ACCIDENT REPORT

Report on the investigation of
the electrical blackout and subsequent
grounding of the feeder container vessel

Clonlee

on the River Tyne, England

16 March 2011

MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

LESS SERIOUS MARINE CASUALTY | REPORT NO 6/2012 | March 2012

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.

Front cover photograph courtesy of Bill West Photography

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GLOSSARY OF ABBREVIATIONS, ACRONYMS AND TERMS

2/E	-	Second engineer
2/O	-	Second officer
AB	-	Able-bodied seaman
AIS	-	Automatic Identification System
COLREGS	-	The International Regulations for Preventing Collisions at Sea, 1972 as amended
CPP	-	Controllable pitch propeller
DG	-	Diesel-driven generator
DOC	-	Document of Compliance
DP	-	Designated person
ECR	-	Engine control room
ETA	-	Estimated time of arrival
GL	-	Germanischer Lloyd
HM	-	Harbourmaster
Hz	-	Hertz
ICS	-	International Chamber of Shipping
IMO	-	International Maritime Organization
ISM Code	-	The International Management Code for the Safe Operation of Ships and for Pollution Prevention
kW	-	kilowatt
m	-	metre
MCA	-	Maritime and Coastguard Agency
MGO	-	Marine gas oil
mm	-	millimetre
NAS Ltd	-	North Atlantic Shipping Limited
NP 54	-	Admiralty Sailing Directions North Sea (West) Pilot
OOW	-	Officer of the watch

PEC	-	Pilotage exemption certificate
PMSC	-	Port Marine Safety Code
rpm	-	Revolutions per minute
SMC	-	Safety Management Certificate
SMM	-	Safety Management Manual
SMS	-	Safety Management System
SOLAS	-	The International Convention for the Safety of Life at Sea (SOLAS) 1974
STCW 95	-	The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978, as amended in 1995 and 1997 (STCW Convention)
t	-	tonne
TEU	-	Twenty-foot equivalent units
UMS	-	Unmanned machinery spaces
UTC	-	Universal time, co-ordinated
V	-	Volts
VHF	-	Very high frequency
VTS	-	Vessel traffic services

Blackout	-	The loss of the main source of electrical power resulting in the main and auxiliary machinery being out of operation
Feederlink	-	Feederlink Shipping and Trading B.V.
ICS Guide	-	The International Chamber of Shipping's Bridge Procedures Guide
Interschalt	-	Interschalt Maritime Systems AG

TIMES: All times used in this report are UTC unless otherwise stated

SYNOPSIS

At 0110 on 16 March 2011, the Isle of Man registered feeder container vessel *Clonlee* suffered an electrical blackout as she entered the Port of Tyne, England. The ship's engineers were unable to restore the ship's power immediately and the vessel ran aground on Little Haven Beach at about 6 to 7 knots. The grounding caused no injuries and the vessel's hull remained intact.

The probable cause of the electrical power failure was an intermittent electrical fault within the ship's electrical power supply and distribution systems. *Clonlee* ran aground because the power failure occurred within the confined waters of the harbour entrance and the master was unable to stop the vessel.

The ship's critical systems had not been operated, tested or maintained in accordance with the manufacturers' instructions or the requirements of the International Safety Management (ISM) Code. Copies of the manufacturer's manuals for the electrical power supply and distribution systems were not held on board *Clonlee* because the ship's owners had not translated them into the ship's working language.

The repetitive nature of the vessel's operation, coupled with a minimalistic approach taken by the company to the objectives of the ISM Code, led to a complacent attitude being taken to navigational practices and safety management. The bridge team did not plan or execute *Clonlee*'s approach to the Port of Tyne in accordance with the ship's safety management system, international maritime regulations or local requirements. The port entry was unsafe and unnecessarily endangered the ship, her crew and the environment.

The ship's machinery had not been prepared for manoeuvring and the deck crew were not standing by prior to entering the harbour. The two-man bridge team was under-resourced to respond to the emergency situation. The master was cognitively overloaded and lost his situational awareness. The lack of emergency preparedness and effective training drills led to a total breakdown of internal communications, which resulted in the failure to '*let go'* an anchor and prevented a full damage assessment being carried out.

Many of the factors that had contributed to this accident had been previously identified on several occasions during external audits and inspections. The Isle of Man Ship Registry and Germanischer Lloyd have implemented processes to ensure non-conformity notes are raised for all identified ISM Code non-compliances, in accordance with the requirements of the Code.

The Port of Tyne Ltd has amended its port passage plan to include the port's seaward approaches, and has taken action to promulgate the amendments to its port users and ensure that its VTS operators closely monitor, and where necessary challenge the intentions of vessels approaching the port in the future.

Recommendations have been made to *Clonlee*'s owners, North Atlantic Shipping Ltd, aimed at addressing the atmosphere of complacency identified on its vessels and improving safety culture through effective safety management and training.

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *CLONLEE* AND ACCIDENT

SHIP PARTICULARS

Vessel's name	*Clonlee*
Flag	Isle of Man
Classification society	Germanischer Lloyd
IMO number	9129471
Type	Container
Registered owner	North Atlantic Shipping Ltd
Manager(s)	North Atlantic Shipping Ltd
Charterer (time charter)	Feederlink Shipping and Trading B.V.
Construction	Steel
Length overall	101.1m
Registered length	96.13m
Gross tonnage	3,999
Minimum safe manning	11
Authorised cargo	Containers

VOYAGE PARTICULARS

Port of departure	Rotterdam, The Netherlands
Port of arrival	South Shields, England
Type of voyage	Short International
Cargo information	1,774t of containerised cargo (188 twenty-foot equivalent units)
Manning	11

MARINE CASUALTY INFORMATION

Date and time	0113 on 16 March 2011
Type of marine casualty or incident	Less Serious Marine Casualty
Location of incident	Blackout: within the Port of Tyne harbour entrance, 1.5 miles east of the Herd Groyne Grounding: Little Haven beach, South Shields
Place on board	Engine control room
Injuries/fatalities	Nil

Damage/environmental impact	Buckling damage to the longitudinal floor and associated floor stiffeners on the port side of number 1 ballast tank. No environmental impact.
Ship operation	North Sea container feeder route between Rotterdam and UK.
Voyage segment	Arrival
External & internal environment	Dark, visibility good, tidal stream negligible and the weather conditions benign.
Persons on board	12 (11 crew plus the master's wife)

Clonlee

1.2 BACKGROUND

The feeder container vessel *Clonlee* was owned and managed by North Atlantic Shipping Ltd (NAS Ltd). She was chartered by Feederlink Shipping and Trading B.V. (Feederlink) and operated on its North Sea trading routes between the ports of Rotterdam, Immingham, Grangemouth, Felixstowe and South Shields.

Clonlee was carrying 1774t of cargo, equivalent to 188 twenty-foot containers. Her fuel oil ready-use and bunker tanks contained a total of 225t of heavy fuel oil and 39t of marine gas oil. Her draught was 5.90m aft and 5.62m forward. In addition to the ship's crew, the master's wife was travelling on board at the time of the accident.

1.3 NARRATIVE

At 0600 on 15 March 2011, *Clonlee* departed Rotterdam, The Netherlands for South Shields, England. During the passage across the North Sea, the ship's electrical power was supplied by the shaft generator[1] and her two diesel generators[2] (DG) were shut down.

The master, having completed his evening 8-12 watch, was relieved by the second officer (2/O) at 2355. During the handover of the watch, the master and the 2/O discussed the prevailing weather conditions and the forthcoming cargo operations. The master told the 2/O that they were likely to arrive at the entrance to the Tynemouth breakwater **(Figure 1)** slightly ahead of their initial estimated time of arrival (ETA) of 0115. Before leaving the bridge, he told the 2/O that he would return 15 minutes before arrival, and instructed him to call the chief engineer 40 minutes before arrival at the breakwater.

At 0030, the 2/O telephoned the chief engineer and told him *Clonlee* was due to arrive at the breakwater in 40 minutes. The chief engineer then woke up the second engineer (2/E), and they both went to the mess room for coffee. They took their coffee to the engine control room (ECR) and then entered the engine room to prepare the machinery for entering port. The chief engineer shut down the ship's fresh water generator while the 2/E carried out a set of routine rounds and checked that the DGs were ready to be started.

At 0040, the 2/O phoned the bosun and told him *Clonlee* was due to arrive at the breakwater in 30 minutes. The bosun then awoke the two off-watch able-bodied seamen (AB). The master returned to the bridge at 0048 and asked the 2/O what time high tide was before seating himself at the bridge console **(Figure 2)**. He took the con and switched the steering to manual.

The 2/O sent the duty AB, who was working as a bridge lookout, to assist the bosun, who had assembled his deck crew in the mess room. After drinking coffee, the deck crew went to their mooring stations and began to rig the ship's ropes and clear away the anchors in preparation for entering port.

At 0055, the master informed the Port of Tyne's Vessel Traffic Services (VTS) that *Clonlee* was 3 miles out **(Figure 3)**. Nine minutes later, the master advised VTS that he was 1 mile out and requested permission to enter the Tyne. The vessel was on

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[1] Shaft generator – an electrical alternator driven via the propeller shaft gearbox by the ship's main engine.

[2] Diesel generator – an electrical alternator driven by an auxiliary diesel engine.

a course of 307º and her speed over the ground was 14 knots. VTS gave approval and advised the master that no other ship movements were currently taking place on the river.

At 0106, with the breakwater's southern pier bearing approximately 275º at a distance of 0.5 mile, the master began to turn *Clonlee* to port. At 0108, the master telephoned the ECR and instructed the chief engineer to change over to the DGs **(Figure 4)**. Twenty seconds later, he reported to VTS that *Clonlee* was passing between the piers. The deck party, having completed its initial preparations for entering the port, began removing the upper deck containers' lashing arrangements.

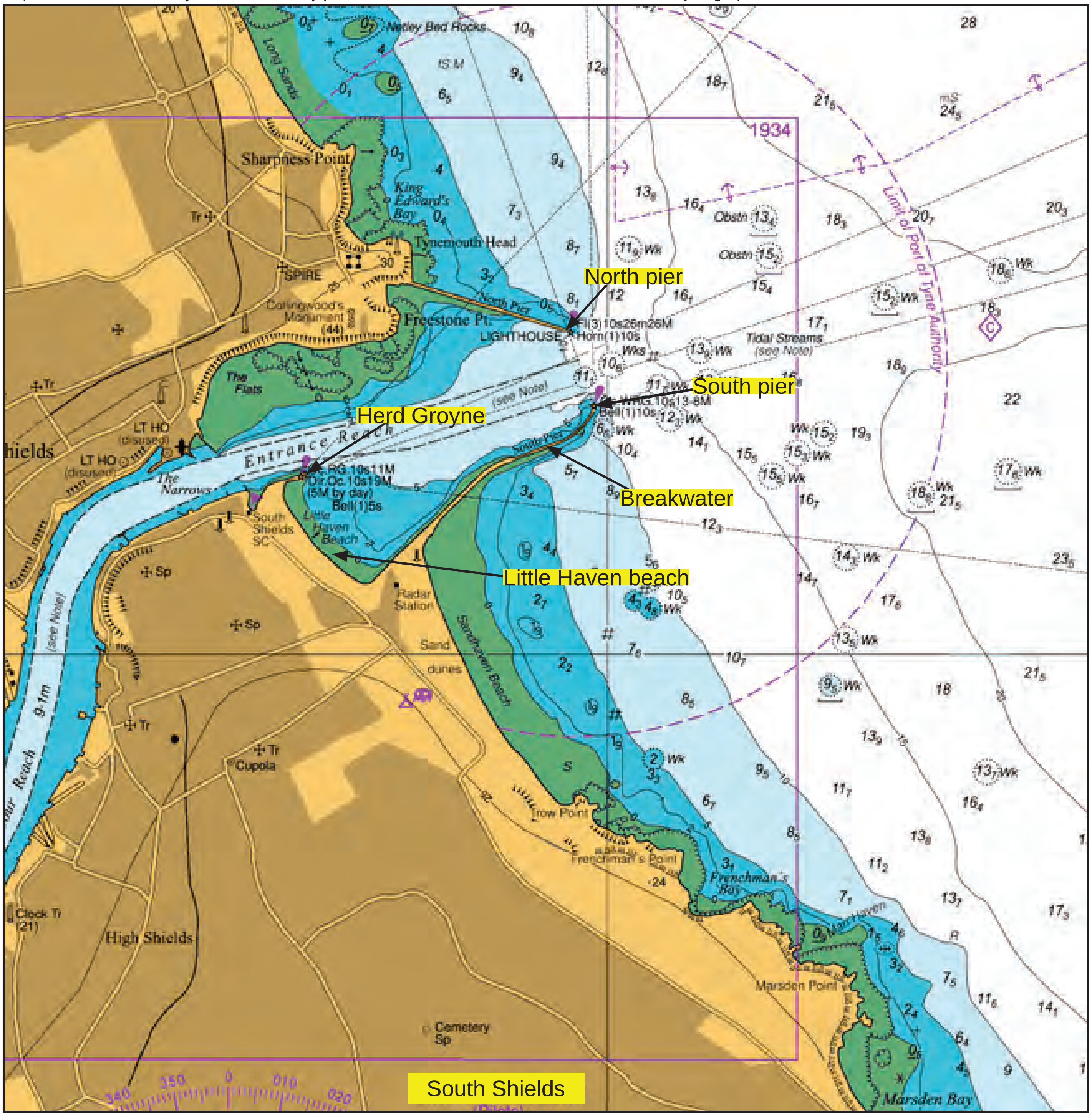

Figure 1: River Tyne harbour entrance

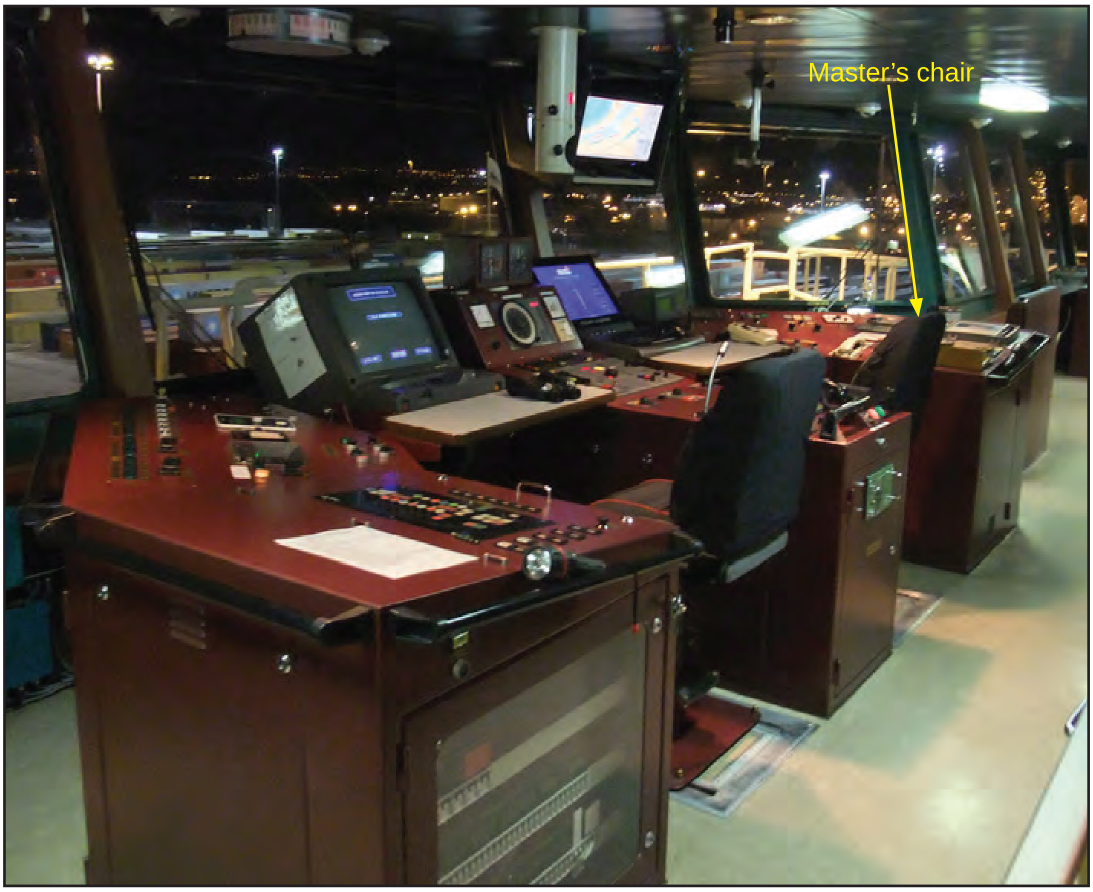

Figure 2: Bridge console

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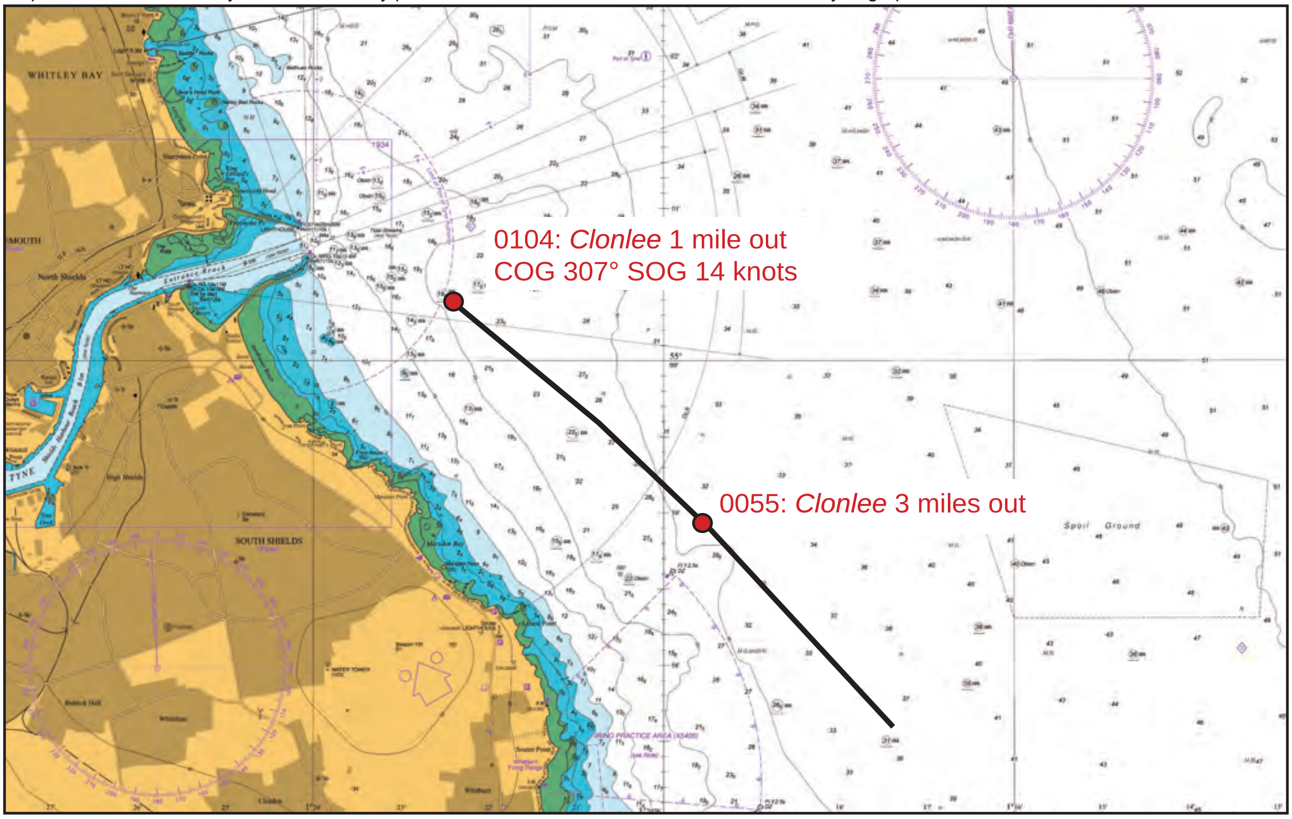

