Report on the investigation

of a hazardous diving incident

involving

MV *Norma*

in the Dover Strait

on 21 June 2008

Marine Accident Investigation Branch
Carlton House
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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

A	-	Ampere(s)
ACOP	-	Approved Code of Practice
ADC	-	Association of Diving Contractors
BA	-	British Admiralty
BV	-	Bureau Veritas
DoC	-	Document of Compliance
DWR	-	Diving at Work Regulations
HSE	-	Health and Safety Executive
IACS	-	International Association of Classification Societies
ICS	-	International Chamber of Shipping
IMCA	-	International Marine Contractors Association
ISM Code	-	International Management Code for the Safe Operation of Ships and for Pollution Prevention
ISO	-	International Standards Organisation
kW	-	kilowatt
MCA	-	Maritime and Coastguard Agency
MGN	-	Marine Guidance Note
OOW	-	Officer of the Watch
RIB	-	Rigid inflatable boat
SMC	-	Safety Management Certificate
SMS	-	Safety Management System
STCW	-	International Convention on Standards of Training, Certification and Watchkeeping, incorporating the 1995 amendments
TSS	-	Traffic Separation Scheme
UTC	-	Universal co-ordinated time
VHF	-	Very High Frequency
VSP	-	Voith Schneider Propeller

Times: All times used in this report are UTC +1

Norma

SYNOPSIS

At 1125 on 21 June 2008, a diver entered the water from the Belgium registered self-propelled crane barge *Norma* in order to replace a line marking the position of the wreck of a German submarine which had been sunk during World War One off the 'Varne' bank in the Dover Strait. As the diver descended to a depth of about 20m, the umbilical cord containing an air supply became entangled in the vessel's aft Voith Schneider propeller, and the diver was dragged towards its rotating blades. The diver's air supply was also pulled from the deck but the diver succeeded in transferring to a bottled air supply before it severed. The diver was approximately 3m from the rotating propeller when the propeller was stopped by the vessel's chief engineer. The diver then managed to cut himself free and make his way to the surface from where he was recovered without injury.

The investigation identified a number of factors which contributed to this hazardous incident, including:

- The control system for the vessel's propulsion had recently been installed, and no procedures for its use had been developed and no familiarisation training had been provided.
- Neither the OOW nor the master verified that the propellers were stopped or informed the engine room that diving operations were about to take place.
- The procedures for diving operations in the vessel's safety management system lacked detail and were not sufficiently robust. They placed an undue reliance on the effectiveness of procedures followed by the embarked diving contractor.
- Diving operations had not been identified as a key shipboard operation by the ship manager or by external audit.

Following the incident, Scaldis Salvage & Marine Contractors N.V, the vessel's manager, and Northern Diving Ltd, the diving contractor took immediate steps to prevent a recurrence. Details of the incident and lessons to be learned have been promulgated to the shipping industry by a flyer published by the MAIB and by a safety alert issued to diving contractors by the International Marine Contractors.

Recommendations have been made to the Maritime and Coastguard Agency, the Health and Safety Executive, the International Marine Contractors Association, the Association of Diving Contractors and the International Chamber of Shipping aimed at ensuring that guidance on the safe conduct of commercial diving operations involving merchant vessels is readily available. Recommendations have also been made to the International Association of Classification Societies and Scaldis Salvage & Marine Contractors N.V. to improve the effectiveness of safety management audits.

