Report on the investigation of the fatal accident to

a motorman on board the ro-ro cargo ship

Sea Centurion

at the Portsmouth Naval Base

on 18 May 1999

Marine Accident Investigation Branch
First Floor
Carlton House
Carlton Place
Southampton
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Extract from

The Merchant Shipping

(Accident Reporting and Investigation)

Regulations 1999

The fundamental purpose of investigating an accident under these Regulations is to determine its circumstances and the causes with the aim of improving the safety of life at sea and the avoidance of accidents in the future. It is not the purpose to apportion liability, nor, except so far as is necessary to achieve the fundamental purpose, to apportion blame.

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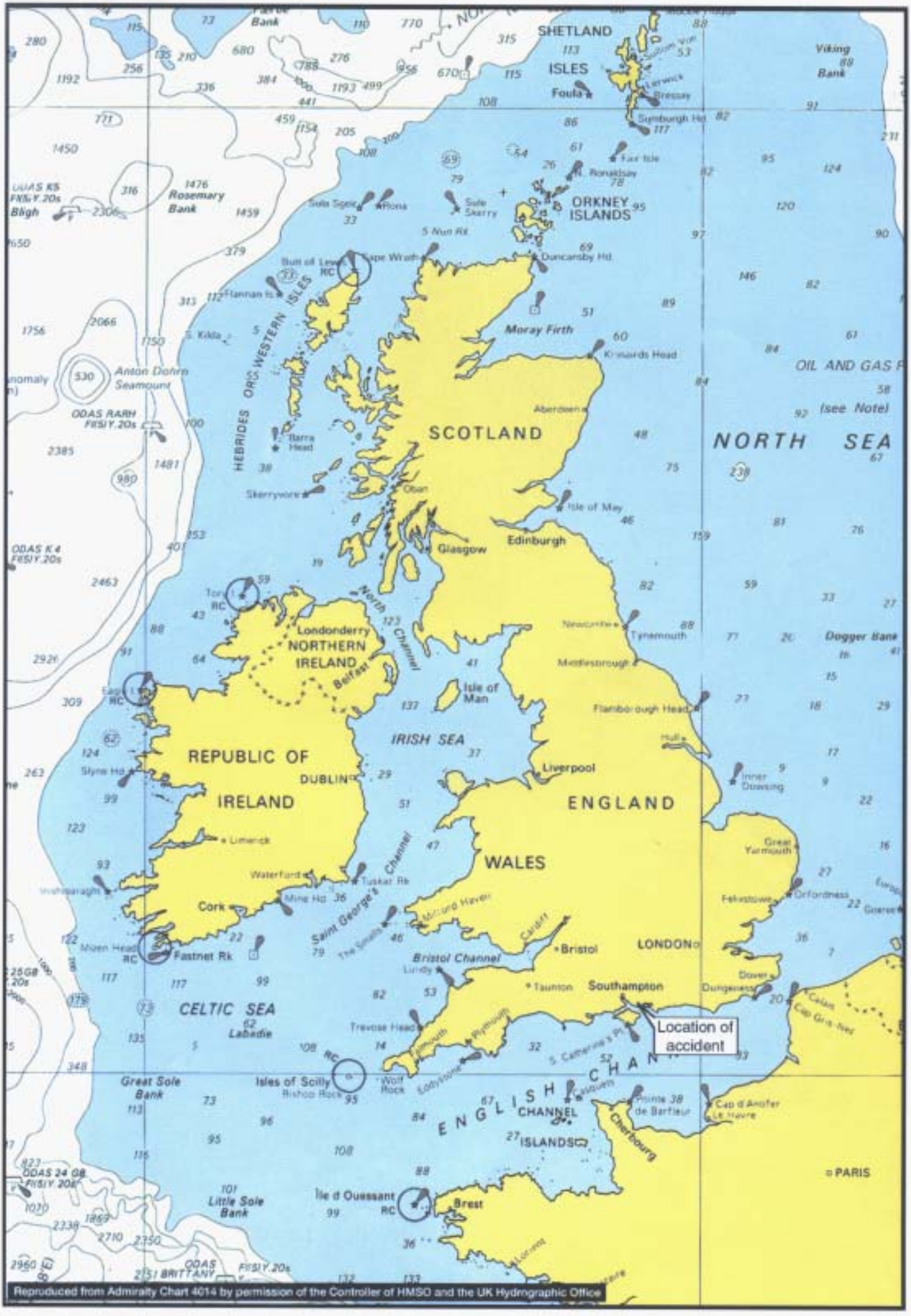
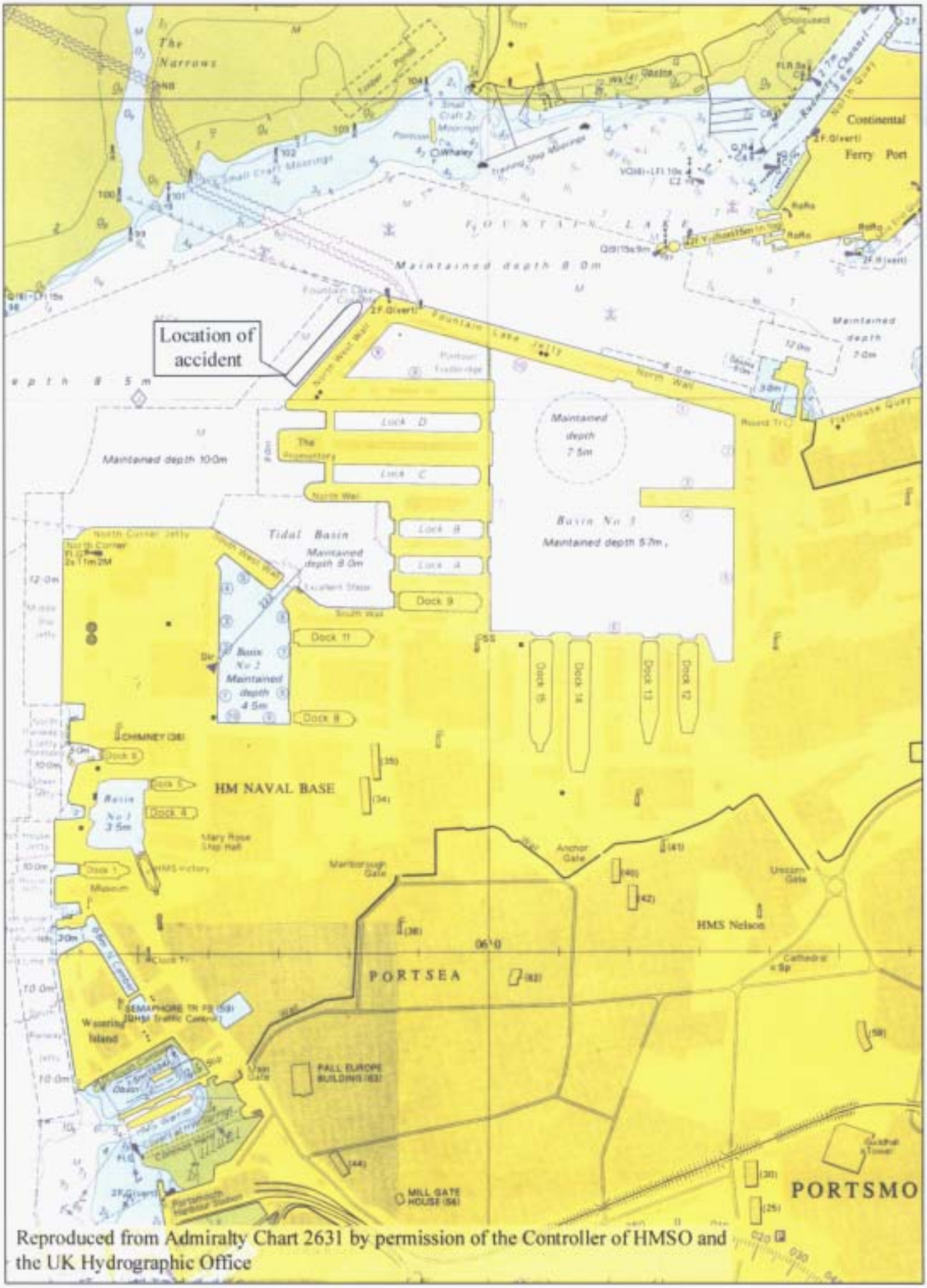
GLOSSARY

AB	Able Seaman
ALARP	As low as reasonably practicable
COMRFA	Commodore Royal Fleet Auxiliary
CPO	Chief petty officer
DETR	Department of the Environment, Transport and the Regions
gt	Gross tonnage
IDF	Inter-departmental Flexibility
IMO	International Maritime Organization
ISM	International Safety Management
kW	kilowatt
LH	Leading hand
m	metre
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MNTB	Merchant Navy Training Board
NVQ	National Vocational Qualification
OOW	Officer of the watch
PO	Petty officer
QHM	Queen's Harbour Master
RFA	Royal Fleet Auxiliary
rpm	revolutions per minute
RMAS	Royal Maritime Auxiliary Service
RMT	National Union of Rail, Maritime and Transport Workers
SG1A	Seaman grade 1A
STCW	Standards of Training, Certification and Watchkeeping
UHF	Ultra-high frequency
UK	United Kingdom
UTC	Universal co-ordinated time
VHF	Very high frequency





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SYNOPSIS

At 1446 Universal co-ordinated time (UTC) + 1 on 18 May 1999, while letting go *Sea Centurion*, a ro-ro cargo ship of 21,104gt, from the North West Wall in the Portsmouth Naval Base, a motorman was struck by a mooring rope and died from multiple injuries. The Marine Accident Investigation Branch (MAIB) was notified of the accident at 1600 that day by Commodore Royal Fleet Auxiliary (COMRFA). Captain P Kavanagh carried out the investigation.

