

Report of the Chief Inspector of Marine Accidents
into the grounding and subsequent salvage of the tanker

SEA EMPRESS

at Milford Haven

between 15 and 21 February 1996

Marine Accident Investigation Branch
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27 March 1997

*The Right Honourable Sir George Young Bt MP
Secretary of State for Transport*

Sir

In pursuance of Regulation 9 of the Merchant Shipping (Accident Reporting and Investigation) Regulations 1994, I submit my Report following the Inspector's Inquiry into the grounding and subsequent salvage of the tanker SEA EMPRESS at Milford Haven, on 15 February 1996.

I wish to place on record appreciation for the co-operation which was extended to the Inspectors who carried out the Inquiry, by the many parties concerned. In particular to the flag state of the vessel; the Liberian Authorities carried out an investigation of their own into the initial grounding in parallel with the Inspector's Inquiry.

Acknowledgement is made to Birkenhead & Associates Ltd for advice on salvage matters, to the Institute of Maritime Law at the University of Southampton for advice on salvage law, to Lloyd's Register of Shipping for stability calculations, to ABP Research and Consultancy Ltd for research into the tidal streams and to Harland & Wolff Shipyard for the measurements of the damage sustained by the vessel.

I am, Sir,
Your obedient servant

Captain P B Marriott
Chief Inspector of Marine Accidents

Extract from
The Merchant Shipping
(Accident Reporting and Investigation)
Regulations 1994

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

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GLOSSARY OF ABBREVIATIONS AND TERMS

Abeam	Position or direction which lies horizontally at right angles to the vessel's fore and aft line
AHTS	Anchor handling/tug/supply vessels
Anchor Cables	Chains for attaching the anchors to the vessel
Bar	A unit of pressure which is 10^5 N/m ² , equivalent to 14.5 lb/in ²
Bollard Pull	The maximum pulling, or pushing, power of a tug
Bow Thruster	An independently powered propeller fitted in a transverse tunnel in the bows of the vessel to improve the handling characteristics during manoeuvring
Bulkhead	A vertical partition in the vessel which is often watertight
Cable	Unit of distance equalling 1/10th of a nautical mile (608 ft/185 metres)
CHA	Competent Harbour Authority
Course Made Good	The actual track of the vessel
DNV	Det Norske Veritas
Draught	Distance from the waterline to the bottom of the vessel when the vessel is afloat
dwt	Deadweight tonnes which is the carrying capacity of the vessel
ETA	Estimated time of arrival
Frame	A continuous structure supporting the sides, bottom and deck plating of the vessel
Gyro	A type of compass
Hawse Pipes	Tubes built into the vessel's bows through which the anchor cables run
IMO	International Maritime Organization

Inert Gas	A gas with an oxygen content of less than 8% which does not support combustion and is pumped into the ullage space above oil cargoes
Knots	Nautical miles per hour
Leading Lights	Two or more lights which identify a line of safe approach when they are in line
Lee	Downwind side of the vessel
List	Transverse inclination of the vessel caused by unsymmetrical distribution of weights
Local Commander	The senior MPCU official in attendance at the scene of the incident
LOF	Lloyd's Standard Form of Salvage Agreement
MARPOL	International Convention for the Prevention of Pollution from Ships 1973/78
MEOR	Marine Emergency Operations Room (situated in The Coastguard Agency headquarters at Southampton)
Merchant Shipping Notices (M Notices)	Notices issued by the Department of Transport to the Shipping Industry, identified by the letter M and a number
MHPA	Milford Haven Port Authority
Mile	Nautical mile, about 1.15 statute miles
MoD	Ministry of Defence
MPCU	Marine Pollution Control Unit of The Coastguard Agency
MPSC	Marine Pollution Salvage Centre which holds MPCU's stockpile of pollution control and clean-up equipment.
MRC	Marine Response Centre located at Milford Haven Coastguard Station during the duration of the incident
MRCC	Marine Rescue Co-ordination Centre of HM Coastguard
MRSC	Marine Rescue Sub-Centre of HM Coastguard
MSA	Marine Safety Agency of the Department of Transport

Overall Commander	The senior Coastguard Agency officer who co-ordinates the efforts of HM Coastguard, MPCU and other organisations involved in dealing with the emergency
P & I	Protection and Indemnity Association
Pressure/Vacuum Valves	A device fitted at the top of a cargo tank to prevent either an over-pressurisation or a vacuum forming within the tank
RNLI	Royal National Lifeboat Institution
SERS	Lloyd's Register of Shipping, Ship Emergency Response Service
Shackle	Length of anchor chain equivalent to 15 fathoms (90ft/27 metres)
Speed Made Good	Average speed of the vessel
Squat	An increase of the vessel's draught caused by her movement through the water
tbp	Tonnes bollard pull
Trim	Difference between the forward and after draughts of the vessel when afloat. The vessel is trimmed by the head when the forward draught is greater than the after draught
Ullage	The measurement between the top of the tank and the surface of liquid in the tank
VHF	Radios using Very High Frequency which have designated marine channels
VLCC	Very large crude carrier (greater than 200,000 dwt)
VTS	Vessel Traffic Services for handling shipping movements within harbour limits
Weigh anchor	To lift the anchor from the seabed
Windlass	Machinery for deploying or recovering the anchors

1. SUMMARY

The motor tanker SEA EMPRESS loaded with a cargo of 130,018 tonnes of Forties light crude oil grounded off the Middle Channel Rocks in the approaches to Milford Haven at 2007 hrs on 15 February 1996. A pilot was on board and the vessel was entering the Haven via the West Channel. Although the main engine was stopped, put astern and both anchors dropped the vessel continued to run ahead and came to rest aground, approximately 5 cables northeast of the initial grounding position. The weather was fine and clear with a west-northwesterly force 4/5 wind.