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *NORMA* AND ACCIDENT

Vessel details

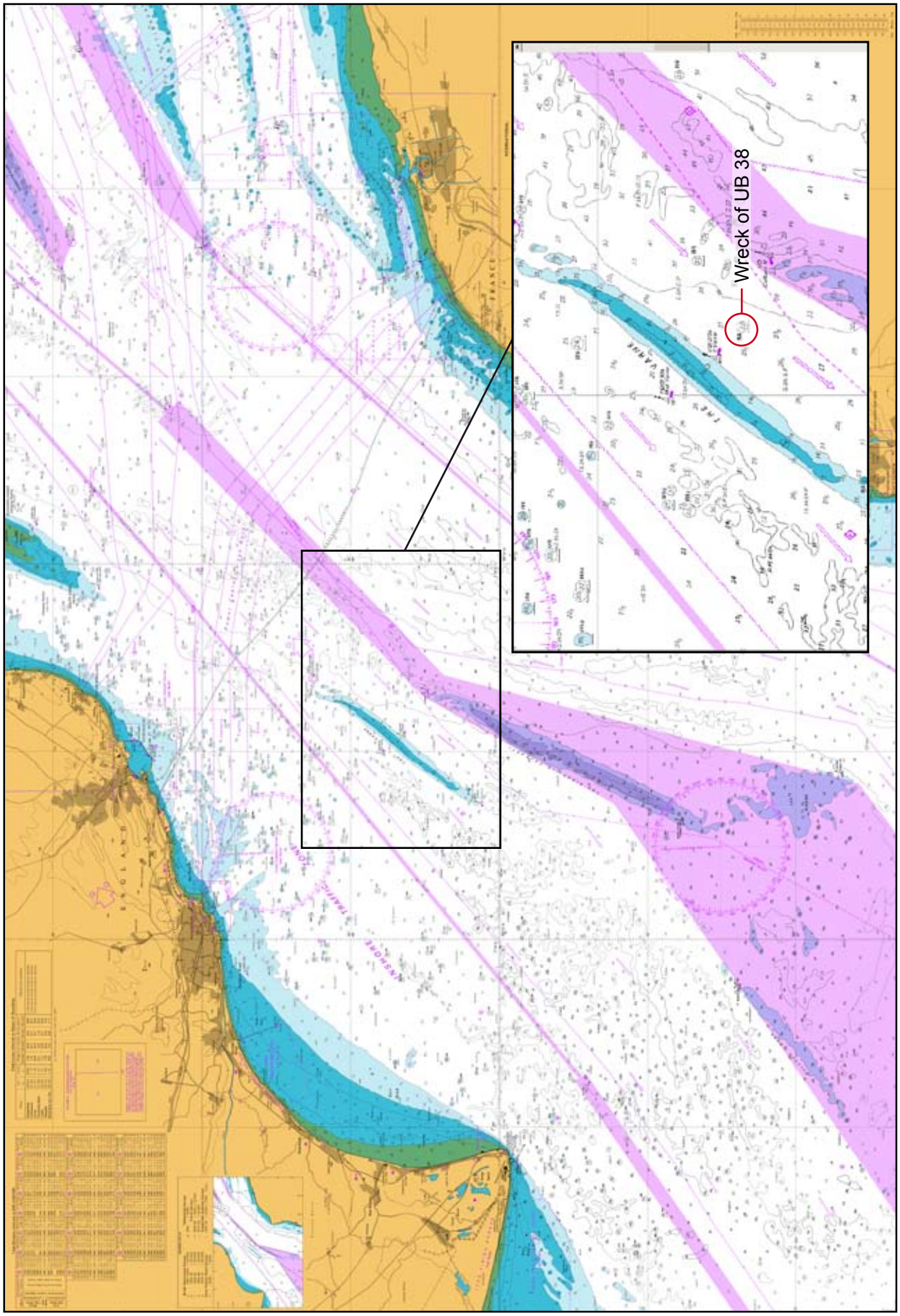
Manager(s)	:	Scaldis Salvage & Marine Contractors N.V.
Port of registry	:	Brugge
Flag	:	Belgium
Type	:	Self-propelled heavy lift barge
Built	:	1969, Dordrecht, Netherlands
Classification society	:	Bureau Veritas
Construction	:	Steel
Length overall	:	82.44m
Gross tonnage	:	2371
Engine power and type	:	2944kW 4 x Lister Blackstone diesel engines
Service speed	:	5 knots
Other relevant info	:	2 x Voith-Schneider propellers Crane Capacity 440t at 7m

Incident details

Time and date	:	1125 on 21 June 2008
Location	:	50°57.8N and 001°21.6E Off the ‘Varne’ bank in the Dover Strait
Persons on board	:	31
Injuries/fatalities	:	None
Damage	:	None

Reproduced from Admiralty Chart BA 1892 by permission of
the Controller of HMSO and the UK Hydrographic Office

Figure 1



Extract of chart BA 1892 - Dover Strait

1.2 BACKGROUND

UB 38, a German naval submarine, was sunk to the east of the 'Varne' bank in the Dover Strait during World War One. Surveys conducted in 2005 showed that there were 23 metres of water over the wreck at the lowest astronomical tide **(Figure 1)**. As the wreck posed a potential risk to deep draught vessels using the south west lane of the Dover Strait Traffic Separation Scheme (TSS), Trinity House[1] decided to have it moved to deeper waters.

A consortium comprising Titan Maritime (UK) Ltd and Scaldis Salvage and Marine Contractors N.V. were contracted to undertake this task; Titan Maritime (UK) provided the diving and salvage expertise and Scaldis Salvage and Marine Contractors N.V. provided *Norma*, a vessel with a heavy lift capability.

1.3 NARRATIVE

1.3.1 Pre incident events

Norma, a Belgium registered self-propelled heavy lift barge departed the port of Newhaven at 2100 on 19 June 2008 along with *Eerland 26,* an anchor handling tug. On board *Norma* were 13 crew, a team of 12 divers and 6 other project-related personnel. She arrived on site at about 1100 on 20 June and her four anchors were laid out in preparation for the operation. *THV Alert* also attended as a guard ship.

By 1830 the master was satisfied that the vessel was holding her position, and ordered the engine room to switch off the electric motors to the Voith Schneider propellers (VSP). The first dive on the wreck took place during slack water at 2307. The diving supervisor requested the master's permission to commence diving, and this was given following the completion of the diving contractor's 'permit to dive'. The safety management system (SMS) on board did not require the vessel to complete a 'permit to work'. Diving operations were suspended at 2338 because the divers were unable to locate the wreck due to poor underwater visibility.

At about 0600 on 21 June, *Norma*'s anchors started to drag as the tide turned. The electric motors for the VSPs were restarted and the anchors were re-positioned to align the vessel with the direction of the tidal stream (south-west/ north-east). At 0930, the dive team located the wreck using sonar fitted to a rigid inflated boat (RIB), and marked its position with a marker buoy attached to a lightweight shot line[2]. *Norma* was then manoeuvred closer to the wreck.

At about 1000, the master instructed the Officer of the Watch (OOW) on the bridge, via VHF radio, to switch off the propulsion motors. The OOW was the second officer and he responded by turning the steering control switch, which was

[1] The Corporation of Trinity House is responsible for wrecks that are a danger to navigation outside port limits but within UK territorial waters.

