GOBIERNO DE ESPAÑA
MINISTERIO DE TRANSPORTES, MOVILIDAD Y AGENDA URBANA
SUBSECRETARÍA DE TRANSPORTES, MOVILIDAD Y AGENDA URBANA
COMISIÓN PERMANENTE DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES MARÍTIMOS

CIAIM-19/2021 REPORT

Operational accident on board the CIUDAD DE PALMA in Santa Cruz de Tenerife during loading operations on the 20th of June 2020, resulting in one fatality and two very serious casualties.

NOTICE

This report has been elaborated by the Spanish Maritime Accident and Incident Investigation Standing Commission (CIAIM), which is regulated by article 265 of the reformed text of the Law of State Ports and the Merchant Navy, approved by Royal Legislative Decree 2/2011, of the 5th of September, and by Royal Decree 800/2011, of the 10th of June.

The aim of the CIAIM when investigating maritime accidents and incidents is to draw conclusions and extract lessons that allow the risk of future maritime accidents to be reduced, and hence contribute to maritime safety and to preventing pollution from shipping. To this end, the CIAIM carries out a technical investigation in each case in which it attempts to establish the causes and circumstances that, directly or indirectly, may have contributed to the accident or incident and, when necessary, to issue the appropriate safety recommendations.

The elaboration of this technical report is not intended in any way to prejudge any judicial decisions that may be produced, nor does it seek to evaluate responsibilities nor to determine guilt.

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Figure 1. Vessel: CIUDAD DE PALMA

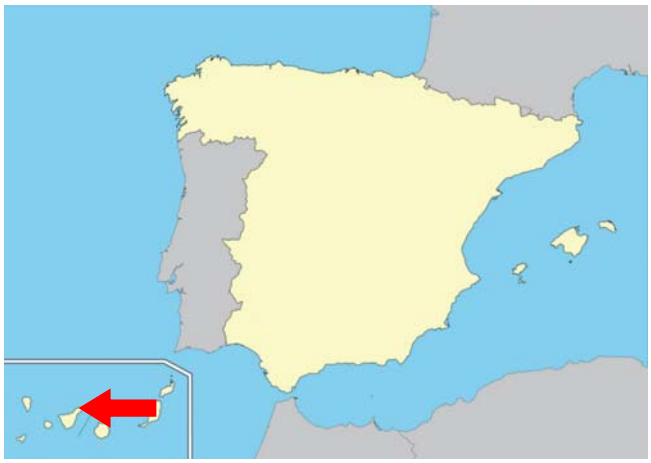


Figure 2. Location of the accident

1. SUMMARY

In the early hours of the 20th of June 2020, the vehicle freight and passenger transport (ro-pax) vessel CIUDAD DE PALMA was docked at the port of Santa Cruz de Tenerife, where vehicles were being loaded and stowed on board. The crew were engaged in tying down the trailers[1] that the dockers, using tractor units, were loading onto the vessel and depositing in the rows assigned for this purpose on the cargo decks.

Around 12:20 a.m. local time, one of the tractor units brought a trailer and positioned it in the specified location. It disengaged from the trailer and moved back a few metres, so that the vessel's crew could tie the trailer down as normal, and then stopped. The driver of the tractor unit then started to change his position within the cab and got ready to leave the vehicle stowage area and head towards the loading dock. When the tractor unit started to move, it did so in the opposite direction to the one expected, and ran over the three seamen who were tying up the recently deposited trailer.

One of the seamen died as a result, while the other two suffered injuries with a very serious prognosis. The deceased and one of the injured seamen were trapped between the tractor unit and the trailer, and had to wait for the firefighters to come and free them.

1.1. Investigation

CIAIM was notified of the incident on the 22nd of June 2020. That same day, the case was provisionally classified as an "extremely serious accident" and the decision was made to open an investigation. A CIAIM committee meeting ratified the classification of the incident and the initiation of the safety investigation. This report was reviewed by a CIAIM committee meeting on the 14th of October 2021 and published on April 2022 after being approved.

[1] In English, these trailers are commonly referred to as "lorries", i.e. semi-trailers adapted for the transportation of containerised or palletised freight on a ro-ro or ro-pax vessel, or in the port area. Some types of trailer can be transported on conventional roads.

2. FACTUAL INFORMATION

PARTICULARS OF THE SHIP / VESSEL	
Name	CIUDAD DE PALMA
Flag / Port of Registry	Cyprus / Limassol
Identification	IMO no.: 9349772 / MMSI no.: 209042000 / Call sign: 5BTW4
Type	Vehicle freight and passenger transport (ro-pax) vessel
Main details	Length overall: 186.40 m Length between perpendiculars: 177.40 m Width: 25.60 m Draught: 6.71 m Gross tonnage: 27,105 GT Hull material: steel Propulsion: 2 MAN model 9L48/60B diesel engines, with 2 variable-pitch propellers and total power of 21,600 kW, providing a service speed of 23.5 knots. Capacity: 949 passengers, 190 cars and 2,247 linear metres of vehicle freight.
Ownership and management	The vessel is owned by COMPAÑÍA TRASMEDITERRÁNEA, S.A. (IMO no.: 0336577)
Classification society	Registro Italiano Navale (RINA)
Shipbuilding details	Construction no. 218 (year 2007) by VISENTINI CANTIERE NAVALE (Porto Viro, Italy)
Minimum safe manning	28, 19 of which are maritime professionals and 9 are classified as "General Service" (non-STCW classification)
VOYAGE PARTICULARS	
Departure / Arrival ports	Departure from Santa Cruz de La Palma and arrival at Santa Cruz de Tenerife
Type of voyage	Commercial; coastal shipping.
Cargo information	Lorries and loaded trailers
Crew	40 crew members, of whom 25 were maritime professionals and 4 were cadets (2 deck cadets and 2 engine cadets), thereby fulfilling the minimum safe manning requirements
Documents	The vessel's documents were in order
INFORMATION ON THE INCIDENT	
Type of incident	Operational accident
Date and time	20Th of June 2020, 12:20 a.m. local time.
Location	Port of Santa Cruz de Tenerife
Vessel's operations	Loading vehicle freight
Location on board	Deck no. 3 (main deck)
Ship damage	No damage
Fatalities / missing / injured on board	1 fatality / 2 people very seriously injured
Pollution	No
Other non-ship damage	No
Other personal injuries	No
MARINE AND METEOROLOGICAL CONDITIONS	
Wind	Wind from the NE, 9 knots, force 3
Sea conditions	Calm (inside the inner harbour)
Visibility	Good
INTERVENTION OF LAND-BASED AUTHORITIES AND REACTION OF EMERGENCY SERVICES	
Organisations involved	112 medical services, port services, Santa Cruz de Tenerife firefighting services
Means deployed	Those of the aforementioned organisations
Speed of intervention	Immediate
Measures adopted	Deployment of firefighting services and ambulances
Results obtained	The injured personnel were freed and attended to *in situ*. The body of the deceased was recovered

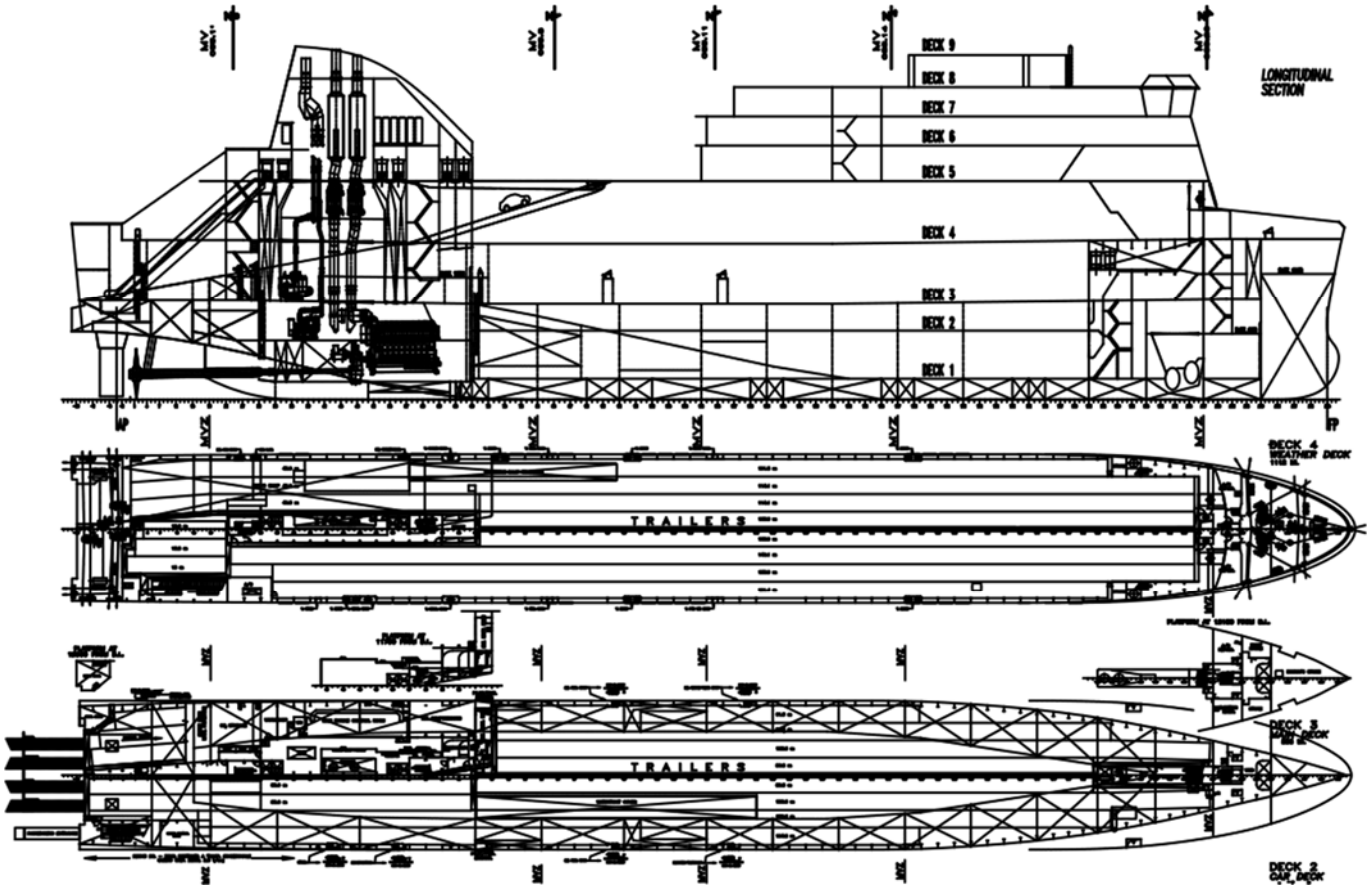


Figure 3. General layout (partial) of the CIUDAD DE PALMA. Only profiles and the floor plan of decks 3 and 4 are shown.