Sea Centurion was due to sail from Portsmouth to Marchwood near Southampton at 1500. *Powerful* was one of two tugs in attendance and was standing-by the port quarter waiting to be made fast. The after mooring party on *Sea Centurion* consisted of the third officer, two able seamen, a cadet and a motorman. The latter had been tasked to assist in the unmooring operations. It was the first time that he had carried out such a task.

During the unmooring operations, one of the mooring ropes became caught in one of the two propulsion units of *Powerful* and pulled the rope off the ship. The motorman was struck by the end of the rope as it came off the storage reel, and he was forced against a flight of steps.

On board *Sea Centurion*, the third officer called the bridge for immediate medical assistance. It was soon realised the motorman was severely injured, and resuscitation techniques were administered. When the ambulance team arrived they knew nothing could be done for him and he was later pronounced dead at the scene by a doctor.

The accident was caused by the motorman trying to stop the rope running out, thereby placing himself in a dangerous position. Contributory factors included his lack of experience and low perception of the dangers associated with a rope running out of control.

The report makes a number of recommendations to COMRFA and to the tug operator.

Sea Centurion

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF SHIP AND ACCIDENT

1.1.1 Details of *Sea Centurion*

Bare-boat charterer	:	Royal Fleet Auxiliary
Port of Registry	:	London
Flag State	:	United Kingdom (UK)
Built	:	1998 at Viareggio in Italy
Construction	:	Steel
Classification society	:	Det Norske Veritas
Type	:	Ro-ro cargo
Length overall	:	179.30m
Gross tonnage	:	21,104
Maximum draught	:	7.4m
Propulsion	:	4 diesel engines giving 23,040kW to two controllable propellers and two bow thrusters
Crew	:	20

1.1.2 Details of the accident

Casualty	:	One fatality
Damage to ship	:	Broken rope reel restraining clamp
Pollution	:	None
Location of incident	:	North West Wall in the Portsmouth Naval Base
Date and time of accident	:	18 May 1999 at 1446 (UTC + 1)

1.2 NARRATIVE

All times are Universal co-ordinated time (UTC) + 1.

1.2.1 Background

Sea Centurion was programmed to sail at 1500 on 18 May 1999 from the North West Wall berth at Portsmouth Naval Base, to Marchwood near Southampton. She had spent some time on the berth on stand-by duties and underwent minor engine repairs.

The arrangement of the after mooring lines **(see diagram opposite)** was as follows:

- Starboard (inboard) quarter - two backsprings leading forward, one stern rope and two steelite insurance ropes which belonged to the shore base.

- Port (outboard) quarter - three stern lines leading to one shore side bollard. Two of the lines were stored on two separate self-tensioning mooring winches **(see photograph 1)**. The third was a Navy Standard manufactured polyethylene size 6 eight-stranded, black multiplaited rope, approximately 160m long. While alongside, this third rope had been secured around the drum end of the after mooring winch, with about eight turns. From the drum end, the rope was partly flaked up and down the deck, forward of the winch area, with the remainder on a large storage reel **(see photograph 2)**.

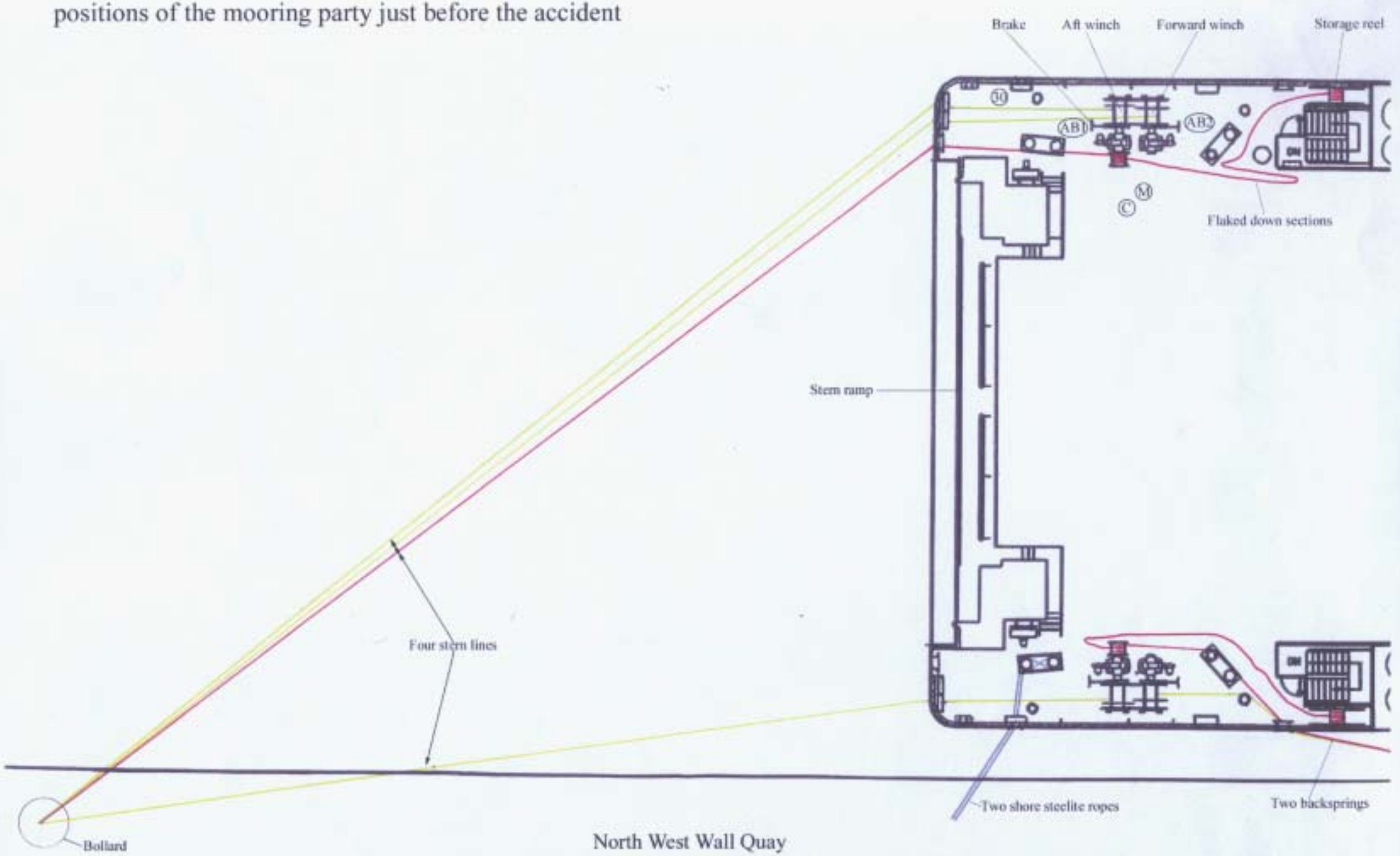
Due to *Sea Centurion*'s manning scale, if one of the deck ratings had either just completed a port night watch or was about to go on night watch, an engine room rating was employed to assist in mooring duties. Before the accident, a particular engine room rating had been used in this capacity on several occasions. However, as he had left the ship, the engine room petty officer and the bosun decided that the motorman should assist the after mooring party in letting go. The motorman had never assisted in making fast or letting go a ship before. The rest of the after mooring party consisted of the third officer, two deck ratings (AB1 and AB2) and a deck cadet. The third officer had a hand-held ultra high frequency (UHF) radio set for communications with the bridge. They were all wearing safety helmets and safety shoes. All deck mooring machinery was functioning correctly.

