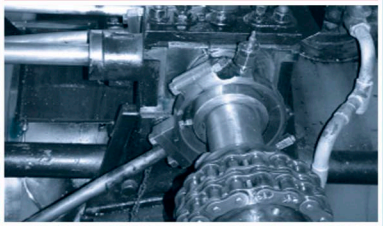
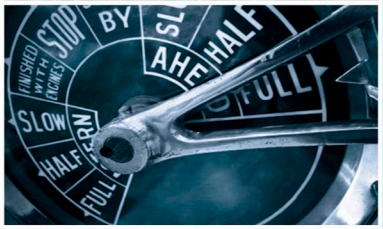
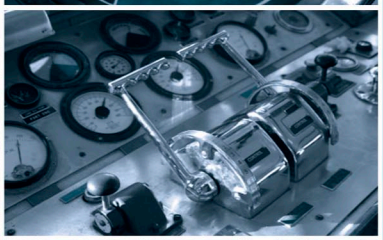
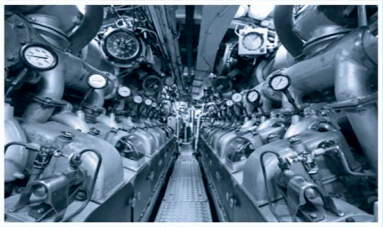
TECHNICAL REPORT A-13/2010

Investigation of the running aground of CH/T SICHEM COLIBRI in the Guadalquivir River on the 11th of August, 2009



GOBIERNO DE ESPAÑA

MINISTERIO DE FOMENTO

SECRETARÍA GENERAL DE TRANSPORTES

COMISIÓN PERMANENTE DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES MARÍTIMOS

Technical report

A-13/2010

Investigation of the running aground of CH/T SICHEM COLIBRI in the Guadalquivir River on the 11th of August, 2009

GOBIERNO DE ESPAÑA
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NOTICE

This report has been drafted by the Standing Commission for Maritime Accident and Incident Investigations, CIAIM, regulated by the 26th Additional Provision to Law 27/1992, dated 24 November, by National Ports' (Puertos del Estado) and the Merchant Navy (Marina Mercante), and by Royal Decree 862/2008, dated 23 May, whose functions are:

1. To carry out the investigations and technical reports of all serious and very serious maritime accidents in order to determine the technical causes that originated them and make recommendations for the purpose of implementing the necessary measures to prevent them from occurring in the future.

2. To carry out the technical investigation of maritime accidents when lessons learned can be obtained for maritime safety, to prevent marine pollution from vessels, and to produce technical reports and recommendations on the same.

In no case will the purpose of the investigation be to determine any fault or responsibility, and the drafting of the technical reports will in no way pre-judge the decision that may fall upon courts of law, nor will it seek the evaluation of responsibilities or determination of culpabilities.

In accordance with the aforementioned, the direction of the investigation listed in this report has been carried out without necessarily resorting to test procedures and without any fundamental purpose other than to determine the technical causes that may have caused the maritime accidents and incidents, in order to prevent these from occurring in the future.

Therefore, the use of the investigation results with any purpose other than the one described is subject in all cases to the aforestated premises and must not, therefore, prejudge the results obtained from any other report that, in relationto the accident or incident, may be initiated in accordance with current legislation.

The use made of this report for any purpose other than for the prevention of future accidents may lead to erroneous conclusions or interpretations.

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GLOSSARY OF ABBREVIATIONS, ACRONYMS, SYMBOLS AND TERMS

AEMET	*Agencia Estatal de Meteorología.* Public Meteorological Agency.
AIS	Automatic Identification System. In Spanish, *Sistema de Identificación Automática;* it may be listed as SIA.
CH/T	Chemical tanker.
Painter	Line or chain used to transfer taught moorings, from the headstock of a machine or windlass and fasten them to a bitt, without losing tightness. Also, a rope used to tie a boat or fast boat.
CIAIM	*Comisión Permanente de Investigación de Accidentes e Incidentes Marítimos.* Standing Commission for Maritime Accidents and Incident Investigations.
CNCS	*Centro Nacional de Coordinación de Salvamento.* National Rescue Coordination Centre.
Cofferdam	Space between two watertight or covered bulkheads inside a vessel for the purpose of isolating storage spaces or preventing leaks from occurring.
DGMM	*Dirección General de la Marina Mercante.* General Directorate for the Merchant Navy.
GT	*Gross Tonnage.* Gross tonnage units.
I	Geographic latitude.
L	Geographic longitude.
MCR	Maximum Continuous Rating. Maximum continuous power at which a vessel's engine operates under normal conditions.
MRCC	Maritime Rescue and Coordination Centre.
n/a	Not applicable.
NT	*Net Tonnage.* Net tonnage units.
Paris-MOU	Paris Memorandum of Understanding on Port State Control (Paris MOU). The Paris-Mou is a harmonized vessel inspection system for the purpose of ensuring that vessels operating at European and North Atlantic ports comply with international safety and standard environmental requirements as well as ensuring that the crews live and work under adequate conditions.
Lightweight	Weight of the vessel as delivered by the shipyard; without a load, fuel, supplies, food or crew.
Oyster stone	Sedimentary stone comprised of marine oysters and rocks that have been eroded by the ocean.
Sp	Stern perpendicular. Vertical line that references the vessel's stern.
SASEMAR	Spanish Maritime Safety and Rescue Agent.
Steering gear	Steering mechanism of a vessel comprised of a rudder operated by hydraulic servomotors.
SEVIMAR	Safety regulations promulgated by the Spanish Administration, which include the provisions of the International Treaty for Safety and Human Life at Sea (SOLAS Agreement) and national supplementary provisions.
Slop tank	Tank of a vessel where spills or waste originating from other vessel's cargo are collected.
DMDSS	Global Maritime Distress and Safety System.
SOLAS	International treaty for safety and human life at sea of 1974, as amended.
t	Tonnes.
GRT	Gross Register Tonnage.
UTC	Coordinated Universal Time.

SYNOPSIS

The accident

At 04:00 h on the 11th of August, 2009 the Maltese dual hull chemical tanker SICHEM COLIBRÍ, which had departed from Lavera France, with 3,150 tonnes of dissolved caustic soda (caustic product, category Y, class IMO 8, number UN 1824) on board, was anchored at coordinate 36º 46.3' N; 006º 28.1' W and was preparing the engine to take the pilot boat and begin crossing the Guadalquivir bar, bound for the Port of Seville.

Once the pilot had embarked, the trip up the Guadalquivir river began via the navigation canal of the Guadalquivir Bar, at a speed of about 11 knots over the bottom.

When the vessel was navigating between buoy pairs 11/12 and 13/14, the Skipper, the Pilot and the Helmsman, who were inside the wheelhouse, noticed that the rudder was not responding and the vessel was quickly turning to her port side. The rudder was stuck at 20º to port.

The Skipper, assisted by the Pilot, attempted to correct the course using the steering propeller and the engine. He stopped the engine and ordered full reverse power.

Given the narrowness of the canal, they were not able to prevent the vessel from running aground on the canal's left margin, facing up river, at about 05:39 h.

The port anchor was cast at 05:45 h in order to maintain the vessel's position.

The vessel pivoted about her bow, turned and stopped at heading 317º, heeling towards port at about 4º, at position 36º 47.2' N; 06º 22.5' W (next to buoy 14 - sandbar known as Bajo de la Riza) aground over a weak oyster rock.

Visibility at the time of the accident was good and the winds were variable, at force 2 or 3, with smooth waves.

During the running aground and during the reverse engine procedure, in an attempt to dislodge the vessel from the ground by her own means, piston no. 1 of the primary engine failed; therefore, the full power of the engine was not available to carry out this operation.