2.1. Other information

CIAIM has had access to the legal file that was opened in relation to this case.

This report was prepared with the cooperation of the owner and crew of the CIUDAD DE PALMA, the cargo-handling company and the Port Employment Centre, whose Occupational Risk Prevention Service has collaborated with the investigation. The following documents and records were accessed:

- Logbook
- Port logbook
- Company procedures for the operations of loading and unloading
- Procedures of the cargo-handling company for the loading and unloading of ro-ro and ro-pax vessels
- Port Employment Centre documents on occupational risk

CIAIM interviewed the injured personnel when their health permitted. The docker who was operating the tractor unit declined to cooperate with CIAIM's investigation. On the advice of their legal counsel, the other three dockers who were in the vessel's vehicle stowage area at the time of the accident also declined to cooperate.

CIAIM brought a technician from the manufacturer of the tractor unit (KALMAR) to inspect the condition of the unit involved in the accident. The inspection was carried out on the 29th and 30th of July and all of the parties involved, including the workers' Risk Prevention Officers, were invited to take part. The inspection took place in the monitored warehouse where the tractor unit was located.

See Appendix A for the dimensions of the tractor unit.

The closed-circuit video monitoring system installed on the vessel was designed for real-time transmission, and was not set up to record. Consequently, there is no video evidence of the moment of the accident.

3. DETAILED DESCRIPTION

This description of events is based on the available data, statements and reports. The times given refer to local time.

Figure 4. The CIUDAD DE PALMA docked, with stern facing the loading dock for vehicle freight and ramp lowered, at the port of Santa Cruz de Tenerife.

At 10:00 p.m. on the 19th of June 2020, the Cyprus-flagged ro-pax vessel CIUDAD DE PALMA arrived at the port of Santa Cruz de Tenerife, having sailed from La Palma[2]. The intention was to carry out various passenger and freight loading and unloading activities and then proceed to the next port (Las Palmas) upon their completion.

Figure 5 shows the chronology of the CIUDAD DE PALMA's visit to the port of Santa Cruz on the 19th and 20th of June.

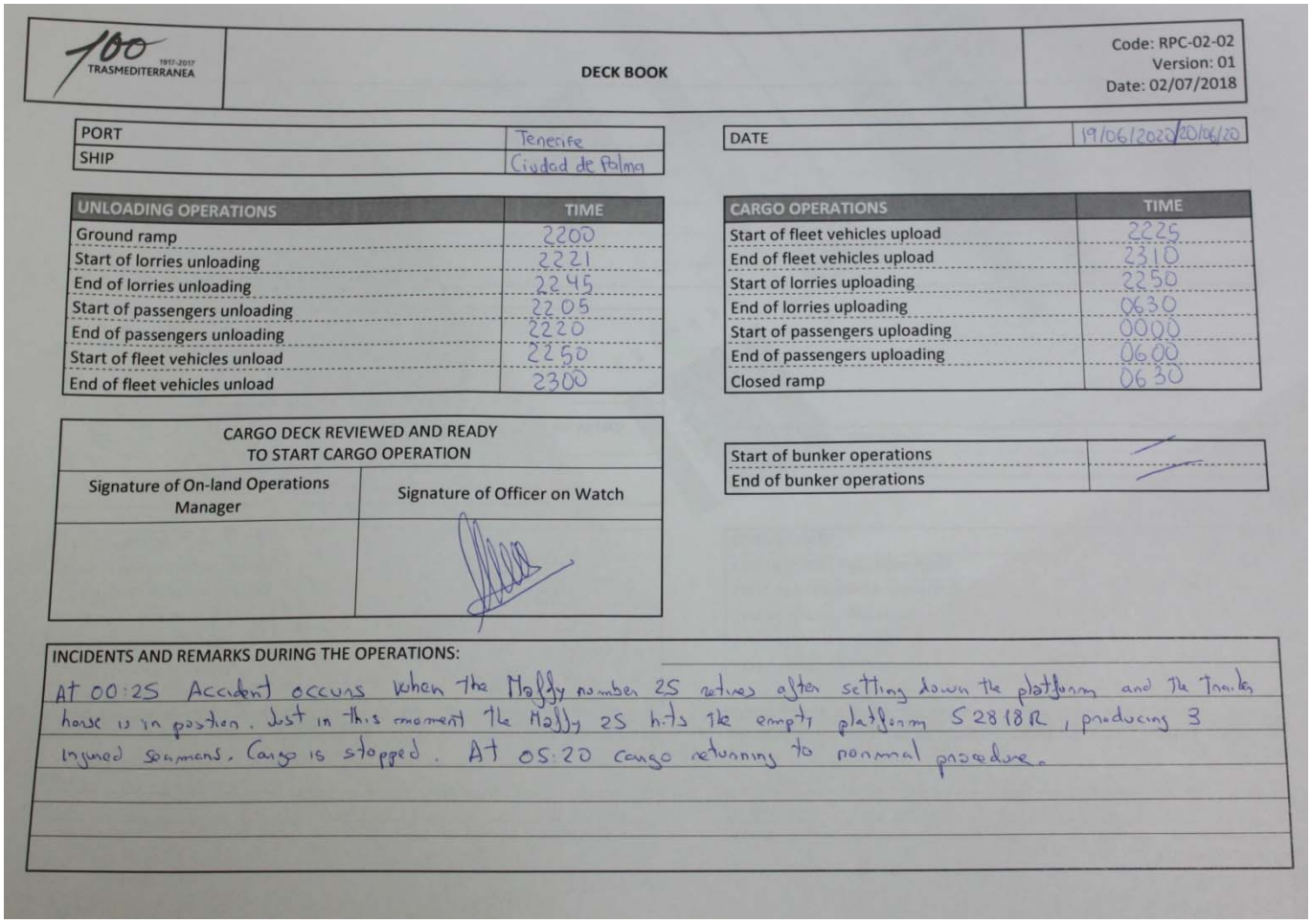
After docking, and once the passengers for Santa Cruz had disembarked, the first officer and the dockers' foreman agreed on[3] the work that was to be carried out during this visit. The tasks of unloading the trailers and lorries destined for Santa Cruz and loading the trailers and lorries destined for other ports were carried out simultaneously. The loading and unloading operations were to be carried out in accordance with the Loading Plan shown[4] in Figure 6.

The crew of the CIUDAD DE PALMA were distributed between the different decks, in order to carry out the operations. The same applies to the dockers.

[2] The vessel was following a pre-established circular route: a regular coastal line that began in Cádiz and called at various Canary Islands ports in accordance with the requirements of the logistics chain and the company's operating decisions. On this occasion, the route took in the ports of Las Palmas de Gran Canaria, Santa Cruz de Tenerife, Las Palmas again, La Palma, and Santa Cruz again, which is where the accident occurred. Subsequently, the vessel was due to call at Puerto del Rosario and Arrecife, before returning to Cádiz and commencing the route again.

[3] This is a very important meeting in which the vessel and dockers are apprised in full of the operations that are to be carried out, and discuss and resolve any problems and unforeseen issues not identified in the Loading Plan. Normally, the Loading Plan is proposed by the terminal or logistics company in charge of loading, and takes into account the characteristics of the vessel and the sequence of the ports that are to be visited. It must always be approved by the vessel.

[4] In black and white, in the original.



100 1917-2017 TRASMEDITERRANEA

DECK BOOK

Code: RPC-02-02
Version: 01
Date: 02/07/2018

PORT	Tenerife
SHIP	Ciudad de Palma

DATE: 19/06/2020 20/06/20

UNLOADING OPERATIONS	TIME
Ground ramp	2200
Start of lorries unloading	2221
End of lorries unloading	2245
Start of passengers unloading	2205
End of passengers unloading	2220
Start of fleet vehicles unload	2250
End of fleet vehicles unload	2300

CARGO OPERATIONS	TIME
Start of fleet vehicles upload	2225
End of fleet vehicles upload	2310
Start of lorries uploading	2250
End of lorries uploading	0630
Start of passengers uploading	0000
End of passengers uploading	0600
Closed ramp	0630

CARGO DECK REVIEWED AND READY TO START CARGO OPERATION

Signature of On-land Operations Manager	Signature of Officer on Watch

Start of bunker operations	
End of bunker operations	

INCIDENTS AND REMARKS DURING THE OPERATIONS:

At 00:25 Accident occurs when the Moffy number 25 retires after setting down the platform and the Trailer horse is in position. Just in this moment the Moffy 25 hits the empty platform S 2818 R, producing 3 injured seamens. Cargo is stopped. At 05:20 cargo returning to normal procedure.

Figure 5. Log of the operations carried out on deck.

With regard to the crew, on Deck 3 (as shown in the Loading Plan) three seamen[5] and one deck cadet were working. With regard to the docker team, there were two people on Deck 3 to handle the trestles that were placed beneath the trailers.

The loading operations were taking place as normal. At one point, the first officer came down to the dock in order to check the draught marks and discuss some pending matters with the bosun. The cadet was responsible for checking the numbers of the trailers that were arriving against the information specified in the Loading Plan. The seamen were responsible for tying down the trailers after the tractor units had withdrawn.

The deck was not yet fully loaded; approximately half of the trailers still needed to be brought on board. During loading, trailer no. S-02818-R (circled in red on the Loading Plan shown in Figure 6, and destined for row 7 on Deck 3) was brought to the vehicle stowage area by the tractor unit. On the starboard side, the space adjacent to the one assigned to the trailer was occupied, while on the port side, the space adjacent was free.

The tractor-trailer comprising the tractor unit and trailer no. S02818 performed a 180º turn in order to position the trailer in front of the assigned space.

The driver then performed a series of routine actions that were necessary in order to deposit the trailer in its space: he looked towards the trailer and the space it was to occupy, and then, guided by the crew, he proceeded to push the trailer into the space specified in the Loading Plan. He then stopped the tractor unit and raised the fifth wheel in order to lift up the end of the trailer. His docker colleagues placed a trestle underneath the trailer, lowered the trailer's supports (or "legs"), and then withdrew.

[5] Technically, there was one seaman and two deckhands: however, they are referred to here as three seamen in order to lend clarity to the text and because they were all performing exactly the same activities.

