Report on the investigation of the

fatal accident due to collapse of a portable bulkhead onboard

mv *Neermoor*

at Teignmouth, UK

on 27 April 2006

Marine Accident Investigation Branch
Carlton House
Carlton Place
Southampton
United Kingdom
SO15 2DZ

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Extract from

The United Kingdom Merchant Shipping

(Accident Reporting and Investigation)

Regulations 2005 – Regulation 5:

"The sole objective of the investigation of an accident under the Merchant Shipping (Accident Reporting and Investigation) Regulations 2005 shall be the prevention of future accidents through the ascertainment of its causes and circumstances. It shall not be the purpose of an investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame."

NOTE

This report is not written with litigation in mind and, pursuant to Regulation 13(9) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2005, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

AB	-	Able Bodied seaman
ADOMS	-	Antigua and Barbuda Department of Marine Services and Merchant Shipping
BST	-	British Summer Time (UTC +1)
cm	-	centimetre
DOC	-	Document of Compliance
DPA	-	Designated Person Ashore
GL	-	Germanischer Lloyd classification society
gt	-	gross tonnage
HMCG	-	Her Majesty's Coastguard
HSE	-	Health and Safety Executive
IACS	-	International Association of Classification Societies
ICS	-	International Chamber of Shipping
ILO	-	International Labour Organisation
ISM	-	International Safety Management (Code)
ISPSC	-	International Ship and Port facility Security Code
kW	-	kilowatt
LR	-	Lloyd's Register of Shipping
m^3	-	cubic metres
MCA	-	The Maritime and Coastguard Agency
MOU	-	Memorandum of Understanding
MSMC	-	Minimum Safe Manning Certificate
OOW	-	Officer of the Watch
OS/Cook	-	Ordinary Seaman/Cook = Combined deck and catering duties
PPE	-	Personal Protective Equipment

PSC	-	Port State Control
SeeBG	-	See-Berufsgenossenschaft
SMC	-	Safety Management Certificate
SMS	-	Safety Management System
STCW	-	The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
t	-	Tonnes
The Company	-	Kapitan Siegfried Bojen Schiffahrtsbetrieb
UTC	-	Universal Co-ordinated Time
VHF	-	Very High Frequency
6-on/6-off	-	As used in this report; a watchkeeping routine shared by two officers, whereby the 24 hour period is covered by each working 6 hours on watch, followed by 6 hours off watch.

SYNOPSIS

Narrative:

Neermoor, a single hold coaster, had discharged her cargo at Southampton, UK and was on ballast passage to Teignmouth, UK to load. The ship was fitted with two portable bulkheads that could be moved within the hold in order to divide the space up into three sections.

After sailing from Southampton, the ship's two Able Bodied Seamen (ABs) were tasked to thoroughly clean the cargo hold before arrival in Teignmouth. To achieve this, there was no requirement to move the bulkheads from their existing longitudinal positions, but both had to be vertically raised to ensure that all remaining traces of the previous cargo were completely removed; this was normal practice for this trade. While cleaning beneath the bulkheads, they were supported by timber packing.

The ballast passage was made in good weather conditions, and when the ship arrived off Teignmouth the cleaning was almost completed. The two ABs assisted with anchoring the vessel and then returned to the hold to finish the task.

Working at the forward face of the aft most bulkhead, the ABs used two separate, portable, hand powered jacks to lift vertically the aft bulkhead off its temporary supports; one jack was operated by each AB.

One AB stopped operating his jack and stepped through the opening in the bulkhead to the aft side. Almost immediately, the bulkhead began to topple, rotating about its lower locating pins so that its top edge moved aft. The bulkhead continued to fall aft, generally rotating about the lower pins until they, too, became disengaged and the bulkhead fell to the deck.

The AB working on the forward side escaped uninjured. Tragically, the second AB was fatally crushed between the fallen bulkhead and the bottom of the hold. The accident occurred at 0538 BST on 27 April 2006.

The sound of the impact was heard throughout the ship. Having seen the fallen bulkhead, and realising that an AB was missing, the master made emergency calls by both VHF and telephone. The remaining crew rushed to the hold to try to free their trapped colleague, but without success. The dead man was not recovered until the ship berthed in Teignmouth and a crane with sufficient capacity to lift the bulkhead arrived on site, several hours later.

Analysis:

The bulkhead fell on to the AB because the upper pins that should have secured it in the upright position became disengaged from the hold sides. The position of the bulkhead securing pins had not been checked for some time, and there was no procedure to ensure that this vital check was made. The upper securing pins were difficult to see and their latches were not well maintained. The bulkhead was sitting lower than designed, consequently the securing pins were making contact with the bottom of the recesses in the hold sides. This contact end-loaded the pins, which then bent their securing latches. With defective latches, there was then little to prevent the securing pins from moving as the bulkhead was raised and lowered to allow hold cleaning over a number of voyage cycles. The lifting method used

was not in accordance with the designer's instructions, and it is likely that asymmetric jacking of the bulkhead caused the securing pins to be forced back into their housings within the bulkhead.

There was no formal survey or inspection regime that covered the portable bulkhead system, thus their gradual deterioration went unnoticed.

Neermoor's SMS did not cover the operation or maintenance of the portable bulkhead system. The crew were not adequately trained and were provided with too little guidance and supervision to operate or maintain the system safely.

The investigation also revealed that *Neermoor* made a night passage without lookouts on the bridge and with the hold hatch covers open.

Conclusions:

Although of poor design, the portable bulkhead system could have been operated safely if the correct lifting equipment had been available, procedures were in place and the system was operated and maintained by trained personnel who followed a fully documented safe system of work.

The checks and balances that should have been provided by an effective survey and inspection regime were not in place and so failed to detect and prevent an unsafe operation.

The number of crew provided to comply with the minimum safe manning certificate was not adequate to operate *Neermoor* in the way required by her owners.

Recommendations (abridged):

Kapitan Siegfried Bojen Schiffahrtsbetrieb is recommended to: conduct a full review of the Company Safety Management System, covering operation, maintenance, inspection, training, management and supervision requirements relating to portable bulkheads systems for all vessels in their fleet that are fitted with similar equipment.

Classification Society Germanischer Lloyd is recommended to: conduct a comprehensive review of the survey and certification requirements relating to portable bulkhead systems on both new build and in-service vessels. The findings of this review should be further promulgated through IACS.

The Secretariat of the Paris Memorandum of Understanding on Port State Control (PSC) is recommended to: bring to the attention of its members, the issues raised in this report so that whenever possible, portable bulkhead systems can be checked during PSC inspections.

The Antigua and Barbuda, Germany, Netherlands and United Kingdom Flag Administrations are recommended to: review their requirements for the design approval, survey and inspection of vessels fitted with portable bulkhead systems, to include the associated Safety Management Systems.

SECTION 1- FACTUAL INFORMATION

1.1 PARTICULARS OF *NEERMOOR* AND THE ACCIDENT

Vessel details

Beneficial owner	:	Kapitan Siegfried Bojen Schiffahrtsbetrieb, Moormerland, Germany
Manager/Operator	:	Kapitan Siegfried Bojen Schiffahrtsbetrieb, Moormerland, Germany
Port of registry	:	St John's
Flag State	:	Antigua and Barbuda (ADOMS)
IMO Number, Call sign	:	9060687, V2AA7
Built	:	1993 at Slovenske Lodenice A.s, Komarno, Slovakia.
Classification society	:	Germanischer Lloyd
Construction	:	Steel
Length overall	:	82.56m
Gross tonnage	:	1589
Type	:	General Cargo Ship - Dry bulk/Container carrier. One hold. Hydraulic folding hatch covers, 2 portable bulkheads.
Approximate hold dimensions (m)	:	57.50L x 9.0W x 6.23H. Cargo Capacity approximately 3144 m^3
Engine power and type	:	1140 KW, Deutz Diesel SBV 6m628
Service speed	:	Approximately 9 knots

Accident details

Time and date	:	05:38 BST, 27 April 2006
Location of incident	:	Cargo hold. Vessel at anchor off the port of Teignmouth, UK at position 50 31.497N 003 28.121W
Persons on board	:	6
Fatality	:	One AB crushed by falling portable bulkhead.
Damage to Ship	:	Minimal

Photograph courtesy of FotoFlite

MV *Neermoor*

Figure 1

1.2 BACKGROUND

1.2.1 General description

Completed in 1993, at Slovenske Lodenice AS, Karmano, Slovakia, motor vessel *Neermoor* **(Figure 1)** is one of 6 similar general cargo vessels operated by this owner.

The owner described the vessel as a sea-river type. The hydraulically operated, telescopic bridge and hinged masts could easily be raised and lowered. This enabled the vessel to navigate rivers spanned by low clearance bridges. At the time of the accident, all were in the raised position.

Neermoor had a double bottom and wing tanks over the full length of the cargo hold. The hold capacity was approximately 3144 m^3 and could be sub-divided into three sections using two portable bulkheads. The ship was also equipped to carry containers, both in the hold and on top of the hatch covers. The hatch covers were of the cantilever type and were divided at the amidships position. The fore and aft sections were made up of four covers each and were lifted equally from the forward and aft operating positions. The covers also provided the hauling force, via mechanical links, needed to move the portable bulkheads.

1.2.2 Trading pattern

Neermoor's trading routes covered the North Sea, Irish Sea and Western Approaches area, and as far south as the Mediterranean Sea. Typical bulk cargoes included animal food pellets, minerals, fertilizers and grains. *Neermoor* commonly undertook short sea passages and rarely operated in any one regular trade.

1.2.3 Manning

Neermoor was operating with a crew of six, the minimum required by the Minimum Safe Manning Certificate: master, mate, chief engineer, two ABs and one OS/cook.

1.2.4 Management

The current operators and managers, Kapitan Siegfried Bojen Schiffahrtsbetrieb, of Neermoor, Moormerland, Germany, acquired the ship new in 1993. The Company has a long established tradition in the coasting trade and operates a fleet of similar ships. *Neermoor* was demise chartered from Siebo Shipping Ltd of Antigua, West Indies, at the time of the accident.

1.2.5 Flag and classification society

Originally operating under the German flag, the vessel transferred to the Antigua and Barbuda flag in December 1993, before transferring back to the German flag for about 5 months in 1998. The ship changed back to the Antigua and Barbuda flag in November 1998, and this was her flag at the time of the accident. The Department of Marine Services and Merchant Shipping, Antigua and Barbuda (ADOMS) is responsible for Flag State affairs.

Neermoor had been classed with Germanischer Lloyd from new.

1.3 NARRATIVE

All times are BST (UTC +1)

1.3.1 The previous voyage

On 24 April 2006, *Neermoor* loaded a cargo of 1491t of sugarbeet pellets at Dordrecht, in the Netherlands. The pellets were bound for Southampton, in the UK. This was the only cargo carried, but the bulkheads were used to divide the cargo into three parcels, the largest parcel being loaded into the centre section of the ship, between the two portable bulkheads. The bulkheads had been left in position from the previous cargo.

Discharge at Southampton began at 0905, and was by two grabs, operated by two cranes. The operation was without problems, no damage or defects being caused during the discharge. During the discharge, the mate and the ABs began preparing the holds for the next cargo. At 1730 on 26 April 2006, the vessel completed discharging cargo.

1.3.2 The ballast passage towards Teignmouth

Neermoor was programmed to load China Clay at Teignmouth. At 1830, she left Southampton for an overnight ballast passage to the next load port with a draught of 3.2m aft, and a trim of about 0.5m by the stern for arrival Teignmouth.