That same day and, once the hull was inspected and the tanks were probed searching for possible damage, which was not found, the vessel was refloated with the help of a tug.

The vessel was towed by her stern to the anchorage area located at the entrance to the canal.

On the 12th of August the vessel was anchored at the Port of Seville.

Main conclusions

The reasonings applied in this report have enabled this Commission to conclude the following:

- The cause for the vessel running aground was a failure in the vessel's steering system due to the rupture of a component of the number 1 servomotor solenoid valve, resulting in the detachment of a metallic piece, which blocked another part of the valve, causing hydraulic fluid to constantly flow in one of the circuits. This occurrence caused the steering system to move the rudder towards the port side and remain blocked in that position, at a 20º angle.
- No proof exists that enables us to explain if the rupture was due to poor maintenance, material fatigue, an error in the design or any other cause.
- The hydraulic blockage alarm incorporated with the system, which should have detected the failure, did not work properly. However, the proper operation of the alarm would probably have not prevented the vessel from running aground.
- The failure detected in the propulsion engine moments prior to the accident did not contrib-

ute to the accident. This failure prevented the vessel's engine from employing all of its power during subsequent procedures that were carried out to free the vessel from the ground.

- Had the manufacturer's instructions been followed in case of a steering system failure or fault, this would not have been able to prevent the grounding due to the limited time that was available to react and the distance required to carry out the manoeuvre in accordance with the vessel's performance charts.
- The instructions for acting in case of a steering system failure should have been available at a location that was readily accessible to personnel steering the vessel, instead of being kept in the panel opposite the steering console.

* * *

Chapter 1. THE INVESTIGATING COMMISSION

1.1. Introduction

The investigation of the accident involving CH/T SICHEM COLIBRI was carried out by the Standing Commission for Maritime Accidents and Incident Investigations (CIAIM), collegial body assigned to the Subsecretaría de Fomento, charged with carrying out the technical investigation of:

- Maritime accidents and incidents involving Spanish civilian vessels.
- Maritime accidents and incidents involving foreign civilian vessels when these occur within Spanish waters or Spanish territorial seas, and those occurring outside these when Spain has considerable interests at stake.

The CIAIM and the Investigation of Maritime Accident and Incidents is regulated by the twenty sixth Additional Provision to Law 27/1992, dated 24 November, by National Ports and the Merchant Navy, and by Royal Decree 862/2008, dated 23 May.

The investigation carried out by CIAIM was limited to establishing the technical causes that caused the accident as well as to making recommendations in an effort to prevent accidents from occurring in the future.

1.2. Investigation

The investigation tasks were carried out by CIAIM Secretariat personnel.

On the 30th of November 2010, the CIAIM's Plenary, which is made up of the members listed in Annex 1 of this report, unanimously approved its contents as well as the conclusions and recommendations obtained from it.

1.3. Compiling the information

For the investigation and subsequent drafting of this report, the CIAIM was assisted in the task of compiling information, by the Maritime Authority of Seville, the Directorate General of the Merchant Navy (DGMM), the national Rescue Coordination Centre (CNCS), the Maritime Rescue and Safety Society (SASEMAR), and the shipowning company "EMS Ship Management".

The primary documentation used for this report was:

- "Chemical Tanker SICHEM COLIBRI grounding report", drafted by the Maritime Authority of Seville.
- Sea protest statement made by the vessel's Skipper.
- Statements provided by the crewmembers to CIAIM investigators.
- Report from the Port of Seville Pilot.
- Report regarding the repair of the steering gear provided by Aker Solutions
- Submarine inspection report carried out by Mac-Pherson Servicios Subacuáticos.
- General Emergency Report issued by SASEMAR.
- The Following vessel documentation:
  - Crew List.
  - Certificates.
  - Technical characteristics of the steering gear.
  - Official Log Books or Official Navigation Books of the Wheelhouse as well as of the Engine Room.
  - Bell Book or Steering log.
  - Ship Management System checklist.
- Pictures taken at the location during the accident and the refloating operations.
- Data from the ship's Voyage Data Recorder.
- Internal investigation report of the accident carried out by the Company (EMS Ship Management LTD).

* * *

Chapter 2. FACTUAL INFORMATION

2.1. The vessel

The CH/T SICHEM COLIBRI is a dual hull chemical tanker with a Maltese flag, with its base port at Valleta, Malta. The vessel belongs to company EITZEN CHEMICAL (SINGAPORE) PRIVATE PTE.

The vessel was built in 2001 at Mokpo, Korea by Ilheung Shipbuilding & Engineering Co. Ltd

2.1.1. *Main Characteristics*

Its main characteristics are:

Table 1. Main Characteristics

Vessel Name	SICHEM COLIBRI
Builder	Ilheung Shipbuilding & Engineering Co. Ltd
Year built	2001
Type	Chemical/Products tanker (DB)
IMO	9216042
Call sign	9HHB8
SSCC	Lloyd's
LR Class	A1
Length overall	92.89 m
Length between perpendiculars	83.50 m
Breadth	14.40 m
Depth of the Main Deck	7.00 m
Moulded draught	5.94 m
Freeboard	1,060 mm
GT	2.764
NT	1.042
GRT	3,592 t
Lightweight displacement	5,491.4 t
Propulsion	1 variable pitch propeller with 4 blades
Propulsion power	2,400.00 kW

The service speed at 90% MCR is 13.2 knots. The vessel has a transverse thrust propeller on the bow with 253 kW of power.

Figure 1. CH/T SICHEM COLIBRI

2.1.2. *Highlights of construction and vessel operation*

The main highlights in construction and operation of the vessel, in accordance with the data listed in Lloyd´s (www.lloydsmiu.com) and Equasis (www.equasis.org) databases are:

Construction

- Keel installation: 27 Dec, 1999
- Launched: 31 Jul, 2000
- Delivered: 23 Apr, 2001.

The vessel was christened with the name COLIBRI, which was later changed in 2005 to SICHEM COLIBRI.

Flag history:

The SICHEM COLIBRI has operated under with the following flags since she was built:

- Madeira: 01.01.00 to 05.11.04
- Singapore: 06.11.04 to 30.01.05
- Portugal: 31.01.05 to 09.04.05
- Singapore: 10.04.05 to 07.08.05
- Portugal: 08/08/2005 to 26/08/2005
- Malta: 27/08/2005 to date

Vessel managers:

The vessel has been managed by different companies from the time she was commissioned, but the relevant fact is that its managers, in accordance with the ISM code, were Spanish during the period between her commissioning and December, 2007 ("EITZEN CHEMICAL SPAIN" SA, and "EMS SHIP MANAGEMENT SL").

Currently, she is managed by the company "EMS SHIP MANAGEMENT INDIA".

2.1.3. *Certificates and remarks*

On the date of the accident, all of the vessel's certificates were valid, as could be verified in the Paris-MOU database. Also, on the same day of the accident an MOU inspection was carried out to confirm this.

Table 2 lists the status of the most important certificates.

2.1.4. *General arrangement*

The design of the vessel is typical of a chemical products vessel, with a dual hull with a total of 10 tanks and ballast tanks at the bottom and the sides.

The load capacity of the SICHEM COLIBRI at 98% of total capacity and excluding the slops, is 6,684 m3, distributed inside the 5+5 tanks, arranged along the cargo area.

The fuel tanks are located forward of the engine room, next to the cofferdam and on both sides of the vessel.