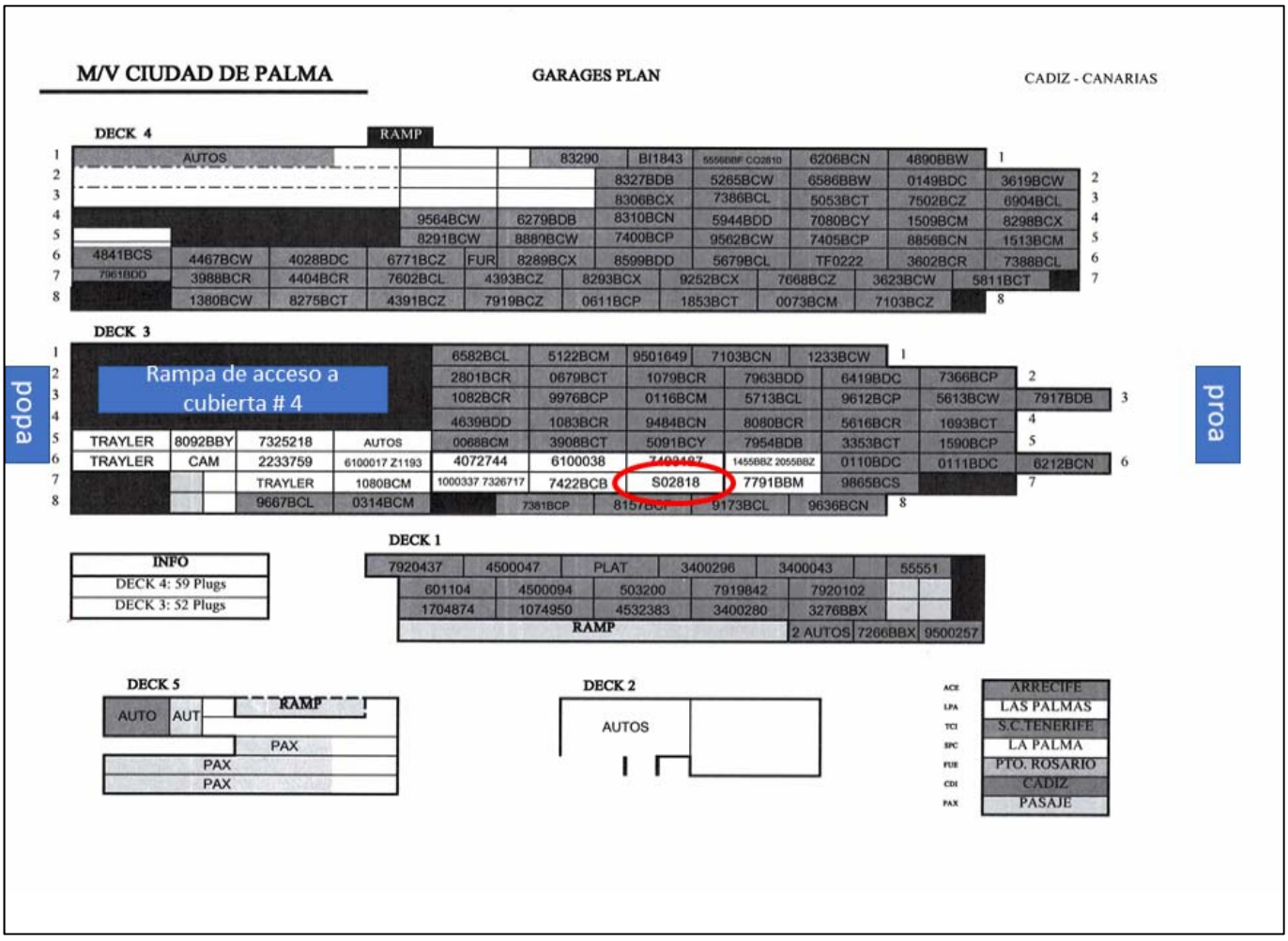


Figure 6. Loading Plan

The driver withdrew the tractor unit around five metres from the trailer he had deposited, and then stopped[6]. Meanwhile, the crew made their way to the trailer in order to tie it down, to which end they positioned themselves between the trailer and the tractor unit. While the seamen were working at the front of the trailer, with their backs to the tractor unit, they were alarmed to hear the sound of an unexpected acceleration[7]. The cadet was positioned a short distance away from the tying-down area, in order to avoid getting in the way, and he saw the tractor unit drive at full speed - owing to the acceleration provided by the engine - into the trailer. He gave a warning shout, but there was not enough time for the seamen to react to it and they were unable to avoid the impact. The tractor unit's fifth wheel impacted violently[8] against the trailer's king pin, lifting the trailer up and moving the trestle.

Figure 7. Trailer similar to the one involved in the accident, shown from the rear.

Two of the seamen were impacted in the collision and trapped. The third seaman was also impacted, but was knocked aside and therefore was not trapped. The accident occurred at approximately 12:20 a.m. on the 20th of June.

[6] Normally, the driver waits for a few moments to make sure it is not necessary to adjust the trailer's position.
[7] To the best of their recollection, the injured individuals were aware that the tractor unit was accelerating and that something was wrong, but they did not have enough time to get out of the way.
[8] As explained in the "Analysis" section, this is relevant because it indicates the force with which the accelerator was pressed.

The cadet immediately used his walkie-talkie (VHF channel 72) to request help from the first officer and telephoned the vessel's doctor. The first officer ran to the scene, while telephoning 112 to request ambulances. When he arrived at the scene, around a minute later, he found that the dockers had left[9], accompanied by the driver, who was in extreme distress.

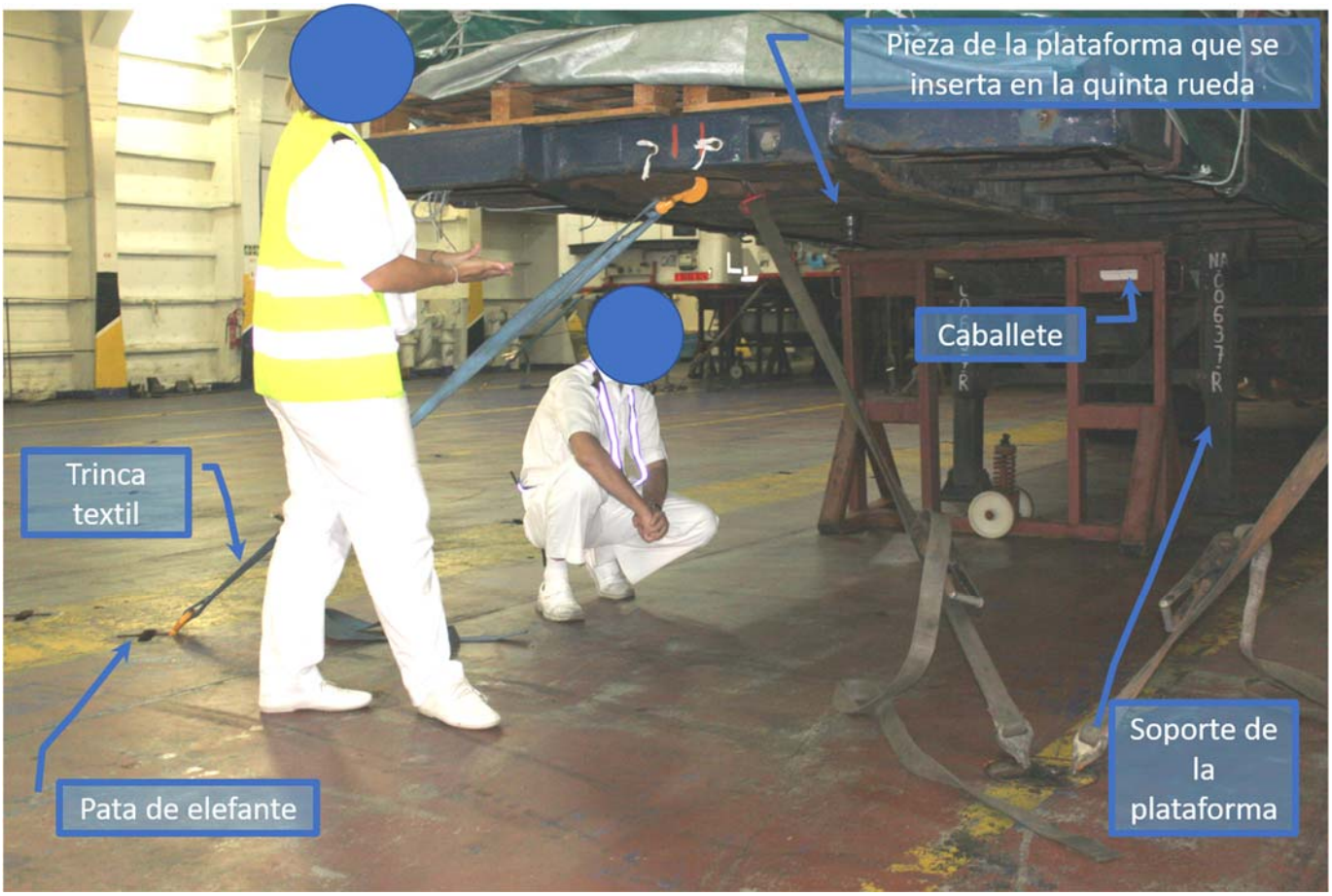


Figure 8. Officers of the CIUDAD DE PALMA demonstrating a working environment similar to the one in which the accident occurred[10].

The doctor and officers tended to the injured personnel until the 112 medical services arrived, some minutes later; however, they found that they could do little to help the trapped men, as they could not be moved from their position. Meanwhile, a number of dockers came to try to help free the injured men.

The medical services contacted the firefighters to request their assistance in rescuing the injured men. The dockers brought over a machine called a "lifter"[11], which was used to free the injured men. When they were freed, it was found that one of the men was already dead[12]. The other two were taken to hospital with very serious injuries: the first man was taken shortly after the ambulances arrived, and the second after he was freed.

4. ANALYSIS

4.1. Vessel-dock interface.

4.1.1. Working on board the CIUDAD DE PALMA.

The deck crew comprised a first officer, two second officers, a bosun, five seamen, and three deckhands.

[9] This circumstance is discussed in the "Analysis" section.
[10] The trailer's supports are retracted while the trailer is moving.
[11] A pallet lifter.
[12] According to the witness statements, and the vessel's doctor in particular, nothing could be done for the man, owing to the severity of his injuries.

During loading and unloading, the crew were distributed between the different decks in order to ensure that the vehicle freight was loaded correctly, as per the Loading Plan, and to tie it down. In each vehicle stowage area where work was being carried out there were three or four seamen tying down the trailers, accompanied by an officer with a walkie-talkie who made a note of the numbers of the trailers brought by the dockers, in order to check that the Loading Plan was being followed correctly.

As the trailers did not have their own means of traction, they had to be coupled to tractor units that transported them to the locations specified in the Loading Plan.

The tractor units that are used in shipping terminals allow the driver to rotate 180º within the cab, so that he has the visibility and capacity to push or pull the trailer according to the needs of the task at hand and regardless of the gear (forward or reverse) that the tractor unit has engaged.

At the loading dock, drivers hitch a trailer to the tractor unit using a device called a fifth wheel, and then tow the trailer along the dock, onto the vessel and into the position assigned in the Loading Plan. The final manoeuvre to position the trailer is carried out with the driver "facing the trailer" and pushing it, so that he has maximum visibility of the working area, and with the crew signalling the final movements that need to be made (a little to the left/right, forward, come forward slowly, stop, etc.).

