Bundesstelle für Seeunfalluntersuchung
Federal Bureau of Maritime Casualty Investigation
Federal Higher Authority subordinated to the Ministry of Transport,
Building and Urban Affairs

Investigation Report 329/03

Very Serious Marine Casualty

Fatal casualty in the scavenge air receiver of the main engine of the CMS LONDON EXPRESS in the night of 24 to 25 October 2003 on the voyage from Savannah/USA to Norfolk/USA

15 October 2007

www.bsu-bund.de

The investigation was conducted in conformity with the law to improve safety of shipping by investigating marine casualties and other incidents (Maritime Safety Investigation Law - SUG) of 16 June 2002.

According to this the sole objective of the investigation is to prevent future accidents and malfunctions. The investigation does not serve to ascertain fault, liability or claims.

The present report should not be used in court proceedings or proceedings of the Maritime Board. Reference is made to Art. 19 Para. 4 SUG.

The German text shall prevail in the interpretation of the Investigation Report.

Issued by:
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1 Summary of the marine casualty

On 26 October 2003, at around 11:30[1] and immediately after the full container ship LONDON EXPRESS, sailing under German flag, had moored at the Norfolk International Container Terminal (Virginia/USA), the 27-year-old German Ship Operations Officer[2] was found dead inside the forward access hatch to the main engine's scavenge air receiver upon opening it.
This crew member, who had primarily been assigned to Second Engineer functions, had last been seen alive in the engine room two days earlier, on 24 October 2003, between 17:30 and approximately 18:00, following completion of repairs carried out during the port call at Savannah (Georgia/USA). The engineer was reported missing at the latest at approx. 20:30, when he unexpectedly did not report at the ship's Board Management Centre (BMC) for the preparations of port departure manoeuvres planned for 21:00. Initial searches in the engine room and in the superstructure areas, including in the engineer's room, were unsuccessful. Thereupon the preparations for the imminent departure were stopped at around 21:00 and the general alarm was sounded. Subsequent interrogation of all crew members and a search of the ship were equally unsuccessful. Ship's command therefore assumed that the Engineer had undoubtedly left the ship to go ashore and had not returned on board on time. At 21:30 the Master therefore decided to clear the berth in Savannah for another container vessel already within visual range and to start on the sea voyage to Norfolk.

[1] All times in the report are local times = UTC – 5 h.
[2] Ship Operations Officer = SOO = crew member having both a navigational and a technical certificate of competence and therefore as a result of his [dual] qualification can be assigned to either Navigational Watch Officer (if applicable as Master) or to Engineering duties.

2 Scene of the accident

Type of event:	Very serious marine casualty
On the trip from:	Savannah
Location:	Savannah / Georgia / USA
Latitude/Longitude:	φ 32°02'N λ 081°07'W
Date :	24 October 2003
to:	Norfolk
Location:	Norfolk / Virginia / USA
Latitude/Longitude:	φ 36°51'N λ 076°19'W
Date	26 October 2003

Detail of the US ENC data sets of the US Hydrographic Service (NOAA), prepared at the German Federal Maritime and Hydrographic Agency in Hamburg.

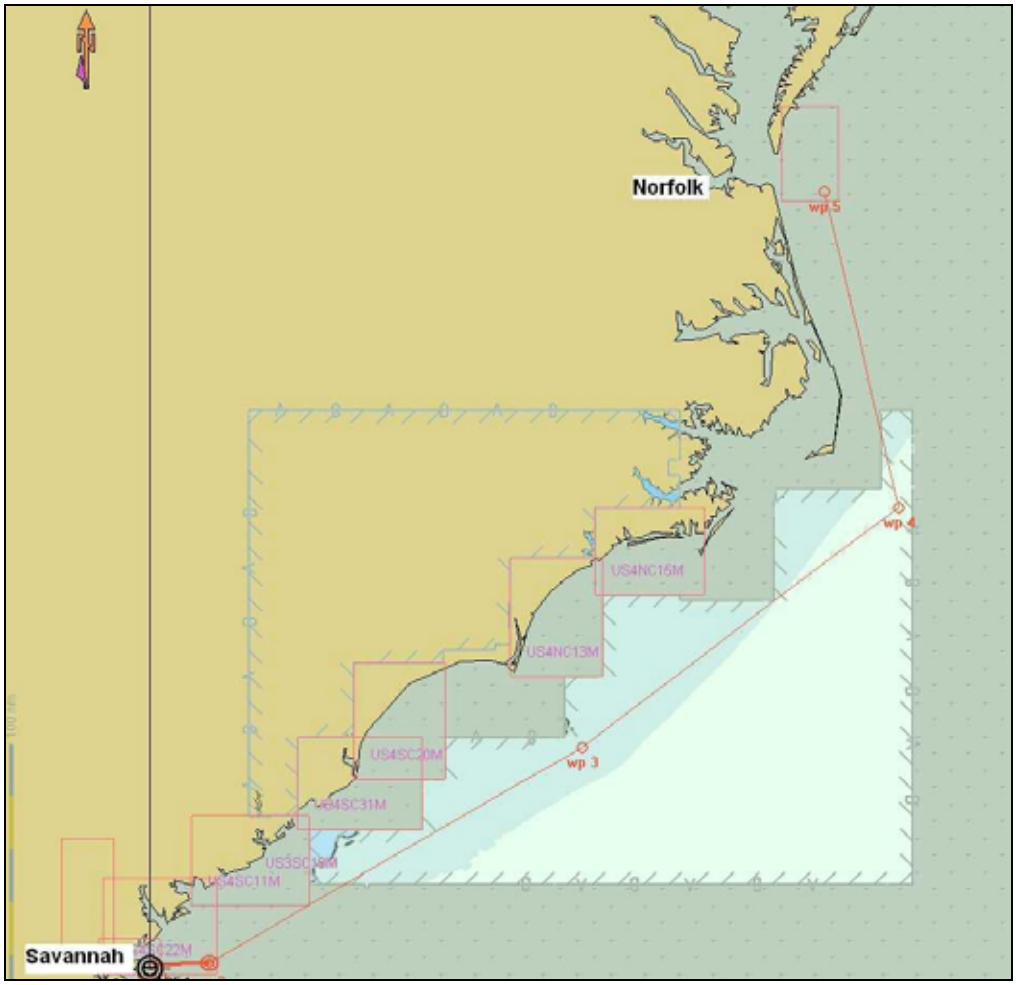


Figure 1: Position of vessel

3 Vessel Particulars

3.1 Photo CMS LONDON EXPRESS

Figure 2: Vessel photograph - CMS LONDON EXPRESS[3]

3.2 Particulars

Name of the vessel:	LONDON EXPRESS
Type of vessel:	Container vessel
Nationality/Flag:	Germany
Port of registry:	Hamburg
IMO number:	9143568
Call sign:	DPLE
Vessel operator:	Hapag-Lloyd Container Line GmbH
Year built:	1998
Shipyard:	Samsung Heavy Industries Co., Ltd. Koje
Yard No.:	1210
Classification society:	Germanischer Lloyd
Length overall:	294.04 m
Breadth over all:	32.25 m
Draught at time of accident:	forward: 7.88 m; aft: 10.04 m
Gross tonnage:	53,523
Deadweight:	66,577 t
Engine rating:	41,130 kW
Main engine:	MAN-B&W 9K90 MC
Speed:	24 kn
Crew:	23

[3] Source: Photograph - Hasenpusch Photo-Productions.

4 Course of the accident

4.1 Preliminary remarks

4.1.1 Service, equipment and manning of the CMV LONDON EXPRESS

LONDON EXPRESS, built 1998 in South Korea at the SAMSUNG shipyards, has since its commissioning been deployed in different worldwide scheduled liner services of the Hapag-Lloyd Shipping Company between the most important container ports of North America, South East Asia and Europe. The ship's container carriage capacity is 4,612 TEU[4]. At the time of the accident, this Panamax vessel[5] met all regulatory equipment and crewing requirements. Except for a minor case in 1999, worldwide and regularly conducted Port State Controls never established deficiencies to the ship.[6]
The ship's propulsion is a fixed right-handed propeller. The manoeuvring system consists of a semi-balanced underhung rudder, an autopilot unit (NAUTOPILOT 2010) and a bow thruster. LONDON EXPRESS' navigational equipment includes two radars (ATLAS 9600 ARPA/S and ATLAS 9600 ARPA/X), two satellite navigation systems (NT 200 and NT 200 D), an echo sounder (ATLAS 9205), an electronic sea chart (ECS CHARTPILOT ATLAS 9300) and the track control system ATLAS NACOS 35-2. The vessel's main engine is a 9 cylinder two-stroke diesel engine of the 9 K 90 MC series developed by engine manufacturer MAN B&W and built by SAMSUNG in Korea under license.

At the time of the accident, the crew of LONDON EXPRESS comprised 23 seamen. Because of the upcoming rotation related replacement of the Ship Operations Officer (SOO), for the two weeks preceding the accident the Second Engineer's function had been performed by two people. The crew member due to take over the position of the Second Engineer had many years' professional experience with other shipping companies, including as a Marine Engineer on smaller vessels. He was supposed to be made familiar with the special aspects of the type of engine on board LONDON EXPRESS and to receive instruction in the specific administrative procedures applied by his new employer. This on-the-job training, which was almost completed, was the responsibility of the departing SOO.[7]
The Master, the Chief Mate, the Chief Engineer, the SOO, the (future) Second Engineer and the Master of Ship Operations were all German nationals. The remaining crew consisted of 17 Filipino nationals.

4.1.2 Information sources concerning the course of the accident

The first investigations concerning the sequence of events were carried out in Norfolk by the Virginia Port Authority Police, the Virginia State Police, the Coast Guard Criminal Investigative Services and the Coast Guard Marine Safety Office Hampton Roads.

[4] TEU = Twenty Foot Equivalent Unit = measurement unit for container transport capacity.
[5] Panamax = denomination applied to ships whose beam is just small enough to enable transiting the Panama Canal, i.e. not greater than 32.3 m.
[6] Source: www.equasis.org.
[7] To avoid confusion the casualty will henceforth be referred to exclusively with the designation Ship Operations Officer or SOO, while the Second Engineer due to replace him will only be referred to as such without the additional qualification of "replacement".

The summary result of these investigations, which took place – with interruptions – over two days and nights and included comprehensive interrogation of all crew members, was that the American authorities could rule out a criminal background as the cause of death. The fatal accident was said to be the result of a chain of unfortunate circumstances.
The Federal Bureau of Maritime Casualty Investigation [*Bundesstelle für Seeunfalluntersuchung* (BSU)], which had been informed by the vessel's shipping company on 28 October 2003 of the events having taken place on board, was in direct contact with the United States Coast Guard (USCG) Headquarters in Washington DC and with the local investigating US Coast Guard Marine Safety Office in Hampton Roads. These agencies transmitted early information in a timely manner by telephone and via email, which was then used by the BSU within the scope of its own inquiry pending the result of the US investigation. The BSU made its own enquiries on board LONDON EXPRESS upon its arrival at Bremerhaven on 12 January 2004 and again on 21/22 November 2006 in Savannah. In addition, the technical specificities of the sister ships DÜSSELDORF EXPRESS[8] and KOBE EXPRESS[9] were also examined.
The Master of LONDON EXPRESS and other crew members were extensively interviewed by the BSU. In addition, records and statements of the ship's command and log entries were evaluated. Valuable information was ultimately provided by the records of the questionings drawn up by the US and German police authorities within the scope of the accident investigation, which were made available to the BSU.

Despite the numerous and varied sources of information rendered accessible to the BSU, the following representation of the course of the accident must be considered to be the result of partially significantly contradictory statements and records. This report will nonetheless attempt to draw up as objective as possible a picture of the course of the accident. In doing so it will be unavoidable to let the different versions of the course of the accident that were provided by the individual witnesses stand insofar as they have not unequivocally been refuted. Any discussions concerning the plausibility of individual statements, the credibility of witnesses and the resulting determination and evaluation of the probable sequence of events on board will be deferred at first. They constitute the subject of Chapters 5 and 6 of the present investigation report.

4.1.3 Relevant sites on board

For a better understanding of the events, the relevant areas on board will be described with special emphasis on the site of the accident before proceeding to the chronological description of the events.

4.1.3.1 Arrangement of the superstructure from the main deck upwards

The superstructure of LONDON EXPRESS consists, in addition to the facilities on the main deck, of the tween decks A, B, C, D, E arranged above it, and of the navigation bridge deck and the flying bridge. The main deck is connected with the abovementioned tween decks and the bridge by means of a lift and a staircase.

[8] Shipboard inspection on 14 November 2003 in Bremerhaven.
[9] Shipboard inspection on 16 March 2004 in Bremerhaven.

The following table shows the facilities to be found on each individual deck[10]:

Deck denomination (from bottom to top)	Relevant facilities
Main deck	Board Management Centre (BMC)[11] with adjacent Board Management Office (BMO), Hospital changing room for engine personnel, with connecting access to the uppermost companion-way into the engine room
A Deck	Officers' mess with lounge and bar, crew mess for the Filipino crew, Duty Mess for the German crew members[12], pantry, galley
B Deck	TV/leisureroom for crew, crew accommodation
C Deck	Gym, pool, crew accommodation
D Deck	Crew accommodation, laundry
E Deck	Master's, Chief Engineer's, Chief Mate's, SOO's accommodations

4.1.3.2 Engine room layout

The main access to the engine room is via the technical personnel changing room. To providepractical access options to the individual components of the centrally positioned main engine and for optimal space utilisation in the arrangement of various auxiliary aggregates the engine room is subdivided into several main levels. Several intermediate levels lead immediately around the main engine; they are accessible from the main levels via companionways of a few steps each. The respective heights of these intermediate levels are arranged with a view to optimising access to the engine components and units that are of relevance for maintenance and repair purposes.
Upon entering the engine room, one first reaches the uppermost intermediate level via a portside companionway and the cylinder head level via a further portside companionway[13] (**Figures 3** and **4**).

[10] N.B.: This enumeration is not exhaustive. It is limited to the areas relevant for the subsequent description of the events.
[11] N.B.: In its structure and function the BMC corresponds approximately to the formerly customary ECR (engine control room), but instead of being located in the engine room, to match its broader purpose as an information and control centre for overall technical ship operations it is set up on the main superstructure deck.
[12] N.B.: The three Mess Rooms are connected via wall openings with limited view from one to the next.
[13] N.B.: The denomination of this and the following levels, which also comprises the respective intermediate levels does not correspond to any accepted standard but is intended only for better comprehension.

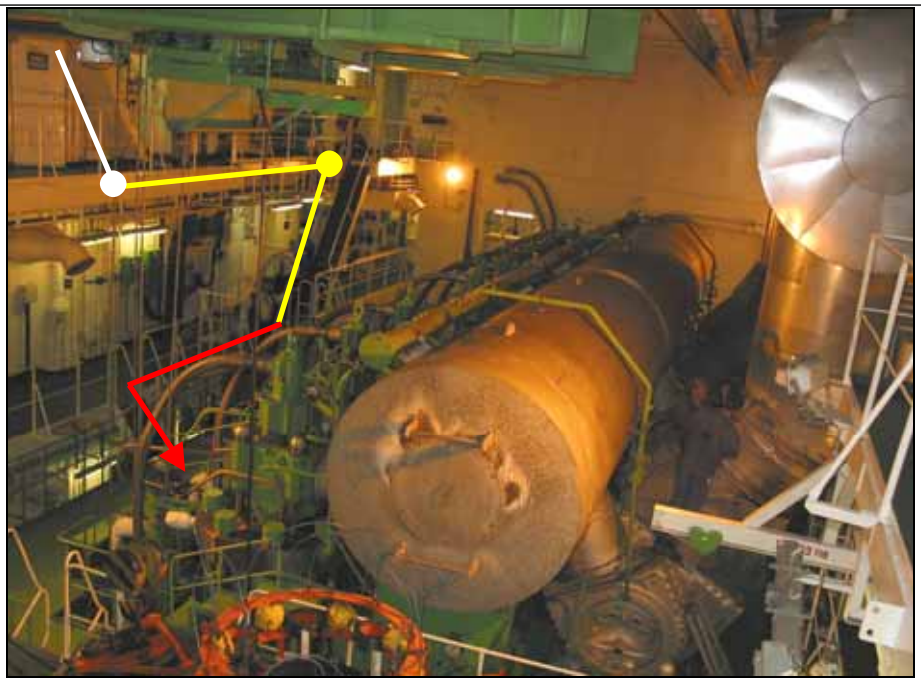


Figure 3: Way to the cylinder head level[14]

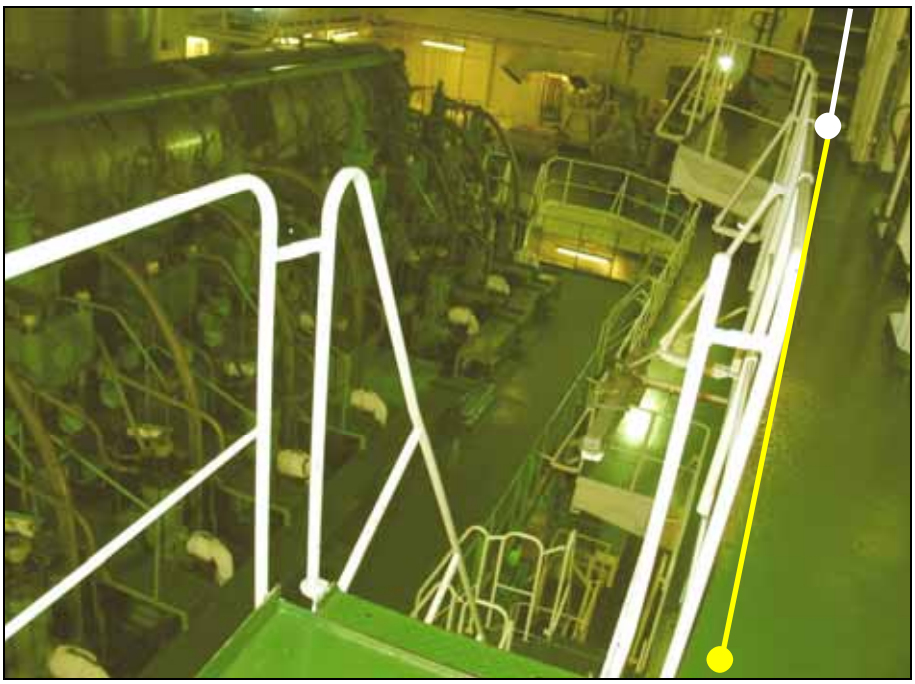


Figure 4: View of the cylinder head level[15]

From the cylinder head level, and again on the port side, two alternative companionways lead to the scavenge air receiver level, which is of particular relevance for the accident (**Figures 5** to **9**). Companionway 1 (marked in red in the following figures) ends in the immediate vicinity of the forward end of the main engine, while companionway 2 (marked in yellow) leads onto the scavenge air receiver level between Cylinders 5 and 6.

[14] Viewing direction: From aft onto the main engine.
[15] Viewing direction: From forward onto the main engine (cf. identical point markings in Figs. 3 and 4).

Figure 5: Companionways 1 and 2 from the cylinder head level to the scavenge air receiver level (1)[16]

Figure 6: Companionways 1 and 2 from the cylinder head level to the scavenge air receiver level (2)[17]

[16] Viewing direction: From the cylinder head level aft.
[17] Viewing direction: From the scavenge air receiver level aft.

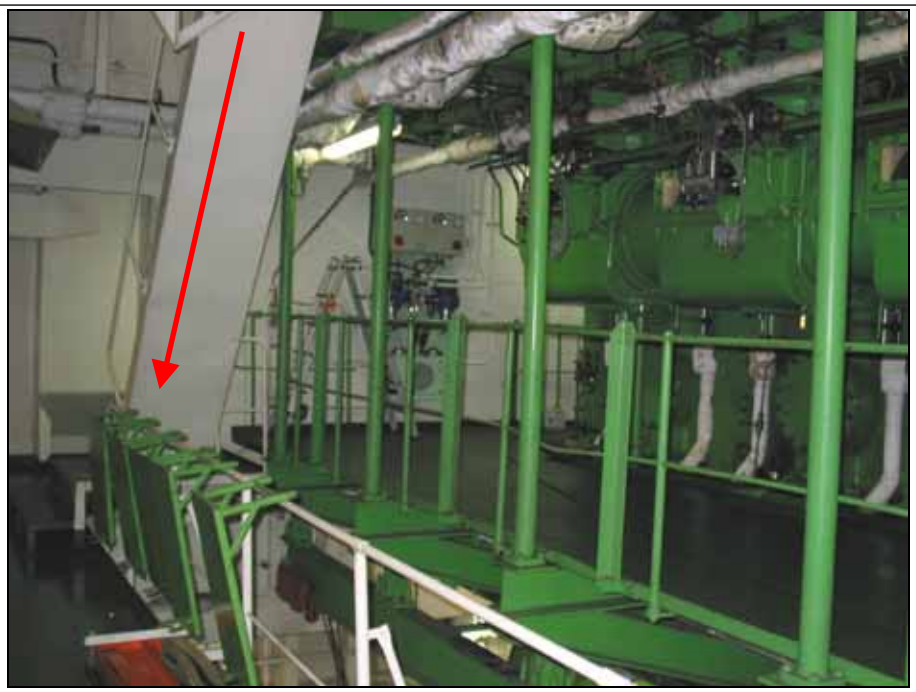


Figure 7: Companionway 1 from the cylinder head level to the scavenge air receiver level (1)[18]

The intermediate levels A and B, which surround the main engine at different heights and conceptually form part of the scavenge air receiver level, are specially marked[19] in **Figures 8** to **14**. Level A of the scavenge air receiver level is reached via companionway 1 and companionway 2. This level comprises the port side alleyway and the forward and aft crossways with the two frontal access hatches to the scavenge air receiver. The starboard side alleyway, which runs below and to the side of the scavenge air receiver, is on the lower Level B (**Figures 12** and **13**). Therefore it is not possible to circulate all around the main engine at one and the same level with reference to the scavenge air receiver. Rather, in order to pass on the starboard side it is necessary to use the companionways provided at the forward and aft ends in order to proceed from Level A to Level B.

[18] Viewing direction: From the scavenge air receiver level forward.
[19] Remark: Allocation of letters A and B by the author of the report.

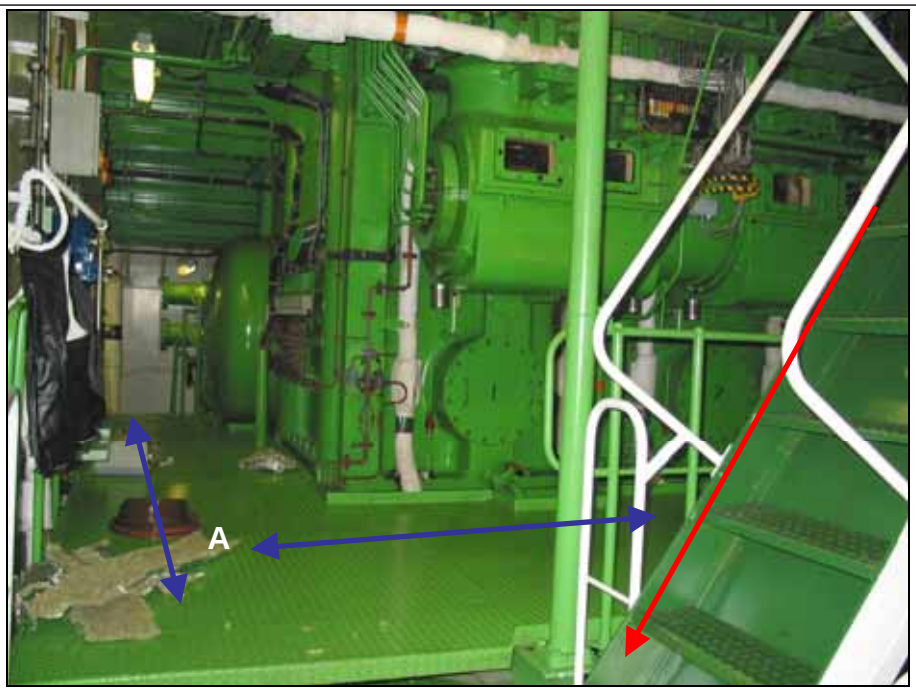


Figure 8: Companionway 1 from the cylinder head level to the scavenge air receiver level (2)

Figure 9: Companionway 2 from the cylinder head level to the scavenge air receiver level

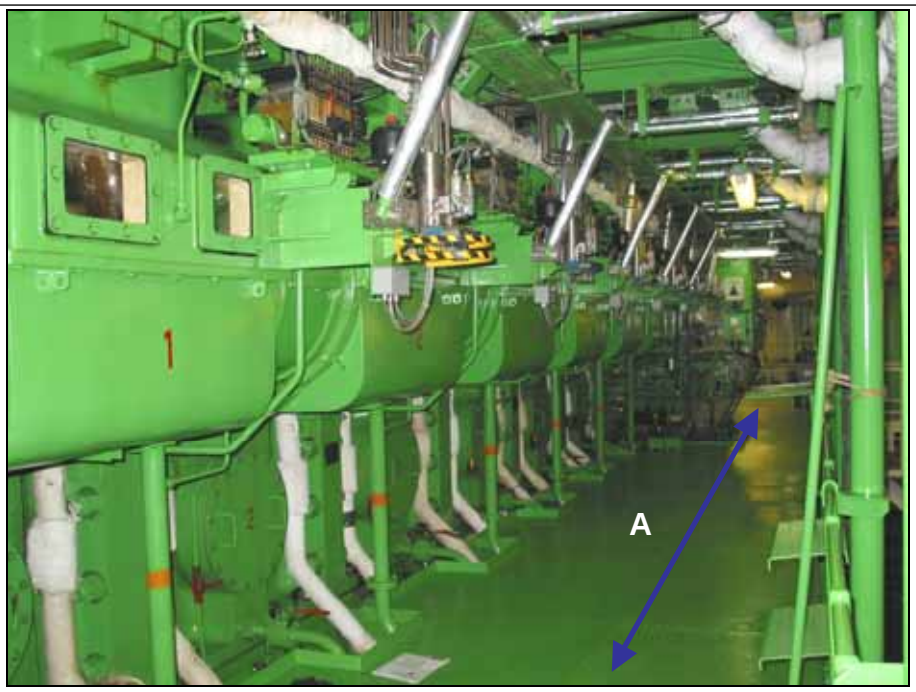


Figure 10: Scavenge air receiver level – port side[19]

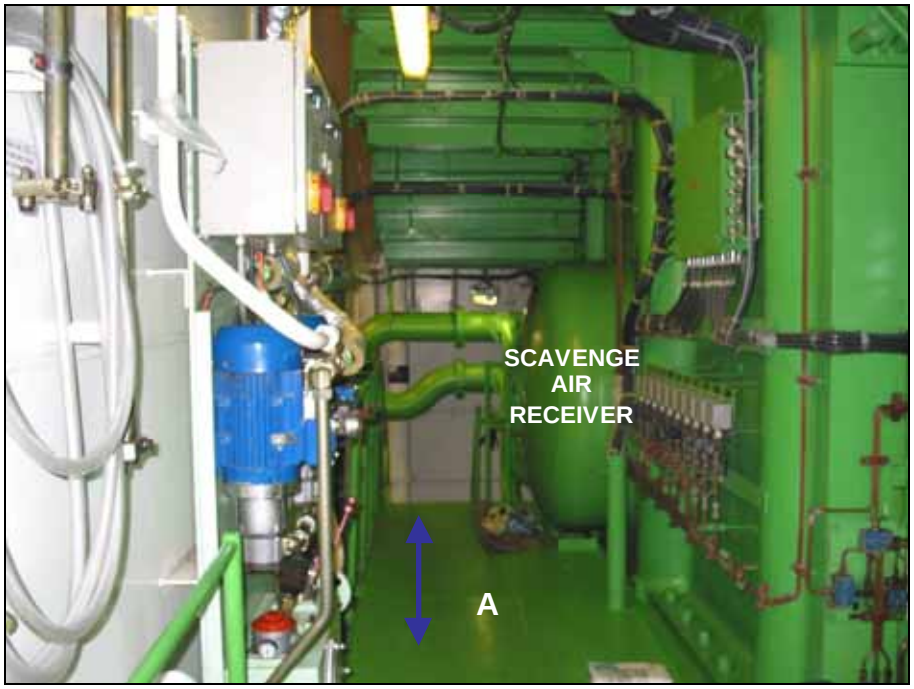


Figure 11: Forward crossway (scavenge air receiver level forward end)[20]

[19] Viewing direction: Engine port side from fore to aft. (The scavenge air receiver itself runs along the starboard side).
[20] Perspective: Approx. from the same location as Fig. 10, but viewing in the direction of the fore end of the scavenge air receiver.

Figure 12: Scavenge air receiver level, forward end and starboard side[21]

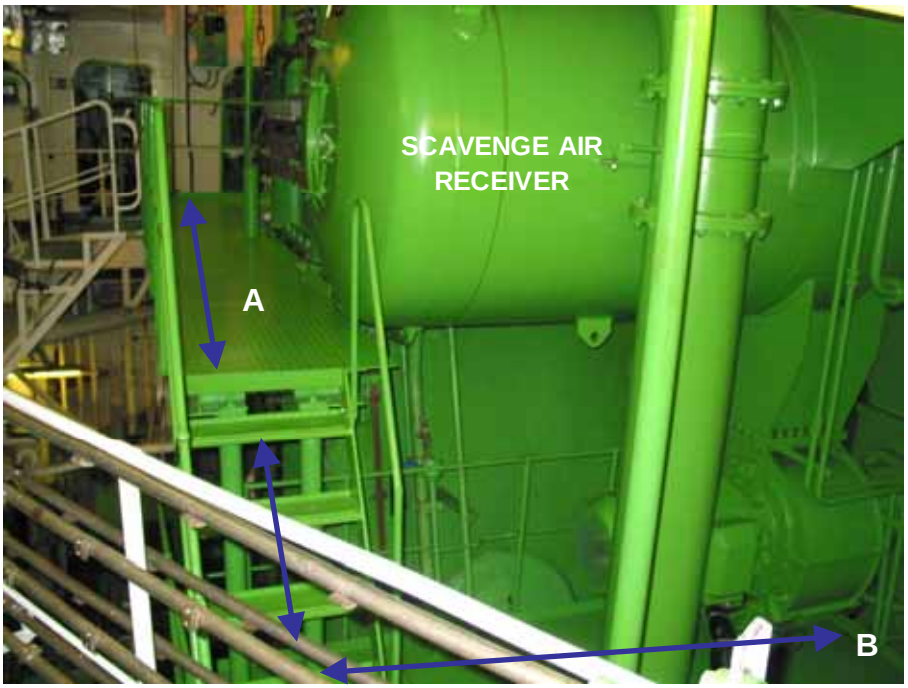


Figure 13: Aft crossway (Scavenge air receiver level, aft end and starboard side)

[21] Viewing direction: Engine starboard side from fore to aft.

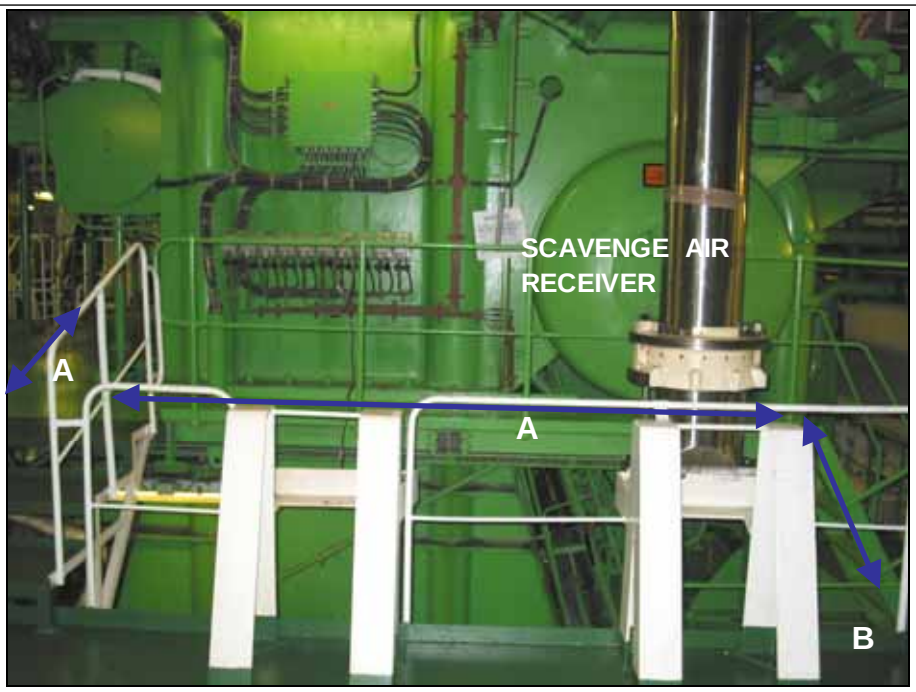


Figure 14: Scavenge air receiver level, aft end

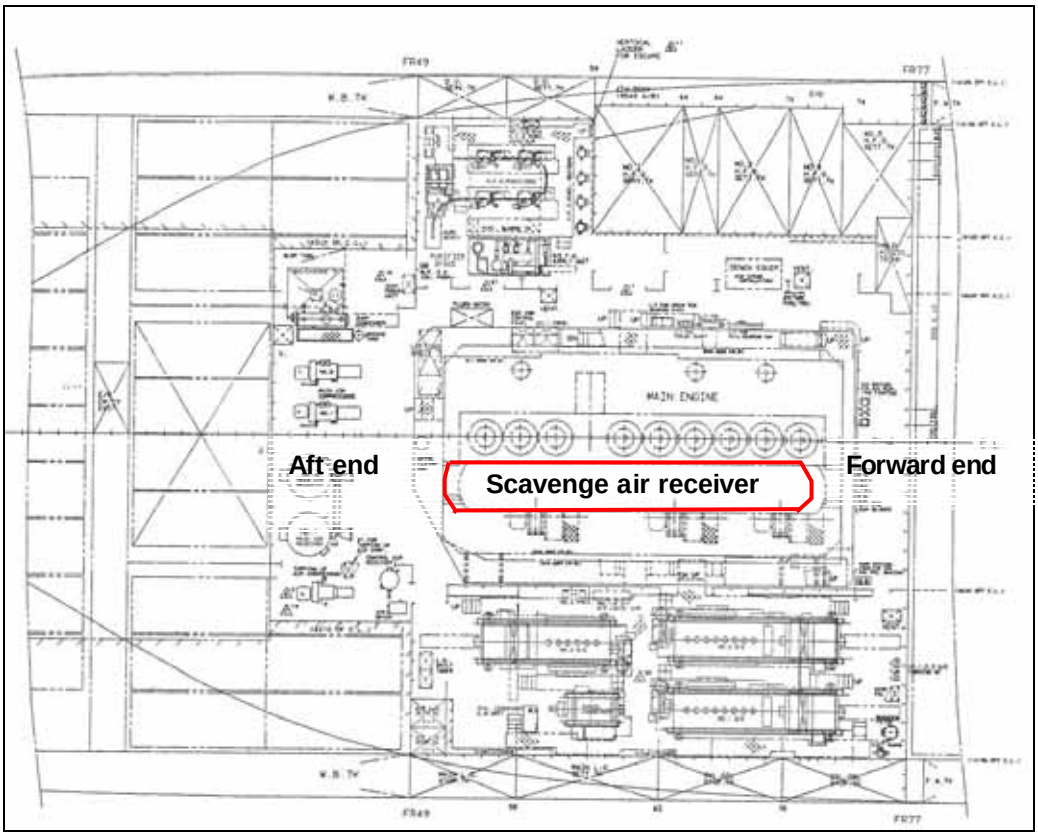


Figure 15: Position of the scavenge air receiver within the engine room (top view)[22]

[22] Source: Design drawing of the manufacturer (licensor) MAN B&W Diesel A/S. (Unless otherwise stated, this remark applies to all excerpts from technical drawings included in this report)

Figures 16 and 17, finally, show the power unit level, which is connected with the scavenge air receiver level above via a port side companionway.