The vessel is constructed with some side ballast tanks but no double bottom tanks. The starboard side cargo and ballast tanks were ruptured when the vessel first grounded resulting in a heavy trim by the head and a starboard list. A quantity of oil was released from the damaged cargo tanks.

Both the Milford Haven Port Authority's Emergency Plan and the Marine Pollution Control Unit's National Contingency Plan were implemented promptly. Within hours the managers of SEA EMPRESS had accepted an offer of assistance from a salvage consortium on the terms of Lloyd's Standard Form of Salvage Agreement, "No Cure - No Pay" (LOF95).

SEA EMPRESS was manoeuvred into deeper water where she could be anchored and held in position with the aid of the harbour tugs from Milford Haven. This was achieved without further loss of cargo and the intention was to lighten the casualty as soon as possible so as to allow her to enter the Haven and discharge the remainder of her cargo. A suitable lightening vessel was identified and preparations were commenced to ready SEA EMPRESS for this operation.

The prediction of gale force winds led to the decision to turn the casualty and re-anchor her so that she would be heading into the wind. This operation was carried out on 17 February while the preparations for lightening were still underway. It was just after this turning operation, and when the weather conditions had already deteriorated, that control of the casualty was lost and she grounded off Saint Ann's Head.

For the next four days efforts by the salvors to regain control of the casualty were unsuccessful and the casualty went aground again on a number of occasions, both off Middle Channel Rocks and Saint Ann's Head. It was not until 21 February that the casualty was successfully refloated and brought under control. She was then taken to a berth inside the Haven where the remainder of her cargo was discharged.

There was no loss of life or serious injuries.

The cause of the initial grounding has been found to be due to pilot error.

The main factors, apart from the bad weather, which resulted in the salvage operation taking so long, were insufficient tugs of the appropriate power and manoeuvrability, together with a lack of full understanding of the tidal currents in the area.

The initial grounding resulted in approximately 2,500 tonnes of crude oil escaping and about a further 69,300 tonnes was lost to the sea during the period of the salvage operation.

A number of recommendations have been made, which are addressed to Milford Haven Port Authority, the Department of Transport/Marine Safety Agency, The Coastguard Agency and Acomarit (UK) Ltd.

PART I FACTUAL ACCOUNT

2. PARTICULARS OF VESSEL AND CREW

2.1 General Description

Name	:	SEA EMPRESS
Port of Registry	:	Monrovia, Liberia
Registered Owners	:	Alegrete Shipping, Co. Inc. Monrovia
Commercial Managers	:	Seatankers Management, Cyprus
Technical Managers	:	Acomarit (UK) Ltd, Glasgow
Built	:	Spain, delivered 1993
Length Overall	:	274.30 metres
Breadth Extreme	:	43.20 metres
Depth Moulded	:	23.80 metres
Loaded Draught	:	17.02 metres
Deadweight	:	147,273 tonnes
Classification	:	Det Norske Veritas +1A1 Tanker for Oil
Main Engine	:	M.A.N. B&W Type 6S70 MC 2-stroke 6 Cylinder oil engine
Maximum power	:	13,475 kW
Propeller	:	Single fixed pitch Right-handed
Steering Gear	:	EIMAR-WEIP 4 ram type
Service Speed	:	14 knots
Manoeuvring Speed	:	11 knots (loaded)
Minimum Speed	:	4.5 knots (loaded)
Astern Power	:	60% of Ahead Power
Rudder	:	Single plate semi-balanced

She is a single-hull, segregated ballast, suezmax crude oil carrier with the propelling machinery and accommodation superstructure in the conventional aft position. The main engine, which runs on heavy fuel oil at all times, can be controlled from the bridge, which is provided with a comprehensive outfit of navigation equipment. When the vessel arrived off Milford Haven all her Convention, Flag State and Class certificates were valid.

2.2

Cargo and Ballast Tanks and Heavy Fuel Storage Tanks

The hull is subdivided to provide fourteen cargo tanks, which include two slop tanks, with a total capacity of 164,156 cubic metres; the cubic capacity of each cargo tank is as follows:

No 1 Port and Starboard	5,310 cubic metres each
No 3 Port and Starboard	11,796 cubic metres each
No 5 Port and Starboard	4,017 cubic metres each
No 6 Port and Starboard Slops	2,647 cubic metres each
No 1 Centre	16,423 cubic metres
No 2 Centre	29,471 cubic metres
No 3 Centre	14,735 cubic metres
No 4 Centre	14,735 cubic metres
No 5 Centre	29,471 cubic metres
No 6 Centre	11,781 cubic metres

The cargo pump room is immediately forward of the machinery space, with the motors and turbines for the pumps on the after side of the bulkhead. All cargo pumping operations can be controlled and monitored from the cargo control room, which is on the navigating bridge deck adjacent to the combined wheelhouse/chart room.