Figure 3: *Clonlee*'s positions when she reported to VTS

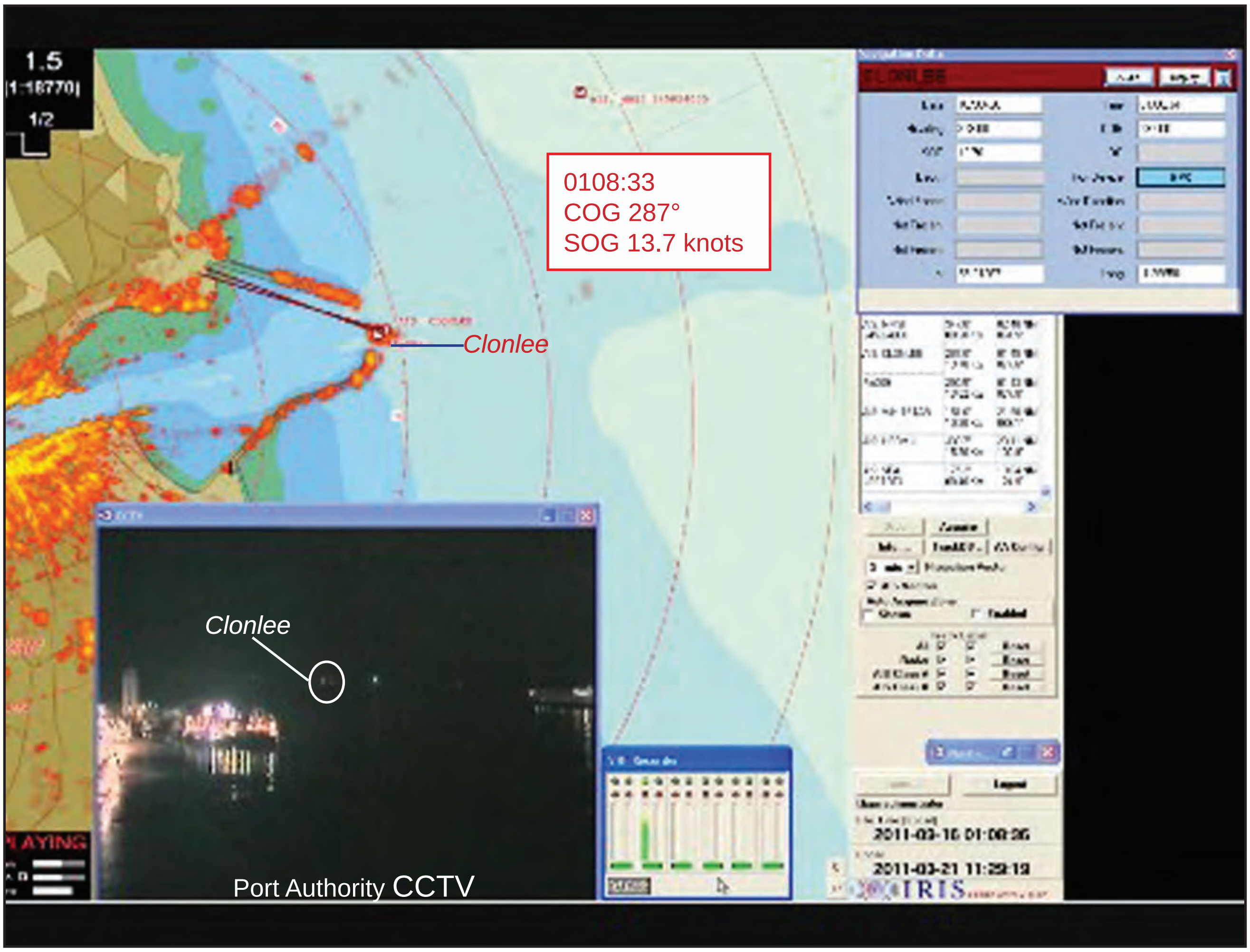

Figure 4: *Clonlee*'s position when the chief engineer was instructed to change over to manoeuvring mode

The engineers started the DGs and transferred the ship's electrical load to them from the shaft generator. They then made power available to the bow thruster by closing its circuit breaker on the main switchboard in the ECR. The 2/E entered the engine room and switched the main engine emergency telegraph repeater from its 'full away on passage' position to the 'stop' position **(Figure 5)**. The master acknowledged that the engineers had changed over to the DGs by switching the bridge telegraph repeater to 'stop'. The 2/E then began to reconfigure the engine room sea water cooling system to its harbour mode.

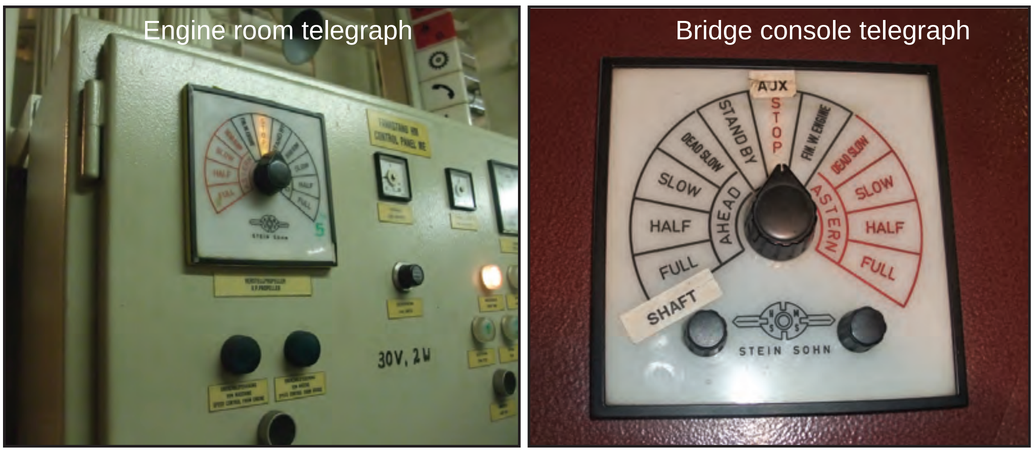

Figure 5: Engine emergency telegraph

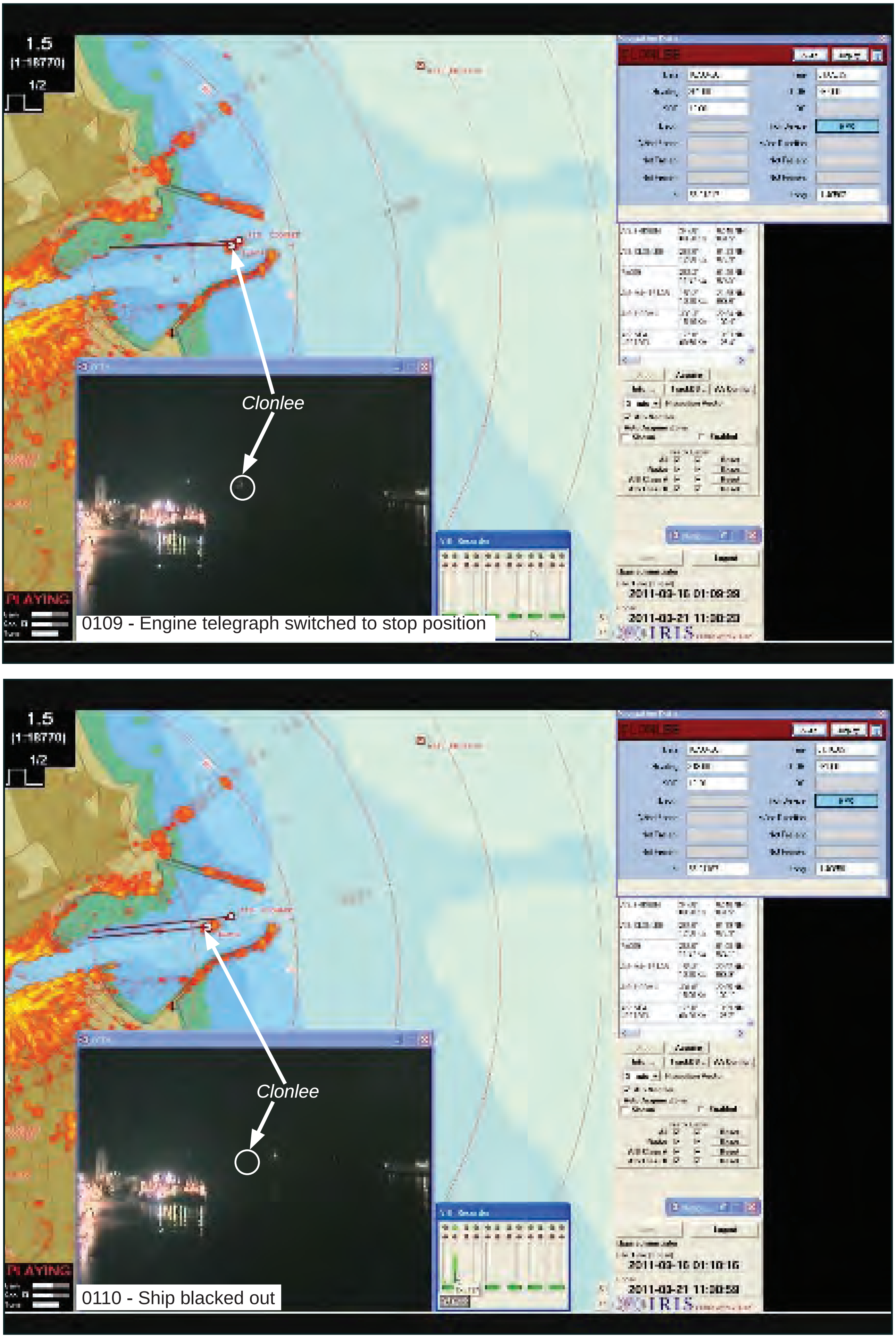

Figure 6: *Clonlee*'s position when the blackout occurred

At 0110, the ship suffered a total electrical blackout[3] **(Figure 6)** and its main engine slowed to its idling speed. The ship had just steadied on a course of 248º and was making 12.3 knots over the ground. Twenty-one seconds later, the emergency generator cut in automatically and restored power to the ship's emergency circuits. The master had control of the steering gear but could not adjust the ship's controllable pitch propeller (CPP) setting. The engineers in the ECR restored the ship's main power supply momentarily but the vessel blacked out again after about 30 seconds.

[3] A *blackout* situation means the loss of the main source of electrical power resulting in the main and auxiliary machinery being out of operation.

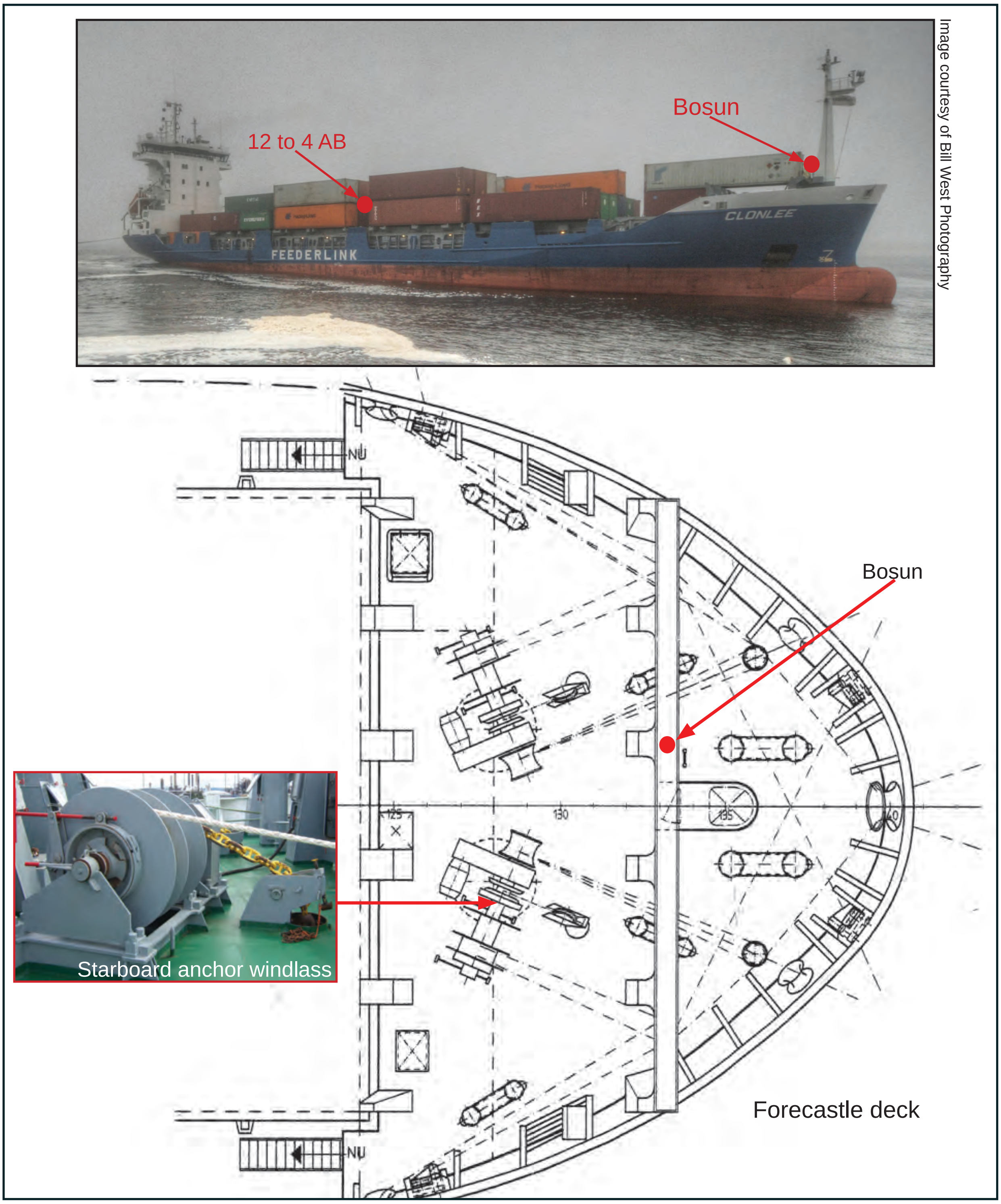

Figure 7: Location of the deck crew at the time of the blackout

The bosun was unlashing the containers at the forward end of the vessel **(Figure 7)** when he realised the ship had blacked out. He climbed down from the container support stanchion and made his way to the anchor windlasses on the forecastle deck.

At 0112, the master shouted, *"tell him to have an anchor ready".* The 2/O used his hand-held very high frequency (VHF) radio to relay the master's order to the AB assigned to the 12-4 watch. This AB, who was unlashing containers towards the aft end of the main deck **(Figure 7)**, acknowledged the order and began to make his way forward towards the forecastle deck. About 15 seconds later, the master shouted, "*tell him to drop that starboard anchor quick*". Again, the 2/O used his radio to relay the order. The AB told the 2/O that he was still running forward and had not yet reached the forecastle.

The master alerted VTS that he had *"big problems"* on board, then told the 2/O to call his wife. Recognising that his vessel was now less than 3 ships' lengths from the Herd Groyne rocks and closing at about 7 knots, the master instructed the 2/O to tell the AB not to drop the anchor. The AB received the order not to drop the anchor as he met the bosun at the starboard windlass.

The master put the rudder hard-over to port to steer *Clonlee* away from the rocky groyne and, at 0113, the vessel grounded on the sand of Little Haven beach at South Shields **(Figure 8)**. The master immediately informed VTS that his vessel was aground and requested the assistance of a tug. The VTS duty officer alerted the harbourmaster (HM) and suspended all ship movements within the port limits.

Figure 8: *Clonlee* aground on Little Haven beach

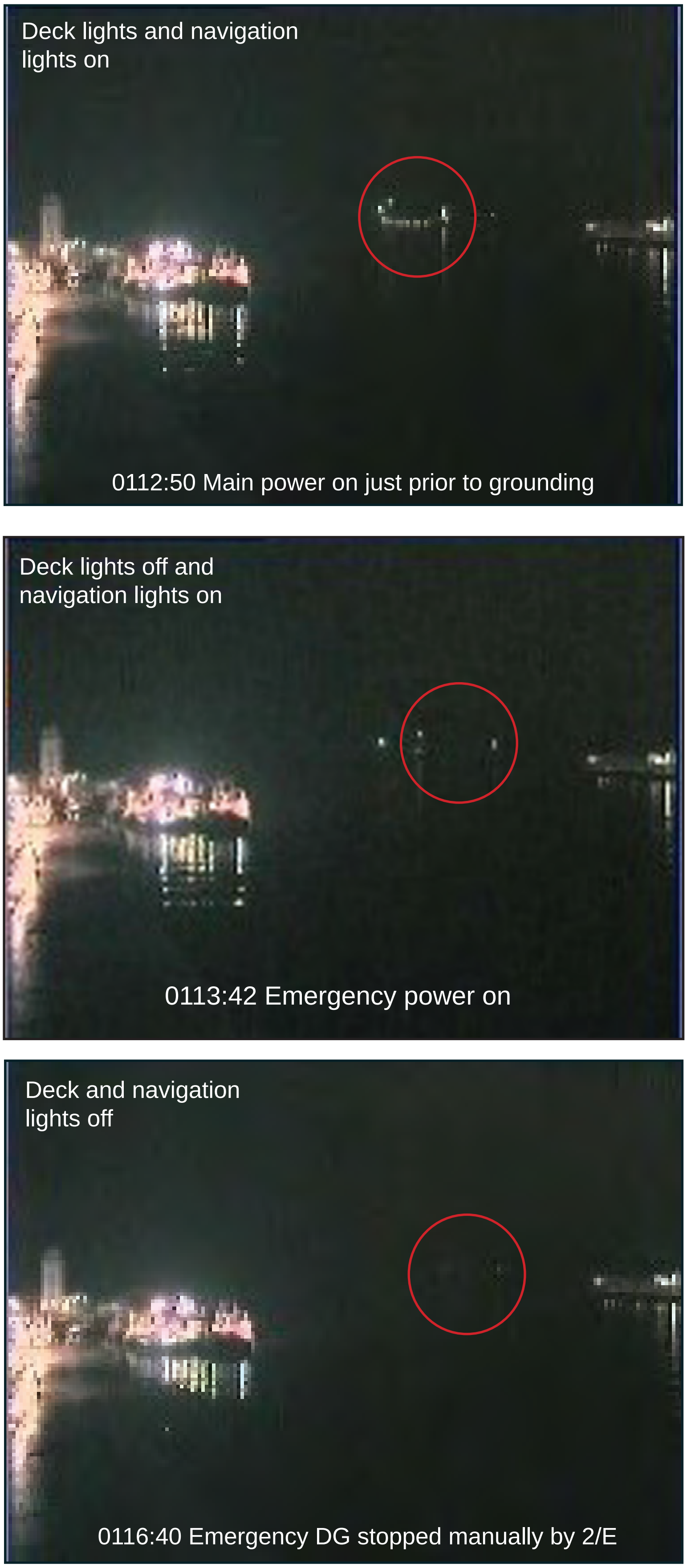

Figure 9: Third blackout as *Clonlee* runs aground

Clonlee's engineers had restored the main electrical power for a second time just as the vessel grounded **(Figure 9)**, but again, after about 30 seconds, she blacked out. At 0116, the engineers manually stopped the emergency generator and attempted to restore power by operating the switchboard in its manual mode.

The chief officer, having been awoken by the sound of the alarms, arrived on the bridge shortly after the grounding. The master and the chief officer briefly discussed the vessel's ballast condition but, without electrical power, pumping out the forward tanks was not an option. At about 0124, the master told the chief officer and 2/O to go and have a look around the deck and check for any oil spillages over the ship's side.

A few minutes later, the master's wife arrived on the bridge and asked what had happened. The master explained to her that the ship had lost power and was aground. He then phoned the number for NAS Ltd's designated person[4] (DP) ashore and left a voicemail message requesting him to call *Clonlee* as soon as possible.