Figure 16: Power unit level starboard side[23]

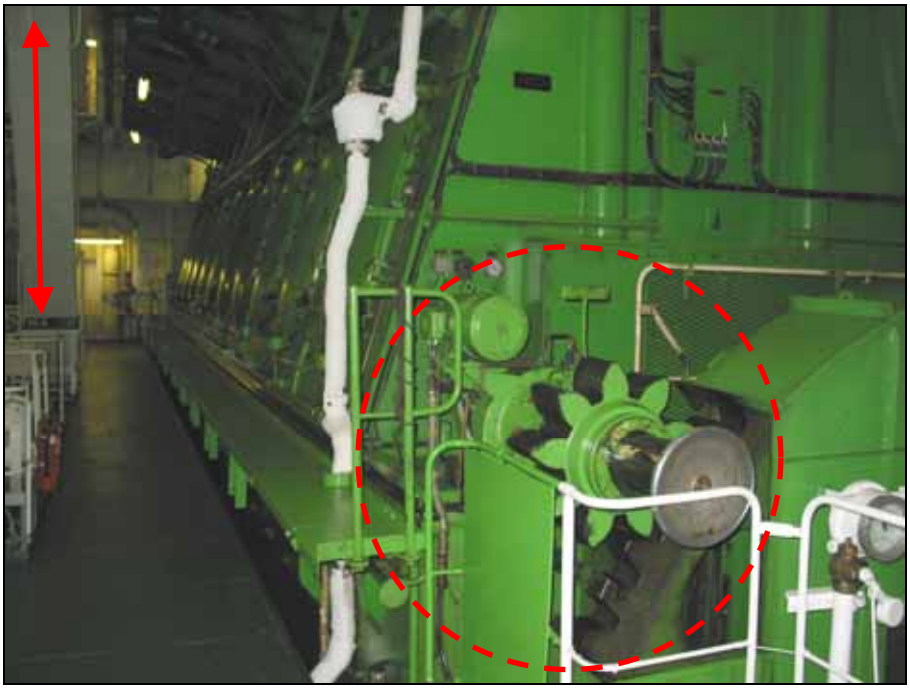


Figure 17: Power train level port side with companionway and turning gear[24]

Figure 17 shows the "turning gear"[25] marked in addition to the companion-way to the scavenge air receiver level (red arrow). The turning gear consists of an electric motor

[23] Viewing direction: From aft forward.
[24] Viewing direction: From aft forward.

with a sprocket that can be shifted horizontally on the electric motor's driving shaft by means of a handwheel. This produces a transmission of power by means of a gear wheel fixed on the main engine's main shaft. After engaging the turning gear it becomes possible to turn the main shaft by means of the electric motor in order to move the engine's pistons up and down.[26]

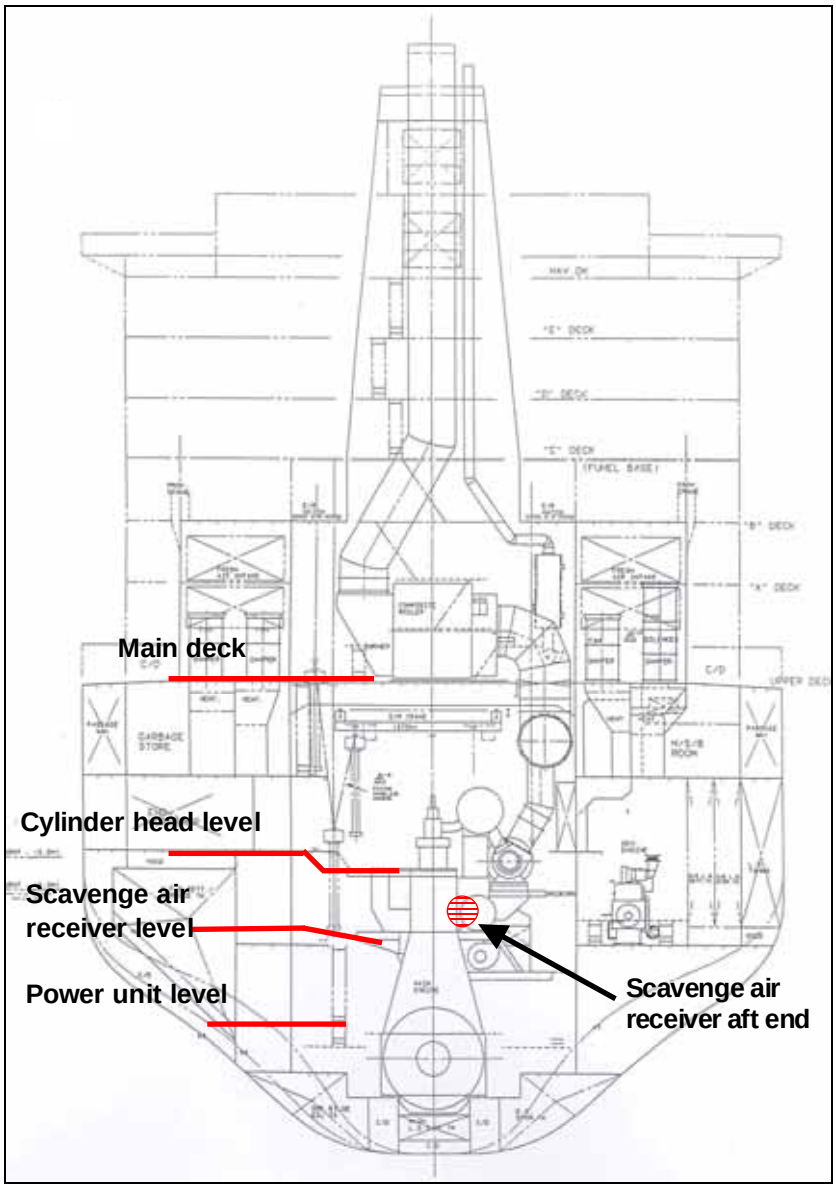


Figure 18: Cross section of vessel seen from aft

[25] Because it turns the shaft.
[26] N.B.: The so-called "turning" of the pistons is an integral part of clearing the engine for operation – it serves the purpose of checking that they move freely and build up a lubricant film. The turning gear is also used – with a cable-operated remote control – to direct the pistons in the cylinders into the desired position for maintenance and repair work.

4.1.3.3 Scavenge air receiver layout

The scavenge air receiver, which leads the fresh air necessary for the compression process to the individual cylinders of the combustion engine, is shaped like a tube and is approx. 16.6 m long. Its diameter is approx. 1.68 m. At both its forward and aft ends the receiver has a circular access opening having a diameter of approx. 0.73 m for control, maintenance and repair purposes. **Figure 19** clearly shows the relationship between the diameters of the scavenge air receiver and the access hatch and the height of a man of average build.

Figure 19: Scavenge air receiver – aft end with access hatch closed

The closing arrangement for the two access openings consists of manhole covers opening only inwards in horizontal gate fashion and mounted on two hinges. The hinges are within the scavenge air receiver. The covers are closed from the outside by reaching into the scavenge air receiver and grasping a vertical handle welded onto the centre of the cover, then swivelling the cover into the opening. By means of a special bolting system consisting of three identical locking devices set at 120° angles the cover is then pressed against the inner circumferential lip of the scavenge air receiver opening. [27] This design ensures that the pressure developing within the receiver while the engine is running and the resulting additional contact pressure further assist the cover's sealing function. However, this also means that intentional opening of the hatch with the engine or the auxiliary fan running is not possible using only normal muscle strength.

[27] Cf. Point 5.5.2.2.2. for the technical details

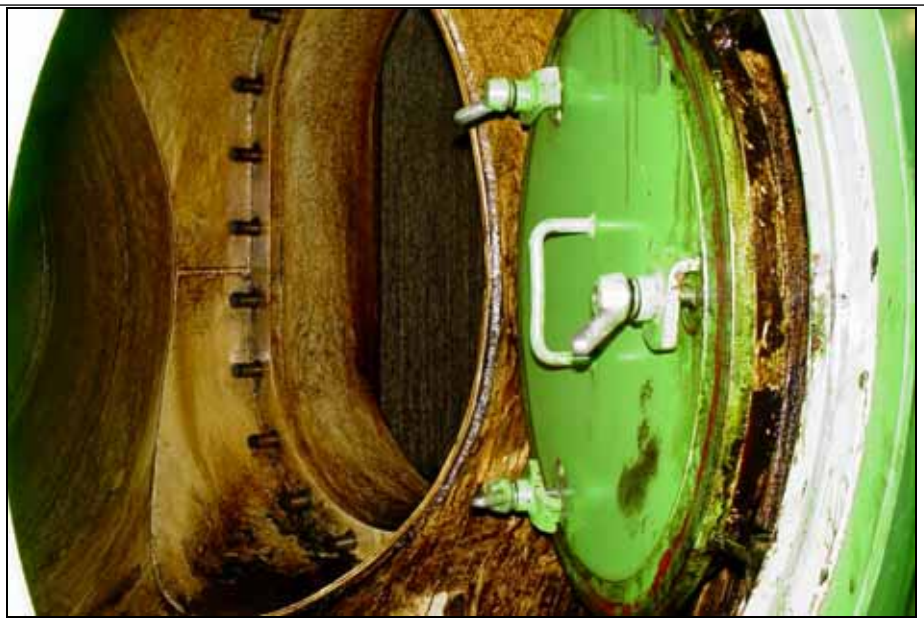


Figure 20: Scavenge air receiver man hole cover – forward end – swung inwards

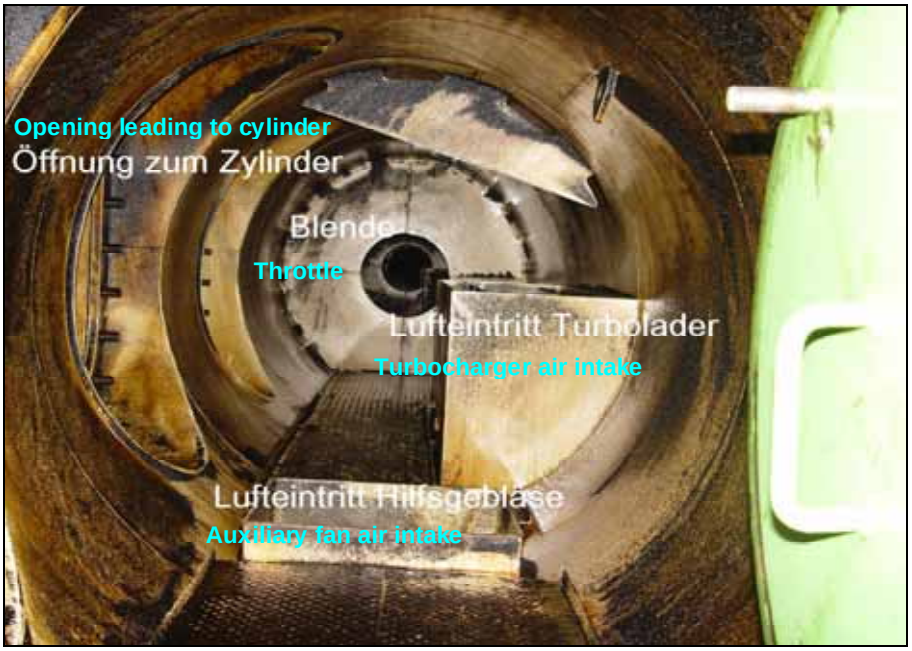


Figure 21: View from the aft end into the scavenge air receiver[28]

The purpose and layout of the scavenge air receiver facilitate inspection of the cylinders and pistons without opening the engine. For this purpose, the position of the pistons can be changed by means of the above described turning gear. In this way it is possible to carry out a wipe test for engine oil analysis to check proper operation of the piston rings and the lubrication system.

[28] N.B.: The light in the receiver is mainly generated by the camera flash.

Figure 22: Scavenge air receiver manhole cover – forward end – inside view[29]

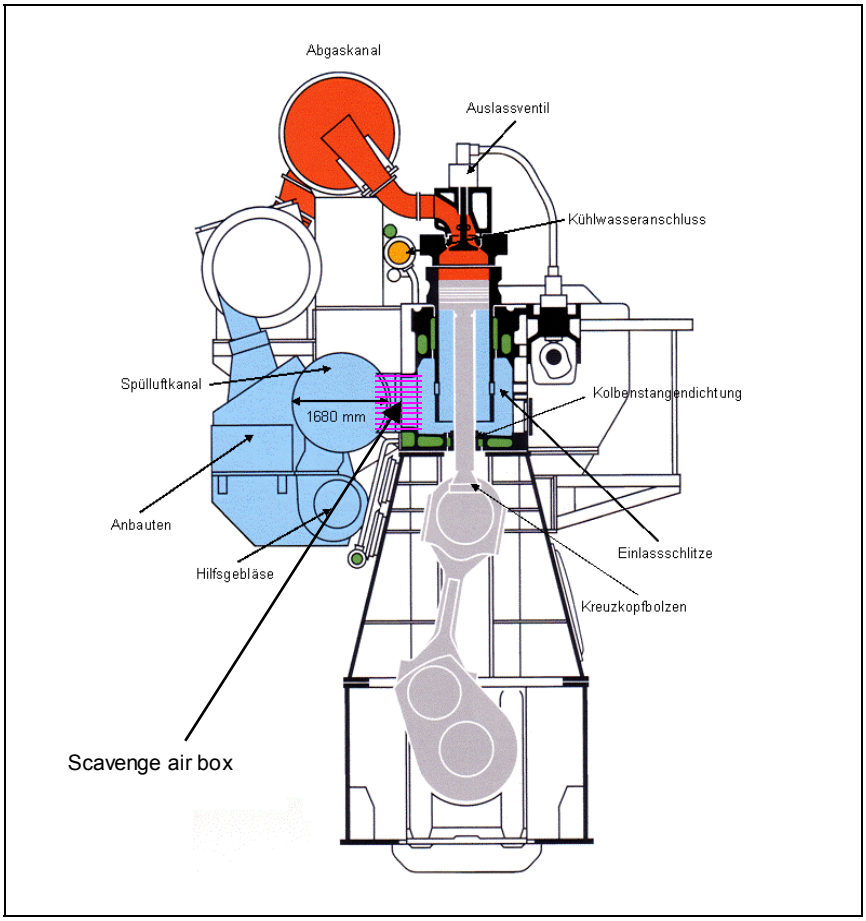


Figure 23: Main engine – cross section[30]

Abgaskanal = Exhaust gas channel
Auslassventil = Exhaust valve
Kühlwasseranschluss = Cooling water inlet
Kolbenstangendichtung = Piston rod seal
Einlassschlitze = Inlet port
Spülluftkanal = Scavenge air receiver
Anbauten = Additional components
Hilfsgebläse = Auxiliary fan
Kreuzkopfbolzen = Cross-head pins

[29] N.B.: The light in the receiver is exclusively generated by the camera flash.
[30] Source: Opinion of the technical expert commissioned by the BSU; cf. Sources.

4.2 Course of the accident

The following description of the course of the accident has been broken down into three time periods to provide a better overview and also as an introduction to the discussion for purposes of investigation and analysis of the marine casualty at sea as set forth in Chapters 5 and 6:

- Events up to the confinement in the scavenge air receiver (4.2.1)
- Missing person search (4.2.2)
- Discovery of the missing person (4.2.3)

4.2.1 The day's events up to confinement in the scavenge air receiver

Arriving from New York, LONDON EXPRESS reached its berth in Savannah on 23 October 2003 at approximately 05:00. The agent set the time of departure to 21:00 taking into account the number of containers to be moved and the tides on the Savannah River. At around 05:30 work began on the planned replacement of piston No. 6 of the main engine. The person responsible for this extensive work, which lasted until approx. 17:30 including tidying up of the work area, was the Ship Operations Officer (SOO), later found to be missing. The repair team also included the (future) Second and the Third Engineer, the Ship Operations Foreman (SOF), the two Oilers[31], the Fitter[32] and the Wiper[33]. The necessary work was primarily carried out on the cylinder head (disassembly of the cylinder head cover) and from the power unit level (loosening the screw connections for the piston rod seal and nuts on the piston cross head pins)[34]. Then the piston was drawn out of the engine with the gantry crane installed on the ceiling of the engine room, and later the new piston was assembled using the reverse work sequence.

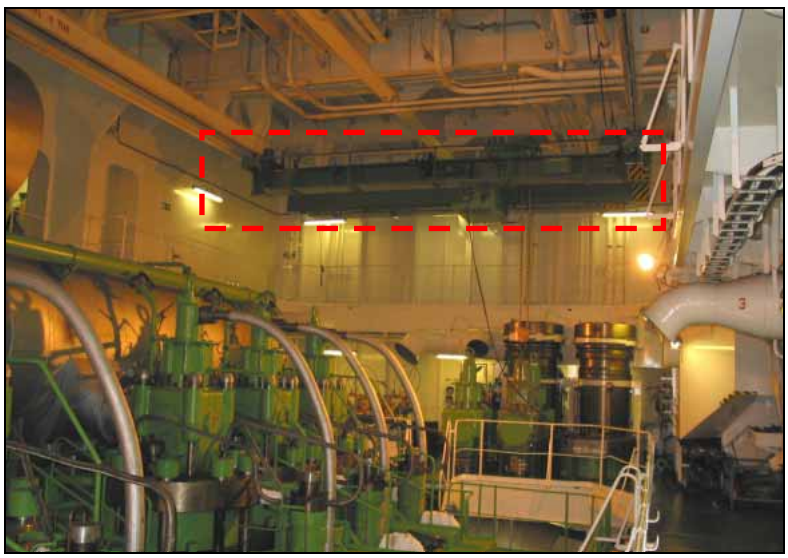


Figure 24: Gantry crane system

[31] Oiler = Skilled worker in the engine area.
[32] Fitter = Welder = Skilled worker in the engine area.
[33] Wiper = mechanical cleaner = Unskilled worker in the engine area.
[34] Cf. Figure 23.

The physically very strenuous work due to the dimensions of the components to be assembled and the standard engine room temperatures of around 30 °C advanced rapidly.
Aside from differences of opinion between the SOO and the Second Engineer concerning among other things the assignment of tasks within the team, according to all crew members participating in the work there had been no problems or delays worth mentioning during the day in connection with the repair. Work was interrupted for the following customary breaks:

07:30 to 08:00	Breakfast
10:00 to 10:20	Coffee
12:00 to 12:30	Lunch
15:30 to 15:50	Coffee
17:30 to 18:30	Window for dinner

The Chief Engineer did not participate in the piston maintenance work. In the course of the day he inspected the engine room several times and obtained information on the progress in the work during the breaks in the Duty Mess. In addition he supervised the bunkering activities, which took place over the entire day, recorded them in a table, and took care of the related formalities. For this purpose and according to his own statements he also boarded the bunker barge on several occasions. The necessary work on deck was carried out by the different Filipino crew members.

08:40	Bunker barge (heavy fuel oil) alongside
09:50	Start pumping
13:45	End pumping
14:45	Bunker papers completed
18:40	Bunker barge (diesel oil) alongside
19:30	Start pumping
20:00	End pumping
20:30	Bunker papers completed

During the afternoon break the Master, the Chief Engineer, the Chief Mate, the SOO and the Second Engineer met at the Duty Mess as was customary when in port. According to statements from the abovementioned persons, it was a relaxed break, as up to this point the repairs had proceeded according to plan. When questioned about the content of the conversation that took place during the break, the Chief Engineer indicated among other things that the SOO had stated that the work in the engine room would be completed by between 17:00 and 17:30. In addition, he had announced that thereafter he wanted to carry out the piston check conducted in every harbour “if [he] could still manage it”[35].

[35] Quoting the SOO as remembered by the Chief Engineer.

Remark:
The background for the piston check to be carried out as a routine harbour procedure was the installation, performed a few weeks earlier, of the new “Alpha Lubricators”. According to the shipping company, these are a new lubricating system produced by the engine manufacturer, intended significantly to improve cylinder lubrication, lower expensive lubricant consumption and – after a successful introduction phase – reduce inspection time and frequency. In the piston check, which is carried out from the scavenge air receiver, an oil analysis from a wipe test of the individual cylinders is carried out along with other checks. This allows conclusions to be drawn about the functionality of the new lubricating system. Whether a check of this type would still be able to provide meaningful results after the engine had been off for more than 12 hours is debatable. In any event, on the day of the accident the inspection of cylinders and pistons could not take place immediately after entering port because the repairs needed to be started without delay.

After the end of the break, the technical personnel, with the exception of the Chief Engineer, returned to the engine room and carried out the remaining work. Thereafter and along the way, the tools were put away and inventoried. Finally the relevant work stations were cleaned, and the used rags disposed of. Shortly after 17:00 the SOF was first to leave the engine room. At 17:13 the cooling water supply to cylinder 6, which had been interrupted early in the morning to enable the repair work to take place, was restored – probably by the SOO.[36] At approx. 17:30 and according to concurring statements, the SOO also explicitly released all Filipino crew members from duty. According to statements from several witnesses, at this point the scavenge air receiver was closed.[37]
The SOO and the Second Engineer remained in the engine room. The latter stated that immediately after the Filipino crew had left the engine room the SOO had requested his assistance with the piston check still to be carried out. To perform the check, the SOO was said to have entered the scavenge air receiver through the forward hatch. The Second Engineer for his part had posted himself at the aft hatch of the scavenge air receiver, which he had opened, and had taken over control of the turning gear by means of the cable remote control device. The SOO was said to have inspected the individual pistons one by one with a torch, starting at cylinder 1, and instructed the Second Engineer via light signals and calls to modify the piston stroke as needed. In the course of his inspection, the SOO was said gradually to have approached the aft hatch access, then to have turned around and to have exited the scavenge air receiver via the forward hatch. The Second Engineer reported closely having observed the SOO exiting the receiver as well as the subsequent closure of the forward hatch, thereupon having, for his part, properly closed the aft hatch. The piston control was reported to have lasted for a maximum of 30 minutes instead of the normally estimated one-hour minimum[38]. The SOO was reported to have abridged the inspection. The

[36] At 17:13 the disturbance printer of the automatic engine alarm and safety system recorded the clearing of the Shut Down Alarm, which had been set off by the interruption of the cooling water supply before the start of the repair work.
[37] N.B.: It was not necessary to enter or open the receiver within the scope of the repair work.
[38] The witness hesitated in his different statements concerning this issue between periods of 10 to 15 minutes and later thought that “it might perhaps have been 30 minutes”.

Second Engineer speculated on two possible reasons for the shorter inspection time. On the one hand the SOO had been fully aware of the condition of the individual cylinders as a result of the regular inspections, and on the other hand he had already completed a 12-hour working day and was therefore probably hungry and tired just like the rest of the crew having participated in the repair.
The Second Engineer reported having left the engine room immediately after having dogged the aft hatch. He indicated no longer being able to remember whether he was still on the companion-way from the cylinder head level to the upper intermediate level or whether he had already reached it when he last saw the SOO.[39] In any event – so the Second Engineer – at this moment in time the SOO was also on his way up and was in the forward area of the cylinder head level (cylinder stations 1 to 3). Again according to the Second Engineer, there had been eye contact and the SOO had indicated his agreement that the Second Engineer, too, could now go off duty.

The Filipino crew and the SOF had already appeared to the Crew's and Duty Mess shortly after 17:30 for dinner. The Master and the Chief Mate had eaten their meal in the Officer's Mess at about the same time. The Filipino crew and the SOF had finished dinner already before18:00.
The Second Engineer and the Chief Engineer both indicated, independently from each other, having had dinner in the Duty Mess from approx. 18:00 onwards. While the Chief Engineer had confirmed, after initial hesitation, that they had eaten together, the Second Engineer affirmed that he was alone at the table.
It appears from a statement made by the Steward to the USCG investigators and confirmed by another witness, that at around 18:30 the Steward had asked the Chief Engineer in the Mess where the SOO might be. At this time, the Second Engineer was at table with the Chief Engineer. The Steward reported waiting for the SOO in particular because he wanted to tidy up the Mess and go off duty himself. The Chief Engineer is reported to have answered to the Steward's question that he did not know where the SOO was. The Second Engineer is reported not to have replied.
At a certain point in time that could no longer be more accurately determined, but which on the basis of the vague witness statements collected would most likely have been during the dinner period, the Second Engineer is said to have reported completion of the repair work to the Chief Engineer, and that the main engine was again ready for operation.
After dinner, the Chief Engineer once again returned to the bunkering activities. According to their own statements, the SOF and the Filipino crew, who were not needed for bunkering, retired to their rooms to rest. The Second Engineer also stated having gone to his room, but according to information received from the Chief Mate, at around 19:00 he was at the BMC processing technical documentation. At that time, the Chief Mate was completing loading documentation at the BMC after completion of loading and unloading operations. As both the cargo handling and the repair work were reportedly finished, but departure was planned only for 21:00, the atmosphere on board was calm and relaxed instead of the otherwise sometimes unavoidable hectic harbour operations related activity.

[39] Cf. the area marked in yellow in Figs. 3 and/or 4.

The Oiler on watch was reported to have started at around 20:00, i.e. as usual approximately one hour before the planned departure, to get the main engine ready for sea operation. The log of the engine's automatic alarm and safety systems documents that the Slow Down Alarm had been cancelled at 19:54. The reason for this was the connection of the lubrication oil pumps in combination with the preparations for starting the main engine.
Towards 20:30 the members of the deck crew were reported to have been ordered to take up their positions at the manoeuvre stations forward and aft for the imminent sailing. At 20:40, according to the entry in the ship's log book , the pilot arrived on board for the forthcoming approx. two-hour passage on the Savannah River[40]. According to the main engine log book, the main alarm monitoring system was switched from the BMC to the bridge at 21:03.

4.2.2 Missing person search

Reconstruction of the search measures proved to be very difficult due to contradictory witness statements and the fact that some witnesses gave partially clearly diverging information at different times. What seems to be clear, however, is that there were three original, apparently partially overlapping search phases. The first phase concerns the search activities from the moment of the first evidence that the SOO was missing until the sounding of the general alarm at approx. 21:00 (cf. 4.2.2.1). The second phase comprises the search measures after the sounding of the general alarm until the decision to sail, made by the Master at 21:30 (cf. 4.2.2.2).The third phase includes the activities carried out during and/or immediately after departure, which are said to have lasted until shortly after 22:00 (cf. 4.2.2.3).
The search in the immediate vicinity of the access hatches to the scavenge air receiver is of particular importance as concerns the description, examination and analysis of the events leading to the accident. To this extent the BSU is faced with particularly strongly diverging, partially even contradictory statements from witnesses who searched in the questionable area or at least claim to have done so. The description of the corresponding particulars cannot be incorporated into the scheme of the abovementioned three search phases with ultimate certainty because of lacking or contradictory timing information, so that the individual crew members' activities are initially only set forth in a summary manner and assigned to the different phases on the basis of the highest plausibility.[41]

4.2.2.1 Evidence that the SOO was missing

It is not known from what concrete point in time onwards the SOO was seriously missed on board. In this connection, the Chief Engineer stated that the first time he had noticed that the SOO was missing was at around 20:30. As LONDON EXPRESS was due to sailat 21:00, he had been surprised at not finding the SOO at the BMC. The SOO, whose original duties included the engineering monitoring of the main engine starting preparations at the BMC, was unexpectedly not at his post. A first search conducted by the Chief Engineer in the engine room, including questioning of the Oiler, who had been working in that area on getting the main engine ready since approx. 20:00, did not bring to light any information concerning the SOO's whereabouts. The

[40] This was the River Pilot.
[41] For the corresponding details, cf. the overview of the search activities in the scavenge air receiver area described below under Point 5.6.3.

Oiler confirmed that he had been asked by the Chief Engineer whether he had seen the SOO. However, this had reportedly not at first been done in person but by telephone. According to the Oiler's statement, he was occupied closing the indicator cocks on the cylinder head level when the telephone in the engine room rang at approx. 20:30. The Chief Engineer had reportedly phoned and asked the Oiler whether he had seen the SOO. Later, in the further course of readying the main engine, the Oiler reports having encountered the Chief Engineer in the engine room and being asked directly whether he knew where the SOO was.
Contrary to the Chief Engineer's statement, the SOF indicated that he had already been woken up at approx. 19:45 by a *first* phone call from the Chief Engineer, in which the latter enquired whether the SOF knew where the SOO was. He had reportedly answered this question in the negative and gone back to sleep. He had then reportedly been called a *second time* by the Chief Engineer at approx. 20:45 and requested directly to participate in the search measures. Thereupon, the SOF reports having dressed and gone to the BMC as well as, at a later stage, to the engine room to participate in the search.
According to his own statements, the Second Engineer was also called by the Chief Engineer in his room and asked whether he was aware of the SOO's whereabouts.
However, the Second Engineer was unable to remember, when asked again, whether he too had been contacted twice as had been the SOF.
In any case he stated that he too had subsequently gone at first to the BMC at around 20:40 and that he had later also looked for the SOO in the engine room.

The Chief Mate and the Master, who were on the bridge together with the River Pilot in view of the impending departure manoeuvres, both reported having been called on the telephone by the Chief Engineer at around 20:40. The Chief Engineer had reportedly indicated that the engine was ready for operation and in doing so had implied that there was "a problem". The SOO could not be found. The Chief Engineer was said to have asked for the SOO's room, located immediately below the bridge deck, to be searched, since a telephone call to the room had gone unanswered. The Chief Mate is reported immediately to have set out and to have cast a quick glance into the SOO's accommodation and his bathroom, without however finding him. On the bridge, the Master had reportedly informed the Pilot and – by telephone and via the agent – the Port Authority of the fact of a missing crew member and the developing difficulties in relation to being able to keep to the 21.00 departure time. The Port Authority had reportedly organised a search in the harbour facilities and clearly stated that the berth occupied by LONDON EXPRESS would have to be free from 21:30 onwards to accommodate an arriving container vessel.
After the telephone call to the bridge, which he had placed from the BMC, the Chief Engineer at first went alone to the engine room. There he reportedly searched all levels. He reportedly also opened the scavenge air receiver, but only the aft access hatch.[42] He finally reportedly returned to the BMC and from there informed the bridge by phone that the SOO had still not been found.

[42] For the details stated here cf. Point 5.6.3.1 below

The Second Engineer stated that subsequently speculations were formulated in the BMC in terms of whether the SOO might have gone ashore. In order to find some indications for or against this theory, he reportedly visited the SOO's room, but did not find any fitting clues there.

At the same time and from the bridge the Chief Mate is reported to have contacted the already manned manoeuvring stations via VHF. However, no further information could be obtained about the SOO's whereabouts from those stations. Equally unsuccessful were a visual binocular scan of the deserted pier area and the sounding of a signal with the Tyfon. The conjecture that the SOO could possibly be making a telephone call from one of the terminal's phone boxes visible through binoculars from the bridge could not be confirmed. In his subsequent searches within the superstructure and on the upper deck the Chief Mate had reportedly also asked the sailors posted at the gangway whether they had noticed the SOO leaving the ship. Their answers were said to have been hesitant and doubtful, so that he did not obtain either a categorically affirmative or negative answer.
As time was getting shorter and shorter for the scheduled departure, the decision was finally made on the bridge to sound the general alarm without further prior warning in order to interrogate the entire crew and include them in the search activities. The general alarm was said to have been sounded at approx. 21:00.

4.2.2.2 Activities following the sounding of the general alarm

After the general alarm the crew members assembled in the area of the BMC, on the hallway in front and partially also in the changing room. The Master and the River Pilot remained on the bridge. The Chief Mate and the Chief Engineer informed the crew of the fact that the SOO was missing and asked each in turn whether anyone knew where he might be. According to witness statements, the Chief Engineer is reported to have said about the engine room area that everything had already been searched there, "including the scavenge air receiver".[43]
A Filipino technician is said to have made the observation that he had seen the SOO after completion of the work in the changing room changing his shoes. Afterwards it was however no longer possible to verify whether this statement had actually been made and if so, by whom.
The Steward later made a statement to the effect that he had been directly addressed by the Chief Mate and asked whether the SOO had had dinner. The Steward reported having clearly denied this.
After interrogation of the assembled crew they were instructed to search for the SOO in their individual areas of responsibility. The bridge issued a clear order to the Chief Engineer by telephone to search all possibly relevant areas in the engine room in depth. The Chief Engineer reportedly therefore transmitted this order to the technical personnel pointing out that "if the SOO were not found" then the engine itself, "including the valve[s] [covers]"[44] would have to be opened up again.
Thereupon all engine crew members, accompanied by the Chief Engineer, are reported to have gone to the engine room and to have searched its various levels looking for the SOO. The Chief Engineer on the other hand emphatically stated several times no longer having participated in engine room searches after the general alarm.

[43] Original quote as remembered by the witness.
[44] Quoting the Chief Engineer as remembered by a witness.

Rather, he stated having remained in the BMC waiting for reports.[45] This statement is refuted by the unanimous account of all remaining relevant crew members, who concurred in saying that the Chief Engineer had been present during the engine room search carried out after the general alarm. The statements of the Second Engineer and

of the Filipino crew members indicate that during the engine room search all areas, including the scavenge air receiver level, had been checked.

To the US investigators, a Filipino witness allowed that during his search he had passed the forward access hatch to the scavenge air receiver at around 21:10. There he had seen a red-bordered, oil-soaked rag jammed between the closed access hatch and the frame in an approximately "two o'clock" position. He had not succeeded in pulling the object out. In the same area he had also determined an air flow exiting. He reported having considered his observation and presumed that the rag had possibly been jammed into the gap for sealing purposes. However, he also reported having had, at the same time, a "hunch" or a "gut feeling" that the SOO could possibly be "caught" in the scavenge air receiver.[46] The witness was allegedly unable accurately to remember the position of the three locking devices, although he had even admitted to having used a torch, but in response to intensive questioning he ultimately admitted that he bolts were not entirely swung into the circular groove of the access hatch frame.
To the question why in spite of his suspicions he had not opened the hatch the witness answered that he would have needed authorisation to do so. He reported being obligated to follow the so-called chain of command, which for him began with the Third Engineer, leading to the Chief Engineer and his OK. He therefore first continued his search without telling anyone of his observation, going to the bilges next. Some time later he had then reportedly informed the Third Engineer of his suspicions, but was not sure of the exact timing. The Third Engineer reportedly pointed out that preparations for imminent departure were already under way, and that both the main engine and the fans were ready for operation. This was reportedly the reason why the Second Engineer was not requested to open the hatch. The Third Engineer disputes this account.[47] The Chief Engineer was reportedly also made aware of the irregularity at the forward access hatch and the questionable object jammed in it. He is reported thereupon to have examined the object by means of a torch and in the presence of witnesses. According to the witnesses, however, the Chief Engineer was not particularly interested in either the object or the imperfect seal, but had rather uttered words to the effect that the issue could be taken care of the following morning, because the ship now needed to leave. The Chief Engineer on the other hand emphasised only having been made aware of the jammed object the next morning.