2.1.5. *The steering system*

The SICHEM COLIBRI is equipped with a steering system supplied by Aker Solutions with brand name Aker Porsgrunn Type 230-12/2. This system is comprised of the following components:

- A rotary vane actuator that acts upon the rudder stock.
- 2 independent control circuits, each of them comprised of:

  — Pumps
  — Electric motor
  — Oil tank
  — Directional control valves
  — Safety valves
  — Filters
  — Instrumentation

A diagram of the vessel's hydraulic steering system is shown in Figure 3:

Table 2. Status of the vessel's certificates

Certificates as of 11/08/2009	*Status*	*Date issued*	*Expiration date*	*Interval/ yearly*
International Ship Security Certificate	Approved	17/12/2007	02/08/2011	23/03/2009
Cargo Ship Safety Construction	Approved	15/05/2006	22/04/2011	17/06/2009
Cargo Ship Safety Equipment	Approved	22/06/2009	22/04/2011	
Cargo Ship Safety Radio	Approved	25/06/2009	22/04/2011	
Danger Chemical bulk of/bc-code	Approved	26/06/2007	22/04/2011	25/06/2011
Document of Compliance	Approved	07/11/2007	07/07/2010	03/07/2008
Load lines Certificates	Approved	25/06/2009	22/04/2011	
Safety Management Certificate	Approved	06/02/2008	02/08/2011	25/03/2009
Minimum Safe Manning Certificate	Approved	22/08/2005	21/08/2010	
Tonnage Certificate	Approved	05/10/2005		
Oil Pollution Prevention	Approved	22/06/2009	22/04/2011	