Once the two ABs had finished their unberthing duties, they were ordered to complete a thorough clean of the hold, which was to be finished before arrival at Teignmouth. The hatch covers were partly open in order to provide some light and ventilation while the ABs worked in the hold.

At 1947, having dropped the pilot, the master stood the bridge watch until midnight. The mate went to his cabin to rest before his midnight to 0600 bridge watch. The navigational watches were undertaken by the master and then the mate without lookouts, as the two ABs were working in the hold. The mate did not go to the hold to check on the progress of the cleaning task, but one of the ABs came to the bridge at about 0200 to discuss the work. At that time he reported that about one third of the hold was finished. During the passage, the ABs jacked up both bulkheads and supported them on wood packing, about 4cm above the tanktop. They then swept, washed and dried the hold. Cleaning was finished just before arrival at Teignmouth.

1.3.3 Arrival at Teignmouth

At 0500, *Neermoor* arrived off Teignmouth and was required to wait for a pilot. The ABs were needed to assist with anchoring, so they left the hold and went to the foc'sle. At this time, one AB told the other that he had already lowered the forward bulkhead, so the only task left was to lower the aft bulkhead. When the mate saw the ABs on deck he assumed that they had finished cleaning the hold, because of the time that they had spent on the job.

1.3.4 The accident

On returning to the hold after anchoring, the two ABs began to lift the aft bulkhead, using two separate hydraulic jacks, in order to remove the wooden packing before lowering the bulkhead back into its working position. The ABs were working at the for'd side of the bulkhead. The jacks were each given several strokes of their handles.

At this stage, the first AB stopped pumping, picked up the vacuum cleaner and stepped through the access opening in the bulkhead, to the aft side. It is not known why he did this as the calls between the two men were drowned out by machinery noise.

As the wood packing could not be removed, the AB, remaining at the for'd side gave one more pump of his jack. Almost immediately, the bulkhead began to topple, rotating about its lower locating pins so that its top edge fell aft. He had an impression of the face of the bulkhead moving towards him and he started running away from it. This AB was not injured.

The bulkhead rotated fully aft and, as it did so, its lower locating pins also became disengaged, allowing it to fall to the deck. As it did so, it crushed the AB who had been carrying the vacuum cleaner, with fatal consequences.

At 0538, the master, who was on the bridge, heard a loud bang. He immediately went down on to the main deck and there was sufficient daylight for him to see through the open aft hatch of the fallen bulkhead. He heard one AB calling the name of the other AB, and he shouted to him to try to find out where the second man was. The AB replied that he did not know, but it was dark underneath the fallen bulkhead and he could not see anything; also there was no sound. The AB retrieved a torch they had been using during the cleaning work and, using it to look beneath the bulkhead, he saw his trapped colleague.

1.3.5 Post accident actions

The master returned to the wheelhouse and by telephone instructed the mate to muster the crew in the hold. The crew were all awake as they had only just completed dropping anchor.

Ten minutes after the accident, the master used his mobile telephone to call the vessel's DPA, and at 0602 he called the emergency telephone number for Teignmouth harbourmaster, receiving an immediate reply. The master reported the incident and requested emergency medical assistance from the Teignmouth harbourmaster, who referred him to HM Coastguard Brixham.

In the hold, the mate and AB were attempting to lift the bulkhead off the victim, using the jacks and baulks of timber. They lifted the bulkhead a little, but were not successful in freeing the victim, as they had difficulty in finding safe points on the bulkhead against which to jack.

At 0703, a pilot and local police boarded, and *Neermoor* got underway at 0712. She arrived alongside in Teignmouth at 0800, where paramedics were waiting on the quay to receive the deceased AB.

1.4 CASUALTIES

The victim had been moving away from the bulkhead in an aft direction, when the bulkhead struck him, trapping and fatally crushing him. He was pronounced dead at the scene. There were no other injuries.

1.5 DAMAGE AND THE RECOVERY OPERATION

1.5.1 The aft bulkhead and ship structure

The aft bulkhead was positioned at frame number 56/57 when it fell. There was some relatively minor damage to the fallen bulkhead, local indentation of the tanktop and associated deformation of the double bottom internal structure.

1.5.2 The recovery and salvage operation

Neermoor did not have the equipment necessary to lift the fallen bulkhead, so a road-mobile crane was hired for the recovery operation. This lifted the aft bulkhead using chains attached to the upper edge. The bulkhead was then held vertically in order to allow safe inspection of both faces.

1.6 ENVIRONMENTAL CONDITIONS

The ballast passage was uneventful and weather conditions were good; there was a calm sea and slight swell and the ship moved easily, with little vibration.

On the morning of 27 April 2006, just before the accident the weather conditions were very good.

1.7 MANNING - COMPLEMENT, COMPANY POLICY AND CREW ON BOARD

1.7.1 Complement

Neermoor had a total crew of six, comprising master, mate, chief engineer, two AB deckhands and an OS/cook. At sea, the master and mate worked 6 on/6 off navigational watches, with the master keeping the 6-12 watches and the mate the 12-6 watches. The two ABs were employed on deck and as lookouts as required, assisted by the OS/cook when he was not busy with his catering duties. The chief engineer was solely responsible for the engine room and other technical issues.

The crew were all serving on short term renewable contracts, arranged through a third-party manning agency. This complement was in accordance with the minimum manning level specified in the vessel's MSMC. However, the ship had previously operated with a crew of 7.

1.7.2 Company manning policy

The ship managers' stated policy, contained within their SMS[1], was that, in general, they appointed masters who had gained sufficient experience as chief mates within their company, over a period of several contracts. Chief mates would be promoted from within the company, and that promotion would depend upon a recommendation being given by at least two masters who had sailed with the officer.

1.7.3 The crew

The 34 year old Ukrainian master held an STCW II/2 >3000gt certificate, and had served as master of *Neermoor* since March 2006. This was his first trip on this ship and with this company, but he had sailed as master of similar ships since 2004.

The Russian mate was 41 years old and also held an STCW II/2 >3000gt certificate. He had served as a chief officer since January 2001. He joined *Neermoor* on 19 April 2006 at Aberdeen, where he received a one day handover from the previous

[1] Safety Management Manual at section 6.1.

mate. This was the first ship that he had worked on that had been fitted with portable bulkheads; he had no experience of moving the bulkheads on *Neermoor* and had received no specific training. He had been on board for about one week at the time of the accident and this was his first trip with this company.

The Ukrainian AB, who was fatally injured, had joined *Neermoor* on 1 March 2006. He held an STCW II/4 certificate and the other necessary certificates to qualify as an AB. He had previously completed a 10 month trip on another of this company's ships and that ship was fitted with similar portable bulkhead systems.

The surviving AB was a 24 year old Ukrainian who had joined the ship in January 2006. He was completing his training to obtain an STCW II/2 qualification but was serving as an AB on *Neermoor*. This was his first trip on *Neermoor* and with this company. While he had served on other bulk carriers of a similar size and type, this was the first time that he had worked with portable bulkheads. He had been involved with moving of the ship's bulkheads on about 10 occasions since joining *Neermoor.*

The 38 year old Ukrainian chief engineer held an STCW III/2 certificate, and had started his current contract in April 2006. He was responsible for the technical aspects of any movement of the bulkheads, specifically the deployment of the transport wheels. He was not directly involved with this accident.

The OS/Cook was a 40 year old Ukrainian. He joined *Neermoor* on 1 March 2006, at the same time as the AB who was killed. The OS/Cook was not directly involved with this accident.

1.8 FATIGUE - HOURS OF WORK AND REST

1.8.1 Regulations

The requirement for monitoring and recording of hours of work or rest is contained in ILO Convention (No. 180) concerning Seafarers' Hours of Work and the Manning of ships, and STCW 1978 as amended.

Neermoor was registered in Antigua and Barbuda, and this government has not ratified the ILO 180 convention. However the "no more favourable treatment clause" in EC Directive 1999/95/EC[2] applied to *Neermoor at* the time of the accident.

1.8.2 Flag State requirements

ADOMS Circular 01-002-04 ILO Convention 147 and 180 **(Annex A)** states that ships registered in Antigua and Barbuda should, in principle, comply with ILO Convention 147 and 180, although Antigua and Barbuda is not party to those conventions. This circular also confirms application of ECD 1999/95/EC and S A-VIII/1 of STCW 1978, as amended.

ADOMS Director's Directive[3] 02-2002 **(Annex B)** Sections 14 and 15, reinforces these requirements to owners, managers and senior officers of Antigua and Barbuda vessels.

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[2] Directive 1999/95/EC Of The European Parliament and of the Council of 13 December 1999 concerning the enforcement of provisions in respect of seafarers' hours of work on board ships calling at Community ports. Article 9.

[3] Director's Directive 02-2002: The Merchant Shipping (Familiarisation Information for Officers at the Management Level serving on Antigua and Barbuda Vessels) Directive.

1.8.3 Company policy on working hours

The company SMS made no mention of the requirement to record hours of work or rest.

1.8.4 Hours of rest records

Although hours of rest records were kept on board *Neermoor*, the records for the week preceding the accident were not available at the time of the accident, and they have not since been produced. While full details of crew hours just before the accident are not available, conclusions have been drawn from logbook entries, voyage reports and other sources.

The master and mate, as the only two navigating officers on board, worked a 6-on/6-off watchkeeping routine while on passage. In addition, they were required to work standby periods for arrival and departure from port, as well as administrative/ship's business and cargo related duties while in port.

The crew had a similar workload, as shown by the narrative of this accident. After the short passage from Dordrecht to Southampton, they were required for arrival and then berthing duties. The logbook shows that a security watch, in accordance with the requirements of the ISPSC, was maintained during the time spent discharging in Southampton. Once they had completed their unberthing duties, the ABs were set to work cleaning the hold; this took most of the night and they were barely finished on arrival at Teignmouth.

1.9 LOOKOUT RESPONSIBILITIES

1.9.1 Definitions and regulations

The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), includes the following text[4].

Look-out

13. A proper look-out shall be maintained at all times in compliance with rule 5 of the International Regulations for Preventing Collisions at Sea…

14. The look-out must be able to give full attention to the keeping of a proper look-out and no other duties shall be undertaken or assigned which could interfere with that task.

15. The duties of the look-out and helmsperson are separate and the helmsperson shall not be considered to be the look-out while steering, except in small ships where an unobstructed all-round view is provided at the steering position and there is no impairment of night vision or other impediment to the keeping of a proper look-out. The officer in charge of the navigational watch may be the sole look-out in daylight provided that on each such occasion:

.1 the situation has been carefully assessed and it has been established without doubt that it is safe to do so;

[4] Mandatory provisions; Section A-VIII/2, Part 3-1 *Principles to be observed in keeping a navigational watch.*

.2 full account has been taken of all relevant factors, including, but not limited to:

- *state of weather,*
- *visibility,*
- *Traffic density,*
- *proximity of dangers to navigation, and*
- *the attention necessary when navigating in or near traffic separation schemes; and*

.3 assistance is immediately available to be summoned to the bridge when any change in the situation so requires.

1.9.2 Flag State requirements

The government of Antigua and Barbuda has issued clear and unequivocal guidance[5] to all ships registered under their flag **(Annex C)**.

> *Ships are prohibited from operating with the officer of the watch as the sole look-out during periods of darkness.*

1.9.3 UK guidance

Operators and masters of all ships in UK territorial waters are strongly advised[6] not to operate with the officer of the navigational watch acting as the sole lookout during periods of darkness.

Masters, owners and operators are reminded[7] that the UK considers it dangerous and irresponsible for the OOW to act as sole lookout during periods of darkness or restricted visibility.

