



**MARINE ACCIDENT REPORT  
DIVISION FOR INVESTIGATION OF MARITIME ACCIDENTS**

**PEARL OF SCANDINAVIA  
Fire  
17 November 2010**

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**The casualty report has been issued on 02 August 2011**

**Case:** 201012794

The casualty report is available from the webpage of the Danish Maritime Accident Investigation Board [www.dmaib.dk](http://www.dmaib.dk).

#### **Division for Investigation of Maritime Accidents/Danish Maritime Accident Investigation Board**

The Division for Investigation of Maritime Accidents investigated maritime accidents and serious occupational accidents on Danish merchant and fishing vessels. The Division also investigated maritime accidents in Danish waters involving foreign ships.

On 15 June 2011, the Division for Investigation of Maritime Accidents was discontinued and its tasks were taken over by the Danish Maritime Accident Investigation Board. This report has been finalised by the Danish Maritime Accident Investigation Board in agreement with the Danish Maritime Authority in accordance with the guidelines that applied to the Division for Investigation of Maritime Accidents of the Danish Maritime Authority.

#### **Purpose**

The purpose of the investigation of the Division for Investigation of Maritime Accidents and the Danish Maritime Accident Investigation Board is to procure information about the actual circumstances of the accident and to clarify the reasons and the sequence of events leading to the accident for preventive purposes.

The aim of the investigation is not to establish criminal or economic liability.

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# 1 Summary

PEARL OF SCANDINAVIA departed from Oslo on 16 November 2010 at 17:30 on a voyage to Copenhagen.

At 05:58 a fire alarm indicated fire on the car deck and it was established that some cars and trailers were on fire in two sections on the car deck aft in the port side.

The fire was extinguished by the ship's sprinkler systems and subsequently by the ship's fire-fighting teams assisted by Swedish fire-fighters who had been flown to the ship by helicopter.

The cause of the fire was an electric car that was being charged during the voyage.

After having recognized the fire, all passengers were evacuated to safe areas in the ship. Neither the passengers nor the crew were injured.

PEARL OF SCANDINAVIA arrived at Copenhagen on 17 November 2010 at 12:15 by its own power.

## 2 Conclusion/Findings

- It has been established by the DBI – the Danish Institute of Fire and Security Technology – that the origin of the fire was in a battery pack in the rear end of the electric car.
- It has not been possible to establish the cause of the fire.
- It has been established by the DBI – the Danish Institute of Fire and Security Technology – that a short circuit in the cable manufactured by the owner of the car in order to charge the car was not the cause of the fire.
- It is the assessment of the Division for Investigation of Maritime Accidents that the fire-fighting was carried out in an effective manner in compliance with the fire muster list and ship's procedures for fire-fighting.
- It is the assessment of the Division for Investigation of Maritime Accidents that the evacuation of the passengers was carried out in an effective manner.

## 3 Preventive measures and considerations by the ship owner

Immediately after the fire, it was announced that charging of batteries in electric cars, caravans, auto campers, etc. would not be allowed in the companies' ships until further notice.

An automatic release of the drencher system is considered. The system could be an automatic release of the existing sprinkler systems by a system where detection of a fire by both a flame detector and a heat detector within the same zone of the sprinkler system would activate the system in the specific zone.

The shipping company also considers equipping the company's ships with portable thermographic equipment in order to enable fire-fighters to locate hot spots in adjacent rooms in case of a fire.

#### **4 Preventive measures by the Danish Maritime Authority**

The Division for Investigation of Maritime Accidents concluded that the fire in the electric car started while charging the car. Consequently, the Danish Maritime Authority issued a warning to Danish shipping companies and initiated a study on the possibilities of charging electric cars on board ships.

The Danish Maritime Authority will consider whether any concrete proposals for enhancing the fire safety on ships will be forwarded to the Maritime Safety Committee or, as appropriate, to the relevant Sub-Committees within the International Maritime Organization, IMO.