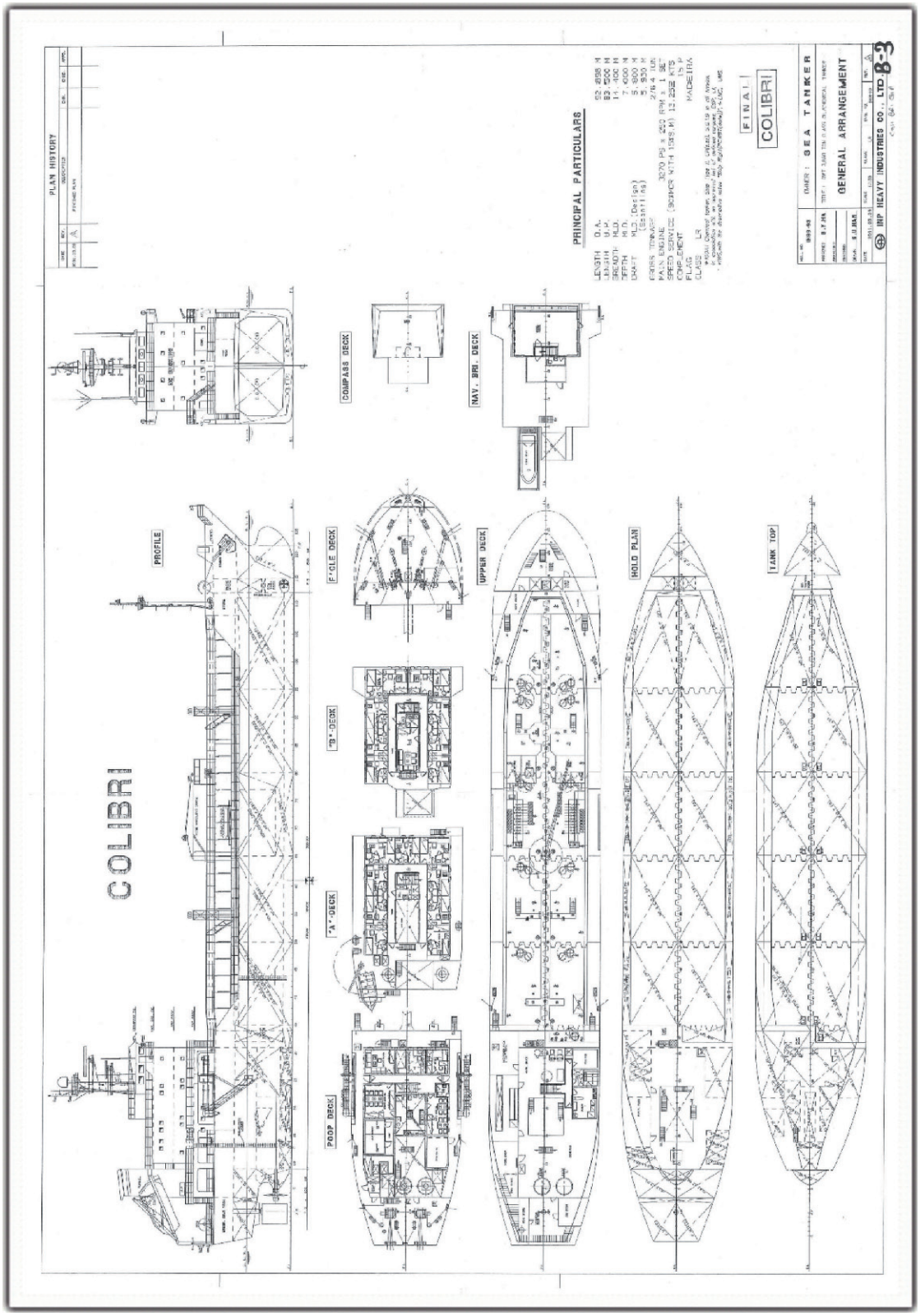

Figure 2. CH/T SICHEM COLIBRI. General arrangement

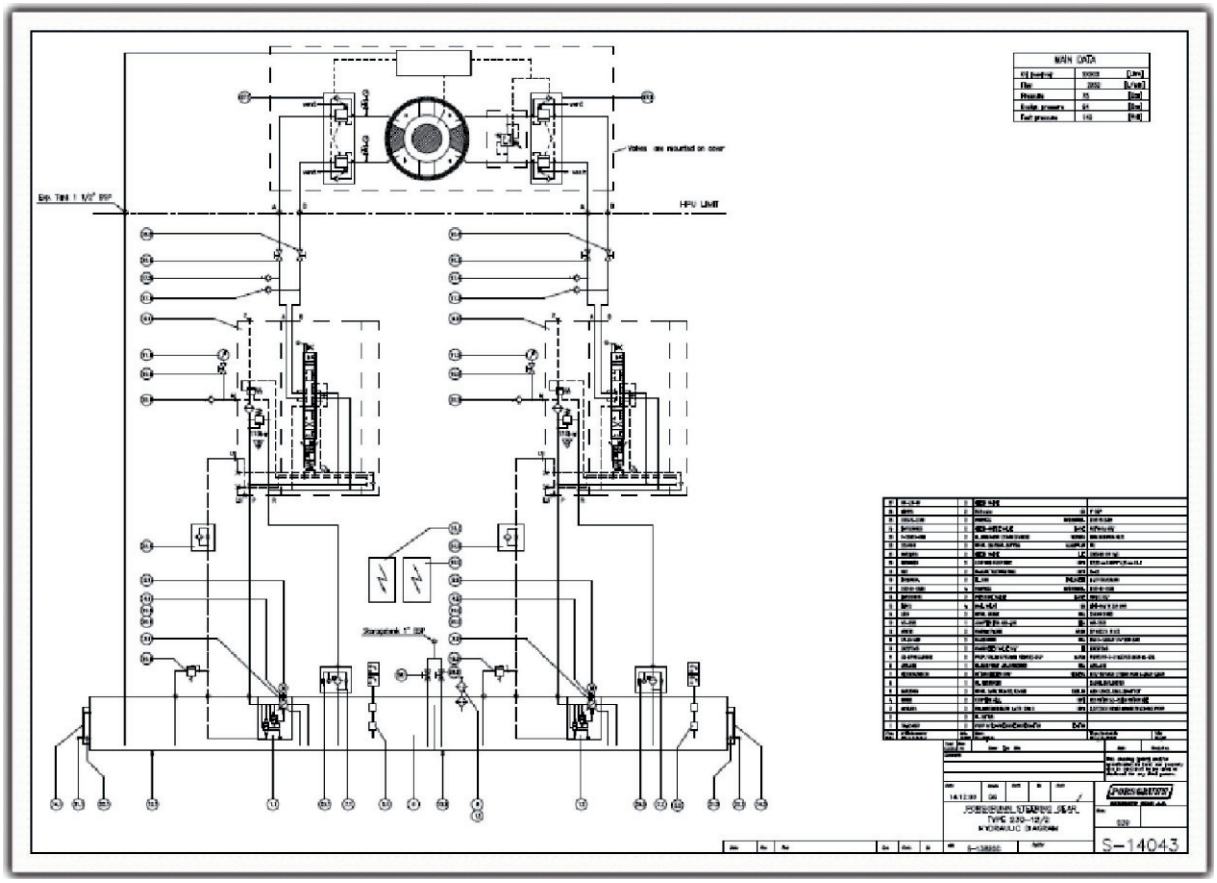

Figure 3. Diagram of the PORSGRUNN TYPE 230-12/2 hydraulic system

The design of the steering system for this type of vessel is regulated in Part I, Chapter II-1, Part C of the SOLAS convention. This chapter specifies that each vessel must have a primary and an auxiliary steering system arranged in a manner that if one of the systems fails, it does not affect the proper operation of the other.

In the event of failure of any of the steering systems, an acoustic alarm must be heard in the wheelhouse.

Chapter II-1 of the SOLAS Agreement of 1974 describes those anomalies of the steering system that must mandatorily trip a visual and acoustic alarm in the wheelhouse.

There are 5 alarms, which are listed in Table 3.

Table 3. Mandatory steering system alarms

ALARM	*REFERENCE (SOLAS 1974 - Chapter II-1)*
Power supply failure	Art. 29.5 (2)
Electrical overload	Art. 30.3
Failure in one of the phases	Art. 30.3
Steering system power supply failure	Art. 28.8 (4)
Low level in each hydraulic fluid reservoir	Art. 29.12

2.2. The Company

At the time of the accident, the vessel belonged to the company Eitzen Chemical Singapore Pte, based out of Singapore.

The main function of this company is the transportation of chemical products, with a fleet of more than 80 vessels. This company operates out of different offices located in Denmark, Spain, the USA and Singapore.

2.3. The Crew

The crew was managed through the company IBERNOR S.L., located in Bilbao, as requested by the vessel's operator. The personnel hired were of five different nationalities, but all of them spoke Spanish. In spite of this, the working language was English.

Table 4 compares the requirements mandated by the vessel´s minimum crew certificate with the actual crew on board.

All personnel were in possession of the titles, endorsements and certificates required for carrying out their jobs, in accordance with the provisions required by the STCW Agreement of 1978, as amended, and the minimum safe manning certificate issued by the flag authority.

This circumstance was confirmed by inspectors from the maritime Authority of Seville, who boarded the vessel to carry out an MOU inspection.

Table 4. The vessel's minimum crew and the status of her competency certificates

Crewmember	*Number of persons required*	*Number present on board with the required qualification*	*Nationality*	*Remarks*
Skipper	1	1	Spanish	
First Officer	1	1	Peruvian	
Deck Officer	1	2	Peruvian	1 Second Officer + 1 Third Officer
Chief Engineer	1	1	Peruvian	
First Engineer	1	1	Peruvian	
Engineering Officer	1	1	Peruvian	
Deck Seaman	3	4	Honduran, Peruvian and Colombian	1 Boatswain and 3 boatswain Assistants
Engineering Seaman	2	2	Peruvian	1 Fitter + 1 Oiler
Wiper	1	1	Chilean	Carries out the duties of a cook

Special conditions required by the "Minimum Safe Manning Certificate":

- The Skipper, the First Officer, the Chief Engineer and the First Engineering Officer must be properly certified in accordance with rule V/1 of the STCW Agreement of 1978, as amended *(Minimum training and qualification requirements for Skippers, Officers and Seaman on board tankers)*.
- At least two of the Deck Officers must be in possession of an SMSSM (GOC) general operator certificate.

* * *

Chapter 3. THE ACCIDENT

The times indicated in this report correspond to Spanish official time, unless expressly indicated otherwise.

3.1. Background

On the 10th of August, 2009 CH/T SICHEM COLIBRI, with 3,125 t of sodium hydroxide solution (caustic soda) in bulk, arrived at the mouth of the Guadalquivir River and anchored awaiting docking at Seville. She had originated from Lavera in France, from where she had departed on the 7th of August.

Her maximum draught was 6.70 m, to stern.

The weather conditions were favourable, with good visibility and good sea conditions, and the embarking of the pilot was scheduled for the following day at about 05:00 h.

Before the pilot came on board, the checks included in the company procedures were carried out, which consisted of testing the different essential equipment, including the primary engine and the steering system.

These operations began on the 11th of August at about 04:00 h, confirming that the forward and reverse operation of the primary engine was working properly. At around 04:30 h, the vessel's Skipper went up to the wheelhouse and at 04:36 they began to weigh anchors. The operation of the rudder was checked and no anomaly was detected. At 04:50 h the weighing of the anchor was completed and the helmsman was replaced with the most experienced one on the vessel. At 05:04 h, the pilot embarked and the vessel began her journey up river.

During the previous operations, at about 04:59 h, a high sweep temperature alarm in cylinder number 1 of the primary engine tripped. The Chief Engineer notified the Skipper and requested that 100% of propulsion power not be used for the manoeuvre.

The tide was rising and, therefore, the vessel would be subjected to an additional push by the entering current. High tide was expected at 07:05 h.

The vessel's course during its voyage up river was 069º. Her speed was progressively increasing until reaching 11.1 knots over the bottom, moments prior to the accident, as per the AIS.

Both servomotors were connected as required by Rule 25 of Chapter V of the 1974 SOLAS, and the steering was being carried out manually.

3.2. The accident

At 05:39 h, when the SICHEM COLIBRI had just surpasses buoys 11 and 12, the vessel began falling towards her port side and the helmsman warned the Skipper that the rudder was not responding and was stuck at a 20º angle towards the port side. No alarm sounded to warn of the blocked rudder.

Immediately, the Skipper began to shut down the engines and attempted to correct the course using the forward propeller, but he did not obtain the desired result. Then he set the primary engine into "full reverse" but, due to the vessel's inertia, her running aground at the left margin of the Guadalquivir Bar could not be avoided.

The Skipper was able to operate the rudder by shutting down and restarting the pumps, but the vessel had already run aground.

Figures 5 and 6 show the position of the SICHEM COLIBRI while she was travelling through the entry canal bar, at the exact moment prior to the steering gear failure being detected and turning towards her port side.