Apparently the search particularly concentrated on the bilge[48] area. With the exception of the Chief Engineer, all technical personnel emphasised their search activities in that

[45] Cf. in this context also Point 5.6.3.
[46] Excerpt from the US witness interrogation report: "*He* (the witness*) had a hunch and he* (the SOO*) is probably in there."*
[47] Cf. in this context also Point 5.6.3.4.
[48] Bilge = Collecting area for condensation and leakage water as well as oil waste in the lowest area of the ship directly above the ship's bottom.

area. The reason given was the presumption that the SOO might, in the course of a final inspection round following the repairs, have collapsed within the engine room or within the bilge itself while checking that area.
Besides, the electrician had reportedly checked the funnel and the other technical facilities outside of the engine room, also including the bow thruster room in the ship's bow and the steering gear compartment. On part of this search round he had reportedly been accompanied by an Oiler.
The German SOF stated that within the scope of his search activities he had opened the aft access hatch to the scavenge air receiver and had called into the tunnel. He then reported having been on the way to the forward hatch in order to look into the scavenge air receiver from that end. While he was still in the vicinity of the aft hatch he reportedly met the Chief Engineer and the Second Engineer. The SOF had reportedly been given to understand that the scavenge air receiver had already been checked, so that he concluded that further searches were not necessary in that area. It was reportedly only for this reason that the SOF had abstained from going to the forward access hatch and opening it. This key issue was contested by the Chief Engineer and the Second Engineer.[49]

Reportedly, in the meantime the deck crew had searched the ship's upper deck. The cargo holds were however excepted from the search procedure upon instructions from the Master, in reaction to enquiries to that effect. In his interrogation, the Master justified this decision by arguing that the cargo holds could only be accessed from the deck via the lashing platforms. On that type of ship, refrigerated containers were reportedly not stowed below decks, nor were there reportedly any technical facilities in that area. As therefore there was no apparent reason for the SOO's presence there, a search of that area was considered to be superfluous.
Simultaneously with the abovementioned activities and according to the ship's log entry, the Harbour Pilot came on board at 21:10. In addition, at the same time – 21:10 – the assistance tugs tied on fore and aft.
According to information received, after the muster session in the BMC the Chief Mate together with the Steward systematically searched all facilities in the superstructure, including the unused accommodations. At the same time, the Master had reportedly tried to obtain information from land with the help of the Pilot and the Agent concerning the SOO's potential whereabouts. There had reportedly been a concern that the SOO might have suffered an accident within the port facilities. The missing SOO's description had been transmitted to the Port Authorities in order to support further investigations ashore in this connection.

Reportedly, after the unsuccessful search of the superstructure, the Chief Mate had gone to the BMC but found no-one there. He had then himself intended once again to go to the engine room. On the way there he was met by the entire search party, led by the Chief Engineer, on the top companion-way Thereupon allegedly everyone met again in the BMC, where animated discussion took place as negative search results continued to come in. The Chief Engineer is said to have explained to the Chief Mate that the engine room had been searched without success. The Filipino crew members

[49] Cf. in this context also Point 5.6.3.

were asked to continue the search. Accordingly, another unsuccessful search for the SOO is said to have taken place, in particular in the superstructure.[50]

The Chief Mate later stated that the Chief Engineer's confirmation to the effect that the SOO could not be found in the engine room had been particularly decisive for him. It had been immediately clear to him that the ship would now immediately leave port even without a final clarification of the whereabouts of the missing SOO. Therefore and because he did not wish to take final responsibility for the results of the search measures in the engine room he reportedly asked the Chief Engineer to transmit the corresponding report in person to the Master. This was then reportedly done in his presence. The Chief Engineer explicitly reported to the Master that all technical areas had been searched. The term "scavenge air receiver" was reportedly explicitly quoted as being an area that had been searched.

The Master stated that the reports of the Chief Mate and of the Chief Engineer to the extent that the SOO had not been found in their respective areas of responsibilities, i.e. on the one hand on deck or within the superstructure or otherwise within the technical areas, including the explicitly mentioned scavenge air receiver, had caused him now to initiate their voyage without delay and to clear the berth for the next ship, which was already in visual range, and which in fact actually required the assistance of LONDON EXPRESS's tugs for manoeuvring within the nearby turning basin. In addition, in consultation with the Agent's office, he had given the order to continue the search during the subsequent approximately two-hour river passage. The start of the sea voyage was ordered at 21:30, following verification of compliance with the Minimum Safe Manning regulations by means of the certificates of competence. At 21:42 the manoeuvring station crews started shortening the lines. At 21:45 all lines were off and, according to manoeuvre printer records, the first engine manoeuvre took place at 21:48. At 22:03 the Harbour Pilot left the ship after the tugs had been dismissed approx. 10 minutes earlier.
The Master had found his decision to depart facilitated by the fact that on its voyage to Norfolk the ship would remain within US waters and that therefore all relevant authorities ashore had been informed by the Agent.

4.2.2.3 Search measures after the beginning of the sea voyage

To the [German] Federal Bureau of Maritime Casualty Investigation the Master of LONDON EXPRESS emphasized that the search measures on board were intended to be continued also after departure. The Chief Engineer and also the Chief Officer had on the other hand emphasised that no explicit order for a renewed search of the ship had been given by the Master. From the Master's point of view an explicit instruction of this type had no longer been necessary after departure, as both in direct conversation and over the telephone both the Chief Engineer and also the Chief Mate had intended to, and did in fact carry out the appropriate measures as a matter of course. The last report from the Chief Engineer is said to have taken place when dropping off the Pilot, when the Chief Engineer was personally present on the bridge during a telephone conversation between the Agent and the Master. The remaining crew members stated that they had – insofar as at all – continued to search for the SOO only on their own initiative. Owing to at least significantly matching witness statements it would seem to

[50] In this context, witnesses explicitly mentioned as search areas the emergency generator room, the TV room the swimming pool and the funnel.

be established that immediately after starting the main engine and/or the auxiliary fans[51] necessary to start the engine, both the Oiler on watch, who was on his round, and also the Second Engineer, now responsible for the last preparations for the start and for monitoring the engine start following the unavailability of the SOO, remarked a leakage at the forward access hatch to the scavenge air receiver. This had become apparent due to the loudly hissing sound of air and/or an air/oil mixture escaping. The Oiler had originally not taken any further notice of the matter because the Second Engineer was also already on site and had tried to close the hatch airtight by means of a pipe extension [a handled fastener]. The Oiler had at first reportedly continued on his round and had once more passed the forward access hatch a few minutes later. At this time he noticed that the leakage still persisted. He reportedly immediately informed the Second Engineer, who stated that the leakage was not a particularly significant problem and that the necessary repair could wait until the ship arrived at the following harbour.

In a first interrogation by the US authorities in Norfolk, a Filipino crew member allowed that shortly after departure there had been speculation about the SOO's whereabouts in the circle of his Filipino colleagues and that among other presumptions it had been mentioned that the missing engineer had possibly entered the scavenge air receiver and could be locked in there.[52] It had therefore been decided without any specific instruction again to search the engine room for the SOO on a voluntary basis, but it had also been clear that the Chief Engineer would have to be informed before it would be possible to check inside the receiver.[53] During this search, the forward hatch of the scavenge air receiver had also been visually inspected at around 22:00. The hatch was said to still have leaked, but the Oiler on watch had informed his colleagues and the Third Engineer of the fact that the Second Engineer was already aware of the problem and that he had in the meantime examined and improved the degree to which the hatch was bolted. It was stated that for this reason the matter had not been given any further consideration; the search activities moved on to other areas of the engine room and were later discontinued due to lack of success.

4.2.3 Search activities during the voyage to Norfolk

Early the following day (25 October 2003) shortly after 00:00 LONDON EXPRESS reached the open seas after two-hour passage of the Savannah River. The River Pilot, who according to the log entry had left the ship at 00:08, had been handed the missing crew member's passport following coordination with the Agent. This was intended to ensure that he SOO could follow the ship without any formality problems. Shortly beforehand the Master was reported to have spoken to the Agent on the telephone; the Agent reported that all attempts to locate the SOO ashore, in particular via the police and enquiries with local hospitals had been unsuccessful. At 02:00 and as part of the routine safety round, the Watchman reportedly also went through the engine room.

[51] N.B.: According to various witness statements it is customary to activate the auxiliary fans from the bridge only immediately before starting the main engine so that both events as a rule take place at the same time. Whether this was actually the case on the day of the accident however could no longer be determined, (cf. Point 5.6.3.8 No. 6).

[52] Excerpt from the US interrogation report: "*They thought that he (the SOO) may have went in there by himself. He (the witness) got a gut feeling or hunch that he (the SOO) went along and got trapped in there.*"

[53] N.B.: Because of the overpressure in the receiver the main engine would have had to be switched off in order to be able to open the hatches.

In the morning of that day, further conjecture took place on board concerning the SOO's whereabouts. Following the lack of positive news from Savannah the Master reportedly worried increasingly about the fate of the missing officer and discussed the matter with the Chief Mate. Together, they reportedly once again examined the SOO's room, including the mobile telephone found open on the bedside table in regard to potentially informative contacts, but to no avail. The Chief Mate reportedly inspected the entire ship and also the engine room. He therefore reportedly also passed the scavenge air receiver, but did not take any notice of the leakage at the forward access hatch, much less of the jammed object. On that day the remaining crew was involved in the regular daily work and/or watches. No renewed search for the SOO was initiated.

4.2.4 Discovery of the missing person

4.2.4.1 Sequence of events on the bridge

On 26 October 2003 LONDON EXPRESS arrived on schedule at Norfolk, its destination port. According to the entry on the ship's log, at 08:48 the Pilot had come on board, and at 10:48 the aft tug was made fast. The forward tug accompanied the ship in standby position. At 11:14 the first line was ashore and at 11:30 the berthing manoeuvre was completed.
At the same time the Master was getting ready to leave the bridge, and the Chief Mate was busy switching off the instruments and other service units on the bridge, or switching them to harbour mode.At this moment the telephone is said to have rung, and the Chief Engineer reportedly informed the Chief Mate, from the BMC, that the SOO had been found in the scavenge air receiver. The Chief Mate reportedly immediately notified the Master, who was still on the bridge. Thereafter he stated immediately having gone ashore to inform the Harbour Police officers routinely waiting on the quay.

4.2.4.2 Events in the engine room

While still the last lines were handed to dock personnel to moor the ship, the Master had informed the Chief Engineer in the BMC, as was customary, that the engine would no longer be needed. Switching of the aggregatesto harbour operation was said to have begun right away. At the same time, an Oiler had been instructed to open the hatches to the scavenge air receiver to air it out.[54] As the Oiler was still busy with other preparatory measures[55] for accessing the scavenge air receiver, the SOF had opened the forward access hatch to the scavenge air receiver. In doing so he reportedly immediately noticed that the toggle nuts on the bolting mechanism could be opened very easily. Although he had applied a pipe extension / handled fastener as usual, the normally necessary assistance of an additional striking or impact tool had not been necessary. He had reportedly loudly ranted about what in his opinion was careless bolting of the receiver.
Upon opening the hatch he had reportedly seen the SOO lying motionless immediately behind the access hatch in the entry area to the scavenge air receiver. He had briefly touched him and upon the total absence of reaction he reportedly immediately went to the BMC, where he had found the Chief Engineer and relayed the information.

[54] N.B.: There are widely varying rationales concerning the motivation for the rapid opening of the scavenge air receiver, cf. Point 5.7 below.
[55] In this context, preparation of a hand lamp and rags were mentioned.

4.2.4.3 Events following the discovery of the missing officer[56]

Following the report of the event to the Harbour Police officers, the harbour police had reportedly come on board, viewed the scene of the casualty and conducted a first interrogation of the ship command. The Master reportedly informed the shipping company in Germany as well as the representative offices in New York and in Norfolk; the latter was said to have informed the Coast Guard. The external appearances of the initially inexplicable events on board reportedly caused the Harbour Police to classify the incident as a "criminal act"[57]. Accordingly, the investigation was conducted both intensively and energetically. The scene of the accident was reportedly cordoned off and all access to the engine room was forbidden and/or if absolutely essential, then permitted only in the company of a police officer. At approx. 14:30 the Coast Guard reportedly arrived on board and took over the responsibility for the investigation from that point onward for jurisdictional reasons. The entire crew had reportedly been ordered to meet at the Duty and Crew Messes, where they had had to remain over the following hours. Their identity had been verified. At the same time, all facilities in the superstructure had been checked in the company of the Chief Mate.
Interviewing of the individual crew members began in the Officers' Mess at approx. 18:00 and in the presence of a legal advisor instructed by the shipping company. The drawn-out interrogations were conducted by a panel consisting of representatives of the Coast Guard, the Harbour Police and the Virginia State Police.
At around 20:30 the crew members were released to their rooms. The investigations at the scene of the accident had been concluded late in the evening. The body of the SOO was taken ashore and transferred to the forensic medicine department.
The ongoing interviews were said to have been discontinued the next day (27 October 2003) at around 04:00. At 06:30 the ship was reported to have been transferred to Norfolk - Hampton Roads. Once there, the interrogation was resumed at 17:30.
On 28 October 2003 at approximately 03:30 the investigation was finally terminated, since ultimately an accident scenario was now assumed. LONDON EXPRESS left Norfolk headed for New York at 14:30.

5 Casualty investigation

5.1 Casualty report to the BSU

The BSU was informed of the casualty by the shipping company two days after the SOO's body was found. In this regard it must be emphasised that an early involvement of the BSU in the investigations in Norfolk was objectively not possible owing to the special circumstances of the casualty. Although immediately after the SOO had been found there had been a first contact on the part of the ship's command to the shipping company management in Germany and thereafter also very briefly to the SOO's family members, the immediately implemented police activities on board, which owing to the external appearance of the events were originally understandably conducted on the assumption that the death of the engineer could only be a criminal act, were combined with a strict limitation of communications between the ship and the external world.

[56] Source: Master's event report of 28/10/2003.
[57] N.B.: As quoted by the Master.

Owing to the vague information situation, both the shipping company representatives in Hamburg and the American authorities were therefore unable to make a timely casualty report to the [German] Federal Bureau.
At the time of the report, the investigations of the US authorities, which had also not made prompt contact with the BSU, had already been completed, and LONDON EXPRESS was once again at sea. Immediate participation in the on-site investigation measures, the interviews of the crew members in Norfolk or a parallel interrogation of the witnesses while still under the immediate impression of the events was therefore not possible.

5.2 Assistance provided by the US authorities and the shipping company

Within the scope of the subsequent investigations conducted by the BSU, the US authorities were very cooperative, and quickly and unbureaucratically provided the BSU with their remaining investigation results as well as with the autopsy report and a number of photographs taken of the scene of the accident together with highly informative video documentation. A complete transfer of all information obtained and findings collected was however not possible, as according to US law, for example, the fragments of the torch found next to the SOO in the scavenge air receiver as well as his clothing and a great part of the photographs had been destroyed after completion of the investigation and the classification of the event as an accident.
The shipping company also supported the BSU's casualty investigation from the very beginning. Technical documentation of all types was quickly made available, and the escorted visits to LONDON EXPRESS and her sister ships received the necessary logistical support.

5.3 Course of the investigation

The investigation in Norfolk was primarily carried out from a criminological point of view, as it initially seemed inexplicable that the SOO should have lost his life in an accident. Certain aspects of a potentially inadequate search management effort also constituted the subject of the extensive interrogations. However, the content of the relevant depositions reveals that only relatively small efforts had been made to clarify the contradictions arising in the pertinent statements. When, finally, and in parallel to the ongoing interrogations it had been determined by means of experiments involving the hatch that self-caused confinement was technically possible, the investigation was promptly discontinued.

Owing to the complexity of the underlying facts, the contradictory nature of the information obtained, and last but not least the fact that due to the external appearance of the events at least at the beginning not "just" a marine accident but also the presence of a criminal background could not entirely be excluded as the cause of death in spite of the conclusions of the US authorities, consultations with the Hamburg Landeskriminalamt (LKA)] were in fact essential. This police authority had been instructed by the Office of Public Prosecutor of Hamburg to clarify any potential instances of criminal liability in regard to the death on board LONDON EXPRESS in parallel with the BSU's investigation.[58]

[58] N.B.: It should be emphasised that the contact to the LKA took place within the scope of the statutory requirements and the different goals of the respective investigations were strictly respected.

Contrary to the regular investigation procedure, which fundamentally provides for a parallel determination of the circumstances of the accident by the BSU pursuant to its statutory investigation task, the Director of the Federal Bureau in consultation with the State Office of Criminal Investigation (LKA) and in agreement with the shipping company decided in the summer of 2004, for the time being, to suspend the BSU investigation after the first conclusions had been drawn. The goal of this decision was to prevent the Federal Bureau from potentially prematurely publishing investigation results that might subsequently have to be fundamentally revised owing to new insights that might be obtained at a later date.

In addition to the contact with the US authorities, there had already been interrogations of the German crew members as well as inspections carried out by the BSU on board LONDON EXPRESS and her sister ships DÜSSELDORF EXPRESS and KOBE EXPRESS with the participation of a technical expert working for the BSU.
As an intermediate result of the abovementioned measures and owing to the hazards that had been identified and in order to prevent future casualties of the same or a similar nature, a Safety Recommendation was published on 12 February 2004.

In the autumn of 2006 the Federal Bureau once again resumed its investigations after the LKA's investigation results confirmed, in conclusion, that there were no indications of any kind pointing to intentional confinement of the SOO by a crew member.

5.4 Content of the investigation

Two scenarios were central to the Federal Bureau's investigation. On the one hand it was attempted to determine how the SOO's (self?)-confinement in the scavenge air receiver could have come about (cf. Point 5.5 below). And on the other hand the question of why the search measures implemented after it had become evident that the SOO was missing remained unsuccessful even though his last whereabouts before the accident were approximately known also needed to be examined (cf. Point 5.6 below). The technical issues relevant in this connection were examined with the help of an expert acting on behalf of the Federal Bureau.
The circumstances of the death and in this connection more particularly the question as to whether the SOO would have survived the accident if he had still been found on the day of the accident were also examined (cf. Point 5.8 below). To clarify these issues the Federal Bureau requested a separate opinion from the technical expert. His evaluation of the physical conditions in the scavenge air receiver constituted the basis for the determination of the survival period effected in a forensic report.
Finally the investigation took into consideration the surrounding circumstances on board that could have contributed to the occurrence of the accident (5.9).

5.5 Confinement in the scavenge air receiver

The question of how the SOO got locked in could not be clarified in all details and with final certainty. However, certain technical specificities that in combination with the evaluation of witness statements give rise to the presumption that human error was the original cause for the Engineer's confinement in the scavenge air receiver were identified and examined within the scope of the investigation (5.5.1). Most probably thereafter the special design of the bolting system together with the action of a force whose origin could not however be determined had led to the scavenge air receiver becoming a death trap for the SOO (5.5.2).

5.5.1 Human error as the originating cause of the casualty

Since neither the BSU's investigations nor more particularly the enquiries of the LKA provided any indication of an intentional confinement of the Engineer in the scavenge air receiver, it must be assumed that the main cause of the casualty was the fact that the SOO entered the scavenge air receiver without taking the appropriate safety measures (a). The only conceivable alternative to this assumption would consist in the theory that a safety lookout had at first been used, but that this person would either intentionally or negligently, but in any event in an irregular manner have left his post before the SOO had again exited the scavenge air receiver (b).

(a) The possibility that the SOO might have entered the scavenge air receiver without posting a second crew member as a safety watch is supported by an in any event unconfirmed witness statement according to which the Engineer had already allegedly entered the scavenge air receiver during a previous harbour stop on the occasion of the mandatory piston inspection without posting another crew member as a safety watch.
In particular however the information concerning the SOO's attitude to occupational health and safety, although contradictory at first sight, would seem to render his entering the receiver without a safety backup possible. On the one hand it was emphasised that he had always been very ambitious, had done good work, and that this had been expressed in an exemplary way in his compliance with safety regulations. On the other hand several witnesses pointed out that the SOO was sometimes a little overeager and often in a hurry.
In addition, it is a fact that perhaps not only the SOO had underestimated the potentially vitally important necessity of posting a safety watch. Even the Chief Engineer conceded that during earlier joint activity in the receiver he had also decided not to post a safety watch. During interrogation he justified this by saying that the access hatch could not have slammed shut because the finger-thick cable of the turning gear remote control, which he had taken with him into the receiver, would have prevented accidental closure.
The combination of the relevant witness statements ultimately supports the assumption that while the SOO fundamentally worked in a safety-conscious manner, he obviously took shortcuts if and provided that none of his colleagues would be placed in jeopardy and if he considered it expedient within the scope of rapid accomplishment of a task and of his attitude to work, which was characterised by his great motivation and sense of duty.
To this extent it is therefore at least not far-fetched that the SOO, remaining alone in the engine room after completion of all the work including the piston check, might once more have entered the scavenge air receiver in order to, for example, and consistently with his high quality standards, quickly take a last look at the piston having undergone maintenance during the day. It can further also not be excluded that in view of the late hour and the only brief period of time to be spent in the receiver he might not have wanted specially to bring another crew member back on due for assistance.

(b) However, it is also conceivable that the SOO could in fact have used the backup and assistance of another crew member when entering the scavenge air receiver,

but that the crew member in question could have prematurely left his post either intentionally or negligently. It can be concluded from the statements of the Chief Engineer and of the Second Engineer that on the day of the accident the SOO had intended to carry out the mandatory piston inspection from the scavenge air receiver starting at approx. 17:30. The Second Engineer had assisted him in doing so, posted at the aft hatch. He stated that he had seen the SOO after a brief and therefore only very superficial inspection exit the receiver at the forward end, that he had then closed the aft hatch and that he had thereafter still seen the SOO outside of the receiver.

However, there are significant doubts as to the accuracy of this witness' description of the event, in particular because he had made highly contradictory statements both in the US and in Germany concerning all events on the day of the accident. Thus for example during his interrogation in the US he had entirely omitted to mention that after the repair work he had remained alone with the SOO in the engine room, that he had assisted him in a piston inspection and that he had only taken leave from the SOO in the engine room by eye contact after completion of that inspection.

The corresponding statement that he had seen the SOO exit the receiver, had then closed the aft hatch and had left the engine room thereafter is however doubtful in particular because the description of the allegedly preceding piston inspection leaves many questions unanswered.

On the one hand this is supposed to have taken all in all only approximately half an hour[59], although this activity requires at least one to one and a half hours and such a distinct abridging of the process would be a glaring contradiction of the SOO's usual attitude to work.

In addition, the alleged sequence of events could also be described as being at the very least unusual. The Federal Bureau has determined that the standard procedure for the piston inspection consists of two crew members entering the receiver, with one taking along the remote control for the turning gear and operating it, and the other giving the instructions for turning the crankshaft and evaluating the condition of the pistons with a torch or portable lamp.[60]

It is also possible that an Engineer, backed up from the outside, may enter the receiver alone, equipped with the remote control, to carry out the two tasks (turning and inspection) independently and without assistance from a second person. The variant alleged by the Second Engineer, i.e. that a crew member would stand safety watch in front of the hatch and would be instructed by calling out or other signals, e.g. by the upward and downward swinging of a torch, to drive the pistons into the correct position from his location in front of the hatch by means of the remote control has on the other hand been qualified by several experienced ship's engineers confronted with this procedure as being at the very least very impractical, as the necessary communication between the inspecting engineer and the person posted at the hatch would be barely achievable due to the technical conditions inherent in the receiver (narrowness, darkness, noise level). The BSU's technical expert even completely denies the possibility of such a procedure, because a crew member inspecting a piston would not have a line of sight to the hatch access from

[59] N.B.: This timing too was only admitted by the Second Engineer after investigators had insisted due to the unbelievability of the alleged statement reporting approx. 15 minutes.

[60] N.B.: This procedure also meets the recommendations of the Operating Manual, cf. Point 6.2.1.1 below.

the scavange port[61], which compellingly had to be entered to perform this inspection. Acoustic comprehension, too, would not be possible without technical aids, as the throttles[62] would prevent the necessary propagation of sound waves of human origin.

Ultimately it is simply not understandable why the Second Engineer was clearly either unwilling or unable to describe the course of the procedure in greater detail. Thus he did not in any of the various interrogations mention what might for example have become of the cable based remote control for the turning gear which he claimed having used during the piston check. A complete description of the process would definitely also have included reporting that he had e.g. put away the remote control after closing the hatch and only left the engine room after that.

A further problematic issue appears to be that the Second Engineer did not reply to the Steward's enquiry at dinnertime as to the SOO's whereabouts. Perhaps he did not wish to admit in the presence of the Chief Engineer that he had shortly beforehand left the SOO alone in the engine room.

After all that it is therefore definitely possible to imagine that the Second Engineer either had left his position prematurely in the erroneous assumption that the SOO had already exited the receiver, or that at the end of a long and arduous working day he simply did not wish to wait for this to happen.

There is no objective evidence to support either the scenario described under (a) or that under (b). These theories represent the two imaginable reasons for the initiating event of the SOO's confinement in the scavenge air receiver.

5.5.2 Explanatory approaches to the confinement event

5.5.2.1 Possibility of erroneous confinement

On the other hand, the initially considered theory that the SOO would have been in the scavenge air receiver without a safety watch and unbeknownst to other crew members and would have negligently been locked in by a colleague wanting to make good for a presumably forgotten bolting of the hatch could not be substantiated.

This possibility is primarily contradicted by the fact that after evaluation of the witness statements of relevance for this scenario it must be assumed that the forward access hatch had only been fully bolted by the Second Engineer during or shortly after start-up of the main engine, i.e. that its state was modified from being at first partially[63] and then fully locked after two other witnesses had observed the fact that it was not tightly closed. While the witness statements concerning the specific appearance of the leaking hatch and the status of the bolting system are ambiguous, following insistent questioning they gradually admitted that the dogs had not been fully engaged (= partially locked hatch).

In addition, the jammed object between the frame and the hatch cover, whose existence was at first denied, but later and as a result of an "indiscretion" on the part of one individual witness was admitted by more and more crew members once confronted with it, also indicates that the hatch was initially only partially bolted. There appears to be no reasonable reason why during regular (= planned) locking (= bolting) of the hatch

[61] A sort of "antechamber" between the scavenge air receiver and the cylinder, cf. Fig. 23 (p. 29 of the report).
[62] Cf. Figure 21.
[63] N.B.: Details concerning conditions of a partial locking situation follow directly under Point 5.5.2.2.

a foreign object would be either left in or intentionally jammed into the frame. Rather it must be assumed that the textile object (most likely a cleaning rag) had been placed by the SOO in the few millimetres clearance[64] still existing between the hatch and its frame after accidental closure and partial locking of the hatch in order either to draw attention to himself or to remedy the partial closure.

5.5.2.2 Emergence of partial locking

The results of the investigation are considered to have demonstrated with certainty that the technical specificities of the bolting system in combination with an external force of unknown origin led to the scavenge air receiver being partially locked in a manner such that this condition could no longer be counteracted by the SOO from the inside.

5.5.2.2.1 Sources of evidence

The sources of evidence used by the Federal Bureau were, in addition to a video recording made by the USCG, on which the process of self-locking was reproduced, the information obtained from local inspections of LONDON EXPRESS and her sister ships DÜSSELDORF EXPRESS and KOBE EXPRESS. The technical expert acting on behalf of the BSU examined the scavenge air receiver locking system on the ship last abovementioned. By means of the experiments and measurements on board the KOBE EXPRESS and the evaluation of the technical documentation provided by the engine manufacturer the possibility of a person locking himself in accidentally, already documented in the abovementioned video, could be reconstructed leaving no room for doubt.

5.5.2.2.2 Configuration and ascertained specificities of the bolting system

As already mentioned earlier (cf. Point 4.1.3.3), the access openings situated at the forward and aft frontal parts of the scavenge air receiver are closed by manhole covers swinging open gate-fashion and exclusively to the inside and to the right[65], each of which is mounted on two hinges. The bolting system is identical both forward and aft and consists of, in each case, three closing devices of equal construction arranged at 120° angle arc distances from one another. On the hatch cover of relevance for the accident these locking devices are mounted in the 11, 3 and 7 o'clock positions (cf. **Figure 25**).

[64] N.B.: The clearance and the gap that can be created by means of it are only possible for as long as neither an auxiliary fan nor the main engine are running, as from this point onwards the overpressure building up in the receiver causes the hatch cover to be pressed against the frame.

[65] N.B.: The following differences were found on the sisterships inspected concerning the direction in which the door swings open: DÜSSELDORF EXPRESS – Forward end swings open to the right, aft end to the left; KOBE EXPRESS - Forward end swings open to the left, aft end swings open to the right. These differences in construction do not however involve any difference as concerns the sequence of events leading to the accident.

Figure 25: Arrangement of the locking devices

Each of these devices consists of a stud vertically welded onto the hatch cover and equipped with a thread. The stud is loosely capped with a bolt bent into an L-shape whose central mounting borehole (lock bearing) does not have an inner thread and which can therefore very easily be turned by more than 360° on the stud due to the existing clearance between borehole and stud.

Figure 26: Bolt in open position (L-profile visible)

For regular bolting, after the hatch cover has been drawn shut against its frame the bolts must be swung into a circular groove vertically worked into the frame. Then each

individual bolt must be latched in the locked position by means of a single toggle nut[66] that is screwed down on the stud. The correct position of the bolt is supported by a nub-like material reinforcement in the central area of the bolt's contact surface, which must be matched to a corresponding notch on the hatch cover.[67]

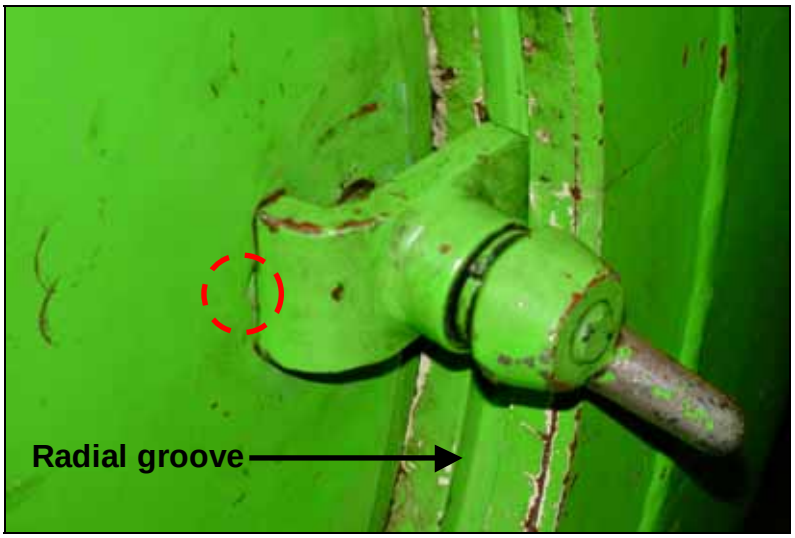


Figure 27: Bolt swung into the full locking position

Direct seating between the cover and the frame ("metal on metal") is prevented by a gasket and glued into a flat groove in the frame[68]. This gasket is compressed when the hatch is bolted down and ensures airtight closure.

Figure 28: Gasket glued onto the hatch frame

[66] N.B.: On LONDON EXPRESS' sistership that were inspected, regular, i.e. double-wing toggle nut was fitted instead of the single toggle nuts

[67] Cf. in this context also the red marking in Fig. 27.

[68] N.B.: In the course of the local inspections, different materials were found even on one and the same scavenge air receiver. The accident hatch had a (black) flat profile textile sealing tape with a very small material excess glued in (cf. Figure 28). The aft hatch had been fitted with an orange circular-section seal ring made of a rubber-like plastic.

In order to open the hatch, the reverse procedure is followed, i.e. after loosening the toggle nuts, the bolts are swung out of the circular groove and brought into a release position in which they have no further contact points with the hatch frame. Because of the relatively short distance between the turning point of the bolt and the hatch frame the opening position can only be a tangential-type position of the bolt that allows for only very little variability (cf. **Figure 29**).

Figure 29: Tangential opening position[69]

The fact that the bolt, or dog, moves so easily on the stud and its concentric centre of mass due to its asymmetrical shape do not, contrary to all expectations, necessarily mean that the dog will take up a given gravity-determined position after the toggle nut has been loosened. **Figure 30** below, instead, clearly shows that the friction between the stud and the bolt together with any slight contact potentially still remaining between the upper edge of the bolt bearing and the toggle nut after it has been loosened is so great that the bolt will in most cases remain in the tangential position into which it had been turned.
However, experiments conducted on board also showed that the phenomenon described above does not always take place. Sometimes the ease of operation of the bolts did indeed result in that once released they would swing out of their set position due to effect of gravity. This applies particularly when the nut had, randomly, been loosened more than necessary for swinging the bolt, so that that there was no more contact between it and the bolt bearing.

[69] N.B.: Figures 29 and 31 to 34 show the latching system of the scavenge air receiver hatches on the MS DÜSSELDORF EXPRESS. As opposed to the otherwise identical design, in that case the manufacturer equipped the system with double-wing toggle nuts.

Figure 30: Bolts remain in the tangential opening position

The fact that the dogs [tend to] remain in the opening position is of decisive importance for the accident, because automatic swinging out of the tangential position due to gravity would cause the two dogs in the 11 o'clock and in the 7 o'clock position to jut out beyond the edge of the hatch cover after it had swung open. Thereafter, only intentional return to the tangential position would enable the hatch cover to be drawn onto the frame and bolted without the hindrance of the displaced dogs (cf. **Figure 31**).

Figure 31: Bolt as a blocking obstacle

When a double-wing toggle nut (sister ship MS DÜSSELDORF EXPRESS) is used, one of the wings would compellingly also become a blocking obstacle if the nut were –

intentionally or unintentionally – turned by hand out of its tangential position after the hatch had been opened (cf. **Figure 32**).

Figure 32: Double wing toggle nut as a blocking obstacle

Various experiments on board LONDON EXPRESS in Norfolk, but also later in Germany, as well as the viewing of the essentially equivalently structured scavenge air receivers on the sister ships DÜSSELDORF EXPRESS and KOBE EXPRESS have shown that the hatch covers, due to their relatively high weight and their hanging type tend automatically to swing open after turning the bolts into the opening position and to remain in a half-open position. This phenomenon was confirmed, without room for doubt, by the expert engaged by the Federal Bureau using measurements and calculations of the intervening forces and torques. Movements within the ship at harbour or due to its trimming on the other hand have no effect on the hatch covers' tendency to swing open and to remain in the open position.

It had already been ascertained during the initial investigations in the US and also later in Germany that the above described ease of operation of the bolts *could* result in that the upper left hand bolt located at the 11 o'clock position would leave its open position previously maintained by friction in the event of abrupt slamming of the hatch cover onto the frame due to the impulse acting upon the bolt as a result of the impact.
The bolt in question then drops as a result of gravity with its "heavier", bent side downwards, into a position different from the tangential opening setting. This compellingly results in that the "lighter", "straight" side of the bolt catches in the circular groove of the hatch frame. [70] Even a slight shift of the bolt from the opening position and therefore an only millimetrical swing into the circular groove would result in a partial locking of the hatch. This situation would be further exacerbated by potential knocking or shaking of the hatch cover, because due to the force of gravity this would

[70] N.B.: The possibility of catching assumes that the hatch cover comes into close contact with the frame, as only then can the bolt and the circumferential groove match. The distance created between the hatch cover and the frame by the (relaxed) gasket is within the tolerance necessary for latching the bolt.

cause the bolt to continue to move towards an approximately vertical position, thus ultimately more or less entirely catching in the circular groove (cf. **Figures 33** and **34**).