At 0132, the chief engineer placed the CPP system in engine room control mode. The master's wife asked her husband if the engineers knew why the ship had lost power. The master replied, *"no, I haven't spoken to them yet"*.

[4] *Designated person* – the person based ashore having direct access to the highest level of management and whose influence and responsibilities should significantly affect the development and implementation of a safety culture within the company, as required by the ISM Code

At 0135, the pilot boat *Collingwood* arrived at the scene. Her crew used the boat's search light to assess *Clonlee*'s condition and check for oil on the surface of the water. At about 0151, the harbour tug *Lyndhurst* arrived at the Herd Groyne and the master instructed his aft mooring party to stand by. He then contacted the bosun, who was forward on the main deck, and asked him to check that both anchors were ready to drop. The bosun confirmed that they were.

At 0155, the master instructed the tug to attach a line aft and attempt to pull his vessel off the beach. The HM, now driving to the VTS centre, was called regarding the use of the tug. He instructed VTS to call the master to confirm that he had conducted a damage assessment and was content that there was no external or internal damage that might be adversely affected by the tug's attempts to refloat *Clonlee*. The master explained that his chief officer had sounded the tanks and had checked the bow thruster space and holds forward, and confirmed there were no signs of water ingress or leaks from the vessel's tanks. At 0200, the tug began to use full power in an attempt to pull *Clonlee* stern-first off the beach.

Collingwood collected the HM and a duty pilot from the Port of Tyne's VTS tower pontoon at North Shields and took them to the site of the grounding. The pilot boat crew took soundings around *Clonlee*'s hull and recorded her draught marks fore and aft. They found the depth of water to be 13m at the vessel's stern and 5m at her bow. From the soundings, the HM calculated that the forward third of the vessel was aground.

By now, the engineers had restored the ship's power and restarted the main engine. With the engine set to its full operating speed and the two DGs supplying electrical power to the switchboard, the chief engineer reset the switchboard to its normal manoeuvring configuration and made power available to the bow thruster. At 0203, almost immediately after closing the bow thruster breaker, the ship blacked out again.

At 0212, the HM and his pilot boarded *Clonlee.* When they arrived on the bridge, the tug was still applying full power to pull the vessel astern. The depth of water at the bow was now 4.7m and the forward third of the vessel was almost 1m aground. On the advice of the HM, the master instructed the tug skipper to pull out on alternate quarters. *Clonlee* remained fast aground and her heading did not change. With the tide still dropping, the HM recommended that the master suspend his attempts to refloat the vessel and wait for the next high tide. The master instructed the tug skipper to stop pulling and asked him to standby at the stern.

At 0220, 1 hour and 7 minutes after the initial blackout, the engineers restored the ship's main power supplies and passed control of the CPP and bow thruster back to the bridge. The chief engineer then phoned the master and informed him that the ship's power had been fully restored and the main engine was running. The chief engineer asked the master if everything was okay, and was told *"no it's not, we are hard and fast aground"*. The master then asked his chief engineer what had happened.

The master was contacted by the coastguard, who had been monitoring the VHF transmissions, and was asked to update them on his ship's condition. He also received a call from his DP and briefed him on the situation.

At about 0230, the master instructed the chief engineer to stop the main engine and told the chief officer to take a set of soundings around the vessel. He then discussed the options for refloating his vessel with the HM and pilot. The HM had calculated that, with some de-ballasting, *Clonlee* would refloat on the rising tide at about 1000, and it was agreed that tugs would only be used to pull her off the beach if she had not refloated by high tide. On the advice of the HM, the master ordered a second tug to arrive at 0900 and then went to his cabin to rest. The pilot returned ashore but the HM remained on board to monitor the situation overnight.

At 0800, the chief officer began to pump out the forward ballast tanks. An hour and 45 minutes later, with deballasting completed and a second tug in attendance, *Clonlee*'s heading started to slowly drift to port. The tugs were advised that the vessel was about to refloat and *Lyndhurst* was asked to pull minimum weight astern **(Figure 10)**. At 1000, *Clonlee* refloated and started to move slowly astern.

At 1015, with tugs in attendance, a pilot on board, and *Clonlee* proceeding on passage, the HM left the vessel. Assisted by the pilot, the master manoeuvred *Clonlee* upriver and berthed her alongside Riverside Quay at 1040.

Image courtesy of Bill West Photography

Figure 10: Refloating of *Clonlee* at 1000 on the rising tide

1.4 ENVIRONMENTAL CONDITIONS

The grounding occurred an hour after high tide. It was dark, the visibility was good, the tidal stream was negligible and the weather conditions were benign.

1.5 NORTH ATLANTIC SHIPPING LTD

NAS Ltd was founded in 2003 and was a family owned business based in Dublin, Ireland. The company's major share holder and founder was its managing director, and his son fulfilled the roles of company secretary, operations manager and DP, as well as being a director. The owner's son had a general management background and had not served in any capacity on board ships at sea. The company employed a marine engineering consultant on an 'as required' basis to fulfil the role of technical superintendent.

Clonlee was purchased from her original German owners in 2007, and was one of two container feeder vessels owned and managed by the shipping company. She was registered in the Isle of Man and classed with Germanischer Lloyd (GL). NAS Ltd's other vessel, *Clonmore,* was slightly larger than *Clonlee* and operated in the Mediterranean. She was registered in the Irish Republic and classed with Bureau Veritas.

Under the time charter agreement, Feederlink managed *Clonlee*'s cargo operations, organised her port schedules and provided the vessel's fuel. NAS Ltd was responsible for providing and managing the vessel's crew, maintaining her material condition, and ensuring she retained her flag state and classification society status.

1.6 SHIP'S CREW

Clonlee was operating with 11 crew members at the time of the grounding. This was in accordance with the minimum requirements set out in her safe manning certificate. The crew comprised the master, two deck officers, two engineer officers, a bosun, three ABs, a motorman and a cook. The master was British, the chief engineer and 2/E were Polish and the remainder of the crew were Filipino nationals. English was the working language on board.

The master had been working for NAS Ltd for 6 years, he had 40 years' experience at sea and held pilotage exemption certificates (PEC) for the ports of Tyne and Felixstowe. He was one of two masters who shared command of *Clonlee* on a 6 week on/6 week off rota. The majority of the ship's crew had worked for NAS Ltd for more than a year and had sailed on board *Clonlee* on several occasions.

1.7 MAIN PROPULSION AND MANOEUVRING EQUIPMENT

Clonlee had a single 9 cylinder medium speed diesel-driven Deutz MWM type 645L9 main engine. The engine ran on low sulphur heavy fuel oil and produced up to 3,825kW of power at a speed of 600rpm. The main engine drove the ship's CPP, via a single reduction gearbox, at a constant speed of 162rpm **(Figure 11)**.

The CPP hydraulic power-pack and its control system were manufactured by Wärtsilä Lips. The CPP system was controlled from the bridge and had ten ahead and astern pitch settings. The hydraulic power-pack's electrical power was supplied from the ship's main switchboard. The system was designed to lock the propeller blades in their set position on loss of hydraulic pressure.

Steering was provided by a single flap type rudder. The electrical power for one of the steering gear's two hydraulic pumps was supplied from the ship's emergency switchboard. *Clonlee* also had a 400kW Jastram reversible fixed pitch tunnel-type bow thruster. The bow thruster had three speed settings and was started and stopped from the bridge.

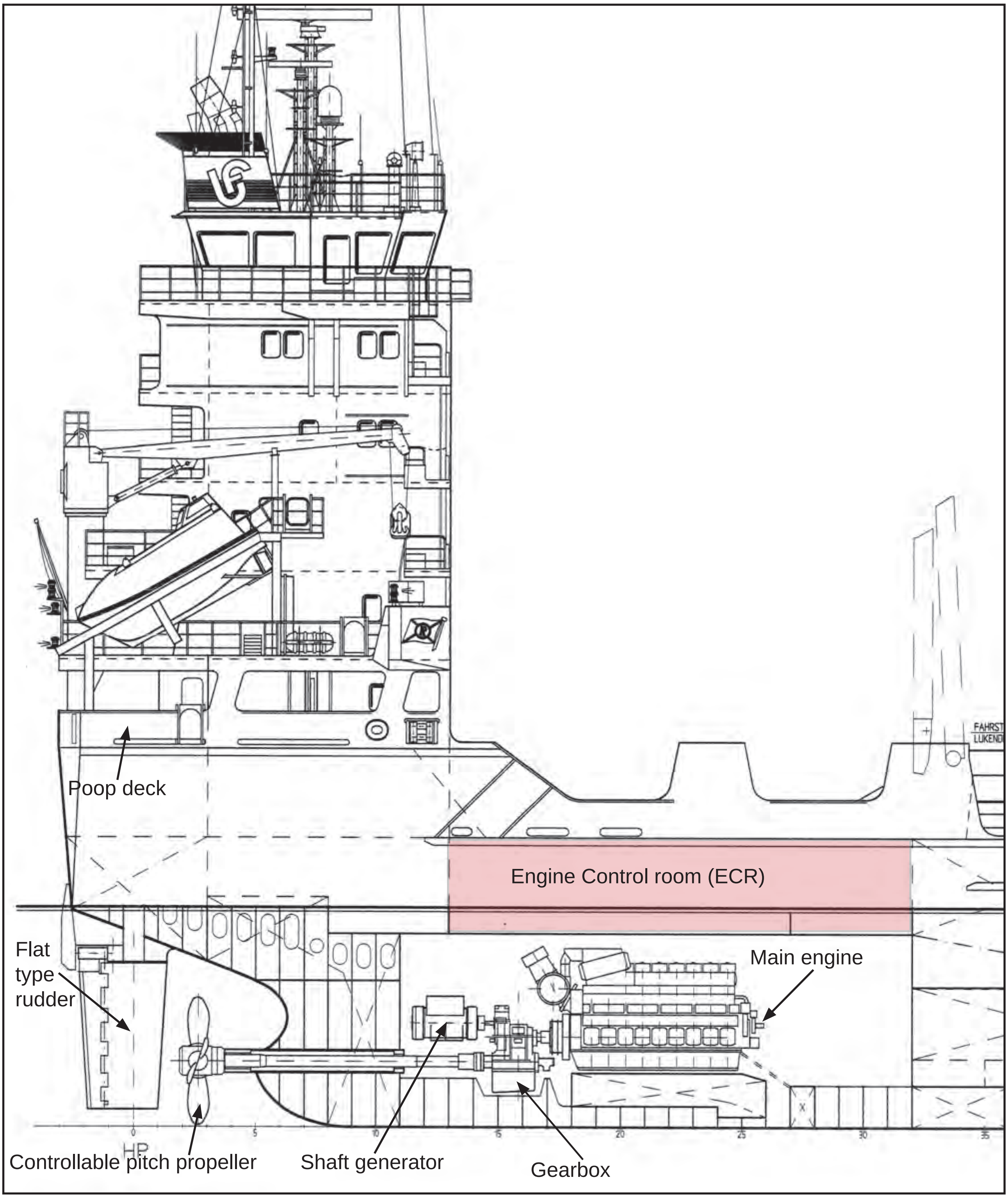

Figure 11: *Clonlee*'s propulsion drive train arrangement

1.8 ELECTRICAL POWER SUPPLY, DISTRIBUTION AND CONTROL SYSTEM

1.8.1 Power supply

The ship's main electrical power was supplied by two 340kW DGs and one 680kW shaft generator. These generators supplied three phase alternating current electricity at 380V and 50Hz to the ship's main and emergency switchboards. The DGs' Caterpillar type 3408 DI-TA prime movers ran on low sulphur marine gas oil and drove the alternators at a speed of 1,500rpm. The shaft alternator was permanently connected to the main engine-driven gearbox **(Figure 11)**. *Clonlee* also had a shore power connection that offered the option of using power generated ashore to meet her electrical load while in port.

Emergency power, in the event of the loss of main electrical power, was provided by a 40kW diesel-driven emergency generator. A bank of 12V batteries ensured a continuous power supply to several of the vessel's essential communication systems in the event of a blackout.

1.8.2 Power distribution

The ship's power distribution and control system was designed and manufactured by Interschalt Maritime Systems AG (Interschalt) and was installed in 1996 while the vessel was being built. The system had been designed and manufactured for the German ship builder J.J. Seitas KG Schiffswerft GmbH & Co. and was installed on board 24 other vessels of the same class.

The main switchboard was located in the ECR and the emergency switchboard was located in a dedicated compartment whose access was on the starboard side of the poop deck **(Figure 12)**. Under normal conditions the emergency switchboard was connected to, and received its power supply from, the main switchboard. Electrical power was distributed around the ship, via seven separate circuits, from the main switchboard **(Figure 13)**. These seven main circuits were:

- essential consumers part 1
- essential consumers part 2
- non-essential consumers
- refrigerated container circuit 1
- refrigerated container circuit 2
- bow thruster supply circuit
- emergency power circuit

The main switchboard was fitted with a coupling breaker that allowed its bus bars[5] to be split. The essential consumers, non-essential consumers and emergency switchboard circuits were fed from bus bar A (main bus bar), while the bow thruster and refrigerated container circuits were fed from bus bar B (shaft generator bus bar).

[5] Bus bars – conducting bars that carry heavy currents to supply several electric circuits

1.8.3 Switchboard configurations

The switchboard was designed to be operated in four different configuration modes. These were:

- Mode 1 – DGs and shaft generator operating **(Figure 13)**
- Mode 2 – one DG operating
- Mode 3 – two DGs operating
- Mode 4 – shaft generator operating **(Figure 14)**