Figure 7 shows the sequence of events from the time the vessel began to turn towards her port side until she ran aground on the left margin of

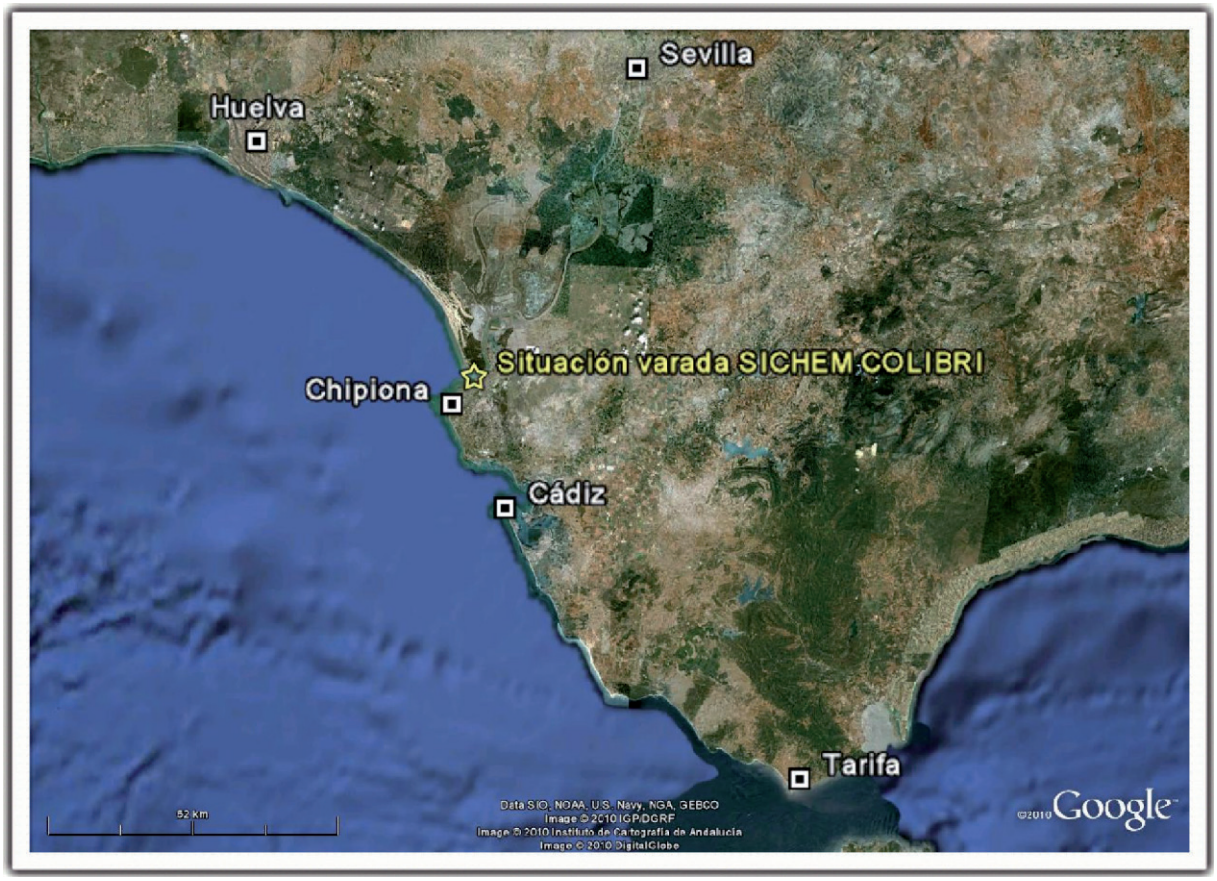

Figure 4. Location of the running aground of CH/T SICHEM COLIBRI, at the Guadalquivir River's mouth.

the bar, in an up river direction. The vessel went from moving at 11.1 knots, to completely stopping in approximately 90 seconds.

The dotted line that starts at the centre of the vessel corresponds to the vector that shows the speed and direction of the vessel's bow as transmitted by her AIS, and is based on information provided by the vessel's GPS; therefore, this information is delayed a few seconds with respect to the actual events. However, the silhouette of the vessel in red shows the direction of the bow as captured at each moment by the gyroscopic compass and, therefore, its depiction corresponds with the actual position of the vessel at that moment.

The sequence enables to verify that the vessel could not stop in time due to its great inertia, in spite of the manoeuvres that were carried out by the Skipper.

During the course of the "full reverse" manoeuvre ordered by the Skipper, the piston of the primary engine's cylinder number 1 was damaged, and the subsequent disabling of the piston by the part of the crew limited the effective power of the engine.

This resulted in the vessel's bow getting stuck at heading 317º, at position 36º 47.2' N; 06º 22.5' W, next to the buoy 14 - sandbar known as Bajo de la Riza.

At 06:10 h, Maritime Rescue was notified that the vessel had run aground at the entrance to the Guadalquivir River.

3.3. After the accident

At 05:45 h, once the SICHEM COLIBRI was aground, the port anchor was lowered in order

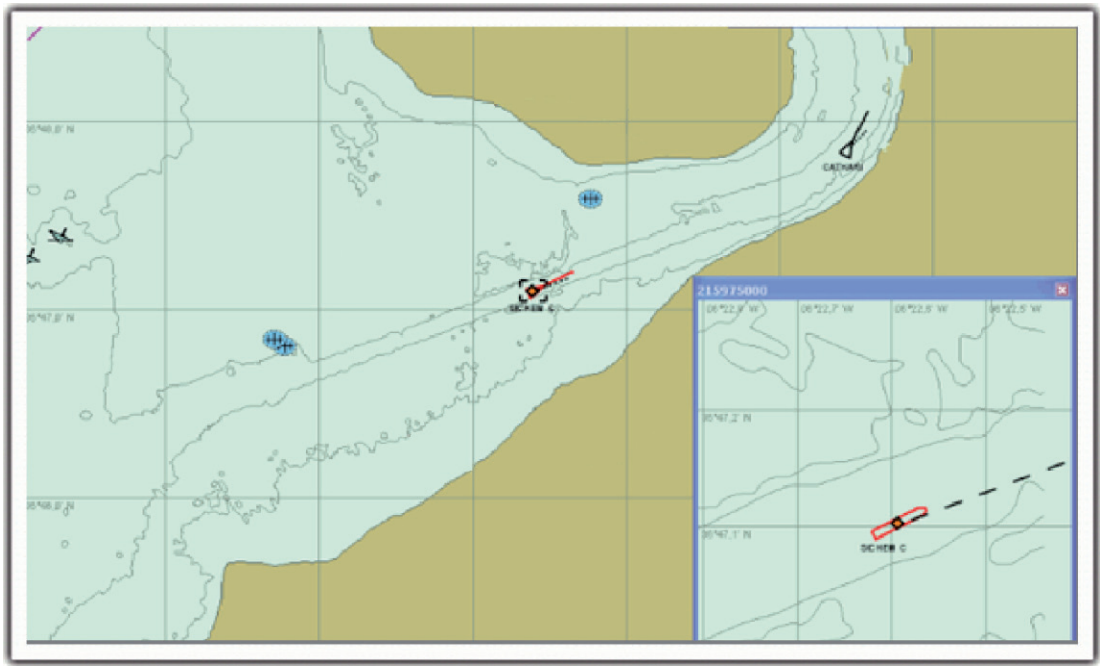

Figure 5. Moment prior to the steering gear failure (picture taken by the SASEMAR's AIS)

Figure 6. Moment prior to the steering gear failure.(picture obtained with Google-Earth)