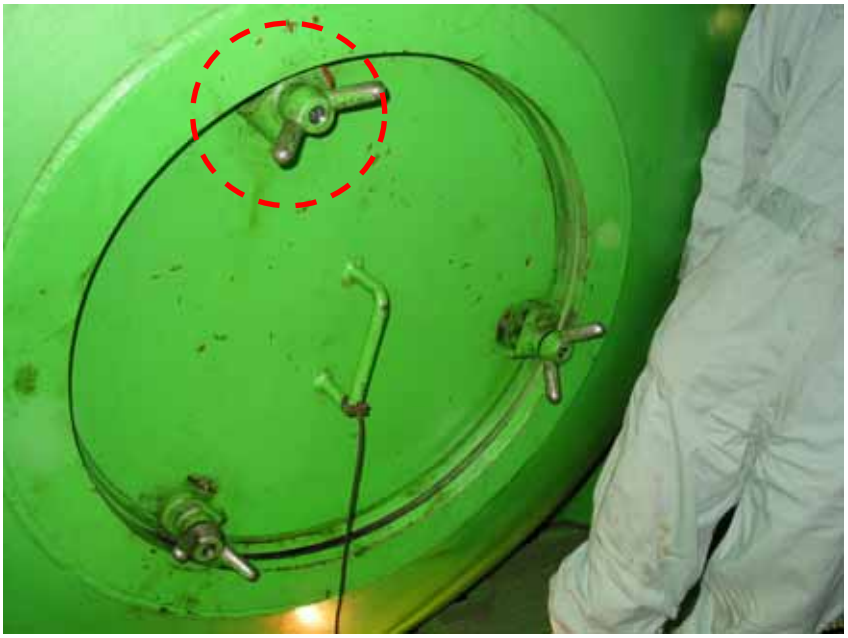


Figure 33: Partial locking condition – overall view

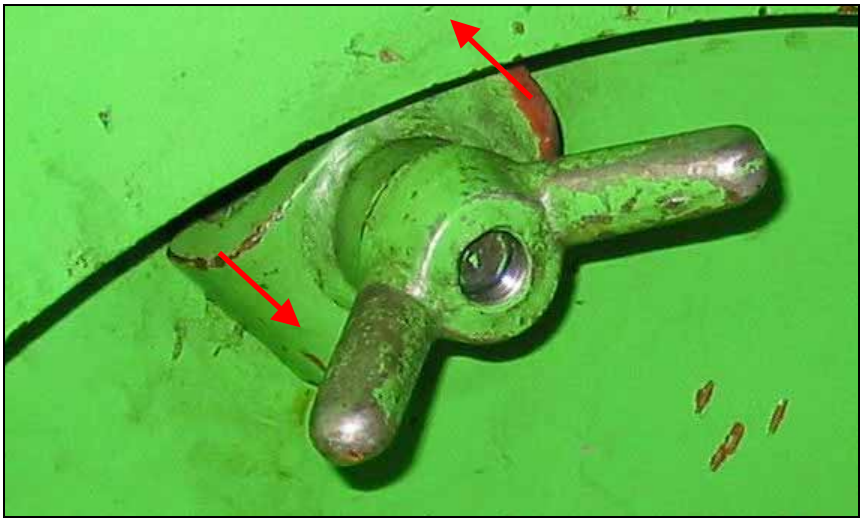


Figure 34: Triggering of a partial locking condition

It is not possible to undo the resulting partial locking condition from the inside of the receiver, as the remaining clearance between the caught hatch cover and the hatch frame is not sufficient to enable any actions having an effect on the dog catching in the circular groove.

5.5.2.2.3 Cause of the necessary effect of force on the bolting system

What actually caused the slamming of the hatch cover into the hatch frame required to trigger the above described self-locking process could not be established.
Possible causes include the start-up of an auxiliary fan (a) or a force emanating from the SOO himself (b).

(a) The electric auxiliary fans provide additional fresh air supply to the main engine during start-up and at low RPMs. The pertinent main switch panels for the three fans are on the scavenge air receiver level but are separated from the engine and the forward access hatch to the scavenge air receiver by a transversal bulkhead (**Figures 35** and **36**). It is possible to switch on the auxiliary fans from the bridge console (**Figure 37**). The switching station is selected by means of a selector switch on the main switching panel, where the "LOCAL" position enables switching on of the fans from the main panel and the "REMOTE" setting enables remote control from the bridge.
Fundamentally the intention is that only once the engine is reported clear the switching control for the auxiliary fans is transferred to the bridge. This is intended to prevent premature start-up of the fans from the bridge in ignorance of potential impediments in the engine room.
The local inspections showed that this safety precaution was not complied with on board the vessels visited. The selector switches had not been switched over from REMOTE to LOCAL after stopping the main engine, so that the auxiliary fans could have been turned on from the bridge at any time.

Figure 35: Main auxiliary fan panels 1 to 3

Figure 36: Main auxiliary fan panel – close-up view

Figure 37: Auxiliary fan control panel on the bridge console

Experiments on board have shown that directly upon start-up of a fan an open scavenge air receiver hatch cover will slam with great force against the hatch frame as a result of the air current and overpressure building up in the scavenge air receiver. However, the fans are usually only switched on by the Master from the bridge in connection with the final preparations for departure just before engine start-up. When exactly they were started up on the day of the accident could not be established. Start-up could have begun between approximately 21:00 and 21:42, i.e. in any event at a time when the SOO had already been trapped in the scavenge air receiver. There appears to be no reasonable reason why and/or by whom, and in deviation from the standard procedure, on the day of the accident one or more fans should or would already have been started up several hours earlier.[71] Thus the switching on of the fans can most certainly be ruled out as the cause for the slamming of the hatch cover that triggered the self-confinement process.

[71] N.B.: The exact point when switched on is also of significance for the evaluation and assessment of the search measures, so that this aspect will be more closely examined only in the relevant Point 5.6.3.8 under No. 6 of this report.

(b) Much more likely is that the spontaneous locking process was triggered by a slamming of the hatch cover that was caused by the SOO himself. Two reasons in particular would seem to indicate this. On the one hand the SOO could, unaware of the danger of self-confinement, have intentionally pressed the hatch cover against the frame, e.g. in order to verify its closure from the inside. He could also unintentionally, e.g. by stumbling in the scavenge air receiver, have struck the hatch cover so that it would have slammed against the frame. Intentional closing of the hatch for purposes of the inspection of Cylinder 1 on the other hand is very unlikely, as access is not impaired in any way by the inward swung hatch cover (cf. **Figure 30**).

5.5.3 Time of confinement

The exact time when the confinement occurred is unknown. One thing that is relatively certain is that shortly before 18:00 the Second Engineer left the engine room and then went to dinner. The SOO for his part never left the engine room. The forensic examination revealed that the casualty's stomach was almost empty, which proves that he did not have dinner on the day of the accident. This in turn is a clear indication that the confinement must have occurred relatively shortly after 18:00. The situation would be different only in the assumption of the theory that the safety watch would have left prematurely (cf. Point 5.5.1 (b) above); in that case the timing for the confinement could already have fallen into the window between 17:30 and 18:00. When disregarding the possibility last abovementioned, the following considerations support the assumption of confinement taking place already shortly after 18:00. It could be supposed that the SOO, like all other crew members who participated in the strenuous and drawn out repair, would have been quite hungry. There are no indications to suggest that he would have wanted to forego dinner. The Steward, too, had assumed that the SOO would still turn up for dinner, as could be surmised from his very specific question to the Chief Engineer. After all, the SOO had not made any intimation to the Second Engineer to the effect that he wanted to spend more time in the engine room and skip dinner.

All this would seem to indicate that the SOO – always assuming that he had actually at first exited the scavenge air receiver – had entered it again only a short time thereafter in order to perform a last task in the receiver immediately before leaving the engine room in the direction of the mess as planned. The assumption that the SOO had indeed wanted briefly to visit the receiver again is supported by the particularities ascertained when the SOO was found in Norfolk. He was wearing khaki coloured working overalls and his ordinary work shoes, although it is usually customary to enter the scavenge air receiver, which is a very dirty area, wearing blue working overalls and rubber boots. In addition, no tools were found next to the SOO, which also supports the presumption that he had only wanted to carry out a very brief last inspection in the scavenge air receiver, perhaps even only in the immediate entry area.

5.6 Assessment of the search activities

5.6.1 Sources of information

An in-depth examination of the measures undertaken on board to find the SOO trapped in the scavenge air receiver was highly problematical. This was due primarily to the fact that for its enquiries the Federal Bureau could only avail itself of subjective witness impressions and recollections. Technical records were available in the form of failure reports of the ship engine's alarm and safety systems that were made available by the shipping company. However, their evaluation was able to provide evidence relating only to the *technical* events on board on the day of the accident. Neither the organisation of or the course taken by the search measures including a clear description of all relevant activities were recorded in writing by either the navigational or the technical areas. Although mandatory, neither the event itself nor the search measures were recorded in a timely manner and at the required level of detail in the ship's log, in particular on one of the blank pages provided for such purposes at the end of the log, although – independently of the tragic background that became known only two days later – the unexplained disappearance of a crew member should in any case have been documented as an unusual event on board. The log book entry was limited to a note signed by the Master and clearly added later in capitals reading "DELAYED DEPARTURE DUE TO UNSUCCESFUL SEARCH FOR MISSING PERSON X.X.",[72] which, to judge by its content, had probably primarily been made to justify LONDON EXPRESS' delayed departure on the record.

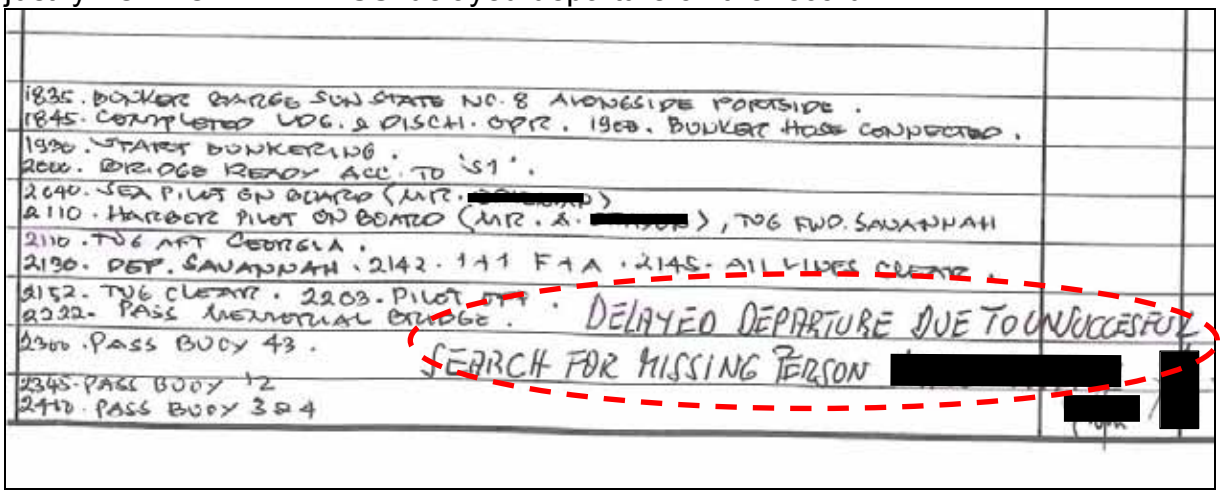


Figure 38: Log book entry concerning the search for the SOO

The Statements of Facts and event sequence reports prepared by the Master and forwarded to the BSU by the shipping company within the scope of the accident investigation provide only [makeshift] substitutes for the required information. They were only produced once the objective inadequacy of the measures carried out had become obvious by the determination of the tragic accidental death of the SOO. The documentation is therefore – as indeed are the witness statements – characterised by the attempt retrospectively to describe the search activities on board as having been carefully organised and standard-compliant in every respect.

[72] N.B.: In the source text the SOO's name is shown instead of X.X..

Concerning the validity of the witness statements it should be borne in mind that the most revealing information could be obtained from the interrogation reports resulting from the inquiries carried out in Norfolk relatively shortly after the casualty had taken place. However, the special deposition situation before the US authorities should be taken into account when evaluating the credibility of those witnesses most directly concerned with the events and the persuasiveness of their statements. In this context, the conjecture that individual witnesses had become concerned that they might potentially be held to be solely or jointly criminally responsible for the death of the SOO suggests itself. But possible (founded or unfounded) inner admissions of bearing at least a shared moral responsibility for the unsuccessful outcome of the search measures would most likely have had a negative effect on the crew's objectively undoubtedly inadequate willingness to make statements and on the quality of those statements.
The abovementioned aspects similarly apply to the assessment of the statements provided to the LKA and the BSU. In this regard it should be added that as time goes by and the casualty events recede further into the past the human tendency consciously or subconsciously to cast a more positive light onto actual events regularly increases, and/or actual – understandable – lapses in memory develop. Furthermore, there are indications of a restriction in the willingness to provide information due to a misconception of the notion of esprit de corps and the resulting efforts not to make any statements that might be prejudicial to third parties.
Independently of these observations, the willingness of the crew members heard by the BSU to answer comprehensive questioning by the investigation team fundamentally calls for respect. Before the interrogation they were exhaustively informed and instructed that any statements they would make to the BSU are subject to a statutorily enshrined ban on utilisation as evidence. None of the witnesses questioned took advantage of the additional statutory right to refuse to answer questions that might involve the risk of legal prejudice, which had explicitly been stated before the hearings.
From the BSU's perspective, the statements of those witnesses who could have furnished the most detailed particulars concerning the actual course of events in the engine room on the day of the accident unfortunately were not as informative as had been hoped. This is regrettable especially because owing to the ban on admissibility as evidence the information provided to the BSU would have been the most likely to help clarify the causes of the casualty without simultaneously exposing witnesses to the danger of criminal prosecution.

In particular that part of the investigation which deals with the question as to why the search for the SOO conducted in the engine room was unsuccessful could have led to a result based to a significantly lesser extent on clues and limited to theories and probabilities if there had been a higher degree of trust on the part of the relevant witnesses.

In spite of all the abovementioned difficulties, a global overview of the information ascertained in the investigation comprising the start, the organisation, the course and, last but not least, the now known negative outcome of the search measures on board LONDON EXPRESS led to investigation results that, although unable reliably re-create the actual events on board in full detail, nonetheless allowed the Bureau to draw the conclusions necessary for an analysis of the casualty.

5.6.2 Timing of the start of the search

It has already been described earlier that various different statements had been made concerning the moment in time when the disappearance of the SOO became obvious. The detailed description provided in this regard by the SOF, who remembered having gone back to sleep after the first phone call from the Chief Engineer (approx. 19:45) and later (at approx. 20:40) having been contacted by the latter a second time does however argue for the assumption that the Chief Engineer had indeed enquired about the SOO's whereabouts already distinctly before the time declared by him on the record (= between 20:30 and 20:40). In addition, the following two facts constitute indications for the presumption that the Chief Engineer had probably already experienced some concern about the absence of the SOO before 20:00:

- They had not seen each other over the last few hours. Contrary to the usual practice implemented at the shipping company, which is characterised by thoroughly organised, disciplined on-board operations and compliance with clear [hierarchical] structures, the SOO, who was responsible for the repair and was undoubtedly known as a very conscientious individual, had not reported completion of the extensive repairs carried out on the main engine to the Chief Engineer.
- The ship's departure had been announced for 21:00. The SOO, whose original area of responsibility included the main engine[73], was therefore also responsible for the technical preparation of the departure manoeuvres and more particularly for the supervision of the regular start-up of the engine following the significant repairs carried out by him, yet he could not be reached either at the BMC or in the engine room.

It is also doubtful that the Second Engineer would or should not also already have wondered about the SOO's whereabouts distinctly before the start of the officially known search measures. This particularly applies if it is assumed that according to the statement made by the Second Engineer the work in the engine room had been completed [by him and the SOO] at about the same time, but that nontheless – and as would have been usual according to witness statements – they did not see each other again at the Mess during dinner. This should have provided food for thought also because the period of time provided on board for dinner was coming to its end and the Steward had even pointed this out.
Another aspect that allows for the conjecture that the Second Engineer had also become aware of the disappearance of the SOO significantly earlier than he had asserted is that the SOO was responsible for his on-board training and that therefore it would have been indicated within the scope of the administrative work to be carried out following the repair that he should have had the SOO show him the procedures used on board LONDON EXPRESS and/or by Hapag-Lloyd as the shipping company. Instead and according to a witness statement, towards 19:00 the Second Engineer was busy *on his own* at the BMC processing technical documentation that was said to have concerned the repair carried out during the day. However, he neither admitted this activity nor did he state that the SOO had already provided training in this respect at an

[73] Source: "Watch Plan – Field of Duties Voyage 30, Hong Kong, September 18, 2003 signed Capt.".

earlier stage. This latter possibility would also not be very likely, as this was the first instance of piston maintenance carried out by both together.
Other crew members on the other hand would likely not have had cause to worry unduly about the SOO's whereabouts before becoming involved in the official search activities. There are no statements to the contrary.

What is noteworthy is that the Chief Engineer and the Second Engineer most probably had already started wondering about the SOO's whereabouts significantly earlier than reported by them. To what extent this had however already led to initial search activities could not be determined. It can nonetheless be surmised that neither of the Engineers at first took the indications of the developing problem not particularly seriously; otherwise the compelling consequence would have had to be earlier reporting to the ship's command and the involvement of further crew members.

5.6.3 Search activities in the area of the scavenge air receiver level

Because of the difficulty involved in determining the moment in time after which superficial surprise regarding the fact that the SOO could not be contacted turned into a motivation to conduct a targeted search it is practically impossible to determine from what moment on in actual fact and with what intensity which individuals searched for the SOO and in what areas. It must however be assumed that serious search activities did in fact only start after 20:30, as from this point in time onwards the absence of the SOO became an objective problem on board for two reasons. On the one hand the preparations for readying the main engine in regard to the announced 21:00 departure time were entering their last phase, which required the presence of the SOO at the latest at this time. On the other hand, the ship's imminent departure was generally being prepared everywhere on board. Accordingly, the crew members responsible for individual tasks were already heading for the forward and aft manoeuvre stations. To this extent too it was now essential to be sure that the entire crew as on board.

Of special significance for the investigation of the search measures was the examination of the activities taking place in the engine room, and more particularly the events on the scavenge air receiver level. These activities will be described below, at first separately according to the statements of the pertinent witnesses from the technical areas.[74] In addition, and in order to verify individual statements, the visibility conditions inside and outside the scavenge air receiver were examined (cf. Point 5.6.3.6) and the audibility of any potential knocking sounds from the inside of the receiver in various different areas of the engine room was also assessed (cf. Point 5.6.3.7).

5.6.3.1 The Chief Engineer's version

There were basic differences in the various statements made by the Chief Engineer in the different interrogations he submitted to. However, in each case he emphasised that during an unaccompanied search of the engine room taking place before the general alarm was sounded he had opened the aft hatch of the scavenge air receiver and shone his torch into the receiver. Nothing special had caught his attention while doing so. Later – "probably still before departure" - the SOF had reportedly informed him that

[74] N.B.: The strong contradiction between the individual statements, the differing degree of responsibility and competence as well as the logic of the BSU's conclusions are confronted with a description in which the actors and the information provided by them are anonymised even more than already done.

he too had again opened the aft hatch to the scavenge air receiver and that he had called in.
The following table summarises the most important information reported on the record by the Chief Engineer.[75]

Time / Period	**Activity**
Until 20:30	Bunkering formalities; slight surprise that he had not seen the SOO since the afternoon and that he had also not reported completion of the repair
From approx. 20:30	Waits for / expects the SOO at the BMC for his planned participation in the imminent departure manoeuvre; tries to reach him on the phone; phones the Second Engineer and the SOF
20:35 – 20:45	Goes alone to the engine room; makes a round; meets the Oiler on the power unit level, who has however not seen the SOO
Approx. 20:45	Is back at the BMC and informs the bridge
20:45 to shortly before 21:00	Goes once more to the engine room, again alone; on his round, passes the aft hatch of the scavenge air receiver; opens it briefly and shines his torch into the receiver; finds nothing special; does not, however, go directly to the forward hatch, as he is of the opinion that if the SOO were in the receiver he would have made his presence known; on his round, he sees from a certain distance that the forward hatch is closed
Shortly before 21:00	Back at the BMC; in the presence of the Second Engineer, calls the bridge again and reports that the SOO still can't be found; also mentions the search in the scavenge air receiver area
Approx. 21:00	Sounding of the general alarm; crew gathers at the BMC; the technical personnel is instructed to search for the SOO in their respective areas of responsibility within the engine room and/or other technical facilities; the SOF and the Second Engineer are not given any specific search instructions; the scavenge air receiver is not pronounced a special search area[76]; Chief Engineer remains alone in the BMC and receives the negative search results coming in one after the other
Between 21:00 and 21:30 or later	Finds out from the SOF that he too had again looked into the scavenge air receiver from the aft end
21:30	End of search, ship leaves
Approx. 22:00	In the presence of the SOF, the Second Engineer reports to the Chief Engineer that during his inspection round immediately after the first manoeuvres, undertaken because of the repair carried out during the day, he [the SE] had ascertained an air leak at the forward hatch of the scavenge air receiver and its incomplete bolting, and that he had eliminated the problem; he reproaches this to the SOF, who points out that he hadn't even opened the forward end at all
Morning of the following day (25 October 2003)	Receives information from Filipino crew members concerning the leaky forward hatch of the scavenge air receiver; evaluates its condition and decides that it not a very serious problem and that it will be remedied in the next port; takes note of the jammed object; does not worry unduly about it

[75] Although this information is subjective, reported speech will not be used here to facilitate comprehension.
[76] N.B.: Responding to the question as to whose area of responsibility would have been a repeat verification of the scavenge air receiver, the Chief Engineer said "Don't know, normally nobody would have been told to look there."

As concerns checking the scavenge air receiver as asserted by the Chief Engineer, it should be particularly emphasised that he was very certain of having been alone on that occasion. However, once in Norfolk the Second Engineer reportedly pointed out to him that he had looked over his shoulder during the action in question. The Chief Engineer however could still not recall this sequence of events, but did not want to exclude the possibility that they had indeed taken place in that way.

5.6.3.2 The Second Engineer's version

In the different interrogations the Second Engineer made widely differing statements concerning his search activities. He was unable to remember the exact times, but reported on the record that there had been two search phases before the ship's departure. He gave a different account of the content of each search phase at different points in time. In his most precisely formulated statement in this connection, however, he indicated that the first search had been of a rather superficial nature and had been conducted under the premise that the SOO was presumably in some not immediately visible corner of the engine room, carrying out some sort of maintenance activity. The second search, initiated after the general alarm, had been comparatively much more intensive and had also e.g. included the bilges. During this search he reported having seen the Chief Engineer open the aft scavenge air receiver hatch, joining him and looking into the hatch together with him.
He reported having performed an inspection round of the engine room after departure and on that occasion and already before the pertinent report from the Oiler, who had also noticed the problem, having ascertained a leakage at the forward hatch of the scavenge air receiver. The bolts were said to be engaged. He had then allegedly and in the presence of the Oiler tightened two or possibly all three toggle nuts in order to improve the closure of the hatch.
He stated having found out after the search or on the next day that the SOF had also opened the aft hatch of the scavenge air receiver. The following table contains a summarised version of the relevant assertions.[77]

Time / Period	Activity
After 20:00	Call from the Chief Engineer and enquiry as to the whereabouts of the SOO; Not sure if requested by the Chief Engineer in his first or second phone call to look for the SOO
Before the sounding of the general alarm	First search in the engine room; cannot remember whether all members of the technical personnel were already involved; superficial search, as it is presumed that the SOO is somewhere in the engine room and busy; engine room inspection round comprises boiler and cylinder station, shaft tunnel, workshop and spare parts store
After the sounding of the general alarm	Meeting in the changing room; Chief Engineer asks in English who might have seen the SOO last and where; the Oiler on watch states last having seen the SOO in the changing room changing his shoes; checks the bilges; during the subsequent repeat round of the engine room sees the Chief Engineer at the aft hatch to the scavenge air receiver; goes there; both look into the receiver together; see nothing special
At some point prior to departure	Goes into the SOO's room; looks for clues to support the presumption that the SOO might have gone ashore; does not find any indication for this; also looks for the SOO's mobile phone but cannot find it

[77] N.B.: Here, too, we will forego the use of reported speech.

Time / Period	Activity
During / shortly after departure (i.e. between approx. 21:30 and 22:00)	Takes over the function of Second Engineer and the responsibility for starting the engine; routine verification of proper engine start up after piston maintenance; ascertains leakage at the forward scavenge air receiver hatch during his round; tightens at least two, perhaps also all three toggle nuts; cannot recall an object jammed between the hatch cover and the frame

The Second Engineer too emphasised upon multiple enquiries that he had only found out after the search or the next day that the SOF had also opened the aft hatch to the scavenge air receiver.

5.6.3.3 The SOF's version

The SOF could not remember the relevant times exactly. He himself had not consciously noticed the differentiation between two search phases separated by the general alarm. After the Chief Engineer's telephone request he reported going into the BMC and there receiving the instruction to carry out a search together with the rest of the crew. The Chief Engineer was said to have made a statement to the effect that "everything" should be opened up if the SOO could not be found. However, there was no explicit order to open up the scavenge air receiver.
On his round through the engine room he had reportedly opened the aft hatch of the scavenge air receiver and called in, but not received an answer. Although he had not had a torch on him and had therefore only been able to see into approximately half of the receiver, he had assumed that if the SOO were actually and against all expectations in the receiver he would answer or that he [the SOF] would see the SOO's torch. Then, while he was dogging the hatch, the Chief Engineer and the Second Engineer came by in his immediate proximity. The Chief Engineer reportedly called out to him that he no longer needed to look into the forward end as everything had already been checked. This reportedly caused the SOF to abandon his original plan also to open the forward hatch. The abovementioned encounter is mentioned by the SOF in each of his interrogations, although in versions differing in certain details. Thus he stated in Norfolk that only the Chief Engineer had been present. His statements also diverge in relation to the exact point at which they met. On one occasion the SOF asserted that they had met next to the stairs, but then later he said that it was when closing the hatch that the Chief Engineer and the Second Engineer had seen him from some distance away tinkering with the aft hatch. The SOF could also no longer exactly recall the exact wording, the presumed meaning or his own conclusions concerning the utterance of the Chief Engineer. In view of the special meaning of this encounter, which – assuming that it actually did happen – in any event is supposed to have led to the SOF's momentous decision not to open the forward hatch to the scavenge air receiver, the versions asserted by the SOF are tabulated below.

Measure taken by the SOF	Presumed Interpretation of the measure by the Chief Engineer and the Second Engineer	Chief Engineer's comment, in essence	Conclusion drawn by the SOF
Dogging the aft hatch	Opening the aft hatch	"We already took a look forward, everything is OK"	The SOF (erroneously?) takes this information too literally and dispenses with opening the forward hatch.
		"You don't need to look in there any more, everything is OK"	The SOF (erroneously?) believes this demand to apply to the entire scavenge air receiver and is sure that the Chief Engineer and the Second Engineer had already looked into the forward end, because both were coming from that direction; therefore gives up on his plan to go to the forward hatch.

He reportedly found out about the leakage in the forward hatch of the scavenge air receiver and the object jammed into it in Norfolk, while talking with crew members about the content and course of the interrogations.[78]

5.6.3.4 Filipino crew members[79]

With the exception of the Oiler on watch, all other members of the engine room crew, including the Third Engineer, had reportedly been informed of the absence of the SOO and sent to search the engine room and the ship's other technical facilities only during the meeting in the BMC area after the general alarm at approx. 21:00.
The statements of the Filipino crew members concerning the search measures in the engine room only differ from one another in individual details. They have already been incorporated in detail into the description of the course of the accident in Points 4.2.2. and 4.2.3, so that they need not again be analysed in detail. However, it seems necessary to underscore the discrepancies found between the individual statements (a) and in regard to those of the German crew members (b).

(a) The clearest discrepancy is that only one crew member conceded that he had already noticed a leakage and a jammed object in the forward hatch of the scavenge air receiver shortly after the general alarm at approx. 21:10. The subsequent report of this observation to the Third Engineer and his reaction that there would be no more time to take care of this due to the impending departure is disputed by the Third Engineer. The witness in question emphasised that he had also reported the event to the Chief Engineer before departure, but there was also no confirmation of this contention.[80] The same witness also indicated that after

[78] N.B.: When the hatch was first opened following arrival in Norfolk and according to his own statement the SOF had not taken any notice of the object.
[79] N.B.: This refers to the entire Filipino engine room crew, including the Third Engineer and the Electrician.
[80] N.B.: In his first statement in Norfolk the witness emphasised that the report to the Chief Engineer had only been made the next morning. He later asserted already having informed the Chief Engineer during

discontinuing the search and following the ship's departure the crew had talked among themselves about the fate of the SOO and that they had speculated that he might potentially be in the scavenge air receiver. However, upon further questioning no other crew member could recall this event, or at least not that such speculations had been voiced. The only thing that was confirmed was that at approx. 22:00, i.e. shortly after departure, the crew had voluntarily gone to the engine room once more, where they met the Oiler on watch and then together viewed the leakage at the forward hatch of the scavenge air receiver.

(b) All Filipino crew members denied the existence of any specific search orders in addition to the general request to look for the SOO in the engine room.
The Chief Engineer reportedly went with them into the engine room after the general alarm, but allegedly did not directly participate in the search but remained in the area of the companionways on the port side throughout the search. The search was finally terminated by him with the words "We won't find anything here!" and in essence a mention of the imminent departure. None of the witnesses reportedly saw either the Chief Engineer or the SOF open the scavenge air receiver.

5.6.3.5 Work records in the technical area

A review of the handwritten notes of the technical crew revealed that the work carried out on the day of the accident had been recorded only succinctly in a few keywords. The Chief Engineer explained that repairs were logged via input of the most important information into the data screens of the electronic maintenance program mandated by the shipping company.[81] In addition, with extensive repairs a comment was added to the engine log book provided in the BMC (cf. **Figure 39**). Accordingly, only the following entry was made on the log page for 24 October 2003:

the search in Savannah. Then there is a matching description of the Chief Engineer's easygoing reaction, which consisted of [saying] that the repair of the leakage could wait till Norfolk.

[81] N.B.: The BSU has no documentary evidence (computer printout) of this.

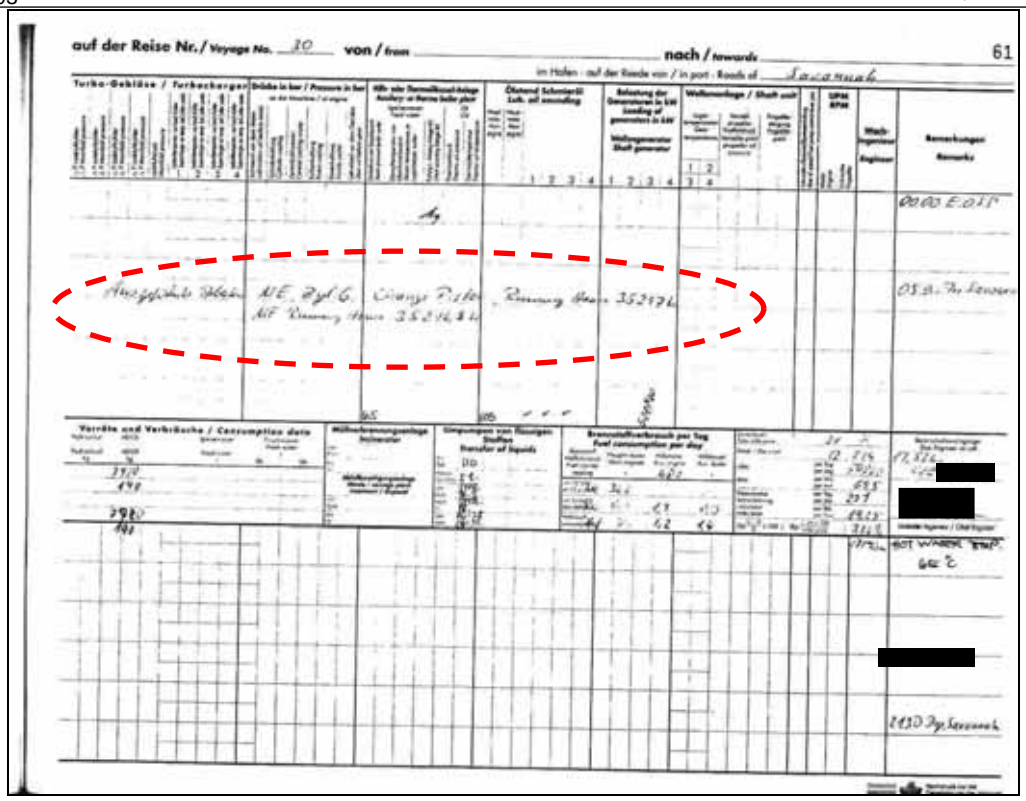
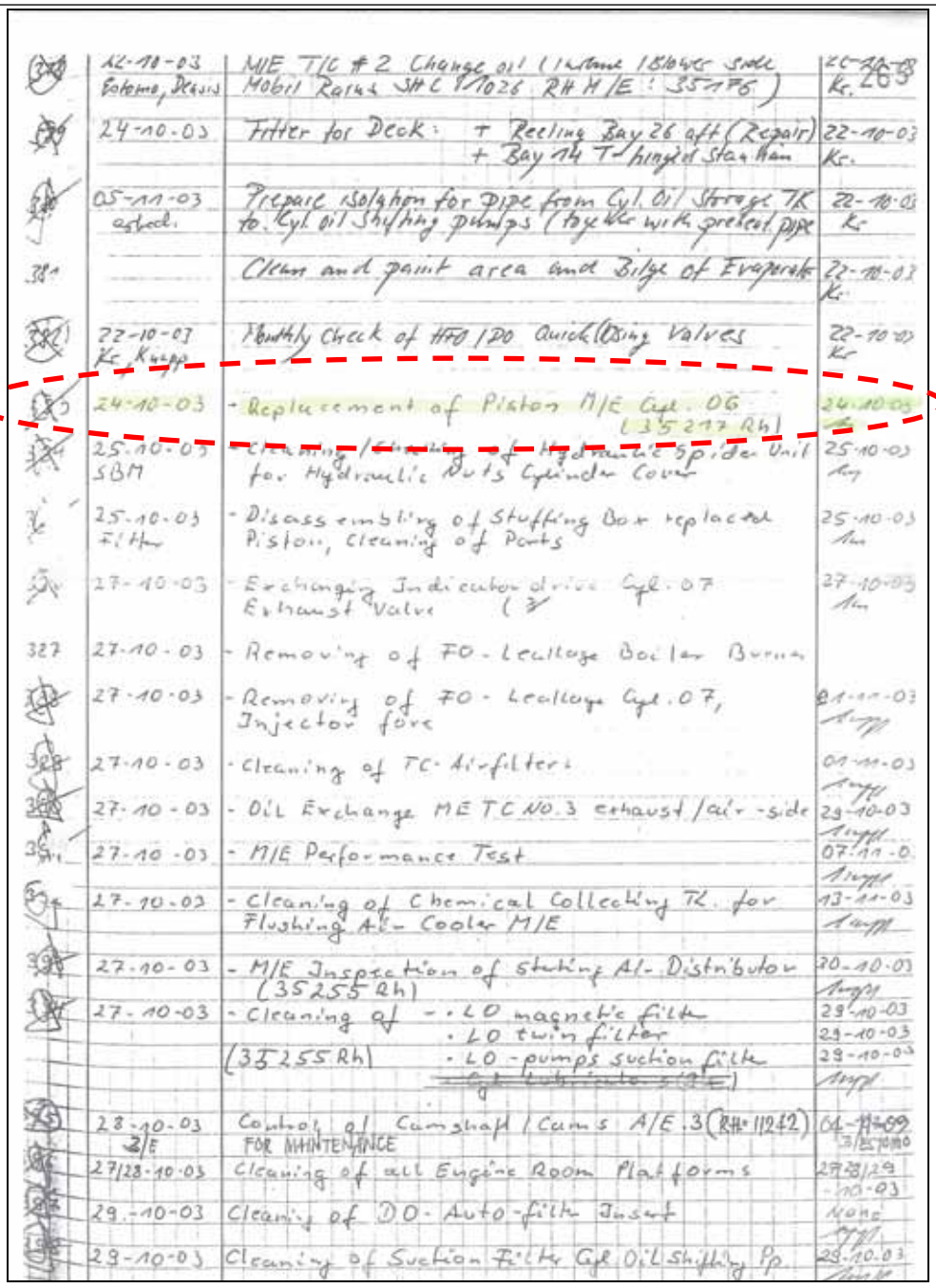


Figure 39: Extract of the engine log book for 24 October 2003

"Work carried out on ME Cyl. 6 Change Piston, Running Hours 35217 h
ME Running Hours 35216.8 h"

The subsequent measures in connection with the search for the SOO were not mentioned at all in the engine log book. According to the statements of witnesses from the technical area, the only handwritten working document in addition to the engine log book was the entry in what was referred to as the "workbook". **Figure 40** shows the workbook sheet pertaining to the time of the accident.