#### **5 Recommendation**

The fire on the car deck on board PEARL OF SCANDINAVIA is one of a number of recent fires on the car deck on ro-ro passenger ships:

- COMMODORE CLIPPER on 16 June 2010 is investigated by the MAIB.
- LISCO GLORIA on 8 October 2010 is investigated by the BSU.
- MECKLENBURG-VORPOMMERN on 20 November 2010 is investigated by the BSU.

These fires have a number of features in common.

- Based on the fires on the car decks on PEARL OF SCANDINAVIA, COMMODORE CLIPPER, LISCO GLORIA and MECKLENBURG-VORPOMMERN and the reports issued, the Danish Maritime Accident Investigation Board recommends that the Danish Maritime Authority in co-operation with the industry and other relevant parties assess the need to promote international initiatives in order to prevent fire and enhance the fire resistance on the car decks on ro-ro passenger ships.

The shipping company is recommended to evaluate the procedures for counting the passengers and crew members under all circumstances in order to ensure that all persons on board are accounted for.

## 6 The investigation

The Division for Investigation of Maritime Accidents went on board PEARL OF SCANDINAVIA on 17 November 2010 to carry out investigations at the scene of the fire.

Statements were taken from the master and the chief officer.

Furthermore, information has been obtained from:

- DFDS A/S
- Admiral Danish Fleet
- Copenhagen Police
- DBI – the Danish Institute of Fire and Security Technology
- Danish Technological Institute
- Danish Maritime Authority

## 7 Factual information

### 7.1 Accident data

Type of accident	Fire
Time and date of the accident	05:58 local time on 17 November 2010
Position of the accident	56° 23'5 N – 012° 19'8 E
Area of accident	6 nm NV of Kullen, Sweden
Injured persons	None
IMO Casualty Class	Serious

### 7.2 Navigation data

Stage of navigation	En route from Oslo to Copenhagen
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### 7.3 Ship data

Name	PEARL OF SCANDINAVIA
Home port	Copenhagen
Call sign	OWFU2
IMO no.	8701674
Flag State	Denmark
DOC holder	DFDS A/S
IMO Company No. (DOC)	0310102
Construction year	1989
Type of ship	Ro-ro passenger ship
Tonnage	40,039 GT
Classification	Det Norske Veritas
Length	176.10 m
Engine power	23,760 kW

## **7.4 Crew and passengers**

Number of crewmembers and repairmen	161
Number of passengers	490

### **Narratives**

As a fairly new initiative, it was possible to have electric cars charged during the voyage between Oslo and Copenhagen. Due to differences in the plugs used on board PEARL OF SCANDINAVIA and in some countries, it was necessary to have converter cables in order to charge the cars. Such converter cables were not available on the ship and had to be provided by the car owners.

Plugs intended for power supply for reefer containers were used to charge the cars. These plugs are placed at the rear end of the ship. Electric cars are therefore embarked last. At departure on 17 November 2010, the ship had only one electric car on board.

### **7.5 The electric car**

The car was originally a conventional Nissan Qushai with a combustion engine, but had been rebuilt by the owner to be powered by electricity.

On 16 November 2010, the car was embarked as one of last vehicles and the owner of the car was allowed to connect his car to a 220 volt charging station placed on the port side of the car deck aft.

The owner of the car had manufactured an electrical cord on his own in order to be able to charge the car batteries in Norway. This cable was used when charging the batteries on board PEARL OF SCANDINAVIA. The cable had been used on several previous occasions without any problems.

When the charging began, 2% of the battery capacity was left. When the fire broke out, it is estimated that the capacity was 53%.