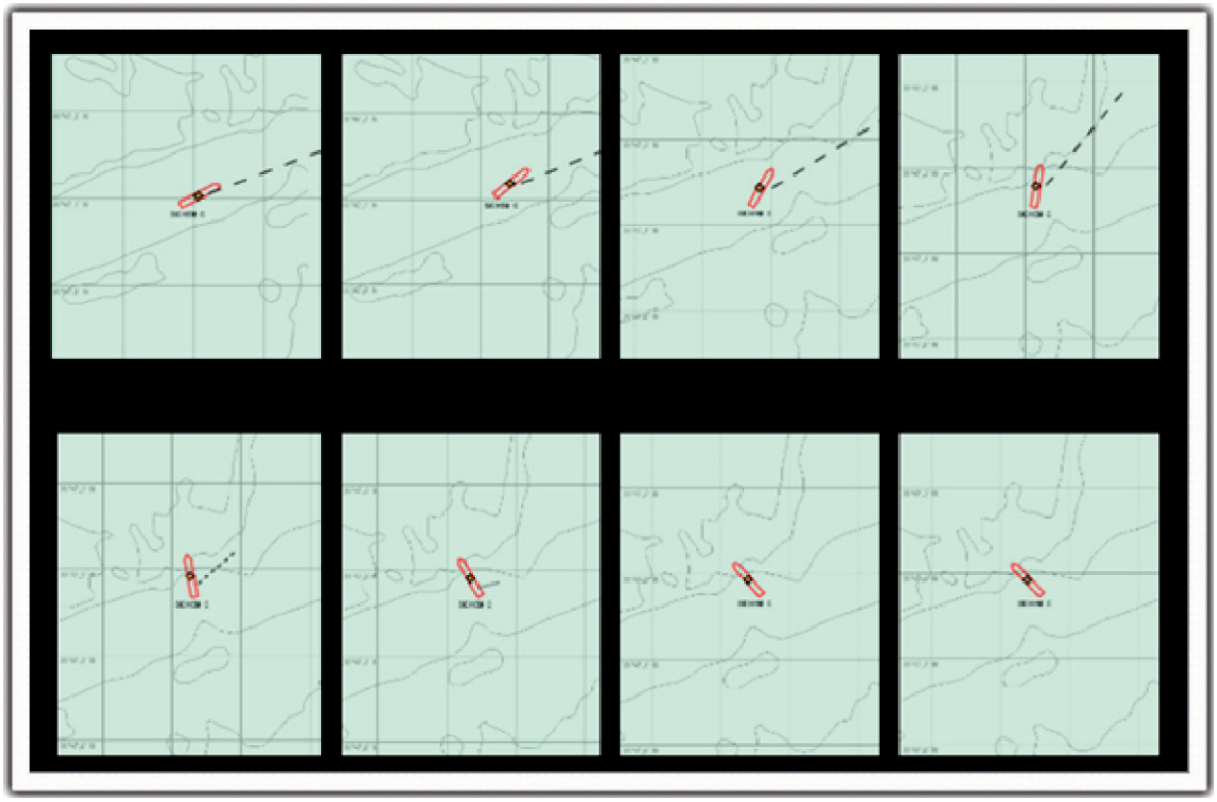

Figure 7. Sequence of events shown via the SASEMAR Rescue Centre's AIS screen.

to keep the vessel in a stable position while the tank depths and probes were checked, and to determine if the hull had suffered any damage.

The load inside starboard tank 1 was transferred to tanks 5 port and starboard in order to improve the vessel's stability.

At around 07:00 h, coinciding with high tide, an attempt was made to free the vessel using her own means by setting the engine in "full reverse", moving the rudder using the emergency steering and with the steering propeller, but due to the damage that had occurred to the piston of the primary engine's cylinder 1, and the indications that further damage may be caused, the manoeuvre was cancelled and they awaited assistance from a tug.

Rescue vessel "Salvamar SUHAIL" and rescue tug "R/V ZAMBRANO" arrived on scene to provide support in case of a spill. Since no spills were detected, they remained on standby. Also, rescue aircraft "R/A SERVIOLA DOS" carried out an aerial reconnaissance searching for possible leaks, with negative results.

Figure 8. Position in which the CH/T SICHEM COLIBRI ran aground

At the next high tide, at about 18:00 h, a second attempt was made but this time assisted by tugboat "VB SARGAZOS". At 17:48, the "VB SARGAZOS" was hooked to CH/T SICHEM COLIBRI and the tanker began raising her anchor. When it was raised, the tug began to pull and at about 18:14, CH/T SICHEM COLIBRE was released from the ground.

Figure 9. Position in which she ran aground next to buoy nº. 14 (La Riza)

Another inspection looking for signs of contamination was carried out, with negative results.

At 18:13 hours, the vessel was released from the ground and towed by her bow to an anchoring point located off of Chipiona. Tugboat "VB SARGAZOS" remained next to the SICHEM COLIBRI following the manoeuvre.

The next morning, on the 12th of August 2009, at 05:00 h, the SICHEM COLIBRI departed from the anchorage area of Chipiona towards Seville with tugboat "VB SARGAZOS" at her bow and the "VB SEVILLA" at her stern.

Figure 10. Salvamar rescue boat Suhail assisting the SICHEM COLIBRI

In Seville, inspectors from the vessel's Classification Society and from the Maritime Authority carried out an in-depth inspection that concluded on the 18th of August in Algeciras, where a submarine inspection was carried out to check the status of her hull. No serious damage was found in the steel but there were large areas in the forward bulb where the paint had disappeared (about 10%) or other areas where the paint had suffered serious damage (about 70% of the forward bulb) with numerous scratches. At the bottom area, in addition to areas in which the paint had been affected, a dent of approximately 1 square metre was discovered.

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Chapter 4. ANALISYS OF THE ACCIDENT