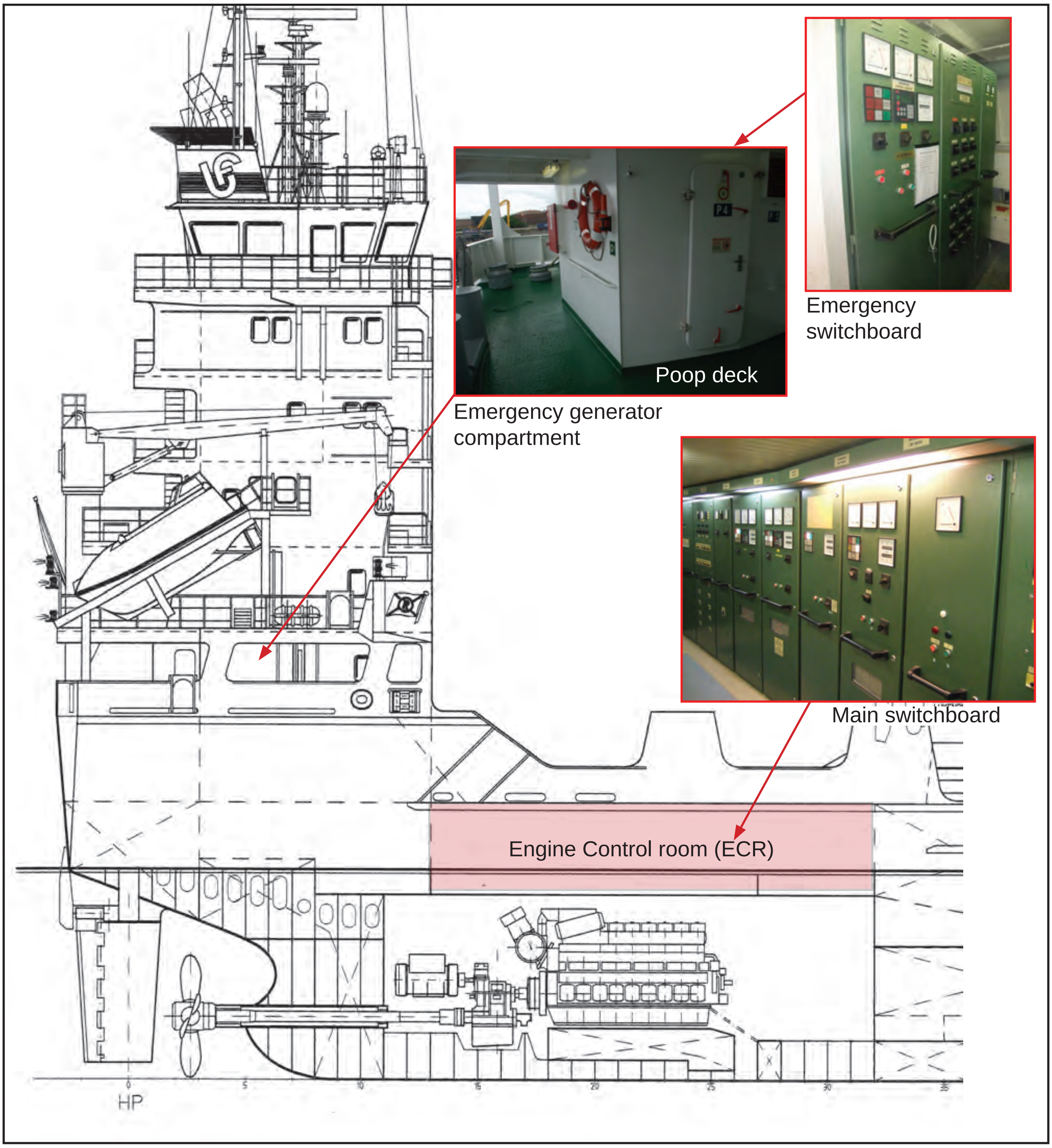

Figure 12: Main and emergency switchboards

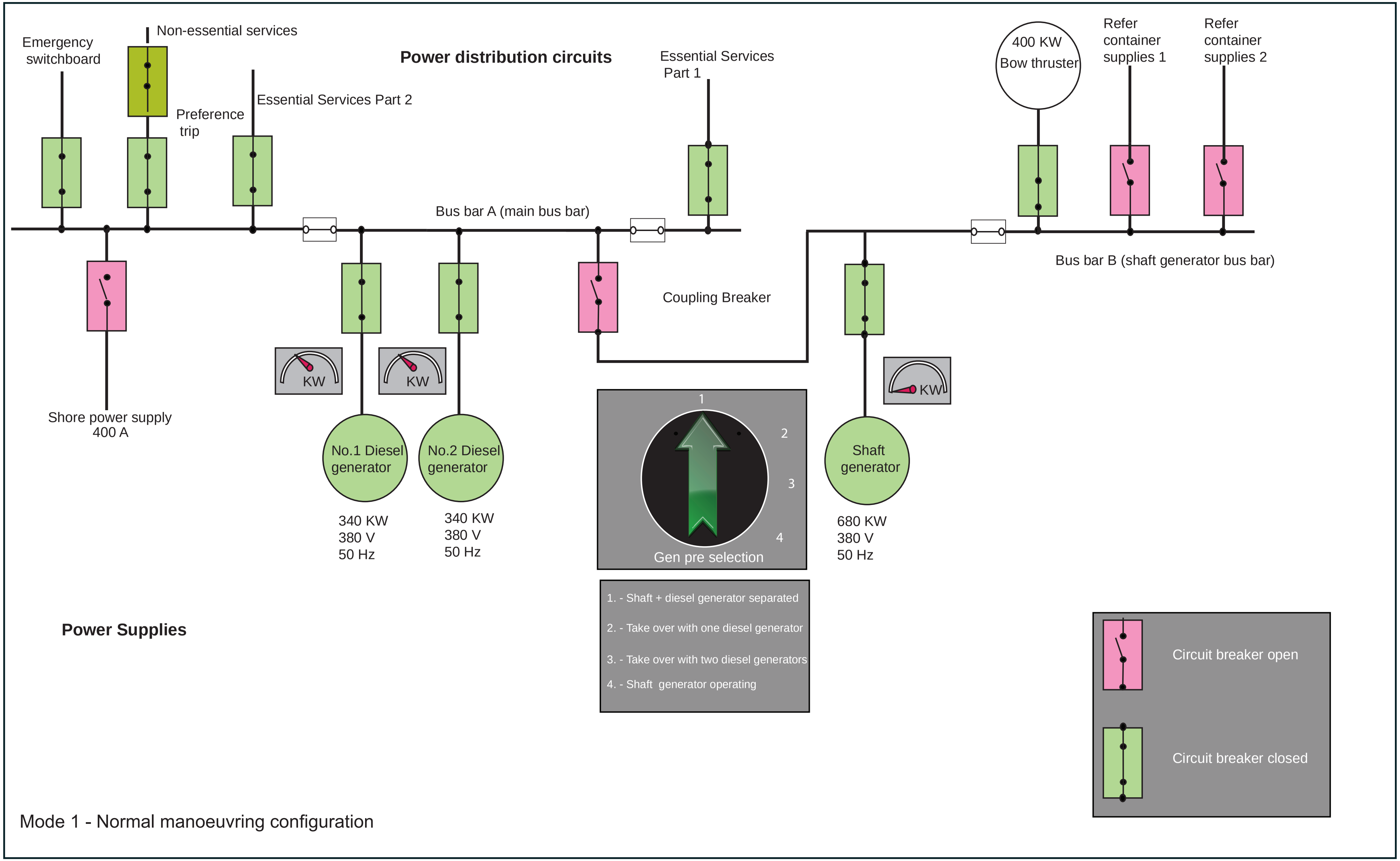

Figure 13: Switchboard power supply and distribution circuits

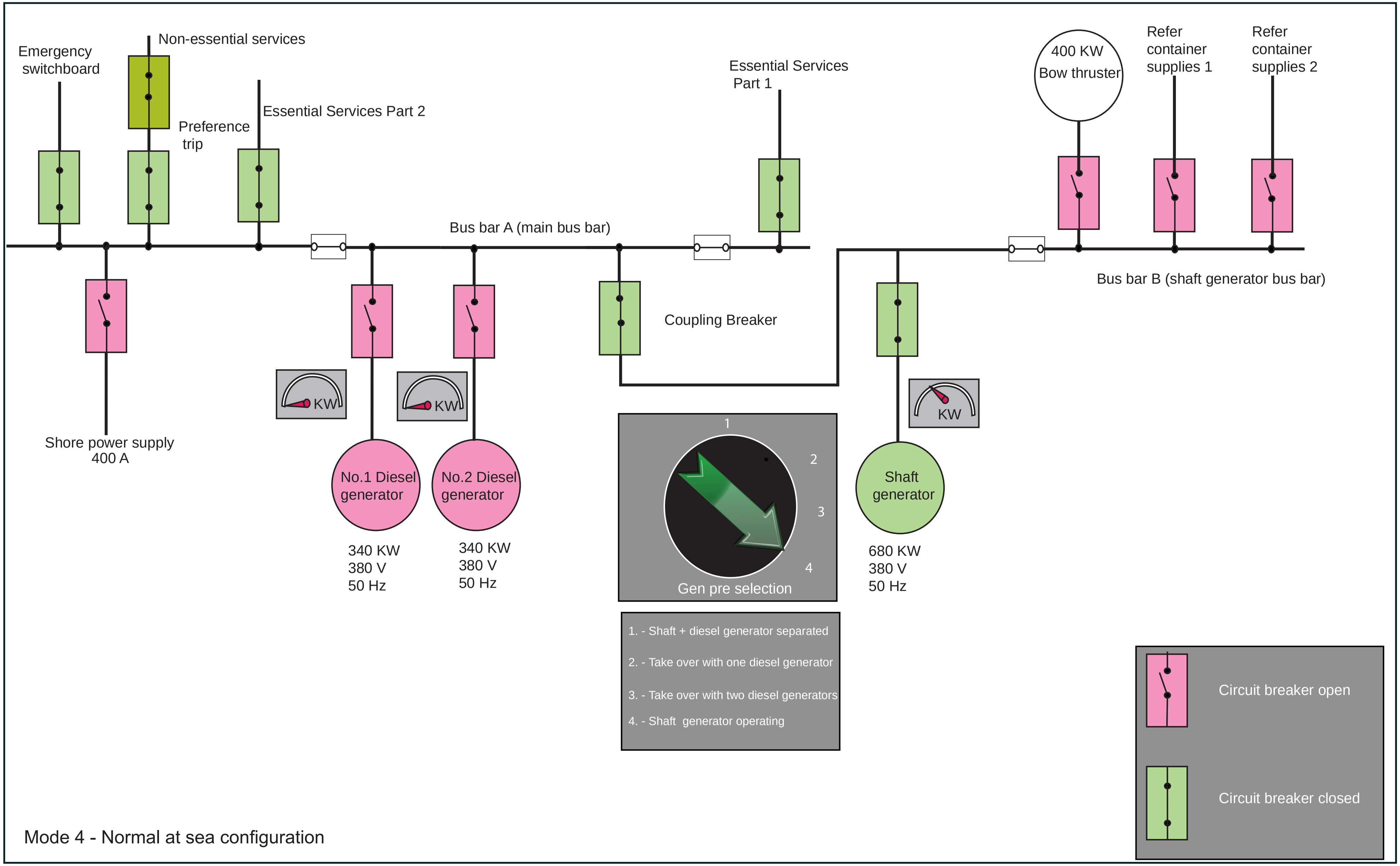

Figure 14: Switchboard mode 4 configuration

The switchboard and its associated control systems were not designed to allow the DGs and shaft generator to operate in parallel. In mode 1, the bus bar coupling breaker was in its open position and the switchboard was split. The DGs (one or both) supplied power to bus bar A and the shaft generator supplied power to bus bar B. In modes 2, 3 and 4, the bus bar coupling breaker was closed and power was delivered to the whole switchboard by either a single DG, both DGs operating in parallel or the shaft generator. Typically, the switchboard was operated in mode 4 while at sea and mode 2 or 3 in port, depending on the ship's electrical load.

The bow thruster could only be operated when power was being supplied by the shaft generator or by two DGs. Mode 1, with both DGs connected in parallel supplying bus bar A and the shaft generator supplying bus bar B, was selected during manoeuvring operations. This offered a high level of reserve power when the bow thruster was operating and provided 100% redundancy to the ship's essential services.

1.8.4 Generator control and power management systems

The diesel engines, alternators and related systems connected to the main bus bars were controlled, monitored and protected by ABB *Dicon* and *Synpol* electronic devices **(Figure 15)**. These formed an integrated electronic protection and control system and provided semi-automatic power management that allowed the switchboard configuration to be changed without the need to interrupt the power supply to the ship's electrical circuits.

Switchboard configuration changes had to be initiated manually by adjusting the position of the generator pre-selection switch **(Figure 15)** and pressing the appropriate DG start buttons on the Dicon control panels. When the DGs were started in their automatic mode the control system adjusted their speed, synchronised the alternators, operated the circuit breakers and shared the electrical load without the need for any further manual intervention.

1.8.5 Protection devices

The DGs' Caterpillar 3408 D1-TA prime movers were protected by dedicated alarms, shutdown trips and a power reduction function. These protection devices included:

- low lube oil pressure alarms and trips
- high cooling water temperature alarms and automatic power reduction
- overspeed trips

The alternators and related systems connected to the main bus bars were protected against overload, short circuits, under and over voltage, failure to synchronise, reverse power and under frequency. The trip reset switches were on the front of the Synpol units located inside the generator panels on the main switchboard **(Figure 16)**. There were three switches on the panel: the two on the left reset the switchboard trips and the one on the right was a synchronisation test switch. The synchronisation test switch was used to test the synchronisation sequence without closing the main breaker. If the test switch was not in its central run position the breaker would not operate. It was noted that all three switches had been marked with the letter *'R'.*

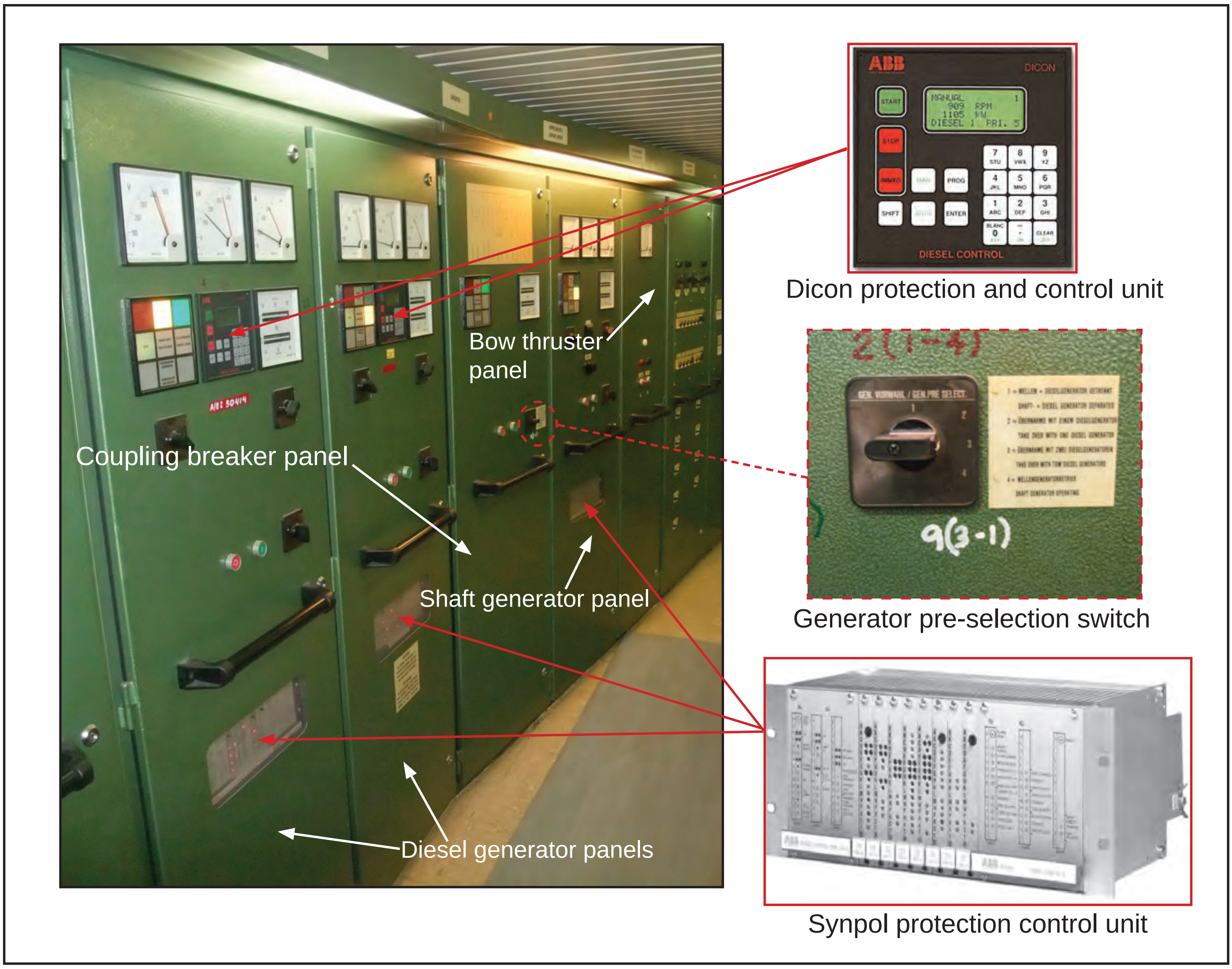

Figure 15: Switchboard protection and control devices

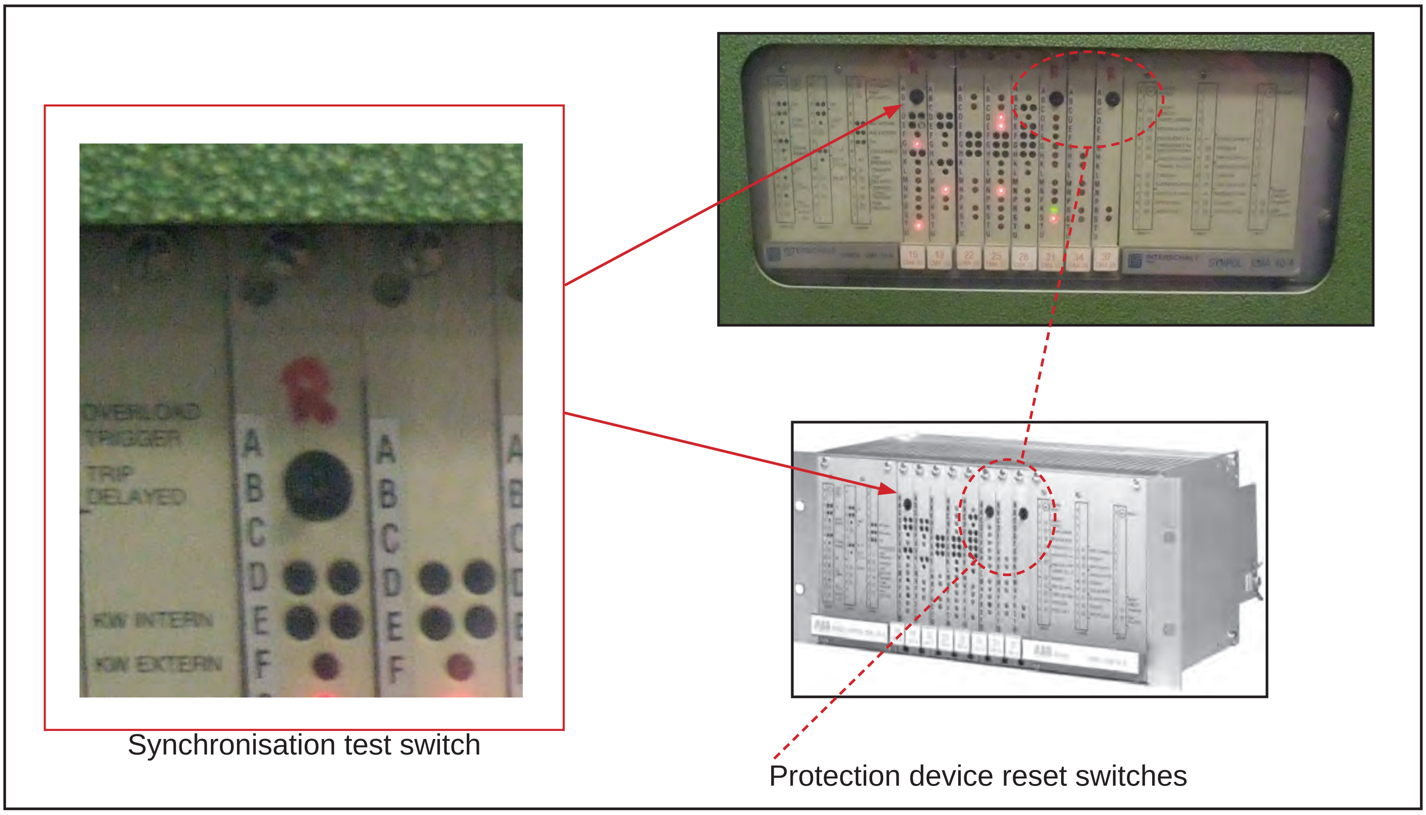

Figure 16: Synpol protection and control device reset switches

The control system was programmed to provide several other safety features, including:

- Automatic shedding of non-essential loads during overload conditions.
- A 2 minute limit on the parallel operation of the DGs and shaft generator during switchboard mode changes.
- Automatic shutdown of DGs if either one, or both fail to synchronise with the shaft generator within 1 minute when changing from mode 4 to mode 3.

To parallel the shaft generator with the DGs or the coupling breaker, the speed of the DGs was adjusted to match that of the shaft generator.

1.8.6 Switchboard configuration changeover procedures

Clonlee had crossed the North Sea with her main switchboard operating in mode 4 **(Figure 14)**, with her entire electrical load being supplied by the shaft generator. At the time of the blackout, the switchboard was reported to be in mode 1, with both DGs connected to the switchboard with power available to the bow thruster **(Figure 13)**.

The ship's safety management system (SMS) required the engines, steering gear and auxiliary machinery to be prepared and tested in accordance with the equipment manufacturers' instructions and guidance. Interschalt's instruction manual described the switching sequences from mode 4 to either mode 2 or 3 and from modes 2 or 3 to mode 1.

The sequence described in the manual for changing from the shaft generator (mode 4) to two diesel generators (mode 3) was:

1. *Turn generator pre-selection switch from position 4 to position 3*
2. *Start two DGs in automatic mode*
3. *The DGs will automatically:*
    a. *run up to their operating speed*
    b. *synchronise with the main shaft generator*
    c. *connect to the switchboard*
    d. *take the load from the shaft generator*
4. *Two seconds after the second DG has connected to the bus bars the shaft generator circuit breaker will open*

In circumstances where only one DG connected to the switchboard and the second failed to synchronise within 60 seconds, the control system was programmed to stop both DGs and leave the shaft generator supplying the ship's power until the problem could be resolved. This safety feature was designed to prevent a single DG being overloaded during periods of high power demand.

The sequence described in the manual for changing from position 3 to position 1 was:

1. *Turn generator pre-selection switch from position 3 to position 1*

2. *The shaft generator will automatically synchronise with, and connect to, the switchboard*

3. *Two seconds after the shaft generator has connected to the switchboard the bus bar coupling breaker will open and split the switchboard*

Clonlee did not hold copies of Interschalt's electrical equipment instruction manuals. Interschalt had provided operating and maintenance manuals when the vessel was built, but they were written in German. NAS Ltd held the original manuals in its Dublin office, but had not translated them into English.

The ship's written procedures for starting and stopping the ship's main machinery **(Annex A)** had been developed locally by the chief engineers and included the following instructions for changing from sea mode to manoeuvring mode:

1. *If so, stop water production (FWG stop)*

2. *Start both 1D/G and 2D/G on auto mode, and coupling switch change over from position 4 to position 1, D/G's automatically switching on on MSB*

3. *Bow thruster switch on knob and push on green button*

4. *Telegraf from "full" position (shaft run), change over to "stop" position (D/G's run)* [sic]

This procedure of changing directly from mode 4 to mode 1 was followed prior to the blackout.

1.8.7 Blackout recovery

In the event of a blackout on the main switchboard, the power supply to the emergency switchboard would also be lost. If the power was being supplied by either the shaft generator or one DG at the time of the blackout, the system was designed to restore power to the main and emergency switchboards by automatically starting the standby DG and connecting it to the main bus bars. If a standby generator was not available the control system should have restored power to the emergency switchboard by automatically starting the emergency generator after a 15 second delay.

At the time of the first blackout on board *Clonlee,* both DGs were reported to be running and connected to the main switchboard. With no standby DG, the emergency generator started and power to the emergency switchboard was restored after 21 seconds.

The procedure described in the switchboard operating manual for recovering from a blackout condition required the engineers to:

1. *Place the generator pre-selection switch to position 1 (shaft and DG separated)*

2. *Set the DG start units to manual*

3. *Press the chosen DG start button on the Dicon panel*

4. *If necessary, adjust the DG's speed to provide rated frequency*

5. *Press the DG circuit breaker 'on' button.*

The DG would then provide power to the ship's essential services and emergency switchboard from bus bar A. The restoration of power to the unessential services and bus bar B would then have to be instigated manually. Once the initial fault condition had been rectified, the system could be returned to its normal automatic mode.

The blackout recovery procedure produced on board **(Annex B)** included the following steps:

1. *After blackout st-by generator set starts itself, if not, next st-by starts itself, if still not, emergency generator starts itself.*

2. *If necessary, start and switch on 1 D/G and 2 D/G on main switch board*

3. *Knob switch change to poz. No 3 and green button on*

4. *Non essential consumers switch on* [sic]

Following the blackout, the engineers reset the trips on the front of the Synpol panels **(Figure 15)** and then attempted to recover the main power supply with the DGs in their automatic mode and with the generator pre-selection switch set to position 3. After their first two attempts to restore power failed, the 2/E went to the poop deck and switched the emergency generator to its manual mode and stopped it. This resulted in the loss of electrical power to the ship's emergency circuits. The engineers then attempted to operate the main switchboard manually. They made several unsuccessful attempts to restore power from this blacked out condition before returning the emergency generator to its automatic mode. After each blackout the engineers recalled having to reset the DGs' high frequency trips.