1.2.2 The accident

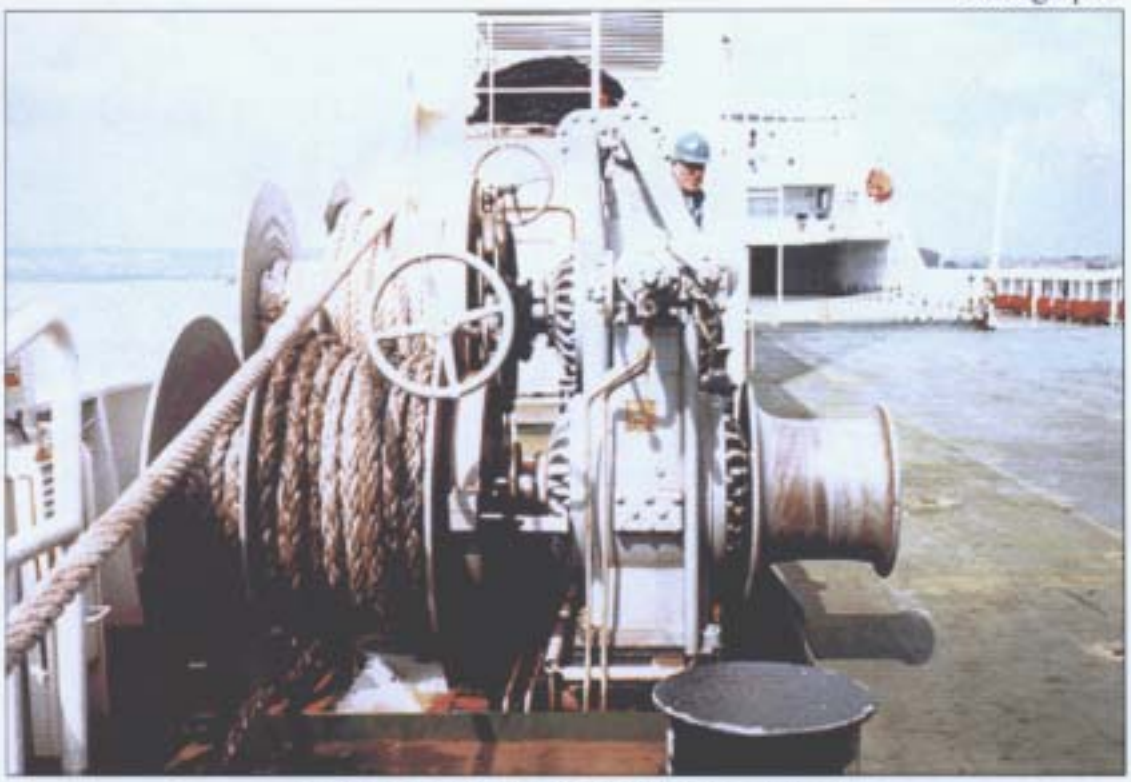
At 1400, a pre-sailing brief was held on board *Sea Centurion,* attended by the commanding officer, all deck officers and the bosun. The commanding officer ordered the after mooring party to single up to two sternlines and a backspring.

The pilot boarded the ship and reached the bridge at 1428. He was introduced to the commanding officer, the chief officer and the navigating officer and was given a copy of the ship's handling data. They discussed the passage plan and

Mooring and afterdeck arrangement for *Sea Centurion* with positions of the mooring party just before the accident



Photograph 1



Port side self-tensioning mooring winches

Photograph 2

Port side rope storage reel

the tug positions. The tugs tasked to assist the unberthing, were *Powerful* and *Bustler*. They were to be made fast to the ship but, when she moved off the berth, they were not to put any weight on their tow lines. The ship's engines were running, all mooring lines were still secured, and the gangway was still connected to the shore.

At 1435 *Powerful* left her berth at the entrance to 'D' lock and went round to Fountain Lake jetty to drop off one of her engineers. She then returned to take up position off *Sea Centurion*'s port bow, by which time *Bustler* had taken up station off the ship's port quarter. *Powerful*'s mate checked the very high frequency (VHF) radio communications with the pilot on channel 13. Due to a personal preference, the pilot told the tugs to change places. *Powerful* was being manoeuvred by a relief master and while the tugs were exchanging places the master went below to the lavatory. Meanwhile, the pilot made his intentions for the unberthing known to the two tugs. *Powerful* took up her station off the ship's port quarter to wait for the ship's after mooring party to take her tow line.

While waiting, *Powerful*'s relief master and the mate decided that they should use the fairlead at the forward end of the mooring deck on *Sea Centurion*'s port quarter. The pilot said that they could use whatever lead was suitable for them as long as they kept a slack tow line.

At 1440, the shore riggers arrived on the quay; one gang went to the bow; the other gang went to the stern, and the master rigger remained near the line of the forward accommodation. The master rigger had two radio sets; one set was on (VHF) radio channel 13 (the same frequency as the ship's bridge, the pilot and the tugs were using) and the other was on a frequency used by the fore-and-aft shore mooring gangs. At this time the mooring parties were called to their stations. Ten minutes before the call, the bosun had given a verbal safety brief on safety clothing, duties and safety awareness. The bosun told the motorman that he should wear his safety helmet and safety boots; not stand in bights of rope; only handle ropes, and not to operate the winch controls; and follow orders.

At 1443, the main engines were clutched in and the engine controls were transferred to the starboard bridge wing, which is an integral part of the enclosed bridge. The bridge team members were waiting for the fore and aft mooring parties to report that they had singled up, before giving the instructions to secure the two tugs.

As they made their way aft, the two ABs were joined by the motorman. He jested that he would show them how their job should be done, but then asked AB1 what to do. AB1 said that he would tell him and that letting-go was a simple operation.

On arriving aft, they let go the two steelite insurance ropes to the shore riggers. When asked by AB1 if the tug should be made fast, the third officer replied that

he had received no instructions to make the tug fast, and that they should single up to two stern lines and a backspring.

AB1 took the starboard winches out of self-tensioning mode and then went below to the deck machinery room where he switched on the two main motors to start the winching operations. Meanwhile, AB2 took the port winches out of self-tensioning mode. When AB1 returned to the deck, the rest of the mooring party was on the port quarter.

The third officer was right aft, AB2 was on the controls at the forward end of the forward winch, and the motorman and cadet were by the drum end. By the time AB2 had joined the rest of the mooring party, the motorman had slackened off the black rope, but there were several turns still remaining around the drum end so that it would not run outboard. AB1 went to the aft side of the after winch and put the brake on, disengaged the winch, and engaged the drive for the drum end to heave in the black rope. The third officer had signalled to the shore riggers to let go the black rope from the bollard, and the eye of the rope was dropped into the water. There was considerable turbulence directly astern of the ship from the revolving propellers, although the bridge pitch controls were set at zero.

The third officer, who had his foot on the black rope, turned and told AB2 to slacken off the forward winch rope. The black rope jumped under the third officer's foot and began to surge and run out. He and AB1 realised that something was pulling the rope out and, as it gathered speed and the turns uncoiled from the drum end, they shouted for everyone to get out of the way and to let it go.

AB1 and the third officer crouched under the after winch, and AB2 under the forward winch. The cadet and the motorman ran towards the centre line. As the flaked-down sections of the rope began to run out, the motorman moved back in an attempt to stop the rope, by placing his foot over it. However, he fell and knocked his head on the forward winch platform. As he was straightening up on his feet and putting his safety helmet back on, there was a bang. The restraining clamp for the storage reel came away from the bulkhead **(see photograph 3)**. The small binding securing the eye of the black rope to the reel parted, and the end of the rope flew off the drum and struck the motorman. He was carried aft until he struck a short flight of steps **(see photograph 4)**. The motorman could now be seen by the third officer and AB1. The third officer called the bridge on his radio set and said there had been an accident and that immediate medical assistance was needed.

Immediately before the accident, *Powerful*'s mate exclaimed about the lead of the black mooring rope. The relief master looked around one of the window stanchions and saw that the black rope was leading from the port quarter to the water at an angle of about 35°. He could not see where the rope entered the water because his view was obstructed by the port funnel. The rope became taut and then immediately went slack. The relief master realised that the rope was leading towards the tug and he moved the control sticks for the two

Photograph 3

Starboard side storage reel and retaining clamp

Photograph 4

Sea Centurion's port side, aft mooring station

propulsion units to zero. He then saw the end of the rope run out of the fairlead. He moved the starboard propulsion unit so that the tug would move ahead out of the way. He did not use the port unit, as the rope was nearest to that side. He then ran forward from the after control station to the starboard side of the bridge, and pushed the emergency control stop for the port engine. At this time, the tug master returned to the bridge and was informed that a ship's mooring rope might have caught around the port propulsion unit. He went to the bridgewing and, when he looked over the tug's side, he saw no rope, only a light sheen of oil.

After the urgency call from the third officer, the navigating officer, who acted as a medical officer, was despatched from the bridge to the port quarter. The pilot called the Queen's Harbour Master (QHM) for an ambulance. They pulled the motorman from under the short flight of steps to give him medical assistance. He was unconscious and blood was coming from his nose and mouth. The chief officer arrived on the scene and, realising the motorman was severely injured, decided that they should try to resuscitate him and carry out heart massage. This was done until the ambulance arrived at 1457. At 1505 the commanding officer was told that the accident had been fatal. At 1536 a doctor boarded the ship and declared the motorman dead. His body was taken to Saint Mary's Hospital in Portsmouth.

At 1457 *Powerful* told *Sea Centurion* that a mooring rope might have been caught in one of her propulsion units and asked to be relieved by a nearby tug. On her way back to the berth, *Powerful*'s propulsion unit was started but it did not appear to be operating properly. Later that evening, divers removed the entire length of the black mooring rope from the port propulsion unit. The starboard one was clear.