The Fore and Aft Peak tanks and Nos 2 and 4 Port and Starboard tanks are dedicated ballast tanks with a total capacity of 52,495 cubic metres; the cubic capacity of each ballast tank is as follows:

Fore Peak	3,968 cubic metres
No 2 Port and Starboard	11,670 cubic metres each
No 4 Port and Starboard	11,700 cubic metres each
Aft Peak	1,787 cubic metres

Heavy fuel oil is carried in four wing storage tanks on the port and starboard sides, located outboard of the slop tanks and pump room, with a total capacity of 4,998 cubic metres.

A general arrangement plan of the vessel, together with cargo, ballast and fuel oil tanks is shown at Figure 1.

2.3 **The Crew**

SEA EMPRESS was manned with a total crew of 27, all Russian nationals. The officers were the Master, Radio Officer, three deck officers, four engineer officers and the Electrical Officer. The ratings were the Bosun, Pumpman, six seamen, a fitter, three motormen and three catering ratings. All the officers and ratings were properly certificated or qualified. Two cadets were also carried.

2.4 The Master was aged 58 and had served as master of tankers since 1966. He joined Acomarit in 1993 and had been in command of SEA EMPRESS, apart from periods of leave, since the vessel was new. He had completed a course on the handling of very large tankers in Grenoble, France.

3. NARRATIVE

Times are UTC (Universal Co-ordinated Time)

Chart extracts showing the main positions of the vessel from the time of approaching the West Channel entrance to Milford Haven on the evening of 15 February to the final float off on 21 February are at Figures 2 - 4. The chart extracts are taken from the edition of British Admiralty Chart 3274, which was current at the time of the incident, and not the new edition published in November 1996.

- 3.1 SEA EMPRESS loaded her cargo of Forties light crude oil at Hound Point, in the Firth of Forth and sailed from there for Milford Haven on 13 February 1996. All the cargo tanks were filled to normal capacity, with recorded ullages on completion of between 1.08 and 1.40 metres. The vessel's figure for cargo on board was 130,018 tonnes. The dedicated ballast tanks had been emptied except for about 890 tonnes in the Aft Peak tank, for trim purposes. A route via the English Channel to Milford Haven was decided upon and a sea passage plan was prepared to a position 4.5 miles south-southwest of the entrance to the West Channel to Milford Haven. This position was designated 'Way Point 20'.

Thursday 15 February

- 3.2 The three deck officers and the helmsman/lookouts were keeping the conventional four-on eight-off watch rota. The Master was not standing a watch. During the sea passage, on 15 February, a pilotage passage plan into Milford Haven was prepared. This plan started from 'Way Point 20' with a course almost coincident with the line of the Outer Leading Lights to the West Channel entrance and continued with further courses up the West Channel and thence into the port. The Tanker Check List and Pilot Card were also prepared for arrival at Milford Haven.
- 3.3 'End of Sea Passage' was at 1905 hrs on Thursday 15 February when SEA EMPRESS was 7.5 miles south-southwest of the West Channel entrance and steering a course of 022°. Both steering gears were running and the main engine was on bridge control. At 1910 hrs course was altered to 012° towards the boarding area requested by the pilot, which was four miles southwest of Saint Ann's Head. The wind was west-northwesterly force 4/5 and it was fine and clear. Engine speed was gradually reduced and the vessel was then manoeuvred to maintain a boarding speed of about 5 knots and a starboard lee for the pilot, who boarded at 1940 hrs. At this time SEA EMPRESS was 3.8 miles southwest of Saint Ann's Head on a heading of 010° and the main engine was on 'dead slow ahead'. The Bosun had cleared the anchors for letting go and the bow mooring party went forward, followed by the Third Officer who had escorted the pilot to the Bridge and would take charge forward.