1.9.4 Company policy

The SMS and ISM documentation on board *Neermoor* did not specifically address the requirement for lookout at sea, and custom and practice onboard had developed such that it was normal routine for the master or mate to keep navigational watches alone, both by day and at night. During the night passage from Southampton to Teignmouth, both ABs were working in the hold, leaving the master and the mate to keep navigational watches alone, on a 6-on/6-off routine.

1.10 PORTABLE BULKHEADS

1.10.1 General description

Neermoor's cargo hold was fitted with two, fabricated steel, portable dividing bulkheads (described as "Grain Bulkheads" in their documentation), each weighing about 10t. **Figure 2** shows the forward bulkhead in its operating position.

The bulkheads were approximately 9.0m x 6.23m matching the width and height of the hold. Fitted to the ship when new, they enabled the single hold to be separated into three sections. This allowed for cargo segregation if different types or grades

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[5] Circular 01-002-98 *Look-out during periods of darkness*.

[6] MGN 137, S 1

[7] MGN 315, S 2.6

Figure 2

Forward bulkhead in operating position, looking forward

of cargo were to be carried simultaneously. They could also be used to break up a single bulk cargo for reasons of ship stability, or trimming. If the bulkheads were not required, they could be moved to their respective stowage positions at the ends of the hold. The movement of the bulkheads was conducted by the ship's crew using the ship's equipment; no external assistance was normally required.

The shape of the hold was such that the lower outboard corners of the portable bulkheads were profiled to match the end sections of the hold where the bulkheads were stowed when not in use. When the bulkheads were in use and secured in their working positions, portable plates were fitted to close these triangular cut-outs, and any remaining small gaps were filled with high expansion construction foam. Vertical sealing flaps, made of a flexible heavy rubber material (similar to conveyor belting), were fitted to both the forward and aft outside edges of each of the port and starboard sides of the bulkhead.

Attached to the bottom face of the portable bulkheads were soft-wood packing pieces which protected the tanktop as well as providing a seal along the bottom edge. Access openings through the bulkheads were closed off with wood boards when not required.

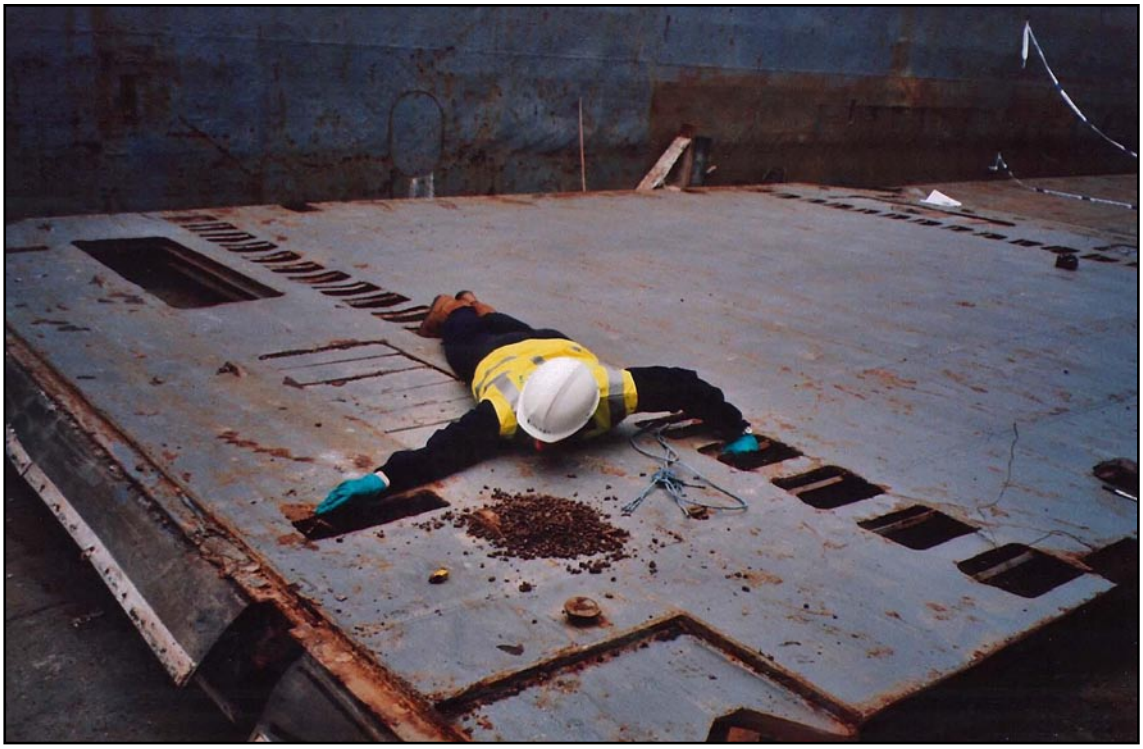
The bulkheads were secured against movement in the fore and aft direction by means of four, hand-operated mechanical pins, one upper and one lower on each vertical side. The pins slid horizontally out of their housings within the bulkhead, into pockets recessed into the sides of the hold. The inboard end of each pin was fitted with an easing handle.

The pins were secured in the protruding position by a “drop-nose” latching arrangement so as to prevent inadvertent disengagement of the pins; for example, due to vibration or ship movements. The latches were fabricated from light steel plate and were manufactured with large clearances within the mechanism, intended to reduce problems due to corrosion or cargo residues.

Seven sets of pin pockets were recessed fully flush into the hold side plating, to allow the bulkheads to be positioned along the length of the hold. The pockets were elongated vertically, to allow the bulkhead to be jacked up while remaining in position. All pockets were of a very similar size and shape. The top part of the pocket was of constant depth, extending over about two-thirds of the overall height of the pocket, so effectively forming a parallel “slot”. The depth then tapered from a maximum of about 125mm at the top, becoming flush with the hold side plating at their lower edge, so giving a wedge-like cross section over the lower one third of the overall height of the pocket. The taper design was to reduce water accumulation in the slot and therefore reduce any corrosion; it also helped prevent any accumulation of cargo residue in the pockets.

The operating controls for the pins were recessed into the forward face of the bulkhead. Gaining access to the two upper pins on the bulkheads was both difficult and potentially dangerous. In order to operate the upper pins it was necessary to climb up the ladder recessed into the face of the bulkhead to gain access to them, some 4m above the bottom of the hold. Once the operator was at this height, the easing handles of the pins were at a full stretch **(Figure 3)**.

Figure 3



General arrangement of pin operating position,
aft bulkhead shown lying on the bottom of the hold.

The crew sometimes used portable ladders to access the upper pins, and the dangers involved in this practice had been identified in the minutes[8] of the "Shipboard Management Meeting" – the safety committee. Positively confirming the position of the pin was similarly difficult and potentially dangerous, so was sometimes done by observing the upper pins from the main deck.

This model of bulkhead did not have any locating pins on the lower, horizontal face.

In order to enable the bulkheads to be moved fore and aft, each was fitted with two sets of solid steel wheels that ran along trackways on the sides of the top of the hatch coamings. In the stowed position, the wheels were swung inwards and down on cranked arms into recesses in the top of the bulkhead. To deploy the wheels, the bulkhead was first lifted sufficiently to allow them to be swung out from their stowed position. The wheels were then rotated upwards and out, and located on the hatch coamings and locked in position with a pin. This arrangement allowed the bulkhead to be moved along the length of the hold, with the motive power being provided by mechanical connections to the hatch covers.

The wheels on both bulkheads were found in the stowed position. The bulkhead involved in the accident had not been moved for about 4 weeks, but it had been lifted several times.

1.10.2 Design, manufacturing, installation and commissioning

The portable bulkheads were designed and manufactured by the shipbuilders. Their work included the bulkhead securing arrangements, including the details of the securing pins and their safety latches.

The bulkhead lifting gear and the transport system for their movement was designed by Kvaerner Brug Deutschland GMBH of Bremen**.** They also supplied the original bulkhead lifting equipment. However, the shipbuilders did not involve Kvaerner during the manufacturing, installation or commissioning phases.

1.10.3 Lifting the bulkheads

In order to thoroughly clean the hold or to move the bulkheads, they had to be lifted clear of the tanktop. Two recesses allowed hand-operated portable hydraulic jacks to be inserted into the base of the bulkhead. The securing pins and the design of their locating pockets allowed the bulkhead to be jacked vertically while remaining secured against inadvertent horizontal movement.

1.10.4 Bulkhead lifting jacks

The manufacturer's operating instructions showed a single, hand-operated, hydraulic power pack supplying two separate 10t lifting jacks, one fitted in each recess **(Figure 4)**. The jacks lifted the bulkhead vertically by operating against the top face of their recesses and the tanktop. A parallel lift was assured as the one power pack supplied two matched jacks via a common hydraulic hose, thus equal lifting effort was applied to each jack.

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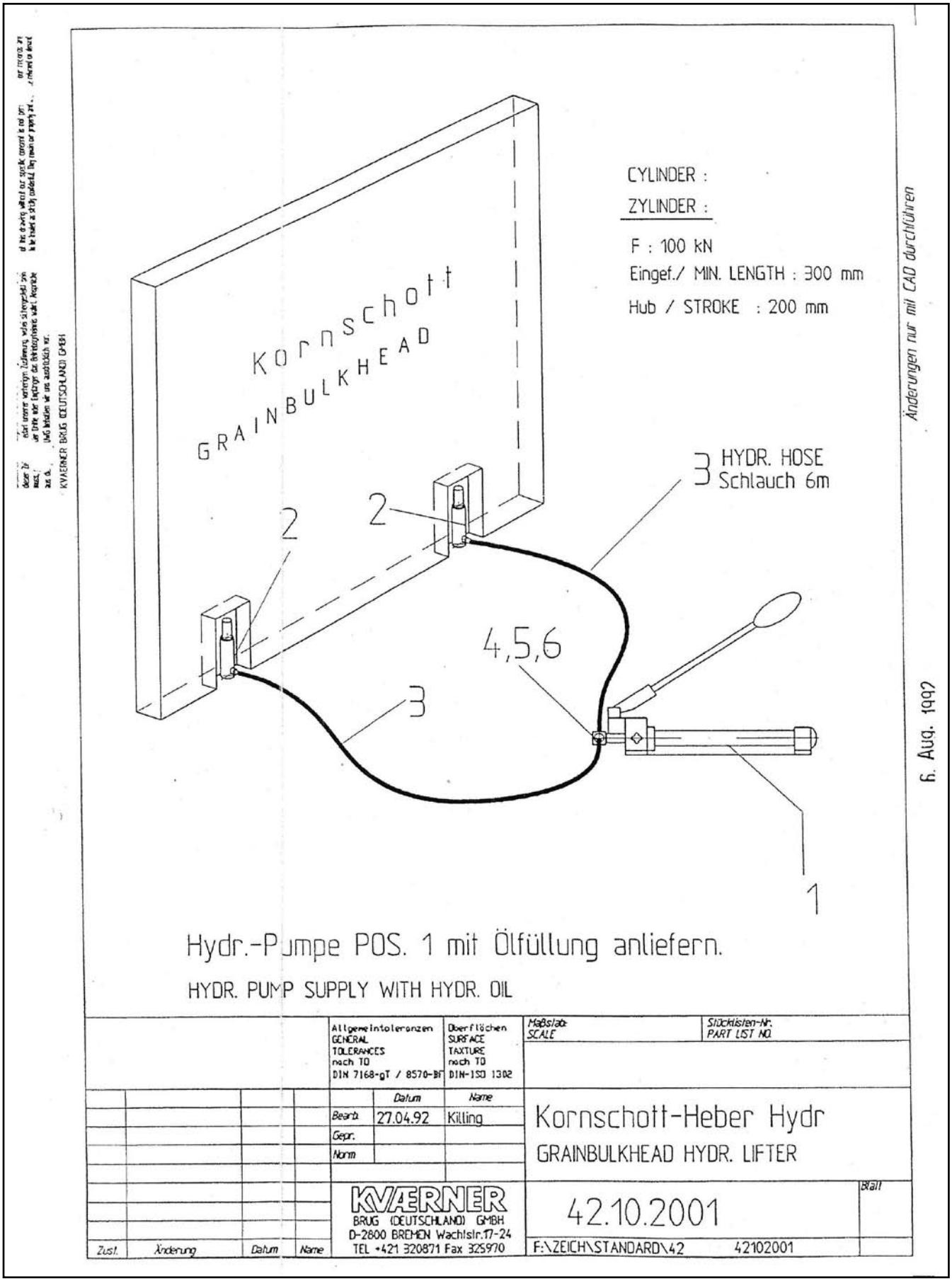
[8] Minutes dated 21st September 2003.