[2] A shot line is a line attached to a weight that sits on the sea bed or wreck and is held at the surface by a buoy. This provides the diver a reference point between the surface marker and the dive site below.

sited on the Voith Schneider propeller (VSP) control panel **(Figure 2)**, to the off position. He then called the master using VHF radio and informed him that the motors had been switched off. The second officer did not inform the engine room that the electric motors were no longer required.

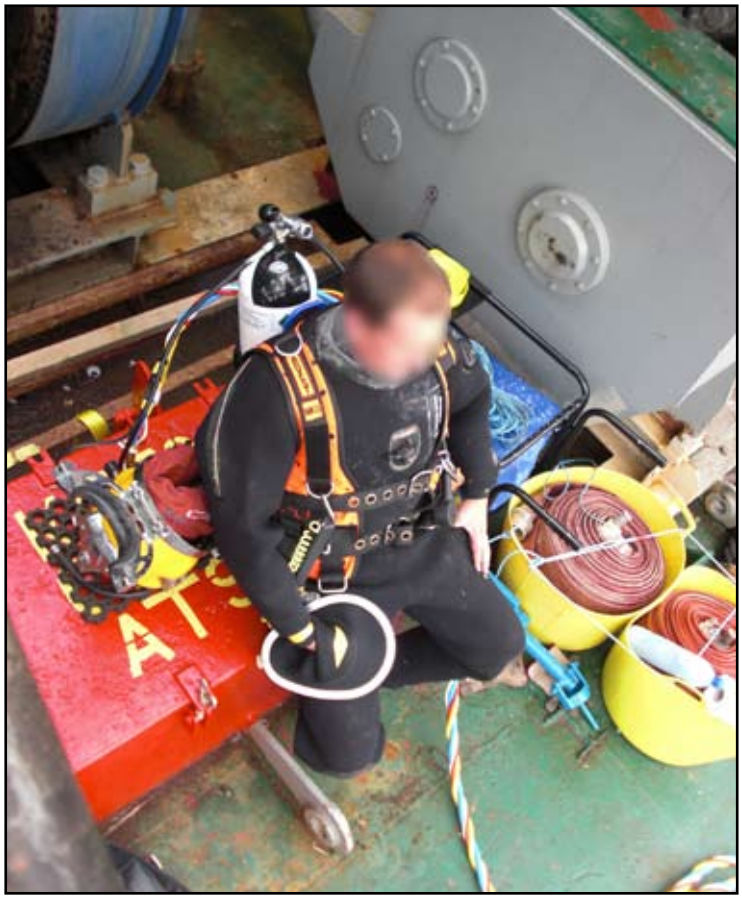
Figure 2

Propulsion and steering control panel

At about 1100, the master was on the bridge, where he saw that the switch on the VSP control panel was in the off position. At 1115, the diving supervisor approached the master for permission to resume dive operations. This was given after the contractor's 'permit to dive' was again completed **(Annex A)**. The duty engineer was not informed of the impending diving operation.

The purpose of the dive was to replace the light shot line with a 32mm polypropylene rope. The diver entered the water at 1125 using a full diving suit **(Figure 3)** and was attached to an umbilical cord which provided him with air, communications and a video link. The diver reported to his diving supervisor that the tide was slightly stronger than expected, but that he was happy to descend. About 3 minutes after leaving the surface he informed the diving supervisor that he was having difficulty because of tension on the umbilical cord. When he reached a depth of 20 metres, he reported that he could hardly move, and asked the diving supervisor if the surface crew were pulling on his umbilical cord. In response, the diving supervisor replied that they were not and, when the diver remarked that he wanted to come up, the supervisor told him to let go of the shot line and surface.

Figure 3



Diving suit

As the diver started to ascend, he was pulled violently by his umbilical cord and the polypropylene rope towards the vessel's stern. At the same time, the surface crew were unable to hold onto the diver's umbilical as it tightened, and the coiled airline was rapidly whipped from the deck along with the polypropylene rope. The umbilical cord ran free until it reached the last few coils of airline secured to a door on the vessel's aft deck. At this point, the umbilical cord severed and communications with the diver were lost.

The supervisor immediately contacted the bridge on VHF radio and was informed by the master that the VSPs were not running. However, the master quickly called the engine room and was told by the chief engineer that the VSP motors were running in neutral. The chief engineer immediately switched them off. The standby diver was deployed and a RIB was launched at 1137 to search for the now missing diver.

Meanwhile, the diver had been rotating violently and had realised that he was being dragged towards the aft VSP **(Figure 4)**. He was unable to cut his umbilical cord but managed to turn on the air supply from his bail out bottle[3]. When the VSP finally stopped, he was about 3 metres away. He was then able

[3] A cylinder with an emergency supply of air.

Figure 4

Voith Schneider propeller

to cut himself free; he climbed above the entangled coil of umbilical cord and pulled himself to the surface on the polypropylene rope. The diver surfaced towards the vessel's stern at about 1155. He removed his helmet and shouted for assistance. He was recovered from the water and, although suffering from shock, the diver was uninjured.

1.3.2 Post incident actions

Diving operations were immediately suspended in order to investigate the circumstances of the hazardous incident. The anchors were heaved up and, at about 1700, *Norma* headed towards Dover so that her fouled VSP could be cleared.

The following morning, the project team and the vessel's senior management agreed measures to isolate the vessel's propulsion. These included the placement of warning signs on the VSP switchboard in the engine room **(Figure 5)** and the use of 'emergency stop' switches, which disabled the VSP's starting circuit from the bridge **(Figure 6)**. A 'permit to work' system covering diving operations was also implemented **(Annex B)**.