1.9 MACHINERY AND NAVIGATION ALARM SYSTEMS

Clonlee's electronic machinery supervision system was originally designed by Noris Automation GmbH in 1980. The Norimos 1000 alarm panels were located in the ECR **(Figure 17)** and a repeater panel was provided on the bridge console. A paper printer had been provided to record the machinery alarm history as the machinery supervision system's micro-processors did not store historical data.

At the time of the accident, the ECR machinery alarm printer was not working and therefore the alarm history immediately prior to the blackout had not been recorded. The witness accounts indicated that no machinery alarms sounded in the ECR prior to the blackout.

Clonlee's unmanned machinery space (UMS) alarm system was also designed and manufactured by Noris Automation GmbH. It transmitted machinery alarms to remote panels located in the duty engineer's cabin and the crew mess room when the ECR panel **(Figure 17)** was set to its 'unattended' mode.

An Interschalt SMA48 navigation system alarm panel was also provided on the bridge. Its 32 alarms primarily related to navigation systems, but did include several machinery related alarms. These included:

- steering gear failure
- steering gear overload/phase failure
- fault bow thruster
- wire equipment feed from emergency switchboard

The alarm on the SMA48 navigation panel activated on the bridge 20 seconds before the blackout. The alarm was silenced on the bridge but its activation was not recorded.

Figure 17: Noris machinery supervision system

1.10 INTERNAL COMMUNICATIONS

1.10.1 Intercom and main broadcast

Clonlee had an integrated internal intercom and main broadcast system **(Figure 18)**. The intercom or main broadcast modes were manually selected from the system's master panel on the bridge console. Remote intercom panels were located in the ECR, the steering gear compartment and at the forward and aft mooring stations. Two remote panels **(Figure 18)** had been provided on the forecastle deck to serve the forward mooring station. The system's main power supply was taken from the ship's emergency switchboard. A battery-powered backup supply had been provided to ensure the system's continued availability during blackout situations.

The internal intercom provided the primary means of communication between the bridge and the deck mooring stations. However, the intercom was not used during the vessel's approach to the Tyne, or to relay messages to the forecastle after the blackout.

Figure 18: Internal intercom

1.10.2 Internal telephone system

The ship's internal telephone exchange was powered from the emergency switchboard, but it did not have a battery-powered backup supply. The master used the bridge telephone to communicate with the chief engineer in the ECR.

1.10.3 Hand-held radios

Clonlee had three hand-held VHF radios that were used for internal communications. During a normal working day, the duty officer and the duty rating each carried a radio. The master had marked the third CAPT PRIVATE **(Figure 19)**, and kept it for his own personal use.

At the time of the blackout, the master's radio was in his cabin. The 2/O used his radio to relay the master's post-blackout orders to the deck crew. The 2/O and the AB communicated with each other on working channel 8 in their native Filipino language.

Figure 19: Master's hand-held radio

1.11 SAFETY MANAGEMENT SYSTEM

1.11.1 General requirements of the International Safety Management Code

The objectives of the International Safety Management (ISM) Code[6] are to ensure safety at sea, prevention of human injury or loss of life, and avoidance of damage to the environment. In order to achieve these objectives the ISM Code requires shipping companies to:

- provide for safe practices in ship operation and a safe working environment;
- assess all identified risks to its ships, personnel and the environment and establish appropriate safeguards; and
- continuously improve safety management skills of personnel ashore and aboard ships, including preparing for emergencies related both to safety and environmental protection.

Companies are required to provide safety management systems that should ensure:

- *compliance with mandatory rules and regulations; and*
- *that applicable codes, guidelines and standards recommended by the Organization, administrations, classification societies and maritime industry organizations are taken into account.*

The functional requirements of the SMS should include:

- A safety and environmental protection policy.
- Instructions and procedures to ensure safe operation of ships and protection of the environment in compliance with relevant international and flag state legislation.
- Defined levels of authority and lines of communication between, and among, shore and shipboard personnel.
- Procedures for reporting accidents and non-conformities with the provision of the ISM Code.
- Procedures to prepare for and respond to emergency situations.
- Procedures for internal audits and management reviews.

1.11.2 North Atlantic Shipping Ltd’s safety management system

The documents used to describe and implement the company’s SMS were contained in its vessels’ safety management manuals (SMM). NAS Ltd’s SMMs were based on an SMS originally developed and used by another shipping company.

[6] ISM Code - The International Management Code for the Safe Operation of Ships and for Pollution Prevention

Paper copies of the SMMs were held on board *Clonlee* and *Clonmore* and were controlled by the DP from his office in Dublin. The DP used company memos and document transmittal notices to disseminate changes made to the company's SMS and any subsequent amendments required to be made to the ship's manuals. An amendment was last made to *Clonlee*'s SMM on 29 September 2010 **(Annex C)**.

1.11.3 Verification and review process

Administrations are responsible for verifying compliance with the requirements of the ISM Code and for issuing Documents of Compliance[7] (DOC) to companies and Safety Management Certificates[8] (SMC) to ships. To ensure its continued validity, the DOC is subject to annual verification by the administration or by an organisation recognised by the administration. NAS Ltd's annual office-based DOC audits had been carried out by GL on behalf of the Isle of Man Ship Registry. An SMC was valid for a period not exceeding 5 years. To ensure its continued validity, the SMC was subject to at least one intermediate audit by, or on behalf of, the administration. *Clonlee*'s SMC verification audits had all been carried out by the Isle of Man Ship Registry's ISM Code auditors.

The ISM Code requires shipping companies to carry out internal safety audits on board and ashore at intervals not exceeding 12 months to verify that safety and pollution-prevention activities complied with the SMS. NAS Ltd's DP had carried out all of the company's internal audits on board *Clonlee*.

ISM auditors are required to document all their observations[9] and then review their observations to determine which are to be reported as non-conformities[10]. The definition of an observation used by the Isle of Man Ship Registry differed to that given in the ISM Code. The approach adopted by its auditors was to raise observation notes for what they perceived to be minor non-conformities. The registry also used feedback notes to highlight examples of good practice that exceeded the minimum regulatory requirements.

To comply with the requirements of the ISM Code[11], the company's SMS should contain procedures to ensure that non-conformities, observations and hazardous occurrences are reported to the company's management. In addition, the company should have a system in place for recording, investigating, evaluating, reviewing and analysing such reports. NAS Ltd did not have any procedures in place to manage observations raised during external audits.

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[7] *Document of Compliance* – a document issued to a company which complies with the requirements of the ISM Code

[8] *Safety Management Certificate* – a document issued to a ship which signifies that the Company and its shipboard management operate in accordance with the approved safety management system

[9] *Observation* – a statement of fact made during a safety management audit and substantiated by objective evidence

[10] *Non-conformity* – an observed situation where objective evidence indicates the non-fulfilment of a specified requirement

[11] Guidelines for the operational implementation of the International Safety Management (ISM) Code by Companies (*Annex to MSC-MEPC.7/Circ.5*)

1.12 MAINTENANCE MANAGEMENT SYSTEM

1.12.1 General requirements

The ISM Code requires shipping companies to establish procedures to ensure their ships are maintained in accordance with relevant rules and regulations, and the instructions provided by equipment manufacturers. In order to achieve this, companies should provide maintenance management systems that ensure:

- inspections are held at appropriate intervals;
- any non-conformity is reported with its possible cause, if known;
- appropriate corrective action is taken; and
- records of these activities are maintained.

Shipping companies are required to identify critical equipment and technical systems, the sudden operational failure of which may result in hazardous situations. Specific measures aimed at promoting the reliability of such equipment and systems must be recorded in the SMS along with instructions and records for the regular testing of standby arrangements and protection devices.

1.12.2 North Atlantic Shipping Ltd's maintenance management system

NAS Ltd operated a paper based maintenance management system on its two vessels, and the planned maintenance schedules were included in the ship's SMM. Its chief engineers submitted monthly maintenance reports to the company's office in Dublin. The DP forwarded the monthly reports to the company's consultant technical superintendent for assessment.

The SMM included a generic list of critical equipment typically found on board ships. The list did not include the power distribution and control system, the main engine, the ship's alternators or the CPP system. The ship had no planned maintenance schedules for the switchboard or its power distribution network. The SMS required the chief engineer to oversee the 3-monthly testing of the machinery shutdowns and 6-monthly testing of the machinery alarms. However, the SMM did not include an accurate list of the machinery shutdowns or alarms, and the ship's engineers did not routinely test the protection devices provided for the ship's alternators, their prime movers or the switchboard.

The ship undertook a statutory docking period in Amsterdam 2 months before the accident. The work specification included a general inspection and service of the ship's switchboard and power distribution system **(Annex D)**. However, the specification did not require the electrical contractor to test the safety devices or check the functional operation of the generator control system. NAS Ltd had no test records for the alternator and switchboard protection devices fitted on board *Clonlee*.

1.13 ONBOARD WORKING ROUTINES AND PRACTICES

1.13.1 Watches and duty routines

According to *Clonlee*'s SMM, the composition of the ship's bridge watches was to be:

> *…adequate and appropriate to the prevailing circumstances and conditions, under normal operating conditions the minimum composition of the watches shall be:*
>
> *Deck department – 1 certified deck officer and 1 AB*
>
> *Engine room department – 1 certified engineer.*

The SMM also required the procedures and duties of the deck officer on watch to be in accordance with international rules and regulations, and guidance contained in the International Chamber of Shipping's Bridge Procedures Guide (ICS Guide).

At sea, the navigation officers operated a 4 hours on, 8 hours off, three watch routine. The master was the navigational officer of the watch (OOW) between the hours of 8 and 12; the 2/O was the OOW between 12 and 4; and the chief officer between 4 and 8. In port, the chief officer and 2/O oversaw the vessel's cargo operations by working a 6 hours on, 6 hours off routine, while the master remained available to assist as required. The ABs were allocated sea watches and worked to those hours both at sea and in port. At sea, they acted as lookouts on the bridge, and in port they undertook general shipboard maintenance activities, assisted in cargo-handling operations and carried out gangway watches.

The generic instructions given in the ship's SMM stated that the procedures to be followed by the engineer OOW were to be in accordance with requirements set out in The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978, as amended (STCW 95). STCW 95 section A-VIII, *Standards Regarding Watchkeeping*, stated that:

> *The chief engineer officer of every ship is bound, in consultation with the master, to ensure that watchkeeping arrangements are adequate to maintain a safe engineering watch.*

Although much of the guidance provided in the SMM related to engine room watchkeeping routines, *Clonlee* was designed, manned and certificated to operate with her machinery spaces unmanned, therefore the engineering officers operated to a day work routine. For ships operating with UMS, the company's SMS required the chief engineer to establish an engineer officers' duty cycle in order to ensure the engineer on duty had received sufficient rest. When the engine room was unmanned, the remote alarm was to be set to the duty engineer's cabin.

An engineers' duty cycle had not been established on board *Clonlee*. Instead, the practice adopted by the chief engineer required his 2/E and him to work together, as a pair, and remain on call 24 hours a day, 7 days a week. The UMS alarm was set to sound in both engineers' cabins at the same time **(Figure 17)**, and they both responded to out of hours machinery alarms. This practice was reflected in their recorded hours of work and rest **(Annex E)**.

Although these practices were contrary to the requirements set out in the company's SMM, the DP ashore was aware of the local work practices adopted on board *Clonlee*, and similar routines had been adopted on board *Clonmore*.

1.13.2 Requirements for the composition and roles of the bridge team

The ICS Guide explains that a preliminary plan, setting out the composition and roles of the bridge team, should be prepared prior to entering pilotage waters. The guide points out that such a plan should still be prepared even when the ship's master holds a PEC. The ICS Guide also recommends that the ship's pilot card **(Annex F)** be updated prior to arrival at a port.

According to Rule 5 of The International Regulations for Preventing Collisions at Sea, 1972 as amended (COLREGS):

> *Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision*

According to STCW 95 section A-VIII, *Standards Regarding Watchkeeping*:

> *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.*

The ICS Guide points out that, while steering, a helmsman should not be considered to be the lookout, except in small ships with an unobstructed all-round view at the steering position.

The Port of Tyne authority's *General Directions for Navigation* within the port and its seaward approaches required the master of every vessel underway in the port to ensure their vessels are under the direct manual control of a competent helmsman other than the master or the pilot.

Clonlee's SMM contained little guidance regarding bridge team composition when manoeuvring or in hazardous situations, and did not discuss procedures for entering or leaving ports when utilising a master's PEC. It was normal practice on board *Clonlee* for the bridge team to comprise the master and an OOW when entering or leaving ports where the master held a PEC. It was also normal practice for the master to take the helm and the OOW to assume the role of lookout. The watchkeeping ABs were usually sent to assist the bosun on deck.

NAS Ltd's SMS required at least one engineer officer and an assistant to be present in the ECR when the ship was manoeuvring or in hazardous situations. On board *Clonlee*, the chief engineer and 2/E manned the ECR during these standby situations.

1.13.3 Pre-arrival checklists

The forms section of *Clonlee*'s SMM included bridge team pre-departure and pre-arrival checklists **(Annex G)**. The pre-arrival checklist included the following tasks:

- steering gear and rudder indicators checked
- engine control/telegraph tested
- internal and external communications tests
- anchor cleared
- pilot card
- crew informed of standby time
- engine room informed of stand by time

The SMS required the OOW to complete the form within 2 hours of arrival at a port and hand it to the master prior to arrival. An entry was to be made in the logbook after the master had acknowledged the completed form. The pre-arrival form was not completed prior to arrival at the Tyne on the day of the accident. Furthermore, it was not common practice for the bridge teams to complete these checklists.

1.13.4 Hours of work and rest

The crew's daily hours of work and rest were recorded on NAS Ltd's *Records of Hours of Rest* forms **(Annex E)**. A review of the hours recorded by the crew indicated that their hours of rest during the 2 weeks preceding the grounding satisfied the minimum requirements stipulated by the International Maritime Organization (IMO).

The records for March 2011 indicated that the master worked an average of 8.2 hours per day during the 2 weeks prior to the accident, with the most hours worked in any 24-hour period being recorded as 11 hours - the day before the accident. The chief officer recorded an average of 10.2 hours of work per day, and the 2/O recorded the longest working hours, averaging 12 hours per day. The records also indicated that the chief engineer and 2/E worked identical hours and averaged 11.2 hours per day.

1.14 PASSAGE PLANNING

1.14.1 General requirements

The Convention for the Safety of Life at Sea (SOLAS)[12] requires a ship's master to ensure that the intended voyage had been planned using the appropriate nautical charts and nautical publications for the area concerned, taking into account

[12] SOLAS chapter V – Safety of Navigation: Regulation 34 – Safe Navigation and Avoidance of Dangerous Situations.

the guidelines and recommendations contained in IMO Resolution A.893(21) - *Guidelines for Voyage Planning*. The guidelines explain that:

> *The development of a plan for voyage or passage, as well as the close and continuous monitoring of the vessel's progress and position during the execution of such a plan, are of essential importance for safety of life at sea, safety and efficiency of navigation and protection of the marine environment.*

The IMO resolution discusses the four key components necessary to ensure the effective planning and achievement of a safe passage. The initial voyage planning **appraisal** stage involves the gathering of all information relevant to the intended voyage. The next stage requires the detailed **planning** of the whole voyage from berth-to-berth. The third and fourth stages are the effective **execution** of the plan and **monitoring** the progress of the vessel during the implementation of the plan.

1.14.2 Company requirements

In accordance with the requirements set out in the SMM, the 2/O was responsible for preparing and submitting a berth to berth voyage plan to the master for his approval prior to departing each port. The SMM also required passage planning to be carried out in accordance with the guidance contained in the ICS Guide. Chapter 2 of this guide provides detailed guidance on the four distinct stages discussed in IMO resolution A.893(21).

A voyage plan was not produced prior to *Clonlee* departing Rotterdam on 15 March 2011. When approaching and entering the River Tyne, the vessel's bridge team relied on a passage plan that had been produced and marked on the chart prior to a previous similar voyage between Rotterdam and South Shields.

1.14.3 Appraisal stage

The ICS Guide explains that, before planning can commence, the charts, publications and other relevant information appropriate for the voyage will need to be gathered together and studied. To assist in this task the ICS Guide includes a passage plan appraisal checklist **(Annex H)**. Guides to port entry are included on the checklist.

The publication, Admiralty Sailing Directions North Sea (West) Pilot (NP 54), contains general information about the Port of Tyne, local traffic regulations and directions for entering and departing the port. It defines the port's seaward approaches **(Figure 20)** as the sector with a radius of 3 miles which lies between the light on the North Pier bearing 242º and the light on the South Pier bearing 288º. It also states that:

> *From about 2 miles ENE of the harbour entrance the white sector (246.5º - 251.5º) of Herd Groyne directional light, shown throughout 24 hours, leads to the harbour entrance*

A copy of NP 54 was available on *Clonlee*'s bridge.

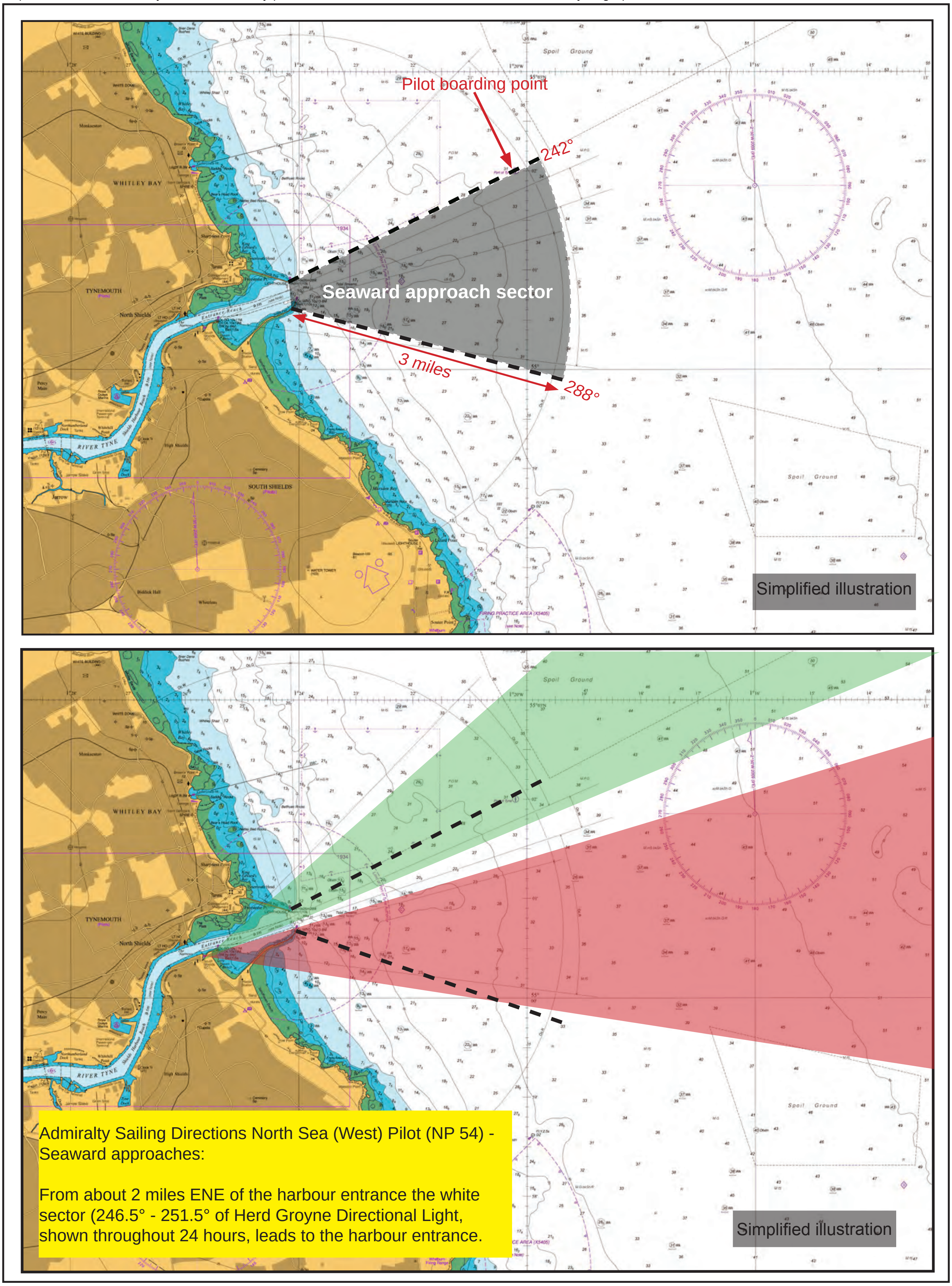

Figure 20: Port of Tyne seaward approaches

1.14.4 Planning stage

On the basis of the fullest possible appraisal, a detailed passage plan should be prepared. The key elements of the plan, that are required to ensure safety of life at sea, safety and efficiency of navigation, and protection of the marine environment, are listed in IMO Resolution A.893(21) and the ICS Guide. One of the elements listed is the need to identify the positions where a change in machinery status is required. In accordance with the requirements set out in the IMO resolution, the details of the plan should be clearly marked and recorded, as appropriate, on charts and in a voyage plan notebook or on a computer disk.