	12-10-03 Kotsomo, Dessis	M/E T/C # 2 Change oil (... Mobil Rarus SHC 9/1026 RH M/E : 35175)	Kr.
	24-10-03	Fitter for Deck: + Reeling Bay 26 aft (Repair) + Bay 14 T-hinged Stay Rail	22-10-03 Kr.
	05-11-03 asked.	Prepare Isolation for Pipe from Cyl. Oil Storage TK to Cyl. oil Shifting pumps (together with present pipe	22-10-03 Kr.
381		Clean and paint area and Bilge of Evaporator	22-10-03 Kr.
	22-10-03 Kr. Kuppe	Monthly Check of HFO / DO Quick Closing Valves	22-10-03 Kr.
	24-10-03	- Replacement of Piston M/E Cyl. 06 (35217 Rh)	24-10-03
	25-10-03 SBM	- Cleaning / Checking of Hydraulic Spider Unit for Hydraulic Nuts Cylinder Cover	25-10-03 Kuy
	25-10-03 Fitter	- Disassembling of Stuffing Box replaced Piston, Cleaning of Parts	25-10-03 Fitter
	27-10-03	- Exchanging Indicator drive Cyl. 07 Exhaust Valve (3	27-10-03 Fitter
327	27-10-03	- Removing of FO - Leakage Boiler Burner	
	27-10-03	- Removing of FO - Leakage Cyl. 07, Injector fore	27-10-03 Kuppe
	27-10-03	- Cleaning of TC Air-filters	01-11-03 Kuppe
	27-10-03	- Oil Exchange M E T C No. 3 exhaust / air - side	29-10-03 Kuppe
	27-10-03	- M/E Performance Test	07.11.0 Kuppe
	27-10-03	- Cleaning of Chemical Collecting TK. for Flushing Air - Cooler M/E	13-11-03 Kuppe
	27-10-03	- M/E Inspection of starting Air - Distributor (35255 Rh)	30-10-03 Kuppe
	27-10-03	- Cleaning of - LO magnetic filter - LO twin filter (35255 Rh) - LO - pumps suction filter	29-10-03 29-10-03 29-10-03 Kuppe
	28-10-03 2/E	Control of Camshaft / Cams A/E 3 (RH 11242) FOR MAINTENANCE	04-11-03 3/E
	27/28-10-03	Cleaning of all Engine Room Platforms	27/28/29 -10-03
	29.-10-03	Cleaning of DO - Auto-filter Insert	None
	29-10-03	Cleaning of Suction Filter Cyl Oil Shifting Pp.	29.10.03

Figure 40: Extract from the workbook

Each page of this workbook, which is also kept at the BMC, consists of four columns. The first column contains a sequential order number for the entry in the corresponding line. Column 2 is intended to show the date on which the measures described in Column 3 were commissioned in the technical area or on which a fault requiring rectification was discovered. Column 4 is used for the final confirmation by the crew member responsible for the work once the job has been done. At this point in time the sequential number in Column 1 is circled and crossed out to signify that the item has been processed.
For 24 October the following entry was made and confirmed by the Second Engineer; the same handwriting appears throughout:

"Replacement of Piston M/E Cyl. 06 (35217 Rh)"

The date "24-10-03" is identical in Columns 2 and 4. Review of the remaining entries on this page of the workbook revealed that coincidence of both dates is rather exceptional. Mostly, and evidently corresponding to the date on which the job was actually done, the confirmation date is a few days later than the commissioning date. [82]

The start and end of an extensive repair as well as the time at which the main engine is again operational are not documented in either the workbook or in the engine log book.

5.6.3.6 Visibility

5.6.3.6.1 Visibility outside the scavenge air receiver

The various different local inspections revealed that the engine rooms of LONDON EXPRESS and her sister ships are very well lit around the clock. The passageway in front of the two access hatches to the scavenge air receiver, which is delimited by a guardrail, is brightly lit by means of overhead fluorescent lamps (**Figures 41** and **42**).

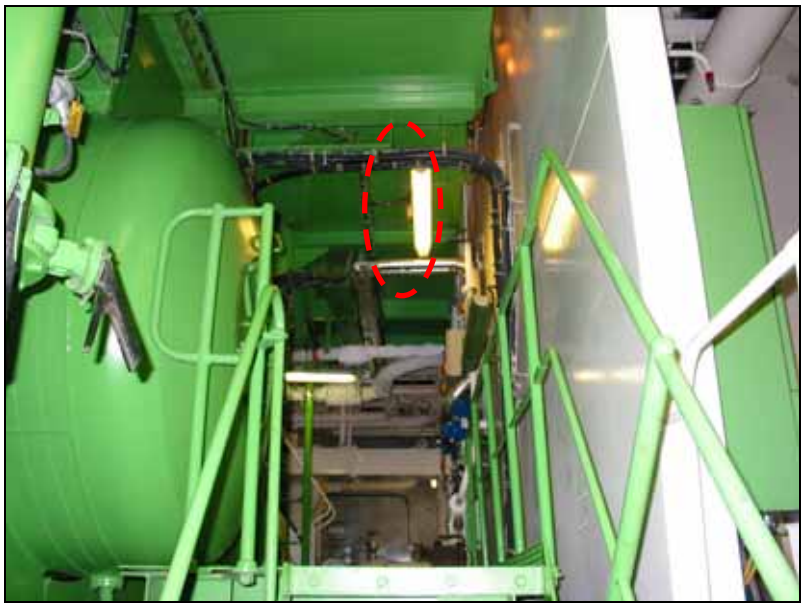


Figure 41: Lighting at the forward access hatch

[82] N.B.: In the second and third entries from top however the usual notation was deviated from, for the date in Column 4 (Release) would otherwise in this case always be before that of the work order.

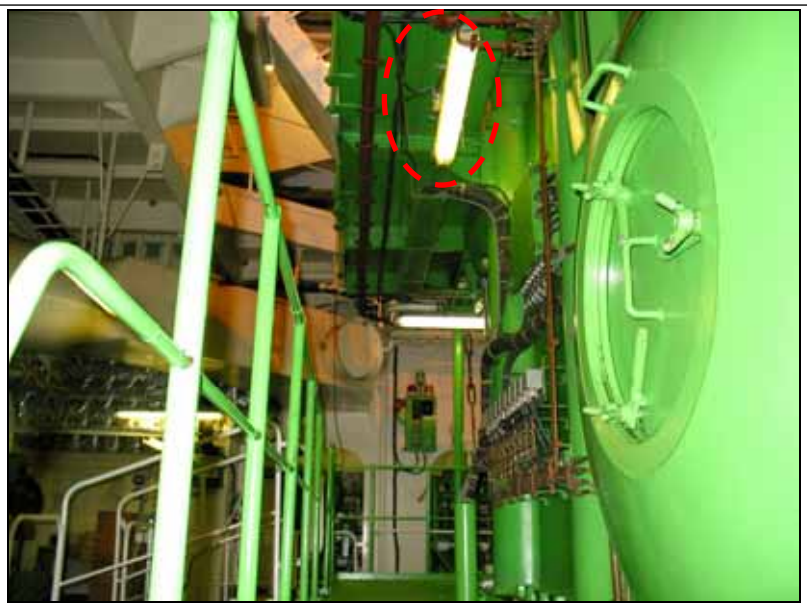


Figure 42: Lighting at the aft access hatch[83]

The passageway is approx. 0.9 m wide in front of the forward access hatch and approx. 0.7 m wide in front of the aft access hatch. This fact clearly shows that irregular bolting of the hatch cover would compellingly be noticed under normal circumstances when using the pertinent passageway even without using a torch and without any specific concentration concerning (unsuspected) irregularities.

5.6.3.6.2 Visibility inside the scavenge air receiver

As **Figure 43** below will shows that the visibility into the scavenge air receiver from the aft hatch is limited by its design, namely by the throttle, and this regardless of lighting conditions. It becomes obvious that the easily visible portion practically ends at the throttle before Cylinder 6, and that the area after the next throttle (Cylinders 6 to 1) appears as a “black hole”.

[83] N.B.: This photograph was taken on 21 Nov 2006 in Savannah and shows the locking bolts as modified after the casualty. Cf. in this context Point 7.4 below.

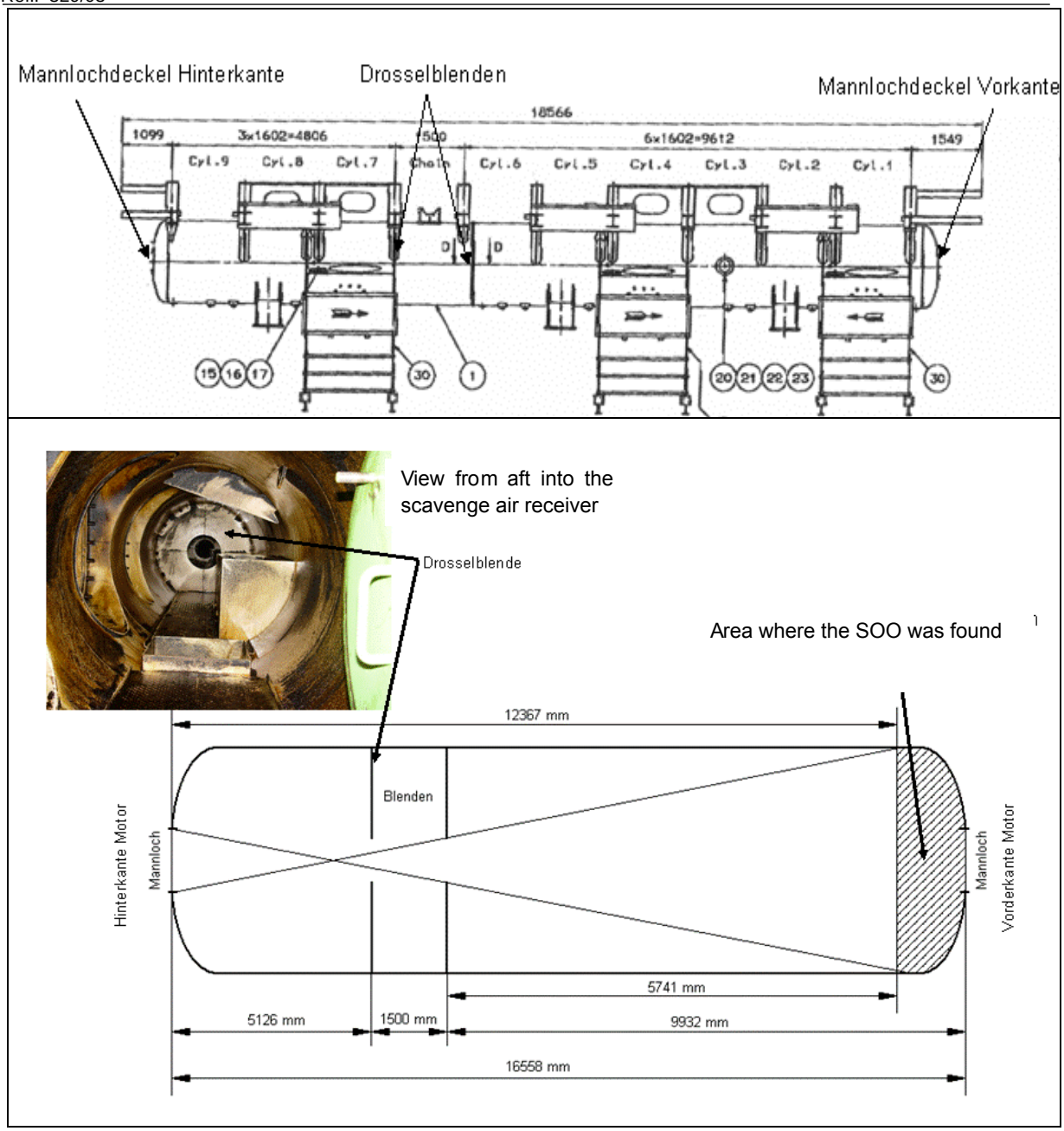


Figure 43: Schematic representation – Visibility in the scavenge air receiver[84]

Hinterkante Motor = Engine aft end
Vorderkante Motor = Engine forward end
Mannloch = Manhole
Mannlochdeckel = Manhole cover
Blenden = Flow restrictors
Drosselblende = throttle

[84] Source: Expert opinion of the BSU's appointed investigator.

Figure 44 shows the view through the scavenge air receiver with both access hatches open, from the forward end and with a person standing outside the aft hatch. The entering light enables the opposite open hatch to be recognised as a brightened area.

Figure 44: View from the forward end into the scavenge air receiver, with aft hatch open

In contrast, **Figures 45** and **46** show that with the opposite hatch closed visibility is insufficient in the only weakly lit scavenge air receiver, as the entering light is strongly absorbed by the dark oily inner surfaces of the tubular receiver. Accordingly, the person who was positioned inside at the opposite, closed access hatch when **Figure 45** was taken cannot be discerned on the photograph, and the passage of this person through the throttles in **Figure 46** is only schematically visible despite the relative brightness created by the flash.

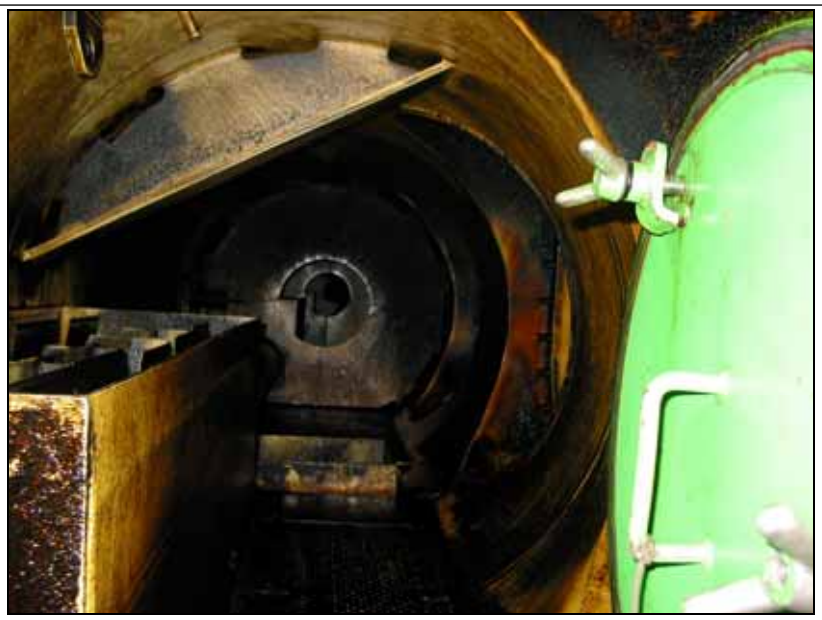


Figure 45: View from the forward end into the scavenge air receiver, with aft hatch closed

Figure 46: Person between the throttles in the receiver, with aft hatch closed

Experiments in which, with the forward hatch closed, the scavenge air receiver was lit from aft with the standard type of torch found on board showed that the contours of a person dressed in light coloured clothing and positioned in the area of the forward hatch can be discerned with difficulty when concentrating (**Figure 47**).

Figure 47: Person with a light coloured cloth at the forward hatch

At the time of the accident the SOO wore khaki coloured work overalls. When his body was discovered in Norfolk, the broken pieces of a torch were found by his side. It must be assumed that he had used the torch as the only possible striking tool available to him to generate sound signals and that in doing so he had destroyed it already before any potential opening of the scavenge air receiver in the course of the searches. He therefore probably no longer had a functioning light source by means of which he could have been seen despite the highly restricted visibility in the receiver at the time when the searches were initiated.

5.6.3.7 Audibility of knocking sounds

During the visit on board in Savannah the technical expert acting on behalf of the Federal Bureau examined, among other things, the sound propagation characteristics in the engine room in order to determine whether and/or to what extent and within what distance the knocking sounds presumably generated [by the SOO] could be heard in the vicinity of the scavenge air receiver.

Measurements of the propagation of knocking noise generated with different methods revealed that

- Impact sounds generated by striking the access hatch to the scavenge air receiver with pliers could no longer be heard at a distance of approx. five meters due to their reduced enhancement as compared to the general noise level of approx. 90 dB and could also no longer be recorded for measurement at that distance;
- Impact sounds generated by slamming the access hatch to the scavenge air receiver were still perceptible at a distance of approx. 10 m by by the companionway leading down to the cylinder station owing to a greater sound level enhancement and could still be recorded owing to a residual sound level enhancement of approx. 2 ÷ 3 dB, but could no longer be heard at a distance of

approx. 17 m at the access hatch to the scavenge air receiver at the Cylinder 9 from the other end of the engine, nor could they be recorded for measurement.

The above described special construction of the scavenge air receiver has a sound absorbing effect. In combination with the regular sound background in the engine room, which is significant even at harbour, this means that voice exchanges between the two ends of the receiver are practically impossible. In addition, potential calls directed to the interior of the receiver from the aft hatch within the scope of the search could perhaps potentially be heard at the forward hatch, but as a result of an already developing weakness the SOO might no longer have had the strength to react audibly.

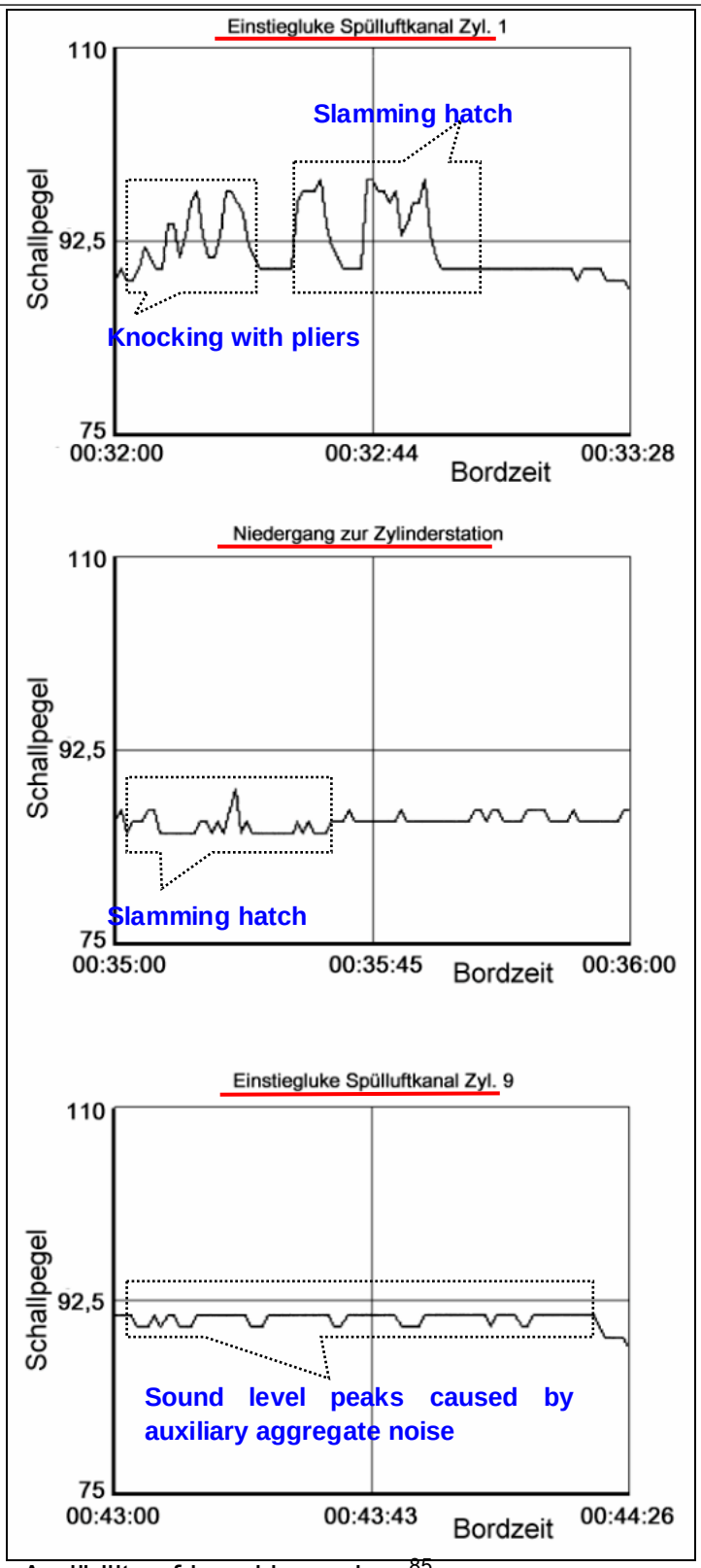


Figure 48: Graph – Audibility of knocking noises[85]

Schallpegel = Noise level
Bordzeit = Time on board
Einstiegluke Spülluftkanal Zyl. 1 = Scavenge air receiver access hatch at Cyl. 1
Niedergang zur Zylinderstation = Companionway down to cylinder station
Einstiegluke Spülluftkanal Zyl. 9 = Scavenge air receiver access hatch at Cyl. 9

[85] Source: Expert opinion of the BSU's appointed expert.

5.6.3.8 Conclusions

The search activities in the engine room are described in very different ways by the relevant witnesses. After comparisons, plausibility checks and taking into account all information at hand, the Federal Bureau arrives at the following conclusions:

1. It is considered to be a certainty that the Chief Engineer and most probably also the Second Engineer had already carried out a first search for the SOO before the general alarm sounded at approx. 21:00 and that this search had also included the engine room. This assumption is supported by statements made to this effect by the Oiler on watch, who at this time was the only other crew member working in the engine room and who was likely involved in this first search at least to some extent.

2. It is doubtful that the Chief Engineer would actually have opened the aft hatch of the scavenge air receiver during his round as he affirmed. An argument against this is that this first search for the SOO was only carried out very superficially and against the background that he was busy carrying out some sort of a repair somewhere in a "hidden corner" of the engine room. It is furthermore unlikely that the Chief Engineer would really have taken the trouble to open up the tightly closed aft hatch cover although at that point there were still no indications to look in this very atypical location of all places, all the more so before methodically checking all much more likely places in the superstructure. Finally it is not understandable why only the aft hatch should have been opened. The technical conditions in the scavenge air receiver certainly do not enable a reliable view to the opposite end. If therefore – acting from an inner inspiration – the scavenge air receiver had indeed been taken into consideration as the potential whereabouts of the SOO, this would compellingly have had to lead to also opening the forward hatch.

3. The Second Engineer's "confirmation" of the alleged opening of the receiver and his assertion that he had looked inside together with the Chief Engineer are also no believable. It can be considered to be ruled out that the Chief Engineer would not recall someone looking over his shoulder when he opened the hatch. In addition, the Second Engineer too was unable to provide any justification for the fact that in spite of the inadequate visibility circumstances it was nonetheless decided to open up only one of the hatches. The Second Engineer's questionable assertion in any event also does not match his other accounts. For, if it is assumed that after completion of the piston inspection the Second Engineer had really seen the SOO exit the scavenge air receiver and then observed the closure of the hatch, then the logical reaction after meeting the Chief Engineer at the aft hatch would have been to inform him of that event at the latest at this point in time. Instead, the Chief Engineer's and the Second Engineer's statements reveal that the piston inspection allegedly performed jointly was not addressed either in connection with this encounter nor at any other – later – point in time. Finally, the Second Engineer's "confirmation" is also not credible because he emphasises that they had looked into the scavenge air receiver from aft *after* the general alarm, while the Chief Engineer had stated in each of his interrogations that he had opened the aft hatch only and exclusively once, and this *before* the general alarm.

4. After the general alarm all remaining members of the engine room crew, including the Third Engineer, the SOF and the Electrician, met at the BMC. They were

informed of the fact that the SOO was missing and instructed to look for him in the engine room.

The Chief Engineer's assertion that a structured search action had been initiated is not credible. It is not confirmed by any of the relevant witnesses. There is also no apparent reason why a potential explicitly order to search in specific areas would have been kept quiet. On the contrary, such statements would have had an exclusively exculpatory effect for all witnesses who had not been sent to search in the vicinity of the scavenge air receiver, as they would have exonerated them from any responsibility for the absence of a search in the area of the receiver.

It must therefore be assumed that the technical personnel went into the engine room in a more or less aimless fashion and that once there the different levels were inspected without any particular plan or design. After the general alarm the Chief Engineer also went into the engine room. Although he disputed his, all [other] witnesses confirmed his presence. There is no apparent reason why they should have lied in this respect.

5. There was no reliable documentation concerning the work performed on the day of the accident and its completion on LONDON EXPRESS. The workbook, which in appearance is manifestly supposed to provide information concerning the timing, participants and completion of activities in the technical area on a day-by-day basis was kept by an ambiguous group of individuals in an unreliable manner as a result of the lack of appropriate unambiguous instructions from the Chief Engineer. It was thus not possible to draw conclusions concerning the whereabouts of the SOO from reviewing this book, whose maintenance and update is admittedly not a legal requirement.

6. The assertion made by a Filipino crew member to the effect that he had passed the forward hatch of the scavenge air receiver at approximately 21:10 and had noticed an air current and a jammed object moving in it is probably true. There is no reasonable reason why the witness should have invented information of this kind, which was ultimately even incriminatory to him.

The cause of the leakage on the other hand is questionable, as at this point the ship's engine had not yet been started, as indicated by the corresponding technical reports.

The auxiliary fans that support engine start-up and which are the only other components that could have caused the air current are also said not to have been in operation yet at that time. At first sight this also appears plausible because they are usually only started up from the bridge a few seconds before starting the main engine. It should however be taken into account that the ship's departure had already been scheduled for 21:00 and for the Master now only depended on the clarification of the SOO's whereabouts, which was now expected at any moment. Therefore, according to the main engine log printout, main alarm system monitoring was switched from the BMC to the bridge at 21:03. The tugs, too, has made fast at 21:10. There was also a lot of time pressure to clear the berth for the next ship. All in all it is therefore not far-fetched if, as a result of growing impatience and with the intention to cast off as close to schedule and as soon as possible, the auxiliary fans had already been switched on from the bridge significantly earlier than stated.

7. What could not be clarified is whether and at what time on the day of the accident the Filipino witness had reported his observation to the Third Engineer and/or the Chief Engineer. However, he reported in a most convincing manner and in several congruent statements that his report had been answered with the remark that the matter could not be further dealt with at that time because the ship was in the process of leaving the berth. The course of the altogether fairly unstructured search, which was conducted under significant time pressure, gives strong reason to presume that the possibility that the SOO could be trapped in the main engine's scavenge air receiver was not seriously taken into account. It is therefore certainly plausible that the relevant witness report may indeed not have received further attention. This is all the more likely if one assumes that at the time when this report was made the main engine of LONDON EXPRESS or at least the auxiliary fans had already been started. Only stopping the fans and the main engine would now have made it possible to open up the scavenge air receiver.

8. The opening of the aft hatch asserted by the SOF in connection with his inspection round after the general alarm and the encounter with the Chief Engineer and the Second Engineer that allegedly took place at that time have not been proven. The SOF made statements of differing contents at different times when describing the event in question. Nonetheless, last but not least the personal impression obtained by the investigation team in connection with the interrogation of this witness and his credibility speak for the accuracy of his statement. Contrary to the descriptions provided by the Chief Engineer and the Second Engineer, which were contradictory and partially demonstrably incorrect in many other respects and which do not provide a plausible rationale for the alleged opening of the receiver on only one side, it is understandable if the SOF asserts that the fact that the Chief Engineer called out to him words to the effect that it was no longer necessary to open up "there" caused him to pay no further attention to the scavenge air receiver as a whole. This applies regardless of the actual formulation. In fact, only the presumption formulated under No. **6**, namely that the auxiliary fans had already been switched on shortly after the general alarm would argue against the SMO's assertion. This would mean that due to the internal positive pressure the SMO too would no longer have been able to open the receiver with mere muscle strength. It should however be taken into consideration that the [exact] timing of the fan start-up, which is presumed to have taken place distinctly earlier than the main engine start-up, is not actually known. It is thus certainly possible that the SOF might under those circumstances have opened up the aft hatch "just in time". The presumption analysed under No. **6** and the SOF's statement are therefore not compellingly mutually exclusive.

9. The search in the engine room was discontinued before 21:30 by order of the Chief Engineer.

10. The first engine manoeuvre was carried out at 21:48.

11. The Oiler on watch had observed a leakage from the forward scavenge air receiver hatch at the very latest shortly after the engine had been started. He and the Second Engineer had both congruently and plausibly reported that the latter had

become aware of the problem at approximately the same time and had tried to eliminate the leakage by tightening the bolts.
However, the Second Engineer's statement that the three dogs of the bolting system had been in the correct position before he tightened two or even all three of the loose toggle nuts is not internally coherent. Experiments with the hatch cover unequivocally revealed that in fact partial self-locking by *partial* engaging of the upper left hand dog is possible from a constructional design point of view. Tis does however, not mean that this dog and certainly not the two other dogs would entirely swing into the correct locking position. This is technically impossible. If it is however assumed that already prior to the action taken by the Second Engineer and despite assertions to the contrary somebody had e.g. within the scope of the search tampered with the at first only partially locked hatch cover, then it would be inexplicable why in such a case the dogs would have been turned into the correct locking position but the toggle nuts would not have been tightened.

12. The leakage at the forward hatch was not a problem that had already repeatedly occurred in the past weeks or months. The Second Engineer's assertion to this effect is not credible. It is countered by various statements, including in particular those made by the Filipino crew members. They had unanimously stated that in their partially more than six months on board there had not been a single case of leakage in the area in question. They were also not aware of this type of problem on other ships despite many years' seafaring experience.

13. The Chief Engineer did not order the search to be continued after departure. Whether in omitting to do so he had breached a procedure agreed upon with the Master could not be determined, as there are no witnesses to the Master's assertion to this effect.

14. After departure, several of the Filipino witnesses returned to the engine room in order again to search for the SOO voluntarily and of their own accord. Owing to the extensive coherence among the relevant descriptions it must be assumed that they did indeed meet at the forward hatch of the scavenge air receiver and noticed both the leakage and the jammed object. Their decision not to concern themselves further with those observations after the Oiler on watch had reported that the Second Engineer had already be informed and had himself manipulated the hatch is also at least a priori plausible.

15. What is certain is that a foreign object was jammed between the forward hatch cover and the frame at a 2 o'clock position. Its existence was confirmed by all witnesses with the exception of the Second Engineer, in part however only as a result of intensive in-depth questioning.
Concerning the dimensions, the colour and the material of the object in question the witness statements diverged very widely. It was described by some as a dirty, oil drenched rag, frayed at the edges, and by others as a kind of thread or string resembling a shoe lace. One witness described the object as a red or red bordered rag, another as potentially a component of a (textile material) gasket. Contrary to the abovementioned conjecture the object can hardly have been a shoelace, as when he was found in the receiver the SOO was wearing buckle closure shoes. The

length reported for the object varied between “the size of a fingernail” and four inches[86].

Some components of the object in question still adhered to the hatch cover even after the hatch had been opened in Norfolk. Amazingly, however, the US authorities paid no attention at all to it.

Before the hatch was dogged in Norfolk for purposes of moving to the roads, the SOF removed the remains of the object that were still stuck to the cover and handed them over to the Chief Engineer. The latter asserted having placed them in an envelope and then into a drawer at the BMC. However, the envelope could not be found again later. Thus the BSU was unable to conduct more accurate investigations concerning the nature and origin of the jammed object. It is however considered to be very likely that after the partial locking of the hatch the SOO had tried to pass a cleaning rag he may have taken with him through the existing gap between the hatch and the frame in order to draw attention to himself and/or act on the bolting mechanism.

In the interrogations it became clear that most of the witnesses found it very embarrassing to admit awareness of the object; it was therefore attempted to classify it as an entirely insignificant matter of trifling importance.

Within the scope of the detailed evaluation carried out by the [German] Federal Bureau of the photographs of the scene of the accident that had been made available by the US authorities, the one and only (accidentally recorded) visual evidence of the existence of the textile object was discovered on one image (**Figures 49** and **50**). This photograph had been taken by the US authorities before LONDON EXPRESS moved to its anchorage in Norfolk, i.e. before the object had been removed by the SOF.

[86] 1 inch = 2.54 cm.

Figure 49: Remains of the jammed object – overall view

Figure 50: Jammed object – Image section enlargement

16. The Chief Engineer became aware at least of the leakage and of the inadequate locking of the forward hatch to the scavenge air receiver at the latest shortly after departure. Whether he still inspected the hatch that same evening could not be determined. It is however certain that he did not consider the information he had been given to constitute a reason to devote serious thought to opening the hatch and to check inside the scavenge air receiver.
Stopping the engine for a targeted search in the receiver was not taken into consideration either at this point in time or later on the way to Norfolk by either the Chief Engineer or the Second Engineer.

17. Owing to the restricted width of the passageway in front of the hatches to the scavenge air receiver (less than one metre) and the very good lighting conditions in this area it is incomprehensible that individuals having passed the forward hatch during the search conducted prior to departure would not have discovered the incomplete locking of the hatch and the jammed object. There are only two conceivable explanations for this. Either only the crew member who admitted having observed the irregularities had searched in that area, or else any observations made were concealed.

18. The measurements of the propagation of knocking sounds from the interior of the scavenge air receiver revealed that the difference in sound levels generated by such knocking are too small against the general noise background in the engine room. It must be assumed that the people who searched in the engine room and were wearing hearing protection in accordance with occupational safety regulations did not hear any knocking sounds, which in any event could only have been made with a torch, which was not a particularly suitable tool for this purpose.

5.6.4 Search activities outside the engine room

Concerning the search activities outside the technical area, in addition to the statements made by the ship's command and further crew members, the Federal Bureau is in possession of two Statements of Facts drawn up by The Master of LONDON EXPRESS; they were prepared at different times and contain some telling differences. In addition, and further to a request from the Federal Bureau, the Master drew up an ex post facto report concerning the search for the SOO. The documents in question are presented in the following subsections and then evaluated taking into account the witness statements available to the Bureau.

5.6.4.1 Statement of Facts of 26 October 2003[87]

From: [redacted]
To:
Cc:
Date: Montag, 27. Oktober 2003 4:44
Subject: Toedlicher Unfall von [redacted]

Sehr geehrte Herren,

Nachfolgend ein von uns zusammengestelletes Stament of facts uebe die Ereignisse an Bord unseres Schiffes waehrend der letzten Tage.

[redacted]

Statement of facts concerning missing crewmember on board CMS London Express, Mr [redacted]

The following statement of facts is the chronological order of single events and measures, as it had been undertaken by the undersigning Captain or his staff.

MV London Express called the port of Savannah, GA on October 24, 2003 between 05:00 and 21:30. The departure time was set in the morning hours by the agency for 21:00 same day.

At approximately 20:40 the Chief Engineer realised, that the 2nd Engineer / SOO Mr [redacted] is not present as appointed for this departure.
A search in the engine room area was carried out immediately. After an unsuccessful telephone call to his cabin, the cabin was opened and investigated by Chief Officer too.

At this time the ship's crew was already stand by on station, ready for departure. Therefore, at approximately 21:00 the General Alarm was released. On this occasion, the completeness of the remaining crew was verified.

Therefore, an intensified search over the entire ship was initiated with negative result. In the meantime the seapilot Mr [redacted] informed via VHF that the vessel is unable to sail.

Furthermore, the Husband Agent was informed via telephone about the situation. It was agreed between Captain and Agent that the search would be carried out on the pilot waters. The Agent would take over the duty and task to inform all concerned parties in the port of Savannah.

After careful consideration the Captain set the departure time for 21:30. The search was continued on the pilot waters, with negative result. Therefore, the passport of Mr [redacted] was handed over to the seapilot, who took over the task to forward it to the Agency.

After dropping the seapilot, the Agent was contacted again by telephone and informed about the situation on board.