When the trailer is in the correct place, but before it is definitively positioned in its spot, the driver raises the fifth wheel and two of his colleagues unfold the trailer's front supports or "legs", then slide a trestle underneath in order to support the trailer at that end. Once the trestle is in place, the dockers withdraw and the driver lowers the fifth wheel, so that the full weight of the trailer is supported by the wheels, front supports and trestle.

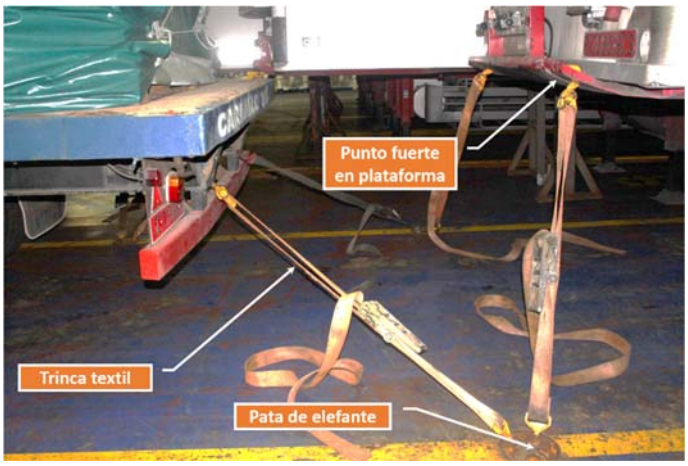


Figure 9. Tying down the ends of the trailers.

The driver, who is still sat facing the trailer, then withdraws the tractor unit and stops around five or six metres away. He then rotates the driver's seat 180º within the cab, i.e. going from facing the trailer, to having his back to the trailer. Once the driver has his back to the trailer, and provided everything else is in order, he departs the area in order to pick up another trailer. He is now moving forwards and has his back to the trailer, i.e. driving conventionally.

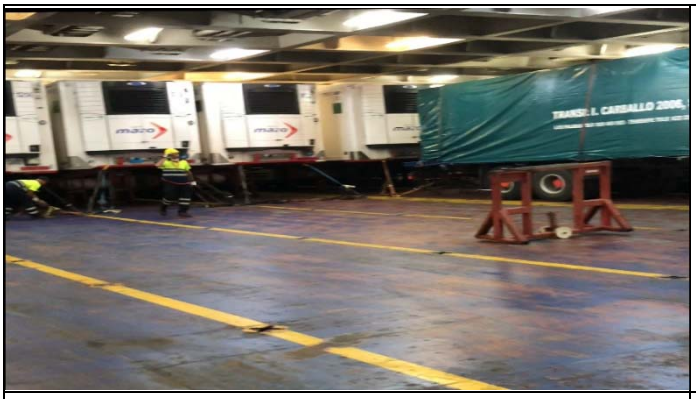
Meanwhile, the crew, after making sure the trailer's number matches the one specified in the Loading Plan, use fabric straps to tie down the ends of the trailer to the lashing points provided for this purpose on the deck, in order to prevent the trailer from moving around while at sea.

4.1.2. Sequence of movements

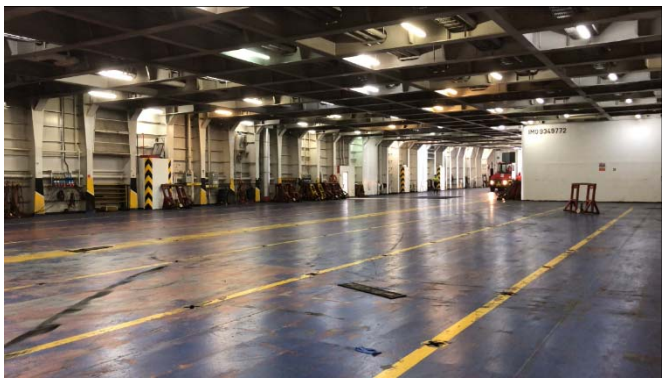
Below is a sequence of typical movements, corresponding to a loading scenario similar to the one in which the accident occurred. As the sequence shows a normal scenario, the events surrounding the accident may not have occurred in exactly this way. Some actions overlap with others, and it is not known whether the timings were shortened at any stage, or whether the crew or dockers moved in too close before it was time to do so, with the exception of the final moment. However, based on the data that is known to CIAIM, it cannot be inferred that such a situation occurred.

The trailer shown below is positioned in a nearby space on the same Deck 3 on which the accident occurred: consequently, the photographs show a working area similar to that of the accident[13].

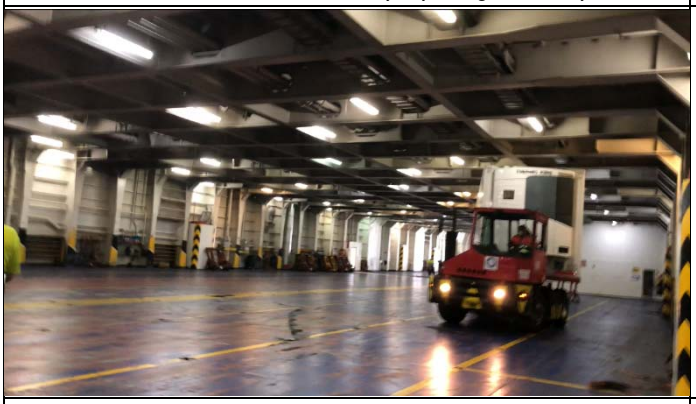
[13] The lighting conditions shown in the photographs are also similar to those at the time of the accident.



1. The dockers and crew prepare the materials required for stowing and tying down. A trestle is visible in the foreground, and in the background on the left some crew members are preparing the straps.

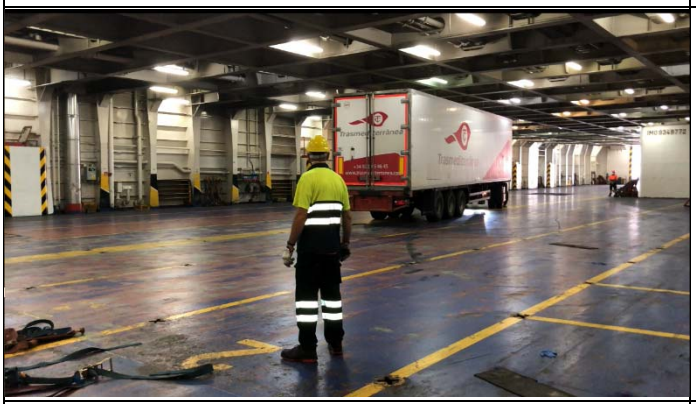


2. The tractor unit enters the deck from the stern, towing a trailer.



3. The tractor unit moves completely over to the port side, in order to reverse.

4. Reversing.



5. The tractor-trailer stops. The driver attempts to position the trailer in the correct row. The unit switches from “towing” to “pushing”.

6. The trailer approaches the space in which it is to be stowed.

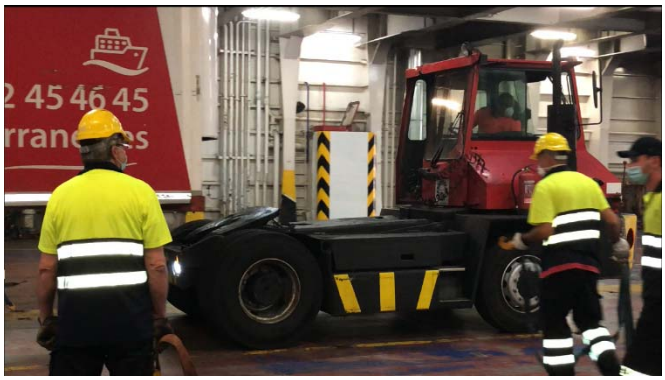
7. Trailer in position. The driver stops the tractor unit. The crew members gather the tying-down material.

8. The dockers bring trestles over to the area. The crew members move in to tie down the trailer.

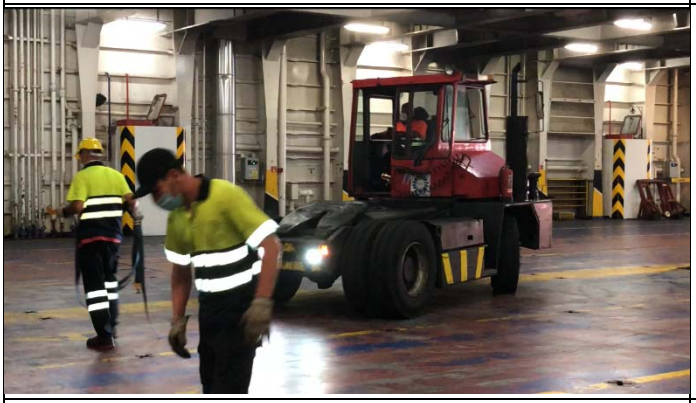
9. The driver raises the fifth wheel. The dockers position the trestle.

10. The driver lowers the fifth wheel. The trestle supports the weight of the trailer at this end. The dockers lower the trailer's supports ("legs"). The crew members prepare the equipment to tie down the trailer at this end.

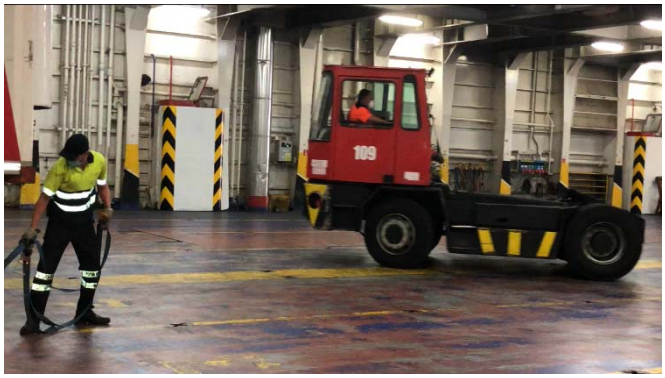
11. The driver begins the manoeuvre to withdraw from the trailer.



12. The tractor unit separates from the trailer. The crew members approach both ends of the trailer in order to tie it down.



13. The tractor unit moves five metres away from the trailer. It stops, so that the position of the seat can be rotated 180º[14]. The crew members start to tie down the front of the trailer. At this point, at the time of the accident, the driver should have rotated his seat in order to sit with his back to the trailer, and then move towards the deck exit in "towing" mode. THE ACCIDENT OCCURRED AFTER THIS POINT.



14. THE ACCIDENT OCCURRED BEFORE THE VEHICLE EXITED THE DECK AND DEFINITIVELY LEFT THE SCENE. The crew members continue to tie down. At this point, the procedures diverged. The photograph shows the tractor unit moving away in "push" mode, as the driver has not rotated his seat. THIS WAS NOT THE CASE AT THE TIME OF THE ACCIDENT. The statements indicate that the driver's intention was to rotate his seat and exit the vehicle stowage area normally, i.e. in "towing" mode.