Clonlee had an electronic chart system on the bridge, but paper charts provided the vessel's primary means of navigation. The passage plan for entering the River Tyne was marked on chart number 1934 **(Figure 21)**.

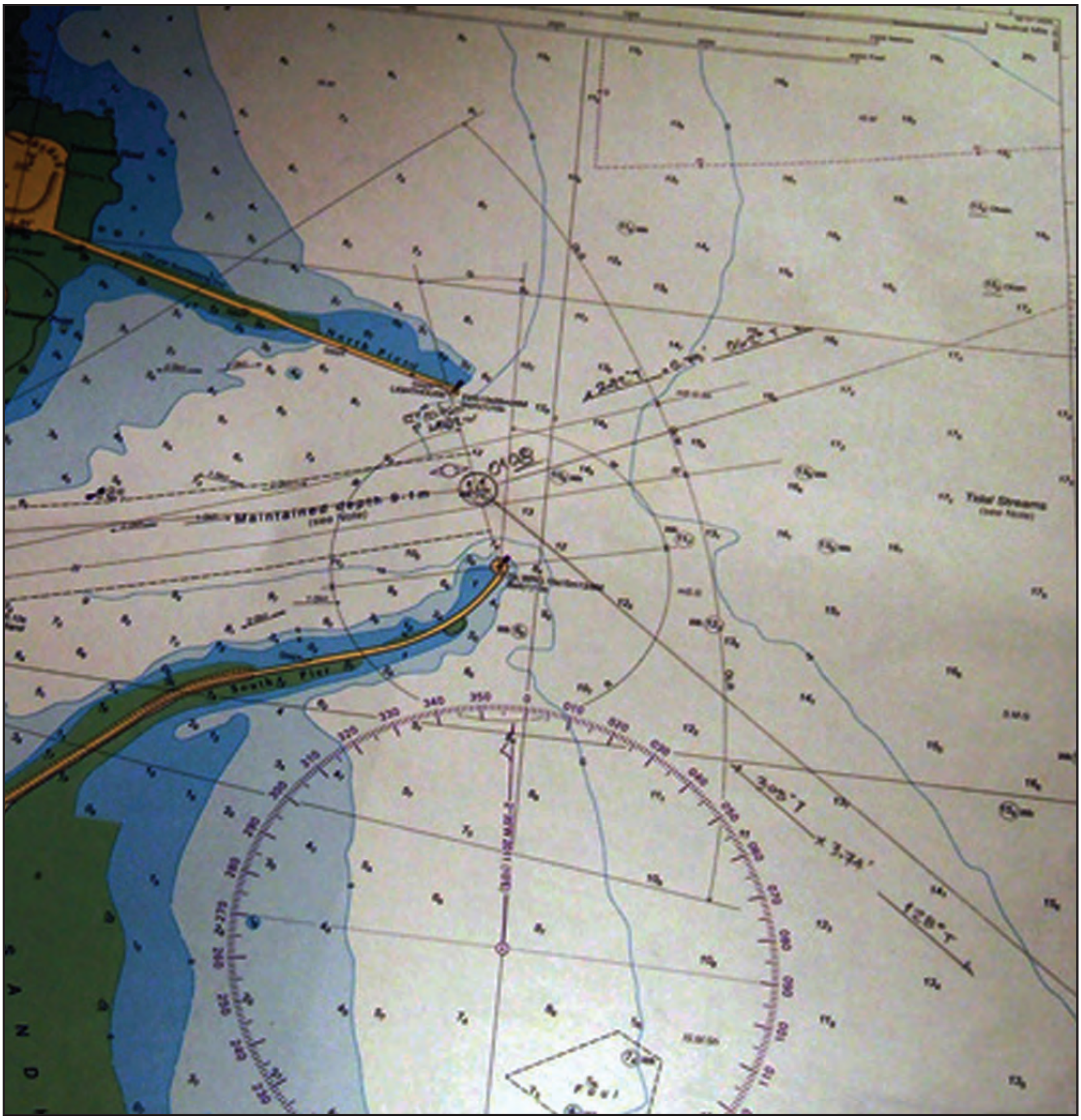

Figure 21: Passage plan marked on the paper chart

1.14.5 Execution stage

Having finalised the plan, '*the voyage or passage should be executed in accordance with the plan or any changes made thereto*[13]'. *Clonlee's* passage from Rotterdam on 15 March 2011 to South Shields was in accordance with the ship's short term programme arranged by Feederlink, and the estimated times of departure and arrival were not subject to any late changes or delays. The master had contacted the Port of Tyne VTS 24 hours before his scheduled arrival and confirmed his estimated time of arrival.

The master took the con of his vessel for her arrival at the River Tyne when *Clonlee* was just over 3 miles SE of the breakwater entrance. He did not follow the track marked on his chart as he headed north-west towards the harbour entrance **(Figure 22)**.

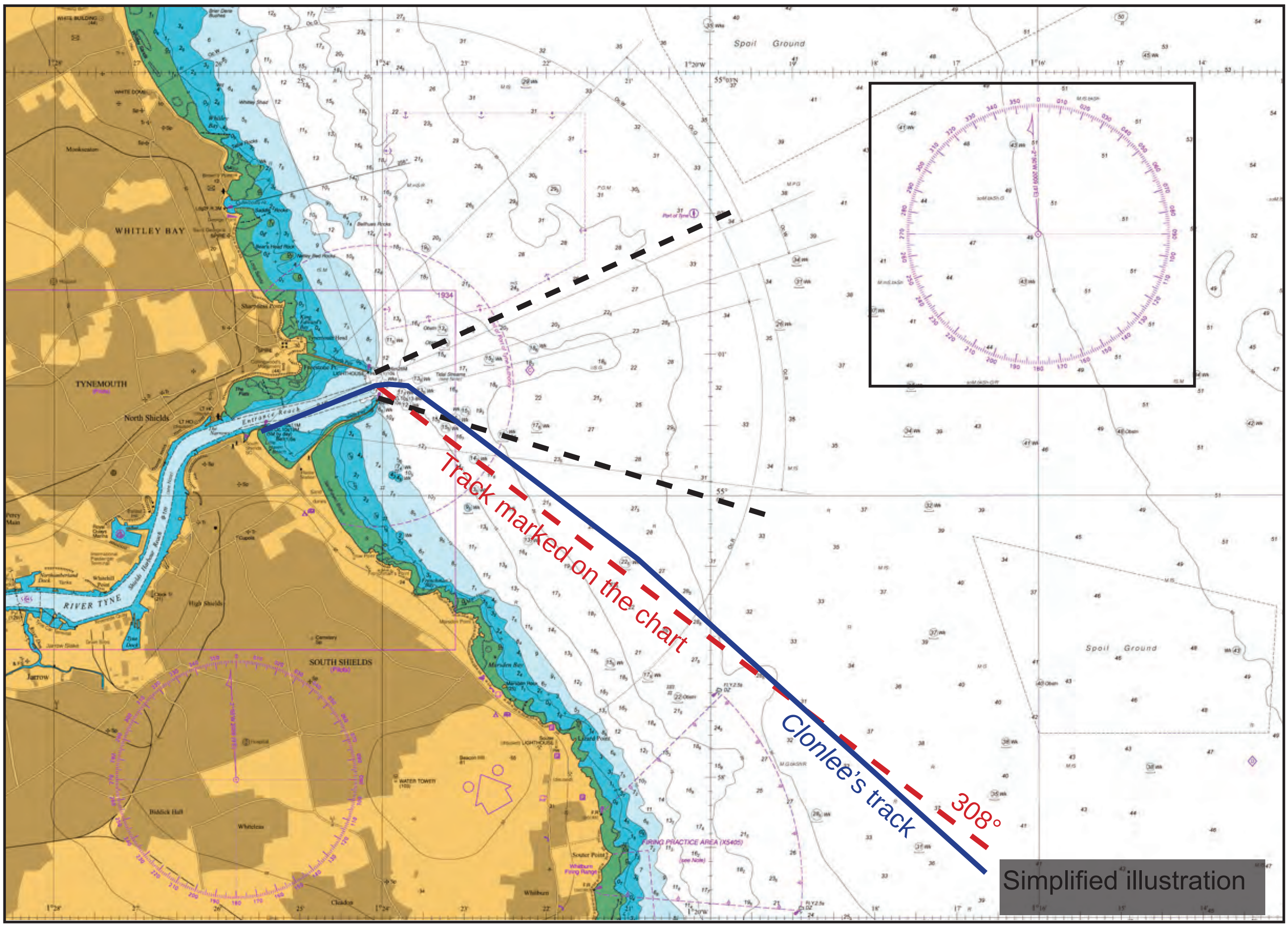

Figure 22: *Clonlee*'s approach to the River Tyne

1.14.6 Monitoring stage

The passage plan should be available at all times on the bridge, and officers of the navigational watch should closely and continuously monitor the progress of the vessel against the plan. Any changes made to the plan should be clearly marked and recorded. It should include details regarding the frequency of position-fixing, regardless of whether or not electronic navigation systems are used.

[13] IMO Resolution A.893(21) – *Guidelines for Voyage Planning*

1.15 HARBOUR AUTHORITY REQUIREMENTS

1.15.1 Harbour authority

The Port of Tyne Ltd was the harbour authority for the River Tyne. The harbour authority's seaward limit was bounded by an arc, radius 1 mile, centred on the entrance between the piers of the Tynemouth breakwater. The authority also exercised certain powers outside its port limits. These powers included monitoring the seaward approaches to the port.

The Department for Transport Port Marine Safety Code (PMSC) was introduced in 2000, and was developed to improve safety in UK ports and to enable harbour authorities to manage their marine operations to nationally agreed standards. The explanatory document, *A Guide to Good Practice on Port Marine Operations,* was prepared and published in conjunction with the PMSC to provide supplementary information and more detailed guidance on a number of issues relevant to harbour authorities.

Chapter 5 of the PMSC details the harbour authorities' specific duties and powers. These include powers to direct vessels and regulate the time and manner of ships' entry to, departure from and movement within the authority's waters.

1.15.2 Port passage plans

The *Guide to Good Practice on Port Marine Operations* explains that, in order to support safe navigation, harbour authorities' powers of direction should be used to require the use of port passage plans, whether vessels are piloted or not. Several UK harbour authorities have developed generic sets of port passage plans in order to promote best practice and ensure that all relevant parties are aware of the local requirements.

The port authority had produced a port passage plan for the river and published its *General Directions for Navigation* within the port. Its port passage plan did not include the seaward approaches. This omission had been recognised in 2010 by the port authority's SMS review team and an action had been taken, by the HM, to amend the plan. At the time of the accident, this action had not been completed.

The Port of Tyne VTS station was a designated[14] information service, but in addition, its duty staff had the port duty holder's delegated powers of direction. It was required to monitor and direct ship movements in compliance with national and local regulations to ensure the safety of navigation within the port authority's waters and optimise traffic management.

1.15.3 Pilotage requirements

Pilotage was compulsory within the Port of Tyne for vessels over 50m long. The nominated pilot boarding point was in the northern section of the seaward approaches, 2.5 miles from the breakwater entrance **(Figure 20)**.

The port authority had discretionary powers to issue pilotage exemption certificates to masters or first mates of vessels of lengths greater that 50m but less than 100m, but masters and mates of vessels greater than 100m were required to pass the port's formal examinations.

[14] MSN 1796(M+F) – Vessel Traffic Services (VTS) – Designation of VTS stations in the United Kingdom

In order to be eligible to apply for a PEC, applicants were required to complete 12 movements in or out of the port in the preceding 12 month period with a pilot or other PEC holder on board. PEC candidates were required to demonstrate knowledge of the port's general directions and byelaws, and were also expected to be familiar with the guidance provided in NP 54. The examination process included the conduct of an assessed river passage and the sitting of written and oral examinations. The master of *Clonlee* had successfully completed the port's examination process in 2008 and had renewed his PEC annually.

1.16 EMERGENCY PREPAREDNESS

Clonlee's SMM included a set of procedures, instructions and checklists designed to limit damage to people, the environment, the ship and its cargo during shipboard emergencies. These included tabulated emergency instructions for *loss of electrical power*, *main engine failure* and *grounding* **(Annex I)**. The instructions listed the standard actions to be taken by both the deck and engine room departments in response to the specific emergency situations.

The '*grounding'* checklist included the following actions to be undertaken by the engineers:

- close all watertight doors
- sound all tanks and bilges
- check sea chests
- check engine room for damage
- check shaft oil for leakage
- record engine room data logger.

The bridge and engine room teams did not use the emergency instructions checklist after the grounding and the engine room team were not aware that the vessel was aground.

The company's SMM also included an annual schedule for undertaking onboard safety and emergency drills **(Annex J)**. This training matrix required *electrical power failure*, *main engine failure* and *grounding* emergency response drills to be conducted once a year. The ships' masters were required to report the outcome of these training drills to the DP in their monthly returns **(Annex K)**.

The drills typically involved table top discussions among the key members of crew, with reference being made to the emergency response instructions contained in the SMM. According to the company's records, an emergency drill for electrical power failure was last conducted in August 2010. The grounding drill was due to take place during the month of March, but the actual grounding was not referred to in the monthly return **(Annex K)**.

1.17 PRE-ACCIDENT INSPECTIONS AND AUDITS

1.17.1 External Safety Management Certificate audits

When NAS Ltd took ownership of *Clonlee* in 2007, the Isle of Man Ship Registry issued an interim SMC to the vessel and then conducted an initial verification audit of the shipboard SMS on 3 October 2007. No non-conformities were raised during the audit and *Clonlee* was issued a full-term SMC. The audit report contained three observation and five feedback notes. The auditor's observations and feedback included recommendations for improvements related to the requirements of the ISM Code. As part of his feedback, the auditor noted that the vessel had no chief engineers' standing orders and the UMS operating requirements set out in the SMM were not being met.

On 16 June 2010, the Isle of Man Ship Registry, as the flag state, conducted an intermediate SMC audit on board *Clonlee* in Grangemouth, Scotland. Two non-conformities and three observation notes were raised by the auditor. One of the non-conformities related to vessel position monitoring. The auditor found that the vessel's position had not been fixed and plotted on the paper chart at regular intervals, in accordance with the vessel's procedures and the recommendations contained within the ICS Guide, on her approach to Grangemouth. The auditor also observed that the passage planning procedures adopted on board were not in accordance with the guide as they did not include position fix frequencies, parallel indexing and clearing bearings. The observation note recommended the introduction of a standard pro forma or template to assist in passage planning. This recommendation was not acted upon by NAS Ltd

Another of the observations identified that the SMM did not contain any arrival and departure procedures for the engine room team. The auditor noted that the procedures produced on board by the engineers were uncontrolled, contained only very basic information, and did not include the testing of safety devices or standby machinery. The report recommended that the company review the chief engineer's arrival and departure procedures and consider including them in the SMM. This recommendation was not acted upon by NAS Ltd

1.17.2 Internal safety management system audits

The DP had conducted four annual internal SMS audits on board *Clonlee* since 2007. The most recent audit was conducted on 2 July 2010. No non-conformities were raised during the audit and the DP's report **(Annex L)** stated that ship's crew showed an excellent understanding of the ship's SMS. The DP had raised no non-conformities during the vessel's previous three internal audits.

1.17.3 External Document of Compliance audits

The last annual external DOC audit prior to the accident was carried out by a GL surveyor on behalf of both the Isle of Man and Irish administrations at NAS Ltd's Dublin office on 6 July 2010. No non-conformity or observation notes were raised as a result of the audit. The auditor's report stated that:

> *The company shows a good safety ethos and the SMS appears to be well implemented and filing is kept in good order.*

1.17.4 Classification Society surveys

On 31 January 2010, GL conducted its annual hull and machinery class surveys **(Annex M)** on board *Clonlee* in Rotterdam. During the machinery survey, the Class surveyor identified that the ECR alarm printer was defective and imposed a machinery memorandum[15] on the vessel.

On 23 June 2010, a GL surveyor attended *Clonlee* in Felixstowe, England to close out a condition of class[16] relating to the main engine turning gear. His survey statement **(Annex M)** recognised that the ECR alarm printer memorandum remained extant and the printer was to be repaired.

1.17.5 Risk analysis and loss prevention inspection

A surveyor representing one of NAS Ltd's insurers carried out a risk analysis and loss prevention inspection on board *Clonlee* 6 weeks before the accident. He identified several control measures or corrective actions that needed to be implemented to reduce the level of risk exposure of the ship, her crew and the environment to an acceptable level.

Of note, the surveyor identified that routine testing of the machinery alarms and emergency shutdowns was not being carried out. His report pointed out that this omission presented a risk of blackout and loss of propulsion. NAS Ltd was recommended to introduce a testing routine for the vessel's machinery alarms and shutdowns. The report also noted that there was an increased risk of machinery failure because the engineers were not recording non-routine maintenance. Several shortfalls were identified that presented a risk of delay or confusion during emergency situations, including:

- fire detectors and alarms had not been routinely tested
- some emergency system locker keys had not been labelled
- instructions and labels for some of the ship's emergency gear had not been provided in English.

1.18 POST-ACCIDENT INVESTIGATIONS, INSPECTIONS AND SURVEYS

1.18.1 Germanischer Lloyd

A local GL surveyor attended *Clonlee* shortly after she berthed at Riverside Quay, South Shields. He conducted a structural survey and found that the vessel's hull had not been breached during the grounding and no damage had been caused to the ship's propeller, shaft arrangement, main engine or bow thruster. It was evident that the grounding had caused some minor indentation damage to the vessel's bottom shell plating and buckling of several longitudinal girders and stiffeners on the port side of number one double bottom tank between frames 109 and 120. A condition of class was issued against the vessel's hull to allow her to continue to operate until rectification work could be undertaken at her next docking period.

[15] GL Class memorandum – any information deemed noteworthy for GL's convenience as well as defects and/or deficiencies which do not affect the Class or the maintenance of Class.

[16] Condition of class – any defect and/or deficiency affecting the Class, and which has to be dealt with within a limited period of time.

The classification surveyor also investigated the cause of the blackout. Several attempts were made to reconstruct the sequence of events that led to the power failure, but the fault condition was not replicated. Based on the information given to the surveyor by the chief engineer, a condition of class was imposed on the vessel's power distribution and control system. GL required a service engineer to inspect the changeover equipment for the auxiliary and shaft generators with the bow thruster in operation. The bow thruster was not to be used until this had been done and a tug was to be used when entering and leaving port.

1.18.2 The Maritime and Coastguard Agency

Two Maritime and Coastguard Agency (MCA) surveyors also boarded *Clonlee* shortly after she arrived alongside following the accident. They carried out a general survey of the dependent territory vessel. They raised five deficiencies and identified several factors that might have contributed to the machinery failure and subsequent grounding. The contributory factors identified by the surveyors included:

- The prepared passage plan did not follow the recommendations for the approach courses to the River Tyne given in NP 54.
- The SMS did not have a specific procedure for pre-arrival checks in the engine room or a time frame for when they should be carried out.
- The SMS pre-arrival checklist for the bridge team **(Annex G)** did not include any information on the bow thruster.
- The manning levels on the bridge were not in accordance with the ICS Guide and therefore were not in accordance with the ship's SMS.
- The SMS did not contain any clear instructions about operating under a pilot exemption.