In the morning of the following day, Oct. 25, the cabin of Mr. [redacted] was investigated again by Captain and Chief Officer. It was found out, that his US Crewmember Landing permit and other personal documents were in his cabin. Furthermore, a private cell phone was switched on.

The voyage was continued until next port of Norfolk. Vessel arrived on October 26 at 11:30. When the scavenge air receiver were opened, the body of Mr [redacted] was found inside at the fore end.

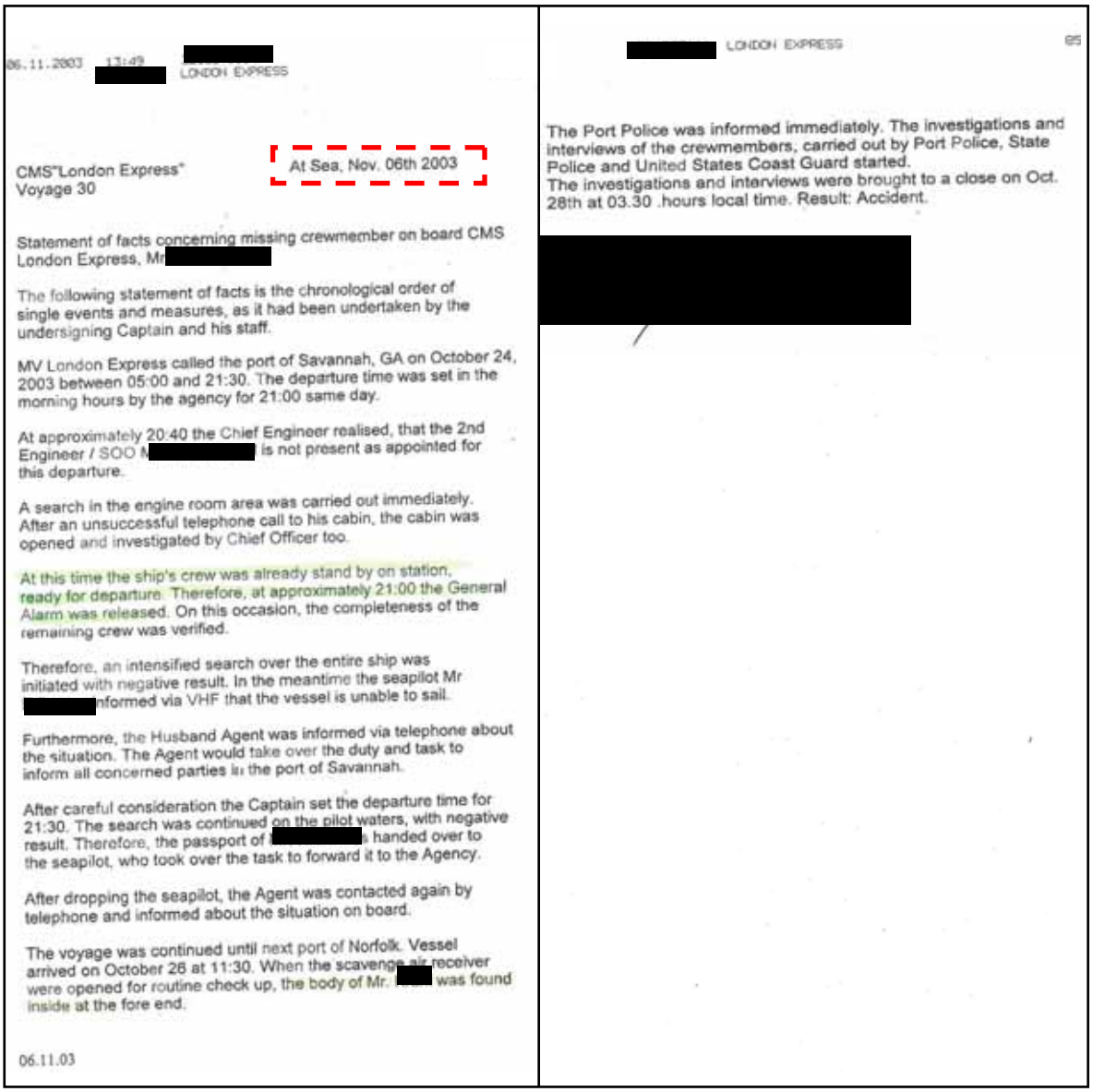
The Port Police was informed immediately. The investigations and interviews of the crewmembers, carried out by Port Police, State Police and United States Coast Guard are continuing at the moment.

This statement was written down until October 26, 2003 at 23:30 local time.

[redacted], Capt.

[87] N.B.: This version of the Statement of Facts was provided to the BSU by the USCG.

5.6.4.2 Statement of Facts of 6 November 2003[88]



06.11.2003 13:49 [redacted] LONDON EXPRESS

CMS"London Express"
Voyage 30

At Sea, Nov. 06th 2003

Statement of facts concerning missing crewmember on board CMS London Express, Mr [redacted]

The following statement of facts is the chronological order of single events and measures, as it had been undertaken by the undersigning Captain and his staff.

MV London Express called the port of Savannah, GA on October 24, 2003 between 05:00 and 21:30. The departure time was set in the morning hours by the agency for 21:00 same day.

At approximately 20:40 the Chief Engineer realised, that the 2nd Engineer / SOO M [redacted] is not present as appointed for this departure.

A search in the engine room area was carried out immediately. After an unsuccessful telephone call to his cabin, the cabin was opened and investigated by Chief Officer too.

At this time the ship's crew was already stand by on station, ready for departure. Therefore, at approximately 21:00 the General Alarm was released. On this occasion, the completeness of the remaining crew was verified.

Therefore, an intensified search over the entire ship was initiated with negative result. In the meantime the seapilot Mr [redacted] informed via VHF that the vessel is unable to sail.

Furthermore, the Husband Agent was informed via telephone about the situation. The Agent would take over the duty and task to inform all concerned parties in the port of Savannah.

After careful consideration the Captain set the departure time for 21:30. The search was continued on the pilot waters, with negative result. Therefore, the passport of [redacted] handed over to the seapilot, who took over the task to forward it to the Agency.

After dropping the seapilot, the Agent was contacted again by telephone and informed about the situation on board.

The voyage was continued until next port of Norfolk. Vessel arrived on October 26 at 11:30. When the scavenge air receiver were opened for routine check up, the body of Mr. [redacted] was found inside at the fore end.

06.11.03

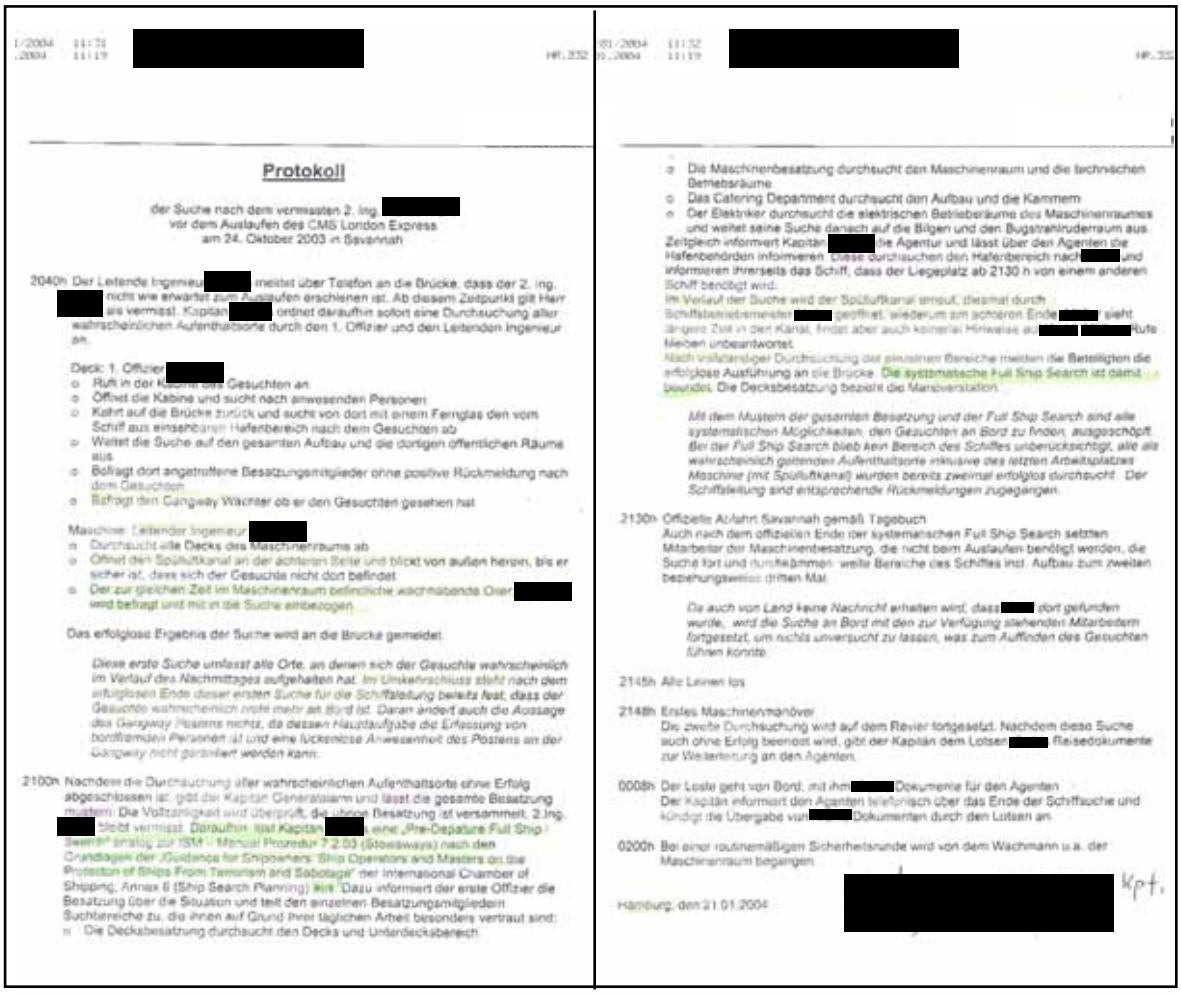
[redacted] LONDON EXPRESS 05

The Port Police was informed immediately. The investigations and interviews of the crewmembers, carried out by Port Police, State Police and United States Coast Guard started.
The investigations and interviews were brought to a close on Oct. 28th at 03.30 .hours local time. Result: Accident.

[redacted]

[88] N.B.: This version of the Statement of Facts was provided to the BSU by the shipping company operating the vessel.

5.6.4.3 Search report of 21 January 2004[89]



Protokoll

der Suche nach dem vermissten 2. Ing. [redacted]
vor dem Auslaufen des CMS London Express
am 24. Oktober 2003 in Savannah

2040h Der Leitende Ingenieur [redacted] meldet über Telefon an die Brücke, dass der 2. Ing. [redacted] nicht wie erwartet zum Auslaufen erschienen ist. Ab diesem Zeitpunkt gilt Herr [redacted] als vermisst. Kapitän [redacted] ordnet daraufhin sofort eine Durchsuchung aller wahrscheinlichen Aufenthaltsorte durch den 1. Offizier und den Leitenden Ingenieur an.

Deck: 1. Offizier [redacted]
- Ruft in der Kabine des Gesuchten an
- Öffnet die Kabine und sucht nach anwesenden Personen
- Kehrt auf die Brücke zurück und sucht von dort mit einem Fernglas den vom Schiff aus einsehbaren Hafenbereich nach dem Gesuchten ab
- Weitet die Suche auf den gesamten Aufbau und die dortigen öffentlichen Räume aus
- Befragt dort angetroffene Besatzungsmitglieder ohne positive Rückmeldung nach dem Gesuchten
- Befragt den Gangway Wächter ob er den Gesuchten gesehen hat

Maschine: Leitender Ingenieur [redacted]
- Durchsucht alle Decks des Maschinenraums ab
- Öffnet den Spülluftkanal an der achteren Seite und blickt von außen herein, bis er sicher ist, dass sich der Gesuchte nicht dort befindet
- Der zur gleichen Zeit im Maschinenraum befindliche wachhabende Ing. [redacted] wird befragt und mit in die Suche einbezogen.

Das erfolglose Ergebnis der Suche wird an die Brücke gemeldet.

Diese erste Suche umfasst alle Orte, an denen sich der Gesuchte wahrscheinlich im Verlauf des Nachmittages aufgehalten hat. Im Umkehrschluss steht nach dem erfolglosen Ende dieser ersten Suche für die Schiffsleitung bereits fest, dass der Gesuchte wahrscheinlich nicht mehr an Bord ist. Daran ändert auch die Aussage des Gangway Postens nichts, da dessen Hauptaufgabe die Erfassung von landfahrenden Personen ist und eine lückenlose Anwesenheit des Postens an der Gangway nicht garantiert werden kann.

2100h Nachdem die Durchsuchung aller wahrscheinlichen Aufenthaltsorte ohne Erfolg abgeschlossen ist, gibt der Kapitän Generalalarm und lässt die gesamte Besatzung mustern. Die Vollzähligkeit wird überprüft, die ganze Besatzung ist versammelt, 2.Ing. [redacted] bleibt vermisst. Daraufhin lässt Kapitän [redacted] eine „Pre-Departure Full Ship Search" anhand der ISM - Manual Prozedur 7.2.03 (Stowaways) nach den Grundlagen der „Guidance for Shipowners, Ship Operators and Masters on the Protection of Ships From Terrorism and Sabotage" der International Chamber of Shipping, Annex 6 (Ship Search Planning) ein. Dazu informiert der erste Offizier die Besatzung über die Situation und teilt den einzelnen Besatzungsmitgliedern Suchbereiche zu, die ihnen auf Grund ihrer täglichen Arbeit besonders vertraut sind:
- Die Decksbesatzung durchsucht den Decks und Unterdecksbereich
- Die Maschinenbesatzung durchsucht den Maschinenraum und die technischen Betriebsräume
- Das Catering Department durchsucht den Aufbau und die Kammern
- Der Elektriker durchsucht die elektrischen Betriebsräume des Maschinenraumes und weitet seine Suche danach auf die Bilgen und den Bugstrahlruderraum aus.

Zeitgleich informiert Kapitän [redacted] die Agentur und lässt über den Agenten die Hafenbehörden informieren. Diese durchsuchen den Haferbereich nach [redacted] und informieren ihrerseits das Schiff, dass der Liegeplatz ab 2130 h von einem anderen Schiff benötigt wird.

Im Verlauf der Suche wird der Spülluftkanal erneut, diesmal durch Schiffsbetriebsmeister [redacted] geöffnet, wiederum am achteren Ende [redacted] sieht längere Zeit in den Kanal, findet aber auch keinerlei Hinweise auf [redacted] Rufe [redacted] Meiden unbeantwortet.

Nach vollständiger Durchsuchung der genannten Bereiche melden die Beteiligten die erfolglose Ausführung an die Brücke. Die systematische Full Ship Search ist damit beendet. Die Decksbesatzung bezieht die Manöverstation.

Mit dem Mustern der gesamten Besatzung und der Full Ship Search sind alle systematischen Möglichkeiten, den Gesuchten an Bord zu finden, ausgeschöpft. Bei der Full Ship Search blieb kein Bereich des Schiffes unberücksichtigt, alle als wahrscheinlich geltenden Aufenthaltsorte inklusive des letzten Arbeitsplatzes Maschine (mit Spülluftkanal) wurden bereits zweimal erfolglos durchsucht. Der Schiffsleitung sind entsprechende Rückmeldungen zugegangen.

2130h Offizielle Abfahrt Savannah gemäß Tagebuch
Auch nach dem offiziellen Ende der systematischen Full Ship Search setzten Mitarbeiter der Maschinenbesatzung, die nicht beim Auslaufen benötigt werden, die Suche fort und durchkämmen weite Bereiche des Schiffes incl. Aufbau zum zweiten beziehungsweise dritten Mal.

Da auch von Land keine Nachricht erhalten wird, dass [redacted] dort gefunden wurde, wird die Suche an Bord mit den zur Verfügung stehenden Mitarbeitern fortgesetzt, um nichts unversucht zu lassen, was zum Auffinden des Gesuchten führen könnte.

2145h Alle Leinen los

2148h Erstes Maschinenmanöver
Die zweite Durchsuchung wird auf dem Revier fortgesetzt. Nachdem diese Suche auch ohne Erfolg beendet wird, gibt der Kapitän dem Lotsen [redacted] Reisedokumente zur Weiterleitung an den Agenten.

0008h Der Lotse geht von Bord, mit ihm [redacted] Dokumente für den Agenten.
Der Kapitän informiert den Agenten telefonisch über das Ende der Schiffsuche und kündigt die Übergabe von [redacted] Dokumenten durch den Lotsen an.

0200h Bei einer routinemäßigen Sicherheitsrunde wird von dem Wachmann u.a. der Maschinenraum begangen.

Hamburg, den 21.01.2004 [redacted] Kpt.

Translation into English of above "Protokoll":

Hapag-Lloyd
Container Line

Report

on the search for the missing Second Engineer [redacted]
prior to departure of the CMS London Express
on 24 October 2003 in Savannah

2040h Chief Engineer [redacted] reported by phone to the bridge that Second Engineer [redacted] had not appeared as expected for departure. From this point forward Mr [redacted] was considered to be missing. Master [redacted] thereupon

[89] N.B.: This report was prepared by the ship's Master upon request from the BSU. (Colour emphasis was added in the course of evaluation of the document).

immediately ordered a search of all probable whereabouts by the Chief Mate and the Chief Engineer.

Deck: Chief Mate, Mr [redacted]

- Phones the missing person's cabin
- Opens the cabin and searches for any persons present
- Returns to the bridge and from there searches the port area visible from the ship with binoculars for the missing person
- Expands the search to the entire superstructure and the public rooms in that area
- Questions crew members met there without obtaining positive information on the missing person
- Questions the gangway watch as to whether he has seen the missing person

Engine – Chief Engineer [redacted]

- Searches all engine room decks
- Opens the scavenge air receiver on the aft end and looks in from the outside until he is sure that the missing person is not in there
- The Oiler on watch, Mr [redacted], is in the engine room at the same time and is questioned and involved into in the search

The unsuccessful result of the search is reported to the bridge

This first search comprises all locations where the missing person had probably been in the course of the afternoon. Conversely, after the unsuccessful end to this first search the ship command already assumes with certainty that the missing person is probably no longer on board. This is also not affected by the statement of the gangway watch, as his main task is to record persons not belonging to the crew and continuous presence of the watchman at the gangway cannot be guaranteed.

2100h After the search of all probable areas has been completed without success, the Master sounds the general alarm and orders the entire crew to the muster station. Full crew presence is checked, the remaining crew is assembled, Second Engineer [redacted] is still missing. Thereupon Master [redacted] initiates a "Pre-Departure Full Ship Search" in analogy to the ISM Manual Procedure 7.2.03 (Stowaways) based on the "Guidance for Shipowners, Ship Operators and Masters on the Protection of Ships From Terrorism and Sabotage" of the International Chamber of Shipping, Annex 8 (Ship Search Planning). The Chief Mate informs the crew of the situation and assigns the individual crew members to search areas they are particularly familiar with due to their daily work:

- The deck crew searches the decks and the area below deck

Hapag-Lloyd
Container Line

- The engine room crew searches the engine room and the technical operations areas
- The Catering Department searches the superstructure and the cabins
- The Electrician searches the electrical operations areas of the engine room and then expands his search to the bildes and the bowthruster room. At the same time Master [redacted] informs the Agent and has the Agent inform the port authorities. The authorities search the port facilities for [redacted] and on their part inform the ship that at 2130 h the berth will be needed for another vessel.

In the course of the search the scavenge air receiver is again opened, this time by the Master of Ship Operations, Mr [redacted] again from the aft end. [redacted] looks into the receiver for a while, but also does not find any sign of [redacted]. [redacted] calls go unanswered.
After a full search of the individual areas the participants reported the unsuccessful execution to the bridge. The systematic Full Ship Search is thus completed. The deck crew reports to the manoeuvring station.

With the mustering of the entire crew and the Full Ship Search all systematic possibilities to find the missing person on board have been exhausted. No area of the ship remained unaccounted for in the Full Ship Search, all potentially probable whereabouts including the last workplace engine (with scavenge air receiver) have already been searched twice, unsuccessfully. Ship command received the corresponding reports.

2130h Official departure Savannah according to ship's log book
Also after the official end of the systematic Full Ship Search the engine crew members not needed for departure continued the search and searched wide ranging areas of the ship incl. the superstructure for the second / third time respectively.

Since there was also no news from shore [redacted] had been found there, the search is continued on board with the available crew members in order to leave nothing untried that could lead to finding the missing person.

2145h All lines cast off

2148h First engine manoeuvre
The second search is continued on the pilotage waters. After this search too is concluded unsuccessfully, the Master gives [redacted] travel documents to the Pilot to be forwarded to the Agent

0008h The Pilot leaves the ship, taking [redacted] documents with him for the Agent
The Master informs the Agent by phone of the end of the ship's search and announces that the Pilot will deliver [redacted] documents to the Agent

0200h During a routine safety round the watchman also patrols the engine room

Hamburg, 21/01/2004

5.6.4.4 Conclusions

As opposed to the information provided about the course of the search in the engine room, which diverged very widely in some fundamental points, the statements given by the relevant witnesses in relation to the individual measures implemented in the superstructure and on deck substantially match one another, so that it is not necessary to analyse the individual versions separately. However, the evaluation of all available sources also revealed discrepancies concerning the nature and execution of the search activities outside the engine room. To this extent too it became obvious in the scope of the investigation that there were shortcomings attached to the organisation and execution of the measures taken.

The following findings resulting from the investigation can be considered to constitute certainties:

1. The Master and the Chief Mate were informed of the absence of the SOO at approximately 20:40 when they were already on the bridge.

2. As the vessel's 21:00 departure was imminent, the forward and aft manoeuvring station crews were already on standby.

3. The Chief Mate received the order to determine the SOO's whereabouts. For this purpose he checked the SOO's room and probably also – superficially – all superstructure decks. He made VHF contact with the manoeuvring stations to determine whether the crew members on standby there had any information that could help determine the SOO's whereabouts. The seaman posted at the gangway was also asked whether he had seen the SOO leaving ship. All searches were unsuccessful.

4. Subsequently the dock area was examined with binoculars from the bridge, as it was speculated that the SOO might be in one of the telephone boxes.

5. Following the negative outcome of the first search in the engine room, which had been received in the meantime, the general alarm was sounded at approximately 21:00.

6. The mustering of all crew members at the muster station on deck, mandatory after a general alarm, did not take place. In this case the crew did not follow the mandatory procedure of the safety role, compliance with which was not enforced by the ship's command in this situation. Any crew members who had not already become aware of the disappearance of the SOO due to targeted questioning were raised from their evening sleep by the alarm. Some of them geared up with hard hats and life vests according to regulations and got underway in the direction of the muster station. However, on the way there they were already informed by their colleagues of the situation and the reason for the alarm. Finally most of the crew gathered in the area of the BMC and the passageway in front of it.

7. The ship's command assertion that the *entire* crew had gathered there and had subsequently been ordered to proceed to different search areas in a structured manner does not correspond to the truth. It is countered by the statement of an Officer who declared that he had been on his way to the muster station when the Chief Mate asked him about the SOO. Upon answering that he did not know where the SOO was, the Officer was immediately released again back to his night-time rest. There is no doubt about the credibility of this statement. The seaman assigned to helmsman duty, too, and according to his own statement, did not participate in the search measures as he was on standby on the bridge owing to the imminent departure manoeuvres. In addition it should be taken into consideration that according to the entry in the ship's log book the assistance tugs were supposed to have made fast forward and aft at 21:10. If it is assumed that at least three seamen are needed for each tug to accomplish this manoeuvre it becomes clear that at least these six crew members could not have been permanently involved in a structured search after the general alarm. Rather, it must be assumed – and this is also congruent with corresponding witness statements – that the deck crew as a whole was only very superficially involved in search activities, as it had been ordered to look out for the SOO at the manoeuvring stations and in particular at the traffic corridors on deck. In fact the Master had stated that a great part of the vessel, i.e. the cargo holds, should be excluded from the search measures as they could a priori be excluded as potential whereabouts for the SOO in view of the limited working area for the SOO's usual activities during the time shared on board.

8. The unoccupied rooms and other recreation rooms were most probably indeed checked by the Chief Mate and the catering personnel after the general alarm.

9. The situation described by the Steward, in which the Chief Mate reportedly asked him whether the SOO had eaten dinner, can most probably be assumed indeed to have taken place even though the Chief Mate did not mention it. There is no apparent reason why the Steward should have invented this event. In addition it seems more than obvious within the scope of a search to try to find out the last known whereabouts of a missing person.

10. All activities before and especially after the general alarm took place under significant time pressure. According to the Master's statement, the next ship was already within sight under a bridge over the Savannah River approx. 3 sm away. The port authorities, too, had pointed out that the berth had to be cleared.
Against this background the text passage contained in the Master's first Statement of Facts of 26 October 2007 also becomes understandable as concerns its content, as after the information that an enhanced search had been carried out throughout the entire ship, he further states: *"It was agreed between Master and Agent that the search would be carried out on the pilotage waters."* As compared to this, the above passage is not contained in the Statement of Facts of 6 November 2003 although it otherwise consists of absolutely identical text blocks aside from another difference still to be discussed.

11. There were no objective clues to indicate that the SOO might have gone ashore.

The Master's assertion that the SOO had frequently used US phone cards to avoid high roaming fees, so that it had been presumed that he had, as had very often been the case during his time on board, gone ashore to phone, is questionable. The Federal Bureau is in possession of the SOO's mobile phone bills. Both these phone bills and also the information provided by his next of kin indicate that his numerous phone calls home were made from his mobile phone.
The SOO had not registered on the shore list board used on the vessel. He had also not signed off to his superior or another crew member. The seamen posted at the gangway had not seen the SOO go ashore. In this context the Master argued that the job of the gangway watch did not consist in recording who left the ship when. Although the constant monitoring of the gangway had been a "must" in particular in Savannah due to the strong mechanical strain it was exposed to by the current and passing ships, this would nonetheless not exclude the possibility that the gangway watch might have overlooked the SOO quickly leaving the ship.
Independently thereof, however, it is certain that the SOO was considered to be a disciplined and reliable crew member. The assumption that he would have left the ship without the required sign-off and in spite of being aware of the ship's departure set for the evening hours to go ashore should therefore have met with very serious scepticism from the very outset.

12. The Master did not explicitly order the search to be continued after departure as in his view this was evident as a result of direct and telephone conversations with the Chief Mate and the Chief Engineer.

13. The Master, who most probably did not leave the bridge during the entire period of time[90], delegated the implementation and coordination of the search activities to the Chief Mate and the Chief Engineer. These two individuals as the on-board heads of the navigational and the technical departmens, respectively, within the meaning of Para 107 Sec. 2 Seamen's Act therefore were responsible to the Master for all measures in the areas assigned to them, i.e. deck and engine.
It could not be determined if on the day of the accident the Master had assigned the Chief Mate special command authority in regard to the Chief Engineer.[91] The fact that in daily operation the Chief Engineer reports directly to the Master, so to that extent he is solely responsible for the technical area, and also of the additional fact that none of the witnesses questioned made any assertions to the effect of such delegation would be arguments against this possibility, the actual events during the searches do nonetheless create the impression that in any event the Chief Mate was actually the primary coordinator and liaison between the crew (including the Chief Engineer) and the Master. A further indication for

[90] N.B.: Some witnesses reported that the Master had personally been present in the BMC after the general alarm had been sounded. The great majority of witnesses however asserts the contrary. The Master's uninterrupted presence on the bridge is more believable. This version corresponds to the presumption, supported by further indications, that the Master would already not have left the bridge because he expected to receive a positive report at any moment and wanted to depart immediately thereafter without further delay. In addition he had to ensure communication with the manoeuvring stations (tying up the tugs).
[91] N.B.: An instruction dependent seniority of the Chief Mate over the Chief Engineer exists only in the event of inability on the part of the Master, within the scope of the watch duty (cf. § 2 Sec. 3 and/or § 107 Sec. 4 Seamen's Act) and in cases in which the ship's safety roll explicitly so provides.

this assumption is also the fact that according to congruent witness statements the flow of information concerning the initiation, status and result of the searches undoubtedly primarily and on several occasions also personally took place between the Master and the Chief Mate. Throughout the entire search, beginning with the general alarm and until the decision to depart the Chief Engineer did not once speak in person with the Master concerning the existing situation. Instead, communications were conducted exclusively by telephone, with even the telephone contact between the Master and the Chief Engineer evidently not being a priority for either of them. Thus the Chief Engineer informed the Master directly about the unsuccessful search in the engine room only upon an explicit request from the Chief Mate, who was of the opinion that this momentous report was outside of his own area of responsibility.

14. What is understandable is the follow-up search claimed by both the Master and the Chief Mate that took place on board the ship on the following day. Owing to the lack of positive news from Savannah, in the course of the morning of 25 October the SOO's room was again checked, this time by both witnesses together. It is however difficult to imagine that the SOO's mobile phone, left lying open and switched on on the bedside table, should have been noticed only at this point (cf. **Figure 51**). The US landing permit and other papers were allegedly discovered only now in a drawer (cf. **Figure 52**). From the point of view of the Chief Mate, a search of lockers, drawers etc. the first time that the SOO's room was entered was inappropriate and would have constituted insubordination without the presence of the Master, which is understandable as concerns the period of time in which the first enquiries took place. What is significant is in any event the fact that the second viewing of the SOO's room and the observations made in this context were not mentioned either in the Statement of Facts of 6 November 2003 or in the search report of 21 January 2004. The relevant paragraph from the Statement of Facts of 26 October 2003[92] prepared for the shipping company – just like the passage concerning the agreement between the Master and the Agent to the effect that "*the search would be carried out on the pilotage waters*" – is no longer contained in the otherwise identical Statement of Facts of 6 November 2003. The only plausible explanation for this change is that it was not desirable that it should become explicitly clear to the Federal Bureau that ship command could possibly have been faced with ever cleared indications on the voyage to Norfolk that the SOO could have been on board all along.

[92] Content of the text passage: "*In the morning of the following day, Oct. 25, the cabin of Mr. XX was investigated again by Master and Chief Officer. It was found out, that his US Crewmember Landing permit and other personal documents were in his cabin. Furthermore, a private cell phone was switched on*".

Figure 51: The SOO's mobile phone

Figure 52: US landing permit

15. Despite the lack of positive information from Savannah and the evidence found in the SOO's room (papers, wallet, watch, mobile phone), which – even if not compellingly so – argued against the hypothesis that he might have gone ashore, ship command undertook no measures in order methodically to search the entire ship again or to interrogate the crew.

16. It could not be determined whether the Chief Mate and/or the Master had obtained information concerning the irregularities at the forward scavenge air receiver hatch. The Chief Mate also had a technical certificate of competency and according to his own statement had personally once more searched the engine room on 25 October 2003. If in doing so he should have passed by the forward hatch to the scavenge air receiver it is unlikely that he would not have noticed the leakage and the jammed object. However, he emphasised that he had no

knowledge of these irregularities before being interviewed by the BSU's investigation team.

17. The searches on board LONDON EXPRESS were neither recorded in the ship's log book nor documented in a timely manner in a separate annotation or memorandum by either the Master or the Chief Mate.

5.6.5 Overall search methodology

In the report of 21 January 2004 the Master stated that the search performed after the general alarm had been conducted as a *"Pre-Departure Full Ship Search" in analogy to ISM[93] Manual Procedure 7.2.03 (Stowaways) according to the principles of the "Guidance for Shipowners, Ship Operators and Masters on the Protection of Ships From Terrorism and Sabotage" published by the International Chamber of Shipping, Annex 6 (Ship Search Planning).*[94]
This imputes a certain specific methodology to the search on board which cannot objectively be reconstructed in view of the facts found and in particular taking into account the inadequate result.
Furthermore, analogous application of the abovementioned procedure is only possible to a limited extent owing to the lack of comparability between the search for a stowaway and that for a missing crew member, a fact that must have been obvious to the Master (5.6.5.1). It must however be recognised that at the time of the incident there was no special search procedure applicable to a missing crew member, so that the Master was forced to use an existing pattern.
Ultimately however there are objective indications that argue against the assumption that the procedure – even to the extent that an analogy potential could actually be said to exist – was actually applied (5.6.5.2).

5.6.5.1 Analogy analysis of the ISM "Stowaways" Pre-Departure Full Ship Search Procedure

The relevant chapter of the ISM manual on LONDON EXPRESS was formulated in great detail in anticipation of the coming into effect of the ISPS Code[95] and in compliance with its terminology and has been part of the Ship Security Plan since 1 July 2004. It defines the term "stowaway" (a), contains, among other things, the rationale for the necessity of the procedure (b), describes the responsibilities (c) and defines the measures to be carried out (d).

(a) Definition

[93] **I**nternational **S**afety **M**anagement Code, cf. Chapter IX of the Ship Safety Convention.
[94] N.B.: The BSU is in possession of the relevant excerpt from LONDON EXPRESS's ISM Manual in English.
[95] **I**nternational **S**hip and **P**ort Facility **S**ecurity Code = International Code for the Defence against Hazards to Ships and in Port Facilities (BGBl. [Gazette] 2003 II, p. 2043)

A stowaway[96] is a person who is secreted on a ship, or in cargo which is subsequently loaded on the ship, without the consent of the owner or the master and who is detected on board the ship after it has departed from a port.

(b) Necessity of the procedure
The necessity of a special procedure is explained by reference to the significant disadvantages stowaways can entail for the ship and the shipping company. The following aspects are specifically mentioned:

- Difficulty in removing stowaways from on board ship
- Upkeep expenses
- Risk of liability in terms of immigration provisions when stowaways leave the ship

(c) Persons responsible
According to the procedure, the *Master* is responsible for carrying out all measures intended to prevent stowaways coming on board and any searches once a stowaway is actually on board. The **S**hip **S**ecurity **O**fficer (SSO)[97] is responsible for the implementation, organisation and execution of the protective measures and search activities.

(d) Rules concerning required measures (relevant excerpt)
- Access to the vessel must be delimited and monitored
- The Master instructs the SSO and the officers responsible for individual areas to search the ship prior to departure
- The Master or the SSO supervise the search
- The search must be documented and the relevant notes added to the ship's log book[98]
- The search system must be developed based on the individual crew members working areas
- Search plans must be defined in advance to ensure efficient and rapid searches
- The search system must be broken down into two categories depending on the required intensity of the search:
  - search to take place only in non-locked areas plus verification that locked areas were not opened, or
  - comprehensive search in locked and non-locked areas
- List of the locked and non-locked rooms to be searched:
  - Superstructure, including general access areas, galley, mess rooms, toilets, lift, accommodations
  - Life boats

[96] N.B.: The English term stowaway is also commonly used in the German seafaring jargon. The German terms are "Blinder Passagier" or "Einschleicher" [an "unseen passenger" or a "sneaker"].
[97] N.B.: According to the provisions of the ISPS Code the SSO is the person in charge of preventing dangers on board (cf. ISPS Code Part A No. 2.6). Therefore there was not an SSO yet on board LONDON EXPRESS at the time of the accident, which was before the effective date of the ISPS Code.
[98] N.B.: The corresponding provision is repeated in two places within the formulation of the rules.