1.3 ENVIRONMENTAL CONDITIONS

The wind was from the north-east, force 3. The weather was fine and dry. High water was predicted at 1426 with a height of 4.9m and spring tides had been two days before.

1.4 *SEA CENTURION*

1.4.1 Brief description

The ship was launched as *Sea Ausonia*, but was very soon bare-boat chartered by the Royal Fleet Auxiliary (RFA) and renamed *Sea Centurion*. She was designed as a commercial ro-ro ship and had a high degree of automation. She was based in Marchwood, was operated under strategic shipping for the joint rapid response defence force, and had been sailing in the Mediterranean and north-west Europe. She was capable of carrying 2175 lane-metre of vehicles, which were loaded through a large stern ramp. The after mooring stations are

on each side of the ramp, and on the top deck on each quarter. The ship is highly manoeuvrable, with twin screws, two rudders and two bow thrusters.

1.4.2 The ship's complement

All the officers and crew are employed by the RFA. At the time of the accident there were 20 crew members on board; the commanding officer, two chief officers, a third officer, two navigating cadets, a chief engineer, two second engineers, two electricians, a deck petty officer, four able seamen, an engine room petty officer, a motorman, a cook petty officer and a cook/steward.

The motorman was 23 years old and had been employed by the RFA since 7 January 1996. Between 8 January 1996 and 9 February 1996, he attended a National Vocational Qualification (NVQ) Level 2 training course in merchant vessel operations suitable for motormen, at North West College. He received the basic sea survival, fire fighting and first aid certificates approved by the Merchant Navy Training Board (MNTB) and the Department of the Environment, Transport and the Regions (DETR). During his time at the college, he was required to:

- Show a reasonable competence in general ship knowledge, including rope work (including types, splicing, rigging and staging), wires and wire work: and

- Demonstrate a knowledge of hatches and lifting gear, blocks and tackles (including winches, derricks, cranes and associated equipment).

The college deck instructor's remarks concerning the motorman were:

> *With on-board studying and practical experience, his knowledge will expand.*

He joined *Sea Centurion* on 10 April 1999 at Marchwood.

The commanding officer was 45 years old and had started his sea-going career with the RFA in 1972. He served on all types of ships in the fleet. He was promoted to third officer in 1976 and to chief officer in 1986. He has a Class 1 Master's Foreign-Going certificate of competency. He joined *Sea Centurion* on 6 April 1999 and served continuously on board up to the time of the accident.

The third officer was 20 years old and had joined the RFA in 1995 as deck cadet. He had served on many types of ships within the company. He passed the Class 3 certificate of competency in March 1999 and joined *Sea Centurion* on 7 May 1999, serving for the first time as third officer. During the four years as cadet, he had assisted mooring parties many times.

The cadet was 18 years old, had joined the RFA in September 1996 and had served on many types of ships within the company. The cadet had assisted

mooring parties many times, including a number of occasions since joining *Sea Centurion* on 9 April 1999.

AB1 was 54 years old and had been in the Merchant Navy since 1960. He had served on many types of ships trading throughout the world. His last company was P&O Containers Ltd, but shortly after being made redundant was employed by the RFA - on 1 December 1998. He joined *Sea Centurion* as Seaman grade 1A (SG1A) that day.

AB2 was 39 years old and had been in the Merchant Navy since 1976. He had served with a number of companies and on different types of ships trading throughout the world. His last company was P&O Containers Ltd. and, after being made redundant, he was employed by the RFA and joined *Sea Centurion* on 5 May 1999. He was also graded as SG1A.

Sea Centurion complied with the Maritime and Coastguard Agency's (MCA) *Safe Manning Document for a United Kingdom Registered Sea-going Ship,* issued on 21 October 1998.

1.4.3 Working practices

All 22 vessels in the RFA fleet operate under the *Inter-departmental Flexibility Manning Agreement*, which was made between the RFA and the National Union of Rail, Maritime and Transport Workers (RMT) on 2 November 1992. It applies to all chief petty officers, petty officers, leading hands (LH) and ratings, reference to which is held within BR 875 (the RFA Quality and Safety Management System) Volume 3 section 5.6.1.

As far as an IDF task is concerned the Agreement states:

> *CPO, POs, LHs and ratings may be assigned to carry out work for any shipboard department providing that such work relates only to cleaning, general ship husbandry, security, or the loading and discharging of stores and equipment. Any job so allocated will be known as an "IDF task".*

Reference is made in BR 875 Volume 3 section 5.7.13 *Berthing and Mooring:*

> *The Petty Officer assigned to each party is responsible for the supervision of the ratings making up each mooring party. He is to ensure that the operation is conducted in accordance with the Code of Safe Working Practices.* (See section 1.6) *It may be necessary to call on the ratings from other departments under certain circumstances. These ratings will require additional supervision to ensure safety is maintained.*

Only *Sea Centurion* and *Sea Crusader* (both ro-ros) regularly employ motormen in berthing and unberthing operations. On other RFA ships,

motormen are employed in tending moorings only when the safety of the ship is in question.

1.5 *POWERFUL*

1.5.1 Brief description

She is a 30.8m long, twin-unit tractor tug of the *Adept* class and was brought in to the Royal Maritime Auxiliary Service (RMAS) fleet in 1985. She was built for harbour work, and has a coastal towing capability with a nominal bollard pull of 27.5 tonne. She has two Ruston diesel engines geared to two Voith Schneider propulsion units **(see annexe)** and has a service speed of 12 knots. She has operated exclusively in Portsmouth since entering service **(see photograph 5)**.

At the time of the incident, *Powerful*'s engines were on 80%* output at a constant speed of 720 revolutions per minute (rpm). The gearbox reduced this speed by a factor of just over 11, so that the Voith Schneider blades turn at 64rpm.

(*Note: *Powerful* operated at 100% power output (900rpm) when assisting ships larger than *Sea Centurion* and on request from pilots.)

On 12 August 1996 the bare-boat charter of RMAS tugs was taken over by Serco Denholm.

Powerful has a Safety Management Certificate under the International Safety Management (ISM) code and issued by the MCA.

When operating in Queen's Harbour Master's (QHM) waters, a vessel of *Sea Centurion's* size must have tugs in attendance while berthing and unberthing, whether the master and pilot use them or not.

Each day, the tugs receive a movements sheet from the QHM for ships arriving and leaving Portsmouth. The move for *Sea Centurion* from the North West Wall to Marchwood was confirmed the day before, and *Powerful* and *Bustler* (both of the same class) were assigned to the task. The scheduled sailing time was 1500 on 18 May, and the tugs had to be on-site between 15 and 30 minutes before.

1.5.2 The master and relief master

The master was 33 years old and joined the RMAS as junior seaman in 1982, working in Portsmouth on various harbour and seagoing tugs. He progressed to ordinary seaman, to able seaman and then to leading seaman. In 1990 he obtained his Class 4 Deck Officer Certificate of Competency and was promoted to mate, taking an appointment on tugs in Rosyth. He obtained his Limited Command Endorsement in 1994 and was promoted to tug master, returning to

Photograph 5

Tug *Powerful*

serve in Portsmouth. He has served as master on *Bustler* and *Powerful* since 1995.

The relief master was 34 years old and joined the RMAS as junior seaman in 1981, working in Portsmouth on various tugs and seagoing ammunition vessels. He progressed through the ranks and obtained his Class 5 Deck Certificate of Competency in 1993 and Limited Command Endorsement in 1998. He was mate on *Powerful* between 1993 and 1997, during which time he gained much experience in handling the tug. He was promoted to tug master, serving on *Helen* (which has a single Voith Schneider unit) until 14 May 1999. He had been designated to become relief master for all of the Serco Denholm tugs in Portsmouth harbour and, at the beginning of that week, started a programme to gain more experience and re-familiarisation of the various types of tugs.

1.6 RELEVANT SECTIONS FROM THE *CODE OF SAFE WORKING PRACTICES FOR MERCHANT SEAMEN*

The Code is issued by the MCA and Chapter 25 deals with *Anchoring, Mooring and Towing Operations.* Under the sub-section *Making Fast and Casting Off*, the following points are relevant to this accident:

> *25.3.1*
> *During mooring and un-mooring operations a sufficient number of personnel should always be available at each end of the vessel to ensure a safe operation. A responsible officer should be in charge of the mooring parties, and a suitable means of communication between the responsible officers an the vessel's bridge team should be established... All personnel should wear suitable protective clothing (see Chapter 4).*
>
> *25.3.6*
> *Ropes and wires stowed on reels should not be used directly from stowage, but should be run off and flaked out on deck in a clear and safe manner, ensuring sufficient slack to cover all contingencies. If there is doubt of the amount required, then the complete reel should be run off.*
>
> *25.3.8*
> *Personnel should not in any circumstances stand in a bight of rope or wire. Operation of winches should preferably be undertaken by competent personnel to ensure that excessive loads do not arise on moorings.*
>
> *25.3.9*
> *When moorings are under strain all personnel in the vicinity should remain in positions of safety, ie. avoiding all "snap back" zones. Immediate action should be taken to reduce the load should any part of*

the system appear to be under excessive strain. Care is needed so that ropes or wires will not jam when they come under strain, so that if necessary they can quickly be slackened off.