Figure 10. Sequence of movements

[14] To clarify the discrepancy observed in the images, the two photographs illustrating stages 13 and 14 of the example shown in Figure 10 do not show the action described: rather, the driver chose not to stop and instead continued to operate in the "push" position, first reversing back in order to withdraw several metres, then stopping, then selecting a forward gear and driving away in "push" mode, without rotating his seat.

4.1.3. Working language and communication between crew and dockers.

There were people from seven different countries working on the vessel, including people from Spain, Central and South America, and Eastern Europe. The deceased was of Croatian nationality, while the injured men were of Romanian nationality.

The official working language on board the vessel was English, although Spanish was also used given that it was spoken by most of the crew, and in light of the vessel's route and the ports visited. The investigation did not produce any evidence of language problems on board.

Communication between the crew and the dockers who were on board the vessel was conducted via the individuals in charge of the two working groups, i.e. the first officer and the foreman. Any comments or complaints were directed through this channel.

There was no direct communication between the dockers and the crew beyond routine indications to direct and position the trailers, which were effected using gestures and whistles. The movements of the tractor units and the trailers they towed were evident from the noise they produced, especially during acceleration. Moreover, the tractor units had an audible signal to indicate reversing.

The crew also had a whistle that could be used to hail the driver of the tractor unit when necessary.

4.1.4. Study of the accident prevention systems in place with regard to the interface between the crew and the dockers: the on-board safety management system compared to the docker team risk assessment. Discussion.

Employers of the personnel working at the vessel interface.

It is necessary to clarify the nature of the employment relationship between the parties and the workers who share the working environment of the vehicle stowage area during loading and unloading, in order to determine who is the employer from an occupational risk prevention perspective. To this end:

1) The crew members of the CIUDAD DE PALMA were employed by Compañía Trasmediterránea.
2) Dockers:
    a. Compañía Trasmediterránea contracted the cargo-handling company (hereinafter, the "cargo handler") Terminal de Carga Rodada de Canarias S.A. (TCRC) to carry out the loading and unloading operations at the port of Santa Cruz de Tenerife. TCRC holds a cargo-handling licence issued by the Tenerife Port Authority.
    b. TCRC requested temporary cargo-handling personnel from SESTIFE S.A. CPE, a body that has the status of a "Port Employment Centre" (hereinafter, the "CPE")[15], for the tasks of loading and unloading the vessels that TCRC handled at the terminal it held the concession for.
    c. SESTIFE is obliged to supply port workers with the appropriate professional category and training, in line with the personnel requirements submitted by TCRC for each operation.
    d. Responsibility for managing, organising, supervising and monitoring the activities of the port workers supplied by the CPE to the cargo-handlers corresponds to the latter during the period for which they are made available.

The following section analyses the documentation pertaining to the shipping company, the cargo-handler and the CPE.

Study of the documentation on workplace training and safety

Based on the documentation provided by the parties with regard to training, CIAIM concludes that the training given to the maritime party was adequate. However, it has reservations regarding the docker party, as it does not know the specific content of the training given to the port workers.

[15] For more information, visit the following website:
https://www.mites.gob.es/es/Guia/texto/guia_1/contenidos/guia_1_4_5.htm

CIAIM examined the risk assessment corresponding to the role performed by the driver[16] at the time of the accident. This document specifically cites the risk of "Collision or impact with vehicles"[17] and specifies a "medium-high" [18] priority of action, based on a low level of probability, a high level of severity and a medium level of risk. However, in its analysis of this risk, the document explains that the assessment is aimed at protecting the "person operating the tractor unit", which is consistent with the aims of all occupational risk assessments.

The loading and stowing procedures that the shipping company had established in its Safety Management System (SGS)[19] were generic, and did not go into detail with regard to how these procedures should be carried out. The same applies to the individual roles related to the safety of subordinate personnel[20]. As such, the tying-down operations were carried out as specified in the approved Manual for the Fastening of Cargo.

Lastly, TCRC (the company in charge of loading the CIUDAD DE PALMA) had a document titled "Operational Safety Management Procedure"[21], which comprised the prevention plan drawn up in response to the findings of the risk assessment carried out by TCRC. This document only stipulates a single process, with no record-keeping. In view of its relevance, the stipulation in question is reproduced verbatim below.

-Citation begins-

4. PROCESSES.

In accordance with the occupational risk assessment carried out at TCRC and the proposed prevention plan to mitigate, as far as possible, the risks inherent to the activities in question, the terminal managers, the dock operatives responsible for inspecting the process, the foremen and the prevention officers must contribute to and ensure compliance with the following safety measures, in all operations. Each worker shall ultimately be responsible for incorporating these measures into their activities once they have been informed of them.

Limit the speed of vehicles, so that the inertia of their cargo and the movements they make cannot cause them to overturn. This measure must be borne in mind especially when using ramps.

Connect the air hoses between the tractor unit and the attached trailer for transfers to the upper deck or holds, when it is necessary to ascend or descend a ramp, provided there is a potential risk of slipping.

Switch off the engines of the tractor units when they are not being used, particularly in holds with poor ventilation.

Use the tractor units' warning lights, and when necessary their audible signals, to warn of manoeuvres.

When the tractor unit is connected to a roll-trailer, the driver must get down from the MAFI in order to attach the chains from the gooseneck hitch to the roll-trailer, having first placed the lever in neutral and activated the tractor unit's parking brake.

-Citation ends-

Additionally, according to TRCR the risk of hitting a third party was taken into consideration, by means of the preventive coordination provided by the PREVENTE joint prevention service. However, the investigation has ascertained that this coordination did not exist in practice: none of the individuals involved were aware of this preventive coordination, and therefore it was not put into practice.

It can be concluded that in practice, none of the three safety management systems provided effective management of the risk of running over pedestrians in the vehicle stowage area on board a vessel.

[16] Document: "Risk assessment for port workers – Chapter 2: Risks when operating vehicles: person operating the tractor unit". Produced by the PREVENTE External Prevention Service for the employer SESTIFE CPE. Document dated June 2017, update no. 3.
[17] The specific description given in the document for this risk is as follows: "Collisions between vehicles and persons: vehicle-related accidents where the injured worker(s) is/are in a vehicle or vehicles".
[18] According to the methodology of application for the measure proposed in the assessment.
[19] SGS document SEG 07-06, version 3, Rev. 6, dated 10/05/2014.
[20] SGS document SEG 03-01, version 3, Rev. 6, dated 28/07/2015.
[21] Document P.07/0, dated 08/09/03, regarding the quality management system.

4.2. The tractor unit

4.2.1. Inspection and maintenance.

The tractor unit[22] is a KALMAR model TRX-182 AL[23], with a capacity[24] of 24,000 kg, manufactured in 2003.

There are maintenance records for the unit. The last regulated maintenance carried out prior to the accident was on 11/02/2020, and consisted of a check following 250 hours of operation (the unit's hour meter marked 5,200 hours, according to this inspection). In this respect, it is relevant to note that the section corresponding to "Check the operation of the rotating seat and check that it anchors correctly in both positions" is marked as "seen", and in the "Comments" section the text "Check cab, outer bodywork has rust" was added.

An annual inspection was performed on 05/11/2019, according to the Certificate of Compliance issued by the company OCASUR 2010, S.L. in accordance with Article 4 of Royal Decree RD 1215/1997. No faults or comments were noted.

Figure 11. The tractor unit involved in the accident, shown from either side.

4.2.2. Main features of the tractor unit referred to in this report.

Movement

The tractor unit can tow or push the trailer, and move in different directions. For the purposes of this report it is better to use the terms "tow" and "push", rather than "forwards" and "backwards", which could generate confusion.

Place of operation

The seat of the tractor unit rotates: in other words, regardless of the vehicle's direction of travel, the driver could sit facing out of the front of the cab (i.e. "towing" mode) or sit facing out of the back of the cab (i.e. "pushing" mode). The seat is integrated into a rotating workstation incorporating the steering wheel and a series of controls, including the handbrake. See Figure 12, where the movable workstation comprising the seat, steering wheel and controls of the terminal tractor models TRX/TTX-182/192 is highlighted in green.

In each of these positions, the driver had access to accelerator and brake pedals.

The controls

Apart from the brake and accelerator pedals, the main controls that were used to operate the tractor unit are shown in Figure 13.

The tractor unit had a Clark transmission and gear-change system installed.

[22] The manufacturer describes it as a "terminal tractor". In the industry, these types of unit are often referred to by the generic name "MAFI", a well-known manufacturer of similar vehicles whose name has become synonymous with these units.
[23] According to the manufacturer's coding: Ro-Ro tractor, extended, 4x4, maximum engine power of 182 kW, VOLVO PENTA engine, left-sided cab.
[24] Although the operating manual gives a maximum load of 32,000 kg for the auxiliary wheel (see the Appendix), the "Record of compliance for work equipment: machine safety" specifies a capacity of 24,000 kg.

The "Forward" and "Back" directions indicated in Figure 13 are not absolute; rather, they are relative to the position that the vehicle's seat has been placed in. In other words, "Forward" always refers to movement in the direction that the driver is facing. If the driver is sitting in the "push" position and moves the lever forward (as shown in the figure), to an outside observer it will appear as though the tractor unit is reversing, and vice versa.