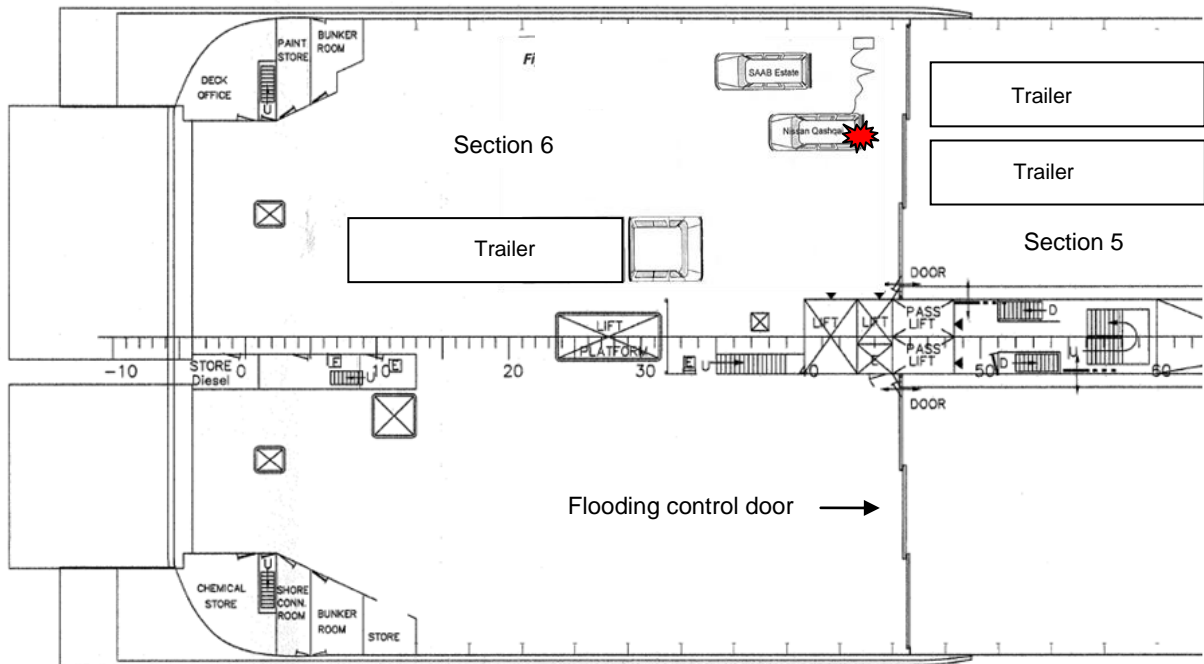
### **7.6 The scene of fire**

The scene of the fire was deck 3, the car deck. The car deck is divided into sections by flooding control doors. The purpose of these walls is to prevent water from flowing freely between the sections. The flooding control doors do not fit tight to the deck above. From the upper edge of the flooding control door and up to the deck, there is a gap with a height of approximately 0.5 metres.

The electric car was parked in the port side just behind such a flooding control door in close proximity to a charging station. The flooding control door divided the car deck into sections 5 and 6 in the port side.

The car's front end was pointing toward the rear end of the ship. The distance between the rear end of the car and the flooding control door was approximately 1 metre.

In section 6 there was another car and a trailer. In front of the flooding control door (section 5), there were two trailers close to the flooding control door.



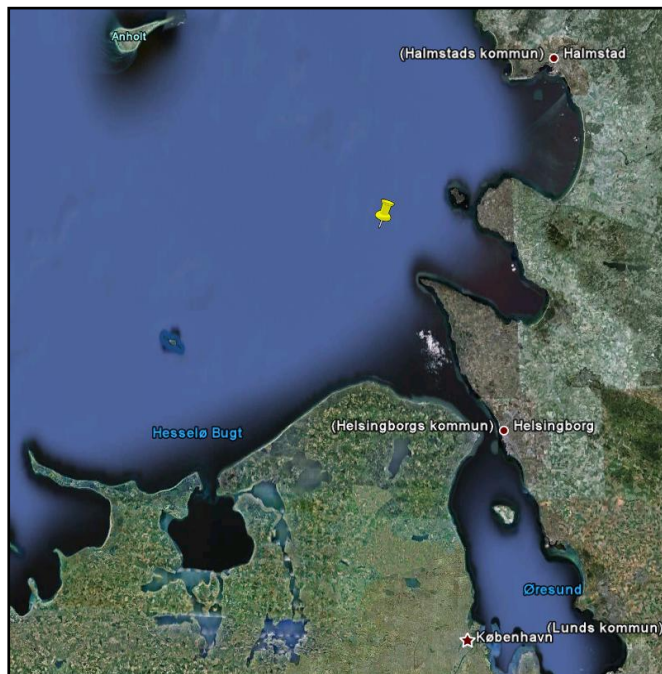
*The car deck aft showing where the electric car was parked*