25.3.10
Where moorings are to be heaved on the drum end, one person should be stationed at the drum end, backed up by a second person and coiling down the slack.

1.7 OCCUPATIONAL HEALTH AND SAFETY

The International Maritime Organization's (IMO) Standards of Training, Certification and Watchkeeping (STCW) gives **mandatory** minimum requirements for certification, familiarisation and basic safety training and instruction for all seafarers. The familiarisation training should be given to people before being assigned shipboard duties and pertains to communications on safety matters, man-overboard situations, the detection of smoke and fire, and actions to be taken when a fire or abandon ship alarm is sounded.

Section B-I/14 gives **guidance** regarding the responsibilities of companies and recommended responsibilities of masters and crew members. This includes any doubts surrounding a newly employed seafarer's knowledge of shipboard equipment and operating procedures. The master should always ensure that a suitable period of supervision is given.

Seafarers who do not promptly attain a satisfactory level of familiarity must notify their supervisors.

Under the *Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997*, which came into force on 31 March 1998, all employers have the duty to ensure as is reasonably practicable the health and safety of workers and others affected by their activities. MCA's Marine Guidance Note MGN 20 (M+F) refers. The principles for ensuring health and safety include avoiding risks, evaluating unavoidable risks and taking action to reduce them.

To establish the likelihood of harm, the adequacy of control measures already in place should be considered. The following issues (relevant to this accident) should then be typically assessed:

- Number of personnel exposed;
- The frequency and duration of exposure to the hazard;
- Possibility of unsafe acts by people for example, who
    - ◊ may not know what the hazards are;

- ◊ may not have the knowledge, physical capacity, or skills to do the work;
- ◊ underestimate risks to which they are exposed;
- ◊ underestimate the sense of safe working methods.

The likelihood of harm can be assessed as highly unlikely, unlikely, or likely. Any given hazard is more serious if it affects a greater number of people.

Ship specific risk assessments had not been completed at the time of the accident. The ship safety case for *Sea Centurion* was nearing completion, but had not been received from the Ship Procurement Agency. The safety case would have highlighted those areas where unacceptable or high risks had been identified. Those unacceptable risks would then have been addressed, and additional controls introduced to comply with "as low as reasonably practicable" (ALARP) procedures. During the writing of this report the proposed safety case was received and mooring operations were assessed as ALARP.

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, with the aim of preventing similar accidents occurring again.

2.2 ALLOCATION OF TASKS

Section 25.3.9 of the *Code of Safe Working Practices* **(see section 1.6)** refers to mooring operations, and recommends that personnel should remain in positions of safety. In the letting go operation, ropes are not generally placed under strain, indeed the reverse is the case. Therefore, the ship's personnel considered the unberthing of *Sea Centurion* was a routine and relatively safe operation, even for someone who had not done it before.

Sections 25.3.1, 25.3.6, 25.3.8 of the *Code of Safe Working Practices* **(see section 1.6)** were being complied with at the time of the accident.

The third officer's task was to give directions to the rest of the party and, by radio, to convey information to the bridge team and to receive instructions. The two seamen, who were very experienced in these operations, were primarily to operate the winches. The only two ropes which were not on the winch storage drums, were the loose black ropes on each quarter. These ropes had to be slackened off, so that the shore riggers could let them go from the bollard on the shore to allow them to be heaved in on the drum ends. Section 25.3.10 of the Code **(see section 1.6)** refers to this letting go, which would have been carried out by the motorman and the cadet. Providing the rope does not become fouled, this is a relatively simple and easy task, as there is little weight on the rope.

While the IDF agreement does not specifically identify mooring operations as an IDF task for engine room ratings, BR 875 **(see section 1.4.3)** did allow them to be employed in such a way. If motormen are to assist mooring parties, then extra supervision is required. The presence of two well-experienced ABs should have ensured that the motorman, in this case, was being adequately supervised.

2.3 THE SNAGGING OF THE MOORING ROPE

A set of circumstances which caused this routine operation to become an accident, led to the motorman's death.

A significant factor was the amount of turbulence from *Sea Centurion*'s two constantly revolving propellers. Variable pitch propellers revolve at a constant speed, even when the ship is not moving and the bridge pitch controls are set at

zero. In this condition, the revolving propellers will produce turbulence athwartships or at right angles to the fore and aft line of the ship. However, on the day of the accident, there was significant turbulence directly astern of the ship. The likely explanation is that, despite the controls being set to zero, the propellers had a slight positive pitch and would have needed some small adjustment to stop the turbulence. It would have been a sensible precautionary measure for the third officer to have contacted the bridge and commented on the significant stern turbulence from the propellers.

The mooring party slackened off the black rope and, before it was let go by the shore riggers, the rope was pushed out in an arc or bight as a result of the astern turbulence and the slackness in the rope. Once they had been given a signal by the third officer, the shore riggers took the eye of the black rope off the bollard and dropped it into the water. There was a delay before it could be heaved in by the mooring party on board *Sea Centurion*, because the winches had to be changed. The winches could have been changed in readiness before the operations started and before the rope was slackened off. In the event, after being let go, the eye would have been pushed away from the quay by the wash from the propellers. It would have moved on the surface of the water in an arc **(see diagrams overleaf and photograph 6)**.

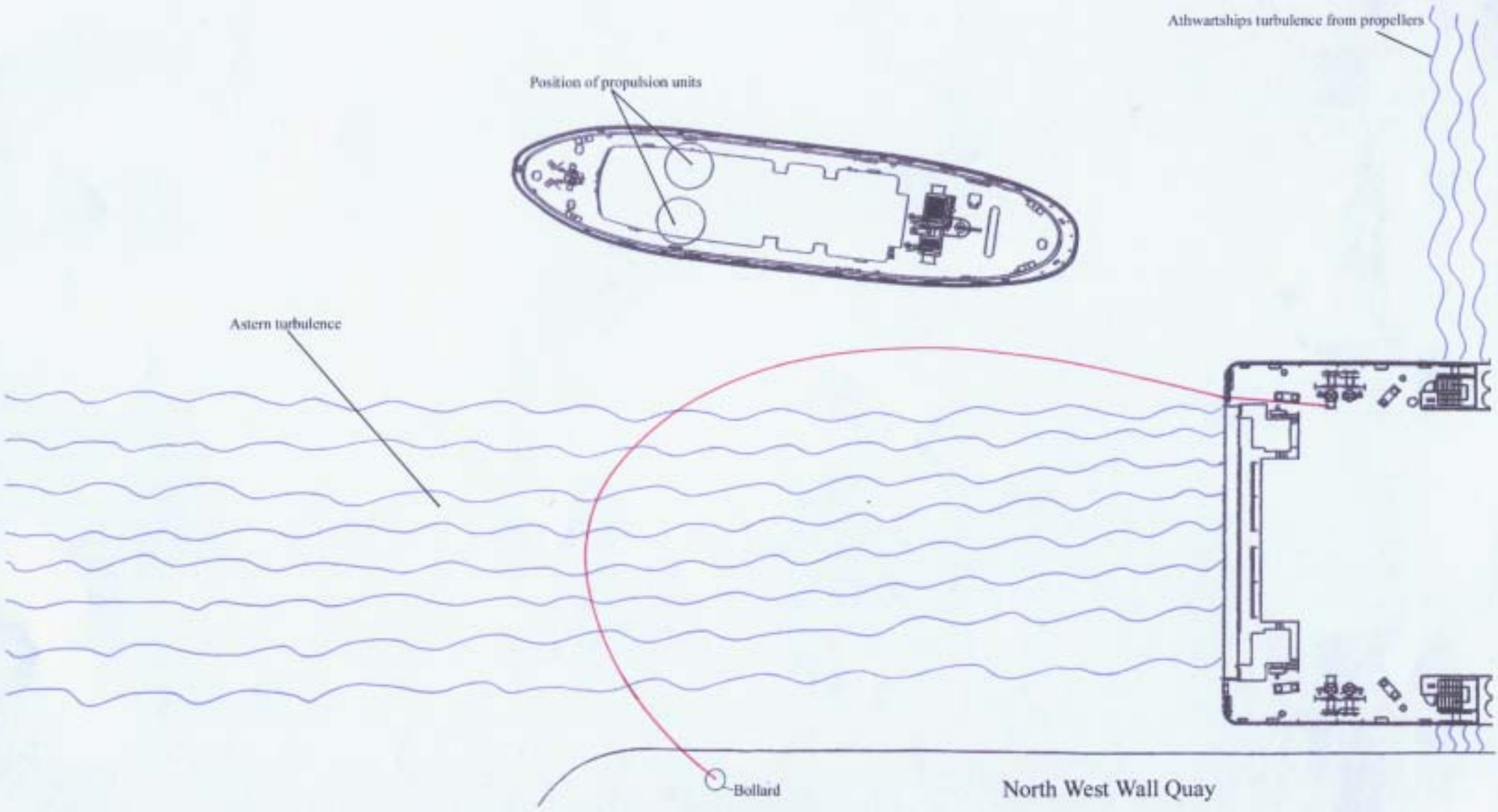
Neither the shore riggers, the third officer (who had turned to give AB2 instructions), nor the mate and relief master of the tug, saw the rope move in an arc as described above and suggested in the diagrams. Therefore, no warning was given that the rope was becoming too near to the propulsion system of *Powerful*. The crew on the after working deck of *Powerful*, were best placed to monitor the tug's proximity to mooring ropes or any other hazard.