- 3.4 On arrival on the bridge, which was manned by the Master, Chief Officer and helmsman, the pilot inspected the information on the Tanker Check List and Pilot Card, which he found in order. The arrival draught had been reported by the Master as 15.9 metres, with the vessel on an even keel. The pilot expected the tidal stream to seaward of the West Channel to be slack at this time, but there was still an outgoing tide running in the Channel, the predicted time of low water in the port being 2130 hrs. At 1944 hrs the pilot ordered 'full ahead' and a turn to starboard to a course of approximately 060°. At 1948 hrs the vessel was 2.75 miles southwest of the Channel entrance and working up to full manoeuvring speed.
- 3.5 At 1951 hrs the vessel was 2.3 miles southwest of the Channel entrance and the pilot could see both Outer Leading Lights and both Inner Leading Lights for the West Channel (see Section 4 for detailed description of the entrance to Milford Haven). At about 1955 hrs he ordered progressive changes of course to port, by about 5° at a time, until the vessel was on a heading of 035°. A position plotted by the Chief Officer at 2000 hrs showed the vessel to be one mile from the entrance to the Channel and about midway between the lines of the Outer and Inner Leading Lights (see Figure 2). The pilot was steering the course of 035° in order to make a judgement as to which way the tide was likely to affect the vessel. He was satisfied with the performance of the helmsman and had the impression that the course of 035° was being made good. The speed made good had increased progressively to about 10 knots.
- 3.6 According to published tidal information, the east-southeast running tidal stream to seaward of the Channel entrance was predicted to begin at about 2000 hrs. When SEA EMPRESS was two or three cables from the Channel entrance, the pilot saw from the changing aspect of the Outer Leading Lights that there was a set to the east. He ordered a course change of 5° to port. The vessel, which was now closing with the Mid Channel Rocks Light Buoy, started to turn to port. The pilot saw the Outer Leading Lights close and then open to the east (that is, the rear Leading Light appeared to move to the right of the front Leading Light) as the bows entered the channel. The Buoy was very close to starboard and the pilot now saw that the fixed red and fixed white lights of the Outer Leading Lights, the ones indicating the east side of the deepest water in the Channel entrance, were also open to the east.
- 3.7 After the bows had passed the Middle Channel Rocks Light to starboard there was a shuddering vibration, then a sound from the deck below of liquid being forced under pressure, accompanied by a strong smell of oil. The time was 2007 hrs (see Figure 2). The helmsman reported that the vessel was not steering and the pilot ordered 'full astern', both anchors to be let go and called out the four harbour tugs which were waiting to assist SEA EMPRESS to her berth. At 2008 hrs the Chief Officer recorded this order and the vessel's position, which was 1.4

cables northwest of Middle Channel Rocks Light. SEA EMPRESS, which was trimming by the head and taking a starboard list, continued to run ahead as the anchors were let go. There were further main engine movements and the vessel finally lost all way at approximately 2015 hrs after she grounded again in a position about 3.3 cables south-by-west of the Mill Bay Buoy (see Figure 2). The main engine was put to 'stop'. SEA EMPRESS was by this time significantly trimmed by the head and had taken an 18° list to starboard with the starboard fore part of the deck awash and was heading in a northwesterly direction.

- 3.8 The engineers in the engine control room felt the vessel vibrate very heavily. The starboard list then caused a number of alarms to sound in the engine control room and both the port and starboard boilers shut down automatically due to the extent of the list. The main engine and alternators, however, remained fully operational with no alarm condition being recorded. The starboard boiler was re-started and the engine room and steering gear compartment were checked for damage and leaks. None were found.
- 3.9 In response to the pilot's request the four waiting tugs proceeded to SEA EMPRESS with all speed. By about 2023 hrs the tugs DALEGARTH and THORNGARTH had made fast their lines to the bow of the casualty and TITO NERI and STACKGARTH were instructed to standby off each quarter in case the crew had to be evacuated. However the Master decided that, because SEA EMPRESS appeared to be in no immediate danger, the crew would remain on board.
- 3.10 Initial reports of a damage assessment, undertaken by the casualty's crew, indicated that Nos 1 & 3 Starboard and No 6 Centre Cargo tanks together with Nos 2 & 4 Starboard Ballast tanks had been damaged. Some flooding of the pump room was also indicated. The casualty's initial angle of list, recorded as 18° to starboard at 2024 hrs was reduced to about 10° by running sea water into the two port side ballast tanks, Nos 2 and 4, under gravity from the damaged starboard side ballast tanks via the ballast main. An offer of salvage assistance by a consortium comprising Smit Tak BV, Cory Towage Limited and Klyne Tugs (Lowestoft) Limited on the terms of Lloyd's Standard Form of Salvage Agreement "No Cure-No Pay" 1995 Edition (LOF95) was accepted by Acomarit, the managers of SEA EMPRESS, by 2305 hrs. **(See Annex A for general details of marine salvage and LOF, and Annex B for general details of the Government's role in a major incident.)**

Friday 16 February

- 3.11 By 0040 hrs on Friday 16 February STACKGARTH and TITO NERI were made fast to the stern of the casualty. The Master and the pilot agreed that SEA EMPRESS should be manoeuvred into the deeper waters of the 'pool' where she could be held by the tugs (see Section 4 for details

of the 'pool'). It was also decided to reposition the anchors. These proposals were passed to the Signal Station at 0055 hrs. High water at Milford Haven was predicted to occur at 0342 hrs.