With the aft VSP cleared of the remnants of the umbilical cord and polypropylene rope **(Figure 7)** *Norma* departed Dover at 1545 on 24 June to return to the dive site. The relocation of *UB38* was successfully completed on 14 July despite several delays due to bad weather.

Figure 5

Warning sign on VSP switchboard

Figure 6

Emergency stops on bridge -
measures to isolate motors from activation

Figure 7

Recovery of umbilical cord and shot line in Dover

1.4 ENVIRONMENTAL CONDITIONS

At the time of the incident, the weather was good. The wind was from a west-south-west direction, force 2 and the sea was slight with a low swell **(Figure 8)**. High water at Dover was at 1339 and the predicted tidal stream at 1139 was 0.4 knot in a south-westerly direction.

Figure 8

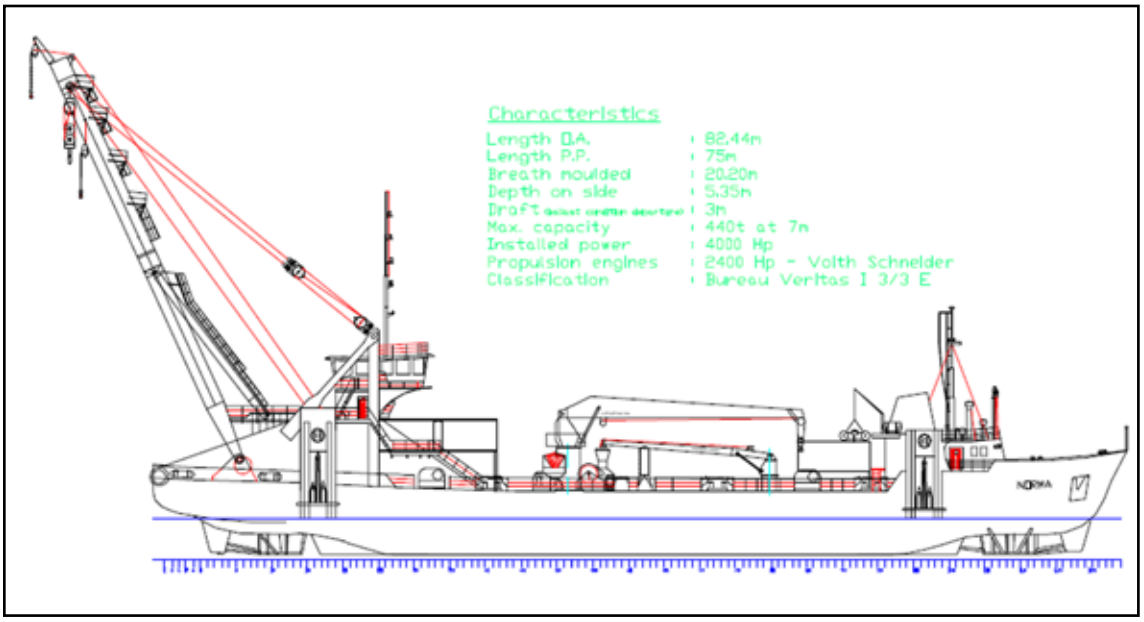
Weather-view of diver before entering the water

1.5 *NORMA*

1.5.1 Description

Norma was built in 1969 as a stone dumping barge for use in the construction of dykes in the Netherlands. She was later sold and converted to a self-propelled crane barge and fitted with a heavy lift crane **(Figure 9)**. The vessel's core activity was marine heavy-lifting, but she was also involved in other marine related activities and had previously been used as a diving platform in conjunction with lifting and salvage operations. A record of the vessel's history since 2005 is at **Annex C**. Immediately before the incident, *Norma* had sailed from Zeebrugge, Belgium on 16 June and arrived in Newhaven the following day. The vessel was managed by Scaldis Salvage and Marine Contractors N.V.

Figure 9



Profile plan of *Norma*

1.5.2 Propulsion

The vessel's propulsion system consisted of two Voith Schneider propellers, each rated at 1200 hp and located forward and aft **(Figure 4)**. The propellers were driven by independent electric motors directly coupled via a reduction gearbox. At least three of the vessel's four diesel generators were required to be running to enable the propulsion system to be operated.

The electric motors were started from the VSP switchboard sited in the engine control room. Once running, the VSP units idled at 650 RPM in neutral pitch and each drew about 500A of electrical current. Control of the pitch was via the steering control system, which was switched on and off at the VSP control panel on the bridge **(Figure 2)**. The control panel was also fitted with ammeters to indicate the power drawn by the units **(Figure 10)** along with emergency stops, which had to be depressed in a locked position. When activated, the emergency stops broke an electrical circuit, and the engines could not be restarted unless the bridge stops were reset.

The VSP control system was installed between January and May 2008. On completion, the system, including the emergency stops, was tested to the satisfaction of the attending Bureau Veritas surveyor, master, chief engineer and company superintendent on 22 May 2008. No instruction manuals or familiarisation training was provided to the bridge team.

The engine room was permanently manned when *Norma* was underway, and watches were shared between the chief engineer and second engineer on a 6 on/6 off basis.

Figure 10

Ammeters on bridge control panel

1.5.3 Crew

General

The vessel was manned in excess of the minimum requirements established by the Belgium administration. The crew consisted of north European officers and ratings, with the exception of the steward, who was from Cape Verde. Apart from key personnel such as the master, chief engineer and bosun, most of the crew were employed specifically for the project through a crewing agency.