Powerful was about 15 to 18 metre away from the port quarter of the ship, in readiness to take a heaving line from the mooring party. The relief master maintained this distance as he did not know when the mooring party would take in the tug's tow line. However, the bridge team's intention was to make the tugs fast after the fore and aft mooring parties had singled up. The third officer had not been told whether the tug was to be made fast or not. The tug could have waited further off until called in by the bridge team or the third officer after the ship had singled up. The relief master had positioned the tug in the clear water between the astern and the athwartships turbulence. The relief skipper knew that if the large after skeg went into the turbulence, it would have caused directional instability and he would have had difficulties in maintaining station.

Due to the ergonomic design of the tug, and their positions at the controls at the after end of the wheelhouse, the relief master and the mate were unable to see the sides of the tug apart from the after deck. Their attention was concentrated on the ship to maintain position off her. Even the relief master's view of the rope leading from the water to the poop deck was obscured by the framing of the window and the port funnel. The mate had a slightly different

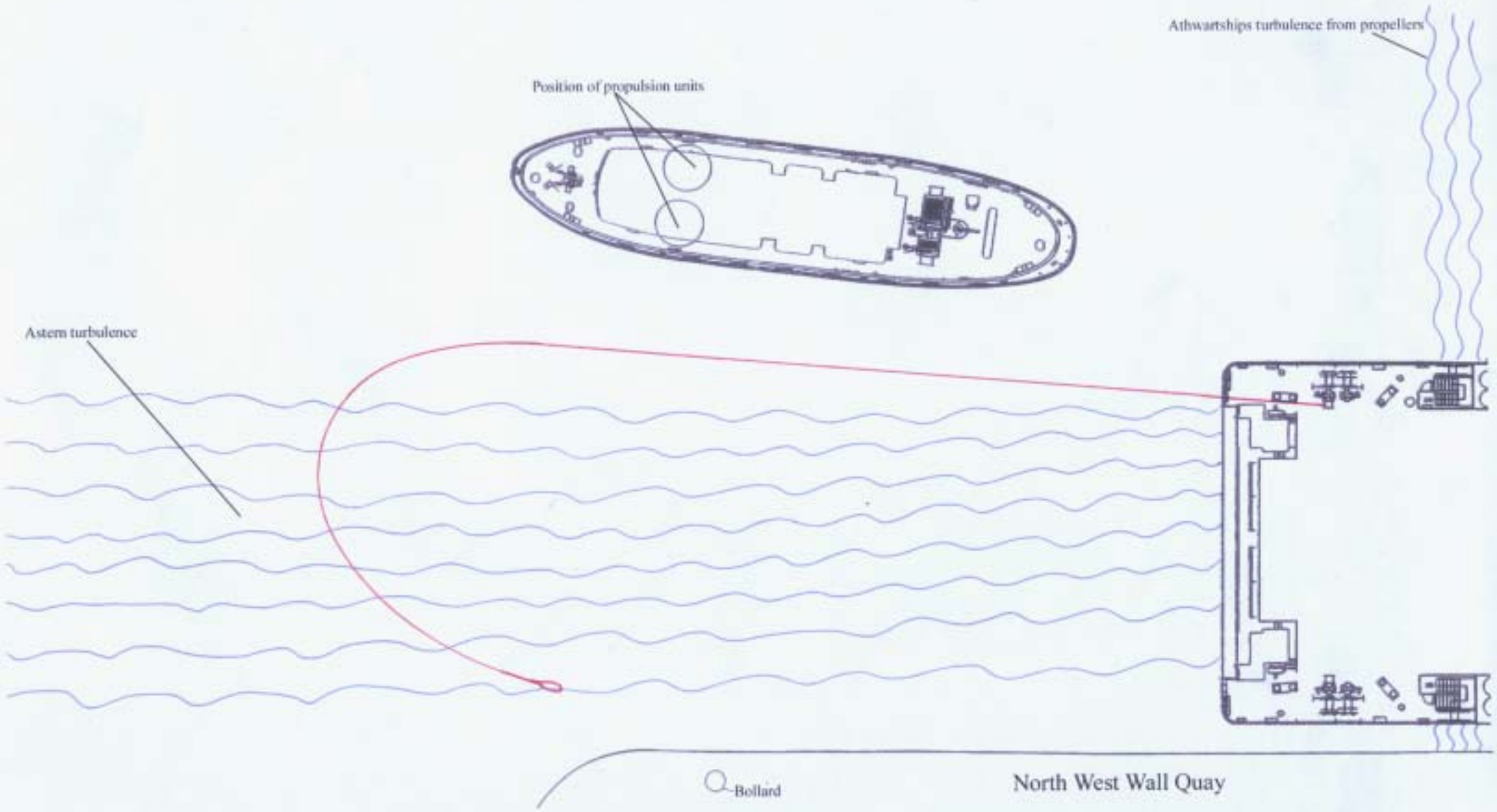
A reconstruction of the snagging of the mooring rope

1. Rope slackened off, but still fast ashore



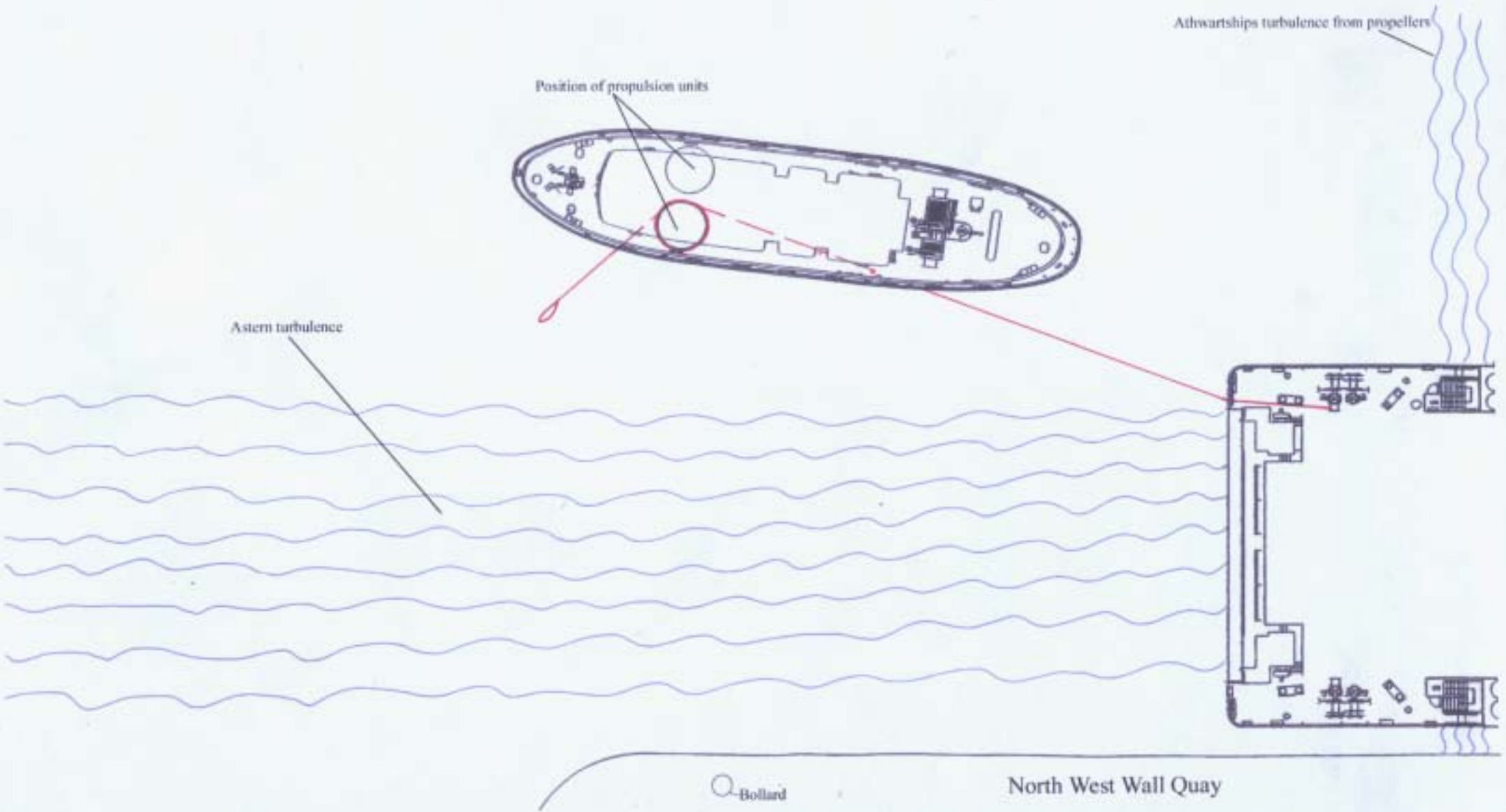
A reconstruction of the snagging of the mooring rope

2. The mooring rope clear of the bollard



A reconstruction of the snagging of the mooring rope

3. The mooring rope caught in the port propulsion unit



Photograph 6

Mooring rope pushed away by astern propeller turbulence

perspective and he saw the black rope surge but, when he drew attention to it, the relief master had to look around one of the window frames.