- Stores and lockers, including rope stores
- Pilot's locker
- Bunker stations
- Bow thruster room
- Emergency generator room
- Steering gear compartmen
- Cargo holds
- Engine room
- Air conditioning room
- Funnel
- Void spaces

- The leader of the search teamsmust report conclusion of the search measures to the bridge or the SSO
- In the event of discovery of a stowaway, the following rules apply among others:
  - Repeat search of the entire ship
  - Report to the shipping company's ship command (Designated Person), to the insurance department and to the regional representative in charge
  - When in US waters, telephone report to the USCG (telephone numbers for West Coast / East Coast arrivals are listed)

The purpose and means described clearly show that there are some parallels between a search for a stowaway and a search for a missing crew member. These parallels refer, e.g. to:

- The necessity of preventive measures (in particular efficient boarding and disembarkation checks)
- Monitoring of all measures by the master or a person assigned to the task by him
- Determining responsibilities for search measures
- Defining and complying with prescribed reporting channels
- Developing search plans in advance taking into account the work areas assigned to the different crew members
- Developing search documentation and adding it to the ship's log book
- Reporting to ship command (Designated Person)
- Involvement of local authorities

On the other hand there are also basic differences that should be taken into account additionally and exclusively in connection with the search for a missing crew member. This concerns e.g. the following aspects[99]:

- Structured collection of relevant information concerning potential whereabouts of the missing person and/or his last known whereabouts by means of targeted questioning of all crew members
- Contacting family members to find out any potential indications of the crew member's whereabouts

[99] N.B.: The list is not set up by order of priority.

- Taking into account a potential endangerment of the possibly helpless crew member, so that departure must be considered particularly carefully in cases of unexplained disappearance[100]
- Searches should not be limited to spaces constituting potential hiding places
- Careful observation of areas searched bearing in mind that a potentially helpless person might have produced or might still be producing (perhaps atypical) distress signals or traces

The enumeration of the essential additional requirements to be taken into account in the context of a search for a missing crew member clearly shows that a mere analogous application of the procedure employed for the discovery of stowaways does not suffice in order to search for missing crew members.

5.6.5.2 Application of the ISM "Stowaways" Pre-Departure Full Ship Search Procedure?

The evaluation of the search measures reveals that they were not organised and carried out in application of the directives stipulated in the ISM Manual for stowaway searches. This procedure was first mentioned as constituting the basis for the search measures in the report prepared respectively after upon request from the Federal Bureau. Apart from the Master, no other crew member emphasised a reference to the rules in question. Certain basic points of the rules were either insufficiently or not at all applied during the search. The following aspects are of particular significance in this respect:

- Gaps in the boarding and disembarkation monitoring system admitted by the Master himself (no permanent guarantee of a gangway watch)
- Inadequate assignment of responsibilities (not clear whether search supervised by the Master or by the Chief Mate or perhaps, in deviation from the procedure, also by the Chief Engineer)
- Unclear reporting channels
- Search not documented and therefore no drafting of an attachment to be added to the ship's log book
- Lacking involvement of the entire available crew
- No utilisation of a pre-prepared search plan
- Designated Person was not immediately informed

[100] N.B.: The search for potential stowaways too must take place before departure, but endangerment of the persons in question just by the mere fact of the ship's departure – aside from the familiar events, in which stowaways are later found dead in cargo rooms or containers – is to this extent a lower ranking consideration. Searching for potential stowaways prior to departure is rather intended to prevent the difficulties encountered after their discovery.

5.6.5.3 Summary

The search for the missing SOO did not follow a structured and efficient procedure either in the engine room or in the overall ship operational area. There was not even a conscious and targeted adherence to the guidelines of the ISM procedures stipulated for stowaway searches. This would in any event have been completely inadequate as a result of the lack of comparability between the two situations. There was no independent procedure for searching for missing crew members in LONDON EXPRESS's Ship Safety Manual.

5.7 Opening of the scavenge air receiver in Norfolk

5.7.1 Reason for opening the receiver

It is striking that the forward hatch to the scavenge air receiver was opened immediately after mooring in Norfolk. Different witnesses justified this measure in different ways. The Chief Engineer and the SOF asserted that the reason for opening the hatch was the routine piston control that needed to be carried out. The Filipino crew members indicated that the order to open the hatch was given in order to eliminate the leakage. The Second Engineer on the other hand stated both in the US and also in Germany that the reason for the early opening of the scavenge air receiver in Norfolk had been the fact that in the meantime no information had been received concerning the SOO having potentially remained in Savannah. Since furthermore in the meantime his mobile phone and his wallet had been found in his room, the Chief Engineer – probably in consultation with the Master – had given the order to open up the power unit and the scavenge air receiver in order to "check all that again".

5.7.2 Peculiarities

The SOF reported that opening the bolting system had been unusually easy. He had not needed to use the impact tools he would normally have applied.[101]
The above described ease of operation allows for the conjecture that someone had already opened the hatch before the SOF or had at least tried to do so and that subsequently the toggle nuts had not been tightened again. It is however unlikely that the hatch had already been opened once *after* arrival in Norfolk, as there would probably not have been sufficient time to do so. Nor was it probably opened at sea, i.e. with the engine running, as this would have required an improbable amount of effort because of the overpressure in the receiver.[102]

The theory that an *attempt* to open the forward hatch had been made on the voyage from Savannah to Norfolk is supported by the following considerations:
The hatch had leaked at the time of departure from Savannah and/or shortly thereafter. The Second Engineer tried to eliminate the leakage by tightening the bolting nuts using a pipe extension tool. Regardless of the fact that the leakage could also still be felt later it is therefore certain that the greatest possible force was applied to the bolting system. The tightening of the bolting mechanism was further "helped" from the inside by the overpressure in the receiver. When the overpressure declined

[101] Cf. above the detailed description under Point 4.2.4.2.
[102] N.B.: The technical records reveal that the engine had not been stopped anywhere on the way.

after the engine had been stopped the strong tension to which the screw connections were exposed should even have increased. It is therefore not comprehensible that opening the hatch for the first time should have been particularly easy.

5.7.3 Conclusions

On the basis of the plausible reason, specified above, indicated by the Second Engineer for the immediate opening of the forward hatch in Norfolk and the peculiarities found when doing so it must be assumed that after the departure from Savannah in addition to a number of objective evidence there had also been subjective suspicions on board LONDON EXPRESS concerning the possibility of the SOO being trapped in the scavenge air receiver. It is possible that there may have been at least one unsuccessful attempt to verify such suspicions by opening the scavenge air receiver.

5.8 Circumstances of death

To determine the circumstances of death, the BSU referred to the autopsy reports of the US and German forensic institute, and also commissioned an opinion from the Director of the Department of Legal Medicine of the Hamburg-Eppendorf University Clinic, Prof. Dr K. Püschel, and from the technical expert acting on behalf of the Federal Bureau.[103]

5.8.1 Cause of death

The cause of death was cardiovascular failure as a result of hyperthermia. In the estimation of the forensic, the external injuries found on the body were most likely caused by striking objects and/or falling within the scavenge air receiver. No evidence of the use of force by third parties or of a physical altercation was found.

5.8.2 Time of death

As the cause of death was cardiovascular failure due to hyperthermia it was necessary to determine how long the SOO remained alive after his confinement in the receiver. For this purpose the investigation first examined the survival conditions within the scavenge air receiver and then determined the survival time that could be derived therefrom.

5.8.2.1 Physical survival conditions in the scavenge air receiver

The Federal Bureau commissioned a technical expert to determine the environmental conditions in the closed scavenge air receiver of the non-operating main engine of LONDON EXPRESS. The expert examined the composition of the breathing atmosphere in the scavenge air receiver and produced comprehensive theoretical considerations and calculations in particular in relation to the ambient temperatures in the receiver. The results were verified by means of practical experiments on board LONDON EXPRESS in the port of Savannah in the night from 21 to 22 November 2006 and confirmed except for minor differences. As at the time of the experiments the outside temperatures were distinctly lower than on the day of the accident, within the scope of the final theoretical considerations the effects of the difference in the

[103] Cf. Sources for more detailed information concerning the origination and timing of the reports and opinions.

outside temperature, which in turn influences the temperature in the engine room, were examined with regard to temperature conditions in the scavenge air receiver. The temperature profile was theoretically examined and the influence of the outside temperature was evaluated by means of elaborate CFD[104] simulation calculations.

The investigation concluded that contrary to the original presumptions the temperature in the closed scavenge air receiver with the non-operating man engine does not rise significantly, but rather falls very slowly but constantly (cf. **Figure 53**). "Ventilation" of the scavenge air receiver by means of opening both hatches also had no significant influence on the air temperature inside the receiver even after an extended period of time. The calculated mean temperature in the closed scavenge air receiver was 36.6 °C after the engine had been off for six hours. The calculated result was confirmed by the only slightly deviating measured value of 37.7 °C (engine room temperature = 23 °C on 22 November 2006). With an engine room temperature higher by 10 K under assumption of the simulation calculations on the day of the accident the resulting maximum temperature inside the scavange air receiver was of 41 °C (cf. **Figure 54**). The relative humidity in the receiver is of approx. 25 %.

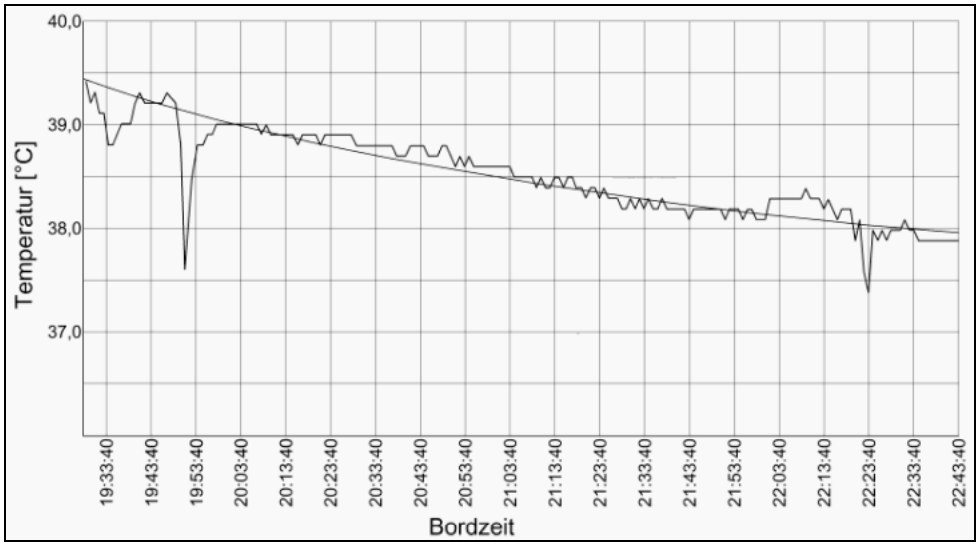


Figure 53: Temperature profile over time in the closed scavenge air receiver

[104] CFD = **c**omputational **f**luid **d**ynamics = an established method for approximated solution of problems in fluid mechanics *[sic]*.

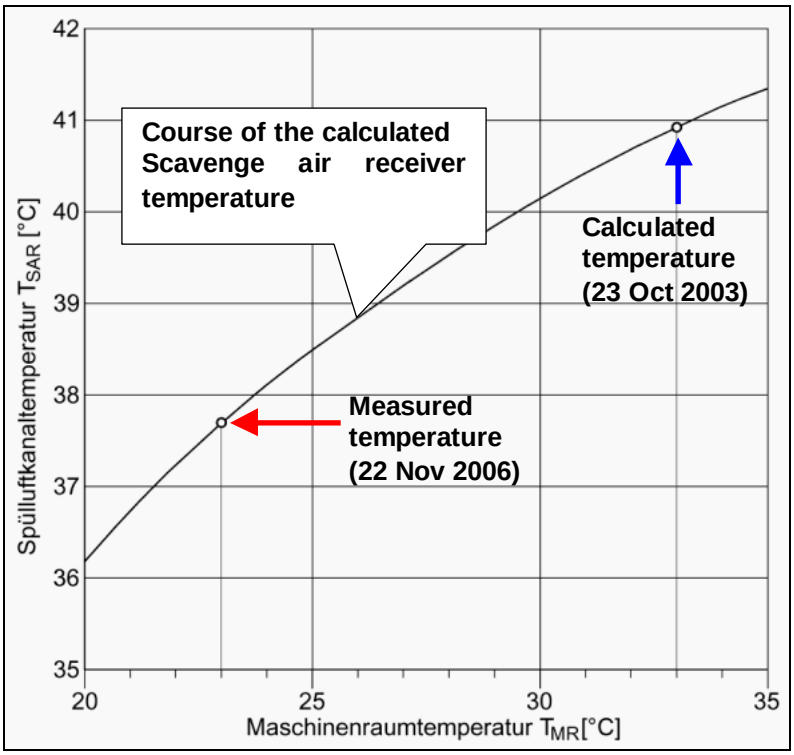


Figure 54: Relationship between scavenge air receiver and engine room temperatures[105]

Spülluftkanaltemperatur = Scavenge air receiver temperature
Maschinenraumtermperatur = Engine room temperature

The gas analysis that was carried out (oxygen, carbon monoxide, carbon dioxide, hydrocarbon mixtures) did not render any appreciable differences for the closed scavenge air receiver as compared to the composition of the breathing air in the engine room.

5.8.2.2 Survival time

The forensic report prepared for the BSU in regard to the survival period under the ambient environmental conditions states that with an assumed maximal possible peripheral blood circulation and with normal body heat and clothing, under the influence of environmental temperatures of 50 °C a so-called “flight time” (the period of time during which physical and mental capabilities are fully maintained) of three hours can be assumed. With environmental temperatures of 41 °C this time period rises to 5 to 10 hours.

5.8.3 Conclusion

It is considered to be a certainty that the SOO was still alive when LONDON EXPRESS left Savannah, and that he would have been saved if he had been found in and recovered from the scavenge air receiver.

[105] Source for Figures 53 and 54: Expert opinion of the BSU appointed investigator.

5.9 Investigation of other circumstances

5.9.1 Qualifications and professional experience

5.9.1.1 SOO

The SOO, who was 27 at the time of the accident, had been on board since 11 July 2003 and was due to be replaced shortly within the scope of the standard rotation scheme. After his training as a Ship's Mechanic at the company owning LONDON EXPRESS, during which he had last been assigned to an Assistant Officer's position, he had studied Ship Operations Engineering since 1997. In the year 2000 he worked for two months on LONDON EXPRESS as an Assistant Officer. He completed his studies in 2002 with the Certificates of competence as Second Technical Officer and Navigational Watch Officer. After his studies the SOO had two deployments of approx. four months each on two of the shipping company's container ships before being assigned to LONDON EXPRESS.
Because of his dual qualification he was mustered both in the navigational and in the technical area as a Ship Operations Officer. In accordance with his personal interests and the shipping company's needs he was primarily assigned to the duties of a Second Engineer. His functions in the navigational area were essentially limited to occasional supervision of a manoeuvring station crew when berthing or casting off. According to the watch schedule provided by the shipping company, as a navigational officer he was assigned to bridge watch service from 16:00 to 20:00 when at sea during the accident relevant voyage.

5.9.1.2 Master

The Master of LONDON EXPRESS was 64 years old at the time of the accident and had taken over command of the ship on 31 August 2003. He had worked as a Master for the shipping company for many years.

5.9.1.3 Chief Engineer

The Chief Engineer, who came on board on 31 August 2003, was 60 years old at the time of the accident and had comprehensive experience as a Senior Marine Engineer.

5.9.1.4 1. Chief Mate

The 30 year old Chief Mate had joined the ship on 11 July 2003, just like the SOO, and also possessed the dual navigational/technical qualification and had several years' shipboard experience.

5.9.1.5 2. Engineer:

The Second Engineer, who was 46 at the time of the accident, had been on board since 10 October 2003 and was shortly supposed to replace the SOO in his technical duties. Before the voyage on LONDON EXPRESS he had been to sea for approx. 20 years as an Engineer on ships of various shipping companies, most of the time and until the end of that period as a Senior Marine Engineer. With his new employer he was now supposed to be familiarised with the administrative specificities on the shipping company's vessels in the role of a Second Engineer before taking over an

assignment as a Chief Engineer. The period of service as Second Engineer would also serve to help him gain experience with engines of a different scale than those he had been working with hitherto. The on-the-job training function had been assigned to the SOO.

5.9.1.6 SOF

The function of the Ship Operations Foreman is a special qualification level located between the Engineers and the ratings in the crew structure comparable to the position of a foreman on shore. The SOF was 49 and had come on board on 10 October 2003 together with the Second Engineer. He had many years' shipboard experience.

5.9.1.7 Filipino crew members

The Filipino crew members had spent varying lengths of time on board at the time of the accident. The Third Engineer had been on board since the end of March 2003 and was thus the crew member with the longest period of service on the vessel. All members of the Filipino crew had shipboard experience from their previous employment.

5.9.2 Working hours

The time sheet documenting working and rest periods signed by the Master reveals that the SOO had complied with the legal requirements concerning maximum working hours and minimum rest hours. There is also no indication of demands inconsistent with regulations being made on the crew on board the vessel as concerns the remaining crew members.

5.9.3 Atmosphere on board

5.9.3.1 Crew

The Federal Bureau's investigation has shown that – as is not uncommon on ships sailing under the German flag whose personnel consists essentially of German ship command and Filipino or other foreign seamen – there was a cultural and task-dependent separation between the two crew contingents. This obvious comes e.g. by the fact that meals are taken in different mess rooms and partially at different times, and that joint leisure activities tend to be the exception rather than the rule.

5.9.3.2 Crew cohesion

In addition, the crew interrogations made it clear that amicable relationships on board LONDON EXPRESS were not highly developed outside the circle of the Filipino crew. Aside from the leisure activities including all crew members and quite customary at sea, such as a quick after-hours drink, birthday celebrations, BBQs etc. mentioned by the Master, contact among crew members was essentially limited to work matters. This could be due to the general organisational conditions and requirements of modern seafaring, e.g. inclusion in the watch system, the multiplicity of tasks to be carried out on board and the short port call times. This is matched by the fact that on the day of the accident itself even the formerly common gathering of the crew following an extensive repair to finish a hard day in a friendly atmosphere did not take place. Although the shipping company strives to have crews or parts

thereof repeatedly voyage on its ships in the same composition, a real feeling of togetherness ultimately fails to develop also because of the constant rotation related change of individual crew members. For LONDON EXPRESS, a review of the crew list of 10 October 2003 showed that the 23 people mustered had come on board at eight different dates.

5.9.3.3 Hierarchical structures

It is also known that the hierarchical structures always present and fundamentally also necessary at sea prevent greater personal closeness among crew members and thus necessarily affect the scope and quality of communication. Accordingly, hierarchical aspects will have impaired the spontaneous flow of information between the Filipino seamen and the German Engineers on board LONDON EXPRESS on the day of the accident.

5.9.3.4 Professional interaction

The highly specific work and living conditions on merchant ships are characterised by a high workload, limited leisure time options and physical proximity in addition to the other factors already described in greater detail above. Furthermore, differing lengths of professional experience and diverging outlooks and opinions concerning typical workday issues can lead to professional differences. Such differences sometimes also negatively affect the leisure aspect and human relations altogether.
According to the Federal Bureau's findings, these aspects had already marked the SOO's still very young professional life. Contradictions between the knowledge potential acquired in his studies and the demands of the practice on board, but especially the at least isolated reservations of experienced Masters, officers and engineers towards young colleagues had generated conflict situations for the SOO in the past, in which he felt that the necessary respect and trust in his abilities was lacking. These events did not however, and this must be explicitly emphasised, concern the collaboration with the ship command group as it was constituted at the time of the accident. This is evidenced by the fact that the SOO's deployment on board had even been extended at his own request. This undoubtedly argues for the assumption that he felt fundamentally comfortable on board, in particular under the leadership of the last Master and Chief Engineer. It can nonetheless not be ruled out that previous negative experiences in conjunction with his own, very high standards concerning the outcome of work he was responsible for could have had tragic consequences for him on the day of the accident. It is thus certainly conceivable that the SOO might have intentionally carried out the last inspection in the scavenge air receiver without "witnesses" in order not to risk leaving himself open to any criticism.

5.9.3.5 On-the-job training of the Second Engineer

It can be concluded from the evaluation of the witness statements that the on-the-job training of the experienced Second Engineer, who until joining LONDON EXPRESS had gone to sea as a Chief Engineer for several different shipping companies, by a younger colleague with much less professional experience as a ship's engineer did not go entirely smoothly. Thus on the day of the accident there had been several severe verbal arguments between the two Engineers reportedly concerning among other things worker assignment and the organisation of the repairs. In this connection

the Filipino crew experienced an authority and competence skirmish and received work assignments from both engineers that were partially contradictory.

5.9.4 Summary

In addition to the technical and organisationally determined aspects of the sequence of events surrounding the casualty and already described in detail above, the general atmosphere on board would likely also have caused the casualty event, at least or have contributes its occurrence. In addition to the time pressure, inadequate work related and also non-work related communication prevented a [free] flow of information and, hand in hand with it, prevented a feeling of trust and common purpose that, had it been present, might have resulted in a successful outcome of the search for the SOO.
The dual manning of an executive or leadership position over several weeks for purposes of training a replacement not familiar with the technical and/or administrative specificities on board, which is common practice with this shipping company, is fundamentally to be welcomed. On board LONDON EXPRESS, however, the special combination of on-the-job training of an engineer who had been going to sea for approx. 20 years by a very young Ship Operations Officer generated a potential for friction that also transcended to the events on the day of the accident.
Excessive fatigue or inadequate levels of qualification on the other hand can be ruled out as factors contributing to the casualty, in particular in view of the long professional experience of the ship's command.

6 Analysis

6.1 Preliminary remarks

The events leading to the casualty on board LONDON EXPRESS could not be reconstructed in full detail. Nonetheless, important conclusions were drawn in the course of the investigation that, regardless of whether or not the underlying facts were indeed causally determining for the actual events, are nevertheless highly instructive. Within the meaning of the statutory sense and purpose of the Federal Bureau of Maritime Casualty Investigation, future consideration of these conclusions is in any event suitable for use in the prevention of similar or comparable casualties of the same kind in the future.
In the analysis set forth below the possible factors and causes determined in the investigation for the confinement of the SOO in the scavenge air receiver will be examined in the light of current legal and technical requirements (6.2). However, the evaluation of the search management function is also very important (6.3). This applies primarily because the weaknesses found in this area were ultimately a necessary condition for the tragic outcome of the casualty event. The analysis concludes with some comments on the documentation requirements on board LONDON EXPRESS (6.4).

6.2 Confinement in the scavenge air receiver

6.2.1 Safety regulations concerning entering the scavenge air receiver

6.2.1.1 Manufacturer

In its Part 1 ("Volume 1"), which applies to all engine types, the operating manual published by the engine manufacturer MAN B&W Diesel A/S contains a chapter relating to inspections to be carried out from the scavenge air receiver (cf. excerpt below). The instructions are concentrated on explanations concerning the purpose of inspections and the procedures to be complied with in carrying them out. The remarks primarily focus on a detailed description of the piston check to be performed from the scavenge air receiver.
However, aside from the requirement that before work is carried out in the scavenge air receiver the air supply to the main starting valve should be interrupted and the turning gear should be engaged, this chapter only contains the underlined safety advice that the scavenge air receiver must not be entered before it has been thoroughly ventilated. It is also recommended to have the inspection inside the receiver carried out by two people working together. The more experienced person is to carry out the actual inspection using a lamp, with the support of an assistant working directly alongside, who notes down the results and operates the turning gear by means of the remote control device brought into the receiver.[106]

Excerpt from Volume 1 of the Instruction Book for All Types of Engines, Chapter 707.02 (MAN B&W Diesel A/S):

> *"**3. SCAVENGE PORT INSPECTION***
>
> *3.1 General*
>
> *By this method useful information – about the condition of cylinders, pistons and rings – is obtained at low expense.*
>
> *The inspection consists of visually examining the piston, the rings and the lower part of the cylinder liner, directly through the scavenge ports.*
>
> *3.2 Procedure*
>
> *During the inspection the cooling water and cooling oil should be allowed to circulate so that possible leakages can be discovered.*
>
> *Block the starting air supply to the main starting valve and starting air distributor, and couple-in the turning gear.*[107]
>
> *Remove the inspection covers on the manoeuvring side of the scavenge air boxes, and clean the openings.*
> *Take off the cover(s) on the scav. air receiver.*

[106] Cf. blue font colour in the excerpt below.
[107] N.B.: These and following blue font markings added by the BSU.

Do not enter the scavenge air receiver before it has been thoroughly ventilated.[108]

In order to obtain a true impression of the details, it is necessary to use a powerful lamp mounted on a rod (see Plate 70701).

To ensure correct assessment of the piston ring condition, it is necessary to wipe the running surfaces clean with a rag.
The inspection is generally begun at the cylinder where the piston is nearest BDC.
The piston, rings, and cylinder wall are inspected in the order indicated on Plate 70701, and the conditions described in the following points A) to H) should be observed.
The inspection is then continued at the next cylinder whose piston is nearest BDC, and so on. For convenience, the order of inspection should be noted for use at later inspections.

Scavenge port inspections are best carried out by two men, the most experienced of whom inspects the surfaces with the aid of the lamp, and states his observations to an assistant, who records them. The assistant also operates the turning gear.

It is good policy to carry out these inspections at regular intervals, and to combine them with removal of the inflammable oil sludge and carbon deposits in the scavenge air box and receiver.
By always entering the results on a scheme, see for instance Plate 70702, a „log book" of the cylinder condition will eventually be formed.
To ensure easy interpretation of the observations, it is suggested that the symbols shown on Plate 70703 are used.

In connection with the inspection, also the plate flaps and the non-return valves in the auxiliary fan system are checked for easy movement and possible damage. Also record these observations on the scheme (Plate 70702).

3.3 Observations"

This chapter does not contain any remarks concerning the need for posting a safety watch or any other recommendations that would be suitable to prevent the unintentional confinement of one or more people working in the receiver.

6.2.1.2 Accident Prevention Regulations for Shipping Enterprises [*Unfallverhütungsvorschriften-See* or *Unfallverhütungsvorschriften für Unternehmen in der Seefahrt, UVV-See*]

Work carried out in spaces where there exists a risk of confinement, which must also be considered to include the interior of the main engine, is governed on ships sailing under German flag by the Protection Against Unintentional Confinement Regulation (§ 23 UVV-See) of the Marine Insurance and Safety Association:

"§ 23 Risk of confinement

[108] N.B.: Underscoring by the author of the Manual.

Before closing access openings of rooms, tanks and other spaces on board not equipped with exits that can be opened from the inside or emergency hatches it must be ensured that no persons are locked into such areas."

The implementation instruction issued in connection with this standard lists the following as examples of "other spaces": void tanks, coffer dams, the rudder case, pipe tunnels, shafts, boilers, power unit rooms of diesel engines. The enumeration of "other spaces" is explicitly given by way of example only. The regulation contained in § 23 UVV-See is without a shadow of a doubt transferable in its meaning and purpose to main engine scavenge air receivers.

§ 77 UVV-See also describes the safety rules to be observed on Access to dangerous spaces. This Standard focuses on the prevention of asphyxiation and explosion hazards that could be generated by inadequate air supply or the presence or development of poisonous or explosive gases. Accordingly such spaces must be entered only with protective breathing equipment operating independently from the ambient air or when it has been ensured by means of thorough ventilation and determined by means of a gas detector that the ambient air contains enough oxygen. § 77 Sec. 5 additionally stipulates that also areas having been found to be free of [harmful] gases must be monitored for the entire time that people are in them. The operations supervisor must be aware of the potential hazards and stay outside the hazardous area.
According to the implementation instructions pertaining to the Standard, dangerous areas that had been cut off from external air can include, in particular: cargo holds, cargo tanks, water tanks, void spaces, pipe tunnels, coffer dams, fuel and lubricating oil tanks as well as pump rooms.
The scavenge air receiver is not included in this list and according to the manufacturer's specifications can be entered without protective breathing equipment, after thorough ventilation. The monitoring requirement must nonetheless be transferred to scavenge air receivers in analogous application of § 77 UVV-See, because it is ultimately irrelevant whether people become helpless in a space not destined for normal occupation because of a lack of oxygen or through other circumstances. Accordingly the BSU prefers a broader understanding of the term "dangerous areas" to include narrow spaces not intended for habitual occupancy by human beings.[109]

The requirement concerning the use of a safety watch also results from § 9 UVV-See (Dangerous Work):

§ 9 Sec. 1:

"The entrepreneur must ensure hat hazardous work is carried out only under the guidance and supervision of a corporate supervisor and that such work is begun only once all applicable security measures have been taken".

The implementation instruction gives the following examples of "Hazardous Work": welding in confined spaces, driving inside containers or confined spaces, driving

[109] Cf. the USCG's definition of "confined spaces" in its Safety Alert on p. 2 (p. 120 of the Investigation Report).

inside tanks and bunkers, work with naked flames in areas at risk of fire or explosion or on closed hollow components, pressure and leakage tests on containers, testing technical plant, certain types of work on electric installations and equipment and work in areas involving gas hazards.
The so-called “driving inside” confined spaces undoubtedly also includes pedestrian access to the scavenge air receiver. This operation must therefore only be started once the required safety measures have been instituted to counter all potentially expected hazards.
The implementation instruction contains examples of such measures. Posting safety watches is not explicitly mentioned. It must however be taken into account that owing to the broad sphere of applicability of the Standard as a result to the numerous conceivable shipboard activities that involve special hazards it is not possible to define every single safety measure. On the other hand, and pursuant to the wording of § 9 Sec. 1 UVV-See the “individual case requirements” must be observed.
For work inside the scavenge air receiver this means that an outside safety watch person is essential for the safety of the people inside the receiver.

6.2.1.3 Shipping company regulation:

At the time of the casualty there were no special shipping company or shipboard requirements concerning in particular work carried out in the scavenge air receiver and exceeding the rules defined by the manufacturer and the Marine Insurance and Safety Association.[110]

6.2.2 Technical specifications of the locking system

6.2.2.1 UVV-See

When reviewing the potentially applicable provisions of the UVV-See it was found that a self-securing locking device preventing unintentional slamming is prescribed for access hatches to cargo rooms, tween decks and tanks (cf. § 87 Sec. 8 UVV-See). Pursuant to § 202 Secs. 1 and 3 UVV-See, steel hatch covers and gates must also be equipped with devices to secure them in the open and/or operationally required partially open position.
However, there are no comparable stipulations for engine openings. This is probably due to the fact that the gate-like locking system for the scavenge air receiver is a relatively new design, the scavenge air receiver is only rarely opened and entered and work in this area must in any event be carried out applying special precautions.

6.2.2.2 Classification society

In their version in effect at the time of the casualty, the Rules for Classification and Constructions issued by the Germanischer Lloyd also did not contain any stipulations according to which inspection hatches are required to be equipped with special safety devices to prevent unintentional confinement. In this sense it must also be assumed that corresponding design requirements for main engine “spaces” to be entered only for purposes of inspection, repair or maintenance were waived because the duty of special care and attention applies in any case in this regard.

[110] N.B.: There is no statutory obligation in this respect.

6.2.3 Conclusions

Within the scope of the Federal Bureau's investigation it could not be determined with the utmost certainty whether the SOO had truly entered the scavenge air receiver without an external safety watch or whether the safety watch person had left prematurely. In any event it must be assumed that the safety watch was not on site when the partial self-confinement occurred.
In this connection it must be remembered that the existing accident prevention provisions at least indirectly and adequately involve the specification that

- the scavenge air receiver should be considered to be a hazardous area, and
- individuals inside the receiver must be permanently protected by a safety watch posted outside from risks related to unintended confinement or development of any other disabling situation.

In this sense, the relevant chapter of the engine manufacturer's Operating Manual, which nowhere points out the special significance of a safety watch, must be considered to be inadequate.
The safety culture on board LONDON EXPRESS too had already shown areas of deficit in connection with activities to be performed from inside the scavenge air receiver even before the casualty event. In spite of the lack of manufacturer's specifications and explicit shipping company internal regulations, the highly qualified shipboard personnel should have been fully aware of the fact that entering the scavenge air receiver is combined with a special hazard potential. The BSU's investigations revealed that this simple insight had already been regularly ignored before the accident, even by the ship's Chief Engineer.

What is considered to be certain is that the specificities of the scavenge air receiver hatch locking system triggered the casualty. It must nonetheless be emphasised that the origin of the causal chain of events was the presence of the SOO in the scavenge air receiver without a safety watch person. The manufacturer of any given system cannot be expected to provide design solutions for all conceivable cases of a violation of elementary safety regulations when designing a piece of equipment. On the other hand however the necessity of a design to secure open hinge-mounted access hatches is obvious, particularly in marine operations. Only a measure of this nature can – independently of the availability or presence of a safety watch person – guarantee safe entry and exit as well as safe leading of cables for service lighting, tools or remote control devices and prevent spontaneous slamming of the hatch due e.g. to an air current, which would also involve a risk of crushing. The lack of an appropriate self-securing locking device must therefore be classified as a foreseeable design deficit.

6.3 Search management

6.3.1 Safety management system

6.3.1.1 Legal requirements

The measures stipulated in Chapter IX of the International Convention for the Safety of Life at Sea (SOLAS) for the organisation of safe shipping operations (**I**nternational **S**afety **M**anagement Code) effective 1 July 1998 are mandatory for German shipping companies, and therefore also for vessels sailing under the German flag. On the basis of this regulatory framework every shipping company is under the obligation to set up and comply with a *comprehensive* and *seamless* system for the organisation of safety measures. The company must put in writing all tasks and activities concerning safety or environmental protection on board its ships and ensure that they are planned, organised, implemented and monitored in compliance with statutory and corporate regulations. For this purpose companies must introduce procedures for developing plans and instructions for important operating processes on board as regards marine safety. The system for the organisation of safety measures must provide for measures with which it is ensured that the relevant stations can react to hazard, accident and other emergency situations at all times. The documentation serving the description and implementation of the system used for the organisation of safety measures (emergency planning) can be summarised into a “Safety Management Manual”.

6.3.1.2 Implementation on LONDON EXPRESS

At the time of the accident, LONDON EXPRESS had a valid **S**afety **M**anagement **C**ertificate, which had been issued on 24 January 2000 on the basis of an audit of the safety management system conducted by the Ship Safety Division of the Marine Insurance and Safety Association.
On 7 January 2002 the SMS was found to be in conformity with the requirements of the ISM Code according to Rule 6 Chapter IX SOLAS on the occasion of a routine review by the Marine Insurance and Safety Association.
Despite these official certifications of conformity the casualty event showed that the safety concept concerning preparation for and conduct in emergency situations had a fatal gap. There was no emergency plan for a structured course of action in the event of an unexplained disappearance of a crew member.

The alleged analogous application of the “Pre-Departure Full Ship Search” according to Manual Procedure 7.2.03 (“Stowaways”) of the safety system introduced on LONDON EXPRESS was not suitable as an appropriate reaction to the actual emergency faced because of the manifestly inadequate transferability of the requirements laid down therein to a search for a missing crew member. Furthermore, even those components of the allegedly applied procedure that would have been analogously pertinent were not implemented at the required level of quality.

6.3.2 Other remarks concerning the organisation of operations on board

The Federal Bureau’s investigation has shown that the organisation of the regular work processes in the engine room suffered from accident promoting gaps. There

was no efficient reporting method e.g. for the completion of a repair or the restoration of main engine operating capability after a significant intervention such as e.g. exchanging a piston. The execution of the procedures for making the main engine ready for sea also raised questions. The unsupervised transfer of the necessary activities in this area to a rating (Oiler) is inconsistent with the level of responsibility pertaining to this significant task.
Finally, leaving the control over the operation of the auxiliary fans on the bridge violated the important principle of effective prevention of erroneous remote activation of technical equipment.
A significant weakness in the overall shipboard operations organisation was revealed by the argument put forward by ship command to the effect that it was presumed that the SOO's absence was due to his going ashore. This leads to the conclusion that there either was no system to record or ascertain the crew members on board at any time or that it had also not worked at an earlier time, or that it had in any event at least not been consistently implemented. It is of course also possible that the statements made by the gangway watch were not considered to be reliable.
Written documentation (shore leave register) and an additional verbal notice of shoregoing to the deputy remaining on board would – as regards this casualty – have ensured that the SOO's uninterrupted presence on board would have been known.

