common working language among crew members;
- b) the need to enhance the local structure to deal with this kind of accident, involving HNS cargo; and
- c) the need for a Local Contingency Plan, as recommended by IMO, in order to improve the efficiency of the response operations and also to minimize the environmental consequences of such accident.