### **7.7 The location of the fire and initial measures**

At 05:58 on 17 November 2010, an alarm sounded due to an electrical leak caused by a current-carrying wire leaking to the ship's metal construction. A few seconds later, a smoke alarm sounded indicating a fire on deck 3. A smoke detector indicated that the fire was on the car deck in section 5 close to the flooding control door. Shortly after, numerous smoke detectors indicated fire all over the car deck. When the fire alarm first sounded, the ship was at a position 6 nm west of the peninsula of Kullen in Sweden.

A ship's assistant who was the look out on the bridge was immediately sent to the car deck to make observations. She opened a door to section 5 on the car deck and observed heavy smoke and flames. She saw a trailer on fire close to the flooding control door. At 06:00 she informed the bridge that there was a fire in a trailer on the car deck in section 5. The seat of the fire was therefore believed to be in this section in front of the flooding control door.

Shortly after the first fire alarm at 05:58, the master was called to the bridge. Immediately after the chief officer sounded the fire alarm in the crew's quarters The master arrived at the bridge at 06:03 and took over navigational command.



*Position where the fire broke out Google Earth*



When the fire had been recognized, the master once again sounded a fire alarm only audible in the crew's quarters. He also called these quarters, informed about the fire and required the crew to muster according to the muster lists. Designated members of the crew mustered on the bridge. Among these were the catering officers who should control the evacuation of the passengers.

After a while, the fire detectors in the port side of the car deck showed errors and the detectors in the starboard side also showed fire. As the temperature readings did not change, the fire alarm system was considered out of order and thus useless. The system was rebooted, but it never came into operation again.

It was not possible to see anything on the CCTV as heavy smoke resulted in black monitors.

The fire doors were closed by remote control from the bridge. A few minutes later, the ventilation was shut down in the entire ship. Due to smoke penetrating into the accommodation, the ventilation in the accommodation was turned on again at 06:07.

Lyngby Radio was called on channel 16 where information about the fire was given. The Maritime Assistance Service with the Admiral Danish Fleet was also notified about the situation.

Shortly after the call on channel 16, PEARL OF CANDINAVIA was called by a Swedish Rescue Center, Räddningstjänsten StorGöteborg, which offered smoke diver assistance. This offer was accepted.

The course was altered to prevent smoke passing over and along the ship. The speed was reduced to the lowest speed enabling the ship to keep its course.

## **7.8 The fire-fighting**

At 06:14 the first fire-fighting team was ready for action and during the following minutes a total of 4 teams were ready to go in action.

An attempt to fight the fire by water hoses operated by smoke divers was considered to be dangerous and was given up. It was decided to use the sprinkler system in section 5 where the seat of the fire was believed to be. The sprinkler systems must be operated manually. The sprinkler system in section 5 was activated at 06:15.

Crew members were ordered to monitor the temperature with their hands by touching the bulkheads to the car deck. The deck above the car deck was monitored in the same way.

It was observed that there was no temperature change in section 6, but a temperature decrease in section 5. At that time, the sprinkler system in section 5 had been activated for 20 minutes and the fire in the trailers in section 5 was believed to be extinct.

The sprinkler system in section 5 was therefore closed and the system in section 6 was activated at 06:35.

The doors and the bulkheads to the car deck were still continuously monitored and at a stage the chief officer ascertained that the temperature was decreasing in both

sections 5 and 6. The sprinkler system in section 6 was kept running for an additional 10 minutes.

Shortly after it was possible to open a door to the car deck and have a look. The smoke was not as heavy as before, and no open fire was observed. After these observations the fire was believed to be extinct.

At no time during the voyage and during the fire, there had been any ventilation on the car deck. To improve the visibility on the car deck, a pilot door in the starboard side was opened ajar as well as two bunker doors aft. This made it possible to send in smoke divers to make sure that the entire fire was extinct. A fire-fighting team from the ship entered the car deck and extinguished some small fires.