6.3.3 Working atmosphere on board

The inadequate professional and personal communication on board LONDON EXPRESS as well as the hierarchical but also cultural distance between the German and the Filipino crew members contributed to the events on the day of the accident.

6.3.4 Summary

The all-encompassing question of why the SOO was not found in the scavenge air receiver and thus saved from his accidental death could not exhaustively be answered by the Federal Bureau's investigation. It is however certain that there were multiple indications to the effect that he had never left the ship. Despite the weaknesses in the organisational and information structure there was even sufficient evidence indicating his presence in the engine room.
It is entirely inexplicable that the evidence indicating the SOO's potential presence in the scavenge air receiver, which became practically obvious as a result of the irregularities found at the forward access hatch, were ignored with the insistence that became apparent in the course of the investigation.
The shipping company has greatly emphasised that it is a theoretical and practical corporate standard that in all shipboard decisions the company's own or third party economic interests must strictly be subordinated to the safety and security of the people, the vessel and the cargo. Nonetheless the time pressure triggered on board LONDON EXPRESS by the requirement to clear the berth combined with potentially looming financial losses in the event of the ship being delayed a longer period of time by all accounts appears to have decisively contributed to a misjudgement or underestimation of the hazard potential coupled with the unexplained whereabouts of the SOO.

6.4 Duties of documentation

6.4.1 Ship Safety Act

§ 6 Sec. 3 of the Ship Safety Act [*Schiffssicherheitsgesetz* (SchSG)[111]] stipulates the following duty for the master of a ship:

"The master of the ship shall – unless otherwise stipulated, then in the ship's log books – report without delay and by means of the appropriate entries any and all events on board that are of significance for safety at sea including environmental protection at sea and occupational health and safety. In the event of a marine casualty the ship's master shall, to the extent possible and required, ensure the safety of the documents pertaining to such entries."

Section 5.6.1 of the present report described how in connection with the unusual event of the disappearance of the SOO the ship's log book shows only an entry concerning the fact that departure had been delayed as a result of the unsuccessful search for missing person X.X.. There is not a single word to report on the search measures, the general alarm or the appreciation criteria that ultimately led to the decision to start the voyage despite the absence of a crew member.

6.4.2 ISM Code

The implementation of the "Pre-Departure Full Ship Search" in analogy to the ISM Manual Procedure 7.2.03 ("Stowaways") claimed by the Master would have comprised a duty of documentation. Letter E (Regulations) No. 4 Clause 3 of the Procedure reads as follows:

"The ship search has to be documented and relevant records to be filed in ship's Logbook."

Evidently on account of the special significance of the documentation of search measures, clearly recognised by the author of the procedure, shortly thereafter – under No. 6 Letter b (Search of unlocked and locked spaces) Clause 3 – this requirement is again emphasised:

"The ship search has to be documented in the ship's Logbook."

This procedural requirement was not observed by the Master.

6.4.3 STCW Code

Section A-VIII /2, part 4-4, No. 104.5 of the STCW Code[112] contains the following obligation for the technical area:

[111] Act concerning Adaptation of the Technical and Fiscal Conditions for Maritime Shipping to the International Standard of 9 September 1998, (BGBl. I p. 2860), last amended by Article 323 of the Ordinance of 31 October 2006 (BGBl. I p. 2407).
[112] Code concerning Standards for the Training, Awarding of Certificates of Competence and the Watch Service of Mariners, Resolution 2 of 7 July 1995 (BGBl. II 1997 – Enclosures Volume to No. 26).

"Officers in charge of the engeniering watch shall ensure that all important events affecting the operation, adjustment or ships machinery satisfactorily recorded.

It is obvious that the absence of the Engineer primarily responsible for the operation of the main engine constitutes an important event in the technical area. And yet the engine log book contains no reference to the disappearance of the SOO. There was also no entry concerning the unplanned rapid transfer of the SOO's responsibilities to the Second Engineer.

6.4.4 Working procedures in the engine room

There is no statutory regulation concerning the scope and type of documentation required for maintenance measures in the technical area.[113] The maintenance on piston No. 6 was thus only recorded with a very brief entry in the engine log book.
The workbook used in the technical area was kept without any reliable entry discipline. It was apparently only intended as an aide-memoire for the Engineers. The optionally kept workbook enables reconstruction of the assignment and execution of work orders and any specificities only to a limited extent.

6.4.5 Summary

The entirely inadequate documentation of the search measures rendered the BSU's casualty investigation more difficult. In addition, the following should be noted:
Documentation of processes is generally not only performed to demonstrate their existence and to enable their later traceability. Rather, a written record of processes and background information also enables critical self-assessment which even in writing down the individual points (e.g. in the form of keywords and as a draft) enables a reconciliation as to whether all necessary decision-making factors have indeed been taken into account. This option was wasted by ship command as a result of their disregard of written documentation.

The "soft" requirements regarding the keeping of the workbook prevented successful use of this documentation for purposes of obtaining information about the SOO's whereabouts. An unambiguous regulation – then also implemented with on board – that safety relevant work should first be announced in the book and *immediately after completion* be signed-off by the crew member having carried it out would compellingly have provided the necessary evidence that the SOO had not yet left the engine room.

The violations of the provisions of the Ship Safety Act and of the ISM Procedure (assuming its analogous application) are an important further indication of the fact that the search for the SOO had – contrary to the care and earnestness alleged time and again – only been carried out in a very superficial manner. There would appear to be no other explanation for the neglect of the duty of documentation in connection with the objectively unusual event of the disappearance of a crew member.

[113] In its Chapter VIII Section A Part 3 Nos. 62 and 67, the STCW Code contains only the provision that the Technical Watch Officer must enter repair measures in the engine log book.

7 Actions already taken

7.1 BSU

On 12 February 2004, while the casualty investigation was still ongoing, as a result of the imminent dangers recognised within the scope of the casualty investigation and for the prevention of future casualties due to the same or similar causes the BSU issued a safety recommendation worded as set out below pursuant to para 9 Sec. 2 No. 2; para 15 Secs. 1 and 10 Maritime Safety Investigation Act [*Seesicherheits-Untersuchungs-Gesetz* (SUG)] in conjunction with para 19 Flight Casualty Investigation Act [*Flug-Unfall-Untersuchungs-Gesetz* (FlUUG)]:

"The Federal Bureau is investigating the tragic death of a German Ship Operations Officer which took place on 24 October 2003 in the scavenge air receiver of the main engine of a German container ship.

The investigation has not yet been completed and is expected to take a significant amount of time owing to the complexity of the case. At the present time, however, the BSU is assuming that the design of the access hatches to the scavenge air receiver could have contributed to the cause of death.

These easily operable "access hatch covers" of bulkhead type design on the forward and aft ends of the scavenge air receiver were not equipped with devices for the prevention of spontaneous closure. They were therefore, due to their nature as single-side mechanically pivotable closure units affixed to the main engine system, exposed to the external effect of a number of forces.
The absence of a stop could therefore have caused such an "access hatch" to slam shut in conjunction with other factors that are currently still under investigation. Thereupon, one of the bolting elements (hasps/dogs) may have hooked into the locking groove of the access hatch. The scavenge air receiver could therefore have become a deadly trap because it is impossible to open the (partially) latched hatch cover from the inside.

When reviewing the potentially applicable provisions of the UVV-See it was found that a self-securing locking device preventing unintentional slamming is prescribed for access hatches to cargo rooms, partial decks and tanks (cf. § 87 Sec. 8 UVV-See). Pursuant to § 202 Secs. 1 and 3 UVV-See, steel hatch covers and gates must also be equipped with devices to secure them in the open and/or operationally required partially open position.
However, there are no comparable stipulations for engine openings. This is probably due to the fact that the gate-like locking system for the scavenge air receiver is a relatively new design, the scavenge air receiver is only rarely opened and entered and work in this area must fundamentally be carried out applying special precautions.
Work carried out in dangerous spaces, which must also be considered to include the interior of the main engine, is therefore governed by the provisions for the protection against unintentional confinement (§ 23 UVV-See) and suffocation (§ 77 UVV-See). Furthermore the maintenance instructions issued by engine manufacturers and the internal shipping company regulations concerning access to and work in parts of the main engine contain rules for accident prevention in this high risk area of the vessel (e.g. posting watches and warning signs, ensuring ongoing communication).
Compliance with the rules and regulations last abovementioned is therefore an inherently sufficient basis to – a priori – rule out accidental confinement in the scavenge air receiver.
Nonetheless the Federal Bureau of Maritime Casualty Investigation encourages the installation of lock-stop retaining devices for scavenge air receiver access hatch covers

where such covers are of the bulkhead type design, in analogy to the regulations for other steel access hatch covers and gates (§§ 87 and 202 UVV-See).

Such lock-stop retaining devices would be useful not just for purposes of protecting against unintended self-confinement. Securing the open access hatch covers would additionally also ensure safe entry to and exit from the scavenge air receiver at all times during maintenance work. In addition, the jamming hazard concerning hoses/cables led into the scavenge air receiver in connection with work to be carried out in the canal would also be effectively removed.

The Federal Bureau therefore addresses engine plant manufacturers as well as owners and operators of all maritime vessels whose main engines are equipped with bulkhead type, i.e. unilaterally supported, pivoting access hatch covers permanently connected to the main engine and points out the following pursuant to § 15 Sec. 1 SUG in conjunction with § 19 FIUUG:

The manufacturers of engine plant and the owners and operators of all maritime vessels whose main engines are equipped with bulkhead type access hatch covers to the scavenge air receiver are requested, in consultation with the Marine Insurance and Safety Association and the relevant Classification Society, to examine the possibility of retrofitting a lock-stop system for unilaterally hinged pivotable access hatch covers permanently connected to the main engine and to implement such retrofits without delay as well as to provide for an appropriate modification to the latching system design for new construction.
To conclude it must again be emphasised that although the above safety recommendation is immediately related to the investigation of the initially mentioned fatality of 24 October 2003 it must in no event be misunderstood as constituting a pre-emption of the outcome of the investigation.
In this context the BSU makes reference to the fact that the investigation is at present still ongoing and in particular to the investigation report which will be published upon completion."

7.2 United States Coast Guard (USCG)

As a result of the casualty on board LONDON EXPRESS and of the inquiries made in Norfolk the Office of Investigations and Analysis of the USCG issued a "SAFETY ALERT" on 23 February 2004 concerning the subject of "CONFINED SPACE ENTRY"; the alert was published on their website under http://www.uscg.mil/hq/g-m/moa/docs/2-04.htm. In addition to a short description of the events surrounding the casualty, the safety alert contains the following urgent recommendations (in loose translation *[T.N.: The actual English language text of the Alert is reproduced below]*)[114]:

- "All vessels complying with the International Safety Management Code (ISM) have a specific plan for entering confined spaces outlined within their Safety Management System.

- The confined space entry procedures include and identify various types of shipboard spaces such as those previously mentioned that could be encountered and which should be treated as confined spaces.

- Crew safety meetings address the identification of confined spaces and provide instruction on confined space entry procedures.

- Individual crewmembers that work in confined spaces review existing entry procedures and requirements regularly.

- All other vessels and maritime operations falling outside of ISM requirements develop and include in their marine safety programs similar confined space identification and entry procedures.

[114] Loose translation slightly edited by the Federal Bureau *[T.N.: Into German – the original English version has been reproduced here]*.

U.S. Department of Homeland Security

United States Coast Guard

Marine Safety, Security and Environmental Protection

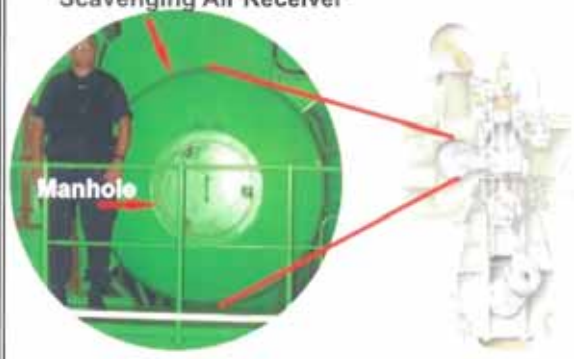
SAFETY ALERT - CONFINED SPACE ENTRY

February 23, 2004 Washington, DC

Last Fall a foreign flagged containership during a coastwise voyage reported upon leaving port that the vessel's second engineer was missing. Despite an extensive search by the vessel's crew and officers, the individual was presumed to have gone ashore and missed the sailing. Upon arrival at the following port the individual was found deceased behind an access door to the main propulsion engine's scavenging air receiver.

The vessel was powered by a Burmeister & Wain, 9 cylinder two stroke engine that develops over fifty-five thousand horsepower. The engine's scavenging air space can be accessed by two manholes located on both ends of the scavenging air receiver.

Scavenging Air Receiver



These circular manholes are secured by three L-shaped dogs having an outer edge that is tightened against an inner circumferential lip on the edge of the access hole. Tightening is achieved by the use a handled fastener.

Dogs in latched position.

Other Information

Investigations and Analysis
Safety Alerts
Lessons Learned
Casualty Reports
Risk-Based Decision-Making
Crew Endurance
Vessel Traffic Management
POISE
Marine Safety and Environmental Protection
Marine Safety Index
Marine Safety Offices
Coast Guard Home
Proceedings Magazine
Maritime Information Exchange

http://www.uscg.mil/hq/g-m/moa/docs/2-04.htm

Coast Guard investigators determined that the engineer entered the scavenging air receiver alone. Although his reason for entering the receiver is not known, engine maintenance was performed in that space while at the first port and he may have returned to inspect the area for left behind tools and materials or to retrieve something. It appears that after his entry, the easily moved hinged / inward-opening door accidentally closed. Investigators believe that at that time, the upper left dog due to its weight and perhaps the vibration of the door as it closed, caused the dog to move allowing its edge to catch the circumferential lip at the opening. Once caught, even with the loosened fastener the door could no longer be opened from the inside of the receiver.

The second engineer was an experienced mariner. It was reported that he was trained and familiar with the vessel's confined space entry procedure. In all previous instances, he followed the procedures and safely performed maintenance inside the space. Unfortunately, on this occasion he entered without informing anyone or having an assistant stationed outside. Despite various searches by the crew within the machinery spaces and the main engine while the vessel was preparing to sail, he went unnoticed.

Mariners may on occasion not associate certain work areas as confined spaces and therefore not take the precautionary steps needed. Main engine crankcases, scavenging air spaces, exhaust ducting, boiler drums, furnaces, stack casings, condensers, sewage plant tanks and other systems, equipment, and components may present potential "confined space" type hazards.

A confined space may be defined as any location that, by design, has limited openings for entry or egress and is not intended for continuous human occupancy. This definition applies regardless of whether or not the atmosphere is explosive or toxic. See related US Department of Labor, Occupational Safety & Health Administration information by clicking here.

In this casualty, there was initially sufficient quantities of oxygen for the second engineer to breath, at least until the engine started causing the ambient environmental conditions inside the receiver to change dramatically and cause the fatality.

The Coast Guard **strongly recommends that:**

- All vessels complying with the International Safety Management Code (ISM) have a specific plan for entering confined spaces outlined within their Safety Management System.
- The confined space entry procedures include and identify various types of shipboard spaces such as those previously mentioned that could be encountered and which should be treated as confined spaces.
- Crew safety meetings address the identification of confined spaces and provide instruction on confined space entry

http://www.uscg.mil/hq/g-m/moa/docs/2-04.htm

procedures.

- Individual crewmembers that work in confined spaces review existing entry procedures and requirements regularly.
- All other vessels and maritime operations falling outside of ISM requirements develop and include in their marine safety programs similar confined space identification and entry procedures.

RELEASED BY - Office of Investigations and Analysis, USCG Headquarters.

- Does your organization have an important safety issue to share via this Safety Alert system? If so, contact Mr. Ken Olsen at 202.267.1417 or kolsen@comdt.uscg.mil.

Enter your email address and indicate your receiving preference to occasionally receive these notifications and other marine safety information. Check unsubscribe to remove your email address from our distribution.

C Html Only C Text Only C Unsubscribe Enter email address. Email Address
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Marine Safety and Environmental Protection
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Webmaster
Disclaimer
Created 2003
Updated

http://www.uscg.mil/hq/g-m/moa/docs/2-04.htm

7.3 Marine Insurance and Safety Association [See-BG]

The Ship Safety Division of the See-BG reacted to the BSU's safety recommendation and the USCG's Safety Alert with the following measures:

- All See-BG inspectors were informed by Circular HT 02/04 of 4 March 2004 of the BSU's safety recommendation and the USCG Safety Alert and instructed to examine access ways to the scavenge air receivers of large engines in regard to a potential risk of confinement.

- The Classification Societies acting as Recognised Organisations on behalf of See-BG have received copies of the Circular in order to make the appropriate verifications during their inspections.

- All shipping companies operating vessels under German flag and powered by large two-stroke engines were also appropriately informed by a letter dated 11 May 2004.

- In cooperation with the Germanischer Lloyd engine manufacturers MAN B&W and Sulzer were asked to state their position in a letter of 10 May 2004. In response, both manufacturers have modified their scavenge air receiver access door designs to the extent that a danger of confinement did exist. They have also proposed retrofits for these doors. The shipping companies were informed of these developments by means of a "Service Letter".

7.4 Shipping company

7.4.1 Technical measures

The shipping company operating LONDON EXPRESS has reacted with a number of steps to the hazards due to potential partial self-locking of hinge-mounted scavenge air receiver access hatch covers.
Directly after the accident a second wing was welded onto the single-toggle nuts and a pipe extension was welded onto the bent side of the latching dogs. The pipe extension has a dual effect – on the one hand it ensures that in particular the upper bolt will in all cases tip out of its dangerous tangential position after release due to the relocation of its centre of gravity, so that in the event of an unintended closure of the hatch it will necessarily strike the hatch frame, thus preventing it from swinging into the locking groove on the frame. In addition, the gravity determined vertical orientation of the lower dog creates an effective hindrance to the hatch slamming shut, because the pipe extension swinging between the frame and the hatch cover will prevent full accidental closure of the hatch as a necessary prerequisite to a partial lock condition (cf. **Figures 55** and **56**).

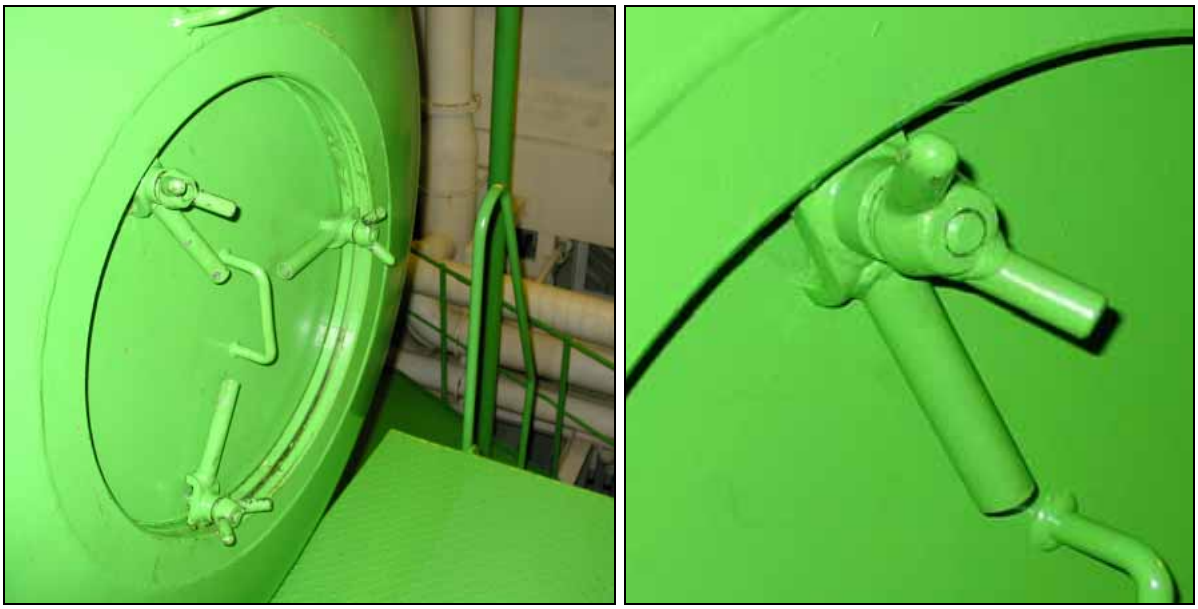

Figure 55: Modified latching dogs and toggle nuts

Figure 56: Blocking position of the welded pipe extension

In implementation of the safety recommendation of 12 February 2004 the shipping company additionally also gradually fitted the scavenge air receiver hatch covers of all relevant ships with a lock-stop retaining device developed and manufactured on behalf of the shipping company (cf. **Figures 57** to **59**).
This newly designed system consists of a movable hook of solid steel that is affixed inside the scavenge air receiver and is kept down by a spring. The hook's long nose

helps the hatch cover independently to slide into the [open] latching position and simultaneously acts as a lever to unlatch the cover [to close it] when leaving the receiver. Unlatching is only possible from the inside of the receiver, so that mistaken, premature closure of the hatch by a person passing on the outside – even independently of the essential requirement of a safety watch – would in any event be prevented. The above described design was approved on the basis of the drawings submitted; the Classification Society approval dates from 12 March 2004 and the Marine Insurance and Safety Association's, from 25 March 2004. The first ship fitted was the BERLIN EXPRESS on 27 March 2004.

Figure 57: Latching hook - overall view

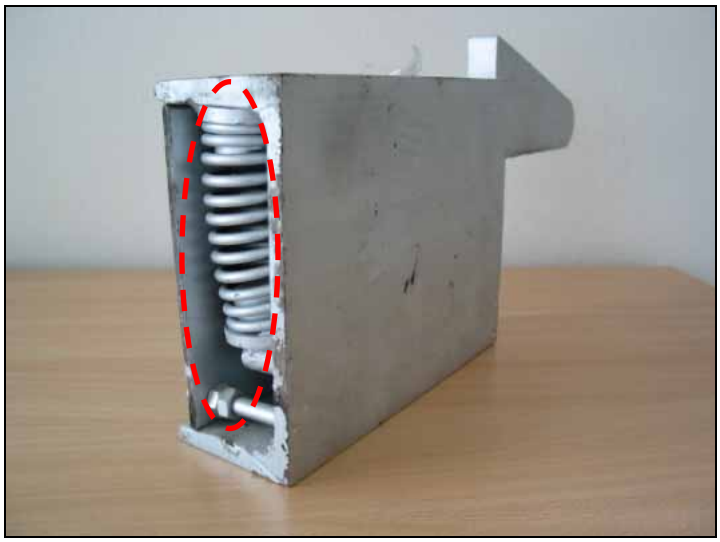

Figure 58: Latching hook – retaining spring

Figure 59: Latching hook fitted and in action

In addition to the abovementioned measures, warning signs were installed at the access hatches to the scavenge air receiver. When LONDON EXPRESS was inspected on 12 January 2004 there were signs hanging next to the hatches and warning stickers were affixed above the hatch openings.

Figure 60: Warnings at the access hatch

7.4.2 Procedural instructions concerning searches for missing persons

The shipping company developed a comprehensive procedure and implemented it in its fleet; the procedure extensively and in great detail describes the necessary measures for a successful search, with particular emphasis on the time and/or place when and where it is determined that any crew member(s) is or are missing (in port or at sea).

7.5 Engine manufacturer

The engine manufacturer (licensor) MAN B&W Diesel A/S Copenhagen sent a "Service Letter" to its customers in October 2004, pointing out, as a reaction to the casualty on board LONDON EXPRESS, the dangers connected with an unintended closure of hinge-mounted scavenge air receiver hatch covers. In addition to making reference to the general specifications applicable to all engines in relation to work to be carried out in the scavenge air receiver[115], in its "Service Letter" the manufacturer urges its customers to retrofit the hinge-mounted scavenge air receiver hatch covers with lock-stop latching devices. These retrofit sets can be ordered as spare parts. Furthermore, the following safety measures are urged:[116]

- Taking along the remote control for the turning gear into the scavenge air receiver (as a visible sign of the fact that someone is in the receiver)
- Securing the latching devices by means of special safety padlocks that can be ordered from the manufacturer as retrofit components (the key should be taken along into the receiver)
- Securing the blocked main starting valve by means of a safety pad lock
- Posting warning notices over the scavenge air receiver access areas (*"Warning: entering a confined space"* and *"Do not close this door without checking for any person inside the scavenge air receiver"*)
- Instruction of the crew concerning the safety measures to be complied with

[115] Cf. Point 6.2.1.1 above.
[116] Loose translation of an excerpt of the "Service Letter" *[T.N.: Backtranslated into English]*

MAN B&W Diesel A/S

Service Letter

SL04-444/CHL
October 2004

Extra Safety Precautions
Scavenge Air Receiver Door
Action Code: AT FIRST OPPORTUNITY

Dear Sirs

The scavenge air receiver can safely be entered for cylinder liner scavenge port inspection, if the safety procedure described in Volume 1 of our instruction book for all types of engines, Chapter 707.02, is followed.

However, even though our safety procedure describes the necessary precautions to be taken before entering the scavenge air receiver, we have recently been informed of a fatal accident resulting in the death of a crew member.

Therefore, MAN B&W Diesel has decided to introduce extra safety precautions for the crew when entering the scavenge air receiver for scavenge port inspection.

To eliminate the risk of unintended closing of the access door to the scavenge air receiver, a locking device is introduced. This consists of a snap that ensures the door is kept open while the inspection is carried out, see the enclosed illustration.

However, this locking device should only be considered an additional safety device and a supplement to our primary safety procedure, which specifies blocking of the main starting valve and engaging of the turning gear before entering the scavenge air receiver.

Furthermore, to show other crew members that work is in progress in the scavenge air receiver, it is recommended that the manual remote control box for the turning gear is taken into the scavenge air receiver while staying there.

HEAD OFFICE (& Postal address)
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DK-2450 Copenhagen SV
Telephone: +45 33 85 11 00
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Telefax: +45 33 85 10 18

MAN B&W Diesel A/S
Denmark
CVR No.: 39 66 13 14

Nevertheless, we strongly recommend installation of this locking device on the scavenge air receiver door, in accordance with the following recommendation.

Scavenge air receiver doors can come in three types with regard to the locking device:

1. Some doors have no hinges and do not need any locking device.
2. Some doors have hinges and a locking device installed. No action is needed.
3. Some doors have hinges, but no locking device. Installation of the locking device is strongly recommended.

A retrofit set of the snap-type locking device can be ordered from MAN B&W Diesel A/S.

The retrofit set can be ordered in two separate parts:

- The locking device for the existing scavenge air receiver door.
- Two padlocks and warning signs.

Safety padlocks and warning signs

In addition to the introduction of our locking device, we also introduce the following additional safety equipment:

- A padlock for locking the snap on the scavenge air receiver door.
- A permanent warning sign to be placed on the scavenge air receiver door with the text:

  "Warning: entering a confined space"

  "Do not close this door without checking for any persons inside the scavenge air receiver"

- A padlock to secure the main starting valve in blocked condition.
- A mobile sign to be placed on the main starting air valve informing who has the key to this padlock.

The purpose of this extra safety equipment is to prevent the following from occurring:

- Closing of the scavenge air door by another crew member during an inspection inside the scavenge air receiver.
- Un-blocking of the main starting air valve by another crew member while a person is still inside the scavenge air receiver – in case no assistant is stationed outside for operating the turning gear.

In summary, we strongly recommend the following actions:

1) Check the actual design of the scavenge air doors on your engines.
2) Order a retrofit set with the relevant extra safety equipment from our Diesel Service department.
3) Introduce the above-mentioned extra safety equipment and update the confined space entry safety procedures accordingly.
4) Underline the normal safety precautions to the crew

Questions or comments regarding this SL should be directed to our Dept. 2110.

Yours faithfully
MAN B&W Diesel A/S

Carl-Erik Egeberg Kjeld Aabo

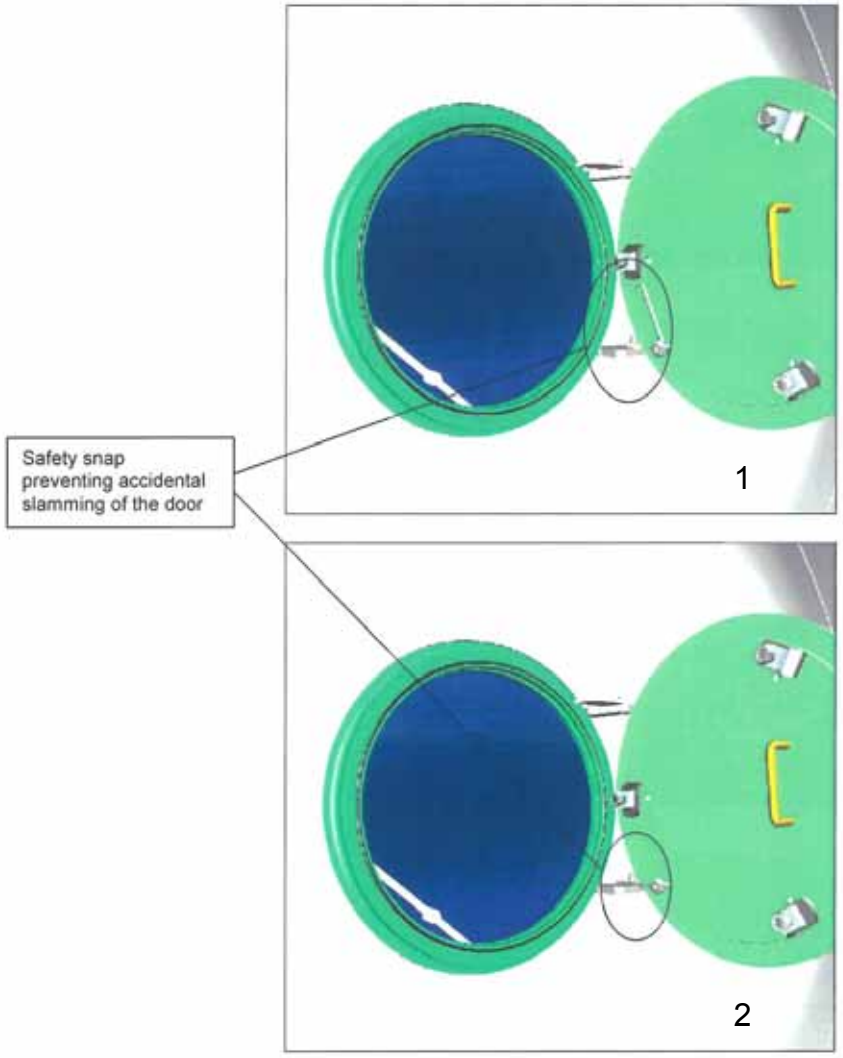
Encl.

MAN B&W Diesel A/S

Enclosure for SL04-444/CHL

Video instruction

Locking device for scavenge air receiver door (seen from the inside)



2110/CHL/JCB
2004-08-05

7.6 Classification society

The Classification Society for LONDON EXPRESS (Germanischer Lloyd) reacted to the confinement danger in connection with hinge-mounted inspection openings with a revision of the relevant section of its Classification and Construction Rules.
In “I - Marine Technology, Part 1 Seagoing Vessels“, item No. 4.7 was included in the 2006 Edition of Chapter 2 – Engine Plant, in Section 2 Combustion Engine Plant and Air Compressors under Letter F (Safety Features), reading as follows:

“Crankcase doors and hinged inspection ports are to be equipped with appropriate latches to effectively prevent unintended closing.

8 Safety recommendations

The recommendations and measures set forth in Chapter 7 show that many effective consequences were drawn from the casualty event on board LONDON EXPRESS by a number of different parties. In the awareness of these already introduced and implemented safety measures, the BSU issues the following additional safety recommendations:

1. The Federal Bureau of Maritime Casualty Investigation recommends that **operators of sea-going vessels** review their safety management system and if applicable supplement it with effective procedures for work in hazardous areas of the ship and for the search for missing crew members.

2. The Federal Bureau of Maritime Casualty Investigation recommends that within the scope of the audit of safety management systems the **Marine Insurance and Safety Association** pays attention to the adequate implementation of procedures aimed at structuring work in dangerous areas of the ship and the search for missing crew members.

3. The Federal Bureau of Maritime Casualty Investigation recommends that **operators of sea-going vessels** and **ship commands** ensure that the presence of crew members on board is recorded as stringently as that of external individuals.

4. The Federal Bureau of Maritime Casualty Investigation recommends that **operators of sea-going vessels** and **ship commands** introduce or optimise existing shipboard systems for real time day to day written recording and sign-off of all work and other shipboard measures that may involve safety relevant aspects.

5. The Federal Bureau of Maritime Casualty Investigation urgently points out to **operators of sea-going vessels** and **ship commands** that remote control for shipboard equipment must at least in the event of repairs and on a precautionary basis be switched to the engine room area. It should also be ensured in other respects within the scope of the introduction and implementation of fixed procedures on board, e.g. when changing from sea to harbour operations, that any erroneous or unintended remote operation of system components is efficiently prevented.

6. The Federal Bureau of Maritime Casualty Investigation reminds **operators of sea-going vessels** and **ship commands** of the existing statutory obligations arising from the Ship Safety Act and the STCW Code as concerns adequate documentation of special events on board in the ship's log book and if appropriate also in the engine log book. The disappearance of a crew member is a special event within the above meaning.

The above safety recommendations do not constitute any presumption of fault or liability in terms of their type, number or sequential order.

9 Sources

- Shipboard documentation from LONDON EXPRESS
  - Excerpts from the ship's log
  - Sequence of events and manoeuvre recorder reports
  - Excerpts from the Ship Safety Management System Manual
  - Crew list
  - Watch schedule
  - Working hours timesheets
- Information from the shipping company, opinion concerning the draft report
- Technical documentation for the main engine from the manufacturer (licensor) MAN B&W Diesel A/S Copenhagen
- Investigation report concerning the
  - Shipboard inspection of the CMS KOBE EXPRESS of 1 June 2004
  - Environmental conditions in the main engine scavenge air receiver on the CMS LONDON EXPRESS

  by Prof. Grad. Eng. Hark Ocke Diederichs, BSU appointed investigator
- Autopsy Report of 27 October 2003 by the Medical Examiner, Dr E. Kinnison, Department of Health, Norfolk, Virginia
- Autopsy report for the second autopsy of 10 November 2003, Dres. D. Schröpfer and J. Semmler, Brandenburgisches Landesinstitut für Rechtsmedizin Potsdam [Brandenburg Land Institute for Forensic Medicine, Potsdam]
- Expert opinion of 4 February 2004 by Prof. Dr K. Püschel, Director of the Institute for Forensic Medicine of the University Clinic Hamburg-Eppendorf
- Supplementary opinion by Prof. Dr K. Püschel of 5 April 2007
- Results of the US Coast Guard inquiry
  - Interrogation reports
  - Photographs, video recording
- Results of the inquiry conducted by the Hamburg Land CID and the Bremerhaven Harbour Police
- Witness interrogations by the BSU, opinions concerning the draft report
- Local inspections of the CMS LONDON EXPRESS, CMS DÜSSELDORF EXPRESS and CMS KOBE EXPRESS in Bremerhaven and/or Savannah
- Vessel photograph, CMS LONDON EXPRESS, thanks to the kind permission of Dietmar Hasenpusch (Hasenpusch Photo-Productions and Agency)
- Detail of the US ENC data sets of the US Hydrographic Service (NOAA), prepared at the German Federal Maritime and Hydrographic Agency in Hamburg
- Germany's National Meteorological Service (Maritime Division): Official opinion concerning the weather and sea conditions on 24 October 2003 between 06:00 and 24:00 LT for Savannah/Georgia and the offshore coastal strip (21:00 to 24:00 LT) of 23 June 2006
- Rules for Classification and construction issued by the Germanischer Lloyd
- Report of the Ship Safety Division of the Marine Insurance and Safety Association of 20 June 2007