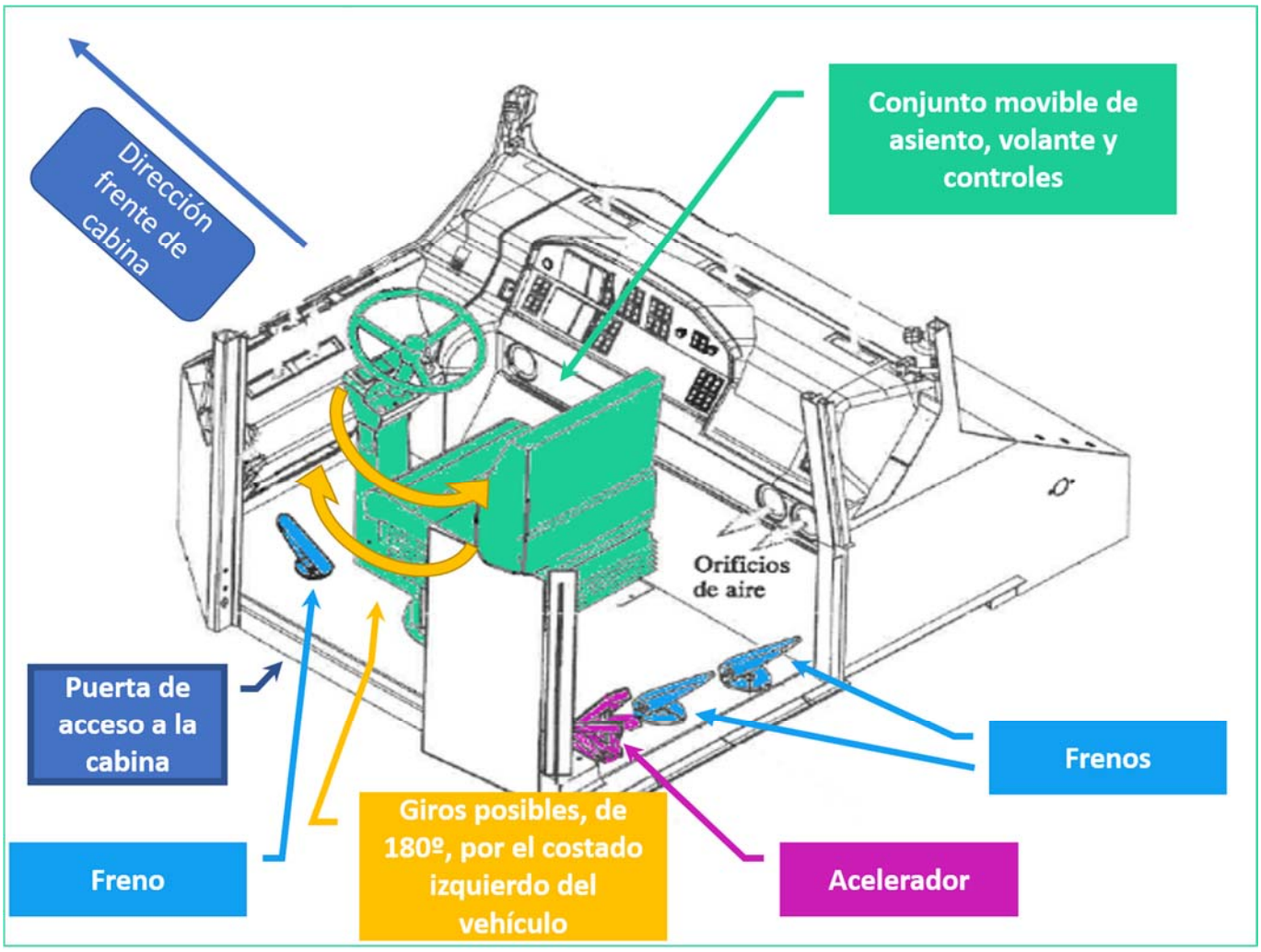


Figure 12. Cab of the tractor unit, with the movable driver's workstation shown in green (source: Operating and maintenance manual for TRX / TTX-182/192 terminal tractors).

CIAIM checked whether the seat's changeover device was working correctly, and found that the point of changeover was located at approximately 90º of the seat's full range of movement (180º), and was therefore compliant.

Operating the tractor unit: handbrake.

The full procedure for operating the tractor unit will not be described here: rather, this report will discuss those aspects that CIAIM believes may have had a bearing on the accident. Operating modes that could not have been used owing to the configuration of the tractor unit (e.g. automatic change) have not been taken into consideration. See the section on the manufacturer's inspection, discussed later on in this report.

Operating the tractor unit in the normal manner is simple. Any change to the orientation of the workstation requires the vehicle to be virtually at a standstill. For this reason, it is usual practice[25] to use the handbrake button in order to make sure that when the driver's seat is being rotated, and when the driver takes his foot off the accelerator in order to begin the rotation, the vehicle remains safely in its current position[26].

[25] The drivers interviewed by CIAIM went so far as to say that this was "good practice".
[26] If the handbrake is not activated, particularly if the tractor unit is in an area with a sloping floor, it is likely that the tractor unit will begin an uncontrolled movement until a brake pedal is pressed or the handbrake is activated.

Thus, after getting into position, the driver moves the gear-change lever forwards or backwards and gently presses the accelerator[27] to start moving.

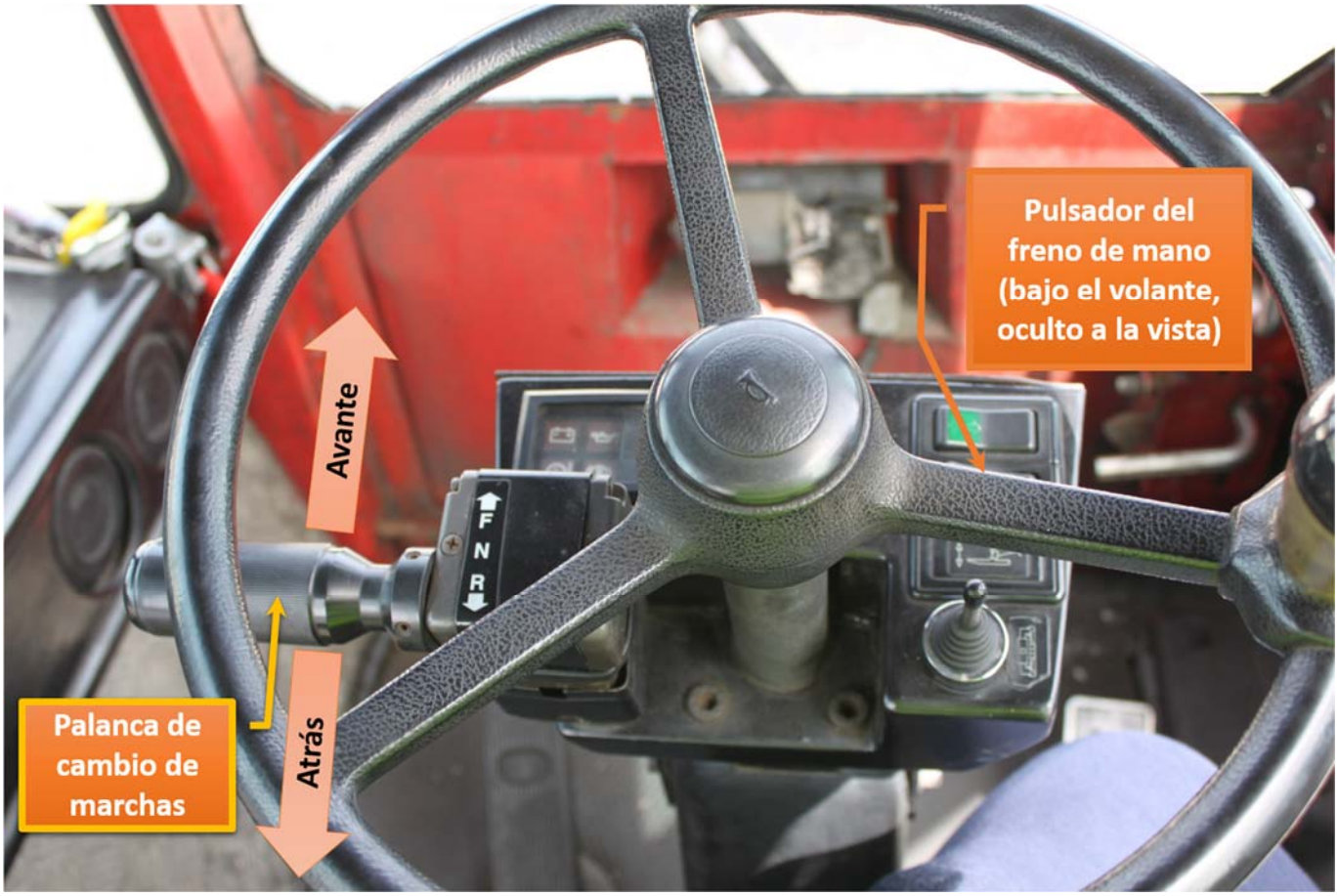


Figure 13. Main operating controls for the tractor unit.

4.2.3. Outcome of the inspection of the tractor unit.

CIAIM contracted the services of the manufacturer of the tractor unit in order to determine whether the unit was faulty, or if it had undergone any modifications since it was purchased. The tractor unit had been placed in the custody of its owner, in a separate location equipped with a monitoring system. The hour meter showed 5,346 hours[28].

The inspection revealed that none of the safety elements had been deactivated; however, it also produced the following findings:

1) The tractor unit was supplied with an automatic gearbox; however, this function had been deactivated and the tractor operated with a manual gear shift. This tractor unit is able to operate with a manual gear shift without any difficulty.
2) The tractor unit's anti-drive inversion relay was disconnected. This relay prevents the direction of travel from being changed until the vehicle's speed drops below 2-3 km/h, in order to avoid damaging the transmission. Although the vehicle can function without this relay, the automatic gearbox could be damaged if the situation persists.

[27] It is possible for the driver to sit crosswise (not at a 90º angle, but at an angle between 0º and 90º, or between 90º and 180º, halfway between one position and the other), slightly oriented towards either of the two ends of the cab, and operate the vehicle with his legs open, i.e. his left foot pressing the accelerator pedal of the rear set of pedals and his right foot pressing the brake pedal of the front set of pedals. CIAIM investigated this possibility, but rejected it owing to the absence of support in the witness statements.

[28] The hour meter was not the original factory model, which was apparently replaced because it was faulty. The tractor unit's total number of working hours is therefore unknown.

3) The tractor unit did not have an automatic brake to immobilise the unit when the seat was rotated, as this was an optional extra at the time this unit was manufactured and the client did not request it.

In summary, the foregoing points imply that gear-changes could be made quickly, even with a change of direction, and that the tractor unit did not have to stop while the seat was being rotated.

4.2.4. Relevant findings of the investigation

CIAIM checked the working area and found that the lighting was adequate. None of the statements and records checked by CIAIM mentioned that the lighting was a problem. The loading and tying-down materials normally used were lightweight and easy to transport from the sides of the vehicle stowage area, and did not constitute an excessive load for the crew members.

Witness statements

The main witness to the accident[29] told CIAIM that at the moment the acceleration began, he was able to turn around in time to see the driver raise his hands to his head, but without braking. After the impact, the engine stopped and the docker remained in his seat for a few moments, then got out of the cab and left. His docker colleagues accompanied him, also leaving the scene of the accident[30].

At no point did this witness observe that the driver had turned around in the opposite direction. The witness saw that the driver was facing them when he accelerated.

Driver's statement

CIAIM has had access to the legal files and also (among other documents) to the record of the statement given by the driver to the investigating police officers six hours after the accident. In view of its relevance, an excerpt of this statement is reproduced below:

-Citation begins-

"HE STATES that he had placed a container in the prow of the vessel's hold. He then uncoupled the MAFI from the container and lowered the trailer until the docker indicated that the container was supported on the trestle that the latter had put in place. He was guided verbally, as he did not have a direct view of the docker who was placing the trestle. He withdrew one metre. Then, seeing that the MAFI had been released, he attempted to turn around in the driver's rotating seat; however, the seat could only make a quarter turn, and did not allow him to rotate it completely. He then returned to his initial position facing the trailer, at which point the vehicle unexpectedly began to move and ran over the seamen. He states that the seamen went to tie down the container too quickly, and therefore took a risk that could have been avoided. He clarifies that the three seamen were underneath the container, tying it down with slings, when they were run over by the MAFI as a result of the vehicle's acceleration, which he did not have enough time to stop. He believes that the vehicle may have been in gear, which is why it started up.