Figure 4



Bulkhead lifting arrangement as designed

The jacks in use at the time of the accident were not those originally supplied as part of the bulkhead system; instead, they were individual bottle jacks. It was not known how long they had been in use, who supplied them or why. The jacks were not a matched pair: one was rated at 15t; the rating plate on the other was not readable, but this jack was physically much smaller, and equal operation of each of the handles produced unequal travel **(Figure 5)**.

In the lead up to the accident, the jacks were individually operated by each of the two ABs.

Figure 5

Bulkhead lifting jacks as found on board

1.10.5 Cleaning the bulkhead area

There was a tendency for the remains of bulk cargo to lodge in various small gaps and ledges around the portable bulkheads. In order to avoid cross-contamination of cargo, thorough cleaning was a very necessary and regular operation. To achieve this, the ship's crew lifted the bulkheads during the period between cargoes. The cargo residue was then manually removed using brushes, vacuum cleaners and water washing as appropriate. It was not generally necessary to move the bulkhead for the purposes of cleaning.

The bulkhead had been repositioned about ten times during 2006, but had been lifted more frequently.

1.10.6 Manning arrangements for lifting and moving a bulkhead

Company fleet instructions state*:*

"…shifting grain bulkheads with less than 3 people is DANGEROUS and prohibited".

During a bulkhead movement operation, custom and practice had developed that required at least four persons, and the master was of the opinion that at least four people were needed to move the bulkhead safely.

In order to move a bulkhead, the two ABs jacked up the bulkhead to allow the chief engineer to rig the bulkhead transport wheels and connect the bulkhead to the hatch cover. The ABs then lowered the bulkhead so that it was supported by the transport wheels, and then disengaged the four bulkhead securing pins. The mate was responsible for co-ordinating the overall operation from the deck and operating the hatch cover controls to move the bulkhead to its new position. The operation to move both bulkheads took about 3 hours and required all available hands. The crew viewed this as a very significant operation.

The "lifting for cleaning" operation was seen by the crew as a much simpler operation. It had become accepted practice for the two ABs to work together, unsupervised, during the cleaning process.

1.11 BULKHEADS – FINDINGS AT THE ACCIDENT SITE

1.11.1 Aft bulkhead

The bulkhead had fallen aft onto its stiffened face, with its base coming to rest slightly forward from its secured position **(Figure 6)**. This suggests that the bulkhead initially rotated about the lower pins as it fell. The recesses between the frames created a small clearance space that allowed the vacuum cleaner being carried by the victim to escape undamaged.

The lower corner portable sections had separated from the bulkhead and lay close-by. There was some damage to the vertical edge sealing arrangements. The lower access way on the port side was seen to be open. The soft-wood packing/sealing pieces on the lower edge of the bulkhead were damaged, and in some places missing **(Figure 7)**. Visual examination indicated that this was old damage that had occurred before the accident.

1.11.2 Aft bulkhead securing pins and pin latching arrangements

The securing pins had all retracted into their housings within the bulkhead to some degree, but no pins had sheared. The pins were reasonably well greased and could be moved by hand once their latches were released. However, the recesses in the forward face of the bulkhead, that house the pin operating handles and latches, contained significant amounts of residue from the previous cargo.

Port lower pin: Found retracted. Latching arrangements incomplete - missing the locking plate and the inboard side of the pivot cheek plate **(Figure 8)**.

Port upper pin: Found half deployed. The outermost end was touching the hold side plating. Locking plate bent and a small bright spot was seen on the rim forming the edge of the locking pin **(Figure 9)**.

Figure 6

The accident site, looking aft

Figure 7

Lower edge of fallen bulkhead

Figure 8

Securing pin port lower aft

Figure 9

Securing pin port upper aft

Starboard lower pin: Found half deployed. Latching arrangement not damaged **(Figure 10)**.

Starboard upper pin: Found half deployed. Locking plate bent inboard in a similar fashion to that seen at the port upper **(Figure 11)**.

1.11.3 Aft bulkhead securing pin pockets at hold sides

All pin pockets were seen to be moderately scaled due to rusting. Rust scale was generally intact in the upper parts of each pocket. No evidence was seen of there having been recent metal-to-metal contact, pocket against pin, in the "slotted" portion of the upper part of each pocket.

Port lower pocket: The witness marks indicated that the pin was only just engaged with the lowermost edge of the pocket, possibly to a depth of only 15mm **(Figure 12)**.

Port upper pocket: Witness marks indicated that the bulkhead securing pin was in contact with the bottom of the pocket towards the lowermost part of the taper **(Figure 13)**.

Starboard lower pocket: The witness marks indicated that the pin was engaged and touching the deepest part of the tapered section of this pocket. Some cargo residue remained in a position that would have coincided with the top of the pin when engaged. The starboard lower was the only pocket containing any cargo residue **(Figure 14)**.

Starboard upper pocket: Witness marks indicated that the bulkhead securing pin was in contact with the bottom of the pocket towards the lower half of the taper **(Figure 15)**. There was some light surface scoring to the starboard side plating of the hold. This was consistent with the arc that would be described by the starboard upper pin as the bulkhead rotated aft, generally about the lower pins. There were no similar marks on the port side of the hold.

1.11.4 Forward bulkhead

Inspection of the forward bulkhead, immediately after the accident, found it to be generally in a similar condition to the aft bulkhead. The pins were greased and the securing latches were variously bent, corroded, or had parts missing. The starboard lower latching arrangement is worthy of particular note in that it was only just effective in locking the securing pin in the position in which it was found.

1.12 OPERATION, MAINTENANCE, INSPECTION AND CLASSIFICATION

1.12.1 Recent operational history of the portable bulkheads

Records show that the bulkhead was last moved about 4 weeks before the accident and no problems were experienced then. However, the bulkheads were lifted for cleaning purposes after each cargo, remaining in situ.

The master and mate were not aware of any operational problems with the bulkheads.