At 07:00 Swedish fire-fighters were lowered from a helicopter onto PEARL OF SCANDINAVIA.

At 07:12 all sprinkler systems on deck 3 were stopped.

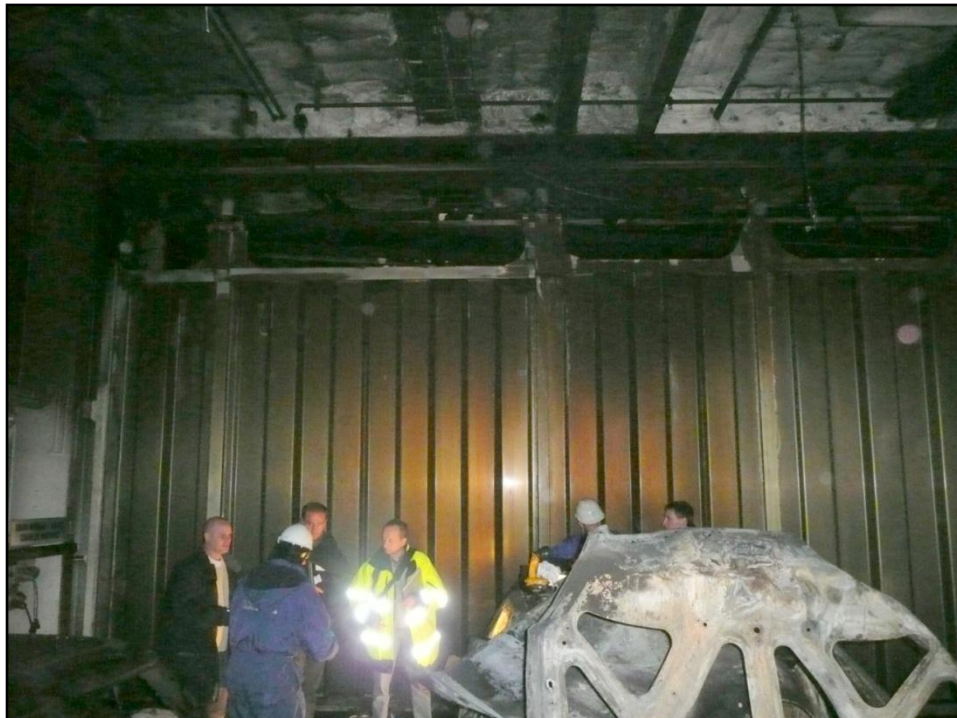
The Swedish smoke divers then entered the car deck to secure the area. They were equipped with heat sensors and could ascertain that there were still some small fires. One of these under the bonnet of one of the cars. These small fires were extinguished by portable fire extinguishers.

At 07:51 the fire was reported extinguished and watchmen were posted for monitoring deck 3. Preventive fire-fighting/monitoring of the vehicles in sections 5 and 6 was continued.

At 09:54 all Swedish pioneers were lifted of PEARL OF SCANDINAVIA.

After the fire-fighting was completed, the manoeuvrability of the ship was controlled and found satisfactory after which the ship proceeded to Copenhagen.

During the whole operation, there was continuous contact between the bridge and the fire-fighting teams.



*The flooding control door and the gap between the door and the deck above*

## **7.9 The alarm and evacuation of the passengers**

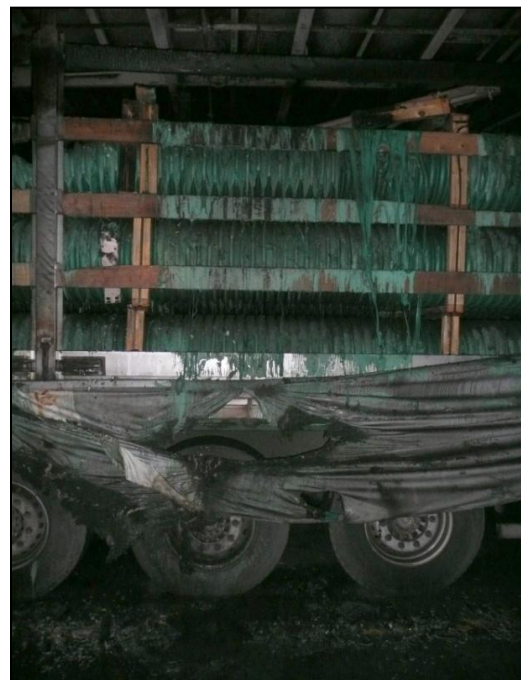
Based on the seriousness of the situation, the master sounded the general alarm at 06:05. The general alarm is also the alarm for evacuation. At 06:05 the master made his first announcement to the passengers over the Public Address system (PA system). More announcements followed frequently. The master decided to evacuate the passengers to two restaurants on decks 7 and 8 in the fore ship. The evacuation groups as well as the passengers were informed about this decision. The passengers were informed over the PA system.