When asked about his reaction to the accident:

HE STATES that he left the scene of the accident because he feared the worst, i.e. a tragedy. He did not see the injured seamen, although he heard one of them shouting."

-Citation ends-

As it has not been possible to interview the driver, CIAIM considers that the statement is not consistent with the usual procedures for this type of operation, nor with other statements regarding the accident obtained directly by CIAIM.

[29] As stated above, CIAIM was not able to interview the dockers. From the statements they gave to the investigating police officers, they did not appear to see anything at the time of the accident.
[30] Corroborated by another witness.

The driver's seat.

The driver told the investigating police officers that the movement of the seat was interrupted before it could complete its rotation, and it therefore returned to its original position[31].

CIAIM checked the driver's seat extremely thoroughly. On the plastic cover of the tractor unit's control panel, on the right-hand side of the cab, there was a large area of abrasion, around 25-30 cm long by 7 cm wide, with a loss of material in the lower middle area. This abrasion is consistent with the deterioration observed in the rear/back section of the driver's seat, and in the seatbelt retractor that protrudes from the back of the seat. See Figures 14 and 15.

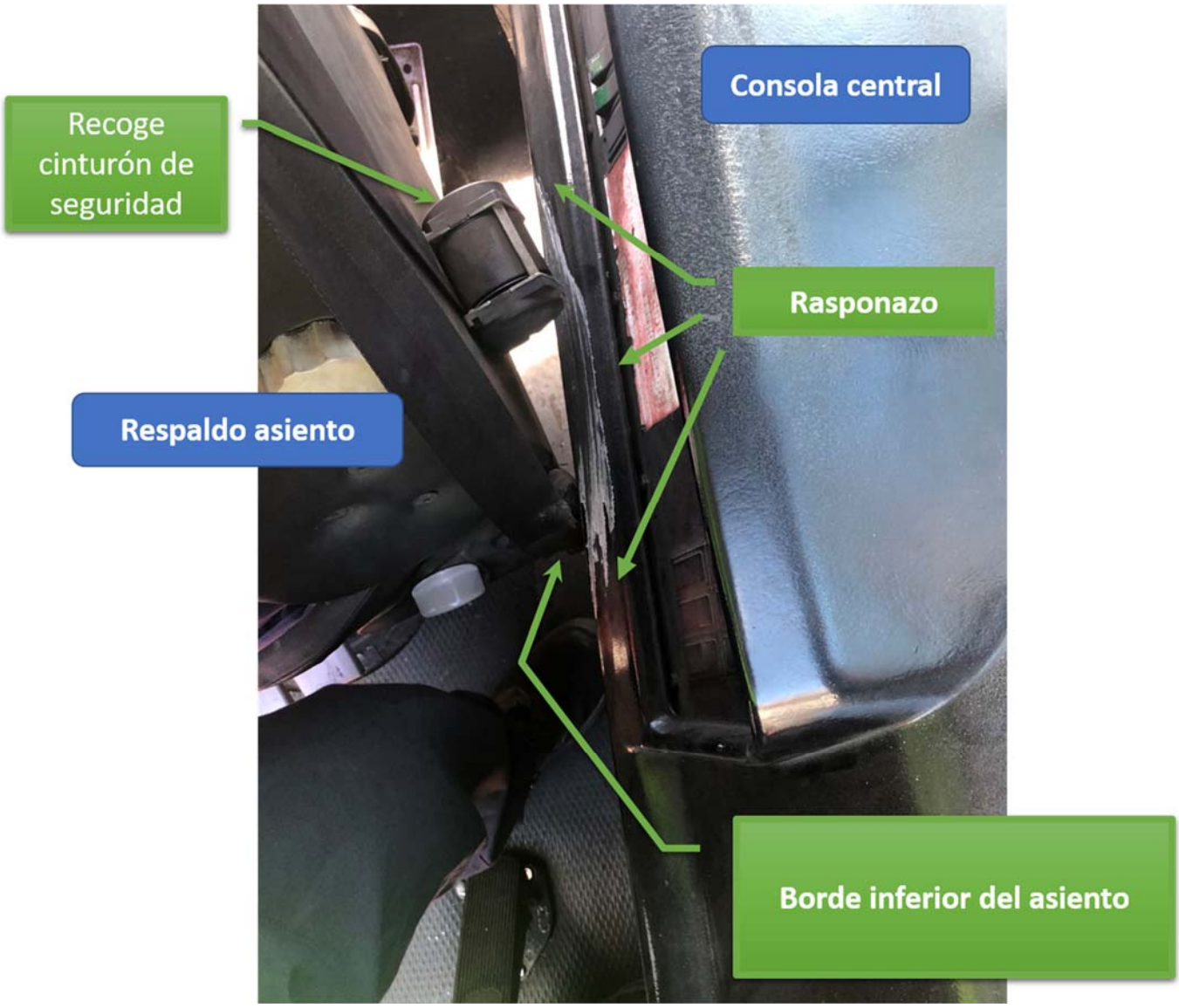


Figure 14. Area of friction between the driver's seat and the centre console

According to the statements of the dockers and the company, these abrasions were not produced immediately prior to the accident; rather, they were known about for some time beforehand. The areas most affected are the seatbelt retractor and the lower inner edge of the seat; both scrape forcibly against the cover of the centre console.

The height and backrest depth of the driver's seat are both adjustable. The checks revealed that the backrest depth is adjusted in "stages" or adjustment points, activated via a lever. The adjustment points are well-defined and sturdy, and the checks demonstrated that they do not move out of adjustment as a result of use, the clattering of the tractor unit, or the movements of the driver in the seat.

[31] The driver's seat is able to rotate 180º on the left-hand side of the tractor unit (i.e. the left-hand side when looking ahead from the driving position).

The investigation revealed that when adjusting the backrest to a certain depth, which is permitted by the adjustment system, the backrest strikes the cover of the panel and prevents the seat from rotating.

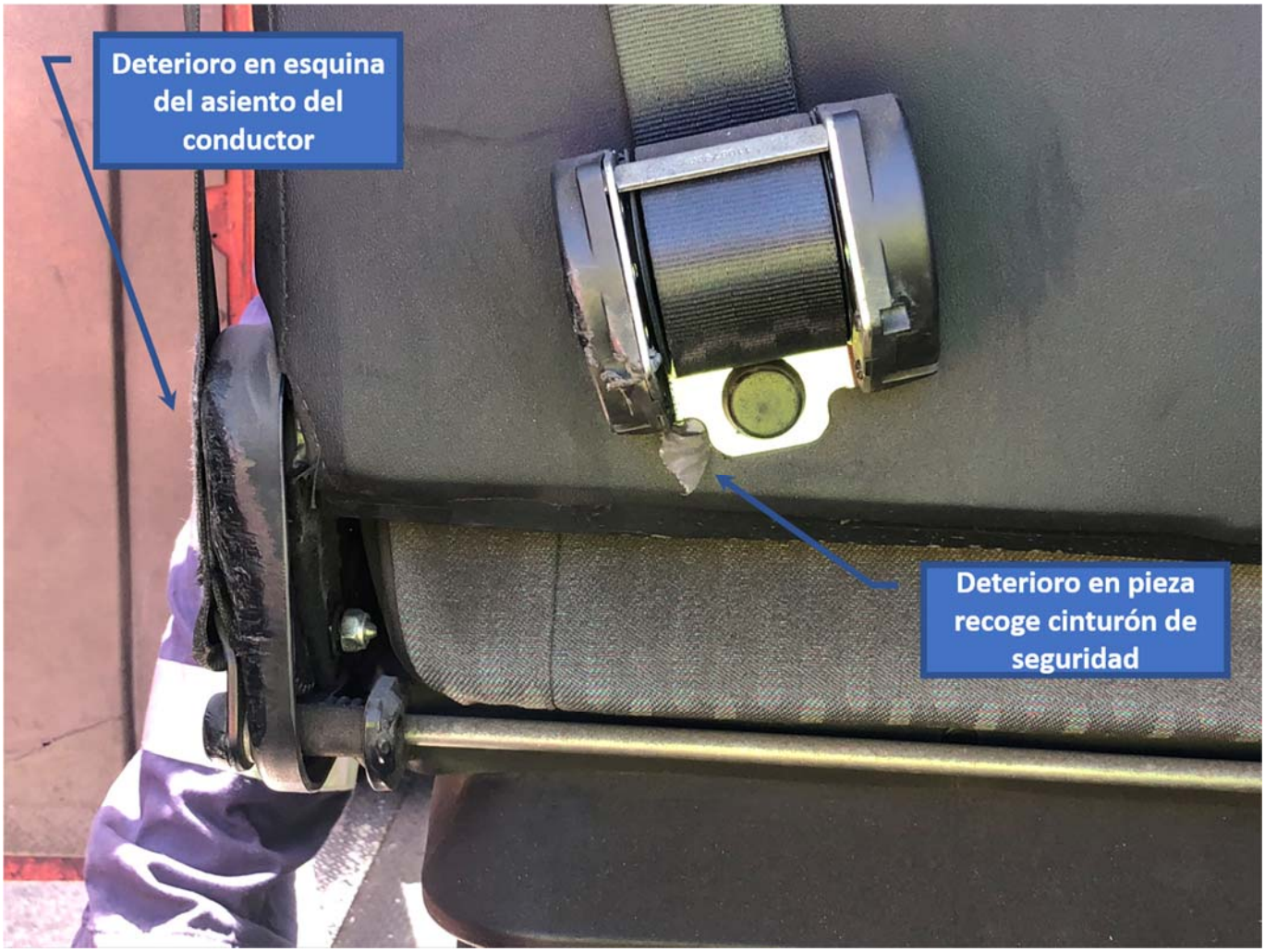


Figure 15. Deterioration of the driver's seat in the tractor unit

According to the various witness statements, the driver was heavyset. The investigation has not been able to explore the ergonomics of the workstation and determine, *in situ*, any restrictions to the movement of the workstation within the cab as a result of the size of the driver. However, the physical evidence found in the form of significant abrasions to the backrest of the driver's seat and the corresponding section of the console support the idea that there were restrictions to the seat's rotation.

In the technical information for the vehicle and the assessment of the workstation there are no specifications or stipulations regarding maximum or minimum sizes for the operators of the port vehicles.

4.3. Immediate cause of the accident

Based on the available data, CIAIM can conclude the following:

1) The inspection carried out by the manufacturer's technician revealed that the working condition of the tractor unit was consistent with the manufacturer's design characteristics when the product was brought to market.
2) In order for the vehicle to have accelerated rapidly[32] towards the trailer in the way that it did, the following conditions must have been met:
    a. The handbrake button had not been pressed. If it had been pressed, the vehicle would not have moved.