Master

The master was a Belgium national and held an officer in charge of a navigational watch licence (STCW[4] II/I) with a master's endorsement that allowed him to be in command of *'contracting material'*[5] vessels within 200 miles of the coastline. Before joining Scaldis in September 2006, he had served mainly on board dredgers as a second mate. He was promoted to chief officer in October 2006 and to master on joining *Norma* in January 2008.

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[4] International Convention on Standards of Training, Certification and Watchkeeping, incorporating the 1995 amendments.

[5] Contracting material means dredgers, tugboats and supply vessels for offshore installations.

Second officer

The second officer was a Dutch national who held an unlimited master's certificate of competency (STCW II/2). He joined the vessel on 14 June for a short-term contract until 23 June.

Chief engineer

The chief engineer was also a Dutch national, and had a certificate of competency which allowed him to sail as a chief engineer (STCW III/3) on '*contracting material*' vessels**.** He had sailed in the rank of chief engineer for 33 years but had also worked ashore in various capacities. He joined Scaldis in November 2007 and this was his second contract on board *Norma*.

1.5.4 Safety management system (SMS)

The working language on board *Norma* was English, although a number of onboard procedures were also written in Dutch. The procedures covered key shipboard operations and were supported by appropriate checklists. The SMS also contained a safe work instruction titled '*Interference with diving operations* (sic)' which required the vessel to check all items on checklist ref.SCF-26-056 'Diving Subcontract' before the start of diving activities to ensure that the procedures and documentation of the diving contractor were sufficiently robust. This checklist was not on board at the time of the incident and there was no other guidance or procedure on board regarding diving operations.

1.6 VESSEL'S ISM CERTIFICATION

Norma was required to comply with the International Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code). Following an initial audit conducted by Lloyd's Register on 17 June 2002, the classification society issued a safety management certificate (SMC) on behalf of the Belgium administration. A periodic SMC audit was conducted in July 2005 but the vessel's ISM certification lapsed in June 2007 on expiry of her SMC. Interim SMC audits were conducted by Lloyd's Register in October 2007, prior to the vessel's employment on a jetty removal project, and again on 14 June 2008, before the vessel's mobilisation to relocate *UB38.* The latter of these audits highlighted a significant number of observations[6] and an interim SMC was issued on 16 June 2008, only after an auditor had verified these observations had been addressed or that corrective action was in hand. The audit report indicated that an initial audit was to be completed before the expiry of the interim certificate, which was 15 December 2008. An extract of the ISM Code relevant to interim certification is at **Annex D**.

1.7 SCALDIS SALVAGE AND MARINE CONTRACTORS N.V.

Based in Antwerp, Belgium, Scaldis was established in 1997 to provide services in marine civil engineering, oil and gas, and heavy-lift salvage projects. In addition to *Norma*, the company also manages *Rambiz*, a non-propelled heavy

[6] Observation means a statement of fact made during a safety management audit and substantiated by objective evidence.

lift barge. The company's Document of Compliance (DoC) was issued by the Belgium administration on 16 July 2007 following the completion of a verification audit by Lloyd's Register.

The company is accredited through Lloyd's Register to ISO 9001:2000 quality standards and the VCA[7] safety assurance system. Both certificates are applicable to:

> *'Salvage, wreck removal, marine heavy lifting & associated marine works'.*

Scaldis does not directly employ divers. In projects where its vessels have been used as diving platforms, separate contractors have conducted the dive operations. Recent projects undertaken by the company have been within UK territorial water and, in order to comply with UK regulations the company has embraced most of the requirements of the Health and Safety Executive (HSE)[8]. At the time of the incident, it was in the process of updating its procedures to align with UK requirements.

An internal audit of the safety management system on board *Norma*, which was conducted by Scaldis between 11 and 12 June 2008, did not identify any non-conformities or observations.

1.8 NORTHERN DIVERS (ENGINEERING) LTD

Northern Divers (ENGINEERING) Ltd (Northern Divers) was founded in 1963. It provides a range of underwater services and is equipped for commercial diving to a depth of 50 metres and out to 12 miles from the shore. The company maintains a quality management system and is accredited to ISO 9001-2000 by UK-AS[9]. It is a full member of the Association of Diving Contractors (ADC).

Northern Divers was contracted by Titan Maritime (UK) to provide diving services and expertise required to relocate *UB38*. In accordance with The Diving at Work Regulations 1997 (DWR), the company produced a diving project plan[10]. It also provided a diving project team on board *Norma* which consisted of 12 commercial divers qualified to HSE Part 1 standards, two of which also held ADC supervisors' certificates, and were nominated as diving supervisors.

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[7] Veilgheidess Checklist voor Aanemeri is a safety checklist used by contractors in harbour and chemical industries. The required accident rate for accreditation is below 20. Scaldis scored 16.1 on 1 million labour hours over 3 years.

[8] The HSE is responsible for the protection of people against risks to health and safety arising from work activity in Britain.

[9] The United Kingdom Accreditation Service is the sole national accreditation body recognised by government to assess, against internationally agreed standards, organisations that provide certification, testing, inspection and calibration services.

[10] A diving project plan is based on an assessment of the risks to the health and safety of any person taking part in the diving project and may include the diving contractor's standard operating rules and generic risk assessments.

1.9 THE DIVING AT WORK REGULATIONS 1997

Commercial diving activities are regulated by The Diving at Work Regulations 1997, which apply to diving projects in support of civil engineering, marine related projects, salvage operations and fish farming conducted inshore within UK territorial waters and includes 'in water' hull inspections. The enforcement of these regulations lies with the HSE through its Offshore Safety Division.