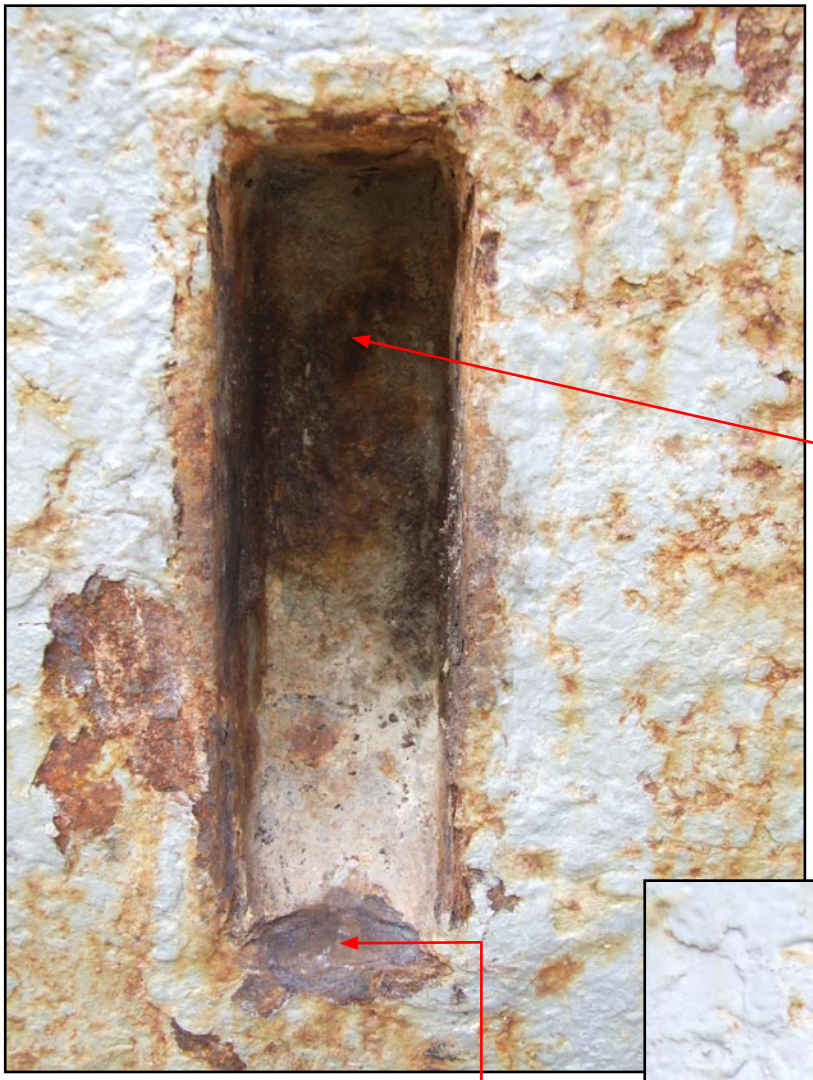
Figure 10

Securing pin starboard lower aft

Figure 11

Securing pin starboard upper aft

Figure 12

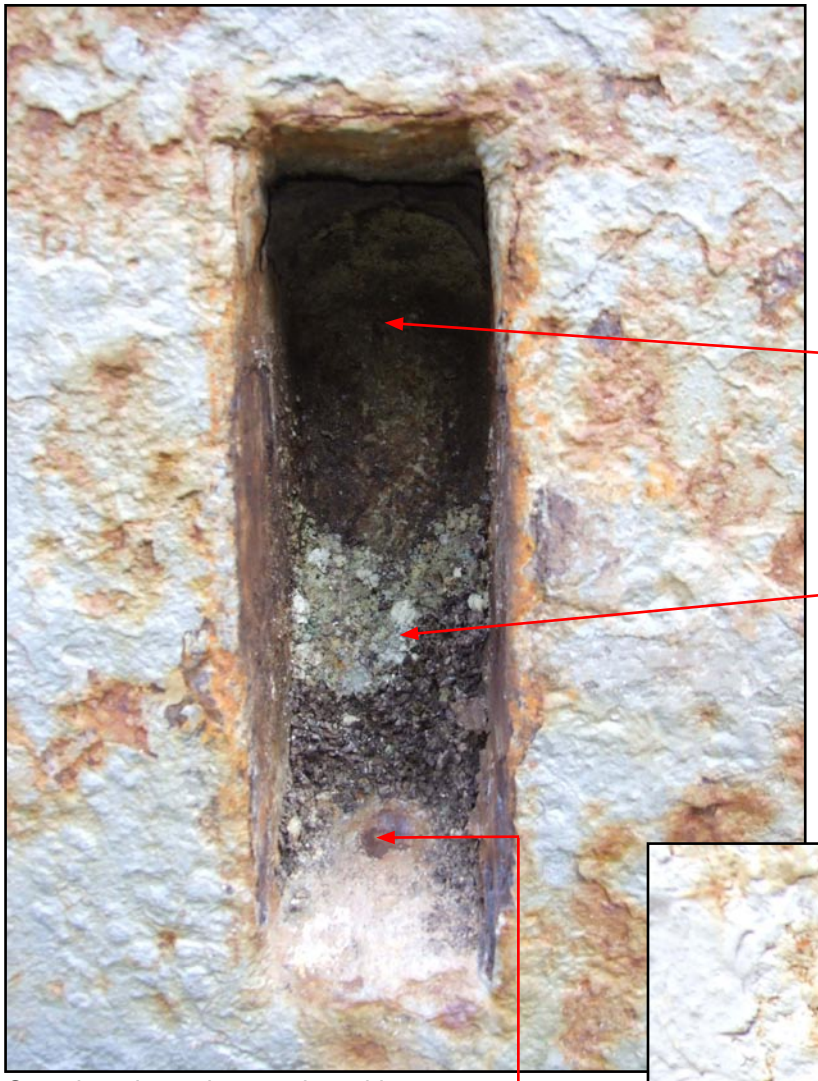


Securing pin pocket, port lower aft

Figure 13

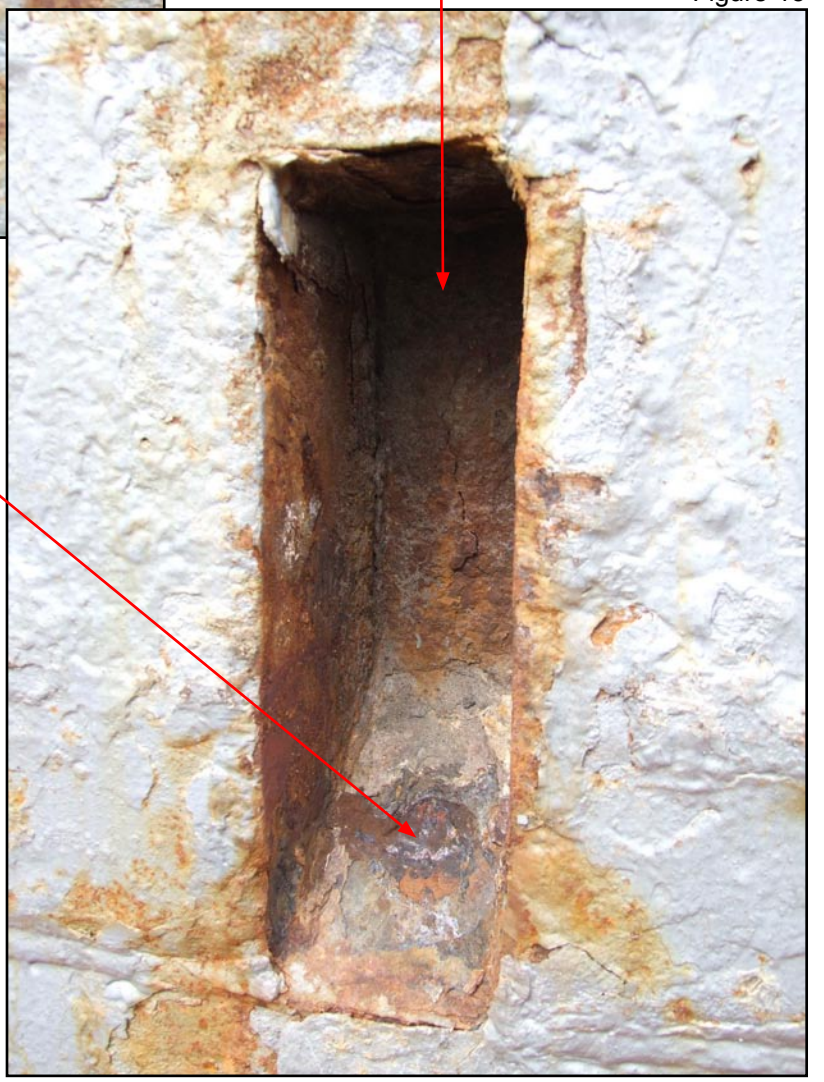
Securing pin pocket, port upper aft

Figure 14



Securing pin pocket, starboard lower aft showing cargo residue in pocket

Figure 15



Securing pin pocket, starboard upper aft

1.12.2 Recent maintenance

The most recent repair yard list[9] that was produced states that the cargo hold bulkheads, wheels and pins had been maintained by ship's staff during the dry-dock period.

1.12.3 Flag State and Port State Control inspections

In accordance with the declared standards of the Flag State inspection regime[10], the most recent annual safety inspection of *Neermoor* by ADOMS was on 21 June 2005. No deficiencies relevant to this accident were recorded.

Having been inspected by Port State Control (PSC) 15 times during the past 6 years, *Neermoor's* details show that she had a good record; her target factor was low and there were no detentions recorded. PSC records identified the specific areas of the ship that were examined by each PSC Inspector, showing that the last inspection that included the cargo hold areas was in August 2003. It has not been possible to verify that this included any specific inspection of the portable bulkhead system.

1.12.4 Classification, approvals and survey - Germanischer Lloyd

The engineering drawings, produced by the shipbuilders, for the bulkheads securing pins and pin latches on *Neermoor,* were examined by GL in 1993. The drawings that were found on board for the main securing pin latching arrangements were stamped *"Geprüft- Examined"* by GL Hamburg.

As *Neermoor* was under the German flag when built, these drawings were then in turn stamped as approved by the See-Berufsgenossenschaft (SeeBG), which is part of the German Flag State Administration.

Neermoor has been classed with GL since building. The certificate of class was last issued in June 2003 and was due to expire in July 2008. The class intermediate survey was scheduled for July 2006. The surveys that might be relevant to this accident are hull, and safety construction. All had been conducted by GL, the statutory safety construction and load line certification being issued by GL on behalf of the Flag State. Hull survey was recorded as completed during a dry-docking period during August 2005. It would have been possible to fully survey the entire portable bulkhead system at that time, but no such survey was undertaken as GL considered that these portable bulkheads were not Class relevant.

Neermoor also held a Document of Authorisation for the Safe Carriage of Grain in Bulk, under the International Grain Code. GL stated that this was the predominant standard against which the portable bulkhead system had been assessed and surveyed by class. Issued by GL in May 1994, this document remained valid without further survey.

SeeBG confirmed that the International Grain Code was used to assess the bulkhead system; they did not approve the operating instructions, operator's manuals or working instructions. In their view, this was the responsibility of the manufacturer.

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[9] "*SI Inspection Report S. Bojen Schiffahrtsbetreib*" dated 2nd March 2006.

[10] ADOMS Circular 04-001-98

GL surveyed the aft grain bulkhead after the accident, once it had been repaired and the pin locking latches renewed. The surveyor verified that when the bulkhead was in position, all four securing pins and locking devices were in position. The aft bulkhead lifting and transport arrangements were not surveyed.

It was not considered necessary to survey the forward bulkhead at that time.

1.13 THE ISM CODE AND THE COMPANY SAFETY MANAGEMENT SYSTEM

1.13.1 International Safety Management (ISM) Code requirements and certification

Neermoor is required to be ISM code compliant. The Safety Management Certificate (SMC) was issued on 16 December 2004 and was due for renewal by 15 October 2006. The Document of Compliance (DOC) was issued on 27 May 2004 and was due for renewal by 23 May 2009. Both certificates were issued by GL on behalf of the Flag State, Antigua and Barbuda.

The owners chose English as the official operating language for their ships[11], and all ISM and safety related information was in this language.

1.13.2 ISM audit – internal

In accordance with company policy[12], the ship was subject to an internal audit on 25 August 2005. The results were positive, and the auditor declared that the ISM system was well implemented on board. Non-conformities from the previous internal audit, during 2004, were found to have been rectified and were closed out. Vessel maintenance was “satisfactory” and no proposals for improvements of the system were made.

1.13.3 GL ISM audits

GL conducted the periodical verification of the SMC on 18 October 2004, and the annual verification of the DOC on 22 August 2005.

1.13.4 The company safety manual – the SMS

To satisfy the requirements of the ISM Code, owner/operators Kapitan Siegfried Bojen Schiffahrtsbetreib KG produced a company safety manual[13] – the Safety Management System (SMS). The SMS on board was endorsed by the ISM certification. However, the documentation did not include instructions for lifting or moving the bulkheads.

The SMS specifically referred to the portable bulkheads (referred to as “Grainbulkheads”) in three instances.

Firstly **(Annex D)**, the guidance entitled *Shifting of Grainbulkheads*[14] found within the Company Safety Manual consisted of one line:

When grain bulkheads are NOT in use, they always have to be shifted back in store position.

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[11] Fleet Instructions/Safety Management NR.02 section 3.

[12] Company manual S 12.

[13] Onboard copy dated 15.01.2004, appr:CJF/HS Rev3.

[14] SMS Fleet Instructions/Operations Deck NR. 05 *Shifting of Grainbulkheads*

The second **(Annex E)** *Securingboltsgrain- bulkheads and containerpockets tanktop*[15] specifically mentioned the maintenance of the securing bolts. However, this fleet instruction primarily raised the potential for commercial consequences if the ship should be delayed due to non-functional securing bolts. No mention was made of safe operational routines. This information had also been circulated separately as fleet circular letter D05 with the same title.

The third instance **(Annex F)** was contained within fleet instructions for the operation of the hatch covers[16] and stated:

…shifting grain bulkheads with less than 3 people is DANGEROUS and prohibited.

This same phrase is repeated twice within this Fleet Instruction.

1.13.5 Inspection and maintenance responsibilities – ship's staff

In accordance with the SMS, on board documentation[17] confirmed that the master was responsible for the general inspection of the cargo hold and grain bulkheads on a weekly basis, if the ship was in a ballast condition. The system also required that the master submitted these results as monthly returns to the Company. The master's inspection report submitted on 2 March 2006 made no mention of any outstanding deficiencies:

Grainbulkheads: Operating condition, accessibilities, damages – satisfactory.

A similar document[18] also confirmed that the mate was responsible for the maintenance of these bulkheads and for overall management of their operation.

1.13.6 Inspection - the company superintendent

The SMS stated that a company superintendent was to inspect each vessel at least once a quarter. *Neermoor* was inspected in February 2006; the report made no mention of any defects in the portable bulkhead system.

1.13.7 Shipboard management meetings

Records show that shipboard management meetings were held on board at approximately monthly intervals. Topics for discussion included safety on board, maintenance procedures and safe operation.

The September 2003 meeting discussed the application of the Code of Safe Working Practice during the moving of the ship's bulkheads. The agenda was mainly concerned with the use of appropriate PPE and safe access to the upper pins when using a portable ladder.

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[15] SMS Fleet Instructions/Operations Deck NR. 06 *Grainbulkheads/Tanktop*.

[16] Fleet Instructions/operations Deck Nr. 10. *Hatch cover operation*.

[17] SMS Fleet Instructions/Operations Deck NR.20 and Company Fleet circular Letter D08 *Weekly Inspections Shipboard* dated 31.01.03.

[18] SMS Fleet Instructions/Operations Deck NR.06 and 19. S 2.3 and Company Fleet circular Letter D05 *Grainbulkheads/Tanktop* dated 13.05.01.

The Code of Safe Working Practice was again the subject of the October 2005 meeting, when the operational aspects of moving the bulkheads were addressed in slightly more detail; the mate was to operate the hatch covers and two crew members were to assist as lookouts, within the hold. Mention was also made of the need to pay attention to the use of the correct PPE. No mention was made of the critical nature of the securing pins or of the lifting operation, prior to moving the bulkhead.