4.1. Cause of the accident

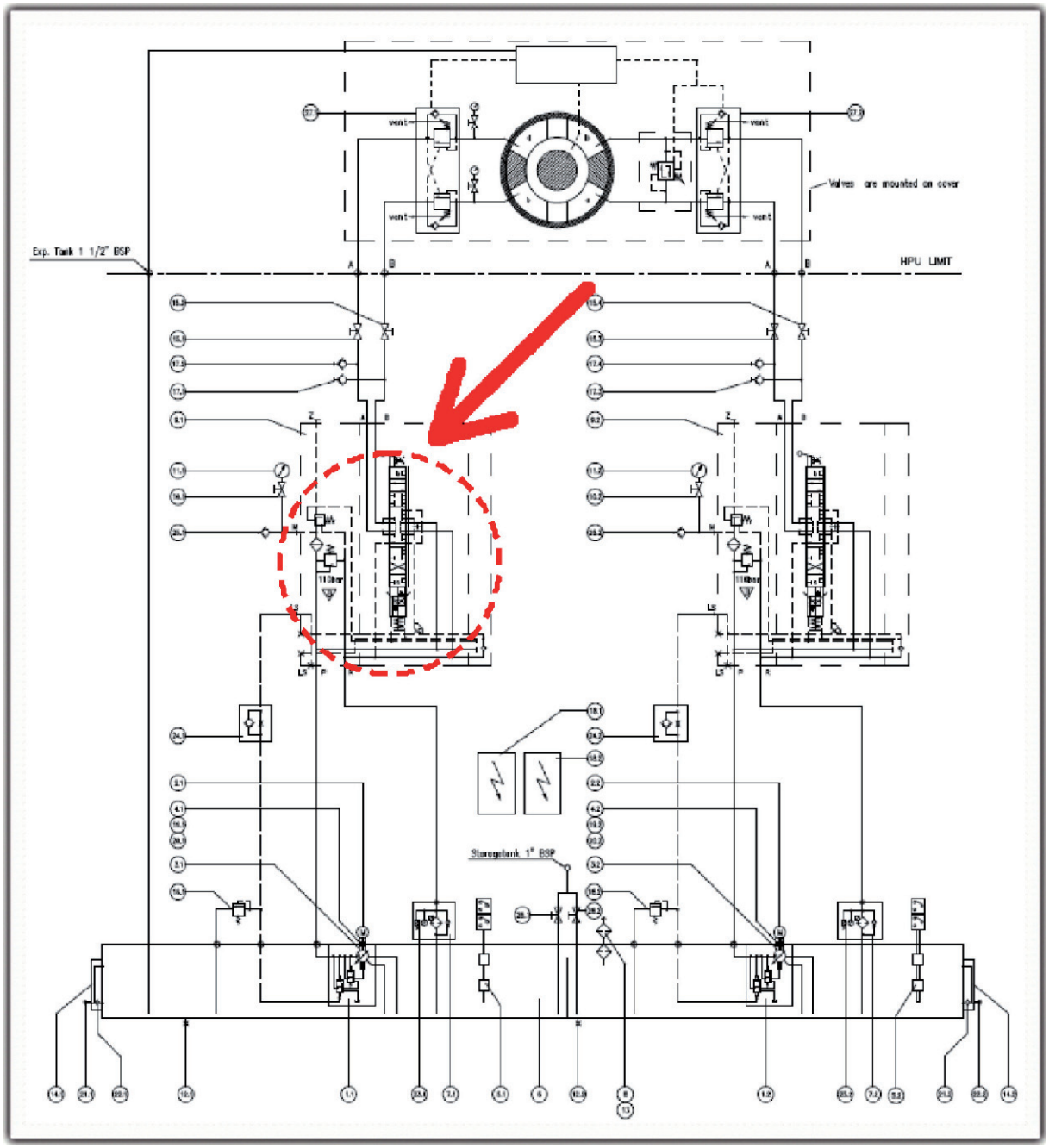

Figure 11. Hydraulic diagram of the steering gear: solenoid valve malfunction.

From the analysis of the technical reports drafted by the steering gear manufacturer, we can conclude the following:

- The cause of the accident was a failure in the remote controlled valve or solenoid valve, of the number 1 (starboard) steering gear system.
- One of the actuators that connected the emergency steering lever to the solenoid valve's piston was discovered broken. A fragment that had detached from this piece was obstructing one of the valve's lines.
- The result was that the valve line was left in a permanently open position, allowing unrestricted flow of hydraulic fluid to the system, which caused the rudder to move to the port side and remain in this position, without responding to rudder commands that were being executed from the Wheelhouse to the steering system.
- According to the manufacturer, this is the first time they have seen this type of failure.

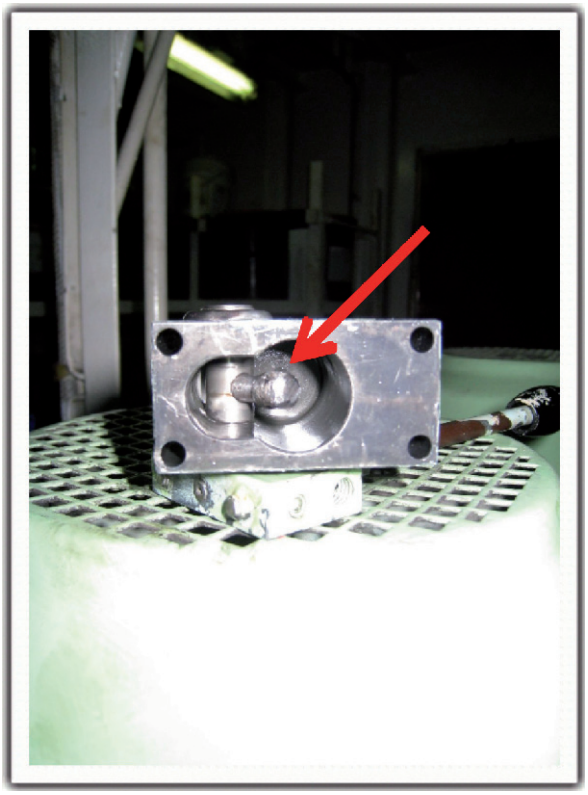

Figure 12. View of the broken solenoid valve actuator

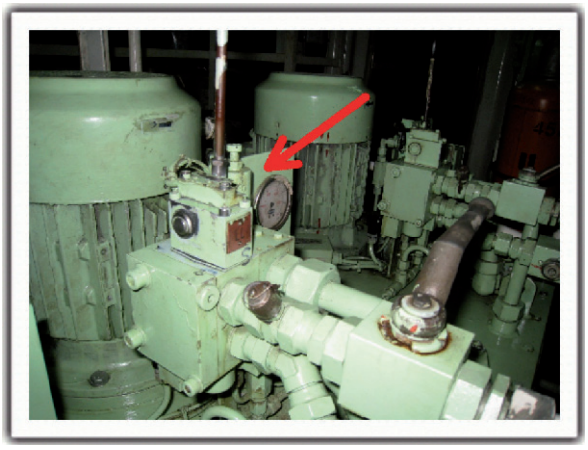

Figure 13. Location of the nº.1 steering gear emergency steering lever

4.2. Restricted canal.

The study of the accident demonstrates that only 26 seconds elapsed from the time the failure occurred until the vessel began to run aground. Another 64 seconds elapsed from the time her bow touched the ground until coming to a complete stop, so the total time from the start of the failure until the vessel stopped was 90 seconds. During the aforementioned 64 seconds, the vessel pivoted about her bow, changing course and losing the inertia she had accumulated due to her initial speed.

From the record of the conversations between the pilot and the crewmembers that were at the Wheelhouse, as well as the data recorded by the radar, GPS, gyroscopic compass and probe, we can see that the effective time elapsed between the moment the crew becomes aware of the failure and the moment in which the vessel runs aground was less than the aforestated 26 seconds, an error which can be easily explained due to the confusion experienced in the beginning.

The evidently limited space available at the Guadalquivir bar, at the location of the accident, about 94 m, further limited the crew's possibilities of preventing the running aground.

4.3. Compliance with regulations for travelling up river

The Port of Seville has not established a Regulation for navigating along the river. There is a limitation to the maximum draught of vessels according to the predicted tide coefficient. This scale is modulated by measurements such as the length, breadth, availability of the forward propeller, type of rudder and engine, etc. The nautical decisions are made by the pilots based on habits and their experience.

No special provisions exist for vessels transporting dangerous cargo, except they must transit during daylight hours.

4.4. Procedures followed by the crew

As per the ship's records, an emergency steering drill had been carried out on the 25th of July; in other words, half a month prior to the accident, as per the picture taken of the vessel's required drills matrix, which is shown in Figure 14.

Regarding the check procedures prior to entering and exiting the port, it could not be verified if the crew checked the steering system prior to beginning the manoeuvre. The history of preliminary checks was also not available, because the approved system on the vessel used an existing document. In other words, the procedures to be carried out by the crew in accordance with the Safety management System was listed on a laminated checklist, which was filled in, dated and signed using a grease pencil any time a port was entered or exited, erasing the previous record.

According to later statements, during the accident the crew did not act in accordance with the procedures approved by the manufacturer for these types of situations; instead, their actions were based on their experience.