Regulation 4 of the DWR requires:

> '*Every person who to any extent is responsible for, has control over or is engaged in a diving project or whose acts or omissions could adversely affect the health and safety of persons engaged in such a project, shall take such measures as it is reasonable for a person in his position to take to ensure that these Regulations are complied with.'*

And

Regulation 8 requires:

> *'The diving project plan shall be based on an assessment of the risks to the health and safety of any person taking part in the diving project and shall consist of a record of the outcome of the planning carried out in accordance with regulation 6(1) including all such information and instructions as are necessary to give advice to and to regulate the behaviour of those so taking part to ensure, so far as is reasonably practicable, their health and safety.'*

1.10 APPROVED CODES OF PRACTICE

The DWR is supported by approved codes of practice (ACOP), which were developed jointly between the HSE and industry associations. There are five ACOPs covering the various sectors of diving operations. In this case, the code relating to *commercial diving projects inland/inshore* is relevant. Extracts of the ACOP relating to Regulations 4 and 8 of the DWR are at **Annex E**.

1.11 SHIPBOARD REGULATIONS AND GUIDANCE

1.11.1 Merchant Shipping (Diving Safety) Regulations 2002

Diving operations on board UK registered ships are regulated by The Merchant Shipping (Diving Safety) Regulations 2002. These rules only apply to diving projects undertaken from a UK ship when outside UK waters. In some cases these regulations may apply within UK waters if the diving operation is taking place from a craft where the master or owner is the diving contractor and where the DWR do not apply. The regulations do not cover diving projects that are already covered by the DWR.

The requirements of The Merchant Shipping (Diving Safety) Regulations 2002 are very similar to the requirements of the DWR but are not supported by any codes of practice.

1.11.2 The ISM Code

The ISM Code requires that:

> '*The Company should establish procedures for the preparation of plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the ship and the prevention of pollution. The various tasks involved should be defined and assigned to qualified personnel'.*

And,

> *'The Company should establish procedures to ensure that new personnel and personnel transferred to new assignments related to safety and protection of the environment are given proper familiarization with their duties. Instructions which are essential to be provided prior to sailing should be identified, documented and given.'*

1.12 PROFESSIONAL DIVING ASSOCIATIONS

1.12.1 International Marine Contractors Association (IMCA)

IMCA is an international trade organisation representing offshore, marine and underwater engineering companies. The organisation promotes good working practices particularly in the areas of health and safety, environmental, quality, and technical standards.

The objectives of the organisation are to achieve and sustain self-regulation in the industry, and provide the framework for training, certification, competence and recruitment to support and sustain the industry globally.

1.12.2 Association of Diving Contractors (ADC)

ADC represents diving contractors who work inland and inshore in the United Kingdom and Ireland. The objectives of the association are to promote commercial diving by establishing uniform safe standards and encourage industry wide observation of such standards and to encourage the enactment and enforcement of appropriate laws. It also monitors and advises members of current and proposed UK and relevant EC legislation, and issues general information notes connected with the industry.

1.13 SIMILAR INCIDENTS AND ACCIDENTS

In April 2003, a hazardous incident was reported to the HSE, which involved divers changing seals on a propulsion shaft while a vessel was alongside. Although the engines had been isolated and a diving permit to work was in place, the engines were started by the engineers shortly after a watch change. There were no reported injuries.

In July 2004, a diver was killed when he got sucked into an idling bow thruster of a container ship. The diving operation had commenced shortly after the vessel had come alongside and, although the master and chief officer had completed the contractor's checklist, the bow thruster had inadvertently been left running.

In November 2005 a diver died following a misunderstanding between the master and the dive team which resulted in the main pump to the vessel's bow thruster being started in error.

In February 2008, strong winds resulted in a vessel parting her forward mooring ropes. In order to check the swing of the bow, the vessel let go an anchor, which landed close to a diver. The bridge team had forgotten that a diver was working on the vessel's bow thruster and neither the vessel nor the diving contractor was following a permit to work system.