1.18.3 North Atlantic Shipping Ltd

Clonlee's owners did not conduct an internal investigation into the circumstances of the accident. The DP did not attend the vessel immediately after the grounding and he did not arrange for the company's technical superintendent to visit *Clonlee* to undertake or assist with the technical investigations. The company did arrange for Wärtsilä and Interschalt service engineers to attend the vessel at different times to survey the switchboard.

Following a review of the working practices on board *Clonlee*, the company concluded that the bridge team composition and resource management was adequate for entering the port on the day of the accident. It was the company's opinion that, due to the nature of the container feeder service, the bridge on board *Clonlee* had been designed for one-man operation from the centre console or from either bridge wing.

1.18.4 Wärtsilä

In accordance with the requirements set out in GL's machinery condition of class, a Wärtsilä electrical technician visited *Clonlee* in Rotterdam on 19 February 2011 at the request of the owner. He witnessed a series of switchboard operations conducted by the ship's engineers and visually examined the switchboard breakers. An MAIB inspector was in attendance at the time of the technical inspection and he also witnessed the trials.

During two of the three switchboard trials witnessed by the MAIB inspector, only one of the running DGs went on to the switchboard when the generator pre-selection switch was turned from position 4 to position 1. The first time the second DG failed to synchronise, the 2/E intervened and manually stopped it. When he restarted the DG in its automatic mode, it successfully ran up to speed, synchronised with the switchboard, its breaker closed and it shared load with the other machine. The second time this happened, the 2/E was instructed not to intervene. The second machine ran for approximately 30 seconds and shut down automatically.

The Wärtsilä technician found no visual signs of arcing or burning on the contactors within the switchboard, but several defects were identified. These included:

- the automatic synchroniser was slow to react
- the main engine's electro-pneumatic speed signal converter was slow to react
- the main engine ran below its rated speed
- the frequency meters on the main switchboard did not function correctly
- the shaft generator volt meter did not work.

The technician was unable to positively establish the cause of the power failure, but identified the possible failure of the switchboard's coupling breaker as a potential cause. His report recommended that the owners replace the faulty switchboard meters, adjust the engine speed to its correct setting and arrange for the switchboard breakers to be inspected and overhauled or replaced as required.

Following the survey, a classification society surveyor was called to the vessel. After consulting with the Wärtsilä technician and the master, the surveyor removed the machinery condition of class.

1.18.5 Interschalt Maritime Systems AG

On 6 June 2011, at NAS Ltd's request, Interschalt's senior service engineer attended *Clonlee* in Rotterdam to investigate the cause of the blackout. He checked the functional operation of the switchboard and inspected its main circuit breakers.

His report found that the system was operating properly and there was no damage. Based on his findings and information provided by the crew, he concluded that the most likely cause of the power failure was a poor contact within one of the control circuit's timing relays.

It should be noted that the service engineer was only on board for a couple of hours, and based his conclusions on his understanding that the ship only suffered a single blackout.

1.18.6 The Netherlands Shipping Inspectorate

A month after the accident, The Netherlands Shipping Inspectorate conducted a port state inspection on board *Clonlee* in Rotterdam. Its surveyor identified that the ECR machinery alarm printer was not working, and raised a deficiency against the equipment.

On 11 July 2011, an electrical service engineer attended the vessel to investigate the fault. His investigation found that there was no communications link between the Norimos 1000 units and the paper printer. In consultation with the equipment manufacturer, the service engineer attributed the communication failure to a defective internal printed circuit board. As a spare part was not available, the printer was still not working when he left the ship.

1.18.7 The Isle of Man Ship Registry

On 19 October 2011, the Isle of Man Ship Registry conducted an additional Flag State Inspection on board *Clonlee,* which identified a total of nine non-conformities. On 2 November 2011, the Flag state conducted an additional ISM DOC audit at NAS Ltd's Dublin office at which a further eight non-conformity notes were raised.

1.19 SIMILAR ACCIDENTS

Clonlee had previously suffered a blackout in the North Sea in January 2008. The ship was operating on the shaft generator when the main engine tripped on over-speed due to a governor fault. Power was restored using the DGs and the vessel returned to port for repairs.

The vessel had had two serious collisions under her previous ownership: one with the tanker *British Cygnet,* in 2006, which was investigated by the Isle of Man Ship Registry[17]; the other with the container ship *Cosco Hamburg,* in 2004, which resulted in the loss of a seaman and was investigated by Germany's Federal Bureau of Maritime Casualty Investigation[18]. Following the collision with *British Cygnet*, the Isle of Man Ship Registry recommended the vessel's operating company to:

- …*review the safety management system to highlight the importance of good bridge team management including the proper use of resources to effectively maintain a safe navigational watch.*
- …*ensure that their passage planning procedures follow the IMO resolution A.893(21) Guidance for Voyage Planning*.

[17] Casualty investigation report No.CA102 – Collision between the tanker *British Cygnet* and container ship *Vera* on 2 December 2006

[18] Very serious marine casualty investigation report No. 45/04 – Collision between CMV *Cosco Hamburg* and CMV P&O *Nedlloyd Finland* on 1 March 2004 on the Lower Elbe/off buoy 91, with the death of one seaman

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 CAUSE OF THE BLACKOUT

Based on the evidence available, the most likely cause of the electrical power failure on board *Clonlee* on 16 March 2011 was an intermittent fault associated with the ship's electrical power supply and distribution systems. The investigation was unable to determine the exact cause of the blackout due a lack of machinery monitoring and alarm data, and because the fault condition could not be replicated during the post-accident reconstructions.

The technical investigations carried out by Interschalt and Wärtsilä service engineers clearly established that the blackout was not the result of a major electrical or mechanical component failure. Interschalt's investigation report concluded that a faulty timing relay might have led to the blackout, while the Wärtsilä report suggested the cause might have been associated with failure of the bus bar coupling breaker.

Had the bus bar coupling breaker failed to open after the diesel and shaft generators had synchronised and shared load, the incompatible alternators would have been forced to operate in parallel. If this was the case, they would not have been able to share load effectively, and either the DGs or the shaft generator would have tended to grab the load. In such circumstances, the switchboard protection devices should have prevented a blackout by electrically disconnecting either the DGs or the shaft generator from the main bus bars.

The ship's engineers had initially linked the blackout with making power available to the bow thruster. However, the Wärtsilä service engineer found no faults on the bow thruster or its electrical circuit. Furthermore, as the switchboard was reported to be split at the time of the blackout, any electrical faults on the distribution circuits fed from bus bar B should only have affected the shaft generator and therefore would not have led to a blackout condition.

Other possible causes of the blackout included a voltage regulator failure, a temporary short circuit, electrical overload and DG prime mover shutdown conditions. Although it would have been satisfying to identify the precise cause of the blackout, the low level of system knowledge and poor maintenance and operating practices adopted by the ship's engineers presented too many possible causes and made it largely immaterial.

2.3 CAUSE OF THE GROUNDING

Clonlee ran aground because she suffered a total electrical power failure within the confined waters of the Port of Tyne's harbour entrance and the master was unable to arrest her forward motion.

The blackout occurred in the confined waters because the bridge team had not planned and executed the voyage between Rotterdam and South Shields in accordance with the requirements of SOLAS, the Port of Tyne Authority and the ship's SMS.

The master was unable to arrest his ship's forward motion because his engineers were unable to restore power and return control of the CPP to the bridge, and the deck crew were not in position to let go an anchor when the order was given.

2.4 ENGINE ROOM TEAM WORKING PRACTICES AND RESOURCE MANAGEMENT

2.4.1 Competence

The ship's engineers were very experienced and held the required certificates of competency for their roles on board. Despite this, they demonstrated a limited knowledge of the ship's electrical power supply, distribution and control systems and they were unable to recover the ship's main power in a timely and controlled manner.

Copies of the equipment manufacturers' operating and maintenance manuals for the electrical power distribution and control systems were not available on board. In addition, some of the manuals held on board for other critical systems were written in German and had not been translated to the vessel's working language. Without access to the type of information contained within equipment manufacturers' manuals, the competence of any engineer to operate and maintain such complex systems would have been compromised.

2.4.2 Machinery operating procedures

The switchboard was not being operated in accordance with the equipment manufacturer's instructions. The locally developed procedure for changing from sea mode to manoeuvring mode involved transferring directly from the shaft generator (mode 4) to a split switchboard (mode 1). To do this the engineers had to start the DGs prior to altering the position of the generator pre-selection switch.

Despite this procedure being produced by ship's staff without reference to or knowledge of the manufacturer's instructions, Interschalt has stated that this practice was acceptable and should not have led to a blackout on a well maintained system. However, as clearly witnessed during the post-accident trials, switching directly from mode 4 to mode 1 introduced the risk of one of the DGs not synchronising, leaving one DG to support the ship's essential services.

Although one DG should have been able to support the reported electrical load at the time of the blackout, redundancy would have been lost and therefore any subsequent shutdown condition on the running DG would have resulted in a blackout. Switching from mode 4 to mode 3 before splitting the switchboard would have added little time to the process, but would have eliminated the risk of losing redundancy.

2.4.3 Blackout recovery procedure

The blackout recovery procedure was produced by the vessel's chief engineers without reference to, or knowledge of, the manufacturer's instructions and so, unsurprisingly, was not in accordance with these instructions. The engineers had initially attempted to recover the ship's main power supply by restarting the DGs in the automatic mode instead of manual mode. Furthermore, the generator pre-selection switch had been placed in position 3 instead of position 1.

The engineers were not able to explain why they chose to cut the power to the emergency services by stopping the emergency generator. It is clear that they had become confused, and it is possible that they might have decided to isolate the emergency switchboard in order to eliminate it as a potential cause of the problem.

There was no communication between the bridge and engine room teams, so the chief engineer did not know what the master's priorities were. In the absence of any instruction from the master, the engineers focused on returning the switchboard to its normal manoeuvring mode with power available to the bow thruster. However, the priority should have been to restore power to bus bar A and return control of the main propulsion system to the bridge as quickly as possible. Restoring power to a split board, in accordance with the manufacturer's blackout recovery procedure, would have isolated any potential faults associated with bus bar B and reduced the risk of overloading the DGs.

The engineers had to reset the Synpol protection and control device trips following each blackout. As the alternator synchronisation test switches on the front of the Synpol panels had been marked with a red letter *'R'*, it is entirely conceivable that the engineers might have thought they were reset switches. Had they moved the synchronisation switches from their mid-point position, they would have further complicated the recovery process as they would not have been able to close the main circuit breakers.

The engineers recalled the breakers tripping on high frequency following each failed attempt to restore power. However, the Synpol devices did not have high frequency protection; only a low frequency trip. One of the most common causes of power failure on board ships is fuel starvation. Fuel starvation could cause diesel generators to slow down to the point at which a low frequency trip would activate. Although there was no evidence to suggest that fuel oil problems caused the initial blackout on board *Clonlee*, it is possible that it affected the recovery of the ship's main power supplies and propulsion systems.

2.4.4 Duty routine

The day to day working routine within the engine room department was not in accordance with the routines described in the ship's SMM, and was not adequate to maintain a safe engineering watch as required by STCW 95. A duty routine had not been established, and the UMS alarm system was permanently left in its unmanned mode and set to sound in both engineers' cabins at the same time. The engineers worked together during the day, covered all machinery '*standbys',* and both responded to out of hours machinery alarms.

The working routine adopted increased the risk of fatigue and would have resulted in both engineers being tired at the same time. Additionally, without a nominated duty engineer, there was a risk of delayed responses to machinery alarms as both engineers might have assumed that the other was taking action.

Despite the working practices being contrary to those described in the SMM, they were endorsed by the DP and were common to those adopted on board *Clonmore*. The engineers were not able to explain why these practices had become the norm. However, it seems likely that they were the result of a lack of confidence on the part of the ship's engineers in their ability to operate systems and diagnose problems on their own.

2.4.5 Maintenance management

Clonlee's critical equipment and technical systems were not maintained in accordance with the requirements set out in the ISM Code. NAS Ltd had not identified all the vessel's critical equipment and systems, and the machinery protection devices listed in the SMM were not routinely tested in accordance with the schedules stipulated. Furthermore, the company was unable to provide any objective evidence that the machinery standby and protection devices had ever been tested by the ship's crew.

The vessel's owners and engineers relied entirely on the assumption that the protection devices for the ship's critical systems would be tested by Classification Society surveyors during their annual machinery surveys. The ship's engineers demonstrated a reluctance to test the vessel's machinery protection devices even though this procedural omission had been previously highlighted on several occasions in external audit and inspection reports. This reluctance was almost certainly due to the lack of manufacturers' instructions and guidance within the ship's SMM.

The ECR machinery alarm printer had not been working for at least 18 months before the accident and, despite the machinery memorandum raised by GL a year before *Clonlee*'s 2011 docking period, no action was taken to repair or replace it. As was evident during this investigation, a lack of machinery monitoring and alarm data would have severely restricted the engineers' ability to identify and diagnose fault conditions. The printer was fitted at build as an essential component within the machinery supervision system. Its malfunction should have resulted in a condition of class being raised. Had a condition of class been issued instead of a memorandum, it is likely that the ship's owner would have resolved the problem in a timely manner.

2.5 BRIDGE TEAM WORKING PRACTICES AND PASSAGE PLANNING

2.5.1 Bridge team working practices

The composition of the bridge team was not in accordance with the ICS Guide and the port authority's general directions for navigation, and therefore did not meet the requirements of the ship's SMS. The ICS Guide explains that:

> *when entering or leaving port, the master will need the support of his bridge team, which should comprise the OOW, a helmsman and lookout(s) as required. When a pilot is on board, he will temporarily join the bridge team and should also be supported accordingly.*

When *Clonlee* entered the Tyne, the master did not have the support of a pilot and was fulfilling the role of the helmsman and OOW. The 2/O had been tasked to act as lookout and, as such, in accordance with the STCW 95, he should not have undertaken any other roles. In these circumstances, there was no-one on the bridge to take fixes and mark them on the chart. A lack of position monitoring during port entries on board *Clonlee* had previously been identified as a shortfall by the Isle of Man Ship Registry, and this procedural omission was clearly evident immediately prior to this accident.

After the blackout, the master spent the first 2 minutes cancelling alarms and waiting for the engineers to restore power. During this time he did not communicate with his 2/O, the engine room, the deck team or VTS. When he realised that the engineers might not be able to restore power, he communicated with the deck crew via the 2/O rather than using the ship's intercom, which was located to his left on the centre console.

It was clearly apparent that the master did not have the cognitive capacity to respond effectively to the machinery failure, and he immediately became overloaded and lost his situational awareness. The company was aware of the working practices adopted on board *Clonlee* that routinely left the bridge under resourced when entering port and, despite having been made aware of the circumstances of the grounding, still claim to be content with the composition of and roles taken by the bridge team when entering port.

2.5.2 Passage planning

The voyage between Rotterdam and South Shields was not appraised, planned, executed or monitored in accordance with the requirements set out in the ship's SMM or SOLAS regulations. A voyage-specific plan had not been produced prior to *Clonlee*'s departure, and the master relied on a passage plan that had been developed for a previous voyage between the two ports.

The voyage plan appraisal stage did not take into consideration the guidance contained in NP 54 or the requirements of the port's general directions for navigation. The plan did not include a nominated point at which the machinery status was to be changed from sea mode to manoeuvring mode or an end of sea passage position.

The passage planning guidance provided by the IMO recognised that ships were particularly prone to power failures and loss of propulsion whenever main machinery and fuel oil systems configurations were changed. Had the passage plan identified a point 3 miles outside the harbour entrance, for end of sea passage, the engineers would have changed over to manoeuvring mode and been standing by in the ECR prior to the vessel entering the port's seaward approaches. *Clonlee* would still have blacked out, but would have drifted in open waters and would not have gone aground.

The track marked on the chart for the seaward approach to the River Tyne was not followed by the master, and therefore the bridge team could not monitor the vessel's progress against the prepared plan **(Figure 22)**. *Clonlee* entered the port's designated seaward approach sector at full speed approximately 0.5 mile from the breakwater, and she was still swinging to port as she passed between the piers.

The master did not use the Herd Groyne directional light to line up his vessel prior to committing to enter the port, and must have relied heavily on his electronic chart plotter to navigate in the dark from his seated helm position.

A review of *Clonlee*'s previous approaches to the River Tyne from the south during the 2-month period prior to the accident **(Figure 23)** identified that this manoeuvre was not an isolated occurrence, but was common practice. It was clearly apparent that the repetitive nature of the vessel's operations had led to the bridge team adopting a complacent approach to passage planning and basic navigational practices.

Reproduced from Admiralty Chart BA 1191 by permission of the Controller of HMSO and the UK Hydrographic Office

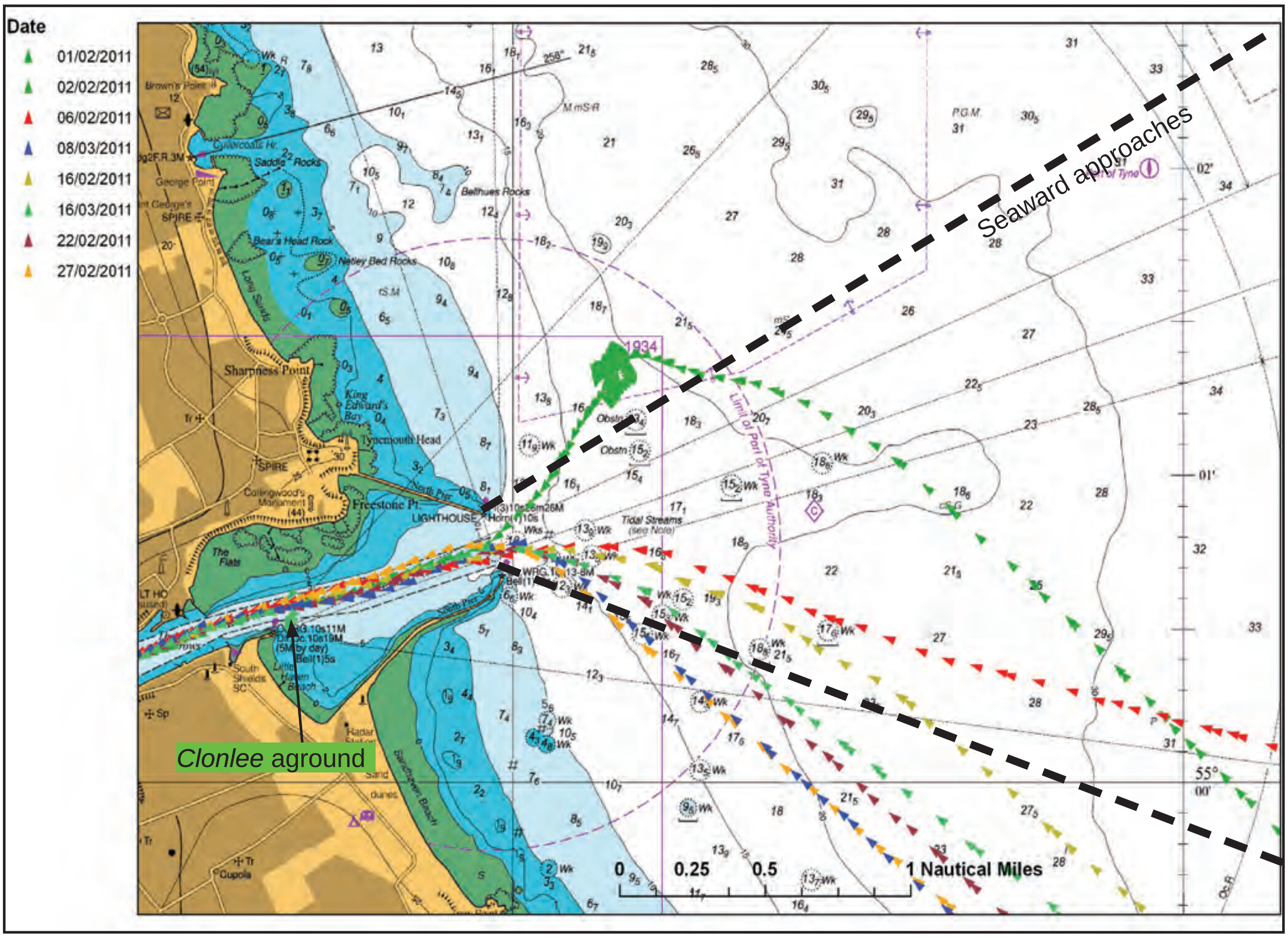

Figure 23: *Clonlee's* approaches to the River Tyne during the two month period immediately prior to the accident

2.6 EMERGENCY PROCEDURES

2.6.1 Emergency preparedness

Clonlee and her crew were not adequately prepared for entering the Port of Tyne and were not ready to respond to the machinery failure. The main machinery had not been configured appropriately prior to entering confined waters, and the deck crew were not mustered at their fore and aft stations.