- 3.12 Commencing at 0127 hrs, the anchors were weighed and with the assistance of the four tugs and the casualty's engine and steering she was moved to the southwest into the 'pool' and onto a northeasterly heading. The port anchor was let go at 0211 hrs but as sea conditions were deteriorating slightly it was decided to let go the starboard anchor also. By 0427 hrs the two anchor cables had been laid out and the engine stopped (see Figure 3). The tugs were experiencing difficulties with their lines parting but they were reconnected and the casualty's position was maintained.
- 3.13 At this stage SEA EMPRESS was considered to be in a stable condition and under control. However, there was some debate within the Harbour Authority on the advisability of ordering the casualty out to sea as soon as possible but this idea was dismissed.
- 3.14 Representatives of the Marine Pollution Control Unit (MPCU) of The Coastguard Agency had begun to arrive in the Milford Haven area from about 0030 hrs. MPCU staff boarded SEA EMPRESS with a local representative of Cory Towage and made an assessment of the casualty's condition. As a result of this assessment MPCU recommended to the Harbour Master that SEA EMPRESS should be held in position and lightened.
- 3.15 One of the first objectives of the salvors was to regain control of the pump room which was flooded to a level of about 5 metres and had a flammable atmosphere. Power packs, pumps and other equipment from the Marine Pollution Salvage Centre (MPSC) in Milford Haven were mobilised and at 0600 hrs began to arrive on board SEA EMPRESS. At 0800 hrs the tug ANGLIAN DUKE arrived and increased the number of tugs made fast to the casualty to five. The presence of a pilot was maintained on board. The tanker STAR BERGEN was on charter to the salvors for an anticipated ship-to-ship transfer of oil.
- 3.16 In the course of the morning various options for the movement of SEA EMPRESS were considered at meetings held on board and ashore. Shipboard discussions resulted in two options being proposed; either taking the casualty to sea or reducing the angle of list and the draught to bring her further into the Haven. A number of indicators pointed to the need for a lightening operation and preparations to lighten the casualty continued. The time chosen for the commencement of this operation was 1100 hrs on Saturday 17 February in order to take advantage of slack water and daylight. However, a forecast of a period of poor weather suggested the lightening operation might have to be delayed. The Salvage Master and a team from Smit Tak arrived at Milford Haven at 1130 hrs.

- 3.17 By 1530 hrs portable MPCU pumps and fans were in place pumping floodwater from the pump room and venting it in order to ensure the atmosphere was safe for entry. By this time the Smit Tak Salvage Master had made his assessment of the casualty's condition. The essential elements of the salvage plan chosen by the Salvage Master consisted of pumping out the undamaged centre tanks to a lightening vessel, transferring cargo from the damaged starboard tanks into the centre tanks using portable pumps and pressurising the damaged starboard tanks with inert gas. The objectives of this plan were to right the casualty, reduce its draught and remove cargo from the damaged tanks to prevent pollution. SEA EMPRESS would then be in a suitable condition to be taken to a berth alongside to complete total discharge of cargo.
- 3.18 Efforts by the salvors continued on board SEA EMPRESS, throughout the remainder of Friday, to achieve this end. Weather conditions deteriorated during the afternoon and evening, however the casualty's position continued to be maintained at anchor in the 'pool', with the use of tugs and the casualty's own main engine.

Saturday 17 February

- 3.19 Concerns over the deteriorating weather, forecasts of a gale and the anticipated difficulty of holding the casualty's stern to the weather were coupled with a desire to give a lee on the port side to assist the lightening operation. These resulted in a decision being made to turn the vessel during the slack water period of Saturday afternoon, 17 February, so that it headed seawards and with the anticipated gale on the starboard bow.
- 3.20 Two further tugs, ESKGARTH and ANGLIAN EARL, had arrived in Milford Haven by 0900 hrs and stood by. Pumping and ventilation operations in the pump room had continued and it was declared safe for entry at 1330 hrs.
- 3.21 Much of the efforts of Saturday morning were directed in the planning and preparation for the turning of the casualty. The operation to turn SEA EMPRESS commenced at 1400 hrs with the manoeuvre under the overall control of a pilot. A total of seven tugs, ANGLIAN DUKE, THORNGARTH, TITO NERI, DALEGARTH, STACKGARTH, ANGLIAN EARL and ESKGARTH, all had lines secured to the casualty. Difficulty was experienced in recovering the anchors of SEA EMPRESS and it was suspected that they were fouled. They could not be brought right 'home' and about one shackle (30 metres) of cable was left from the ends of the hawse pipes. As SEA EMPRESS swung she pointed seawards. The possibility of taking the casualty out to sea was raised by the pilot but the considered opinion of those ashore was that it would be too risky. The turn of SEA EMPRESS was completed at 1555 hrs with the casualty in the southwest corner of the 'pool'. Both of the casualty's anchor cables were then walked out until 11 shackles were streamed on each cable but they were still crossed (see Figure 3).

- 3.22 At 1700 hrs, with the casualty heading approximately west-southwest, it was decided to reposition the tugs in preparation for the forecast poor weather. During these manoeuvres SEA EMPRESS started moving to the west under the influence of the ebb tide. Efforts to arrest this movement by the tugs resulted in at least two tow lines parting. SEA EMPRESS continued to move beam on to the tide, in a westerly direction. In spite of the use of the casualty's main engine and the efforts of the tugs she grounded off Saint Ann's Head at about 1805 hrs. Both anchor cables of the casualty were then slipped in an attempt to free the bows and allow the stern to be towed up into the tide. The wind was reported as being from the west-southwest, force 6/7, (see Figure 3).
- 3.23 Due to the casualty's situation, including the loss of her anchors, a request for more tugs was made by the salvors. The tug DE YUE was reported as having departed Falmouth with an ETA at Milford Haven of 0800 hrs on Sunday 18 February. With 54 personnel on board the casualty it was also decided to evacuate non-essential personnel and this operation commenced at 1910 hrs by helicopter with a second lift at 1950 hrs. Further assessment of the situation led to a decision being made to secure the casualty by the bows in her present position by ballasting, so increasing her ground reaction. The casualty's ballast system was prepared and filling of the Fore Peak and No 2 Port Ballast tanks commenced; inerting of the damaged cargo tanks also began at 2245 hrs.