SECTION 2 - ANALYSIS

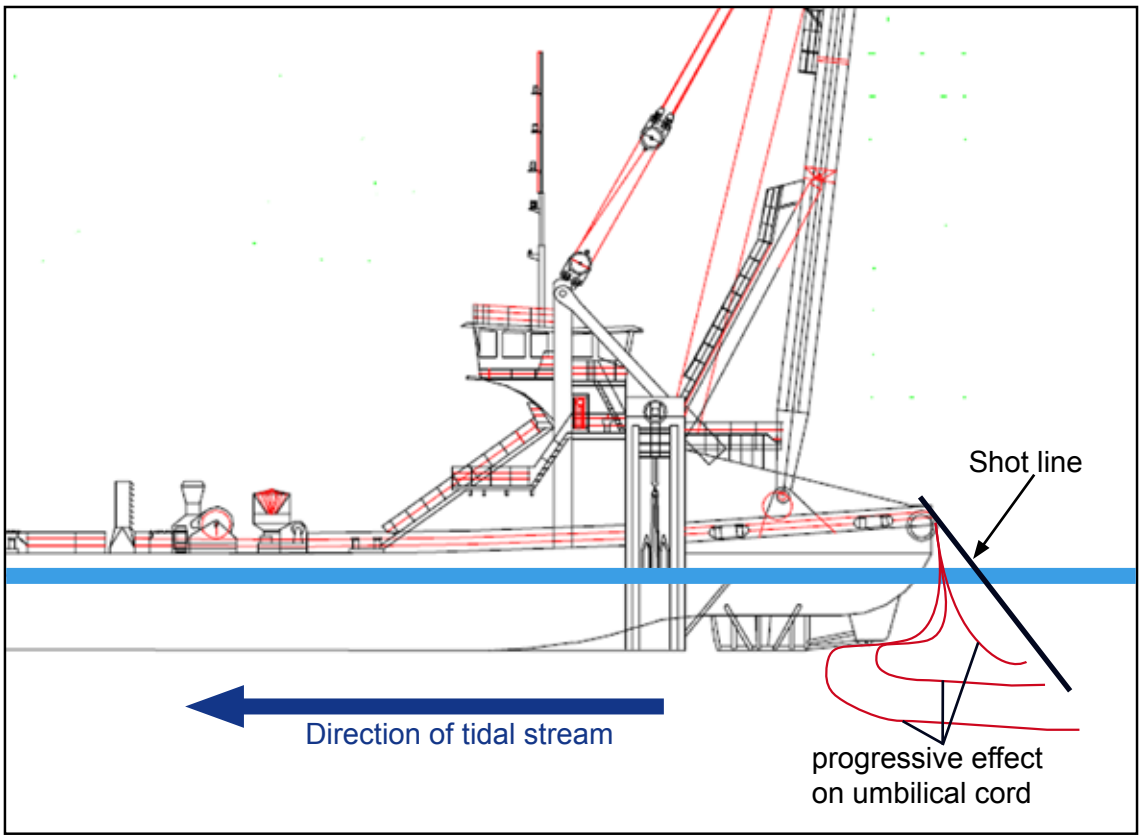
2.1 AIM

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

2.2 THE INCIDENT

As soon as the diver started his descent, it is evident that his umbilical cord and the polypropylene line he was carrying were swept under the vessel's stern by the prevailing tidal stream **(Figure 11)**. The cord and rope then became entangled in the vessel's aft VSP, which was idling on zero pitch, and the diver was reeled in to within 3m of its rotating blades. Loss of life or serious injury was only prevented by the rapid actions taken to stop the propulsion motors and the quick thinking of the diver to switch to his bail out bottle in what must have been an extremely harrowing situation.

Figure 11



Effect of tide on umbilical cord and shot line

2.3 PRE-DIVING CHECKS

The incident would not have occurred if the aft VSP had been stopped as intended. Although the OOW turned the steering control switch to the off position **(Figure 2)**, this only disengaged the control of the propeller pitch; the propellers continued to rotate. It is evident that the OOW was unaware that the VSPs

could only be stopped from within the engine room or by the activation of the emergency stops, and that the master's statement on the 'permit to dive' request **(Annex A)**, that the engines had been isolated, was not correct. It is also evident that neither the OOW nor the master checked the ammeters on the VSP control panel **(Figure 10)**, which would have provided an instant indication that the propellers were still turning. They also did not inform the engine room that diving operations were about to commence, which would have alerted the chief engineer to the potentially dangerous situation which was developing.

2.4 SAFETY MANAGEMENT

A number of shortcomings in the safety management of *Norma* undoubtedly contributed to this incident. In particular: procedures for the operation of the recently fitted VSP control system had not been developed; the second officer was not trained in its use; and no guidance on its operation was available. Moreover, although diving operations were central to *Norma*'s involvement with the removal of *UB 38*, reference to diving operations in the vessel's SMS lacked detail. The action required to be taken by the vessel was limited to the verification of the embarked diving contractor's suitability to undertake the required task via a checklist. No measures were required to ensure that the VSPs were immobilised, and the checklist referred to in the SMS to verify the contractor's suitability was not even held on board.

The implementation of a robust SMS is undoubtedly challenging when a vessel such as *Norma* is out of service for long periods and is only manned for specific projects **(Annex C)**. In such circumstances, there is inevitably a greater onus on the vessel's shore management to ensure that the crew is familiar with critical equipment, and that procedures are in place for all 'key shipboard operations', prior to mobilisation. It is clear these fundamental requirements of the ISM Code were not met on this occasion.

2.5 EFFECTIVENESS OF AUDIT

The absence of robust procedures to cover diving operations on board *Norma*, which was undoubtedly one of the vessel's key operations during her intended employment, was not identified during the company's internal audits or reviews; nor was it identified during the vessel's initial and periodic audits or the company's DoC audit conducted on behalf of the Belgian administration. This was possibly due, in part, to the vessel's disrupted audit cycle in which her ISM certification was allowed to lapse in June 2007 and April 2008 when the vessel was not in service, so that interim audits of the vessel's SMS had to be conducted in October 2007 and in June 2008.

Although disruptions in vessels' ISM audit cycles regularly occur on the change of ship manager or registration, the need for and use of consecutive interim ISM certification due to a vessel's operating pattern is unusual. Interim certification allows a vessel to operate within a specific period while its SMS develops. The criteria to be examined during interim verification **(Annex D)** are necessarily

centred on the provision and planned implementation of an SMS, which meets the objectives of the ISM Code and with which personnel are familiar and understand. The audit is therefore not an audit of records, because none usually exist, or to ensure that procedures are being followed. It is to check that the basic elements required to facilitate the implementation of those procedures and records are in place. Consequently, given the limited scope of the interim audit compared to other ISM audits, the possibility of diving operations being identified as a 'key shipboard operation' was reduced.