The text of the March 2006 meeting is identical to that of October 2005.

1.13.8 Risk assessment

No risk assessment had been made relating to the operation of the portable bulkheads on board *Neermoor*.

1.13.9 Ship specific familiarisation

The SMS required that all new crew members were familiarised with the ship's layout and systems and instructed in their on board duties within 1 week of arriving on board[19]. Documentation produced shows that the familiarisation process for all persons involved with this accident was completed in accordance with the SMS. However, the company's familiarisation checklist did not specifically cover the operation of the portable bulkhead. The previous mate had verbally explained the operation of the bulkhead system to his relief, but no practical instruction or demonstration had been given.

1.14 LOAD LINE REGULATIONS AND POOR SEAMANSHIP

Neermoor transited the English Channel at night. The main hatch covers were partly open while on passage in order to provide ventilation and some light for the men working in the holds.

GL had issued the Load Line certificate for *Neermoor* on behalf of ADOMS. While GL does not give direct operational guidance to owners/masters on this subject, there is an assumption that the crew will follow the rules of good seamanship, national requirements and the Load Line convention in this respect.

The equivalent guidance to UK vessels is found in the MCA Instructions for the Guidance of Surveyors, Load Line Instructions:

Owners, Masters and Skippers are also reminded that proceeding to sea with improperly fitting hatch covers…constitutes non-compliance with the "Conditions of Assignment". [20]

And

…the MCA recommends that the operational procedures listed below should be adopted…Before departure, ensure that…Cargo hatches, access hatches, weathertight doors in exposed positions … are effectively closed…[21]

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[19] This requirement is also found in Directive 03-2002: The Merchant Shipping (Familiarisation Information for Officers at the Management Level Serving on Antigua and Barbuda Vessels) Directive.

[20] MSIS003/Part 3/Rev 1.02/Page 2, S 3.2.6

[21] MSIS003/Part 8/Rev 1.01/Page 40, S 8.29.2

1.15 SIMILAR ACCIDENTS

1.15.1 *Nordstrand*

MAIB conducted a full investigation[22] into a similar accident on board the UK registered vessel *Nordstrand* in Seville, Spain during September 2004.

The synopsis of this accident is at **(Annex G)**. The recommendations arising are at **(Annex H)**.

The International Chamber of Shipping (ICS) received two recommendations following the accident on *Nordstrand*; they issued circular MC (05)20 as a result **(Annex I)**. No feedback has been received by the ICS from national ship-owner associations.

1.15.2 *Claudia Trader*

Claudia Trader was a vessel of similar size and type to *Neermoor*, although the grain bulkheads were of a different construction. An accident occurred during the discharge of a grain cargo on 15 March 2002 while the vessel was alongside in the UK. A temporary/grain bulkhead collapsed, and a dockworker became trapped and sustained serious injuries in the resulting flood of grain.

The ship was also on the Antigua & Barbuda flag register and classed by GL, who had approved the technical aspects of the grain bulkhead arrangements, in accordance with IMO regulations. Both *Claudia Trader* and her management company held valid ISM certification that had been issued by Lloyds Register of Shipping. A PSC inspection by the MCA immediately prior to the accident found all relevant certification to be correct, including the Document of Authorisation for the Safe Carriage of Grain in Bulk.

The only instructions available to the crew regarding the assembly of the portable bulkheads were provided by previous crew members, in the form of handover notes based on their experience. No official documentation, other than the approved engineering drawing, existed. Further, ad-hoc practice had developed on board, resulting in alternative methods of assembling the bulkhead apparently becoming acceptable.

As the portable grain bulkheads were not actually part of the ship's structure, they were not part of the formal survey regime undertaken by GL. These particular bulkheads had not been surveyed in the year prior to the accident and they would not usually have been surveyed unless specifically requested.

Before she sailed, *Claudia Trader* was issued with a PSC Report of Inspection which required that:

Temporary bulkheads are not used until they can be constructed in a safe and appropriate manner… Class Society are to verify the construction in accordance with the drawing.

At the time of this investigation, the accident on board *Claudia Trader* was the subject of an ongoing MCA/HSE investigation.

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[22] Report 8/2005, published April 2005.
http://www.maib.gov.uk/publications/investigation_reports/2005/nordstrand.cfm

SECTION 2 - ANALYSIS

2.1 AIM

The purpose of the analysis is to determine the contributory causes and circumstances of the accident as a basis for making recommendations to prevent a similar accident occurring in the future.

2.2 CAUSE OF THE ACCIDENT

Neermoor was not a new ship, and this is the only significant reported accident involving her equipment. The portable bulkhead could have been operated safely if the correct lifting equipment had been available on board and operating and maintenance procedures been in place and followed.

The bulkhead fell on to the AB because the upper pins that should have secured it in the upright position had retracted from the locating recesses in the hold sides. This allowed the upper edge of the portable bulkhead to begin to rotate about the lower pins and topple. The bottom two securing pins were probably only just engaged and they, too, became disengaged as the bulkhead fell.

The position of the bulkhead securing pins had not been checked for some time, and there was no procedure to ensure that this vital check was done before any attempt to lift the bulkhead was made. The upper securing pins were difficult to see and their latches were not well maintained; this reduced their effectiveness further. The bulkhead was sitting lower than designed due to degradation of the wooden packing piece across its base. Consequently, the securing pins were making contact with the sloping, shallow areas of the recesses in the hold sides. This contact end-loaded the pins, which then bent their securing latches. With the latches broken and defective, there was little to prevent the securing pins from moving as the bulkhead was raised and lowered to allow hold cleaning over a number of voyage cycles. The lifting method used was not in accordance with the designer's instructions, and it is likely that asymmetric jacking of the bulkhead caused the securing pins to be forced back into their housings within the bulkhead.

2.3 DESIGN AND ERGONOMICS

2.3.1 Bulkhead

The design and construction of the bulkheads fitted to *Neermoor* was such that small amounts of bulk cargo would inevitably remain after the discharge. Lifting the bulkhead was therefore a routine and necessary operation to ensure the hold was cleaned to the required standard to prevent cross-contamination of cargoes.

When in use, the securing pins were the only fixings for these bulkheads. During a lifting operation, these pins continued to secure the bulkhead against falling on the operators, until the travelling wheels on its upper edge could be deployed. While moving the bulkhead had been identified as a hazardous operation, its lifting for cleaning had not. Notwithstanding that, during either lifting or moving of the bulkhead safety would be severely compromised if operating instructions were inadequate, or procedures were not carefully followed.

2.3.2 Pin latches

When new, the hinge up-stands were fabricated from 6mm steel plate, sufficient to prevent the pins working back into their housings under normal operation, but not capable of withstanding any significant load. Approved drawings show that the latch pivot mechanism was designed with a relatively large clearance, probably to help ensure that they did not readily seize up due to corrosion or a build up of cargo residue. The fact that they had not been maintained in good working order would have made it even easier for them to be displaced by the inward force of the securing pins.

The latches deformed under the side loads applied to them. Having bent sufficiently for a pin to slide past them, it is likely that the latches would have acted as a "barb" so preventing any potential outward movement of the pins, but continuing to allow them to retract **(Figures 9 and 11)**.

2.3.3 Maintainability

Company fleet instructions, contained within the SMS, required the crew to remove each of the securing pins, one at a time, in order to check their clearances and then to grease them before they were re-fitted. The pin housings in the bulkhead sides were designed to allow the pins to be withdrawn inwards, towards the centreline of the ship.

While the lower pins on both bulkheads could be reached from the deck of the cargo hold, no dedicated access had been provided for the upper pins. The fixed ladder in the bulkhead was not close enough to the pins to allow for maintenance, and due to the size and weight of the securing pins[23] it is unlikely that this could have been achieved safely using a portable ladder: a point that had been raised during Shipboard Management Meetings.

A design which requires heavy pins to be fully withdrawn in order to lubricate them tends to make this vital maintenance task more onerous than is really necessary. This was particularly the case for the upper pins where safe access had not been provided. Grease nipples or automatic greasers might have minimised the need to fully remove the pins for greasing, and thus reduced the risks to the crew. In *Neermoor*'s case, little consideration had been made at the design stage to the through-life requirement to provide safe access for both operations and maintenance.

2.3.4 Access to top pins and latches - ergonomics

It was essential for the safe operation of the bulkhead system that the true positions of all securing devices could be readily and accurately determined. Other than a close visual inspection of each of the pins and latches, there was no indication that the main securing pins were safely engaged.

On this particular bulkhead, access to the lower pins was acceptable. However, the positions of the upper main securing pins were very difficult to check visually. The pins could not easily be seen from the main deck, when looking down into the hold, and the ladders built in to the bulkhead at manufacture were too far displaced to be useful. Further, the residue from the previous cargo that remained within the pin operating

[23] 100 mm diameter, 450 mm long. Approximate weight 30 kg.

recesses might have hindered any but a close visual inspection of the bulkhead securing pins. Another means of indicating that the pins were positively engaged and locked should have been provided **(Figures 3 and 16)**.

Figure 16

General arrangement of pin operating position,
aft bulkhead lying on the bottom of the hold

2.3.5 Bulkhead lifting system - ergonomics

The design of the portable bulkheads on *Neermoor* and similar ships is such that the crew must enter the hold in order to operate them. They are then required to operate lifting equipment very close to the load that they are lifting: a potentially hazardous working practice. It is possible that the length of the hydraulic hoses used in the original jacking system might have allowed the operators to position themselves further from the bulkhead and so remain in a safer area **(Figure 4)**. However, the available information does not specify that intent, and the lengths of hydraulic hose necessary to achieve this would be heavy and cumbersome.

2.4 MAINTENANCE

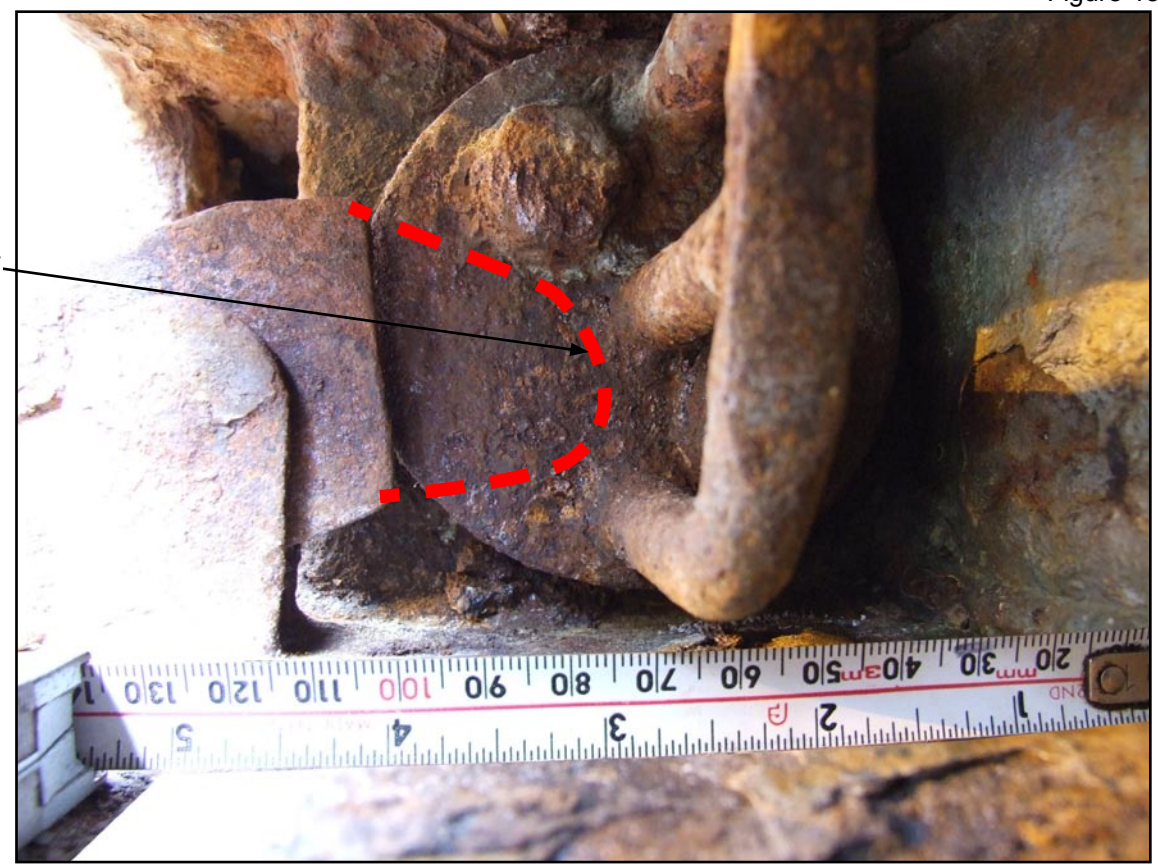
2.4.1 Maintenance of the bulkhead securing system