Sunday 18 February

- 3.24 At midnight the wind was reported as being from the west-southwest, force 9 with a heavy westerly swell. Filling of the ballast tanks continued into the early hours of Sunday morning. Weather conditions were deteriorating and were reported at 0200 hrs as 40 to 50 knot westerly winds; these increased later to 60 knots. Two further tugs, YEWGARTH and ELDERGARTH, arrived in Milford Haven at 0230 hrs and at 0240 hrs a further group of people was evacuated from the casualty by helicopter.
- 3.25 On the rising tide the casualty started to work in the seaway and generate noises which were associated with structural failure. A decision was made to evacuate the casualty and the remaining 14 persons on board were airlifted from her by 0440 hrs. All tugs, except ANGLIAN DUKE and ANGLIAN EARL, were released due to concern for their safety and the possibility of a fire or explosion on SEA EMPRESS. ANGLIAN DUKE and ANGLIAN EARL remained secured to SEA EMPRESS by 750 metres and 650 metres of wire respectively. The main lighting of SEA EMPRESS was seen to fail, and emergency power take over, at 0607 hrs. At about 0800 hrs the casualty floated off and drifted to the east across the channel.

- 3.26 SEA EMPRESS was again reported aground at 0840 hrs, in a new position, further southeast by Middle Channel Rocks, after having been driven across the West Channel and the 'pool' (see Figure 3). DE YUE, which had arrived shortly after 0900 hrs and had a pilot and a Klyne tug master on board, spent a period on trial manoeuvres at the stern of SEA EMPRESS. She then anchored in Dale Roads at 1140 hrs and prepared her towing gear. A small group of salvors were airlifted to SEA EMPRESS in order to handle tug lines. They also attempted to restore the casualty's main power but these attempts proved unsuccessful, even with radioed advice from the casualty's Chief Engineer. The conditions at the casualty were very poor with a westerly wind gusting gale force. DE YUE again approached the stern of SEA EMPRESS at 1520 hrs and a line was secured with the assistance of a helicopter. SEA EMPRESS was observed drifting in a northeasterly direction between 1500 hrs and 1600 hrs. ANGLIAN DUKE, TITO NERI and ESKGARTH were instructed to assist DE YUE who in turn requested guidance from the shore authorities on action to be taken but no positive instructions were received. The salvors left SEA EMPRESS by 1715 hrs aground in a position approximately 6 cables northeast of Middle Channel Rocks Light, but clear of the West Channel, at the northeast end of the 'pool' (see Figure 4).
- 3.27 Additional Smit Tak salvage crew, including a Senior Salvage Master, arrived in the Milford Haven area during the Sunday afternoon. It was accepted that there was little possibility of lightening SEA EMPRESS during the following day (see Photograph 1).

Monday 19 February

- 3.28 At 0044 hrs, after having experienced great difficulties in maintaining position and threatened with grounding herself, DE YUE slipped her tow line and proceeded to an anchorage.
- 3.29 SEA EMPRESS was reported as moving towards Middle Channel Rocks at 0810 hrs where she later grounded (see Figure 4). MPCU staff, salvors and some of the casualty's crew boarded SEA EMPRESS between 0830 hrs and 1015 hrs. Main electrical power was restored, an assessment of the casualty's condition was made and approximate calculations showed that 120,000 tonnes of cargo remained on board. However, the pump room was found to be flooded to sea level and more tanks found to be damaged, including the Fore Peak. Pumping out of the pump room was re-commenced and extra equipment was ordered from ashore to handle the additional damaged tanks.
- 3.30 Later on the Monday afternoon SEA EMPRESS refloated. The five tugs in attendance were unable to control her movements and she moved west across the main channel. At about 1715 hrs, the casualty was in line with the main exit from the 'pool', facing inwards and a request was made to those ashore (MPCU and Milford Haven Port Authority) for

permission to take the casualty out to sea. Although this was agreed to, it was not fully communicated to those on board. However, to take the casualty to sea would require the use of her main engine but as it had not been prepared for use, the question was academic.

- 3.31 SEA EMPRESS was being swept towards Saint Ann's Head where she grounded at about 1815 hrs (see Figure 4). During the early evening efforts were made to introduce inert gas into damaged tanks but with the casualty's hull generating sounds, suggesting that hull failure and a possible explosion might occur, all persons on board evacuated onto attending tugs by 2245 hrs.
- 3.32 Various options were again discussed by the salvors for the following day. It was decided that the damaged tanks should be sealed on deck at low water to create an air lock in each tank then at the following high water it was anticipated that the casualty would refloat. Once afloat she would be deliberately grounded south of the Angle Buoy (see Figure 5), between the East and West Channels, in order to gain control of her.