The bridge team did not use its pre-arrival checklist and did not update the pilot card. When the ship blacked out, the master did not know if his anchors were ready to be let go. Had the checklist and pilot card been completed, early communication links between bridge and the deck party would have been established, and the bridge team would have received positive feedback about the readiness of the anchors.

2.6.2 Emergency response

Following the blackout, there was a total breakdown in communications on board the vessel. The bridge and engine room teams did not talk to each other for over an hour, and the engineers were unaware of the navigational situation throughout. The ship's internal intercom was not used, and the 2/O relayed the master's orders to the deck crew in their native Filipino language.

Two minutes had elapsed before the 2/O was ordered to instruct the deck crew to prepare an anchor. The starboard anchor was not let go because the bosun did not have a radio and the 12-4 AB had not reached the forecastle deck when the order was given. The master might not have been aware that the 2/O was relaying his orders to a member of the deck team who was not on the forecastle deck, as they did not communicate in English. Further, there were three general use hand-held radios on board, but they were not being utilised effectively. Common sense dictated that the bosun, as head of the deck team, and the AB in charge of the aft mooring station, should have each had a radio.

Little Haven beach was the only area of sandy coastline within the mouth of the Tyne and was the ideal place to ground the vessel. It was extremely fortunate in this case that *Clonlee* still had enough headway for the master to be able to avoid the rocks surrounding the Herd Groyne after his attempt to let go an anchor failed. *Clonlee* suffered minimal damage because she grounded on a sandy beach; had she grounded anywhere else, the damage to the vessel and the environment might have been significantly worse.

The bridge and engine room teams were working in isolation and the chief engineer did not fully consider the consequences of his actions. When the engineers manually stopped the emergency generator, they cut the power supplies to the ship's emergency services. This action resulted in the vessel losing its emergency lighting circuits, steering gear and navigation lights **(Figure 9)**. Had *Clonlee* been drifting, or at anchor, as the engineers had assumed, lookouts on other vessels would not have been able to see her in the dark.

A full damage assessment had not been carried out when *Clonlee*'s master initially instructed the tug to pull his vessel off the beach. The vessel's post-grounding checklist was not used, and the master was not aware of the condition of the engine room, its tanks and the main machinery. Had the integrity of the engine room been compromised, attempts to refloat the vessel could have further endangered the ship, its engineers and the environment. Had the crew used the post-grounding checklist contained in the SMM, its prompts would have ensured these omissions would have been avoided.

2.6.3 Emergency drills

The emergency machinery failure and grounding drills reported as being carried out annually on board *Clonlee* **(Annex K)** were clearly ineffective. The periodicity of the drills and the manner in which they were conducted meant that it would have been unlikely that all the crew would have participated in them.

Table top discussions can be extremely useful when considering complex scenarios, such as what might happen to the main engine and CPP when the ship blacks out. However, practical drills should be carried out in order to exercise the whole ship's crew, prove internal communications and challenge a ship's existing emergency preparedness.

2.7 CREW RESOURCE MANAGEMENT

Due to commercial pressures, *Clonlee* was being operated by NAS Ltd with the minimum number of crew permitted by the flag state for safe navigation. This, coupled with the demanding nature of the feeder vessel trade, meant that there was an increased onus on the vessel's masters and chief engineers to manage their resources effectively and efficiently in order to avoid fatigue. However, the working practices adopted on board did not make best use of the crew resources available, and cargo operations appeared to take priority over navigational safety.

At the time of the blackout, the entire deck department, with the exception of the chief officer, were awake and working. The four-man deck crew, having already cleared away the anchors and prepared the mooring ropes, were removing the upper deck container securing arrangements while the forecastle deck was unmanned and the bridge team was under-resourced.

The chief engineer and 2/E were standing by in the ECR as *Clonlee* entered the Port of Tyne, but the motorman was in bed. The SMS required a certificated engineer and a suitably qualified assistant to be in the ECR during manoeuvring operations. The reason for having two people in the ECR during hazardous navigational situations was to allow critical machinery to be operated in its emergency modes and to maintain a line of communication between the bridge and the engine room. The motorman was part of the engine room team but was not used to cover manoeuvring watches. This might have been due to a lack of confidence in the motorman's ability to form an effective part of the engine room watchkeeping team.

Resource management, leadership and teamwork have often been highlighted as weaknesses on board ships during emergency situations. The importance of providing crew resource management has been recognised within the industry for many years, and training has been made available on a voluntary basis by maritime schools and commercial training centres. This type of non-technical training became mandatory on 1 January 2012 following the adoption of *the Manila amendments to the STCW Convention and Code* by the IMO on 25 June 2010. It is clear that NAS Ltd's officers and crew would benefit significantly from this type of training.

2.8 ROLE OF THE PORT AUTHORITY

Clonlee's approaches to the Port of Tyne were unsafe and unnecessarily endangered the ship, her crew and the environment. However, when the master contacted Tyne VTS when *Clonlee* was 1 mile from the breakwater, and asked for permission to enter the port, approval was given and no concerns were raised regarding the vessel's approach. VTS did not use its powers of direction to intervene and request the master to abort his approach. In addition, VTS had not recognised that *Clonlee* was repeatedly ignoring the guidance contained in NP 54.

The AIS tracks of a random selection of other vessels entering the Port of Tyne from the south were analysed in order to establish if any other vessels were ignoring the guidance provided in NP 54. The tracks analysed included those of passenger ships, car carriers and a variety of cargo vessels entering the port with and without pilots on board. All the vessels observed entered the seaward approaches 3 miles from the breakwater, and the vast majority had entered the white sector of the Herd Groyne directional light from a position at least 2 miles out **(Figure 24)**.

Reproduced from Admiralty Chart BA 1191 by permission of the Controller of HMSO and the UK Hydrographic Office

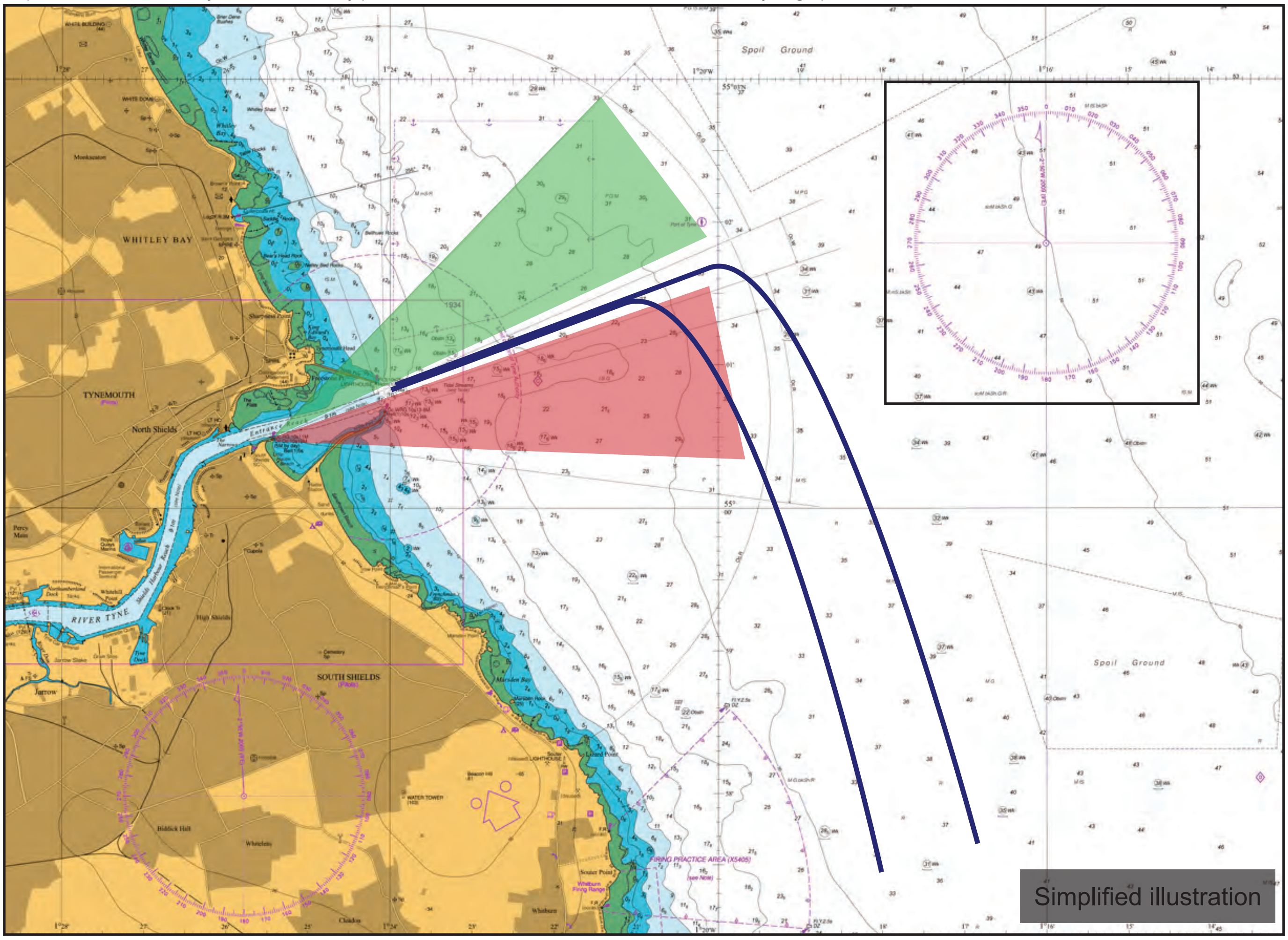

Figure 24: Typical examples of approaches made by other vessels to the River Tyne

In some situations, it would be inappropriate for VTS officers to redirect vessels, as their intervention might compound an already hazardous situation. However, if this is the case, any unsafe acts identified should be reported to the HM. Had *Clonlee's* earlier approaches been identified as being unsafe, the HM could have taken corrective action to address the situation.

The lack of a comprehensive port passage plan might have contributed to the fact that *Clonlee*'s unsafe approaches went unchallenged. The VTS officers might have felt more empowered to intervene had they been in a position to refer to a port passage plan that included the seaward approaches.

Had *Clonlee's* master not held a PEC and so been required to take a pilot, he would have had to implement the requirements listed on the pilot card prior to *Clonlee* reaching the pilot boarding point. Had that been the case, it is likely the crew would have been at their stations for entering harbour and the machinery would have been configured for manoeuvring prior to entering the seaward approaches. Furthermore, the approach would almost certainly have followed the guidance given in NP 54.

Ensuring that a vessel with a PEC holder embarked is following the port passage plan would not also guarantee that the vessel was in all respects ready to enter harbour. However, active monitoring of each vessel's approach by VTS and dialogue with the master at the start of that approach would prompt masters to ensure the appropriate preparations for entering harbour had been made.

2.9 SAFETY MANAGEMENT SYSTEM

2.9.1 Safety management manual

Clonlee's SMM was generic in nature and did not accurately reflect the working practices required of the crew by the company, or the machinery and equipment fitted on board the vessel. Although the SMM might have complied with the requirements of the ISM Code, it did not provide *Clonlee*'s crew with specific clear guidance on how their vessel should be operated.

The non-compliant working practices and navigation procedures routinely carried out on board *Clonlee* demonstrated that a general air of complacency and a lack of professionalism had been allowed to develop on board. This might have been initiated by the repetitive nature of the vessel's operations. However, the fact that the owners had repeatedly ignored the warning signs from audits and had sanctioned non-compliant working practices, had exacerbated the situation to the extent that it was unlikely that any amendments to the SMM would have significantly improved the standards of navigation practised on board. The DP was responsible for promoting a strong safety culture and verifying the implementation of the requirements set out in the ship's SMS. Where procedural non-conformities were highlighted, it was the company's responsibility to provide adequate oversight and management to ensure robust corrective actions were taken.

2.9.2 Internal audits

The DP was aware of some of the procedural non-conformities identified in this report, but had raised no non-conformities and appeared to take no action to enforce the implementation of the requirements set out in the ship's SMM. Furthermore, he had not amended the SMM to reflect the actual bridge team and engine room team working practices that he had tacitly endorsed.

This situation had probably developed over time due to the company's limited resources and the DP's lack of maritime experience and knowledge. The DP was very familiar with his ships' masters and crew, and this close relationship might also have resulted in his audits being less objective as well as adversely affecting his enthusiasm to enforce any necessary corrective actions.

2.9.3 External Safety Management Certificate audits

The majority of the contributory procedural anomalies and equipment defects discussed in this report had been identified prior to the accident on several occasions during external audits and inspections. A review of the actions taken in response to external audits found that NAS Ltd's masters and its DP had a tendency to ignore or reject the recommendations and comments given in the observation notes. Had the company and ship's masters implemented the corrective actions recommended in the observation and feedback notes raised by external auditors, the likelihood of the power loss and subsequent grounding would have been significantly reduced.

It was apparent that many of the documentation and procedural shortfalls raised as observation notes in the vessel's SMC audit reports related to the '*non-fulfilment of specified requirements',* therefore non-conformities should have been raised. The practice of raising observation notes for what were perceived as minor non-conformities was not in compliance with the ISM Code. It was also apparent that feedback notes had been used to document non-conformities rather than highlight good practice. However, regardless of the status given to the observations documented by external auditors and surveyors on board *Clonlee*, the company should have had procedures in place to ensure that they were all adequately addressed.

2.9.4 Document of Compliance audits

The annual office-based DOC audits failed to recognise that the corrective actions taken in response to non-conformities, particularly those relating to critical systems, were inadequate. In addition, they did not identify that the company had no formal procedure for managing the observations made during SMC audits.

The DOC audit conducted 7 months before the accident concluded that the company had demonstrated a good safety ethos and its SMS appeared to be well implemented. However, NAS Ltd's tendency to react only to formal non-conformities and deficiencies, and to ignore or dismiss many of the other safety recommendations made by auditors, surveyors and inspectors provides a clear indication that a weak safety culture was prevalent within the company.

When there is objective evidence that a ship or shipping company has demonstrated examples of best practice over and above the minimum regulatory requirements for specific tasks or operations, positive feedback in an audit report can be a good motivator. However, the type of blanket positive feedback given by the GL auditor can send a confused message to the company and undermine the objectives of the ISM Code.

SECTION 3 - CONCLUSIONS

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

1. A lack of equipment manufacturers' technical manuals on board *Clonlee* compromised the engineers' ability to competently operate and maintain the ship's critical systems. [2.4.1]

2. *Clonlee*'s switchboard was not operated in accordance with the equipment manufacturer's instructions. [2.4.2]

3. The composition of the bridge team was not in accordance with international regulations and local requirements. [2.5.1]

4. When the ship blacked out, the master became cognitively overloaded and lost situational awareness because the bridge team was under resourced. [2.5.1]

5. *Clonlee*'s voyage from Rotterdam to South Shields was not appraised, planned, executed and monitored in accordance with SOLAS requirements. [2.5.2]

6. Neither *Clonlee* nor her crew were adequately prepared for entering the port, and the crew were not ready to respond to the machinery failure. [2.6.1]

7. Inadequate oversight and management of *Clonlee*'s operations by the company had allowed non-compliant navigational practices to become routine on board. [2.9.1]

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

1. *Clonlee*'s critical equipment and systems were not tested and maintained in accordance with the requirements of the ISM Code. [2.4.5]

2. The working routines adopted by engineer officers were not in accordance with the ship's SMS, and they increased the risk of fatigue. [2.4.4]

3. There was a total breakdown of internal communications on board following the blackout. [2.6.2]

4. The ship's emergency procedures were not followed and a full damage assessment had not been carried out prior to attempting to refloat the vessel. [2.6.2]

5. The working practices adopted on board did not make best use of the crew resources available, and cargo operations appeared to take priority over navigational safety. [2.7]

6. The track routinely used by *Clonlee* combined with the vessel's lack of appropriate preparations meant her approaches and entry to the Port of Tyne were unsafe and unnecessarily endangered the ship, her crew and the environment. [2.8]

7. *Clonlee*'s SMM was generic in nature and did not accurately reflect the working practices required of the crew by the company, or the machinery and equipment fitted on board the vessel. [2.9.1]

8. The general reluctance to take corrective actions to address points raised in audit observations, and react only to formal non-conformity notes, indicates that a weak safety culture existed within the company. [2.9.4]

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

1. Despite GL surveyors repeatedly identifying that the machinery alarm printer was defective, a condition of class was not raised against the printer, and it remained out of action for over 18 months. [2.4.5]

2. The Port of Tyne authority had not recognised that *Clonlee* was repeatedly ignoring the guidance contained in NP 54, and therefore did not take the opportunity to use its powers of direction to intervene. [2.8]

3. The Isle of Man Ship Registry had identified several of the contributory factors that led to *Clonlee*'s grounding during previous ISM audits, but failed to raise non-conformity notes because they had been applying different definitions to those contained in the ISM Code. [2.9.3]

SECTION 4 - ACTION TAKEN

4.1 ACTIONS TAKEN BY OTHER ORGANISATIONS

The **Isle of Man Ship Registry** has:

- Carried out a review of its ISM Code audit processes and has undertaken to:
    - Re-write its ISM Code audit instructions to provide clarity on the definitions of a non-conformity, an observation note and feedback.
    - Issue new guidance for organisations undertaking DOC audits on its behalf in order to ensure that they verify that companies are recording and taking appropriate actions to address observation notes.

Germanischer Lloyd has:

- Reviewed its surveyors' audit and inspection report findings relating to North Atlantic Shipping Ltd and has undertaken to:
    - Issue additional guidance to surveyors to help clarify the definitions of memoranda and conditions of class.
    - Amend its DOC audit process to ensure that one surveyor does not carry out repeat audits of the same shipping company.

The **Port of Tyne Ltd** has:

- Amended its port passage plan to include the seaward approaches. The amendment has been:
    - Incorporated into its SMS, PEC application pack and PEC exam syllabus
    - Distributed internally and sent to all PEC holders.
- Issued a marine memo under its SMS clarifying the requirements for approaching the port and instructing its VTS officers, observing any vessel making an un-seamanlike approach to:
    - Raise this with the vessel directly and advise them of the correct approach.
    - Record such events in the SMS incident log for subsequent investigation.

SECTION 5 - RECOMMENDATIONS

North Atlantic Shipping Ltd is recommended to:

2012/106 Carry out a comprehensive review of its Safety Management System, which should, as a minimum:

- Ensure onboard working practices make best use of the crew resources available, and comply with all appropriate international, Flag state and local maritime regulatory requirements.

- Ensure its instructions and procedures are achievable, are adhered to on board, and reflect the machinery and control systems fitted to its vessels.

- Ensure all its vessels are provided with manufacturers' instruction manuals, in the designated working language, for all critical equipment and systems on board.

- Review onboard training, and take appropriate action to improve its crews' emergency response performance. Particular consideration should be given to promoting crew resource management and improving the standards of internal communications.

- Develop a robust process for managing safety-related observations made by external bodies and recording any related corrective actions taken.

Marine Accident Investigation Branch
March 2012

Safety recommendations shall in no case create a presumption of blame or liability

Marine Accident Report

INVESTORS IN PEOPLE