Furthermore, the 15 observations made during the interim audit in June 2008 raise doubt on the thoroughness of the ship owner's internal audit 2 days earlier, during which no deficiencies were recorded. Although audits are necessarily a sampling process, the identification of 'key shipboard operations' is fundamental to safety management and it is essential these are periodically reviewed against a vessel's employment or possible employment.

2.6 DIVING PROCEDURES AND GUIDANCE

Diving operations from ships range from salvage work and other offshore related projects, in which a vessel is used as a platform for protracted periods, to occasional underwater inspections or repairs. However, irrespective of the scale of an operation, it is important that both ships' operators and diving contractors have procedures in place to establish and maintain a safe working environment. A similar safe system of work is already encompassed within the tanker and bulk carrier sectors of the industry where ship/shore checklists must be completed before any cargo work can take place. This ensures that both parties have made a conscious effort to establish safeguards against all identified risks. This incident, along with the accidents and incidents highlighted in Section 1.13 illustrates that ship masters frequently place unwarranted reliance on a diving contractor's procedures alone.

Shipboard procedures are required to ensure that where a risk to a diver is identified, such as a turning propeller, adequate precautions are taken to remove the risk for the duration of the diving operation. In this respect, it is not sufficient for machinery or equipment to be shut down. Where possible, it should also be immobilised through system isolation or 'tag-out' procedures in order to prevent it being inadvertently re-started.

Within the UK, safety guidance is provided to commercial divers through various channels, including the ACOPs, and most commercial divers are generally aware of the generic risks involved in working on, from, or near vessels. This was reflected in the requirements of the 'permit to dive' request **(Annex A)**. However, although the responsibility for removing all shipboard risks rests with a vessel, there is no similar guidance available to ship owners and masters.

SECTION 3 - CONCLUSIONS

3.1 SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT WHICH HAVE RESULTED IN RECOMMENDATIONS

1. Although the use of divers was central to the vessel's employment, it was not identified as a 'key shipboard operation' by the vessel's managers, and the absence of robust procedures in this area was not highlighted during external ISM audits. [2.5]

3.2 OTHER SAFETY ISSUES IDENTIFIED DURING THE INVESTIGATION ALSO LEADING TO RECOMMENDATIONS

1. The large number of observations identified during the vessel's 14 June 2008 interim ISM audit raises doubt on the effectiveness of the ship manager's internal audit 2 days before. [2.5]

2. Irrespective of the scale of an operation, it is important that both ship operators and diving contractors have procedures in place to establish and maintain a safe working environment. [2.6]

3. Guidance on the risks faced by divers working from vessels and the precautions to be taken is not readily available to ship owners. [2.6]

3.3 SAFETY ISSUES IDENTIFIED DURING THE INVESTIGATION WHICH HAVE NOT RESULTED IN RECOMMENDATIONS BUT HAVE BEEN ADDRESSED

1. The master's statement that the engines had been isolated on the 'permit to dive' request **(Annex A)** was not correct, and neither the master nor the OOW checked the ammeters on the VSP control panel **(Figure 10)**, which would have provided an instant indication that the propellers were still turning. [2.3]

2. Procedures for the operation of the recently fitted VSP control system had not been developed, the second officer was not trained in its use, and no guidance on its operation was available. [2.4]

SECTION 4 - ACTION TAKEN

Diving Industry organisations

On 27 September 2008, ADC published a safety alert (ADC Safety Alert 3/08) **(Annex F)** promulgating the details of the incident and the safety lessons to be learned. The incident has also been promulgated by IMCA (IMCA Safety Flash 15/08).

The Marine Accident investigation Branch

The MAIB has issued a flyer to the shipping industry **(Annex G)** providing details of the incident and the lessons to be learned.

Scaldis Salvage and Marine Contractors N.V.

In addition to the action taken immediately following the incident, the vessel's owner has:

- Implemented vessel diving procedures in its safety management system.
- Reviewed its risk assessment on diving operations.
- Adopted a formal procedure which will ensure familiarisation, testing and the supply of instruction manuals for any new equipment that is to be supplied or fitted on board its vessels.
- Prepared an instruction manual for the operation of control systems on *Norma*'s Voith Schneider propulsion system.

Northern Divers (Engineering) Ltd

Following the incident, the diving contractor has reviewed its procedures and updated its 'permit to dive' checklist to take into account the lessons learned from this incident.

SECTION 5 - RECOMMENDATIONS

The **Maritime and Coastguard Agency, Health and Safety Executive, International Marine Contractors Association** and **Association of Diving Contractors** are recommended to:

2009/106 Under the lead of the Maritime and Coastguard Agency:

- Consolidate the guidance available for diving operations conducted from, or within close proximity to merchant vessels.
- Develop generic checklists where appropriate.
- Ensure such guidance is widely promulgated within the shipping and commercial diving industries.

The International Chamber of Shipping is recommended to:

2009/107 Through its membership promulgate the guidance for diving operations conducted from, or within close proximity to, merchant vessels as soon as this has been developed by the Maritime and Coastguard Agency, the Health and Safety Executive, International Marine Contractors Association and Association of Diving Contractors.

The International Association of Classification Societies is recommended to:

2009/108 Highlight to its membership the need to identify key shipboard operations integral to a vessel's intended and potential employment and to ensure appropriate associated procedures have been developed whenever conducting ISM Code audits as recognised organisations on behalf of Flag States.

Marine Accident Investigation Branch
January 2009