The evacuation of the passengers started immediately after the general alarm was sounded. The evacuation groups guided the passengers to the designated restaurants. Guides were posted at all staircases to make sure that no passengers moved down the stairs or towards the aft of the ship. There were zone leaders on each deck responsible for the evacuation each on their deck. The zone leaders had knowledge of the number of passengers on each deck and of what cabins were occupied. All cabins and other rooms were inspected, evacuated, clearly marked and then locked after the inspection. At one point in time, smoke made it impossible for the evacuation team to search the passenger sections and the search was therefore completed by smoke diver teams. All passenger sections were cleared.

The whole evacuation process proceeded in a quiet and calm way according to procedures. When all passenger areas had been thoroughly inspected and evacuated, all passengers were believed to be in the restaurant on decks 7 and 8. The time was then 06:29. At a point in time, a heavy scent relating to the fire was detected on deck 7 and all passengers were then evacuated to the restaurant on deck 8 amidships.

During the fire and fire-fighting, the passengers were kept informed over the PA system and the general alarm was sounded repeatedly to make sure that all passengers were aware of the situation.

## **7.10 Damage caused by the fire**



*The electric car and a trailer carrying plastic pipes*

Besides the electric car, a trailer and a car aft of the flooding control door in section 6 caught fire. In front of the flooding control door, two trailers in the port side caught fire as fragments of red-hot metal from the car batteries and flames and heat passed through the gap between the top of the flooding control door and the deck above, the gap having a height of approximately 0.5 metres.

Although the fire was extinguished effectively, it caused damage on the car deck resulting in the ship being taken out of service for some days.

## **8 Analysis**

### **8.1 The cause of the fire**

As a new initiative, the shipping company offered the possibility of having electric cars charged during voyages between Copenhagen and Oslo.

The car that caught fire had been charged for approximately 13 hours when the fire broke out.

It has been established by the DBI – the Danish Institute of Fire and Security Technology – that the origin of the fire was in a battery pack in the rear end of the electric car.

It has not been possible to establish the cause of the fire.

It has been established by the DBI – the Danish Institute of Fire and Security Technology – that a short circuit in the cable manufactured by the car owner in order to charge the car was not the cause of the fire.

### **8.2 The fire**

An explosion in the battery pack in the rear end of the car spread fragments of red-hot metal in section 6.

Some red-hot metal fragments found their way through the gap between the flooding control door and into section 5. This caused two trailers to catch fire in this section.

The first alarm from the fixed fire detection system located the fire on the car deck in section 5 in front of the aft flooding control door in the port side. The heavy smoke caused by the plastic pipes loaded on one of the trailers very quickly spread to the entire car deck resulting in all fire detectors being activated. Due to the amount of alarms, the fixed fire detection system jammed, and the detection of the continuing fire aft of the flooding control door was obstructed in this jam.

An observation through an entrance in section 5 just in front of the flooding control door revealed that a trailer carrying plastic pipes was on fire and it was consequently believed that this was the seat of the fire.

The television surveillance system could not be used to detect the origin of the fire either due to heavy smoke.

The fire in the electric car placed aft of the flooding control door in section 6 was detected by observing temperatures by hand on bulkheads and decks.

### **8.3 The fire-fighting**

Shortly after the recognition of the fire, crew members mustered according to the fire muster and evacuation lists. At 06:14 the first fire-fighting team was ready for action and during the following minutes a total of 4 teams were ready to go in action.