The easily-observed lower securing pins and their associated latches showed obvious defects, on both the forward and aft bulkheads. On the aft bulkhead, the port lower latch had parts missing, and both the securing pins had retracted; the port lower pin completely **(Figure 8)**. On the forward bulkhead the securing latches on the port side were wasted by corrosion, the pivot cheek plates were deformed, and one latch operating handle was missing **(Figure 17)**. On the starboard side, the lower latch mechanism was apparently sound. However, the end of the latch plate had almost entirely corroded away, so it covered the end of the pin by no more than 10mm **(Figure 18)**.

Figure 17

Forward bulkhead, port lower securing pin

Figure 18



Forward bulkhead, starboard lower securing pin

The defects and deformities to the pins and latches noted on both bulkheads indicate that routine maintenance on board had been neglected for some time. That maintenance was difficult to achieve on the upper pins, had been noted during Shipboard Management Meetings, but the lower pins and locks were in an equally poor condition. This indicates that either the ship's staff was unaware of the requirement to maintain the locking arrangements, or they lacked the time, motivation, or ability to carry out the necessary maintenance.

These significant defects were evidence of poor maintenance, and indicate a lack of awareness of the safety-critical nature of the latches. It also indicates an imperfect SMS and an ineffective inspection/survey regime.

2.4.2 Base of bulkhead – wood facing

The undisturbed corrosion seen around the upper parts of the pockets, and witness marks on both the pins and the sloping pocket faces, indicate that the bulkhead pins had been engaging into the lower, tapering section of the pockets. For this to have occurred, the bulkhead must have been sitting lower than its designed position, in relation to the position of the pockets. The only explanation for this is that the wood facing on the lower edge of the bulkhead was too thin. Some sections of the wood facing were noted to be damaged and missing, but it is also possible that the incorrect thickness of wood facing was fitted at some earlier point **(Figures 7, 12, 13, 14 and 15)**.

A consequence of the bulkhead sitting lower than designed was that the bulkhead securing pins could not extend fully, and would have only engaged into the hold side pockets by a small amount, perhaps only 25mm or so. The vertical misalignment would also mean that the securing pins were working against the tapered part of the pockets, inducing an end-load forcing them back into the bulkhead. This end-loading would have contributed to the bending and fracturing of the latches, ultimately leaving the pins with little to stop them progressively retracting over time.

The drawings available on board did not allow the dimension of the wood facing to be determined, and it is not shown to be crucial to the safe operation of the bulkheads. Had maintenance instructions been on board, and the crew alert to the implications of witness marks on the sloping faces of the pockets, it is possible that the wood facing would have been replaced before the accident.

Operators of similar portable bulkheads should be made aware of critical dimensions and their importance to the safe operation of ships equipment.

2.5 OPERATIONS, PROCEDURES AND THE ISM CODE

2.5.1 Lack of on board documentation

Any manufacturer's maintenance and operating instructions that might have once been available for the portable bulkhead system were not included in the SMS, nor were they found onboard *Neermoor*. The documents would have provided information vital to the safe operation of the portable bulkhead system, and they should have been available to the crew.

Risk assessment helps determine the control measures necessary to ensure safe operation, accounting for different skill levels, knowledge and languages. No risk assessments for the operations of either lifting for cleaning, or lifting and then moving the portable bulkheads were found on board. This omission had not been detected during inspections by the owner's superintendents, company internal audits, classification society ISM audits or PSC inspections.

2.5.2 Lifting jacks

The lifting jacks that were used on the day of the accident were not those originally specified and supplied for the task. How these jacks had come to be used on board *Neermoor* was not known. No evidence was found to suggest that owners, managers or any of the ship's crew were aware of the potential dangers of the substitution of the manufacturer's system for other, less specialised, equipment.

The jacking units played a crucial role in the safe operation of the portable bulkhead system. Because the two jacks used on *Neermoor* had different specifications, it is likely that the bulkhead moved upwards with a slight side-to-side rocking movement. Under this movement, the securing pins would be forced against the sloping faces of the hold pockets, and any cargo residue trapped in the pockets. This effect might have been applied over a number of lifting operations, gradually forcing the securing pins home into their housings within the bulkhead and causing the degree of engagement to decrease with each lifting cycle.

In this accident, it is likely that the asymmetric jacking of the bulkhead by using separate dissimilar jacks caused the securing pins to retract. However, poorly maintained jacks could as easily have led to hydraulic failure resulting in a dropped or jammed bulkhead. As a crucially important piece of equipment that formed an integral part of a lifting system, the jacking system should have been treated with greater respect and perhaps been subject to routine survey.

2.5.3 Operational records

No documentary evidence could be found to verify that the securing pins had been fully engaged and latched in place at the end of the last bulkhead movement. Neither was there any procedure to periodically check the continued integrity of bulkhead securing arrangements, despite the bulkhead having been lifted for cleaning a number of times since it was last moved. There was no positive reporting system in place, and thus no one on board could identify when the securing arrangements had last been checked, and by whom.

An effective safety management regime should have identified the need to positively check the engagement of the pins and latches after each bulkhead move, and periodically between movements.

2.5.4 Instruction and monitoring by owners

The documents described as *Fleet Instructions Operations* and contained within the SMS manual under the group heading *Safety Management* would, perhaps, be more accurately described as fleet circulars as they commonly addressed commercial, rather than safety issues. The safe operation and maintenance of the portable bulkheads received the briefest mention in the SMS; a significant omission that until the time of the accident remained unnoticed.

An essential ingredient of an effective SMS is the management's continual monitoring of the ship's operations. It is particularly important that management ensures that effective risk assessment procedures are in place, and that they are followed. No evidence of this process was found on board.

2.6 INSPECTION AND SURVEY

2.6.1 Access for inspection and survey

The survey, classification and certification system is based on periodical assessments of the ship and its equipment against defined standards. Provision of safe access to all parts of the ship that require survey/inspection is essential and should, ideally, be "designed in" at an early stage. Adequate safe access will allow surveyors and inspectors to monitor the condition of the ship and so detect problems before they escalate to a hazardous level.

Cargo operations may also conflict with the needs of the surveyor/inspector; given the trading pattern of ships like *Neermoor* these difficulties should not be unexpected. Owners/operators must plan to allow safe inspection of key components of the ship.

2.6.2 The Flag State

The Antigua and Barbuda administration delegated periodical inspections and surveys of the ship and its systems to Germanischer Lloyd. It also delegated all aspects of the ISM survey and audit to GL.

2.6.3 Classification Society - Germanischer Lloyd

No evidence was seen to suggest that the collapse was directly due to a mechanical failure in the portable bulkhead system as approved by GL.

Germanischer Lloyd was the classification society which originally approved the design of *Neermoor*. The drawings of the bulkheads, pins and latching arrangements indicate they were examined by GL on 29 October 1993. It would appear that the primary purpose of this examination was to ascertain that the portable bulkheads were structurally fit for the purposes of dividing the cargo, and to ensure the vessel met the requirements of the International Grain Code. The bulkhead designs were not examined from the perspectives of maintainability or operation, and therefore these aspects were not earmarked for periodic 'class' survey.

Similarly, SeeBG approved GL's work against the standards required by the International Grain Code and their approval also did not address maintainability or operations issues.

With GL having decided that the bulkheads were not subject to 'class' survey, the responsibility for establishing their maintenance and safe operational procedures should then have devolved to the owners/managers of the vessel. They, however, did not recognise the safety critical nature of the bulkheads, so dedicated maintenance documentation and procedures as part of the ship's SMS were not produced.

The Flag State had also delegated to GL full responsibility for certifying and subsequently the auditing of *Neermoor*'s SMS. One shortcoming of the ISM system is that a complete audit of an SMS is seldom ever conducted. Auditors will decide the

scope of their audit, and will investigate, in depth, areas deemed to be deficient, the so-called “sampling process”. Unless an auditor chooses or has reasons to review the procedures for maintaining or operating the portable bulkheads, the supporting SMS will not be subject to scrutiny. No evidence has been found to indicate that the portable bulkhead maintenance and operating procedures were audited or, if they were, that any deficiencies were noted. Given the shortcomings in both sets of procedures identified in this investigation, it appears likely that auditing of the portable bulkhead system has never occurred.

The lack of any ongoing formal survey regime applicable to the portable bulkhead system contributed to this accident, as the gradual deterioration of the system continued undetected.

2.6.4 Port State Control

Records of inspection for *Neermoor* show that the cargo hold areas had not been inspected since August 2003. This might, in part, be due to difficulties in obtaining safe access to empty holds during a period when cargo was not being worked.

2.6.5 Inspection and survey weakness

Decisions made during the design and build of a vessel are critical to its safe operation. In deciding that the portable bulkheads were of interest only as regards their ability to resist the loads applied to them, GL staff did not review and endorse the maintenance and operation aspects of their design. Had GL reviewed these aspects, it is likely that the design shortcomings identified above would have been noticed, and either rectified or mitigating measures put in place. Although, since *Neermoor*’s build, there had been many opportunities for numerous surveyors, technical superintendents and ship’s officers to identify the safety critical nature of the portable bulkhead pins and latches, none had done so. To say they were lulled into a false sense of security because the portable bulkheads were not a ‘class’ item might be an over-statement. However, it is almost certainly the case that, had the inter-relationships of the under-bulkhead packing piece, the sloping pin recesses in the hold sides, correct lifting methods and the pin latches, been identified at build, this accident would not have happened.

2.7 PERSONNEL AND MANNING

2.7.1 Role of the mate

The mate was responsible for the maintenance of the bulkhead and any lifting or moving operation. However, he was very seriously handicapped in carrying out his responsibilities as he had not been given any clear guidance or training in operating the bulkhead safely, and there were no written procedures on board for him to refer to. His predecessor’s handover was short and included a brief verbal explanation, but no demonstration of their operation.

Despite having joined the ship only the week before, it is possible that the mate could have made more effort to learn about the operation of the bulkheads as he had no previous experience upon which to draw. However, Company SMS instructions, designers/manufacturers equipment manuals, and even the most basic risk assessment, were not available to him to study, as they were not on board.