Tuesday 20 February

- 3.33 Two further tugs, PORTGARTH and VIKINGBANK, arrived at Milford Haven at about 0600 hrs on Tuesday 20 February. Members of the salvage team re-boarded SEA EMPRESS, which was still aground off Saint Ann's Head, at 0840 hrs to be joined later by some of the casualty's crew. On several occasions during the following two hours grounding noises were heard throughout SEA EMPRESS and significant losses of oil were observed but the casualty's own engineers prepared the main engine for use. Although the salvors continued to prepare tanks for refloating the casualty their preparations were not sufficiently advanced to allow them to pressurise the damaged cargo or ballast tanks at low water as they had originally intended.
- 3.34 SEA EMPRESS began to show signs of movement at 1645 hrs and the main engine was tested and found satisfactory. The salvors were given permission to bring SEA EMPRESS to Herbrandston Jetty if the refloating attempt proved successful.
- 3.35 Eight tugs were in place by this time and over the period to 1936 hrs various main engine and tug movements were made in attempts to refloat SEA EMPRESS. These efforts were unsuccessful. Some of the tugs which were pushing on the port side experienced difficulties due to the oil film on the hull of the casualty causing them to skid and to be unable to apply full power (see Figure 4).
- 3.36 The salvors judged it would be imprudent to remain on board SEA EMPRESS overnight and all persons evacuated by 2245 hrs but three tugs remained in close attendance. Meetings were held late into the night and plans, produced by the salvors for the following day's

operations, were discussed by the concerned parties. It was again decided to increase the casualty's buoyancy, and reduce her list, by pressurising the ballast tanks. The pressures to be used would be higher than for the previous attempt.

- 3.37 The tanker, TILLERMAN, was made available for lightening purposes after assurances to her managers from MPCU that any costs would be underwritten by HM Government.

Wednesday 21 February

- 3.38 Salvors, crew, and MPCU staff had all boarded SEA EMPRESS by 0815 hrs on Wednesday 21 February. The casualty's position was estimated as being about 200 metres west of her position on Tuesday. Attempts to pump out the pump room were proving unsuccessful with flood water remaining at sea level.
- 3.39 As No 2 Port ballast tank was still intact, portable pumps were used to pump out this tank. Preparations were made to pressurise the damaged ballast tanks with compressed air in anticipation of low water. The Aft Peak was also pumped out. Cargo tanks were also pressurised with inert gas at normal system pressure. Shortly before low water at 1350 hrs it was observed that the rate of cargo leakage from the casualty had increased.
- 3.40 The tug ARILD VIKING had arrived during the previous evening and thirteen tugs were in position by 1630 hrs. Two pilots were on board and the line of on board command was set out for the anticipated refloating operation (see Photograph 2).
- 3.41 The bows of SEA EMPRESS started swinging to port, under the influence of the tugs, at 1735 hrs. Although the casualty's main engine failed to start when requested it was eventually started, and subsequently operated, from the emergency controls. The casualty then floated free at 1800 hrs, was moved astern into the main channel (see Figure 4) and proceeded to the selected berth alongside Herbrandston Jetty on the north side of the Haven. First mooring lines were ashore at 2155 hrs.
- 3.42 SEA EMPRESS had lost a total of 71,800 tonnes of cargo during the accident and her salvage.

4. THE PORT OF MILFORD HAVEN

- 4.1 The following section briefly describes the extent of the port of Milford Haven, pilotage, the entrance channels and available information concerning the tidal streams in order to provide a background to the incident and the detailed discussion which follows later in the Report.
- 4.2 The port of Milford Haven includes the whole of the Haven and its area extends from the inner limits on the upper reaches of the River Cleddau to the outer seaward limits some six miles southeast and southwest of Saint Ann's Head. It is a major oil terminal and is one of the few ports within the United Kingdom accessible to fully laden Very Large Crude Carriers (VLCC) with draughts up to 20 metres. Milford Docks is an important centre for the fishing industry while containers and general cargo are handled at Pembroke Dock, where there is a ro-ro ferry terminal for services to Ireland. The port is also used by recreational craft.
- 4.3 Pilotage is compulsory within the port limits for all vessels over 50 metres in length, except certain exempted vessels. The pilots are provided and authorised by Milford Haven Port Authority (MHPA), which is a Competent Harbour Authority (CHA) under the provisions of the Pilotage Act 1987. Pilots are taken out by launch to meet inbound vessels and usually board those which will use the West Channel in an area about four miles to the southwest of Saint Ann's Head, subject to weather conditions.
- 4.4 There are two entrance channels to the Haven which converge to a single dredged channel leading to the port areas. The East Channel has a limiting depth of 9.8 metres. The West Channel is the deep water channel into the harbour and has minimum charted depths of 16.6 metres at its entrance and 16.4 metres at its inner end. The width of the entrance to the West Channel is just over two cables between its charted limits, which are marked by two buoys, Saint Ann's Light Buoy on the port hand and Mid Channel Rocks Light Buoy on the starboard hand. Two fixed white lights, sited on West Blockhouse Point and Watwick Point and known as the Outer Leading Lights, when kept in alignment provide a lead for vessels from seaward into the deepest water near the middle of the Channel entrance. Additionally there is a subsidiary red leading light on each side of the front fixed white light to indicate, in line with the rear light, when the approaching vessel is moving out of the deepest water in the Channel. (The Admiralty Sailing Directions, "West Coasts of England and Wales Pilot", state, erring on the side of safety, that these red lights indicate the west and east sides of the Channel, whereas they actually indicate the deepest water in the Channel.) The Outer Leading Lights were provided in 1971 to give navigational assistance to VLCCs entering close to high water when the tidal stream is ebbing. Prior to 1971 the only leading lights were those

sited on Great Castle Head and Little Castle Head, known as the Inner Leads, which also indicate a passage into the West Channel, although not through the deepest water in the entrance. The Inner Leads continue to be used.