(Some modern tugs have a wheelhouse incorporating a small round deck space, with a central console and full depth all round windows, and angled funnels. On tugs of this type the tug master has a nearly uninhibited view of his own tug and of the surrounding water.)

The tug's Voith Schneider blades were constantly revolving. The relief master made small adjustments to the controls to maintain station on the ship. The vertically revolving blades draw in water from around the tug. The relief master had the pitch levers "split", that is, one was going ahead and one going astern. In this mode he was able to make the tug move bodily sideways, either to port or to starboard. If the tug was moved to starboard, water was drawn in from the starboard side and pushed out to port, and conversely if the tug was moved to port.

Although nobody saw the rope being drawn into the tug's propulsion system, it is likely, as the rope travelled outwards away from the quay, it went beyond the line of the wash by following the arc of the rope from the ship's fairlead. Then the rope probably came under the influence of the water being drawn into the propulsion units from the port side and therefore it is likely that the tug was moving bodily to port.

Once the rope had been caught, the revolving blades acted like a spinning bobbin, coiling in the rope rapidly. The relief master stopped the blades but not in time to prevent the accident to the motorman.

2.4 THE ACCIDENT TO THE MOTORMAN

Trainee deck officers and ratings learn their skills and knowledge of mooring operations by experience on board ship, under the guidance of more senior personnel. There are no simulators at college from which to learn: trainees can learn on college-owned training vessels but there are not many of these.

During a seafarer's career, mooring operations are carried out many times, especially in the coastal trade. The motorman was ordered to assist the mooring party let go the ship, which is perceived as a low risk operation. He was under the guidance of the two very experienced ABs and the third officer, who had been on many mooring parties as a cadet. The motorman was wearing the correct protective clothing.

However, problems can arise and seafarers are, or should be aware of the latent power in a rope or wire under tension. For instance, a wire under load, moving a very short distance, can seriously injure somebody coming into contact with it. When a ship is being assisted by a tug, it is essential that mooring personnel are made to keep clear of the tow line in case it parts under load and whiplashes across the deck. This is a fairly common occurrence.

In this accident, the ropes were not being tensioned, but slackened off, and would have been heaved in after they had been let go from the shore bollard. Four of the ropes would have been reeled in on to the winch barrels and the two black ropes would have been heaved in on the drum ends. It did not reach this stage and at the time of the accident only the black rope had been slackened off and let go from ashore.

Sometimes, when mooring ropes have been let go from the shore, they can become fouled in the ship's own propeller. Usually this happens when engines are run astern before the ropes are clear. This accident was unusual because the rope became fouled, not in the ship's propeller, but in the tug's propulsion unit.

As soon as AB1 became aware that the rope was fouled, he realised that there was no reason to try to stop it going overboard and called out to let it go. Realising the danger of a fast moving rope, the third officer, the two ABs and the cadet instinctively kept clear. The motorman followed the cadet, but then, in that unsupervised moment, tried to stop the rope running out. He stood on the rope, but its speed knocked him over. The rope's end followed, catching him and throwing him into a flight of steps. He suffered severe and multiple injuries.

SECTION 3 - CONCLUSIONS

3.1 FINDINGS

1. The motorman was fatally injured on board *Sea Centurion* at 1446 (UTC+1) on 18 May 1999 while he was assisting the after mooring party to let go from the North West Wall in Portsmouth Naval Base. [1.2.2]

2. Nobody else was hurt and the only damage to the ship was to a broken rope reel clamp securing point. [1.2.2]

3. The motorman had been chosen to assist the mooring party in letting go the ship. [1.2.2]

4. Only on *Sea Centurion* and *Sea Crusader*, both ro-ro ships, were motormen regularly employed on mooring party duties within the RFA fleet. [1.2.1, 1.4.3]

5. *Sea Centurion* complied with the Safe Manning Certificate. [1.4.2]

6. Motormen were employed to assist mooring party duties due to the night watch system, in which deck ratings were resting either before or after their watches. [1.2.1]

7. The motorman had not assisted in a mooring operation before. [1.2.1]

8. The motorman had been given a briefing by the bosun, before the operation, concerning protective clothing, his role and certain hazards. [1.2.2]

9. The aft mooring party consisted of a third officer on his first voyage, two ABs, a cadet and the motorman. [1.2.1]

10. All personnel were wearing the correct protective clothing. [1.2.1]

11. The sections of the *Code of Safe Working Practices*, with regard to making fast and letting go, were being complied with. [2.2]

12. The Ship Specific Safety Case for *Sea Centurion* had not been completed at the time of the accident. [1.7]

13. All deck equipment was functioning properly. [1.2.1]

14. The tugs *Powerful* and *Bustler* were in attendance, waiting to make fast once the ship had singled up. [1.2.2]

15. *Powerful*, under the control of a relief master, was waiting on the port quarter in still water out of the turbulence created by the ship's revolving propellers. [1.2.2]

16. Although, both of *Sea Centurion*'s variable pitch propellers were set at zero, considerable turbulence was being created directly astern of the ship. [1.2.2, 2.3]

17. The first mooring rope to be let go was from the outboard port quarter. [1.2.2]

18. This mooring rope was to be heaved in on the after winch's drum end. [1.2.2]

19. The inboard end of the rope was on a storage reel, which was forward of the port quarter mooring deck space. The reel was secured by a clamp. [1.2.2]

20. At the third officer's signal, the black mooring rope leading from the port outboard quarter, was let go from the shore bollard. [1.2.2]

21. Before it could be heaved in, the rope was taken by the turbulence from the propellers and swept towards *Powerful*. [1.2.2, 2.3]

22. The rope was taken in by the revolving port Voith Schneider propulsion unit and began to wind onto the blades. No one witnessed this and therefore no warning was given. [1.2.2, 2.3]

23. The relief master and the mate did not, due to the ergonomic design of the wheelhouse, see the rope foul the unit. [2.3]

24. Before the black rope could be heaved in, it began to surge and run outboard at great speed. [1.2.2]

25. The third officer and one of the ABs shouted a warning to get clear and then crouched behind the after mooring winch. [1.2.2]

26. The cadet and the motorman, moved out of the way but the motorman returned in an attempt to stop the rope. He was knocked off his feet and when he was picking himself up, the end of the rope caught him and flung him into a small flight of stairs. [1.2.2]

27. Despite resuscitation techniques being applied to the motorman, he had sustained multiple injuries, from which he died. [1.2.2]

28. Divers retrieved the whole of the black mooring rope from *Powerful*'s port propulsion unit. [1.2.2]

29. There were no environmental influences on the accident. [1.3]

3.2 CAUSE

The death of the motorman was caused by his action of trying to stop the mooring rope from running outboard and thereby placing himself in an area of danger. [2.4]

3.3 CONTRIBUTORY CAUSES

1. The motorman's lack of experience in mooring duties. [1.2.1, 1.4.2, 2.4]

2. The motorman's lack of perception of the dangers of a mooring rope running out of control. [2.4]

3. The failure of the motorman to comply with AB1s warning and instruction. [2.4]

4. The turbulence from *Sea Centurion*'s propellers, which swept the mooring rope out towards *Powerful*. [2.3]

5. The failure of the third officer to advise the bridge of the turbulence. [2.3]

6. The failure of the third officer to monitor the rope after it had been let go from the shore bollard. [2.3]

7. The delay between the mooring rope being let go from the shore bollard and being heaved in on the drum end. [2.2]

8. The action of letting go the rope before the winch was ready to heave it in. [2.3]

9. *Powerful* was possibly moving bodily to port and that water in the area of the mooring rope was being drawn into revolving port propulsion unit causing the rope to foul. [2.3]

10. The close proximity of the tug to the ship at that time. [2.3]

11. The need for the tug's relief master and mate to concentrate on keeping station and to maintain communications with the ship. [2.3]

12. No one saw the mooring rope moving too close to *Powerful* and therefore a warning was not given. [2.3]

13. The inability of the tug's personnel to see their proximity to the floating rope and thereby take action to avoid the fouling of the propulsion unit. [2.3]

14. The fouling of the mooring rope in the port propulsion unit causing it to run outboard and out of control from the port quarter of *Sea Centurion*, thereby creating a dangerous situation. [2.3]