2.7.2 Responsibilities and supervision

It was the master's responsibility to ensure that the mate clearly understood the operation of the portable bulkheads and his role in overseeing their use and maintenance. On this occasion, the master did not specify when the bulkhead was to be lifted; and he did not allocate clearly the individual roles and responsibilities. The two ABs were left to operate the bulkhead unsupervised.

The mate failed to check the security of the bulkhead before ordering the crew into the hold. The two ABs who were undertaking the operation were working unsupervised. They had no work instructions, little or no training in the operation of the bulkhead, and they, too, failed to check the securing pins.

In summary, there appears to have been no concerted attempt to manage or plan what was potentially one of the most hazardous operations on board *Neermoor.*

2.7.3 Coastal and short sea trades

It is widely recognised that the short sea trade is a highly competitive business. The margins can be small, and quality cargoes at viable freight rates are difficult to secure. It is acknowledged that crew costs remain one of the largest operating overheads for the owner. Consequently, the number of crew specified on the Minimum Safe Manning Document becomes vital to the cost effectiveness of the vessel. Overheads are trimmed by utilising the master as a watchkeeping officer, working a 2-watch system with the mate. It is incumbent upon owners and managers to ensure that the masters of their vessels are not placed in a position where night watches are kept by lone watchkeepers, while the limited crew are tasked elsewhere.

The operating company should always carefully assess the risks involved in operating their vessels; including the manpower which is required to ensure routine tasks can be completed safely before making an application for a Safe Manning Document. Manpower requirements should be frequently re-assessed to ensure they remain valid for the trading pattern, change of routes, or any other significant change to the operation.

2.8 LOOKOUTS AND MINIMUM MANNING

The master and the mate of *Neermoor* kept navigational watches alone, during a night passage in busy waters close to the UK coast. The requirement that a lookout be used, particularly during the hours of darkness, is well set out and known to seafarers. However, numerous investigations have shown that these requirements are frequently not implemented.

Neermoor was being operated with the number of crew necessary to comply with the statutory requirements of the Minimum Safe Manning Certificate. When the only available ABs are used for other deck duties, they cannot be available as lookouts. If other work, such as hold cleaning in this case, needs to be undertaken while on passage, the manning of the vessel should reflect the workload demanded of the crew. Alternatively, the schedule should be adjusted to allow hold cleaning to be undertaken in daylight, or at anchor or alongside.

For some reason, the master used his crew to commercial advantage, rather than in the interests of safety. This indicates a need for the owners of *Neermoor* to provide detailed, specific guidance on the correct use of manpower, and adequate crew resources to their master.

2.9 LOAD LINE REQUIREMENTS AND GOOD SEAMANSHIP

Neermoor's hatch covers were partly open while on passage. This was a significant departure from the conditions of assignment of the ship's load line, and was potentially a dangerous practice.

Good seamanship must always be exercised, regardless of the type of ship or its area of operation. Flooding is a constant source of danger to the safe and efficient operation of any ship, and these dangers had not been appreciated or they had been underestimated by those on board.

At sea, masters may of course use their discretion as to the occasions on which they may wish to open the hatches when necessary (as in this case) for ventilation, inspection, cleaning or preparatory work associated with the next working of cargo[24]. However, inadequate hold ventilation should not be compensated for by poor seamanship practice. If additional ventilation or natural light is required, then the ship's schedule should be adjusted to allow the hatch covers to be opened in appropriate circumstances. To open the hatches while transiting the coastal waters of the English Channel, at night, with no lookout was not appropriate.

2.10 FATIGUE – HOURS OF WORK AND REST

2.10.1 Hours of work records

The requirement for maintaining and monitoring hours of rest records is clearly articulated and should have been incorporated within the SMS.

The Seafarers Fatigue Steering Group has found evidence to suggest that inaccuracies in rest hours reporting are common throughout the industry. Accurate reporting by the master and crew is essential if companies are to obtain a meaningful interpretation of the rest hours achieved, analyse the results, and implement measures to rectify deficiencies.

2.10.2 Fatigue and the *Neermoor* accident

Despite the lack of formal records, using other information obtained on board, it was possible to gain some understanding of work patterns aboard *Neermoor.* The majority of the crew were subjected to a demanding regime and were likely to be fatigued. The ABs had been involved in the final stages of cargo discharge in Southampton; had unberthed the ship; had spent the night cleaning the hold before anchoring the next morning; and had returned to the hold to finish cleaning before the ship was alongside. They would certainly have been tired after this work, if not suffering from longer term effects of fatigue.

Typical effects of this fatigue might include slow reactions, and slips and lapses in decision making. Any or all of these effects could have contributed to this accident, but were unlikely to be causal factors.

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[24] Load line Instructions MSIS003/Part3/Rev 1.02/Page 2/S 3.2.4

SECTION 3 - CONCLUSIONS

3.1 SAFETY ISSUES

The following safety issues have been identified in the MAIB investigation. They are not listed in any order of priority, but in the order in which they appear in the analysis:

1. Poor design meant that bulkheads had to be lifted to allow thorough cleaning of the hold between each cargo, even if they were not to be moved. [2.3.1]

2. The bulkhead fell because the securing pin safety latches were unable to resist the forces applied to them during the incorrect lifting of the bulkhead; the pins then became disengaged. [2.3.1, 2.3.2]

3. Poor design meant that the bulkhead securing system was unnecessarily difficult to survey/inspect or maintain, and was potentially dangerous to those maintaining it. The maintenance regime on board was inadequate, as were maintenance records. [2.3.3, 2.4.1]

4. Poor design meant that it was unnecessarily difficult and potentially dangerous to check the position of the securing pins and their safety latches. There was no established procedure to check and record that the main securing pins and associated latches were fully engaged, and that they remained in a safe condition at all times. [2.3.4, 2.5.3]

5. The ergonomics of the bulkhead lifting system were poor – it was necessary for the operators to be positioned within the danger zone while lifting the bulkhead. The lifting equipment used was not that originally specified, and the operators failed to recognise the importance of using the correct equipment. [2.3.5, 2.5.2]

6. Onboard documentation was inadequate, and did not facilitate safe operation and maintenance of the bulkhead arrangements fitted to *Neermoor.* Critical parts and their dimensions were not identified. Management and monitoring by owners was ineffective and poorly targeted. [2.4.1, 2.4.2, 2.5.1, 2.5.4]

7. Critical risk assessments, SMS procedures, instructions and other vital documentation was not on board, and this had not been noticed during inspections or surveys by the master, owner's superintendents, company internal auditors, classification society auditors/surveyors or PSC inspectors. [2.5.1, 2.5.3, 2.5.4]

8. The portable bulkhead system hardware had not been subjected to any meaningful inspection or survey regime. [2.5.2, 2.6.1, 2.6.2, 2.6.3, 2.6.4, 2.6.5]

9. The mate lacked experience, familiarisation and training in the inspection, operation and maintenance of the portable bulkhead system. The ABs involved in the incident faced similar handicaps and were not supervised. [2.7.1, 2.7.2, 2.7.3]

10. The master's management of the overall bulkhead system and its operation was poor. [2.7.2]

11. Both the master and the mate failed to obey regulations regarding the requirement for lookouts during a navigational watch. This matter was not adequately addressed by Company instructions within the SMS. [2.8]

12. The master and mate did not exercise good seamanship regarding the watertight integrity of the ship during the ballast passage. No appropriate guidance was provided by the Company. [2.9]

13. The SMS did not adequately address hours of work and rest issues. Regulations regarding recording of hours of work and rest were not adhered to, and findings suggest that maximum hours of work/minimum rest were habitually exceeded aboard *Neermoor*. [2.10.1, 2.10.2]

SECTION 4 - ACTIONS TAKEN

4.1 KAPITAN SIEGFRIED BOJEN SCHIFFAHRTSBETRIEB, MOORMERLAND, GERMANY

4.1.1 Incident report

The Company has issued an incident report, containing a short narrative of events and corrective actions identified:

- *When the bulkhead is rigged in the hold the crew should ensure that all four securing bolts are fully extended, and all four securing devices are functioning and in place.*

- *Whenever the portable bulkhead is secured in a single position, whether in use or stowed, the bolts are to be checked at regular intervals to ensure that the securing devices (catchers) are functioning and that the bolts have not partially retracted.*

4.1.2 Company circular

Kapitan Siegfried Bojen Schiffahrtsbetrieb has issued a circular to all ships in its fleet that are fitted with similar equipment, advising masters to check the securing pins and locking devices as soon as possible. Masters are referred to Company Fleet Instructions/Operations Deck number 06 and Fleet Instructions/Safety Management number 20.

4.1.3 On board safety meetings

Masters have been directed to discuss the importance of the securing and locking devices during the next on board safety meetings.

4.1.4 Repairs to the damaged aft bulkhead

The aft portable bulkhead was landed ashore for repairs and was surveyed by class and independent surveyors upon completion.

4.2 GERMANISCHER LLOYD

4.2.1 Survey of the damaged bulkhead

On 9 May 2006 GL undertook a Non-Periodical survey of the aft bulkhead that was damaged during the accident. The report states:

> *Aft grain bulkhead has been repaired ashore…Also securing pins were overhauled and the pin locking latches have been renewed. It was verified that when grain bulkhead is in position, all four securing pins and locking devices are in position.*

SECTION 5 - RECOMMENDATIONS

Kapitan Siegfried Bojen Schiffahrtsbetrieb is recommended to:

2006/223 Review its procedures, including authorisation and manning requirements for the safe movement of portable bulkheads.

2006/224 Conduct a full review of its SMS procedures and instructions relating to the lifting and movement of portable bulkheads for all vessels in its fleet that are fitted with similar portable bulkheads. This should include:

- Promulgation of revised operating instructions, including the need for periodic checks of the securing pins.
- Promulgation of revised maintenance instructions.
- Provide a means that will:
    - Readily indicate the engaged and disengaged positions of the portable bulkhead main securing bolts, and
    - Clearly indicate that the associated locking devices are in place.

2006/225 Establish and implement a policy guarding against the inappropriate opening of hatch covers while a vessel is at sea.

2006/226 Impress upon their masters, the importance of the following fatigue and STCW related issues:

- Encouraging masters to report if they are aware that they, or their crews, have not received adequate rest and ensuring that accurate records of hours of work and rest are maintained at all times.
- Ensuring that masters understand the importance of fully complying with the STCW and other legal requirements for keeping a safe lookout.

Classification Society Germanischer Lloyd is recommended to:

2006/227 Conduct a comprehensive review of the survey and certification requirements relating to portable bulkhead systems on both new build and in-service vessels. This review should include the need for effective maintenance and safe operating procedures to be incorporated into vessel Safety Management Systems. The findings of this review should be further promulgated through IACS.

2006/228 Conduct a full review of the SMS procedures and instructions relating to the operation and maintenance of portable bulkhead systems fitted to all ships of the Kapitan Siegfried Bojen Schiffahrtsbetrieb fleet that are classed with GL.

The Secretariat of the Paris Memorandum of Understanding on Port State Control is recommended to:

2006/229 Bring to the attention of the Port State Control Committee/MOU Advisory Board the issues raised in this report, and the importance of reviewing the documented bulkhead operating procedures and, whenever possible, inspecting portable bulkhead systems when conducting PSC inspections of vessels fitted with this type of equipment.

The Antigua and Barbuda, Germany, Netherlands and United Kingdom Flag Administrations (as the main flag administrations for vessels with portable bulkheads) are recommended to:

2006/230 Review their requirements for the design approval, survey and inspection of vessels fitted with portable bulkhead systems. The review should, in addition, ensure that Safety Management Systems for the efficient maintenance and safe operation of portable bulkhead systems are checked for effectiveness.

Marine Accident Investigation Branch
December 2006