4.5 On both sides of the West Channel entrance there are shoals and rocky ground, Middle Channel Rocks on the eastern side and Saint Ann's Head Shoals on the western side. The shape of the charted 20 metre depth contour at the southern end of the West Channel resembles an inverted flask, the neck forming the Channel entrance and the body a wide 'pool' extending some six cables up the Channel (see Figure 5). In the vicinity of the West Channel entrance, south of Saint Ann's Head, the tidal streams run approximately at right angles to the line of approach, the flood stream in an east-southeasterly direction and ebb in a west-northwesterly direction.

4.6 An explanation of the nature of the tidal streams in the 'pool' is essential to understanding how on Saturday evening, after the turn had been completed, and over the following two days the salvors lost control of the casualty.

4.7 There are a number of sources providing information about the tidal streams in the approaches to Milford Haven. The published information is on the appropriate Admiralty charts and in the Admiralty Sailing Directions "West Coasts of England and Wales Pilot". Heights of tides are contained in the Admiralty Tide Tables. In the Sailing Directions a description of the tidal streams is given as:

"Across the entrance to Milford Haven the streams run approximately at right angles to the line of approach; within the entrance they run nearly parallel to the channel. There is often a confused sea off the entrance where the streams meet."

It is apparent that the entrance to Milford Haven referred to above is the geographical entrance which lies on a line between Saint Ann's Head and Sheep Island (see Figure 5), and this is supported by a further entry in the Sailing Directions which states that:

"Its (port of Milford Haven) entrance lies between Saint Ann's Head and Sheep Island"

4.8 There is also information from a survey which was undertaken in 1966 on behalf of MHPA. This survey covered the approaches from seaward to the West Channel. A further survey undertaken in June 1996, subsequent to the incident, again on behalf of MHPA, covered the area just inside, just outside and in the vicinity of the entrance buoys.

4.9 An additional source of information is a computer generated numerical model, developed since the accident, to describe the tidal streams in the coastal area off Milford Haven for the purpose of evaluating possible

dredged material disposal sites. For the purpose of the Inquiry the research company which had developed the model was commissioned to provide a detailed study of the tidal streams in the area at the entrance to Milford Haven for the period between 15 February and 22 February. This study has shown that in the major portion of the 'pool' lying to seaward of a line joining Saint Ann's Head and Sheep Island the ebb tidal stream, which runs for about five and a half hours in a westerly direction, is much stronger than the flood which swings around Saint Ann's Head to run in a southeasterly direction across this southern portion of the 'pool'. The southeasterly flood stream flows for about three and a half hours before steadily swinging towards the Haven through east-northeast and then north over the next two to three hours eventually to become the westerly flowing ebb tidal stream.

4.10 The numerical model shows that to the north of the line indicated above including the extreme northerly portion of the 'pool' the tidal streams are much weaker and both ebb and flood streams run generally in line with the West Channel.

4.11 Another source of information, which was available at the time of the incident, is the local knowledge derived from the experience of the pilots, fishermen and others. It was generally known that there were anomalous strong tidal streams at the entrance to the West Channel and around Saint Ann's Head. However, it is apparent that a general "rule of thumb" was used by MHPA and at least some of the experienced pilots. This was that the convergence between the coastal tidal streams, which flow at right angles to the line of approach, and those within the Haven, which generally flow in line with the channel, occurs at and around the West Channel entrance buoys. This differs slightly from the information derived from the numerical model and from the strict interpretation of the Pilot Book which places the convergence nearer to the geographical entrance to the Haven.

4.12 As part of the Inquiry a study was undertaken to compare the published information and that available from the two MHPA surveys against the results given by the computer generated model. The general conclusion of the study is that the computer generated model seems to provide reasonably reliable tidal stream data for the area of the 'pool'. In particular it is concluded that:

- prior to the incident information was available, in the form of the 1966 survey, which indicates that the tidal stream runs at right angles to the line of approach in the immediate vicinity of the entrance buoys;
- prior to the incident no documented information was available with regard to the position at which the tidal streams meet inside the West Channel;

- prior to the incident no documented information was available describing the tidal streams in the area of the 'pool' inside the entrance to the West Channel;
- the tidal stream information from the 1966 Survey and from the Sailing Directions indicates that the streams must meet within the 'pool' located inside the entrance to the West Channel. This is confirmed by the computer generated values.

4.13

The general conclusion reached as a result of the Inquiry's study into the tidal streams within the 'pool' is that they are complex and strong. No accurate description of the tidal stream pattern existed at the time of the incident and the simplistic description adopted by MHPA and some of the experienced pilots was potentially misleading.