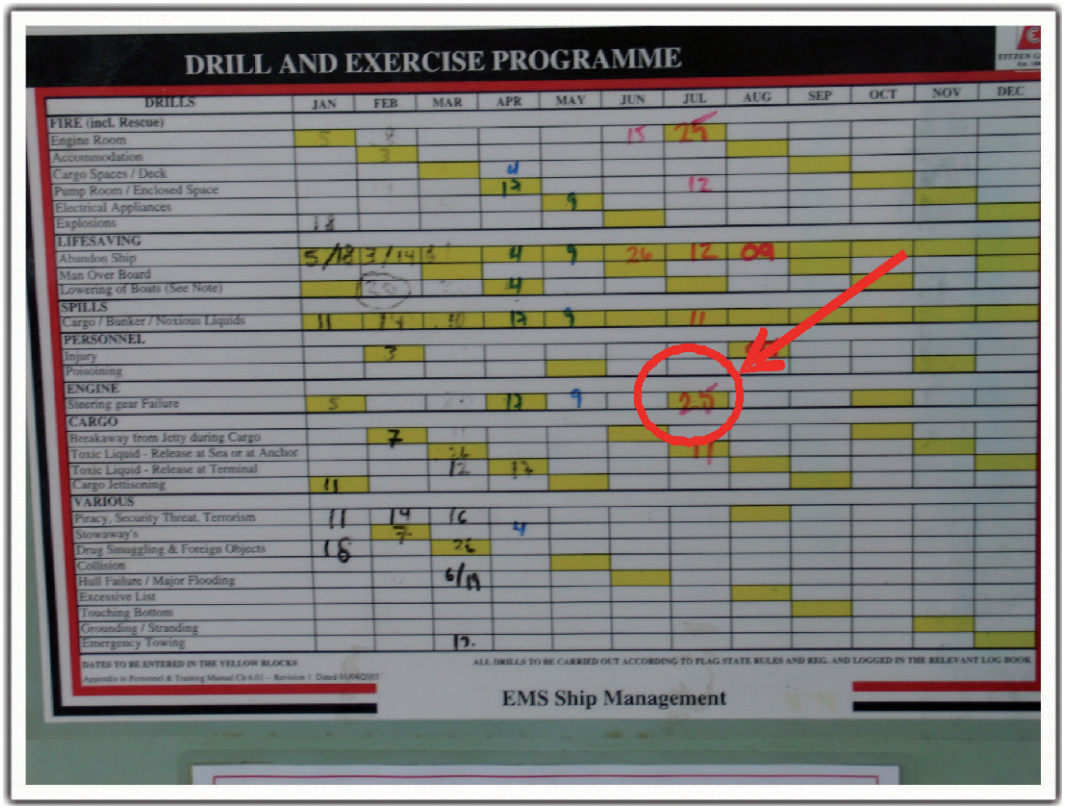

Figure 14. Required drills matrix

Given the lack of time, and the limitations imposed by the location they were in, they were not able to execute additional manoeuvres to prevent the grounding, such as drop and drag the anchors.

4.5. Data collected from the Voyage Data Recorder

The SICHEM COLIBRI was built in 2002 and, therefore, the applicable regulations regarding the installation of voyage data recorders, and especially regarding the data recorded in these devices, are less restrictive than current regulation requirements.

The SICHEM COLIBRI installed a simplified recorder model in 2009, in accordance with Rule 20 of Chapter V of the 1974 SOLAS, which among other data, did not require recording the following:

- The vessel's primary alarms.
- The rudder commands and their response.

Therefore, we can not assess whether or not the checks carried out prior to beginning the manoeuvre were effective. We can also not determine if the failure of the solenoid valve actuator was sudden, or if, on the contrary, it had been showing slight signs of malfunctioning until the moment in which it experienced a total failure.

4.6. Operation of the steering system alarms

The alarms system installed on board included the required alarms as well as the capability of detecting a hydraulic blockage problem and triggering the corresponding alarm, as shown in the picture of Figure 15.

Figure 15. View of the location of the hydraulic blockage indicator on the steering system's warning panel

During the hours prior to the accident and at the exact time of the accident the crew did not report any warning or alarm of any type, regarding the malfunctioning of the steering system and, therefore, they were not able to anticipate the accident and prepare themselves.

The investigator on location was able to verify that no alarm had been generated at the vessel's central warning panel regarding the steering system on that day, except when the system was shut down during the inspection procedure after the accident.

The company that built the steering system reported that the warning control program of the electromagnetic sensors included in the steering system, which activated a hydraulic blockage warning, was in need of an upgrade.

* * *

Chapter 5. CONCLUSIONS

From everything that has been presented, this Commission has concluded the following:

- The cause of the vessel running aground was a failure in the vessel's steering system due to the rupture of a component of the number 1 servomotor solenoid valve, resulting in the detachment of a metallic piece, which blocked another part of the valve, causing hydraulic fluid to constantly flow in one of the circuits. This occurrence caused the steering system to move the rudder towards the port side and to remain blocked in that position, at a 20º angle.
- No proof exists that enables us to explain if the rupture was due to poor maintenance, material fatigue, an error in its design, or if it was due to any other cause.
- The hydraulic blockage alarm built in to the system, which should have detected the failure, did not work properly. However, the proper operation of the alarm would probably have not prevented the grounding of the vessel.
- The failure detected in the propulsion engine moments prior to the accident did not contribute to the accident. This failure prevented the vessel's engine from employing all of its power during subsequent procedures that were carried out to free the vessel from the ground.
- Had the builder's instructions been followed in the event of a steering system failure or fault, thiswould not have been able to prevent the grounding, due to the limited time that was available to react and the distance required to carry out the manoeuvre in accordance with the vessel's performance charts.
- The instructions for acting in the event of a steering system failure should have been available at a location that was readily accessible to personnel steering the vessel, instead of being kept in the panel opposite the steering console.

* * *

Chapter 6. **RECOMMENDATIONS**

In order to prevent similar accidents, and as a result of the assessment of the accident of chemical tanker SICHEM COLIBRI, the Standing Commission for Maritime Accidents and Incident Investigations Plenary recommends the following:

Aker Solutions, company that manufactured the steering system:

1. To carry out an inspection of its production systems to ensure that manufactured components meet the specifications regarding materials' quality, resistance and fatigue behaviour.
2. That when they upgrade the software of any of their systems they notify and offer said software upgrade to the customers that have those systems installed.

The Port Authority of Seville:

3. To study the need to establish special conditions for transiting up the Guadalquivir River for vessel's transporting dangerous cargo. These conditions may be, for example, to limit the speed at specific sections that are particularly difficult, preparing the anchoring manoeuvre, etc.

The Company EITZEN CHEMICAL (SINGAPORE) PRIVATE Ltd.:

4. To position the emergency procedure charts of essential equipment inside their vessels at a location where they can be read by personnel while operating that specific system.

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Annex 1. ORGANIZATIONS THAT COMPRISE THE CIAIM

The organizations that comprise the CIAIM are the Plenary and the Secretariat.

The Plenary

The Plenary Commission is charged with validating the classification of accidents or incidents and approving reports and recommendations provided after a technical investigation has been conducted.

It is comprised of the following personnel:

- The President, appointed by the Minister of Public Works and Transport.
- The Vice President, a civil servant from the General Secretariat of the Minister of Public Works and Transport.
- A board member proposed by the Colegio de Oficiales de la Marina Mercante Española (Spanish Merchant Marine Officers Association), COMME.
- A board member proposed by the Colegio Oficial de Ingenieros Navales y Oceánicos (Official Naval and Oceanic Engineers Association),COIN.
- A board member proposed by the Asociación Española de Titulados Náutico-Pesqueros (Spanish Association of Nautical/Fishing Degree Holders), AETINAPE.
- A board member proposed by the Canal de Experiencias Hidrodinámicas de El Pardo (Public Hydrodynamic Centre for Model Tests), CEHIPAR.
- A board member proposed by the Centre for Public Works Studies and Experimentation, CEDEX.
- A board member proposed by the Secretaría General del Mar del Ministerio de Medio Ambiente y Medio Rural y Marino (Secretariat General of the Sea: Environment and Rural and Marine Affairs Ministry).
- A board member proposed by the Agencia Estatal de Meteorología (State Meteorological Service) AEMET.
- A board member proposed by the Autonomous Community where the accident has occurred.
- The Secretary appointed by the Minister of Public Works and Transport. Will participate in Plenary deliberations with a voice but without voting rights.

The Secretariat

The Secretariat falls under the Plenary Commission Secretary and carries out the investigation work as well as the reports that will be studied and approved afterwards by the Plenary.

The Secretariat is comprised of the following personnel:

- The Commission's Plenary Secretary.
- The investigation team comprised of Career civil servants belonging to the General Administration of the State.
- Administrative and technical personnel assigned to the Secretariat.

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