An attempt to fight the fire with water hoses operated by smoke divers was considered to be dangerous and given up. Instead it was decided to activate the sprinkler system in section 5 where the seat of the fire was believed to be.

Crew members were ordered to monitor the temperature with their hands by touching the bulkheads to the car deck. The deck above the car deck was monitored in the same way.

As no temperature change was observed in section 6, it was decided to activate the sprinkler system in section 6.

The doors and the bulkheads to the car deck were still continuously monitored and, at a point in time, the chief officer ascertained that the temperature was decreasing in both sections 5 and 6. The sprinkler system in section 6 was kept running for an additional 10 minutes and then shut down. At 07:12 all sprinkler systems on deck 3 were stopped.

Shortly after, it was possible to open a door to the car deck and have a look. The smoke was not as heavy as before, and no open fire was observed. After these observations, the fire was believed to be extinct.

To improve the visibility on the car deck, a pilot door in the starboard side was opened ajar. This made it possible to send in smoke divers to make sure that the entire fire was extinct. A fire-fighting team from the ship entered the car deck and extinguished some small fires.

At 07:00 Swedish fire-fighters were lowered from a helicopter onto PEARL OF SCANDINAVIA.

After having stopped the sprinkler systems, the Swedish smoke divers entered the car deck to secure the area. They were equipped with heat sensors and could ascertain that there were still some minor fires. These minor fires were extinguished by portable fire-extinguishers.

At 07:51 the fire was reported extinguished and watchmen were posted for monitoring deck 3. Preventive fire-fighting/monitoring of the vehicles in sections 5 and 6 was continued.

At 09:54 all Swedish pioneers were lifted off PEARL OF SCANDINAVIA.

During the whole operation, there was continuous contact between the bridge and the fire-fighting teams.

It is the assessment of the Division for Investigation of Maritime Accidents that the fire-fighting was carried out in an effective manner in compliance with the fire muster list and ship's procedures for fire-fighting.

#### **8.4 The evacuation of the passengers**

Due to the seriousness of the situation, the master sounded the general alarm at 06:05. The general alarm is also the alarm for evacuation. At 06:08 the master made his first announcement to the passengers over the PA system. More announcements followed frequently. The master decided to evacuate the passengers to two restaurants on decks 7 and 8 in the fore ship. Evacuation groups as well as the passengers were informed about this decision.

The evacuation of the passengers started immediately after the general was sounded. The evacuation groups guided the passengers to the restaurants. Guides were posted at all staircases to make sure that no passengers moved down the stairs or towards the aft end of the ship. There were zone leaders on each deck responsible for the evacuation each on their deck. Every crew member who is to check a certain number of cabins according to the fire bill is provided with a number of control cards that correspond completely to the number of cabins that each member has to check. The control cards are to be placed in the door lock of the cabin door when a cabin has been checked. The crew members have to make sure that all of the cards have been used after they have finished the check of the cabins.

At a point in time, smoke made it impossible for the evacuation team to search the passenger sections and the search was therefore completed by smoke diver teams. All passenger sections were cleared according to procedure.

The whole evacuation process proceeded in a quiet and calm way. When all passenger areas had been thoroughly inspected and evacuated, all passengers were believed to be in the restaurant on decks 7 and 8. The time was then 06:29.

At 07:23 the number of passengers and crew members evacuated to the restaurants were counted giving a total of 595. To count the number of persons on board it is necessary to know the number of crew members engaged in duties according to the fire bill. This number may vary by a few persons from voyage to voyage typically caused by supernumerary crew members performing in-service training or crewmembers training in general. The number of these crew members not designated to the fire bill is not immediate known to the ships management.

Based on the information known to the master he assessed that all passengers were evacuated to the restaurants.

During the fire and fire-fighting, the passengers were kept informed over the PA system and the general alarm was sounded repeatedly to make sure that all passengers were aware of the situation.

It is the assessment of the Division for Investigation of Maritime Accidents that the evacuation of the passengers was carried out in an effective manner.