SECTION 4 - RECOMMENDATIONS

The Royal Fleet Auxiliary is recommended:

1. To ensure preparations are completed before starting mooring operations.

2. To ensure adequate monitoring of mooring operations and the situations surrounding those operations.

Serco Denholm is recommended:

3. To ensure that its tugs remain clear of ships until they are required.

4. To ensure adequate monitoring of operations and the situations surrounding those operations.

Marine Accident Investigation Branch
January 2000

ANNEXE

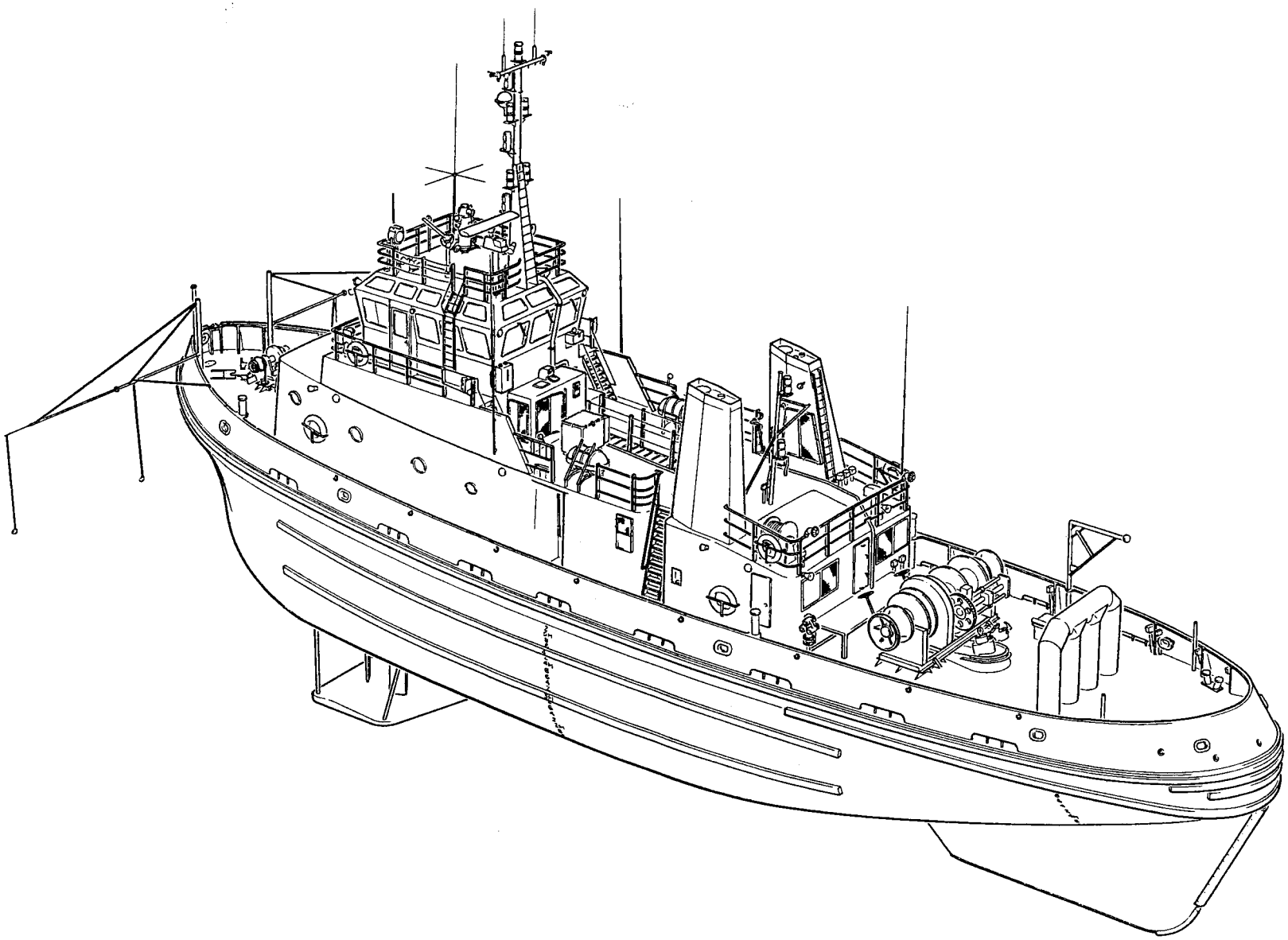
Voith Schneider propulsion units

The cycloidal propeller was invented in 1928, and Voith Schneider propulsion units were fitted primarily to tractor type tugs, which have the ability to manoeuvre in any direction. A modern tug usually has two Voith Schneider units, side-by side, about one third length from forward and a large skeg at the stern **(see diagrams)**.

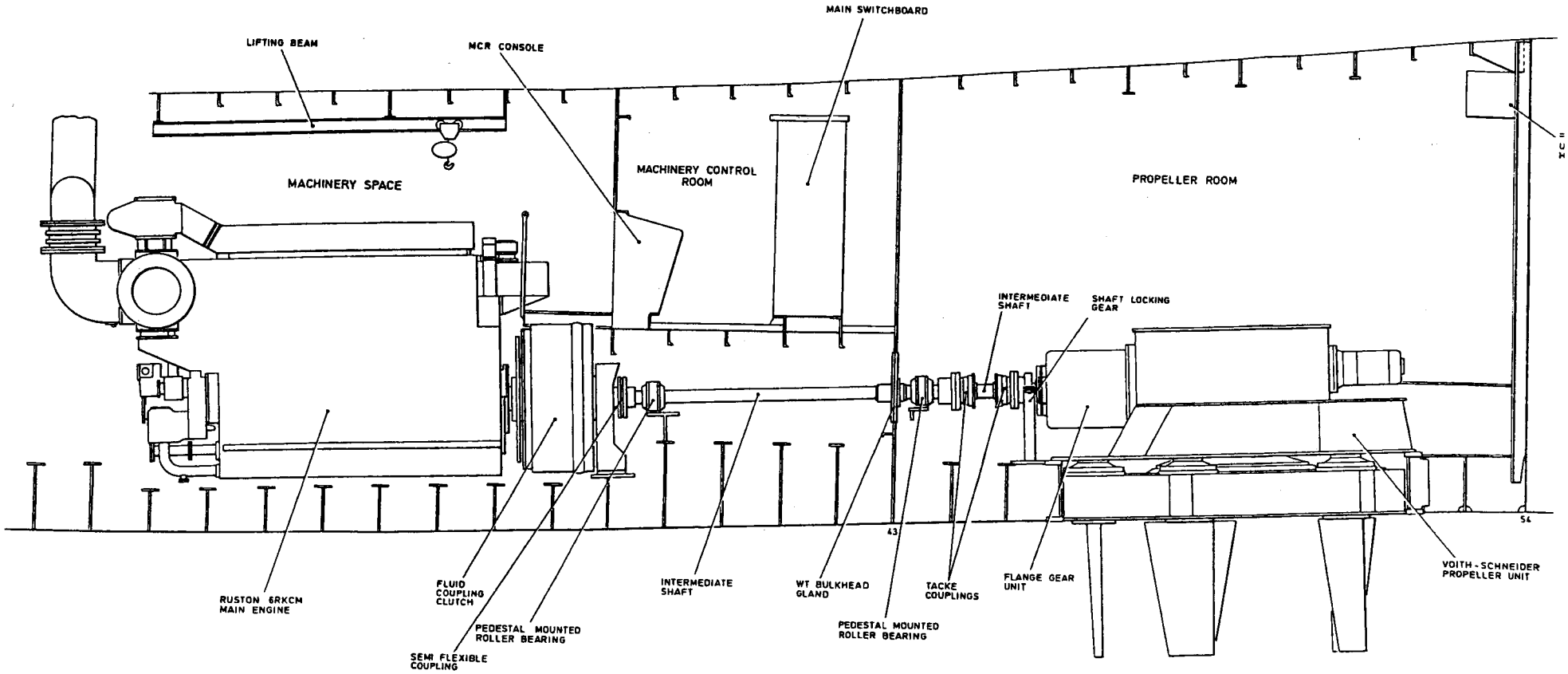
Each propulsion has a series of vertical blades projecting beneath the bottom of the hull. They are connected to a hub, and rotate in one direction with a constant revolution speed. Each blade has a hydrofoil cross-section, and by altering the pitch of the blades, propulsive thrust is produced. By means of mechanical linkage and a control rod, the thrust can be vectored in any chosen direction in relation to the hull, and its force controlled with great precision.

Each unit is self-contained and is driven via a simple shaft by an engine. There is a protection plate fitted below the blades. Voith Schneider-propelled tugs tend to have a relatively deep draught.

The controls, for this type of propulsion system, are provided by a steering wheel and a pitch lever for each of the units. The wheel controls transverse thrust, and the pitch levers control longitudinal thrust. Therefore, this type of tug does not need a rudder or transverse forward or aft thrusters.



Tug *Powerful*, showing her port propulsion unit and the large aft skeg



A Voith-Schneider propulsion unit