[32] The witnesses interviewed by CIAIM stated that the vehicle accelerated as though the pedal had been pressed "to the floor".

b. Given the position of the driver's seat (i.e. facing backwards, towards the trailer), the gear lever was moved into the "forward" position.
c. The accelerator pedal was pressed. If the accelerator had not been pressed, after moving the gear lever into the "forward" position the vehicle would have started to make lurching movements[33].

Of the three factors above, the most important is that the seat rotation manoeuvre was started without activating the handbrake. Otherwise, any errors that occurred during the procedure would not have had any consequences, as it would have been impossible for the tractor unit to move, owing to the brake.

The other two factors are explained[34] by the fact that the seat rotation manoeuvre was performed a split second before activating both mechanisms; like a reflex rather than a conscious action, one that is repeated a thousand times. Except, on this occasion, the rotation could not be completed and the driver remained in the same initial position.

It can therefore be concluded that the accident was the result of human error.

4.4. The human factor

The toxicology tests that were performed on the driver ruled out any possibility that toxic substances played a part in the accident.

The driver had been working as a docker for 18 years. Two years previously, he had taken a course on driving vehicles such as tractor units and had obtained the corresponding qualification. CIAIM is not aware of any issues related to the training he received, or of any other nature.

The driver had begun his shift at 10:00 p.m. on the 19th, some 2 hours and 20 minutes before the time of the accident. In principle, the job and the shift can be classed as "normal", i.e. not arduous or causing fatigue.

Without the cooperation of the interested party, CIAIM cannot study certain important aspects related to the human factor with regard to this accident. One might ask the driver:

- How aware he was of the situation.
- What his usual awareness of workplace safety issues was[35].
- How he was affected by the inadequate ergonomics of the workstation[36].
- If the work was repetitive and monotonous, prompting him to find alternative ways to carry it out.
- If there were any physical factors (discomfort, pain, etc.) that affected his performance.
- If there was any pressure on him to finish the loading process quickly and comply with the vessel's timetable.
- Any psychological traits, depression, personal problems, careful/reckless attitude, etc.

Having studied the error taxonomy[37] for the case at hand, it needs to be asked whether:

1) It was not an "error" as such; rather, it was a violation of the established procedure. In this respect, there was no "procedure" in the strictest sense; rather, "good practice" dictated that any rotation of the tractor unit's seat should be performed with the handbrake activated.
2) A "slip" occurred, i.e. an unintentional action generally caused by a lack of attention. The driver had performed the same operation a thousand times before. The difference on this occasion was that the rotation of the seat, which would have allowed the process to be carried out normally, did not occur.

CIAIM considers that the "slip" was of secondary importance to the violation.

[33] In the same way that a normal vehicle would, if it was put into first gear and the accelerator was not pressed in order to move it.
[34] This can be inferred from the driver's statement and the observations of the main witness.
[35] From the driver's statement to the investigating police officers, it can be inferred that the changes of direction and rotations occurred rapidly, at the technical limit of the vehicle's equipment.
[36] This does not imply that the ergonomics of the workstation were inadequate in general, only that they were inadequate for him in particular.
[37] Types of error based on Reason's theory and habitually used in accident investigations. Essentially, there are four types: violations, slips (unintentional actions generally caused by a lack of attention), lapses (unintentional actions generally caused by a failure of memory) and mistakes (intentional actions involving an error in the planning process; there is no deliberate decision to break the rules).

5. CONCLUSIONS

1) The immediate cause of the accident was the fact that the driver did not activate the handbrake before starting to rotate his seat, in contravention of the good practice reported to CIAIM. If he had activated the handbrake, it would have been impossible for the vehicle to move, even if other contingencies had occurred. As such, the handbrake would have acted as a barrier to the accident.
2) The driver's seat of the tractor unit did not have a safety device known as an "automatic brake" that would have immobilised the tractor unit when the driver started to rotate the seat. This safety measure was an optional extra at the time the tractor unit was manufactured and sold. More modern units are equipped with this safety device as standard.
3) None of the companies involved in the vessel-dock interface demonstrated effective management[38] of the risks of running over third parties inside the vessel's deck/vehicle stowage area.
4) One of the triggers of the accident occurred when the driver's seat could not be rotated, as the dimensions of the tractor unit's cab did not permit unrestricted movement by a person of heavyset build. Neither the technical information for the tractor unit accessed by CIAIM, nor the occupational risk documents provided by the CPE or the cargo-handling company provided for such a contingency.
5) The lack of video systems to record the operations in the vehicle stowage area hindered the effective supervision of said operations, with a view to improving the procedures governing the coordination and interaction between the dockers and the seamen.

6. SAFETY RECOMMENDATIONS

With regard to Terminal de Carga Rodada de Canarias S.A. (TCRC S.A.), SESTIFE CPE, and CÍA TRASMEDITERRANEA S.A.:

1. These parties should modify their Occupational Risk Prevention Plans and Safety Management System (as applicable) to add warnings and stipulate prudence regarding the risk of running people over at the interfaces between dockers and ro-ro vessels during the processes of loading and unloading said vessels. There must be preventive coordination that is effective in practice, not just on paper.

With regard to SESTIFE CPE:

2. Incorporate participatory workshops or discussions that examine or review cases such as this one (and similar examples) into its training processes.

With regard to TCRC S.A.:

3. Draw up a plan to update its tractor units and gradually incorporate equipment that is fully equipped with all of the safety systems currently used by the industry (e.g. automatic brakes), while retiring the oldest - and potentially unsafe - tractor units that are not equipped with these systems.

With regard to SESTIFE CPE and TCRC S.A.:

4. Establish written procedures for the safe handling of the heavy machinery operated by its workers and affiliates.

5. Update its risk assessments, and therefore its prevention plans, taking into account the risks and problems generated by the size of the cabs forming part of various models of heavy machinery that are used by dockers but are not compatible with the physical stature of every docker. This may mean restricting or even preventing the operation of certain items of machinery by operators of a certain size, weight, etc.

With regard to CÍA TRASMEDITERRANEA, S.A.:

6. Add recording capacity to the video-monitoring system for the vehicle stowage areas.

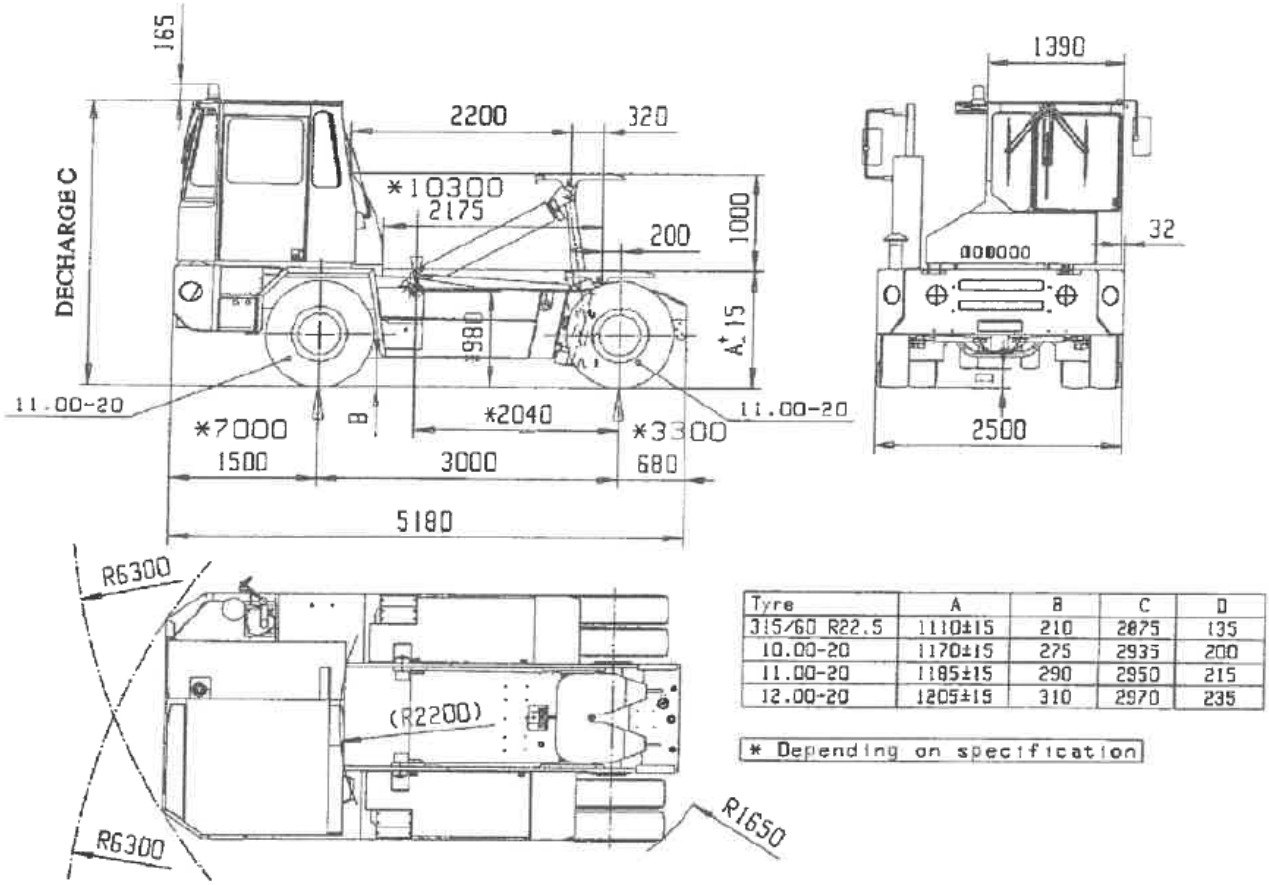
With regard to KALMAR, the manufacturer of the tractor unit:

7. Improve the ergonomics of the workstations of its terminal tractors by restricting the backrest depth and height adjustment of the driver's seat, so that the seat cannot be prevented from rotating.

[38] The coordination was not effective. The investigation has revealed the absurdity of considering the risk of running over a driver inside a tractor unit, but not the risk of running over the crew members operating in the immediate vicinity of the unit.

7. APPENDICES

Appendix A: Dimensions of the tractor unit



Tyre	A	B	C	D
315/60 R22.5	1110±15	210	2875	135
10.00-20	1170±15	275	2935	200
11.00-20	1185±15	290	2950	215
12.00-20	1205±15	310	2970	235

* Depending on specification

Radio de giro
- parachoques delantero, izquierda ..... 6300 m
- parachoques delantero, derecha ..... 6300 m

Longitud total ..... 5 180 mm
Ancho total ..... 2 500 mm
Altura total *) ..... 2 950 + 165 mm
Espacio de los ejes ..... 3 000 mm
Peso total *) ..... 10300 kg
- peso del eje delantero *) ..... 7000 kg
- peso del eje trasero *) ..... 3300 kg

Carga máx. de la rueda auxiliar ..... 32 000 kg